

Commercial Vegetable Production in Wisconsin

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Asparagus
Bean
Carrot
Celery
Cole crops
Cucumber
Eggplant
Horseradish
Leafy greens
Melon
Mint
Onion
Pea
Pepper
Potato
Pumpkin & squash
Sweet corn
Table beet
Tomato



Information current as of October 2012. Pesticide labels change often. This publication is not a substitute for the label. Always read the pesticide label prior to use.

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Herbicide information

Some herbicides containing the same active ingredients but having different trade names are marketed by more than one company. Also, some herbicides are produced in several formulations. Products mentioned in this publication are commonly used formulations of common herbicides. Other products and formulations may be equally good. Check labels on containers to determine whether the product is labeled for your intended target crop and to determine the amount of product to use per acre.

Pesticide information

References to pesticide products in this publication are for your convenience and are not an endorsement of one product over other similar products. You are responsible for using pesticides according to the manufacturer's current label directions. Follow directions exactly to protect the environment and people from pesticide exposure. Failure to do so violates the law.

Pesticides sometimes have restricted time periods for use, such as in a product recall or a use deadline. Always check pesticide registration status with the Wisconsin Department of Agriculture, Trade, and Consumer Protection.

To protect yourself, others, and the environment, always read the label before applying any pesticide.

Best management practices for vegetable production

Vegetable growers must use cultural practices that optimize yields, maximize returns and profits, and minimize environmental impacts. Maximum profits aren't always dependent on maximizing yields. For example, smaller yields of high-quality vegetables may generate a significantly higher profit than a large yield of marginal quality.

Common environmental problems that result from vegetable production include soil erosion from wind and water and groundwater contamination from pesticides and nitrates. Vegetable growers need to assume responsibility for protecting natural resources by reducing harmful impacts. Research has shown that using best management practices (BMPs) can reduce harmful impacts yet sustain profitable production.

BMPs are cultural practices that increase efficiency of inputs such as fertilizers (especially phosphorus and nitrogen), pesticides, and irrigation. By reducing inputs, growers lower their costs and the potential for fertilizer and pesticide leaching. The BMPs reviewed in this publication include crop rotation, tillage practices, fertility management, pest control, and irrigation management.

Crop rotation

Growing the same crop on the same land year after year is considered a poor practice that may lower crop productivity. The decrease in crop yield and quality may result from a buildup of certain crop pests and from changes in soil physical properties, such as compaction. Vegetable growers sometimes try to overcome this productivity loss by increasing fertilizer, pesticides, and irrigation, but increasing these inputs raises both costs and the potential for environmental problems.

Crop rotation is the cultural practice of growing a different crop each year on the same land. One goal of rotation is to avoid growing a given vegetable crop on the same land for at least 3 years. An example of a 3-year rotation program would be a cole crop (broccoli, cauliflower, or cabbage) in the first year, green beans or peas in the second year, and sweet corn in the third. The 3-year cycle could then be repeated.

Well-designed crop rotations help suppress pest problems and improve soil physical condition. Crop diversity effectively controls pests that have short survival periods and a narrow host range. Crop diversity and the resultant pesticide-use diversity also help to prevent the buildup of certain pest problems, particularly weed problems.

Adding organic matter from forage legumes or green manures rebuilds soil structure, adds nutrients (particularly nitrogen), and improves the soil's water and air balance. The result is more vigorous crop growth that can better resist pest and environmental stresses.

Potential crops to include in a rotation depend upon the individual grower's situation and will vary from grower to grower. Crop selection should follow these general guidelines:

- include both deep- and shallow-rooted crops;
- avoid crops with common disease or insect problems;
- use agronomic crops (field corn, oats, and soybeans) where possible; and
- include a forage legume (alfalfa, clover) when possible.

Finding the ideal rotation can be difficult. Production and marketing objectives, land availability, and financial conditions may dictate what rotations are feasible. More diversified and longer rotations can be effective in maintaining crop productivity while reducing production costs and the potential for harming the environment, particularly through groundwater contamination.

Tillage practices

Intensive soil tillage is often used in vegetable production. Depending on the crop, a given field may be subjected to as many as six different tillage operations in a growing season. Such intensive tillage can damage soil structure and increase compaction, especially when working wet fields. Loss of soil structure increases the soil's susceptibility to wind and water erosion. Excessive tillage can also dry the soil's upper portions, causing poor germination, emergence, and early seedling growth.

Reducing tillage trips across the field protects the soil resource and reduces costs. Where possible, vegetable growers should try to implement conservation tillage (CT). This practice reduces tillage to maintain previous crop residue on the soil surface, which helps control soil erosion. However, CT can also increase problems with stand establishment, especially with processing vegetables, where a uniform stand is important. Previous crop residue can hinder the mechanical harvesting of vegetables. The effective use of CT requires a high level of management, and growers should initially experiment with CT on a small number of acres.

Fertility management

The goals of effective fertility management are efficient use of soil and fertilizer-applied nutrients. Fertilizer programs should be designed to meet minimum crop needs. Excessive fertilizer applications must be avoided to maximize net returns. Excessive nitrogen and phosphorus applications must be avoided to minimize contamination of groundwater and surface water.

An efficient fertilizer program considers realistic yield goals to determine phosphate and potash needs. Fertilizing beyond realistic yield goals can reduce returns. Realistic yield goals are usually equal to the average yield for the past 5 years.

Base your fertilizer program on soil test results. These results will indicate the soil's potential for meeting the phosphorus and potassium needs of the crop, as well as some of the other nutrient needs. Only add fertilizer when the soil's nutrient supply fails to meet crop needs. In effect, the soil test results determine the fertilizer amount needed to meet yield goals. Adjust the fertilizer amounts to account for nutrient credits from previous crop residues or other nutrient additions such as manure.

Soil pH influences nutrient availability. Also, some crops are sensitive to different soil pH and development of certain diseases may be accelerated depending on the pH. Lime can be used to increase pH, but it must be added 6 to 18 months before planting crops that require the higher pH to be fully effective.

Fertilizer programs should also take into account fertilizer timing and placement. Generally, leachable fertilizer nutrients

(especially nitrogen) should be applied just before the time of greatest crop need. Similarly, fertilizer placement should maximize uptake while minimizing leaching and tie-up by the soil. Row- and band-placed fertilizer often minimize soil tie-up while maintaining fertilizer availability. Some crops are sensitive to in-row nitrogen applications.

Finally, consider the fertilizer forms used. Some forms of fertilizer are less usable to crops, while in other cases the form may dictate specific placement or use considerations. For example, elemental sulfur is not available to crops until it is converted to the sulfate form (usually in 1 to 3 months).

The form of nitrogen fertilizer can be particularly important on sandy soils. Urea nitrogen is highly leachable as a neutral molecule. However, it is usually converted to the nonleachable ammonium form a few days after application. The ammonium is similarly converted to the highly leachable nitrate form over a 2- to 4-week period. In addition, urea nitrogen spread on the soil surface, without incorporation, can be lost by volatilization.

Conversely, half the nitrogen in ammonium nitrate is immediately leachable, but this form is not lost by volatilization.

Some crops prefer specific forms of nitrogen. Potatoes, for example, show apparent losses in quality if supplied only with ammonium nitrogen. You must consider all the above factors if your fertilizer program is to become more efficient.

See UW-Extension publication *Nutrient Application Guidelines for Field, Vegetable, and Fruit Crops in Wisconsin* (A2809) for additional information.

Pest management

Effective pest management is essential in vegetable production because quality is as important as yield. Uncontrolled pest problems are a major cause of quality and yield losses in vegetables. To ensure profitable yields and quality, many vegetable growers tend to use more pesticides than are needed. Such excessive use leads to increased costs as well as an increased potential for environmental contamination.

Integrated pest management (IPM) is a BMP that can improve pest management efficiency, reduce pest management costs, and minimize dangers to the environment. IPM is a coordinated management strategy, using all suitable techniques to keep pest populations below economically damaging levels. IPM promotes the use of nonchemical control methods. These include using pest-resistant cultivars, well-designed crop rotations, pest-controlling tillage practices, adjusted planting and harvesting dates, exclusion with row covers, mulches, and plant spacing.

Unfortunately, not all pest problems can be controlled with nonchemical control methods. Chemical controls may be needed in order to achieve profitable yields and quality, but IPM ensures that pesticides are used only when necessary to prevent economic loss. Those using IPM monitor weather, crops, and pests in making pest control decisions.

Irrigation management for vegetables

A significant amount of Wisconsin's vegetable production is irrigated. Most of the irrigated vegetable production is on light sandy soils with shallow depths to groundwater. Such areas are sensitive to groundwater contamination by nitrates and pesticides. Excessive fertilizer (especially nitrogen) or pesticides and over-irrigation can increase groundwater contamination problems. Such overuse also adds unnecessary costs.

Yield and quality losses occur when vegetables are subjected to moisture stresses. To avoid moisture stress, adequate amounts of water must be supplied to the crop throughout the growing season. Rainfall generally provides adequate moisture for vegetables grown on silt and clay loam soils. However, on sandy soils, a well-managed and efficient irrigation program must be used to avoid losses.

Efficient irrigation reduces costs and the potential for groundwater contamination problems. Effective scheduling (timing) of irrigation by using a program such as the Wisconsin Irrigation Scheduling Program (WISP) enhances irrigation efficiency.

Over-irrigation applies more water than the crop can use or the soil can hold. It is this excessive water that leaches nitrates or pesticides to the groundwater. Excessive or untimely rains also leach contaminants to groundwater. An effective irrigation scheduling program eliminates over-irrigation, so crop use of rain is maximized.

WISP uses estimates of crop water use to monitor soil moisture levels. The soil moisture status then determines the irrigation frequency and amount. WISP requires knowledge of four parameters for successful operation:

Allowable depletion (AD)—a measure of the soil's water storage. This is determined by soil type and crop rooting depth. A table is available that provides AD values for many crop/soil systems found in Wisconsin.

Rainfall—all rains must be accounted for in the WISP program.

Irrigation—all irrigations must be recorded.

Evapotranspiration (ET)—a measure of crop water use. During the growing season, daily ET estimates are calculated for Wisconsin's major irrigated areas and are available online at www.soils.wisc.edu/uwex_agwx/. Estimates should be adjusted to reflect the proportional canopy cover.

WISP uses the above parameters in a simple, checkbook-like accounting format to provide the needed information for making irrigation decisions. Specifically, WISP provides current soil moisture conditions that, in turn, determine the need for and amounts of irrigation. WISP also emphasizes the use of precipitation forecasts in making irrigation decisions. This approach ensures maximum flexibility in scheduling irrigations. Such flexibility is essential in Wisconsin, where weather patterns, particularly rainfall, are variable and changing. For more information about WISP, refer to UW-Extension publication *Irrigation Management in Wisconsin—The Wisconsin Irrigation Scheduling Program (WISP)* (A3600).

Insect identification

Aphids

Aphids are small 1/10–1/5 inch insects with two tailpipe projections (called *cornicles*) sticking out the abdomen. Both winged and non-winged forms can be found on plants. Large numbers cause plants to wilt and yellow. They also cause distorted and stunted plant growth. Most aphid species will go through numerous generations during the growing season. Aphids also transmit virus diseases to many plants. There are a number of important species in Wisconsin.

The **black bean aphid** is found in clusters on the undersides of succulent bean leaves. Large populations will cause yellowish foliage and poor growth of the crop. Because of the spotty nature of infestations in the field, a number of plants in several areas of the field should be examined. Check 15 consecutive plants (terminals only) in each site. Levels above 5 to 10% infested would indicate treatment is needed. Scout fields weekly.

Cabbage aphids are gray in color and live in closely packed groups. Heavy infestations cause leaves to curl and may prevent head formation. Aphid damage

is most serious on young cabbage and in the seedbed. Once cabbage heads form, this insect is difficult to control.

Corn leaf aphids at first congregate on upper leaves and tassels, but later may be found over all parts of the plant. High numbers may occur on plants during ear filling, but this attack has little effect on yields. Treatment at this late stage will be of little or no benefit.

The **asparagus aphid** is a recent import from Europe that causes a brooming distorted growth of the ferns of asparagus. It is bluish gray in color, and the cornicles

aren't readily apparent. Normally only isolated plants are affected and can be spot treated.

The **green peach aphid** is the most destructive and insecticide-resistant aphid in Wisconsin. Many crops are attacked including greenhouse transplants of pepper, tomato, and cabbage, along with carrot, broccoli, brussels sprouts, lettuce, eggplant, potato, and table beet. Green peach aphids are 1/8 inch long, yellowish green, peach, or dirty red in color, and can be found on the undersides of leaves. This aphid is a very efficient vector of many virus diseases. Scouting is usually done by examining the undersides of leaves and looking for aphid activity.

In potatoes, remove 25 leaves per sample from the lower half of 25 different plants and sample at least 10 sites per field. Treat if more than 10 aphids are found per 100 leaves in seed fields or more than 30 per 100 leaves in table stock or processing potatoes.

Potato aphids are larger than green peach aphids and come in both red and green. They attack eggplant, tomato, and potato and are most often found on young, actively growing tissue. To sample for potato aphids, remove leaves from the terminal parts of 35 plants and count the number of aphids. Repeat in at least 10 locations per field. When aphid counts exceed 20 per 100 leaves in seed potato and 50 per 100 leaves in table or processing potatoes, control measures are suggested.

Melon aphid is a small dark aphid that can be found building up on the undersides of leaves of cucumber, squash, pumpkin, and melon. They can produce up to 10 generations per year and cause infested plants to yellow and wilt. Low numbers are most often controlled by natural enemies.

Armyworms

Armyworms are dark caterpillars measuring up to 2 inches long. They have a dark stripe running lengthwise on the side with a yellow stripe beneath. Dark and light stripes alternate along their back. Armyworms move up from grassy weeds within cornfields or migrate into

cornfields from small grain or forage fields. They may hide in soil crevices and beneath clods by day. At night, they chew corn leaves and weaken plants.

Beetles

The **striped and spotted cucumber beetles** are 1/4-inch yellow-green beetles that become active in very early spring. Adults feed on developing fruit and foliage and, more importantly, transmit bacteria causing wilt disease. Small numbers of beetles can devastate a planting if they carry the disease, and they must be controlled before the disease appears. In the fall, adults of these beetles can chew holes in the developing fruit of vine crops such as cucumber, melon, pumpkin, and squash.

Flea beetles are frequently a pest of early plantings. These small, shiny black beetles jump when approached and chew small circular holes in leaves. This damage is insignificant on large potatoes and tomatoes, but young seedlings can be rapidly killed.

Young seedlings or transplants of cabbage, broccoli, table beet, tomato, eggplant, and all vine crops should be scouted on a weekly basis when they are young. If flea beetle activity is seen, an insecticide rescue treatment will be needed.

Common asparagus beetles are 1/5 inch long and orange, with a back showing white dots on a dark background. They overwinter as adults and emerge in April (earlier than the spotted asparagus beetle) and begin feeding and laying eggs on the spears. **Spotted asparagus beetle** adults may feed on spears but do not begin laying eggs until the plants have ferned out. When both species are present, both the spears and ferns can be heavily damaged.

Cabbage maggot

The adult **cabbage maggot** is a small gray fly that lays its eggs at the base of crop plants in the cabbage family. The small, cylindrical white eggs hatch into legless white maggots that feed on the roots. Seedling plants can be killed rapidly, while transplants tend to wilt and

die slowly. Root crucifers such as radish and turnip show surface tunneling that is often accompanied by soft rots.

Chemical controls require either soil application to seed furrows or transplant drenches. However, these treatments last for only 4 to 5 days and must be applied when the adults are actively laying eggs.

The cabbage maggot has three generations in Wisconsin. The first emergence of adults from overwintering pupae is the largest and most damaging, therefore you want to plant after the pupae have emerged. This emergence and the egg-laying peak may be predicted accurately by keeping track of the degree days. Cabbage maggots do not develop below 43°F (developmental threshold). Peak emergence of first-generation cabbage maggots occurs when 300 degree days have accumulated. For more information, see "Calculating Degree Days" on page 14. If planting is necessary during the time of peak emergence, then insecticide treatments are recommended.

Colorado potato beetle

The Colorado potato beetle is the most distinctive pest of potatoes. Both the yellow-and-black striped adults and the brick-red humped larvae feed on the foliage. Feeding normally is initiated on the terminal growth and can be severe. Adults overwinter and move to emerging potatoes early in the spring (May). The adults lay bright yellow egg masses, and larvae feed for several weeks in the summer before pupating in the soil. Emerging adults then continue feeding throughout the season until no vines remain.

Common stalk borer

Eggs of this cutworm relative are laid in grassy weeds in September. In late May to July, the brown-and-white striped caterpillars migrate into fields and burrow into the stems of tomatoes, potatoes, beans, and other thick-stemmed plants. Once inside the stem, the insect cannot be controlled. Fall grass control will prevent egg laying and is the best control method for common stalk borer.

Corn rootworm

Rootworm larvae are white with black heads and grow 1/2 inch long. **Northern and western rootworm** larvae cannot be differentiated in the field. They feed on crown roots from June to August, causing corn to lodge and “gooseneck.”

Rootworms are most serious in loam soils but are of little consequence in muck or non-irrigated sandy soils. The larvae are not a potential problem unless corn is planted on the same ground in a “rootworm area” for 2 or more years in succession. Annual crop rotation controls these insects, because eggs overwinter in the soil.

The adult beetle of the northern rootworm is yellow to green. The western species is yellow with three black strips. Because rootworm adults congregate in ear tips to feed on silks, large populations in August can impair corn pollination. If there are five or more beetles per plant (check silks), cornfields should be treated during the early silk period. This appraisal should be made prior to 75% silking.

Late-season corn borer and earworm treatments reduce adult rootworms and eggs. Other fields may receive an economic population of overwintering eggs if 0.75 or more adults per plant are present around mid-August.

Cutworms

These are the larval stage (caterpillar) of night-flying moths. They are whitish gray to brown worms, ranging from 1/2 to 2 inches long. They feed almost exclusively at night and hide in the soil during the day. All cutworms curl to a characteristic tight ball when exposed, making them easy to identify. Most cutworms cut plants off at or slightly below the soil surface, making recent transplants especially susceptible. Eventually, plants become too thick and tough for cutworms to feed. Adult females are attracted to tall grasses for egg laying, and cutworm numbers tend to be higher in weedy or trashy fields.

Almost all commercial vegetable crops such as asparagus, carrots, celery, onions, potatoes, and table beets can be attacked by cutworms. It is very difficult to predict when and where an infestation will spring up, and preplant insecticide treatments will not control heavy cutworm infestations. Scouting fields on a weekly basis is the best method for monitoring cutworm activity. If damaging populations are found, a “rescue” treatment will be needed. Bait formulations are the preferred treatment if conditions are dry, whereas both baits and sprays can be used when the cutworms are feeding at the soil surface.

Earworms

These smooth, varicolored caterpillars are up to 2 inches long and feed mostly on ear tips. Insecticide treatment is necessary for early market sweet corn and for late-season canning or market sweet corn (silking after August 15).

European corn borer

Corn borers are small white worms with black heads. In sweet corn, they hatch from egg masses on leaves and can grow to 1 inch. First-generation borers feed on whorl leaves during early summer, making small holes that show as the leaves grow. If uncontrolled, they also feed inside the stalk and ears. Second-generation borers invade ears and hide behind leaf sheaths. They also enter the stalk and ear shank as the shanks mature.

The best procedure for detecting damaging levels of egg-laying adult corn borers is to operate blacklight traps in a field and count trapped moths daily.

Hornworm

The tomato hornworm is a very large green worm (up to 3 inches) with a spine on the posterior end and white side stripes. The larva feeds on both foliage and fruit, and because each larva eats three to four times its weight in food daily, the damage appears dramatic. The adult stage of this insect is a gray hawk moth that is often mistaken for a hummingbird because it feeds on flowers. Because they are usually found in small numbers, hornworms rarely need control.

Leafhoppers

Potato leafhoppers are small (1/8 inch) wedge-shaped, bright green insects that blow up into the state every spring from the southern states. They may arrive anytime from late May to early July. Potato leafhoppers have a toxic saliva that causes injury to many plants. Leafhopper feeding will cause leaf edges to curl and turn yellow, and leaves may eventually brown and die. This “hopperburn” is most serious on potatoes, dry beans, and green beans. Fields should be scouted on a weekly basis to monitor for this pest.

Potato leafhoppers are best sampled with an insect sweep net. For potatoes, take 25 sweeps and carefully turn over 25 leaves per sample site. Select leaves from the middle portion of the plant. Use at least 10 sample sites per 100 acres. Control measures are recommended when a field averages one to two adult leafhoppers per sweep and there are more than 15 nymphs per 25 leaves, or if there are three or more adult leafhoppers per sweep and nymphs are present.

For green beans, take 25 sweeps per sample site with at least 10 sample sites per 100 acres. Nymphs are less mobile and are best scouted by leaf samples. Carefully turn over 25 leaves per sample site and count nymphs. Select leaves from the middle of the plant and sample at least 10 sites per 100 acres. If counts exceed one leafhopper per sweep and one nymph per 10 leaves, then control measures are recommended.

The **aster leafhopper** is an olive, wedge-shaped insect that is 1/6 inch long and has six black spots on the vertex of the head. This leafhopper also migrates from southern states and carries the pathogen that causes carrot (aster) yellows disease. Aster yellows can be a serious problem on carrot, lettuce, celery, onion, and potato. For most crops, it is important to control the disease before symptoms show in the field. For susceptible crops such as lettuce and celery, one or two insecticide applications per week may be needed from seedling stage until harvest. (For more information, see the “Aster Yellows Index” section on page 16.)

Onion maggots

Onion maggots are small whitish larvae found in the bulbs of onions. The adult is a grayish fly that resembles the cabbage maggot. Onion maggots are a problem after a series of cool, wet springs. The most effective way to control these insects is to apply an insecticide in the furrow when planting.

Plant bugs

Plant bugs are 1/4-inch tan to dark brown oval insects with piercing sucking mouthparts. They attack more than 50 different economic crops but are most damaging to strawberries, peppers, and all bean crops in Wisconsin. Feeding by these insects causes poor fruit set and gnarled fruit due to the toxic saliva they inject into the plant. They are highly mobile insects that overwinter in field debris. Large numbers of adult plant bugs migrate out of alfalfa fields when hay is cut.

For both potatoes and commercial beans, take 25 sweeps with an insect sweep net per sample site with at least 10 sample sites per 100 acres. When counts exceed one tarnish plant bug per sweep on a field average, control measures are recommended in potato and green bean.

Seed corn maggot

Seed corn maggot is by far the most serious pest of all beans. The white legless maggot burrows into the seed or seedling, causing very poor seed germination and emergence, and/or stems without

leaves (snake heads). The adult is a small grayish fly that looks identical to the cabbage maggot. This insect overwinters in the pupal stage in the soil and becomes active early in the spring. Heaviest plant damage occurs during cool damp weather, in heavy organic soils, and after peak adult flights. There are five generations per year, but most severe damage occurs in May and June. Peak activity of each generation can be predicted using degree days (200, 600, and 1,000 degree days—with a base temperature of 39°F—for first, second, and third generations, respectively). But since damage is severe for each of the first three generations, it is seldom possible to avoid activity periods.

You can reduce damage by planting seeds during good germinating weather, using seed treated with insecticide, or sowing seed in higher than normal numbers. Planting seeds too early or directly into manure frequently increases problems with this insect. Other crops attacked include peas, corn, vine crops, and crucifers, but beans are the preferred host. For other hosts, damage is most severe when plants are planted before the recommended date or during cool springs.

Thrips

Thrips are small 1/25-inch insects that cause whitish scratches or brownish blotches on plant leaves. Hot, dry weather is correlated with severe thrips problems. Thrips attack cabbage and cause a brownish scarring in the head of processing cabbage. Thrips must be controlled before the plant heads out

in order to assure proper coverage and control. In onions the injury looks similar to both ozone injury and some diseases. Use large-volume sprays (100 gal/a) with a wetting agent for thrips control. A second treatment 5 to 7 days later may be warranted.

White grubs

This insect, which is the larval stage of the June beetle, has up to a 3-year life cycle. Because the adults lay eggs in grassy sodded areas, fields located in plowed-down sodded areas are most susceptible. The characteristic C-shaped grubs feed on the roots of most plants. They are most damaging to root crops such as carrots or potatoes. Tilling the soil to expose the larvae during the spring and fall helps reduce numbers. Granular insecticides can be worked into the soil before planting in areas where damage is expected. Established weed-free fields should have few problems.

Wireworms

This insect is the larval stage of the click beetle and, like the white grub, lays eggs in grassy areas. Wireworms are also troublesome in low, poorly drained areas. Weed control is the best preventive measure. Control procedures for white grubs will also control wireworms. Potatoes and carrots are the most susceptible crops. Grassy or old sod fields will have high populations of wireworms. A soil insecticide should be worked in preplant in these fields.

Natural enemies of insect and mite pests

Biological control is the active utilization of beneficial living organisms to control pests. The beneficial organisms we use are usually referred to as “natural enemies” of the pests and are placed in three broad groups: predatory insects, parasitic insects, and insect pathogens. In the upper Midwest, literally hundreds of types of natural enemies occur naturally in the environments of agricultural crops, managed forests, and managed urban and suburban landscapes. These have a major impact on pest populations, and often result in pests being kept below damaging levels. When there is no human activity involved in managing these natural enemies, we refer to the results as “natural control” of the pests. Natural control is of major importance in pest management, but the benefits frequently go unrecognized because the natural enemies are often very small and their activity is easily overlooked.

To get the greatest benefit from both natural control and biological control, it is necessary to recognize natural enemies and understand their biological characteristics (such as life cycle, preferred host insects, and efficiency at controlling pests). Some natural enemies, such as lady beetles, are readily recognized in the adult stage by most people but may not be recognized in the egg, larval, or pupal stages. Other natural enemies, including most parasites, are much more difficult to recognize.

Although birds, mammals, frogs, and other higher animals can be important as natural enemies, they can rarely be effectively managed for biological control. These animals lie outside the scope of this discussion, which deals primarily with the predatory or parasitic insects of pest insects and mites.

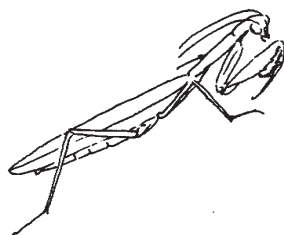
Predatory and parasitic insects

There is a very large number of different types of predatory and parasitic insects. A standard reference book about insects lists a total of 328 families. Between one third and one half of these families contain species that are predaceous or parasitic on other insects. Many of these families, however, are of little or no consequence to agriculture. For example, there are seven families of dragonflies. All species of dragonflies are predaceous on small insects, capturing them in flight, and are important regulators of population numbers of small insects such as gnats, midges, and mosquitoes. However, the diet of dragonflies does not usually contain a significant number of agricultural pests. Therefore, a smaller number of families consist of important natural enemies of agricultural pests, and these are the ones that will be covered here.

The praying mantids (Order Mantodea)

Praying mantids are all predatory on other insects. They have highly modified and strengthened front legs for capturing and subduing their prey, and they have chewing mouthparts. Large mantids can inflict a painful bite if handled. They all belong to the family Mantidae.

Family Mantidae: The praying mantids



Chinese mantid

Mantids are among the most recognizable of predaceous insects. They are often thought to be highly beneficial. However, they are opportunistic feeders, consuming whatever comes into their grasp, including other natural enemies, pollinators such as honeybees, and completely innocuous insects, as well as occasional pests. They are also cannibalistic and will readily consume each other.

Mantids are not native to areas of extreme winters and cannot naturally be found in Wisconsin. Those that are introduced, such as from commercial suppliers, will not survive northern winters.

Mantids have only one generation per year and overwinter as eggs in cases that contain from several dozen to several hundred eggs. It is in this form that they are distributed commercially. These purchased egg cases are distributed outdoors to hatch and populate the area through natural movements of the young. Because of their cannibalistic behavior and their rapid dispersal to avoid cannibalism, rarely can more than one or two be found in the vicinity of the original egg case. This, in combination with their indiscriminate predation on beneficial and innocuous insects as well as pests, renders them virtually useless as effective natural enemies of garden or crop pests.

The true bugs (Order Hemiptera)

All of the true bugs undergo simple metamorphosis, meaning that the immature stages (called *nymphs*) look like small, wingless versions of the adults. All have piercing-sucking mouthparts, meaning that they suck body fluids from their prey rather than chewing it up. Some Hemiptera are serious crop pests and others (such as bedbugs) are pests of human health and livestock. Some predatory Hemiptera can inflict a painful bite if mishandled, sometimes resulting in severe inflammation of the area surrounding the bite, which may persist for several days.

In all predatory Hemiptera, both the nymphs and the adults are predaceous and often can be found in the same general habitat feeding on similar types of insects, although the young nymphs usually require smaller prey. Some predaceous Hemiptera feed to a small extent on plants, sucking plant sap, but there are no indications that this causes plant damage.

Family Anthocoridae: The pirate bugs

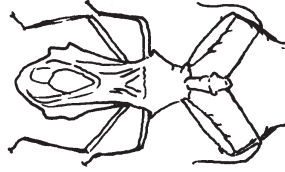
These are tiny insects, only 1–2 mm in size. Nymphs and adults feed on mites, small insects, and eggs. They are very common in many agricultural situations, especially where broad-spectrum insecticides are not routinely used, and are considered to be very beneficial general predators.



Minute pirate bug

Orius insidiosus, the minute pirate bug, is probably the most important species in our region. It is an important predator of thrips, aphids, and spider mites on many crops. It is also an important predator of insect eggs. It is considered to be one of the more important natural enemies of corn earworm and can destroy 50% or more of the eggs of this pest. Both the young and adults of *Orius* can consume 30 or more spider mites per day.

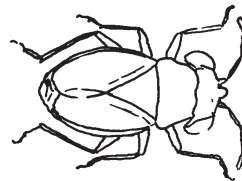
Family Reduviidae: The assassin bugs



Assassin bug

Some assassin bugs are parasitic blood-suckers of mammals and have been implicated with the transmission of serious human illnesses. However, most species are highly beneficial predators of many serious crop pests. These are medium-sized bugs (up to about 1 inch long) and can subdue and kill medium-sized caterpillars and similar insects. They are generalist predators frequently found in gardens and fields.

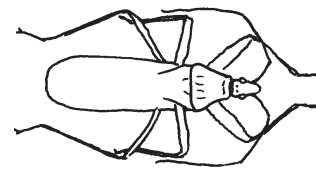
Family Lygaeidae: The seed bugs and bigeyed bugs



Geocoris

This family consists of both plant-feeding insects as well as predators. Many of the plant feeders feed specifically on fruits or seeds, hence the common name. The big-eyed bugs occur in the genus *Geocoris*. These are very beneficial predators that occur in many habitats and feed on many types of prey. *Geocoris punctipes* has been noted to feed on as many as 1,600 spider mites during the course of its nymphal development and an additional 80 mites per day as an adult. Bigeyed bugs are found in many agricultural situations, especially where broad-spectrum insecticide use is minimal, and in many non-crop situations.

Family Nabidae: The damsel bugs



Damsel bug

This is a small family of general predators commonly found in many crop and garden situations. Adults are 1/3–1/2 inch in length and slender bodied. The tan-colored *Nabis ferus* is a common species in our region. It feeds on many types of insects, ranging from leafhoppers to small caterpillars. Some other species of damsel bugs are black in color.

Family Pentatomidae: The stinkbugs



Stinkbug

Stinkbugs are medium-sized insects with a broad, shield-shaped body. They are usually green or brown but are sometimes brightly colored. Many discharge a disagreeable odor, especially when handled, hence their common name. Many are plant feeders and some of these are serious pests on a variety of crops. However, some species, especially in the genera *Podisus* and *Perillus*, are important predators. *Podisus maculiventris* and *Perillus bioculatus* both feed on caterpillars and larvae of leaf-feeding beetles such as Colorado potato beetle and Mexican bean beetle. These are highly efficient predators capable of consuming many prey during the course of their development. *Podisus* has two generations per year, and each female can have 1,000 or more offspring. The eggs are laid in clusters on leaves. The young are small and round. The youngest nymphs of some predatory pentatomids may feed to a limited extent on leaf sap, but such feeding is not damaging.

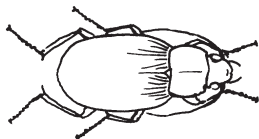
The beetles (Order Coleoptera)

The order Coleoptera is the largest group of insects in the world, constituting about 40% of all known insect species. There are about 30,000 species in the United States. The habits of this group vary considerably: many are aquatic, many are found in the soil, some are parasitic, and many are free living. Many are plant feeders and some are serious pests. Some feed on fungi or are scavengers. Many are predators of other insects.

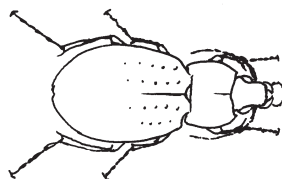
All beetles undergo complete metamorphosis, meaning that the immatures look nothing like the adults; instead they are wormlike or grublike. Depending on the species, larvae and adults may do similar or very different things. For example, both the adults and larvae of lady beetles are predatory, usually on the same types of prey. However, while blister beetle larvae are parasitic on grasshopper eggs and ground-nesting bees, the adults are generally plant feeders.

Approximately 40 families of beetles are known to have predatory or parasitic members. In some families, insect feeding may be only incidental, while in other families it is the rule. By far, the two families most important in crop protection are the predaceous ground beetles (family Carabidae) and the lady beetles (family Coccinellidae).

Family Carabidae: The ground beetles



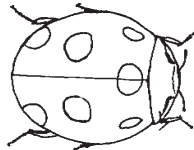
Chlaenius



Calosoma

Ground beetles vary in size from a few millimeters to over an inch in length. Most species are brown or black, but a few are metallic blue or green. There is generally one generation per year, but the adults of larger species are known to live 2 to 4 years. The larvae of some species may require more than 1 year to complete development. Carabids can be found in most agricultural and garden settings. Most species that have been studied are predaceous as both larvae and adults, although some are scavengers and a few feed on plants. The predatory species feed on insects found in or on the soil, earthworms, and similar small invertebrate animals. Many insects, even leaf-feeding insects, spend part of their life cycle in the soil or under leaf litter, especially to pass the pupal stage or to overwinter. Such insects often suffer a high degree of natural mortality at such times, and several studies have shown that ground beetles are important contributors to this natural mortality.

Family Coccinellidae: The lady beetles or ladybirds



Lady beetle

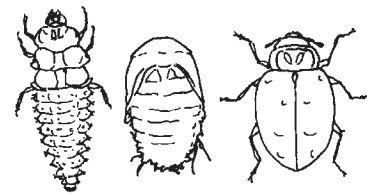
Although frequently called *ladybugs*, these insects are not true bugs and therefore the other common names are preferred.

The lady beetles are a large group containing many important natural enemies. Although most are predaceous as both larvae and adults, a few are fungus feeders and a few feed on plants, including a couple of important pest species such as the Mexican bean beetle.

Predaceous lady beetles feed primarily on aphids, scale insects, mealybugs, and whiteflies. There are specialized lady beetles that limit their feeding to other prey groups, such as small caterpillars and leaf beetle larvae. Although most common species feed primarily on aphids and similar insects, other types of prey will occasionally be taken. Spider mites can

be an important supplemental prey of many species of aphid-feeding coccinellids. Adult lady beetles also tend to feed on nectar and pollen taken from flowers.

Lady beetles overwinter in the adult beetle stage. Some species, such as our native convergent lady beetle, *Hippodamia convergens*, are known to congregate in enormous clusters. Other species overwinter singly or in small clusters. In spring they seek out the aphids or other hosts that will be both adult and larval food. Eggs are laid adjacent to the prey. Many deposit spindle-shaped eggs, laid on end on the leaf surface. Some species scatter individual eggs while other species lay in compact clusters of 10 to 20 or more. The eggs of the aphid-feeding species are usually yellow to orange in color, and 1.0 to 1.5 mm long. Eggs usually hatch in 3 to 7 days.



Larva Pupa Adult

Convergent lady beetle

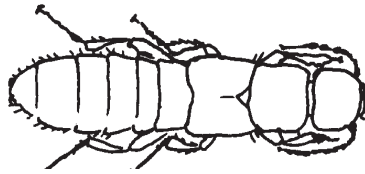
Lady beetle larvae are not as frequently recognized as are the adults, an unfortunate circumstance because they are just as important as the adults in natural control. The larvae of the aphid-feeding species are somewhat slender, with the body tapering to a point at the rear. Depending on species and stage of development, they will be 1/8 to 1/2 inch in length. The color is usually black or dark gray, but there usually are conspicuous, red, yellow, orange, or blue markings. The prominent legs are held to the side. The predators of mealybugs and scale insects may not be as conspicuous, as they are often covered in a white waxy coating similar to that of the prey insects. Larval lady beetles normally consume 500 to 1,000 aphids or similar prey during their growth.

If prey are abundant and temperatures warm, most lady beetle larvae complete development 2 to 4 weeks after egg hatch. When done feeding, the larvae

pupate in the same location. The pupal stage also is unrecognized by most people. The pupal period lasts about 1 week; the entire life cycle takes about 4 to 6 weeks. Generally, there are two to three generations per year, more in warmer areas with longer growing seasons.

There are many species of beneficial lady beetles in the north central United States, and only a few brief examples can be discussed here. The convergent lady beetle is one of the most common throughout the United States and is a very important predator of aphids and other pests. Recently, a large lady beetle from Europe was introduced into the United States for aphid control. *Coccinella septempunctata*, sometimes called C-7 (derived from the scientific name), has rapidly become established and spread throughout much of the region. It is very noticeable because of its large size. The multicolored Asian lady beetle, *Harmonia axyridis*, is another introduced species. It is a specialized predator of aphids infesting trees such as fruit trees. It tends to congregate near buildings in the fall of the year and can sometimes be a bit of a nuisance. This is another reddish orange lady beetle, but the pattern and number of black dots of this species are variable; indeed, some have no black dots at all. Members of the genus *Stethorus* are only a few millimeters long and black in color, and therefore are not very conspicuous. As both larvae and adults, these are important predators of spider mites and are capable of consuming many mites during their lives. The twice-stabbed lady beetle is small and shiny black, with a bright red spot on either side of its body, hence the name. It is an important predator of scale insects and other pests. It is frequently seen in association with cottony maple scale and is undoubtedly important in control of this pest of silver maples.

Family Staphylindae: The rove beetles



Rove beetle

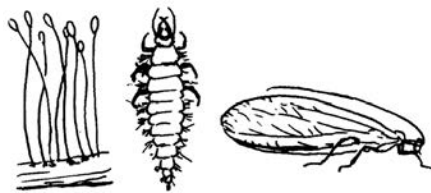
This is the largest family of North American beetles, with about 2,900 species. Most are quite small and of cryptic habits. Most are thought to be predaceous, although many are probably scavengers. Although these are small insects, usually less than 1/4 inch in length, they are quite recognizable because of their slender, usually black body, shortened front wings (elytra), and behavior of curling the tip of the abdomen upwards when disturbed or running.

Most rove beetles are found in association with soil or decaying organic matter. Many are predaceous or parasitic and undoubtedly help reduce populations of filth flies. Several occur in agricultural soils where they probably feed on a variety of types of prey. A few species can be found in vegetation where they feed on many types of small insects.

Lacewings, antlions, and others (Order Neuroptera)

The order Neuroptera contains several small families, most of which are predaceous or parasitic as larvae and predaceous as adults. Most families provide no appreciable benefit to agriculture, but two families of lacewings are quite important.

Family Chrysopidae: Green or common lacewings



Eggs Larva Adult

Green lacewing

Green lacewings are common throughout the United States and are frequently found in fields, orchards, and gardens. Both adults and larvae are important predators of aphids and other small insects. The adults, which are often attracted to lights at night, have pale green bodies about 1 inch long, large, clear, membranous wings with green veins and margins, and long hairlike antennae; the eyes are often golden and the body is slender and soft. The most commonly seen species are in the genus *Chrysoperla*.

The oval white or greenish eggs are readily recognized because each is attached to a slender, hairlike upright stalk, usually about 1/3 inch in length. Although most species lay their eggs singly, some lay their eggs in clusters. The eggs are usually laid on foliage near colonies of aphids or other prey. The eggs hatch into small, gray, slender larvae that are called *aphidlions*. These larvae have enlarged sickle-shaped mouthparts used to puncture the prey and suck out the internal fluids. The larva ultimately grows to about 1/2 inch in length and then spins a spherical silken cocoon, usually on the underside of a leaf, within which it pupates. The entire development period is about 1 month, and there can be from one to several generations per year, depending on species and location.

Green lacewings are highly beneficial insects found in many types of crop and garden situations. They are also raised in commercial insectaries and can be purchased for biological control. Usually it is the egg stage that is sold.

Family Hemerobiidae: Brown lacewings

These are similar to green lacewings in general appearance but are brown in color and are smaller. The eggs are not stalked as in green lacewings. Brown lacewings occur both in field and forest situations but are not as common in agriculture as are chrysopids. Both larvae and adults feed on aphids and other small, soft-bodied insects.

Flies, gnats, midges, and others (Order Diptera)

The flies constitute one of the largest groups of insects, and they are very diverse in their habits and habitats. Approximately 35 families are known to contain species that are predatory or parasitic on other insects. Some of these occur primarily in aquatic or semiaquatic environments where they feed on other insects in those areas, including mosquitoes, blackflies, and other public health or nuisance pests. Only those families that are commonly encountered or important in pest management are discussed here.

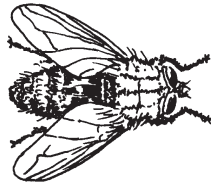
Family Syrphidae: The hoverflies



Syrphid fly

This is a large family of common insects. The adult flies are small to medium in size, with the body often striped yellow and black: some resemble bees or wasps. They are often seen on or hovering near flowers, and the adult flies feed exclusively on flower nectar and pollen. Although the biological habits of the larvae are quite diverse, many are predaceous on aphids, scale insects, and other insects. The aphid predators are quite common. These pale green to yellow maggots have a sluglike appearance, and the larger species become 1/2 inch long. Some studies indicate that larvae consume as many as 400 aphids during development. Some larvae pupate on the foliage near the feeding site, while others leave the plant and enter the soil to pupate. The puparium is often teardrop shaped. The life cycle takes 2 to 4 weeks to complete.

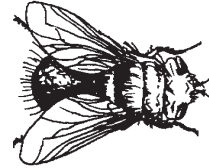
Family Sarcophagidae: The flesh flies



Flesh fly

This is a large family of medium to large flies. They somewhat resemble houseflies but are often gray-and-black striped and distinctly bristly. When they occur in numbers, they can be a significant nuisance because of their persistent droning and inclination to land on food and people. The larval habits are diverse, with some species breeding in carrion and others being parasitic on higher animals. Many species, however, are specialized parasites of other insects. Of the parasitic species, the largest group of hosts are the grasshoppers, and both nymphs and adults can be parasitized. Hosts of other sarcophagids include larval and adult bees (including honeybees and bumblebees), beetles, and caterpillars. One of the most common insect-parasitic sarcophagids in the northern United States attacks the forest tent caterpillar. During outbreaks of the host insect, this large fly occurs in abundance and is considered a nuisance by local residents. However, it provides significant control of the pest.

Family Tachinidae: The tachinid flies



Tachinid fly

This family is by far the largest and most important group of flies, with over 1,300 species in North America. All species are parasitic in the larval stage, and many are important natural enemies of major pests. Many species of tachinids have been introduced into North America from their native lands to suppress populations of alien pests. Tachinid flies are variable in color, size, and shape, but many resemble houseflies. They are usually housefly shaped and gray, black, or striped, often with many distinct abdominal bristles.

Tachinids are usually fairly host-specific, and, as a family, most frequently attack caterpillars and adult and larval beetles. Sawfly larvae, various types of true bugs, grasshoppers, and other types of insects are also attacked. Egg formation and oviposition varies considerably, with most species laying eggs on, in, or near the host. Many tachinids exhibit an unusual trait in which the eggs mature within the mother fly, which then lays eggs that immediately hatch. In some species, egg hatching actually occurs within the mother fly, and she gives birth to living young, a behavior called *larviposition*. Egg and larval development are rapid for most tachinids, and pupation often occurs within 4 to 14 days after oviposition. The pupal period generally lasts 1 to 2 weeks. Many species are capable of several generations per year, but others are restricted to only one generation, especially if their hosts have only a single generation. Most, if not all, tachinids are internal parasites within their hosts. Most species are solitary, but some have anywhere from two or three up to a dozen or more capable of developing from a single host.

Wasps, ants, and bees (Order Hymenoptera)

The order Hymenoptera is divided into two suborders. The smaller consists of the sawflies and horntails. Most of these are plant feeders, and many are serious pests of agricultural and horticultural plants and forest trees. The larger group consists of the bees, wasps, and ants.

There are several families of bees, and all feed primarily on nectar and honey. The ants are in a single family (Formicidae) of diverse habits, but many species are predaceous on other insects, and some are very important in natural control. The wasps are a very diverse group of over 50 families, most of which feed entirely on other insects. The Hymenoptera is the second largest group of insects.

Over 16,000 species are known from the United States and Canada; the majority of species are parasitic on other insects. Many of the parasitic species are very tiny and easily overlooked. These are commonly called *microhymenoptera*, and, because of their small size (as small as 0.5 mm, or 1/50 inch), many are as yet unknown to science.

As an order, the Hymenoptera are the most beneficial of all groups of insects. Bees provide honey and wax, and pollinate our crops. The parasitic wasps are the most important group of natural enemies of pest insects. Many different species have been transported around the world for control of alien pests, and several species are commercially available for the control of specific hosts.

All Hymenoptera undergo complete metamorphosis, having egg, larval, pupal, and adult stages. The most important natural enemies are the many families of parasitic wasps, or "parasites." In these the larval stage develops in and kills a single host insect. Some adult parasites also feed on insects, usually the same species which are host to the larval stage; this behavior is called *host feeding*. Although it may seem inefficient that each larva kills only one host insect, most females can lay many hundreds of eggs, resulting in the death of an equal number of host insects. By reproducing so rapidly,

they efficiently overtake increasing host populations and therefore often are able to suppress pests below injury levels.

The behavior of parasitic Hymenoptera is quite complex. Many are highly selective to a single species of host insect or a narrow range of related hosts. The adult females often have highly developed means of locating the hosts that they will parasitize. This searching ability is important because it means that adult female wasps can locate and parasitize hosts at low host densities, another important factor in keeping pest populations low.

The hosts of the parasitic Hymenoptera are diverse and include almost all groups of terrestrial insects. The important agricultural groups such as caterpillars, beetles, sawflies, aphids, and scale insects are frequent hosts. Depending on the parasite species, virtually any host stage can be attacked: egg, nymph, larva, pupa, or adult.

Although we have thus far discussed primarily the parasitic wasps which, because of their small size are frequently overlooked, many of the larger wasps that are more frequently recognized because of their bright colors and ability to sting, also kill other insects. These larger wasps usually develop a cell of some sort for their larvae and provision these cells with food. In the predatory species the adults forage for insect prey to take back to the cell to feed the young. Many of the larger wasps are social insects, and some can have quite large colonies.

Family Ichneumonidae: Ichneumon wasps



Cryptus

This is one of the largest families of insects. All species are parasitic on other insects. As a group ichneumonid wasps are larger in size than many other parasitic wasps. They parasitize a variety of insects in several insect orders, but the Lepidoptera (moths and butterflies) and

Coleoptera (beetles) contain the largest numbers of hosts. Many ichneumonid females have elongate, very noticeable ovipositors.

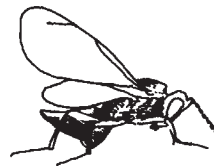
Family Braconidae: Braconid wasps



Rogas

Another large group and closely related to the ichneumonids, the braconids also are exclusively parasitic. Many are very important parasites of major agricultural pests, such as caterpillars, various beetles, aphids, fly maggots and other insects.

Superfamily Chalcidoidea: The chalcid wasps



Pteromalid

This is actually an assemblage of several specialized families. Most species are insect parasites, but a few, such as alfalfa seed chalcid, are plant pests. Most are quite tiny insects and attack fairly small hosts, including aphids, scale insects, fly larvae, leafminer larvae, small caterpillars, and many other types of insects. Some chalcids are so tiny they complete their entire life cycle in the egg stage of their host insect. This is true of all species of the families Mymaridae and Trichogrammatidae. Trichogramma species attack the eggs of many types of serious pests, especially caterpillars. Trichogramma are commercially mass produced and are widely used in biological control programs in Europe and Asia, and to a lesser degree in the United States.

Using blacklight traps and pheromone traps

Trapping is very important to any monitoring and pest management program. Blacklight traps use light to attract nocturnal insects while pheromone traps use “odors,” or pheromones, to attract certain other insects. Blacklight traps are useful for monitoring European corn borer, armyworms, cutworms, and other nocturnal insects. Vegetable insects that can be monitored with pheromone traps include armyworms, black cutworm, cabbage looper, corn earworm, diamondback moth, and variegated cutworms.

Blacklight traps

Blacklight traps will help you determine when nocturnal moths are flying as well as their relative abundance. This information allows pest managers to determine the timing of peak periods of activity and subsequently, pest management activities. Blacklight traps are useful for monitoring pest populations; they are not designed to reduce pest populations. It is not necessary to locate a blacklight trap on every farm. Regional trapping information is available in several printed and electronic newsletters produced by the WDATCP and University of Wisconsin-Extension.

Trap location. Trap placement is important for assuring an accurate representation of the insects you are monitoring. For European corn borers, place traps in “action sites,” grassy areas adjacent to cornfields where the adult corn borer moths congregate. The light should be positioned 3 to 4 feet above the ground over grassy vegetation. The traps should be no more than 300 feet from corn. The farther away from cornfields the traps are placed, the fewer moths that will be caught, although the catches will still show population trends. Trap placement relative to wind direction is not important. Locate traps at least 200 feet away from other sources of light such as post lamps or heavily traveled roads. When

placing traps, you may wish to consider the potential for vandalism. Blacklights, as well as 12-volt batteries, if used, are attractive to vandals.

Trap efficiency. Several variables affect moth catches in blacklight traps. Inclement weather, such as cold temperatures, high winds, and rain, will reduce the number of moths caught. Keep in mind that if weather conditions are interfering with moth catches in light traps, those same conditions may also be affecting mating and egg laying. When the moon is full or nearly full, trap catches may be reduced due to the high amount of background light.

Light traps often don’t detect low densities of moths. Therefore it is important to recognize that even though no moths are being caught, active moths may still be in the area.

Trap monitoring. Blacklight traps should be checked frequently—preferably every other day. Fresh specimens are much easier to identify as many of the identifying characteristics become obscure with age. If possible, check and empty traps prior to rain since water in the collection container will destroy the distinguishing characteristics on the wings. In general, moths smaller in size than the diamondback moth (wingspan less than 5/8 inch) and larger than hawk moths (wingspan greater than 3 inches) are not economically important and can be ignored when sorting through a trap catch. Placing a DDVP (dichlorvos) insecticide strip in the funnel portion of the collection container will kill the insects, making them easier to identify. To aid in moth identification, the UW-Extension IPM program has developed a color fact sheet entitled *Identifying Blacklight Trap Catches in the Upper Midwest*. It illustrates each of the economically important nocturnal moths and describes identifying characteristics. Single copies are available free from the University of Wisconsin IPM program, (608) 262-6429.

Pheromone traps

Insects secrete pheromones to alert other insects about information such as the sex of the insect, trail location, alarm, and grouping. Synthetically produced pheromones mimic the chemicals produced by insects and are used to lure specific insect species to specially-designed traps. At this time, over 60 different pheromones are commercially available to aid in pest monitoring. The most common vegetable pest monitored with a pheromone trap is the corn earworm. Diamondback moths can be monitored with pheromones as easily as the corn earworm. However, most growers haven’t begun to utilize this very useful monitoring tool.

Trapping will take time and additional knowledge to implement. You must learn which type of trap to use, where and when to place the trap, which lure to use, how often to check the trap, and what trap catches mean. However, trapping will save you money in the long run by indicating whether you actually have an insect infestation and whether it is severe enough to require treatment. Trapping will also help you time your treatment efforts to the most susceptible life stage of the pest. By trapping the adult insects, you will realize you have a pest problem long before the damaging larvae are present.

Type of trap. It is important to use the appropriate lure specific to the pest you want to monitor as well as the correct trap. Pheromone traps may be sticky traps such as the delta or winged traps used to monitor gypsy moth and other tree or orchard pests. Some insects such as Japanese beetles and corn earworm moths require specifically-designed traps. For example, corn earworm moths must be trapped in a specialized wire mesh trap called a *Hartstack trap*.

Asparagus

Bean

Carrot

Celery

Cole crops

Cucumber

Timing. Traps should be in place at least 2 weeks before the earliest known emergence of the insect in your area. Extension specialists can help you determine when to set out traps. Check traps at least twice a week. Once insects appear in the trap, monitor at least every other day so you don't miss population trends and peak emergences. Record the number of moths caught at each visit so you can compare trends at a later date if needed.

Location. Trap location is important. Ideally, every susceptible field should have a pheromone trap located in or near it.

For example, if you are trapping corn earworm moths, you should have an earworm trap in every silking sweet corn field. Traps should be placed level with the crop canopy "upwind" at the field edge so that the pheromone can be dispersed through the field.

Storing lures. Lures, the plastic or rubber strips impregnated with the pheromone, should be kept in the freezer until ready to use. Do not expose lures to heat. Replace according to package directions. For example, earworm lures should be changed every 2 weeks. Because there

will still be some pheromone left on the old lure, remove it from the field and dispose of it along with the packaging material for the new lure. Do not leave the used lure in the field as there is enough pheromone remaining to attract (and confuse) the moths.

For information on interpreting your trap catches, contact your county Extension office.

Calculating degree days

Temperature affects the rate of development of plants and insects. Cold weather slows development while warm weather accelerates it. For this reason, it is misleading to describe development in terms of calendar time alone. To monitor crop development and predict pest behavior, professional pest managers often use a system that takes into account the accumulation of heat with passing time. This system is based on degree days.

A degree day (DD) is a unit of measure that occurs for each degree above a base temperature during a 24-hour period. The base temperature is the temperature below which there is no plant or insect development. Specific insects have specific base temperatures. Begin recording degree day accumulations for Wisconsin on March 1.

To monitor plant and insect development using degree days, you will need a maximum/minimum thermometer to obtain the daily high and low temperatures. Calculate degree days using the equations below.

Calculating degree days as a means of estimating insect pest development works best for pests that overwinter in Wisconsin and have discrete generations. Pests that migrate into the state, such as the potato leafhopper and corn earworm, have unpredictable arrival times, making degree-day calibration difficult. Similarly, pea aphids overwinter here, but they reproduce continuously so that generations overlap, making degree-day calculations meaningless. By contrast, the European corn borer is a good candidate. It overwinters as a mature larva and has two generations.

(daily high + daily low) ÷ 2 = daily average temperature

daily average temperature – base temperature = degree day accumulation

Daily high: Use 86°F if the high temperature for the day is above 86°F.

Daily low: If below the base temperature, use the base temperature.

Example: Assume you have accumulated 200 degree days to date using a base temperature of 40°F. If yesterday's high temperature was 75°F and the low temperature was 60°F, then the daily average temperature would be 67.5°F $[(75 + 60) \div 2]$. To calculate the degree day accumulation, subtract the daily average from the base temperature for a total of 27.5DD $(67.5 - 40)$. Add this number of degree days to date $(27.5 + 200)$ for a new total of 227.5.

Resistance management

Whenever pesticides are used to control pest problems, there is potential for the development of pest populations that are resistant to the pesticides used. It is therefore important to use pesticides judiciously to prevent, or at least delay, the development of resistant pests.

Resistance management attempts to prevent, delay, or reverse the development of resistance. It is a complex task that involves more than just pesticides. You should incorporate the following practices into a resistance management program:

- **Use an integrated pest management program.** Combine all available control measures (chemical and non-chemical) into a practical pest management program.
- **Use pesticides only when needed.** A pest population will develop resistance to a pesticide only when you use that pesticide against it. Therefore, if you use the pesticide when you don't need to, you may unnecessarily increase the proportion of resistant individuals. Likewise, poor timing of a pesticide application can increase the risk of disease development. Fungicides and bactericides are generally more effective as protectants when applied before signs of pathogens (e.g., spore masses, bacterial ooze) are visible. If you apply the pesticide after such signs appear, more individuals will be exposed to the pesticide and there will be a greater chance that at least some of those individuals will be resistant to it. Such resistant individuals will then become predominant and control will be much more difficult to achieve.
- **Apply pesticides at the proper rate.** Using higher pesticide rates to try to eradicate pests not only wastes money (because eradication is usually impossible) but also kills a larger proportion of susceptible pests. As a result, the proportion of resistant individuals among survivors will be even larger.
- **Use pesticides from different chemical families.** Try to do this whether you apply pesticides against a pest once or several times a year. This way, pests resistant to the first pesticide will be killed by the second. The pesticide table that follows includes resistance management information.

Aster yellows index

The incidence of aster yellows disease depends on three things—the crop being grown, the number of leafhoppers present, and the percentage of the leafhopper population carrying the disease (infectivity level). With this information, the grower can determine the aster yellows index for the crop and prevent needless insecticide applications.

The aster yellows index is an unbiased method for determining the allowable number of aster leafhoppers on susceptible crops for any aster leafhopper infectivity level. Insecticides are applied when the index exceeds the treatment threshold for that crop, rather than spraying on a strict calendar basis—such as twice a week. The aster yellows index depends on the number of aster leafhoppers collected in 100 sweeps with a sweep net and the percentage of the leafhoppers that carry the disease. Call the UW–Madison Entomology Department (608-262-6510) for information about the infectivity level. Compute the index using the following formula:

**% infectivity in leafhoppers
x (number of leafhoppers ÷ 100
sweeps) = aster yellows index**

For example, if the leafhopper infectivity level was determined to be 2.5% and field sweeping showed there were 20 leafhoppers per 100 sweeps, then:

**2.5% (infectivity rate)
x 20 (number caught ÷ 100 sweeps)
= 50 (aster yellows index)**

The aster yellows index is computed to be 50.

The treatment threshold for carrots, celery, and lettuce with respect to their aster yellows index is:

Crop	Aster yellows index
Carrots	
Resistant	100
Intermediate	75
Susceptible	50
Celery	35
Lettuce	25

In using the aster yellows index computed above as an example, the index of 50 has equaled or exceeded the treatment levels for celery, lettuce, and susceptible carrots. However, intermediate and resistant carrots do not need treatment at this point and need to be resampled in 2 to 3 days.

See the resistance/susceptibility table in the Carrot section (page 64).

Significant variation in aster yellows resistance/susceptibility has sometimes occurred within a given cultivar between different seed lots from different companies. If there is concern about the occasional seed lot variation in yellows resistance, use the treatment threshold for the next lower category. For example, resistant carrots would be treated as intermediate resistance and intermediate resistance carrots would be treated as susceptible carrots. Susceptible carrots do not need to be treated more conservatively. The movement of cultivars to the next lower category changes a conservative treatment threshold to a very conservative treatment threshold.

Relative effectiveness and persistence of selected herbicides

The herbicide effectiveness ratings in the following table are based on Wisconsin field research or are

compiled from similar ratings published by midwestern weed scientists. Because the performance of herbicides is affected

by many variables, actual performance will vary.

Relative effectiveness of vegetable herbicides

Herbicide	Annual broadleaves						Annual grasses			Perennial grass
	Black night-shade	Lambs-quarters	Pigweed	Purslane	Rag-weed	Velvet-leaf	Barnyard grass	Crab-grass	Foxtail	Quackgrass
Accent Q	N	P	G*	—	P	F	E*	P	E*	G*
Alachlor/Intrro	E*	F	G*	G*	P	P	E*	E*	E*	N
Alanap**	F	E	G*	G*	E*	G*	P	G	G	P
Assure II/Targa	N	N	N	N	N	N	E*	E*	E*	E*
Atrazine	G*	E*	E*	*	G*	F*	P	P	P	P
Basagran	P	F	P	E*	G	E	N	N	N	N
Bicep Lite II	E*	E*	E*	*	G*	F	E*	E*	E*	P
Bullet/Lariat	E*	E*	E	*	G*	F*	E*	E*	E*	P
Cadet	P	G*	G*	—	P	E*	N	N	N	N
Callisto	E*	E*	G*	—	F	G*	P	F	P	N
Caparol	—	E*	E*	G*	E*	—	G*	G*	G*	P
Command	P	F	P	*	F	G*	F	F	F*	P
Devrinol	P	G*	G*	G*	P	P	E*	E*	E	P
Dual	E*	F	G*	G	P	P	E*	E*	E*	N
Eptam/EPTC**	F*	G*	G*	*	F	G	G	E*	E*	F
Fusilade DX	N	N	N	N	N	N	E*	E*	E*	E
G-Max Lite	E*	E*	E*	*	G*	F*	E*	E*	E*	P
Goal	F	G	G*	G*	P	P	P	P	P	P
Impact	G*	E*	E*	—	G	E*	G*	G*	F	P
Laudis	G*	E*	E*	N	G*	E*	G*	G*	G*	P
Lorox	G	E*	E*	E*	E*	G	G*	G*	G*	P
Lumax	E*	E*	E*	—	G	E*	E*	E*	E*	P
Metribuzin	P	E*	E*	G	E*	E	P	G	G	P
Option	G*	G*	G*	—	F*	G*	G*	P	E*	G*
Outlook	E*	F	G*	G	P	P	E*	E*	E*	N
Permit/Sandea	N	P	G*	—	G*	E*	N	N	N	N
Poast/Poast Plus	N	N	N	N	N	N	E*	E*	E*	G*
Prefar	P	G	G	G	P	P	E*	E*	E*	P
Princep	E*	E*	E*	E*	E*	E	F*	F*	F*	P
Priority	G*	G*	G*	—	E*	E*	N	N	N	N
Prowl	P	G*	G*	*	N	F	G*	E*	E*	N
Pursuit	E*	P	E*	—	F	G	G	F	G	P
Pyramin	*	G*	G*	G*	G*	P	F	F	—	P
Raptor	E*	F	E*	—	F	G	G	F	G	P
Ro-Neet**	P	G	G	G	P	P	E*	E*	E*	P
Sinbar	E	E*	G*	E	E*	E	E*	E*	E*	F
Sonalan	F	G*	G*	*	P	P	E*	E*	E*	P
Spin-aid	—	G*	P	G*	G*	F	P	P	P	P
Starane Ultra	F	P	P	E	E*	G*	N	N	N	N
Stinger	F	P	P	P	G*	P	N	N	N	N
Treflan	P	G*	G*	E*	P	P	E*	E*	E*	P
Zemax	E*	E*	E*	—	F	G*	E*	E*	E*	N

Abbreviations: E = excellent; G = good; F = fair; P = poor; N = none; — = data not available. Good and excellent ratings are set boldface.

*Manufacturer lists weed as controlled on label.

**This material has a relatively short half-life. It should provide initial control as described in the table but not season-long control.

Pest
management

Asparagus

Bean

Carrot

Celery

Cole crops

Cucumber

Planning for next year—herbicide persistence and carryover

Residual herbicides are those that control weeds for some time after application. The advantage of a residual herbicide is the persistent weed control that increases the efficiency of weed management efforts. The disadvantage of a long-term residual herbicide is that it may persist longer than desired and injure or kill subsequent rotational crops. Herbicide persistence, or the timeframe when an herbicide remains in the soil, varies greatly with climatic conditions, soil type, and crop cultural practices. It is important to distinguish between herbicide persistence and herbicide activity. Some herbicides persist in soil for a long time but are not available for plant uptake and therefore are not active as herbicides. Herbicide persistence is difficult to predict, so it is important to understand the determining factors. Incorporating these factors into crop planning can reduce the risk of herbicide injury.

The most important step is to always read the herbicide label prior to use and follow the label exactly. It contains rotational crop restrictions, and the information may affect your choices of rotational crops.

Factors that affect herbicide persistence in soil

Herbicide persistence in soil and potential carryover are related to the herbicide's rate of degradation by microbial, chemical, or photo decomposition and its availability for plant uptake, which is determined by soil adsorption and leaching in soil water. These factors vary greatly by soil type and pH, climatic conditions between the time of herbicide application and re-cropping, and cropping practices. Understanding the

variables that determine persistence can reduce the risk of crop injury from herbicide carryover.

Factors that affect herbicide availability in soil include:

Soil adsorption. Herbicides adsorbed to solids are not available for leaching, plant uptake, or microbial degradation. Therefore, adsorbed herbicides can persist until they are released from the soil surface. Some active ingredients in herbicides bind to soil so tightly that they persist nearly indefinitely and are not typically available for plant uptake.

Soil type is very important in determining potential adsorption. Organic matter and clay in soil increase soil adsorption because of their chemical reactivity and high number of binding sites. Negatively charged soil components attract and adsorb positively charged herbicides. Water in soil competes with herbicides for binding sites, and therefore, wet soils adsorb less herbicide than dry soils. Soil adsorption is greater in low pH soils as there are fewer positively charged particles to compete for the negatively charged binding sites. Additionally, herbicides that are highly soluble in water are not adsorbed well to soil.

Herbicide leaching. Herbicide leaching in soil water can move herbicides out of the tillage and root zone of subsequent crops. Herbicide leaching is greatest in coarse-textured, low organic matter soils. Highly soluble herbicides are prone to leaching.

Factors that affect the degradation rate of an herbicide include:

Microbial decomposition. Microbial decomposition accounts for a large portion of herbicide degradation in soil. Microbial organisms such as bacteria, fungi, and algae use herbicides as a food source. Microbes are herbicide-specific, and their population in the soil is related

to the amount of herbicide available for consumption. Repeated use of an herbicide can lead to increased microbe populations and a shorter duration of effective weed control. Conditions that support high microbe populations favor rapid herbicide degradation.

Soil type is important for microbe populations. Organic matter in soil provides excellent habitat for microbes. The effect of soil pH on microbial degradation varies by microbe, but in general, the extremes in pH are less favorable for high microbe populations.

In general, climatic conditions that favor optimum plant growth also support microbe activity. Microbe activity is greatest when soil moisture ranges from 50 to 100% of field capacity. Given that the majority of herbicide degradation by microbes occurs in aerobic conditions (those with oxygen), microbe activity is minimal when soil moisture exceeds field capacity. Microbes are most active in warm soils (given adequate moisture). Microbial activity is negligible in cool soils (below approximately 40°F) or frozen soils.

Chemical decomposition. Chemical decomposition is important for some herbicides such as those in the sulfonyleurea family (examples include rimsulfuron and halosulfuron). The majority of chemical decomposition occurs when herbicides react with soil water (called *hydrolysis*), which occurs most actively at lower soil pH and warm soil temperature.

Photo decomposition. Photo decomposition is important for a limited number of herbicides. These herbicides are broken down on the soil surface with energy from sunlight. Therefore, these herbicides are usually incorporated after application to prevent photo decomposition. Photo decomposition is important for herbicides such as trifluralin.

Strategies to avoid herbicide carryover

There are several strategies you can use to avoid herbicide carryover:

Apply labeled rates and follow rotational restrictions. Application of rates greater than those listed on the label can result in herbicide persistence. The rotational restrictions listed on the label are based on extensive field research. Many horticultural crops will often be included in the “all other crops” category. Some labels do not allow rotation to crops not listed on the label. Persistent herbicides can lead to illegal residue

levels in rotational crops even when the risk for visual crop injury is minimal. Crop rotational restrictions for a particular herbicide can vary by application rate and timing, geography, and soil type and pH, so be sure to read the label thoroughly. When tank mixing herbicides, follow the crop rotation guidelines for the more restrictive label unless otherwise noted.

Keep future cropping plans in mind when planning herbicide programs. Avoid the use of long-residual herbicides when sensitive crops are included in the rotation.

Be aware of climatic conditions in the time between herbicide application and the next crop. Low moisture and

temperature, in particular, can slow herbicide degradation and increase the risk for carryover.

Rotate herbicide mode of action to avoid buildup in soil. Although rare, repeated use of the same herbicide, or even same herbicide family in some cases, can lead to herbicide buildup in the soil.

Maintain healthy soil. Keep in mind: Soil conditions that favor plant growth also favor herbicide degradation. Maintain a moderate soil pH and organic matter for optimum herbicide degradation.

Pest management and pesticides

As an alternative to exclusive pesticide use, attention is being directed to the coordinated use of multiple tactics—an approach known as integrated pest management, or IPM (discussed in “Best Management Practices” on page 1).

Federal pesticide-use law

When Congress amended the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) in 1972, it included a mandate for the United States Environmental Protection Agency (EPA) to evaluate all new and existing pesticide products for potential harm they may cause. It also made it illegal to use, except as provided by FIFRA, any pesticide in a manner inconsistent with its labeling. Deviations from the label not recognized by FIFRA are a violation of the law.

The Food Quality Protection Act (FQPA) of 1996 strengthens the system that regulates pesticide residues on food. Recognizing that pesticide residues are present in more sources than just food, the FQPA sets limits on the total exposure from residues found in food, drinking water, and non-dietary sources (such as household, landscape, and pet uses). The more uses a particular pesticide has, the

greater the chance its total exposure will be met and, thus, some or all of its uses will be canceled.

If, during the pesticide registration process, the EPA finds a product to generally cause unreasonable adverse effects on the environment, including injury to the applicator, it will be classified as *restricted use*. Because restricted-use products can be used only by certified applicators, the FIFRA amendments also called for each state to develop a program for training and certifying pesticide applicators. The certification program is designed to ensure that users of restricted-use products are properly qualified to handle and apply these materials safely and efficiently. A current list of restricted-use pesticides registered for use in Wisconsin may be downloaded from the Pesticide Applicator Training (PAT) website (ipcm.wisc.edu/pat).

Wisconsin’s training and certification program

In Wisconsin, responsibility for training lies with the University of Wisconsin-Extension’s Pesticide Applicator Training (PAT) program, while actual certification is the responsibility of the Wisconsin Department of Agriculture, Trade, and Consumer Protection (WDATCP). The

Wisconsin Pesticide Law requires that all commercial applicators for hire participate in the training and certification process if they intend to use any pesticide in the state of Wisconsin, whether or not it is restricted use.

Since 1977, the PAT program has trained over 215,000 Wisconsin applicators in the safe handling of pesticides and prepared them for the written certification exam administered by the WDATCP, which enforces Wisconsin’s pesticide regulations.

The selection, use, and potential risks of pesticides vary depending on the method of application and what it is you want to protect from pests. Therefore, there is a separate training manual and certification exam for 21 pest control categories, including categories for agricultural producers, the agricultural industry (10 categories), use in and around commercial and residential buildings (6 categories), use in right-of-way and surface waters (3 categories), and preserving wood. Certification is valid for 5 years, after which you can recertify by passing a new exam that is based on a revised training manual.

For more information about the Wisconsin PAT program, contact your county Extension agent or visit ipcm.wisc.edu/pat. For

information on Wisconsin's licensing and certification program, visit datcp.wi.gov/Plants/Pesticides/Licenses.

Wisconsin pesticide laws and regulations

Operating under the provisions of the Wisconsin Pesticide Law and Administrative Rule, Chapter ATPC 29 (Register, April 2009), the WDATCP has primary responsibility for pesticide use and control in the state. The Wisconsin Department of Natural Resources (WDNR) has responsibility for pesticide use involving "waters of the state," the control of birds and mammals, and pesticide and container disposal. The Wisconsin Division of Emergency Management (WDEM) has responsibility for helping communities evaluate their preparedness for responding to accidental releases of hazardous compounds, including pesticides, under Title III of the EPA's Superfund Amendments and Reauthorization Act (SARA). The Wisconsin Department of Transportation (WisDOT) has responsibility for regulating the transportation of pesticides listed as hazardous materials (shipping papers, vehicle placarding, etc.) and for issuing commercial driver's licenses. It is your responsibility to become familiar with all pertinent laws and regulations affecting pesticide use in Wisconsin.

Pesticides and community right to know

To help communities evaluate their preparedness for responding to chemical spills, Congress passed the Emergency

Planning and Community Right-to-Know Act (EPCRA). This law is part of a much larger legislation called the Superfund Amendments and Reauthorization Act (SARA) and is often referred to as Title III of SARA. Title III sets forth requirements for reporting of hazardous substances stored in the community and for developing an emergency response plan.

The first step in emergency planning is to know which chemicals can cause health problems and environmental damage if accidentally released. The EPA has prepared a list of such chemicals and calls them *extremely hazardous substances*. These substances are subject to emergency planning and the threshold planning quantity, the smallest amount of a substance which must be reported. Some of the chemicals listed are commonly used in agricultural production (see below).

A complete list of EPA's extremely hazardous substances is available from the Local Emergency Planning Committee (LEPC). For a list of county LEPC directors in the state of Wisconsin, visit: emergencymanagement.wi.gov/EPCRA/forms/County_EM_Director_LECP_Listing_wEmail.pdf.

Any facility, including a farm, that produces, uses, or stores any of these substances in a quantity at or greater than their threshold planning quantity must notify the WDEM and their LEPC that it is subject to the emergency planning notification requirements of Title III of SARA.

In addition to emergency planning notification, agricultural service businesses with one or more employees are subject to two community right-to-know

reporting requirements: submission of material safety data sheets (MSDS) and submission of Tier II inventory forms. Tier II forms request specific information on each hazardous chemical stored at or above its threshold.

Worker Protection Standard for agricultural pesticides

The federal Worker Protection Standard (WPS) for agricultural pesticides took effect January 1, 1995. Its purpose is to reduce the risk of employee exposure to pesticides. You are subject to the WPS if you have at least one employee who is involved in the production of agricultural plants in a nursery, greenhouse, forest, or farming operation.

The WPS requires employers to do the following:

- Display pesticide safety information in a central location.
- Train uncertified workers and handlers on general pesticide safety principles.
- Provide personal protective clothing and equipment to employees.
- Provide a decontamination site (water, soap, towels, and coveralls).
- Provide transportation to an emergency medical facility for employees who are poisoned or injured by pesticide exposure.
- Provide notification to employees about pesticide applications (see next section).

For more information about the WPS and the training requirements for uncertified workers and handlers, download or request a copy of the 2005 edition of the EPA's *How To Comply with the Worker Protection Standard for Agricultural Pesticides* manual (www.epa.gov/agriculture/twor.html).

Oral notification and posting

The WPS requires employers to give notice of pesticide applications to all workers who will be in a treated area or walk within 0.25 miles of a treated area

Examples of agricultural chemicals subject to Title III of SARA

Active ingredient	Trade name	Threshold planning quantity (lb or gal of product)
anhydrous ammonia (fertilizer)	—	610 lb
azinphos-methyl	Guthion 50WP	20 lb
dimethoate	Dimethoate 4EC	125 gal
paraquat	Gramoxone Inteon	5 gal
phorate	Thimet 20G	50 lb
terbufos	Counter 15G	667 lb

during the pesticide application or during the restricted entry interval (described in the next section). Notification may either be oral warnings or posting of warning signs at entrances to treated sites; both are necessary if the label requires dual (oral and posting) notification. A current list of dual-notice pesticides registered for use in Wisconsin is available at ipcm.wisc.edu/pat/download/download/Dual%20Notice_tbl_10.pdf.

Wisconsin's Agriculture, Trade, and Consumer Protection (ATCP) 29 posting rule is designed to protect the general public as well as workers. Thus, it requires posting of areas treated with pesticides having a dual notification statement or, for nonagricultural pesticide applications, if the label prescribes a restricted entry interval for that particular application. Refer to *On-Farm Posting of Pesticide-Treated Sites in Wisconsin* for a flowchart guiding users through a series of questions to determine when posting of treated sites is needed, what warning sign to use, and where the sign should be located. Also covered are the separate posting requirements for chemigation treatments. This publication is available from your county Extension office or online at ipcm.wisc.edu/pat.

Restricted entry interval

A restricted entry interval (REI) is the length of time that must expire after pesticide application before people can safely enter the treated site without using personal protective equipment. Pesticide residues on a treated crop or in a treated area may pose a significant hazard to workers or others who enter the area after treatment. Therefore, nearly all pesticides affected by the WPS (see above) have an REI. Check the Agricultural Use Requirements section on the label for the specific REI for your product. These intervals must be strictly observed.

Pesticide toxicity

There are four common ways in which pesticides enter the human body: through the skin (dermal), the mouth (oral), the lungs (inhalation), and the eyes. Absorption through the skin is the most common route of poisoning of agricultural workers.

Perhaps the greatest hazard for the applicator is in loading and mixing the pesticide concentrate, which presents a significant risk of exposure to the chemical in its most toxic form. Although hazards associated with the actual application are frequently much less severe, they can still be substantial, especially if there is significant drift or if appropriate precautions are ignored. A pesticide may be toxic as a result of exposure to a single dose (acute toxicity) or as a result of repeated exposures over time (chronic toxicity).

Acute toxicities are normally expressed as the amount of pesticide required to kill 50% of a population of test animals (usually rats or rabbits). For oral and dermal exposure, this is referred to as the LD₅₀ or "lethal dose to 50%" in milligrams of toxicant per kilogram of body weight (mg/kg). For inhalation exposure, it is expressed as the LC₅₀ or "lethal concentration to 50%" in parts per million (ppm) of toxicant in the total volume of air when the toxicant is a gas or vapor, and in milligrams per liter (mg/l) of air or water when the toxicant is a dust or mist. **Pesticides with greater acute toxicities have lower LD₅₀ and/or LC₅₀ values; that is, it takes less of the chemical to kill 50% of the test population.**

Labels indicate the relative level of acute toxicity through signal words and symbols (see table below). The toxicity category is assigned based on the highest measured toxicity, be it oral, dermal, or inhalation; effects on the eyes and external injury to the skin are also considered.

In the event of human pesticide poisoning, the pesticide label is your first source of first-aid information. Always bear in mind, however, that first-aid response to pesticide exposure is not a substitute for professional medical help. Seek medical attention promptly and always be sure that the label or labeled container is given to the doctor. The product's Material Safety Data Sheet (MSDS) is a more technical document than the label, and it often contains additional treatment instructions for the attending medical professional.

Poison Control Center (1-800-222-1222). You may call the Poison Control Center at any hour for information regarding proper treatment of pesticide poisoning. While hospitals and other medical facilities may have some information, the Poison Control Center has the most complete and current files, and their personnel are specifically trained to deal with poison cases.

(continued on page 35)

Toxicity categories of pesticides

Measure of toxicity	Toxicity category			
	I High toxicity	II Moderate toxicity	III Slight toxicity	IV Low toxicity
Oral LD ₅₀ (mg/kg)	0–50	50–500	500–5,000	> 5,000
Dermal LD ₅₀ (mg/kg)	0–200	200–2,000	2,000–20,000	> 20,000
Inhalation LC ₅₀ gas/vapor (ppm)	0–200	200–2,000	2,000–20,000	> 20,000
dust/mist (mg/l)	0–0.2	0.2–2	2–20	> 20
Eye effects	corrosive	irritation persists for 7 days	irritation reversible within 7 days	no irritation
Skin effects	corrosive	severe irritation	moderate irritation	mild irritation
Signal word	DANGER*	WARNING	CAUTION	CAUTION

Abbreviations: mg/kg = milligrams per kilogram; ppm = parts per million; mg/l = milligrams per liter; < = less than; > = greater than.

*Products assigned to Category I due to oral, inhalation, or dermal toxicity (as distinct from eye and local skin effects) also must have the word "poison" and the skull and crossbones symbol on the label.

Pesticide class, re-entry and preharvest intervals, and registered crops of insecticides and fungicides

Active ingredient	Product	Manu- facturer	Signal word	Notifi- cation	Resistance mgmt ^a			PHI ^c (days)	Common crop uses
					Chemical group	Group code	REI ^b (hours)		
Insecticides									
abamectin	*Agri-Mek, *Epi-Mek	Syngenta	warning	oral	antibiotic	6	12	7	cucumber, melon, pumpkin, squash, tomato
acephate	Acephate, Orthene	United Phos- phorous, Inc. (UPI), Valent	caution	oral	organo- phosphate	1B	24	7–21	bean, celery, cole crops, leafy greens, pepper
acetamiprid	Assail	UPI	caution	oral	chloro- nicotinyI	4A	12	7	beans, cole crops, cucumber, eggplant, leafy greens, melon, onion, pepper, potato, pumpkin, squash, tomato
azadirachtin	Aza-Direct, Azatin XL Plus, Neemazad, Neemix, Trilogy	Gowan, several	caution	oral	triterpenoid	26	4–12	0	asparagus, bean, carrot, celery, cole crops, cucumber, eggplant, horseradish, leafy greens, melon, onion, pea, pepper, potato, pumpkin, squash, sweet corn, table beet, tomato
<i>Bacillus thuringiensis</i> subsp. <i>aizawai</i>	Agree, XenTari	several	caution	oral	microbial	11B1	4	0	bean, celery, cole crops, cucumber, melon, mint, onion, peas, pepper, potato, pumpkin, squash, tomato
<i>Bacillus thuringiensis</i> subsp. <i>kurstaki</i>	Biobit, Crymax, DiPel, Javelin, MVP	several	caution	oral	microbial	11B2	4	0	bean, celery, cole crops, eggplant, horseradish, lettuce, mint, potato, sweet corn, tomato
<i>Bacillus thuringiensis</i> subsp. <i>tenebrionis</i>	M-Trak, Raven	several	caution	oral	microbial	11C	12	0	potatoes
beta-cyfluthrin	*Baythroid XL	Bayer CropScience	warning	oral	synthetic pyrethroid	3	12	0–7	carrot, pea, pepper, potato, sweet corn, tomato
bifenazate	Acramite	Chemtura	caution	oral	miticide	25	12	3	cucumber, eggplant, melon, pepper, pumpkin, squash, tomato
bifenthrin	*Bifenture, *Brigade, *Capture LFR, *Discipline	UPI, FMC, AMVAC	warning	oral	synthetic pyrethroid	3	12	1–7	bean, cole crops, cucum- ber, eggplant, lettuce, melon, pea, pepper, pumpkin, squash, sweet corn
bifenthrin + imidacloprid	*Brigadier	FMC	warning	oral	synthetic pyrethroid + neonicot- inyl	3 + 4A	12	21	bean, cole crops, eggplant, leafy greens, pepper, potato, tomato

*Restricted-use pesticide.

(continued)

^aTo delay or prevent the development of resistance, select pesticides from different chemical groups. Newly approved pesticide labels bear the group code, a reference to the specific target site of the chemical. For more details, visit www.irac-online.org (insecticides), www.frac.info (fungicides), and www.plantprotection.org/HRAC/ (herbicides).

^bREI = Restricted entry interval.

^cPHI = Preharvest interval. A range of days to harvest indicates that there is variability between crops. Refer to the product label for specific information on the number of days to harvest for each crop.

^dChlorantraniliprole and rynaxypyr are the same active ingredient (ai). Do not exceed a total of 0.2 lb ai/a per season of products containing either of these two active ingredient names.

Pesticide class, re-entry and preharvest intervals, and registered crops of insecticides and fungicides (continued)

Active ingredient	Product	Manu- facturer	Signal word	Notifi- cation	Resistance mgmt ^a		REI ^b (hours)	PHI ^c (days)	Common crop uses
					Chemical group	Group code			
carbaryl	Adios, Sevin	Bayer CropScience	caution/ warning	oral	carbamate	1A	12 hr to 5 days	0–14	asparagus, bean, carrot, celery, cole crops, cucum- ber, eggplant, lettuce, melon, pea, pepper, potato, pumpkin, squash, sweet corn, table beet, tomato
chlorantra- niliprole ^d	Altacor, Coragen	DuPont	caution	oral	anthranilic diamide	28	4	1–14	carrot, celery, cole crops, cucumber, eggplant, horseradish, leafy greens, melon, onions, pepper, potato, pumpkin, squash, table beet, tomato
chlorpyrifos	*Lorsban Advanced	Dow Agro- Sciences	warning	oral AND posted	organo- phosphate	1B	24	30–35	asparagus, cole crops, mint, onion, sweet corn
	Lorsban 15G	Dow Agro- Sciences	caution	oral	organo- phosphate	1B	24	21	sweet corn
chlorpyrifos + lambda-cyha- lothrin	*Cobalt Advanced	Dow Agro- Sciences	warning	oral AND posted	synthetic pyrethroid	1B + 3A	24	21	sweet corn
clothianidin	Belay, Poncho 600	Valent, Bayer Crop- Science	caution	oral	neonicoti- noid	4A	12	14	potato, sweet corn
cypermethrin	*Ammo, *Cymbush, *UP-Cyde	FMC	caution/ warning	oral	synthetic pyrethroid	3	24	1–15	cole crops, garlic, lettuce, onion
cyromazine	Trigard	Syngenta	caution	oral	insect growth regulator	17	12	0–7	celery, onion, potato
deltamethrin	*Delta Gold	Agrilience	danger/ poison	oral	synthetic pyrethroid	3	12	1–3	cucumber, eggplant, melon, onion, pepper, pumpkin, squash, sweet corn, tomato
diazinon	*Diazinon	many	caution	oral	organo- phosphate	1B	24	1–35	bean, carrot, cole crops, cucumber, lettuce, melon, onion, potato, pumpkin, squash, table beet, tomato
dicofol	Dicofol	Gowan	caution	oral	organo- chlorine	UN	12	2–30	cucumber, mint
dimethoate	Dimethoate	many	warning	oral AND posted	organo- phosphate	1B	48	0–14	bean, cole crop, lettuce, melon, pea, pepper, potato, tomato
dinotefuran	Scorpion, Venom	Gowan, Valent	caution	oral	neonicotinyl	4A	12	1–21	celery, cole crops, cucumber, eggplant, leafy greens, melon, pepper, potato, pumpkin, squash, tomato
emamectin benzoate	*Proclaim	Syngenta	caution	oral AND posted	antibiotic	6	48	7	celery, cole crops, lettuce

*Restricted-use pesticide.

(continued)

Pest
management

Asparagus

Bean

Carrot

Celery

Cole crops

Cucumber

Pesticide class, re-entry and preharvest intervals, and registered crops of insecticides and fungicides *(continued)*

Pest management	Active ingredient	Product	Manufacturer	Signal word	Notification	Resistance mgmt ^a		REI ^b (hours)	PHI ^c (days)	Common crop uses
						Chemical group	Group code			
Asparagus	endosulfan	Thiodan	Universal Crop Prot. Alliance	danger/poison	oral	organo-chlorine	2A	24	0–14	bean, carrot, celery, cole crops, cucumber, eggplant, lettuce, melon, pepper, potato, pumpkin, squash, tomato
	esfenvalerate	*Asana	DuPont	warning	oral	synthetic pyrethroid	3	12	1–7	bean, carrot, cole crops, cucumber, eggplant, melon, pea, pepper, potato, pumpkin, squash, sweet corn, tomato
	ethoprop	*Mocap	Bayer CropScience	danger/poison	oral AND posted	organo-phosphate	1B	48	—	potato
Bean	etoxazole	Zeal	Valent	caution	oral	miticide	10B	12	7	melon
	fenpropathrin	*Danitol	Valent	warning	oral	synthetic pyrethroid	3	24	3–7	cole crops, cucumber, melon, pumpkin, squash, tomato
	fenpyroximate	Fujimite	Nichino America	warning	oral	miticide	21	12	1	mint
	fipronil	*Regent	BASF	warning	oral	phenyl pyrazole	2B	0	90	potato
Carrot	flonicamid	Beleaf	FMC	caution	oral	selective feeding blocker	9C	12	0–21	celery, cole crops, cucumber, eggplant, melon, pepper, potato, pumpkin, squash, tomato
	flubendiamide	Belt, Synapse	Bayer CropScience	caution	oral	anthranilic diamide	28	12	1	celery, cole crops, cucumber, eggplant, leafy greens, melon, pepper, pumpkin, squash, sweet corn, tomato
Celery	gamma-cyhalothrin	*Proaxis	Pytech	caution	oral	synthetic pyrethroid	3	24	1–21	bean, cole crops, lettuce, onion, pea, pepper, sweet corn, tomato
	imidacloprid	Admire, Provado	Bayer CropScience	caution	oral	chloro-nicotinyl	4A	12	7–21	carrot, cucumber, horseradish, lettuce, melon, pepper, potato, pumpkin, squash, table beet, tomato
		Gaucho	Bayer CropScience	caution	oral	chloro-nicotinyl	4A	12	seed treatment	bean, sweet corn
Cole crops	imidacloprid + beta-cyfluthrin	*Leverage 360	Bayer CropScience	warning	oral AND posted	synthetic pyrethroid + chloro-nicotinyl	3 + 4A	12	7	potato
	indoxacarb	Avaunt	DuPont	caution	oral	oxadiazine	22	12	3	cole crops, eggplant, lettuce, pepper, potato, tomato
Cucumber	lambda-cyhalothrin	*Lambda-Cy, *Warrior II	UPI, Syngenta	warning	oral	synthetic pyrethroid	3	24	1–14	cole crops, lettuce, onion, pepper, pea, sweet corn, tomato

*Restricted-use pesticide.

(continued)

Pesticide class, re-entry and preharvest intervals, and registered crops of insecticides and fungicides (continued)

Active ingredient	Product	Manu- facturer	Signal word	Notifi- cation	Resistance mgmt ^a		REI ^b (hours)	PHI ^c (days)	Common crop uses
					Chemical group	Group code			
lambda- cyhalothrin + chloran- traniliprole ^d	*Besiege, *Voliam Xpress	Syngenta	warning	oral AND posted	synthetic pyrethroid + anthranilic diamide	3 + 28	24	1–21	bean, cole crops, cucumber, eggplant, leafy greens, melon, pepper, potato, pumpkin, squash, sweet corn, tomato
lambda- cyhalothrin + thiameth- oxam	*Endigo ZC	Syngenta	warning	oral AND posted	synthetic pyrethroid + neonicot- inyl	3 + 4A	24	1–14	cole crops, cucumber, eggplant, leafy greens, melon, pepper, potato, pumpkin, squash and tomato
malathion	Malathion	Gowan, Platte	caution	oral	organo- phosphate	1B	12	0–7	asparagus, bean, carrot, cole crops, cucumber, eggplant, horseradish, lettuce, melon, mint, onion, pepper, potato, pumpkin, squash, tomato
methomyl	*Lannate	DuPont	danger/ poison	oral	carbamate	1A	48	1–10	bean, carrot, celery, cole crops, cucumber, eggplant, horseradish, lettuce, melon, onion, pea, pepper, potato, pumpkin, squash, sweet corn, table beet, tomato
methoxy- fenozide	Intrepid 2F	Dow Agro- Sciences	caution	oral	diacyl- hydrazine	18	4	1–3	cole crops, eggplant, lettuce, pepper, sweet corn, tomato
methyl para- thion	*PennCap-M	Elf Atochem, several	warning	oral	organo- phosphate	1B	48	4–15	dry bean, onion, potato, sweet corn
naled	Dibrom	AMVAC	danger		organo- phosphate	1B	24	1	bean, cole crops
novaluron	Rimon	Chemtura	warning	oral	benzoyl- urea	15	12	14	cole crops, potato
oxamyl	*Vydate	DuPont	danger/ poison	oral	carbamate	1A	24	1–7	carrot, cucumber, pepper, potato
oxydemeton- methyl	*Metasystox -R	Gowan	warning		organo- phosphate	1B	48	3–21	cole crops, cucumber, eggplant, lettuce, melon, pepper, pumpkin, squash
permethrin	*Ambush, *Perm-UP, *Pounce	Syngenta, UPI	caution or warning	oral	synthetic pyrethroid	3	12	0–30	asparagus, celery, cole crops, cucumber, eggplant, horseradish, lettuce, melon, onion, pepper, potato, pumpkin, squash, sweet corn, tomato
phorate	*Phorate, *Thimet	BASF	danger/ poison	oral AND posted	organo- phosphate	1B	48	90	bean, potato, sweet corn
phosmet	Imidan	Gowan	warning	oral	organo- phosphate	1B	24	7	potato

*Restricted-use pesticide.

(continued)

Pest
management

Asparagus

Bean

Carrot

Celery

Cole crops

Cucumber

Pesticide class, re-entry and preharvest intervals, and registered crops of insecticides and fungicides (continued)

Pest management	Active ingredient	Product	Manufacturer	Signal word	Notification	Resistance mgmt ^a		REI ^b (hours)	PHI ^c (days)	Common crop uses
						Chemical group	Group code			
Asparagus	potassium salts of fatty acids	M-Pede	Dow Agro-Sciences	warning	oral	insecticidal soap	—	12	0	asparagus, bean, cole crops, cucumber, eggplant, lettuce, melon, pepper, potato, pumpkin, squash, table beet, tomato
	pymetrozine	Fulfill	Syngenta	caution	oral	—	9B	12	14	cucumber, eggplant, melon, pepper, potato, pumpkin, squash
	spinetoram	Radiant	Dow Agro-Sciences	caution	oral	biological	5	4	1–60	asparagus, bean, cole crops, eggplant, horseradish, leafy greens, mint, onion, pea, pepper, potato, sweet corn, tomato
Bean	spinosad	Entrust	Dow Agro-Sciences	caution	oral	biological	5	4	1–60	bean, carrot, celery, cole crops, cucumber, eggplant, leafy greens, melon, mint, onion, pea, pepper, potato, pumpkin, radish, squash, sweet corn, table beet, tomato
	spiromesifen	Oberon 25C	Bayer CropScience	caution	oral	lipid biosynthesis inhibitor	23	12	7	celery, cole crops, cucumber, eggplant, leafy greens, melon, pepper, pumpkin, squash, tomato
Carrot	spirotetramat	Movento	Bayer CropScience	caution	oral	lipid biosynthesis inhibitor	23	24	7	celery, cole crops, eggplant, leafy greens, pepper, tomato
	tebufenozide	Confirm	Gowan	caution	oral	diacylhydrazine	18	4	7	cole crops, eggplant, lettuce, pepper, tomato
Celery	tebupirimphos + cyfluthrin	*Aztec	AMVAC	warning	oral AND posted	organophosphate	1B	48		sweet corn
	tefluthrin	*Force 3G	Syngenta, AMVAC	caution	oral	synthetic pyrethroid	3A	0		sweet corn
	terbufos	*Counter 15G	AMVAC	danger	oral AND posted	organophosphate	1B	48	60	sweet corn
Cole crops	thiamethoxam	Actara WG, Cruiser, Platinum	Syngenta	caution	oral	neonicotinyl	4A	12	0–30	cucumber, eggplant, melon, pepper, potato, pumpkin, squash, sweet corn, tomato
	thiamethoxam + chlorantraniliprole ^d	Durivo, Voliam Flexi	Syngenta	caution	oral	neonicotinyl + anthranilic diamide	28	12	30	celery, cole crops, cucumber, eggplant, leafy greens, melon, pepper, potato, pumpkin, squash, tomato
Cucumber	thiodicarb	Larvin	Bayer CropScience	warning	oral	carbamate	1A	12	7–14	celery, cole crops, sweet corn
	zeta-cypermethrin	*Mustang Max	FMC	caution	oral	synthetic pyrethroid	3	12	1–7	bean, celery, cole crops, eggplant, leafy greens, onion, pea, pepper, sweet corn, table beet, tomato

^aRestricted-use pesticide.

(continued)

Pesticide class, re-entry and preharvest intervals, and registered crops of insecticides and fungicides (continued)

Active ingredient	Product	Manu- facturer	Signal word	Notifi- cation	Resistance mgmt ^a		REI ^b (hours)	PHI ^c (days)	Common crop uses
					Chemical group	Group code			
zeta- cypermethrin + bifenthrin	*Hero	FMC	caution	oral	synthetic pyrethroid	3A	12	3	beans, carrot, cole crops, eggplant, horseradish, leafy greens, pea, pepper, potato, sweet corn, tomato
Fungicides									
azoxystrobin	Quadris	Syngenta	caution	oral	strobilurin	11	4	0–14	bean, carrot, celery, cucumber, eggplant, horseradish, leafy greens, melon, onion, pea, pepper, potato, pumpkin, squash, table beet, tomato
azoxystrobin + chlorothalonil	Quadris Opti	Syngenta	warning	oral	strobilurin + substituted benzene	11 + M5	12	0–14	bean, carrot, celery, cucumber, melon, onion, potato, pumpkin, squash, tomato
azoxystrobin + difenoconazole	Quadris Top	Syngenta	caution	oral	strobilurin + triazole	11 + 3	12	0–14	carrot, cole crops, cucumber, eggplant, melon, onion, pepper, potato, squash, tomato
azoxystrobin + propiconazole	Quilt Xcel	Syngenta	warning	oral	strobilurin + triazole	11 + 3	12	0–30	carrot, celery, mint, onion, sweet corn
boscalid	Endura	BASF	warning	oral	anilide	7	12	0–21	bean, carrot, eggplant, leafy greens, onion, pepper, potato, tomato
boscalid + pyraclostrobin	Pristine	BASF	caution	oral	anilide + strobilurin	7 + 11	12	0–7	carrot, cucumber, melon, onion, pumpkin, squash
captan	Captan	many	danger	oral	phthalimide	M4	4 days	seed treat- ment	bean, celery, cucumber, melon, onion, pumpkin, squash, sweet corn, table beet, tomato
chlorothalonil	Bravo, Echo, Equus, others	Syngenta, Sipcam, MANA, others	caution	oral	substituted benzenes	M5	12	0–80	carrot, cole crops, cucum- ber, melon, mint, onion, potato, pumpkin, squash, sweet corn, tomato
chlorothalonil Zn	Bravo Zn, Echo Zn, Equus 500 Zn	Syngenta, Sipcam, MANA	caution	oral	substituted benzenes + zinc	M5	12	0–7	carrot, potato
<i>Coniothyrium minitans</i>	Contans	Prophyta	caution	oral	biological	—	4	0	all crops susceptible to <i>Sclerotinia</i> spp.
copper oxy- chloride + basic copper sulfate	C-O-C-S	UAP	warning	oral	organo- metallic	M1	24	0	bean, cole crops, carrot, celery, cucumber, egg- plant, leafy greens, melon, onion, pepper, potato, pumpkin, squash, table beet, tomato
cyazofamid	Ranman	FMC	caution	oral	cyano- acetamide	21	12	0–7	cucumber, melon, potato, pumpkin, squash, tomato
cyflufenamid	Torino	Gowan	caution	oral	phenyl- acetamide	U6	4	0	cucumber, melon, pumpkin, squash
cymoxanil	Curzate 60DF	DuPont	warning	oral	acetimide	27	12	14	potato

*Restricted-use pesticide.

(continued)

Pest
management

Asparagus

Bean

Carrot

Celery

Cole crops

Cucumber

Pesticide class, re-entry and preharvest intervals, and registered crops of insecticides and fungicides (continued)

Pest management	Active ingredient	Product	Manufacturer	Signal word	Notification	Resistance mgmt ^a		REI ^b (hours)	PHI ^c (days)	Common crop uses
						Chemical group	Group code			
Asparagus	cymoxanil + famoxadone	Tanos	DuPont	caution	oral	acetimide + strobilurin-like	27 + 11	12	3-14	cucumber, melon, pepper, potato, pumpkin, squash, tomato
	cyprodinil + fludioxonil	Switch 62.5WG	Syngenta	caution	oral	anilino-pyrimidine + phenyl-pyrrole	9 + 12	12	7	onion
	difenoconazole	Top MP	Syngenta	warning	oral	triazole	3	12	14	potato only
Bean	dimethomorph	Forum	BASF	caution	oral	cinnamic acid derivative	40	12	0-4	cucumber, melon, onion, potato, pumpkin, squash, tomato
	fenamidone	Reason 500 SC	Bayer CropScience	caution	oral	strobilurin-like	11	12	2-14	carrot, cole crops, cucumber, leafy greens, onion, melon, potato, pumpkin, squash, tomato
Carrot	fixed copper	Kocide, Champ	DuPont, Nufarm Americas	caution	oral	organo-metallic	M1	48	0	bean, carrot, celery, cucumber, eggplant, leafy greens, melon, onion, pepper, potato, pumpkin, squash, table beet, tomato
	fluazinam	Omega 500F	Syngenta	warning	oral	pyridin-amine	29	48	14-50	cole crops, potato
Celery	fludioxonil	Cannonball WP	Syngenta	caution	oral	phenyl-pyrrole	12	12	0-7	bean (dry & succulent), celery, melon, onion
		Maxim 4FS	Syngenta	caution	oral	phenyl-pyrrole	12	12	seed treatment	potato
Cole crops	fluopicolide	Presidio	Valent	caution	oral	benzamide	43	12	2-7	carrot, cole crops, cucumber, horseradish, leafy greens, melon, pepper, potato, pumpkin, squash, tomato
	fluopyram + pyrimethanil	Luna Tranquility	Bayer CropScience	caution	oral	benzanilide + anilino-pyrimidine	7 + 9	12	7	potato
Cucumber	fluoxastrobin	Aftershock, Evito 480 SC	Loveland, Arysta LifeScience	caution	oral	strobilurin	11	12	3-7	celery, pepper, potato, tomato
	flutolanil	Moncut 70-DF	Gowan	caution	oral	benzanilide	7	12	in-furrow use only	potato
Cucumber	flutolanil + mancozeb	MonCoat MZ	Nichino	caution	oral	benzanilide + EBDC	7 + M3	24	seed treatment	potato
	fluxapyroxad + pyraclostrobin	Priaxor	BASF	caution	oral	anilide + strobilurin	7 + 11	12	7-21	bean, eggplant, pea, pepper, potato, sweet corn, tomato
	fosetyl-al	Aliette WDG	Bayer CropScience	caution	oral	phosphonate	33	12	12 hr to 14 days	cucumber, melon, onion, pumpkin, squash, tomato

^aRestricted-use pesticide.

(continued)

Pesticide class, re-entry and preharvest intervals, and registered crops of insecticides and fungicides (continued)

Active ingredient	Product	Manu- facturer	Signal word	Notifi- cation	Resistance mgmt ^a		REI ^b (hours)	PHI ^c (days)	Common crop uses
					Chemical group	Group code			
iprodione	Rovral 4 Flowable	Bayer CropScience	caution	oral	dicarbox- imide	2	24	0–14	bean, carrot, leafy greens, onion, potato
kresoxim methyl	Sovran	BASF	caution	oral	strobilurin	11	12	0	cucumber, melon, pumpkin, squash
mancozeb	Dithane, Manzate, Penncozeb	Dow Agro- Sciences, DuPont, UPI	caution	oral	EBDC	M3	24	3–180	asparagus, cucumber, melon, onion, potato, pumpkin, squash, sweet corn, tomato
mandipro- amid	Revus	Syngenta	caution	oral	mandelic acid amide	40	4	0–7	cole crops, cucumber, leafy greens, melon, onion, pepper, pumpkin, squash
mandipro- pamid + difenocona- zole	Revus Top	Syngenta	caution	oral	mandelic acid amide + triazole	40 + 3	12	1–14	potato, tomato
mefenoxam	Apron XL	Syngenta	warning	oral	phenyla- mide	4	48	seed treat- ment	beans, carrot, celery, cole crops, cucumber, melon, onion, pepper, squash, tomato, spinach, NOT potato
	Ridomil Gold GR	Syngenta	caution	oral	phenyla- mide	4	48	7–21	celery, lettuce, tomato
	Ridomil Gold SL	Syngenta	caution	oral	phenyla- mide	4	48	see label	asparagus, bean, carrot, celery, cole crops, cucumber, eggplant, melon, onion, pepper, potato, squash, tomato
	Ultra Flourish	Nufarm Americas	warning	oral	phenyla- mide	4	48	see label	asparagus, carrot, cole crops, cucumber, melon, squash
mefenoxam + azoxystrobin	Quadris Ridomil Gold co-pack	Syngenta	caution	oral	phenyla- mide + strobilurin	4 + 11	0	in- fur- row	potato ONLY
	Uniform pre- mix	Syngenta	caution	oral	phenyla- mide + strobilurin	4 + 11	0	in- fur- row	bean (dry and succulent), celery, cole crops, cucumber, horseradish, melon, onion, squash
mefenoxam + chlorothalonil	Ridomil Gold Bravo SC	Syngenta	warning	oral	phenyla- mide + substituted benzenes	4 + M5	48	0–14	carrot, cole crops, melon, onion, potato, pumpkin, squash, tomato
mefenoxam + copper hydroxide	Ridomil Gold Copper	Syngenta	danger	oral	phenyla- mide + organo- metallic	4 + M1	48	3–21	bean, carrot, cucumber, melon, onion, pepper, potato, radish, spinach, squash, tomato
mefenoxam + fludioxonil	Apron MAXX RTA	Syngenta	warning	oral	phenyla- mide	4 + 12	48	seed treat- ment	bean
	Apron MAXX RFC	Syngenta	warning	oral	phenyla- mide + phenyl- pyrrole	4 + 12	48	seed treat- ment	bean

*Restricted-use pesticide.

(continued)

Pest
management

Asparagus

Bean

Carrot

Celery

Cole crops

Cucumber

Pesticide class, re-entry and preharvest intervals, and registered crops of insecticides and fungicides (continued)

Pest management	Active ingredient	Product	Manu- facturer	Signal word	Notifi- cation	Resistance mgmt ^a			PHI ^c (days)	Common crop uses
						Chemical group	Group code	REI ^b (hours)		
	mefenoxam + mancozeb	Ridomil Gold MZ WG	Syngenta	caution	oral	phenylamide + EBDC	4 + M3	48	3-7	cucumber, melon, onion, potato, squash, tomato
Asparagus	mefenoxam + PCNB	Ridomil Gold PC GR	Syngenta	warning	oral	phenylamide + substituted benzenes	4 + 14	48	at-plant treatment	bean
	metalaxyl	Allegiance FL	Bayer CropScience	warning	oral	phenylamide	4	24	seed treatment	bean, carrot, celery, cole crops, cucumber, eggplant, ginseng, horseradish, melon, onion, pea, pepper, pumpkin, squash, tomato, NOT potato
		Metalaxyl 265 ST	Albaugh/ Agri Star	warning	oral	phenylamide	4	24	seed treatment	bean, carrot, celery, cole crops, cucumber, eggplant, ginseng, horseradish, melon, onion, pea, pepper, pumpkin, squash, tomato, NOT potato
Bean		MetaStar 2E AG	Arysta LifeScience	warning	oral	phenylamide	4	48	see label	asparagus, bean, carrot, celery, cole crops, cucumber, eggplant, ginseng, lettuce, melon, onion, pea, pepper, potato, pumpkin, squash, tomato
		Sebring 2.65 ST	Nufarm Americas	warning	oral	phenylamide	4	24	seed treatment	bean, carrot, cucumber, pea, spinach, table beet
Carrot	metalaxyl + trifloxystrobin	Trilex 2000	Bayer CropScience	caution	oral	phenylamide + strobilurin	4 + 11	24	seed treatment	bean, pea, sweet corn
Celery	metam-potassium	Sectagon-K54	NovaSource	danger	oral AND posted	fumigant	—	see label	soil fumigant	mint, potato
	metam-sodium	Sectagon-42	NovaSource	danger	oral AND posted	fumigant	—	see label	soil fumigant	mint, potato
		Vapam	AMVAC	danger	oral AND posted	fumigant	—	see label	soil fumigant	carrot, celery, eggplant, horseradish, potato, tomato
Cole crops	metconazole	Quash	Valent	caution	oral	triazole	3	12	1	potato
	myclobutanil	Rally 40WSP	Dow Agro-Sciences	warning	oral	sterol inhibitor	3	24	0-30	bean (green), cucumber, melon, mint, pumpkin, squash
	PCNB	Blocker, PCNB 10% granules	AMVAC	caution	oral	substituted benzenes	14	12	soil fungicide	cole crops, potato
Cucumber	penflufen + prothioconazole	Emesto Silver	Bayer CropScience	caution	oral	benzanilide + triazole	7 + 3	12	seed treatment	potato
	penthiopyrad	Fontelis, Vertisan	DuPont	caution	oral	benzanilide	7	12	0-3	cabbage, cucurbits, legumes, onion

^aRestricted-use pesticide.

(continued)

Pesticide class, re-entry and preharvest intervals, and registered crops of insecticides and fungicides (continued)

Active ingredient	Product	Manu- facturer	Signal word	Notifi- cation	Resistance mgmt ^a		REI ^b (hours)	PHI ^c (days)	Common crop uses
					Chemical group	Group code			
phosphorous acid	Phostrol	Nufarm Americas	caution	oral	mono- and dibasic sodium, potassium, & ammonium phosphites	33	4	0	potato
propamocarb hydrochloride	Previcur Flex	Bayer CropScience	caution	oral	carbamate	28	12	2–14	cucumber, lettuce, pepper, potato, squash, tomato
propiconazole	Bumper 41.8 EC, PropiMax EC, Tilt	MANA, Dow Agro-Sciences, Syngenta	warning	oral	triazole	3	12	14	carrot, celery, mint, onion, sweet corn, table beet
prothioconazole	Proline 480SC	Bayer CropScience	caution	oral	triazole	3	12	7	bean
prothioconazole + trifloxystrobin	Stratego YLD	Bayer CropScience	caution	oral	triazole + strobilurin	3 + 11	12	14 (fodder) 0 (forage & ears)	sweet corn
pyraclostrobin	Cabrio EG	BASF	caution	oral	strobilurin	11	12	0–7	carrot, celery, cole crops, cucumber, eggplant, horseradish, melon, onion, pepper, pumpkin, radish, squash, table beet, tomato
	Headline	BASF	caution	oral	strobilurin	11	12	3–21	bean (dry), potato, sweet corn
pyraclostrobin + metiram	Cabrio Plus	BASF	caution	oral	strobilurin + dithiocarbamate	11 + M3	24	3	potato
pyrimethanil	Scala SC	Bayer CropScience	caution	oral	anilino-pyrimidine	9	12	1–7	onion, potato, tomato
quinoxifen	Quintec	Dow	caution	oral	quinoline	13	12	3	gourd, melon, pumpkin, winter squash
streptomycin sulfate	Agri-mycin 17	Syngenta	caution	oral	antibiotic	25	12	0	bean, pepper, tomato
tebuconazole	Folicur, Orius, Tebuzol 3.6F	Bayer Crop-Science, MANA, UPI	caution	oral	triazole	3	12	7–100	asparagus, cucumber, melon, onion, pumpkin, squash, sweet corn, table beet
thiabendazole	Mertect 340F	Syngenta	caution	oral AND posted	benzi-midazole	1	12	—	potato
thiophanate-methyl	Topsin, Topsin M	MANA, Micro Flo, UPI	caution	oral	benzi-midazole	1	12–72	1–21	bean, cucumber, melon, potato, pumpkin, squash
thiram	Thiram	Chemtura, Taminco	caution	oral	dithio-carbamate	M3	24	seed treatment	bean, celery, cucumber, melon, onion, pumpkin, squash, sweet corn, table beet, tomato

*Restricted-use pesticide.

(continued)

Pest management

Asparagus

Bean

Carrot

Celery

Cole crops

Cucumber

Pesticide class, re-entry and preharvest intervals, and registered crops of insecticides and fungicides (continued)

Pest management	Active ingredient	Product	Manu- facturer	Signal word	Notifi- cation	Resistance mgmt ^a			Common crop uses	
						Chemical group	Group code	REI ^b (hours)		PHI ^c (days)
	TPTH	*Agri Tin, *Super Tin 4L	Nufarm Americas, UPI	danger	oral AND posted	organo- metallic	30	48	7	potato
Asparagus	trifloxystrobin	Flint	Bayer CropScience	caution	oral	strobilurin	11	12	0-7	carrots, celery, cucumber, horseradish, melon, pumpkin, squash, table beet, tomato
		Gem	Bayer CropScience	caution	oral	strobilurin	11	12	7	potato
	triflumizole	Procure 480SC	Chemtura	caution	oral	imidazole	3	12	0	cucumber, melon, pumpkin, squash
	zoxamide/ mancozeb	Gavel 75DF	Gowan	caution	oral	benzamide/ EBDC	22 + M3	48	3-5	cucumber, melon, potato, pumpkin, squash, tomato

*Restricted-use pesticide.

Bean

Carrot

Celery

Cole crops

Cucumber

Herbicide common and product names, formulations, manufacturers, safety information, and mode of action

Active ingredient	Product	Formulation(s)	Manufacturer	Signal word	Resistance management ^a		
					Mode of action	Group code	REI ^b (hrs)
2,4-D	2,4-D Amine	various	several	danger	growth regulator	4	48
	2,4-D Ester	various	several	caution	growth regulator	4	12
acetochlor + safener	many	6.4EC, 7EC	several	warning	shoot growth inhibitor	15	12
alachlor	*Intrro	4EC	Monsanto	danger	shoot growth inhibitor	15	12
	*Micro-Tech	4ME	Monsanto	caution	shoot growth inhibitor	15	12
atrazine	*many	90DF, 4L	many	caution	photosynthesis inhibitor (systemic)	5	12
bensulide	Prefar	4E	Gowan	caution		8	12
bentazon	Basagran	4S	Arysta	caution	photosynthesis inhibitor (contact)	6	48
bromoxynil	Buctril	4EC, 2EC	Bayer CropScience	warning	photosynthesis inhibitor (systemic)	6	12 hrs to 12 days
carfentrazone	Aim EC	2EC	FMC	caution	cell membrane disruptor	14	12
carfentrazone + halosulfuron	Priority	62.5DF	Tenkoz	caution		14 + 2	12
clethodim	Select Max	0.97EC	Valent	caution	lipid synthesis inhibitor	1	24
clomazone	Command	3ME	FMC	caution/ danger	pigment inhibitor	13	12–48
clopyralid	Stinger	3S	Dow AgroSciences	caution	growth regulator	4	12
cycloate	Ro-Neet	6E	Helm	caution	shoot growth inhibitor	8	12
dimethenamid-P	Outlook	6EC	BASF	warning	shoot growth inhibitor	15	12
dimethenamid-P + atrazine	*G-Max Lite	2.25 + 2.75L	BASF	warning		15 + 5	12
EPTC	Eptam	7E, 20G	Gowan	warning/ caution	shoot growth inhibitor	8	12
ethalfluralin	Sonalan, Curbit	3EC, 10G	Dow AgroSciences, Loveland	danger	root growth inhibitor	3	24
fluazifop	Fusilade DX	2EC	Syngenta	caution	lipid synthesis inhibitor	1	12
flumioxazin	Chateau	WDG	Valent	caution	cell membrane disruptor	14	12
fluroxypyr	Starane Ultra	2.8S	Dow AgroSciences	warning	growth regulator	4	24
fluthiacet	Cadet	0.91EC	FMC	warning	cell membrane disruptor	14	12
fomesafen	Reflex	2LC	Syngenta	danger	cell membrane disruptor	14	24
foramsulfuron + safener	Option	35DF	Bayer CropScience	caution	amino acid synthesis inhibitor (ALS)	2	12
glyphosate	several		several	caution	amino acid inhibitor	9	4–12
halosulfuron	Permit, Sandea	75DF	Gowan	caution	amino acid synthesis inhibitor (ALS)	2	12
imazamox	Raptor	1S	BASF	caution	amino acid synthesis inhibitor (ALS)	2	4
imazethapyr	Pursuit	2S	BASF	caution	amino acid synthesis inhibitor (ALS)	2	4
linuron	Lorox	50DF	NovaSource	caution	photosynthesis inhibitor (systemic)	7	24

*Restricted-use pesticide.

(continued)

^a To delay or prevent the development of resistance, rotate among herbicides from different chemical groups. Newly approved labels bear the group code, a reference to the specific target site of the chemical. For more details, visit www.plantprotection.org/HRAC/.

^b REI = Restricted entry interval.

Pest management

Asparagus

Bean

Carrot

Celery

Cole crops

Cucumber

Herbicide common and product names, formulations, manufacturers, safety information, and mode of action *(continued)*

Pest management	Active ingredient	Product	Formulation(s)	Manufacturer	Signal word	Resistance management ^a		
						Mode of action	Group code	REI ^b (hrs)
	MCPA	MCPA Amine	various	several	danger	growth regulator	4	48
		MCPA Ester	various	several	caution	growth regulator	4	12
Asparagus	MCPB	Thistrol	2S	NuFarm	warning	growth regulator	4	24
	mesotrione	Callisto	4L	Syngenta	caution	pigment inhibitor	27	12
	metribuzin	several	various	several	caution	photosynthesis inhibitor (systemic)	5	12
	napropamide	Devrinol	50DF	United Phosphorus Inc. (UPI)	caution	shoot growth inhibitor	15	24
	naptalam-sodium	Alanap-L	2L	Chemtura	warning	auxin transport inhibitor	19	48
	nicosulfuron + safener	Accent Q	54.5DF	DuPont	caution	amino acid synthesis inhibitor (ALS)	2	4
Bean	oxyfluorfen	Goal	2XL	Dow AgroSciences	warning	cell membrane disrupter	14	24-48
		GoalTender	4L	Dow AgroSciences	caution	cell membrane disrupter	14	24-48
	paraquat	*several		several	danger	cell membrane disrupter	22	12-24
	pendimethalin	Prowl H ₂ O	3.8CS	BASF	caution	root growth inhibitor	3	24
	prometryn	Caparol	4L	Syngenta	caution	photosynthesis inhibitor (systemic)	5	12
	quizalofop	Assure II/Targa	0.88EC	DuPont/Gowan	danger	ACCCase inhibitor	1	12
Carrot	rimsulfuron	Matrix/Solida	25DF	DuPont/Cheminova	caution	amino acid synthesis inhibitor	2	4
	sethoxydim	Poast	1.5EC	BASF	warning	ACCCase inhibitor	1	12
		Poast Plus	1EC	BASF	caution	ACCCase inhibitor	1	12
	simazine	Princep	90DF, 4L	Syngenta	caution	photosynthesis inhibitor (systemic)	5	12
	s-metolachlor + safener	Dual II Magnum	7.64EC	Syngenta	caution	shoot growth inhibitor	15	24
	s-metolachlor + atrazine + safener	*Bicep Lite II Magnum	3.33 + 2.67L	Syngenta	caution		15 + 5	24
Celery	s-metolachlor + mesotrione	Zemax	3.34 + 0.33L	Syngenta	caution		15 + 27	24
	s-metolachlor + mesotrione + atrazine	*Lumax	2.68 + 0268 + 1L	Syngenta	caution		15 + 27 + 5	24
	tembotrione + safener	Laudis	3.5L	Bayer CropScience	caution	pigment inhibitor	27	12
Cole crops	terbacil	Sinbar	80WP	NovaSource	caution	photosynthesis inhibitor (systemic)	5	12
	topramazone	Impact	2.8L	AMVAC	caution	pigment inhibitor	27	12
	trifluralin	Treflan	HFP	Dow AgroSciences	caution	root growth inhibitor	3	12

*Restricted-use pesticide.

Cucumber

(continued from page 21)

Most labels also list a phone number that you (or medical personnel) can call for specific information on poisoning (or other accidents) involving that particular product.

Pesticide safety

Before you handle pesticides, **stop and read the label**. Labels contain human safety precaution statements and list the specific personal protective clothing and equipment that you need to wear. Some of the following may be label requirements; others are commonsense guidelines that will help minimize pesticide exposure to you, your coworkers, and your family and neighbors.

- Wear a long-sleeved shirt, long pants, shoes, and socks when handling pesticides.
- Wear coveralls (fabric or chemical-resistant) over your work clothes for an added layer of protection.
- Unless the label states otherwise, always wear chemical-resistant gloves whenever you work with pesticides.
- Wear chemical-resistant footwear, gloves, eyewear, and a respirator (if the label requires one) when mixing, loading, or applying pesticides.
- If you wear fabric coveralls, also wear a chemical-resistant apron when mixing and loading pesticides.
- Stand in the crosswind when mixing or loading pesticides.
- Never apply pesticides when there is the likelihood of significant drift.
- Never leave a spray tank containing pesticide unattended.
- Avoid back siphoning into the water source.
- Never eat, drink, or smoke when handling pesticides.
- Wash hands thoroughly after handling pesticides.
- If you splash pesticide on yourself, remove contaminated clothing immediately and wash yourself thoroughly.

- Wash contaminated clothes separately from other household laundry.
- Keep pesticides in original containers.
- Store and lock pesticides out of the reach of children.
- Observe restricted entry intervals on a treated crop or area.

Pesticide accidents

Pesticide spills. Regardless of the magnitude of a spill, the objectives of a proper response are the same—you must **control** the spill, you must **contain** it, and you must **clean it up**. A thorough knowledge of appropriate procedures will allow you to minimize the potential for adverse effects.

Spills of any compound need to be reported to the WDNR. However, you do **not** need to report the spill if it is completely confined within an impervious secondary containment and the spilled amount can be recovered with no discharge to the environment. On the other hand, a spill of any amount is reportable if it occurred outside of secondary containment and it harmed, or threatens to harm, human health or the environment (e.g., back siphoning). The spill is exempt from the WDNR reporting requirements if:

- you deem the spill will not harm, or threaten to harm, human health or the environment AND
- the amount spilled would cover less than 1 acre if applied at labeled rates AND
- if a SARA pesticide, it is less than the reportable quantity.

Reportable spills involving SARA substances (see “Pesticides and Community Right to Know” on page 20) are also to be reported to the WDEM and to your LEPC. To simplify emergency notification requirements to state agencies, call the WDEM 24-hour spill hotline (1-800-943-0003) whenever a spill of any compound occurs. Calling this hotline will not, however, remove your responsibility of notifying your LEPC.

Spills of some compounds may require that you notify federal authorities by calling the National Response Center

(1-800-424-8802). Your call to the WDEM spill hotline should provide you with assistance in determining whether federal authorities need to be notified.

Pesticide fires. In the event of a fire, isolate the entire area and clear all personnel to a safe distance *upwind* from smoke and fumes. Always inform the fire department of the nature of the pesticides involved and of any specific information that may help them in fighting the fire and protecting themselves and others from injury. For information on cleanup and decontamination, contact the WDEM and the pesticide manufacturer(s).

Livestock poisoning. When you suspect animal poisoning by pesticides, first call your veterinarian. If the cause of poisoning cannot be determined, call the WDATCP’s Animal Toxic Response Team Coordinator at 608-224-4500 (during office hours) or the Division of Emergency Government at 1-800-943-0003 (after hours and on weekends).

Wildlife poisoning or water contamination. Contact the WDNR district office. District offices are located in Spooner, Rhinelander, Eau Claire, Green Bay, Milwaukee, and Fitchburg.

Pesticides and endangered species

Endangered and threatened species are the most vulnerable plants and animals in our native natural communities. These species are either in danger of extinction or are likely to become endangered in the foreseeable future. Starting in 2010, the EPA's Endangered Species Protection Program (ESPP) implemented county-specific bulletins to provide applicators the information they need about pesticide use limitations in their county to better protect listed species and their habitat. The first product to carry a label statement directing users to view a bulletin is methoxyfenozide (Intrepid 2F), to protect the endangered Karner blue butterfly and Hine's emerald dragonfly. Please note that it may take several years for products with the new label to replace existing product in the channel trade. As always, pesticide users are to follow the label on the product they are using.

When using pesticides whose label statements instruct you to follow the measures contained in the ESPP Bulletin, you must either access the EPA's Bulletins Live! website or call their toll-free number (1-800-447-3813) within 6 months before using the product. The bulletin will show which counties or portions of counties are affected and the use limitations for that particular product. You must use the bulletin that is valid for the month and year in which you will apply the product.

Go to www.epa.gov/espp/ for general information on the ESPP and to access Bulletins Live! The WDNR is responsible for implementing ESPP for our state. For more information about protected plants, animals, and natural communities in Wisconsin, see www.dnr.wi.gov/topic/endangeredresources/biodiversity.html.

Pesticide drift

It is impossible to totally eliminate pesticide drift. Drift occurs because of unforeseen wind variations and other factors, many of which are beyond the applicator's control. People living in areas subject to pesticide drift worry about the acute and chronic effects of exposure to pesticides. State rules governing pesticide drift attempt to strike a balance between the intended benefits of pesticide use and the potential risks to those exposed to pesticide drift.

According to state law, people living adjacent to land that is aerially sprayed with pesticides can request to be notified at least 24 hours before application. Beekeepers also are entitled to notification of applications that occur within a 1.5-mile radius of their honeybee colonies. Both ground and aerial pesticide applications are subject to advance notification requirements to beekeepers who request such notification.

For ground applications, you can minimize drift by following these recommendations:

- Follow all label precautions for specific drift-reduction measures.
- Spray when wind speed is low.
- Use the maximum-size nozzle orifice without sacrificing pest control activity.
- Keep pressure at the lowest setting possible without distorting spray pattern and distribution.
- Use drift-control agents when permitted by product label.
- Consider using nozzles specifically designed to reduce drift.
- Leave an untreated border strip next to adjacent property.

For more information about drift—what it is, how it occurs, and drift management principles—ask for *Managing Pesticide Drift in Wisconsin: Field Sprayers* from your county Extension office or download it by going to ipcm.wisc.edu/pat/downloads. This publication also describes the critical role the pesticide applicator plays in deciding whether to spray when arriving at the site.

Pesticides and groundwater

Trace amounts of pesticides are found in our nation's groundwater. To minimize further contamination, many pesticide labels contain precautionary statements either advising against or prohibiting use in areas vulnerable to groundwater contamination. A summary of these precautionary statements is included under "Remarks" for each pesticide in this publication.

To protect our state's water resources, Wisconsin's groundwater law (Act 310) created two guidelines to limit the presence of fertilizer and pesticides in groundwater: *enforcement standards* are maximum chemical levels allowed in groundwater, and *preventive action limits* are set at a percentage of the enforcement standard. When contamination approaches preventive action limits, the responsible party must implement corrective measures to prevent further contamination.

Through groundwater monitoring studies, the most commonly found pesticide is atrazine. Consequently, Wisconsin implemented Chapter ATCP 30 to help minimize further contamination of our groundwater by atrazine. Under this rule, statewide rate restrictions have been implemented and, in some geographic areas, the use of atrazine is prohibited.

Mixing and loading pesticides. Mixing and loading pesticides pose a high risk of point source contamination of ground and surface water because of the concentration, quantity, and type of pesticides that are usually handled at a mixing and loading site. To minimize this risk of environmental contamination, Wisconsin requires that certain mixing and loading sites have secondary containment.

Both private and commercial applicators are required to have a mixing and loading pad if more than 1,500 lb of pesticide active ingredient are mixed or loaded at any one site in a calendar year or if mixing and loading occurs within 100 feet of a well or surface water. In-field mixing is exempt from the pad requirements

provided mixing or loading at the site of application occurs 100 feet or more from a well or surface water.

Agricultural Chemical Cleanup Program. Cleanup of contaminated soil or contaminated groundwater is costly. The Agricultural Chemical Cleanup Program (ACCP) helps ease the financial burden for facilities and farms by reimbursing them for eligible costs associated with the cleanup of sites contaminated with pesticides or fertilizers. For more information, contact the WDATCP at 608-224-4518.

Soil fumigant pesticides

Soil fumigants are used on a number of crops in Wisconsin, primarily on potatoes but also on strawberries, tobacco, and trees grown in nurseries. While fumigants are important and useful pesticides, they also pose some unique dangers because they are highly volatile and can move from the soil and the treatment site to the air. They can affect workers and, when vapors move off site, the general public.

Because of this danger, the Environmental Protection Agency (EPA) implemented a series of risk mitigation measures beginning in 2010. All the proposed extra protection measures will be in place as of the 2012 growing season.

All soil fumigants are now registered as restricted-use pesticides. This means that **anyone**, whether a private applicator or a commercial applicator, **must** be certified to use and apply soil fumigants in Wisconsin. People wanting to use soil fumigants in the state must first become certified in a base category (e.g., *Field & Vegetable Crops* for commercial applicators; *General Farming, Greenhouse & Nursery* or *Fruit Crops* for private applicators) and then the supplemental subcategory, *Soil Fumigation*.

Some of the risk mitigation measures the EPA is now requiring on soil fumigant labels include buffer zones around an application area, written site-specific Fumigant Management Plans (FMP), emergency preparedness and community outreach education, lower

application rates, more stringent respiratory protection, a minimum of 5 days for re-entry, and others.

Some soil fumigant labels may have a requirement that applicators attend product-specific registrant training programs. However, in Wisconsin, applicators must be certified in a base category and in the soil fumigation subcategory as discussed above. Registrant training programs would be optional.

For more detailed information on the new mitigation measures, fact sheets, FMP templates, and more, see the EPA's "Soil Fumigant Toolbox" website at epa.gov/pesticides/reregistration/soil_fumigants.

Calibrating pesticide equipment

Accurate and uniform pesticide application is fundamental to satisfactory pest control. Too frequently a grower does not know exactly how much pesticide has been used until the application is completed. This can lead to substantial monetary losses due to unnecessary pesticide and labor costs, unsatisfactory pest control resulting in reduced yields, and crop damage. Good pesticide application begins with accurate sprayer or granular applicator calibration. One method of calibration is contained in the *Training Manual for the Private Pesticide Applicator*. It also is found in the *Training Manual for the Commercial Applicator: Field and Vegetable Crops*. Both of these are available at ipcm.wisc.edu/pat.

Cleaning pesticide sprayers

Thorough sprayer cleaning is necessary when switching from pesticide application on one crop to the application of a different pesticide on another crop. This is especially important when the second crop is quite sensitive to the first pesticide. For example, residue of dicamba left in a sprayer may damage soybeans and other dicamba-sensitive crops during subsequent pesticide applications. No

cleaning method is 100% foolproof, however. If you apply significant quantities of different types of pesticides, reserve one sprayer for herbicides only and another for insecticides and fungicides.

Check the label for specific cleaning instructions. If none are listed, follow these guidelines:

1. Park the sprayer on a wash pad; flush the tank, lines, and booms thoroughly with clean water; and apply the pesticide-contaminated rinsate to sites listed on label. Simpler still, mount a clean water source on your sprayer and flush the system while in the field.
2. Select the appropriate cleaning solution for the pesticide used:

Hormone-type herbicides (e.g., 2,4-D, Banvel). Fill the sprayer with sufficient water to operate, adding 1 quart household ammonia for every 25 gallons of water. Circulate the ammonia solution through the sprayer system for 15 to 20 minutes and then discharge a small amount through the boom and nozzles. Let the solution stand for several hours, preferably overnight. (Please note: household ammonia will corrode aluminum sprayer parts.)

Other herbicides, insecticides, and fungicides. Fill the sprayer with sufficient water to operate, adding 0.25 to 2 pounds powder detergent (liquid detergent may be substituted for powder at a rate to make a sudsy solution) for every 25 to 40 gallons of water. Circulate the detergent solution through the sprayer system for 5 to 10 minutes and then discharge a small amount through the boom and nozzles. Let the solution stand for several hours, preferably overnight.

3. Flush the solution out of the spray tank and through the boom.
4. Remove the nozzles, screens, and strainers and flush the system twice with clean water.
5. Scrub all accessible parts with a stiff bristle brush.

Preparing pesticide sprayers for storage

Before storing the sprayer at the end of the season:

1. Clean the sprayer per label instructions or as specified above.
2. Fill the sprayer with sufficient water to operate, adding 1 to 5 gallons of lightweight emulsifiable oil, depending upon the size of the tank. Circulate the oil/water solution through the sprayer system for 5 to 10 minutes.
3. Flush the solution out of the spray tank and through the boom; the oil will leave a protective coating on the inside of the tank, pump, and plumbing.
4. Remove the nozzles, screens, and strainers and place them in diesel fuel or kerosene to prevent corrosion. Cover the nozzle openings in the boom to prevent dirt from entering.
5. As an added precaution to protect pumps, pour 1 tablespoon of radiator rust-inhibitor antifreeze in each of the inlet and outlet ports. Rotate the pump several revolutions to completely coat the interior surfaces.

Pesticide disposal

It is the legal responsibility of all pesticide users to properly dispose of pesticide waste in an environmentally acceptable manner (it is illegal to bury or burn any pesticide containers in Wisconsin).

Some pesticides are considered “hazardous” by the EPA. Disposing waste or excess resulting from use of these pesticides comes under stringent regulations of the Resource Conservation Recovery Act (RCRA). This federal law and the

accompanying state law (NR 600) regulate generators of hazardous waste—those who need to dispose of hazardous pesticides.

The simplest way to avoid becoming a hazardous-waste generator is to triple rinse all pesticide containers and apply rinsates to labeled sites. If you must generate hazardous waste, disposal procedures may differ depending on the volume of waste generated and its characteristics.

You can reduce the amount of pesticide waste (hazardous or not) by following these guidelines:

- Determine whether the pesticide you intend to use is considered hazardous by the EPA. A list of these pesticides is available from your WDNR regional office. If listed, check for alternative pesticides that are not hazardous and will provide equivalent pest control.
- Mix only the amount of pesticide needed and calibrate equipment so all of the solution is applied.
- Attach a clean water supply to the sprayer unit so the tank can be rinsed and the rinsate applied to the labeled site while still in the field.
- Triple rinse all pesticide containers. Even if the pesticides were hazardous, a triple-rinsed container is not hazardous waste; you can dispose of it in a sanitary landfill.
- Don't mix hazardous waste with other pesticide waste. This will result in the entire mixture being considered hazardous.

Wisconsin Clean Sweep program.

Wisconsin's Clean Sweep program, sponsored by the WDATCP and individual counties, offers a way to dispose of most kinds of pesticide waste, including

liquids, dry formulations, and waste classified as hazardous. For details on when a site will be held in your area, check with your county Extension office or view the WDATCP Clean Sweep interactive map at datcp.wi.gov/environment/clean_sweep/index.aspx. Wisconsin Clean Sweep offers grants for the collection and disposal of agricultural waste, household hazardous waste, and prescription drugs. However, not all municipalities collect all three types of waste at the same time, while some municipalities offer collection sites without use of Wisconsin Clean Sweep funds.

Plastic pesticide container recycling program.

The best way to dispose of plastic containers is to recycle them. The Wisconsin Crop Production Association (WCPA) sponsors a recycling program and sets up collection sites at member dealers throughout the state. This program accepts triple-rinsed (dirty containers will not be accepted) plastic pesticide containers of all sizes, including mini-bulk tanks. Farmers must work through their dealer to recycle jugs and mini-bulks. Visit www.wiagribusiness.org/recycling.php for instructions on the proper preparation of containers intended for recycling and for their summer and fall recycling schedules.

Please note that this recycling program is not a Wisconsin Clean Sweep program; waste pesticides will not be accepted at container collection or granulation sites.

Recycling mini-bulk tanks. Although mini-bulk tanks are recycled at the same time as the smaller jugs, dealers must register with WCPA at least 1 week in advance of a scheduled recycling date for all tanks 60 gallons and larger. Visit the Pesticide Containers Recycling Program at www.wiagribusiness.org/recycling.php for details.

Asparagus

Permanent asparagus plantings in Wisconsin are usually started with year-old crowns. Direct seeding has had limited success in Wisconsin. Plug production of seedlings is also being done on a limited basis and will likely increase in future years as male hybrid seed becomes increasingly available.

Hybrid male cultivars cost more than the open-pollinated varieties, but yields are 1.5 to 2 times that of the traditional cultivars.

Planting

Field transplant production

Rows: 18–20 inches.

Seeds in row: 2 inches (1 inch deep). Use 4–5 lb seed/a. Each pound produces about 10,000 plants, enough for about an acre. (Sidedress with 75–100 lb/a ammonium nitrate about mid-June.) To speed germination, soak seeds in warm water (about 90°F) for 4–5 days before planting. Add a few radish seeds to provide early plants to mark rows for cultivation. The following spring, lift and reset plants in a permanent location.

Indoor transplant production

You can also start seeds indoors around the first of March for transplanting the middle of May. This way you do not need

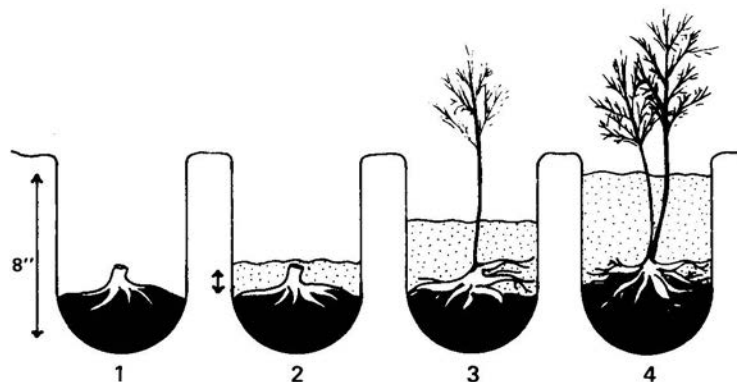
to replant them the following year. Use the same spacing for transplants as recommended for 1-year-old crowns.

Permanent plantings from 1-year-old crowns or from transplants

Rows: 4–6 ft.

Crowns in row: 9–15 inches (6–8 inches deep). Cover the crowns or transplants with 2–3 inches of soil and gradually fill furrows as plants grow (see illustration). Poor stands result if plants are covered too deeply at the start. Ridge the soil moderately over the rows after the plants are well established.

Avoid planting asparagus in fields infested with perennial weeds such as Canada thistle, quackgrass, and field bindweed (creeping Jenny) or eliminate these weeds before planting.



1 Set the plants upright in wide furrows, 6–8 inches deep, with the roots spread.

2 Cover with 2–3 inches of soil.

3 Gradually fill the furrow as the plants grow.

Annual nitrogen, phosphate, and potash recommendations for asparagus

Nitrogen		Phosphate and potash		
Organic matter (%)	Amount to apply (lb/a)	Yield goal (lb/a)	Amount P ₂ O ₅ to apply* (lb/a)	Amount K ₂ O to apply* (lb/a)
<2	80	2,000–4,000	10	20
2.0–9.9	60			
10–20	40			
>20	20			

*Amounts shown are for optimum (O) soil test levels. Apply 50% of this rate if soil test is high (H) and omit if soil test is excessively high (EH). If soil test is low (L) or very low (VL), increase rates according to soil test recommendations.

Lime and fertilizer

Lime: Use dolomitic limestone to maintain a pH of 6.0 on mineral soils and 5.6 on organic soils.

Fertilizer rates: Apply P₂O₅ and K₂O according to soil test recommendations before planting. Use annual nitrogen, P₂O₅, and K₂O recommendations in the following table each year asparagus is grown. Take credits for previous legume crops and manure.

Application: Broadcast and work in before spears begin to grow in early spring.

Nitrogen: On sandy soils, apply half of the nitrogen in early spring and the remaining half after the last harvest.

Disease control in asparagus

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Cercospora leaf spot	mancozeb	2.0 lb Dithane M45, Dithane DF Rainshield	120	Only apply on asparagus ferns after spears have been harvested. Do not apply more than 8.0 lb ai/a per season.
Fusarium root rot	<i>Field choice is very important so that plant stress in subsequent years is avoided.</i>			
Purple spot	azoxystrobin	6.0–15.5 fl oz Quadris	100	Do not apply more than 92.3 fl oz/a product per season. Do not apply more than one application of Quadris or another Group 11 fungicide before alternating to a fungicide with another mode of action.
	trifloxystrobin	3.0–4.0 oz Flint	180	Do not apply more than 12.0 oz/a Flint per season. Do not make more than three applications of Flint or other Group 11 fungicides during the season.
Rust	chlorothalonil	2.0–4.0 pt Bravo Weather Stik, Chloronil 720, Chlorothalonil 720, Echo 720, Equus 720 3.0–5.75 pt Echo Zn, Equus 500 Zn 1.8–3.6 lb Bravo Ultrex, Equus 90DF, Initiate 720	190	Do not apply more than 9.0 lb ai/a chlorothalonil per growing season. Post-harvest application only.
	mancozeb	1.6 qt Dithane F-45 2.0 lb Dithane DF Rainshield, M45 1.6 qt Manzate Flowable 2.0 lb Manzate Pro-Stick 1.5 qt Penncozeb 4FL 2.0 lb Penncozeb 75DF, 80WP, Koverall	180	Use rust-resistant varieties. Do not apply more than 6.0 lb ai/a per season. Apply only on ferns after spears have been harvested. Cut infected plants at ground level in late fall or winter and destroy infected debris.
	myclobutanil	5.0 oz Rally 40WSP	180	Do not apply to harvestable spears. Do not make more than six applications or exceed 30.0 oz/a Rally (0.75 lb ai/a) per year. Former product name was Nova.
	tebuconazole	4.0–6.0 fl oz AmTide TEBU 3.6F, Folicur 3.6 F, Monsoon, Onset 3.6L, Orius 3.6F, Tebucon, Tebuconazole 3.6F, Tebusha 3.6FL, Tebuzol 3.6F, Toledo	180	Postharvest application only. Do not make more than three foliar applications or exceed 18.0 fl oz/a per season.

Pest management

Asparagus

Bean

Carrot

Celery

Cole crops

Cucumber

Insect control in asparagus

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Asparagus aphid	<i>Natural enemies will often eliminate this insect; spot treat when populations are increasing rapidly and biological control is ineffective. Treat when 5% of ferns show injury. New plantings tolerate less injury.</i>			
	azadirachtin	10.0–21.0 oz Azatin XL Plus 0.5–2.0 gal Neemix 0.25EC 0.25–1.0 pt Neemix 4.5EC	0	Apply at 7-day intervals when pests first appear. May apply every 3–4 days for heavy infestations.
	1.0 lb chlorpyrifos	1.33 lb Lorsban 75WG 2.0 pt *Lorsban Advanced	1	Apply at fern stage only. Do not exceed two applications.
	0.5 lb dimethoate	1.0 pt dimethoate 400	180	Apply after the last harvest. Wait at least 7 days between applications. Do not exceed 5.0 pt/a per year.
	0.9–1.25 lb malathion	1.5–2.0 pt (various brands) 57%EC	1	Apply as needed. Aphid colonies appear in late summer.
	1–2% potassium salts of fatty acids	2.0 gal M-Pede/100 gal water	0	Primarily a contact spray. Apply every 7–14 days as needed.
	0.086 lb pymetrozine	2.75 oz Fulfill 50WDG	—	Apply after harvest.
	0.004–0.05 lb pyrethrin	1.0–12.0 fl oz Pyrenone 0.5 EC	0	Primarily a contact spray.
Common and twelve-spotted asparagus beetles, Japanese beetle	1.0–2.0 lb carbaryl	2.0–4.0 lb Sevin 50WP 1.25–2.5 lb Sevin 80S 1.0–2.0 qt Sevin XLR Plus	1	Apply when 5–10% of the plants are infested with adults or 2% of the spears have eggs or 10% of the plants are defoliated by larvae or 50–75% of the plants have larvae.
	1.0 lb chlorpyrifos	Lorsban (several formulations)	1	Apply at fern stage only. See label for rate.
	0.5 lb dimethoate	1.0 pt dimethoate 400	180	Apply after the last harvest. Wait at least 7 days between applications. Do not exceed 5 pt/a per year or apply within 180 days before harvest.
	0.9–1.25 lb malathion	1.5–2.0 pt (various brands) 57%EC	1	Apply as needed.
	0.5–1.0 lb methomyl	1.5–3.0 pt *Lannate LV	1	Do not exceed 4.5 lb ai/a or eight applications per crop.
	0.05–0.1 lb permethrin	*Ambush, *Pounce	1	Several formulations; see label for rate. Do not apply more than 0.4 lb ai/a per season.
	0.031–0.063 lb spinetoram	4.0–8.0 oz Radiant SC	60	Do not exceed 24.0 oz/a Radiant (0.188 lb ai/a) or three applications per crop. Wait at least 4 days between treatments.
	spinosad	4.0–6.0 fl oz Entrust SC	60	Apply to ferns only. Do not make more than three applications per crop. Do not exceed 18.0 fl oz/a Entrust SC per season.
Cutworms	0.5–1.5 lb <i>Bacillus thuringiensis</i>	0.5–1.0 lb DiPel DF	0	
	2.0 lb carbaryl	Sevin bait (several formulations)	1	Apply when 5–10% of the plants show cutworm damage.
	chlorantraniliprole	3.5–5.0 fl oz Coragen	1	Do not make more than four applications per crop season and allow at least 3 days between applications. Do not apply more than 15.4 fl oz/a Coragen per season.
	1.0 lb chlorpyrifos	1.33 lb Lorsban 75WG 2.0 pt *Lorsban Advanced	1	Apply when soil is moist and worms are active.
	0.45–0.9 lb methomyl	1.5–3.0 pt *Lannate 2.4LV 0.5–1.0 lb *Lannate 90SP	1	Do not exceed 4.5 lb ai/a or eight applications.

*Restricted-use pesticide.

(continued)

Pest
management

Asparagus

Bean

Carrot

Celery

Cole crops

Cucumber

Insect control in asparagus *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Cutworms <i>(cont.)</i>	0.05–0.1 lb permethrin	*Ambush, *Pounce	1	Several formulations; see label for rate. Do not apply more than 0.4 lb ai/a per season.

*Restricted-use pesticide.

Weed control in asparagus

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Annual weeds	0.19 lb flumioxazin	6.0 oz Chateau SW		Apply only to dormant asparagus no less than 14 days before spears emerge. Application to nondormant asparagus may result in unacceptable crop injury. Postharvest applications may be made after final harvest and within 2 weeks prior to fern emergence and must be sprinkler- or rainfall-incorporated with 0.5–0.75 inch of water. Do not exceed 6.0 oz/a Chateau SW per growing season.
	3.9 lb pendimethalin	up to 8.2 pt Prowl H ₂ O	14	Prowl H ₂ O may be applied in a single broadcast application up to 8.2 pt/a (maximum 2.4 pt/a on sandy soils) at least 14 days prior to first harvest or after spear harvest and prior to spear emergence. Spray contacting emerged spears may result in severe injury.
	0.5–2.0 lb trifluralin	1.0–4.0 pt Treflan HFP or registered equivalent		Apply to established asparagus as a single or split application, before new spears emerge or after harvest. Rate varies with soil texture and organic matter. Follow recommended soil preparation, application, and incorporation procedures. Must be incorporated within 24 hours.
Annual broadleaves	0.09–0.24 lb mesotrione	3.0–7.7 fl oz Callisto		Callisto can be applied to asparagus as a spring application prior to spear emergence, as a postharvest application (after final harvest), or both. Do not exceed 7.7 fl oz/a Callisto per year or apply more than twice per year. For postharvest applications, use a directed spray to minimize contact with any standing asparagus spears or ferns to prevent crop injury. See label for rate and adjuvant recommendations based on weed and crop growth stage.
	0.8–1.6 lb terbacil <i>(seeding year only)</i>	1.0–2.0 lb Sinbar 80WDG		Plant seed 1.0–1.5 inches deep. Spread a band of activated charcoal over the seeding row and follow with a single application of Sinbar. Use the lower rate on coarser soils.
	1.2 lb terbacil	1.5 lb Sinbar 80WDG	5	Apply before spears and weeds emerge or to small weeds (less than 2 inches tall). Application may be made after clean cutting. Do not exceed 2.5 lb/a per year. Do not use on plants that are diseased or lacking in vigor as crop injury may result. Do not plant to any other crop within 2 years of application.
Annual grasses and broadleaves	linuron	Lorox DF (use and rate varies by soil type—see label)	1	Lorox DF is registered for use on newly planted asparagus and on established beds. Before treating a newly seeded bed, place a 1-inch band of activated charcoal (300 lb/a) directly over the seed. See label for crop height and weed size restrictions. Do not apply more than 4.0 lb/a per year in a maximum of three applications. Do not add surfactant to spray mix.

*Restricted-use pesticide.

(continued)

Weed control in asparagus (continued)

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Nutsedge and some broadleaves	0.023–0.047 lb halosulfuron	0.5–1.5 oz Sandea	1	Sandea controls several broadleaf weeds and nutsedge. It will not control grasses. It may be applied as a postemergent broadcast treatment before or during the harvest season or as a postharvest directed spray using drop nozzles to direct the spray below the ferns. Spray contact with the fern may cause temporary yellowing. Wait to treat first-year transplants until at least 6 weeks after fern emergence. Do not exceed 2.0 oz/a per crop season in a maximum of two applications. Do not use soil- or foliar-applied organophosphate insecticides on asparagus that has been treated with Sandea or serious crop injury may occur. Consult label for other important usage information, precautions.
Germinating annual weeds in established beds	0.8–3.2 lb diuron	1.0–4.0 lb Karmex DF 0.8–3.2 qt Direx 4L		Do not use on newly planted or seeded asparagus during the first growing season. If making two applications in one season, do not exceed 3.0 lb/a of Karmex or 2.4 qt/a of Direx per application. Moisture is needed to activate the herbicide. See label for specific application information and precautions.
	metribuzin	see label	14	Metribuzin is registered for a single preemergence application or a split application preemergence and postharvest. Do not exceed 2.0 lb ai/a per year. Do not apply to plants during the first growing season after setting crowns or to newly seeded beds. Apply in early spring before spears or ferns emerge. For split applications, apply half in early spring before spears or ferns emerge and half after the last harvest of spears but before ferns emerge.
	4.0 lb napropamide	8.0 lb Devrinol 50-DF		Apply in early spring after disking but before weeds emerge. Do not apply to frozen ground or to ground with more than 10% organic matter. Incorporate or irrigate within 24 hours if no rainfall occurs. Treat only once per season.
Emerged broadleaves	2,4-D (see label for rate)	several manufacturers		Apply to actively growing weeds, usually in April or May. If spears are present, treat right after cutting. No more than two applications during the harvest season, and these should be at least 1 month apart. Contact by spray may cause malformed spears; cut and discard. Postharvest sprays require ground equipment using drop nozzles to avoid spraying the ferns. See label for worker re-entry and preharvest intervals.
	0.25–0.5 lb dicamba	8.0–16.0 oz Clarity	24 hours	Apply after cutting, but at least 24 hours before next cutting to actively growing weeds. Multiple applications per season allowed, but do not exceed 16.0 oz/a per year.
	2.0–4.0 lb norflurazon	2.5–5.0 lb Solicam DF	14	Do not apply to asparagus in the first growing season. See label for correct application rate as determined by soil type. Before application, remove or incorporate crop debris. Rain or irrigation needed within 4 weeks of application for activation.
Emerged grasses	0.068–0.12 lb clethodim	9.0–16.0 oz Select Max	1	Add non-ionic surfactant at a rate of 0.25% vol/vol. Wait at least 14 days before repeating treatment. Do not apply more than 64.0 oz/a per season.
	0.124–0.375 lb fluazifop-P-butyl	8.0–24.0 oz Fusilade DX	1	Make postemergence application to actively growing grasses; check label for size range and treatment rate. Always add either crop oil concentrate or non-ionic surfactant to final spray mix. Do not apply more than 48.0 oz/a per season.

*Restricted-use pesticide.

(continued)

Pest management

Asparagus

Bean

Carrot

Celery

Cole crops

Cucumber

Weed control in asparagus *(continued)*

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Emerged grasses <i>(cont.)</i>	0.094–0.47 lb sethoxydim	0.5–2.5 pt Poast	1	Apply postemergence to actively growing grasses. Always add 2.0 pt/a of crop oil concentrate to the spray mix. Apply no more than 5.0 pt/a of Poast per season. Do not apply if rain is expected within 1 hour.
Emerged weeds	glyphosate	several manufacturers and formulations	5	See manufacturer's label to assure that the formulation is labeled for this crop and for specific instructions. Apply at least 1 week before the first spears emerge or apply as a spot treatment after cutting spears or after all spears have been removed. Do not spot treat more than 10% of the field. Direct contact with the crop will cause serious injury.
	*paraquat <i>(rate varies by label)</i>	several manufacturers, not all registered for this use	6	Application will kill emerged crop, so apply to dormant asparagus before emergence or after last harvest. Always add crop oil concentrate or non-ionic surfactant to spray mixture. Follow precautions on label.

*Restricted-use pesticide.

Bean: green, lima, navy, red kidney

Planting

Green bean

The between-row and in-row spacings for green beans depends on whether the conventional or close-row spacing system is being used.

Conventional rows are spaced 30–36 inches apart. The in-row spacing should result in a final plant stand of 7–9 plants/ft of row for irrigated fields and 6–8 plants/ft of row for non-irrigated fields.

Close-row systems have rows spaced 18–24 inches apart. In-row spacing should result in a final stand of 3–4 plants/ft for irrigated and non-irrigated fields. Carefully manage close-row spacings because such systems can increase the potential for white mold disease.

Seed: 75–90 lb/a; depends upon seed size, germination, row spacing. Plant seed 0.5–2.0 inches deep depending on soil conditions. Plant shallow if soil is cool and moist, but deeper in dry, warm sandy soils.

Lima bean

Rows: 18–36 inches. Rows narrower than 30 inches can increase the incidence of white mold. Wider rows allow cultivation and better air circulation, making them less prone to the disease.

Seed: Target stand density of 100,000 plants/a: for 30-inch rows, 5–6 plants/ft; for 18-inch rows, 2–3 plants/ft. Depends upon seed size, germination, row spacing.

Navy and red kidney bean

Rows: 28–32 inches.

Seed: Plant 2 inches apart and 1.0–1.5 inches deep in heavy soil and 2 inches in sandy soil. Use 75–100 lb/a of red kidney; 35–45 lb/a navy bean; depends on seed size, germination, row spacing.

Planting considerations (date, field selection)

Plant green beans from May 10–July 15. They prefer growing season temperatures of 60–70°F and soil temperatures above 50°F. Temperatures above 85°F can result in poor pollination and “split set.” Plant navy and red kidney beans June 1–June 9. Lima beans germinate best at soil temperatures of 65°F. All bean seeds are subject to planter damage. Select planter plates to fit seed and reduce planter speed to minimize cracking of seed coat.

Grow on well-drained soils. Beans should follow corn on farms that use a corn-oats-forage rotation. Don’t use atrazine on the crop preceding the beans; it may leave a soil residue that will injure the beans. Select fields without major weed problems. On sandy soil, plow under rye cover crops before they deplete soil moisture. Allow at least 2 years between bean crops because disease organisms may live in the soil or on plant residue.

Irrigation

Green and lima beans require a constant supply of moisture, especially during the blossom/pod-set period. Moisture stress during blossom/pod-set period may cause blossom and pod drop. This causes split pod set and reduces yields. An effective irrigation program can ensure high yields and high pod quality, particularly on sandy soils. Proper irrigation management should promote uniform germination and emergence, plant development, and harvest maturity—all are important in mechanical harvesting. If the WISP program is used to schedule irrigations,

the AD value for green and lima beans on sands is 1.3 inches, and on silt loams the AD value is about 2.5 inches.

Lime and fertilizer

Lime: Use dolomitic limestone to maintain a pH of 6.0 for dry beans. Green beans should be limed to 6.8 on mineral soils and 5.6 on organic soils to help avoid certain diseases.

Fertilizer rates: Apply P_2O_5 and K_2O according to soil test recommendations. Use annual nitrogen, P_2O_5 , and K_2O recommendations in the following table. Take credits for previous legume crops and manure.

Application: Fertilizer may be applied broadcast or in a band 2 inches below seed and 2 inches to the side. Be sure seed does not contact fertilizer. Beans are salt-sensitive; contact with fertilizer can reduce germination.

Nitrogen (N): Apply broadcast or side-dress at trifoliolate. Split applications on sandy soils. Check with processor for optimum N timing for each variety. On irrigated sands, apply the N in two applications to reduce leaching. In years with leaching due to excess rain, an extra 30–40 lb N/a may be needed on sandy soils. Research has shown that applications to green beans greater than 100–120 lb N/a resulted in yield reductions.

Magnesium: Correct deficiencies on acid soils with dolomitic limestone. If pH is above 6.5, use magnesium sulfate or potassium-magnesium sulfate to apply 10–20 lb/a of magnesium in row fertilizer.

Zinc: Deficiency may occur on sands or eroded soils. To correct, add 2–4 lb/a of zinc (as sulfate, oxide, or frits) to row fertilizer or broadcast 4–8 lb/a of zinc. Add 0.5–1.0 lb/a if using zinc chelates. You can also apply zinc in a foliar spray (1 lb/a Zn as sulfate or 0.15 lb/a Zn as chelate).

Annual nitrogen, phosphate, and potash recommendations for bean crops

Crop	Nitrogen		Phosphate and potash		
	Organic matter (%)	Amount to apply (lb/a)	Yield goal	Amount P ₂ O ₅ to apply* (lb/a)	Amount K ₂ O to apply* (lb/a)
Lima bean	<2	60	2,000–3,000 lb/a	20	40
	2.0–9.9	40	3,001–4,000 lb/a	30	60
	10–20	20	4,001–5,000 lb/a	40	80
	>20	10			
Navy & red kidney bean	<2	40	10–20 cwt/a	20	20
	2.0–9.9	30	21–30 cwt/a	30	40
	10–20	20	31–40 cwt/a	40	60
	>20	10			
Green bean	<2	60	1.5–2.5 ton/a	10	40
	2.0–9.9	40	2.6–3.5 ton/a	15	60
	10–20	20	3.6–4.5 ton/a	20	80
	>20	0	4.6–5.5 ton/a	25	100
			5.6–6.5 ton/a	30	120

*Amounts shown are for optimum (O) soil test levels. Apply 50% of this rate if soil test is high (H) and omit if soil test is excessively high (EH). If soil test is low (L) or very low (VL), increase rates according to soil test recommendations.

Disease control in bean—green, lima, navy, red kidney

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions	
Angular leaf spot (Fungal pathogen: <i>Phaeoisariopsis griseola</i>)	<i>Practice a 2-year break between bean crops to permit decomposition of crop debris. Infested residue should be thoroughly incorporated into the soil to hasten decomposition.</i>				
Bacterial blights (brown spot, common blight, fuscous blight, and halo blight)	copper oxychloride + basic copper sulfate	2.0–4.0 lb C-O-C-S WDG	0	Rotating crops, deep-plowing debris, and planting disease-free seed are very effective controls.	
	copper oxychloride + copper hydroxide	1.0–2.0 pt Badge SC	0		
		0.5–1.25 lb Badge X ₂	0		
	copper hydroxide	0.66–2.0 pt Champ Formula 2	0		Apply at 7- to 14-day intervals when conditions are favorable for disease development. Not effective when disease pressure is severe.
		4.6F, Champ DP	0		
		1.0–3.0 lb Champion 77WP, Champ WG, Kentan DF	0		
		1.5–3.0 lb Kocide 101 77WP	0		
		1.5–3.0 lb Kocide DF	0		
		1.3–4.0 pt Kocide LF	0		
		0.67–2.0 pt Kocide 4.5 LF	0		
0.75–2.25 lb Kocide 2000DF		0			
0.5–1.25 lb Kocide 3000	0				
0.67–4.0 pt Nu-Cop 3L	0				
streptomycin sulfate	30,000 ppm (3%) solution	NA	Treat seed with streptomycin sulfate to help inactivate bacteria on the seed surface.		
streptomycin sulfate	streptomycin sulfate 62.5%				
Botrytis gray mold and Sclerotinia white mold	<i>Rotate bean fields with nonhost crops. Both fungi infect a broad range of crop and weed hosts. Plant on well-drained soil. In areas prone to disease, avoid excessive irrigation before and during the bloom period.</i>				

(continued)

Disease control in bean—green, lima, navy, red kidney (continued)

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Botrytis gray mold and Sclerotinia white mold (cont.)	boscalid	8.0–11.0 oz Endura 70 WDG	7 (succulent) 21 (dry)	Do not exceed two sprays and 22.0 oz/a of Endura per season.
	cyprodinil + fludioxonil	11.0–14.0 oz Switch 62.5WG	7	Do not use more than 56.0 oz/a per year. Application may be made by ground only. Apply prior to or at disease onset.
	fluazinam	0.5–0.85 pt Omega 500F	14 (edible podded & succulent beans) 30 (dry & lima beans)	Do not use more than 1.75 pt/a per year. Make first application at 10% bloom and again 7–10 days later as needed. Use higher rate for most severe disease pressure.
	fludioxonil	7.0 oz Cannonball WP	7	For white mold control, make first application at 10–20% bloom. Ground application only.
	iprodione	1.5–2.0 pt Iprodione 4L AG, Meteor, Nevado 4F, Rovral 4F	14	Apply spray at 10% bloom and again 5–7 days later or at 100% bloom, if necessary. Do not graze or feed treated vines to livestock.
	penthioopyrad (edible podded & succulent shelled beans)	<i>Botrytis:</i> 14.0–30.0 fl oz Fontelis <i>Sclerotinia white mold:</i> 16.0–30.0 fl oz Fontelis	0	Do not exceed 72.0 fl oz/a per season. Make no more than two sequential applications of Fontelis before changing to an effective fungicide with a different mode of action. For Botrytis management, make first application before disease development. For Sclerotinia management, make first application at beginning bloom and 7–10 days later or at full bloom.
	prothioconazole (dried shelled peas, beans)	5.7 fl oz Proline 480SC	7	Follow label for appropriate resistance management strategy. Not labeled for green beans. Labeled for soybean but rates vary for specific diseases.
	thiophanate-methyl (green & dry beans)	1.0–1.5 lb Topsin M WSB 20–30 fl oz Topsin 4.5FL	14 14	Apply spray at 25–50% bloom and again 7 days later at 100% bloom. Do not graze or feed treated vines to livestock.
	1.5–2.0 lb Topsin M WSB 30–40 fl oz Topsin 4.5FL	14 14	Apply once at 50–75% bloom. Do not graze or feed treated vines to livestock.	
thiophanate-methyl (lima beans)	1.0–2.0 lb Topsin M WSB	14	Begin application at 10–30% bloom. Do not exceed 4.0 lb/a product per season. Do not graze or feed treated vines to livestock.	
Common mosaic virus and bean yellow mosaic virus	<i>Common mosaic is seed-borne. Yellow mosaic overwinters in perennial legumes and other hosts. Both are transmitted in the field by aphids. These virus diseases are not controlled by fungicides or seed treatments.</i>			
Pod tip rot (<i>Rhizoctonia</i> spp.)	myclobutanil	4.0–5.0 oz Rally 40WSP	0	Treat when pods begin to develop. Do not exceed 1.25 lb/a product per season. Allow at least 30 days following last application before planting new crops. (Formerly Nova.)
Root rots (<i>Fusarium</i> , <i>Pythium</i> , <i>Rhizoctonia</i>)	<i>Rotate non-legume crops with beans, and use cover crops between plantings and over winter. When symptoms appear, timely irrigation can promote new feeder root development and produce an acceptable crop. Subsoiling 20–22 inches can promote deep rooting and improve yields. Wet soil conditions during emergence may increase root rot losses.</i>			
Rust	<i>Bury all bean debris after harvest. If rust does not appear within 4 weeks of harvest, fungicides are unnecessary.</i>			

(continued)

Pest management

Asparagus

Bean

Carrot

Celery

Cole crops

Cucumber

Disease control in bean—green, lima, navy, red kidney *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Rust <i>(cont.)</i>	chlorothalonil	1.3–3.0 pt Bravo Weather Stik, Echo 720, Equus 720	7	Do not apply more than 9.0 lb ai/a chlorothalonil per season. Do not graze treated areas or feed treated plant parts to livestock.
		1.25–2.7 lb Bravo Ultrex 82.5WDG, Equus DF	7	
		1.125–2.5 lb Echo 90DF	7	
		2.0–4.25 pt Echo Zn	7	
	myclobutanil	4.0–5.0 oz Rally 40WSP	0	Do not exceed 1.25 lb/a product (0.5 lb ai/a) per year. Observe a 30-day plantback interval between last application and planting new crops. (Formerly Nova.)
	prothioconazole	5.7 oz Proline 480SC		Follow label for appropriate resistance management strategy.
	tebuconazole	4.0–6.0 fl oz Folicur 3.6 F, Monsoon, Onset 3.6L, Orius 3.6F, Tebusha 3.6FL, TebuStar 3.6L, Tebuzol 3.6F, Toledo	7	Do not apply more than 24.0 fl oz/a per season of tebuconazole.
Rust, anthracnose, Alternaria leaf spot, Alternaria blight	azoxystrobin	6.2–15.4 fl oz Quadris Flowable	0 (succulent)	Quadris and Headline belong to the Group 11 (strobilurin) fungicide category. Do not exceed more than one application of any of these products before alternating with a fungicide having a different mode of action. Do not exceed four foliar applications of strobilurin fungicides per crop per year. Do not exceed 1.44 qt/a Quadris or 18.0 fl oz/a Headline per season. Do not use pyraclostrobin on lima beans. Do not feed bean forage or hay treated with these products earlier than 14 days after the last application.
			14 (dry)	
			7 (edible pod)	
			21 (dry)	
			14	
			14	
	pyraclostrobin	6.0–9.0 fl oz Headline	7 (edible pod) 21 (dry)	
	azoxystrobin + chlorothalonil <i>(dry beans only)</i>	1.6–2.4 pt Quadris Opti	14	For use on beans to be harvested dry with pods removed. Quadris Opti belongs to Group 11 (strobilurin) and M fungicide categories. Do not apply more than one foliar spray of a Group 11 fungicide before alternating with a fungicide having a different mode of action. Do not exceed four foliar treatments of Group 11 fungicides per year. Do not apply more than 1.5 lb ai/a azoxystrobin or 6.0 lb ai/a chlorothalonil per year.
	fluxapyroxad + pyraclostrobin	4.0–8.0 fl oz Priaxor	7	Use no more than 16.0 fl oz/a per year for resistance management consideration. White mold suppression at 6.0–8.0 fl oz rate. Apply before the start of disease development and continue every 7–14 days if needed. Labeled for edible podded legumes, snap bean, and peas.
	propiconazole	4.0 fl oz Tilt	7	Do not apply more than 12.0 fl oz/a per year for resistance management consideration. Apply when conditions are conducive for disease.

(continued)

Pest management

Asparagus

Bean

Carrot

Celery

Cole crops

Cucumber

Disease control in bean—green, lima, navy, red kidney *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Sclerotinia white mold	<i>Coniothyrium minitans</i>	1.0–4.0 lb Contans WG	0	Apply postharvest to fields with white mold infection before incorporating crop debris or apply 3–4 months before disease onset. Immediately incorporate product into top 1–2 inches of soil. Do not plow before planting. This product is a biological material that should be kept cool before use. Intercept WG helps to reduce the soil-borne inoculum of Sclerotinia. The higher product rate is used when incorporation to a depth of greater than 2 inches occurs.
Seed decay, rot, preemergence damping-off	captan chloroneb fludioxonil mefenoxam metalaxyl pyraclostrobin thiram trifloxystrobin	Maxim 4FS Stamina Trilex		Most seed is treated with fungicide/ insecticide. Do not use treated seed for food or feed. Multiple generic products are available for active ingredients listed without commercial product names.
Virus complex (transmitted by aphids)	<i>A combination of cucumber mosaic virus and alfalfa mosaic virus continues to cause plant stunting, foliage mosaic, blossom abortion, misshapen and discolored pods, and significant yield reductions. The soybean aphid appears to be the primary vector. Planting early to avoid high populations of the soybean aphid that appear in mid-July helps to reduce losses. Field trials continue in an effort to identify cultivars with field tolerance. Insecticide treatments of foliage or seed do not appear to offer cost-effective control at this time.</i>			

Scouting calendar for insect pests of beans

April			May			June			July			August			September		
early	mid	late	early	mid	late	early	mid	late	early	mid	late	early	mid	late	early	mid	late
Seed maggot																	
European corn borer																	
Potato leafhopper																	
Tarnished plant bug																	
Soybean aphid																	
Corn earworm																	

Pest management

Asparagus

Bean

Carrot

Celery

Cole crops

Cucumber

Insect control in bean—green, lima, navy, red kidney

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Bean aphid and soybean aphid	<i>Phorate and disulfoton treatments at planting will also control aphids (see leafhopper section for rates).</i>			
	0.24–0.97 lb acephate	0.25–1.0 lb Orthene 97S	0 (lima) 14 (dry, green)	Do not exceed 2.0 lb ai/a per season. Do not feed treated vines.
	0.5–1.0 lb acephate	8.0–16.0 oz Acephate 97UP	1 (lima) 14 (green)	Do not apply more than 2.1 lb/a of formulated product per season. Do not feed treated vines.
	0.044–0.10 lb acetamiprid	1.0–2.3 oz Assail 70WP	7	Do not exceed three applications or 6.9 oz/a of product per crop season.
	0.047–0.10 lb acetamiprid	2.5–5.3 oz Assail 30 SG	7	Do not exceed three applications or 16.0 oz/a of product per crop season.
	0.025–0.10 lb bifenthrin	1.6–6.4 fl oz *Brigade 2EC	3	Do not apply more than 0.2 lb ai/a or 12.8 fl oz/a of product per season.
	0.06–0.086 lb bifenthrin + imidacloprid	3.8–5.5 fl oz *Brigadier	7	Do not apply more than 16.6 fl oz/a (0.26 lb ai/a) per season. No more than 0.2 lb ai/a bifenthrin and 0.13 lb ai/a imidacloprid are allowed per season.
	0.25–0.5 lb dimethoate	0.5–1.0 pt Dimethoate EC	0	Do not use at bloom. Do not feed treated vines to livestock.
	1.0–2.0 lb endosulfan	2.0–4.0 lb Thiodan 50WP	3	Apply every 5 days as needed. Do not exceed 3.0 lb ai/a per season. Do not apply to lima beans.
	0.025–0.05 lb esfenvalerate	5.8–9.6 oz Asana	3 (green) 21 (dry)	Do not exceed 0.2 lb ai/a per season.
Carrot	0.01–0.015 lb gamma-cyhalothrin	2.56–3.84 oz *Proaxis	7–21	Do not apply more than 0.96 pt/a (0.06 lb ai/a) per season. Do not graze treated area or feed vines to livestock. The 21-day PHI applies only to dried, shelled legumes.
	imidacloprid	1.6–3.2 fl oz Gaucho 600/100 lb seed	—	Green and lima beans only. Preplant commercial seed treatment. There is a 12-month rotational plantback restriction for crops not listed on label.
		7.0–10.5 fl oz Admire Pro	21	Apply in a narrow band centered on the plant row within 14 days of planting.
Celery	3.5 fl oz Provado 1.6	7	Apply every 7 days as needed. Do not exceed 10.5 fl oz/a Provado per season and do not exceed a total of 0.5 lb ai/a imidacloprid per season (any formulation).	
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	7	Do not apply more than 0.12 lb ai/a per season. Do not feed treated foliage to animals.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Besiege 6.0–9.0 fl oz *Voliam Xpress	7 21 (dry)	Do not apply more than 31.0 fl oz/a Besiege or Voliam Xpress per season and allow at least 5 days between applications.
	1.0–1.25 lb malathion	1.5–2.0 pt Malathion EC	1	A short residual contact insecticide. Do not apply more than once every 7 days.
Cole crops	1.0 lb naled	1.0 pt Dibrom 8E	1	Short-lasting residual contact insecticide.
	thiamethoxam	0.765–1.28 fl oz Cruiser 5FS/100 lb seed	—	Seed treatment only. There is a 120-day plantback restriction for crops not listed on the label.
	zeta-cypermethrin	3.2–4.0 oz *Mustang Max	1	Apply every 5 days as needed. Do not exceed 24.0 oz/a Mustang Max per season.
	Bean leaf beetle	0.24–0.97 lb acephate	0.25–1.0 lb Orthene 97S	0 (lima) 14 (dry, green)

*Restricted-use pesticide.

(continued)

Insect control in bean—green, lima, navy, red kidney (continued)

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions	
Bean leaf beetle (cont.)	0.5–1.0 lb acephate	8.0–16.0 oz Acephate 97UP	1 (lima) 14 (green)	Do not apply more than 2.1 lb/a of formulated product per season. Do not feed treated vines.	
	0.0125–0.019 lb beta-cyfluthrin	1.6–2.4 fl oz *Baythroid XL	7	For dry beans only. Do not exceed four applications or 6.4 fl oz/a per year.	
	0.033–0.10 lb bifenthrin	2.1–6.4 fl oz *Brigade 2EC	3	Do not apply more than 0.2 lb ai/a or 12.8 fl oz/a of product per season.	
	0.08–0.086 lb bifenthrin + imidacloprid	5.1–5.5 fl oz *Brigadier	7	Do not apply more than 16.6 fl oz/a (0.26 lb ai/a) per season. No more than 0.2 lb ai/a bifenthrin and 0.13 lb ai/a imidacloprid are allowed per season.	
	1.0 lb carbaryl	Sevin	3		
	0.25–0.5 lb dimethoate	0.5–1.0 pt Dimethoate EC	0	Do not use at bloom. Do not feed treated vines to livestock.	
	0.01–0.015 lb gamma-cyhalothrin	2.56–3.84 oz *Proaxis	7–21	Do not apply more than 0.96 pt/a (0.06 lb ai/a) per season. Do not graze treated area or feed vines to livestock. The 21-day PHI applies only to dried, shelled legumes.	
	imidacloprid	1.6–3.2 fl oz Gaucho 600/100 lb seed	—	—	Green and lima beans only. Apply as a commercial seed treatment before planting. There is a 12-month rotational plantback restriction for crops not listed on the label.
		16.0–24.0 fl oz Admire Pro	21	21	Apply in a narrow band centered on the plant row, 1–2 inches below the seed depth. Apply within 14 days before planting.
		3.5 fl oz Provado 1.6	7	7	Apply every 7 days as needed. Do not exceed 10.5 fl oz/a Provado per year.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Besiege 6.0–9.0 fl oz *Voliam Xpress	7 21 (dry)	7 21	Do not apply more than 31.0 fl oz/a Besiege or Voliam Xpress per season and allow at least 5 days between applications.
	thiamethoxam	0.765–1.28 fl oz Cruiser 5FS/100 lb seed	—	—	Seed treatment only. There is a 120-day plantback restriction for crops not listed on the label.
zeta-cypermethrin	2.72–4.0 oz *Mustang Max	1	1	Apply every 5 days as needed. Do not exceed 24.0 oz/a Mustang Max per season.	
0.04–0.1 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	3	3	Do not apply more than 0.266 lb ai/a per season. Wait at least 5 days between applications.	
Corn earworm	acephate	1.0–1.33 lb Orthene 75WSP 0.75–1.0 lb Orthene 97PE	1 (lima) 14 (dry, green)	14	Do not exceed 2 lb ai/a per season. Do not feed treated vines.
	0.5–1.0 lb acephate	12.0–16.0 oz Acephate 97UP	1 (lima) 14 (green)	14	Do not apply more than 2.1 lb/a of formulated product per season. Do not feed treated vines.
	azadirachtin	10.0–21.0 oz Azatin XL Plus 0.5–2.0 gal Neemix 0.25 0.25–1.0 pt Neemix 4.5EC	0	0	Apply every 7 days as needed. May treat heavy infestations every 3–4 days.
	<i>Bacillus thuringiensis</i> subsp. <i>kurstaki</i>	1.0–2.0 lb Lepinox WDG	0	0	Treat early instar larvae before noticeable feeding damage occurs. Repeat as needed.
	0.0125–0.019 lb beta-cyfluthrin	1.6–2.4 fl oz *Baythroid XL	7	7	For dry beans only. Do not exceed four applications or 6.4 fl oz/a per year.

*Restricted-use pesticide.

(continued)

Pest management

Asparagus

Bean

Carrot

Celery

Cole crops

Cucumber

Insect control in bean—green, lima, navy, red kidney *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Corn earworm <i>(cont.)</i>	0.025–0.10 lb bifenthrin	1.6–6.4 fl oz *Brigade 2EC	3	Do not apply more than 0.2 lb ai/a or 12.8 fl oz/a of product per season.
	0.08–0.086 lb bifenthrin + imidacloprid	5.1–5.5 fl oz *Brigadier	7	Do not apply more than 16.6 fl oz/a (0.26 lb ai/a) per season. No more than 0.2 lb ai/a bifenthrin and 0.13 lb ai/a imidacloprid are allowed per season.
Asparagus	1.5 lb carbaryl	Sevin WP, L, XLR Plus	0	See label for rates. Apply at first sign of damage.
	chlorantraniliprole	3.5–5.0 fl oz Coragen	1	Do not apply more than 15.4 fl oz/a per season and allow at least 3 days between applications. Do not make more than four applications/a per crop.
	0.015–0.05 lb esfenvalerate	5.8–9.6 fl oz *Asana XL	3 (green) 21 (dry)	Do not graze or feed treated vines to livestock. Do not exceed 0.2 lb ai/a per season.
	0.01–0.015 lb gamma-cyhalothrin	2.56–3.84 oz *Proaxis	7–21	Do not apply more than 0.96 pt/a (0.06 lb ai/a) per season. Do not graze treated area or feed vines to livestock. The 21-day PHI applies only to dried, shelled legumes.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	7	Do not apply more than 0.12 lb ai/a per season. Do not feed treated foliage to animals.
Bean	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Besiege 6.0–9.0 fl oz *Voliam Xpress	7 21 (dry)	Do not apply more than 31.0 fl oz/a Besiege or Voliam Xpress per season and allow at least 5 days between applications.
	0.225–0.9 lb methomyl	0.75–3.0 pt *Lannate LV	3	Wait 3 days to feed vines, 7 days to feed hay.
	0.031–0.063 lb spinetoram	4.0–8.0 oz Radiant SC	3	Do not apply more than 28.0 oz/a (0.219 lb ai/a) or exceed four applications per crop.
	spinosad	2.2–3.3 oz Blackhawk	3 28 (dry beans)	Apply when pests reach or exceed established thresholds. Do not apply more than 20.0 oz/a Blackhawk per crop season in succulent beans and 8.3 oz/a per crop season in dry beans. Do not exceed six applications in a year.
3.0–6.0 fl oz Entrust SC		3	Use higher rates for larger larvae. Apply in adequate spray to get good coverage for best control. Do not exceed 0.45 lb ai/a per season.	
Carrot	zeta-cypermethrin	2.72–4.0 oz *Mustang Max	1	Apply every 5 days as needed. Do not exceed 24.0 oz/a Mustang Max per season.
	0.04–0.1 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	3	Do not apply more than 0.266 lb ai/a per season. Wait at least 5 days between applications.
Celery	Cutworms	<i>Spot treat when numbers exceed two larvae per foot of row.</i>		
	0.5–1.0 lb acephate	8.0–16.0 oz Acephate 97UP	1 (lima) 14 (green)	Do not apply more than 2.1 lb/a of formulated product per season. Do not feed treated vines.
		0.67–1.33 lb Orthene 75WSP 0.49–0.97 lb Orthene 97PE	0 (lima) 14 (dry, green)	Do not exceed 2 lb ai/a per season. Do not feed treated vines.
Cole crops	azadirachtin	1.0–3.5 pt Aza-Direct 10.0–21.0 oz Azatin XL Plus 0.5–2.0 gal Neemix 0.25 0.25–1.0 pt Neemix 4.5EC	0	Apply every 7 days as needed. May treat heavy infestations every 3–4 days.

*Restricted-use pesticide.

(continued)

Insect control in bean—green, lima, navy, red kidney *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Cutworms <i>(cont.)</i>	0.0065–0.0125 lb beta-cyfluthrin	0.8–1.6 fl oz *Baythroid XL	7	For dry beans only. Do not exceed four applications or 6.4 fl oz/a per year.
	0.04–0.08 lb bifenthrin	3.4–6.8 oz *Capture LFR	—	Apply as a 5- to 7-inch band over an open furrow or in-furrow with the seed. Do not apply more than 0.1 lb/a Capture LFR per season as an at-plant application.
	0.08–0.086 lb bifenthrin + imidacloprid	5.1–5.5 fl oz *Brigadier	7	Do not apply more than 16.6 fl oz/a (0.26 lb ai/a) per season. No more than 0.2 lb ai/a bifenthrin and 0.13 lb ai/a imidacloprid are allowed per season.
	carbaryl	1.0–1.5 lb Sevin 50WP 1.25–1.88 lb Sevin 80S 1.0 qt Sevin XLR Plus	0	See label for rates. Apply at first sign of pests. Repeat at 7- to 10-day intervals.
	chlorantraniliprole	3.5–5.0 fl oz Coragen	1	Do not make more than four applications per crop season and allow at least 3 days between applications. Do not apply more than 15.4 fl oz/a Coragen per season.
	0.015–0.05 lb esfenvalerate	5.8–9.6 fl oz *Asana XL	3 (green) 21 (dry)	Do not exceed 0.2 lb ai/a per season. Do not graze or feed treated vines to livestock.
	0.0075–0.0125 lb gamma-cyhalothrin	1.92–3.20 oz *Proaxis	7–21	Do not apply more than 0.96 pt/a (0.06 lb ai/a) per season. Do not graze treated area or feed vines to livestock. The 21-day PHI applies only to dried, shelled legumes.
	0.015–0.025 lb lambda-cyhalothrin	0.96–1.6 fl oz *Warrior II	7	Do not apply more than 0.12 lb ai/a per season. Do not feed treated foliage to animals.
	lambda-cyhalothrin + chlorantraniliprole	5.0–8.0 fl oz *Besiege 5.0–8.0 fl oz *Voliam Xpress	7 21 (dry)	Do not apply more than 31.0 fl oz/a Besiege or Voliam Xpress per season and allow at least 5 days between applications.
	zeta-cypermethrin	1.28–4.0 oz *Mustang Max	1	Apply every 5 days as needed. Do not exceed 24.0 oz/a Mustang Max per season.
0.04–0.1 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	3	Do not apply more than 0.266 lb ai/a per season. Wait at least 5 days between applications.	
European corn borer	<i>Apply insecticide when beans are in the early bloom stage AND moth catches in nearby blacklight traps exceed 15 moths/night for first generation or 100 moths/night for second generation. Once moth catches drop, delay applications until beans are 1 inch long.</i>			
	0.24–0.97 lb acephate	0.25–1.0 lb Orthene 97S	0 (lima) 14 (dry, green)	Do not exceed 2.0 lb ai/a per season. Do not feed treated vines.
	0.5–1.0 lb acephate	12.0–16.0 oz Acephate 97UP	1 (lima) 14 (green)	Do not apply more than 2.1 lb/a of formulated product per season. Do not feed treated vines.
	0.75–1.0 lb acephate	Orthene SP	0 (lima) 14 (dry, green)	Do not feed treated vines.
	1.0–2.0 lb <i>Bacillus thuringiensis</i> subsp. <i>kurstaki</i>	Lepinox WDG	0	Treat early instar larvae before noticeable feeding damage occurs. Repeat as needed.
	0.019–0.025 lb beta-cyfluthrin	2.4–3.2 fl oz *Baythroid XL	7	For dry beans only. Do not exceed four applications or 6.4 fl oz/a per year.
	0.025–0.10 lb bifenthrin	1.6–6.4 fl oz *Brigade 2EC	3	Do not apply more than 0.2 lb ai/a or 12.8 fl oz/a of product per season.

*Restricted-use pesticide.

(continued)

Pest management

Asparagus

Bean

Carrot

Celery

Cole crops

Cucumber

Insect control in bean—green, lima, navy, red kidney *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
European corn borer <i>(cont.)</i>	0.08–0.086 lb bifenthrin + imidacloprid	5.1–5.5 fl oz *Brigadier	7	Do not apply more than 16.6 fl oz/a (0.26 lb ai/a) per season. No more than 0.2 lb ai/a bifenthrin and 0.13 lb ai/a imidacloprid allowed per season.
	1.0 lb carbaryl	Sevin WP, S, L, XLR Plus	0	
	chlorantraniliprole	3.5–5.0 fl oz Coragen	1	Do not apply more than 15.4 fl oz/a per season and allow at least 3 days between applications. Do not make more than four applications/a per crop.
Asparagus	0.015–0.05 lb esfenvalerate	5.8–9.6 fl oz *Asana XL	3 (green) 21 (dry)	Do not exceed 0.2 lb ai/a per season. Do not graze or feed treated vines to livestock.
	0.01–0.015 lb gamma-cyhalothrin	2.56–3.84 oz *Proaxis	7–21	Do not apply more than 0.96 pt/a (0.06 lb ai/a) per season. Do not graze treated area or feed vines to livestock. The 21-day PHI applies only to dried, shelled legumes.
Bean	imidacloprid + beta-cyfluthrin	2.4–2.8 fl oz *Leverage 360	7	For dry beans only. Minimum interval between applications is 14 days and maximum allowable crop use per season is 6.4 fl oz/a.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	7	Do not apply more than 0.12 lb ai/a per season. Do not feed treated foliage to animals.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Besiege 6.0–9.0 fl oz *Voliam Xpress	7 21 (dry)	Do not apply more than 31.0 fl oz/a Besiege or Voliam Xpress per season and allow at least 5 days between applications.
	0.225–0.9 lb methomyl	0.75–3.0 pt *Lannate LV	3 (green) 21 (dry)	Wait 14 days before grazing or feeding hay.
	0.023–0.063 lb spinetoram	3.0–8.0 oz Radiant SC	1	Do not apply more than 28.0 oz/a Radiant (0.219 lb ai/a) per crop and do not exceed six applications per year.
Carrot	spinosad	1.7–3.3 oz Blackhawk	3 28 (dry beans)	Apply when pests reach or exceed established thresholds. Do not apply more than 20.0 oz/a Blackhawk per crop season in succulent beans and 8.3 oz/a per crop season in dry beans. Do not exceed six applications in a year.
		3.0–6.0 fl oz Entrust SC	3	Use higher rates for larger larvae. Apply in adequate spray to get good coverage for best control. Do not exceed 0.45 lb ai/a per season. Do not use a buffering agent.
Celery	zeta-cypermethrin	2.72–4.0 oz *Mustang Max	1	Apply every 5 days as needed. Do not exceed 24.0 oz/a Mustang Max per season.
	0.04–0.1 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	3	Do not apply more than 0.266 lb ai/a per season. Wait at least 5 days between applications.
Cole crops	Loopers and green clover-worm	<i>Treat when numbers exceed two to four larvae per foot of row.</i>		
	0.24–0.97 lb acephate	0.25–1.0 lb Orthene 97S	0 (lima) 14 (dry, green)	Do not exceed 2.0 lb ai/a per season. Do not feed treated vines.
	0.5–1.0 lb acephate	12.0–16.0 oz Acephate 97UP	1 (lima) 14 (green)	Do not apply more than 2.1 lb/a of formulated product per season. Do not feed treated vines.
Cucumber	azadirachtin	1.0–3.5 pt Aza-Direct 10.0–21.0 oz Azatin XL Plus 0.5–2.0 gal Neemix 0.25 0.25–1.0 pt Neemix 4.5EC	0	Apply every 7 days as needed. May treat heavy infestations every 3–4 days.

*Restricted-use pesticide.

(continued)

Insect control in bean—green, lima, navy, red kidney (continued)

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Loopers and green clover-worm (cont.)	<i>Bacillus thuringiensis</i> subsp. <i>aizawai</i>	0.5–2.0 lb Ketch DF	0	Use lower rate for light infestations and small larvae; use higher rate for larger larvae and heavy pressure.
	<i>Bacillus thuringiensis</i> subsp. <i>kurstaki</i>	Biobit FC, WP	0	See label for rate.
		1.0–2.0 lb Lepinox WDG	0	Treat early instar larvae before noticeable feeding damage occurs. Repeat as needed.
	0.019–0.025 lb beta-cyfluthrin	2.4–3.2 fl oz *Baythroid XL	7	For dry beans only. Do not exceed four applications or 6.4 fl oz/a per year.
	0.025–0.10 lb bifenthrin	1.6–6.4 fl oz *Brigade 2EC	3	Do not apply more than 0.2 lb ai/a or 12.8 fl oz/a of product per season.
	0.08–0.086 lb bifenthrin + imidacloprid	5.1–5.5 fl oz *Brigadier	7	Do not apply more than 16.6 fl oz/a (0.26 lb ai/a) per season. No more than 0.2 lb/a bifenthrin and 0.13 lb/a imidacloprid are allowed per season.
	0.025–0.05 lb esfenvalerate	5.8–9.6 fl oz *Asana XL	3 (green) 21 (dry)	Do not exceed 0.2 lb ai/a per season. Do not feed treated vines.
	0.0075–0.0125 lb gamma-cyhalothrin	1.92–3.20 oz *Proaxis	7–21	Do not apply more than 0.96 pt/a (0.06 lb ai/a) per season. Do not graze treated area or feed vines to livestock. The 21-day PHI applies only to dried, shelled legumes.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	7	Do not apply more than 0.12 lb ai/a per season. Do not feed treated foliage to animals.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Besiege 5.0–8.0 fl oz *Voliam Xpress	7 21 (dry)	Do not apply more than 31.0 fl oz/a Besiege or Voliam Xpress per season and allow at least 5 days between applications.
	0.225–0.9 lb methomyl	0.75–3.0 pt *Lannate LV	3 (green) 14 (dry)	Wait 3 days to feed vines, 14 days to feed hay.
	1.0–1.5 lb naled	1.0 pt Dibrom 8E	1	A short residual contact insecticide. Do not apply more than once every 7 days.
	0.031–0.063 lb spinetoram	4.0–8.0 oz Radiant SC	1	Do not apply more than 28.0 oz/a Radiant (0.219 lb ai/a) per crop and do not exceed six applications per year.
	spinosad	2.2–3.3 oz Blackhawk	3 28 (dry beans)	Apply when pests reach or exceed established thresholds. Do not apply more than 20.0 oz/a Blackhawk per crop season in succulent beans and 8.3 oz/a per crop season in dry beans. Do not exceed six applications in a year.
		4.0–6.0 fl oz Entrust SC	3	Use higher rates for larger larvae. Apply in adequate spray to get good coverage for best control. Do not exceed 0.45 lb ai/a per season. Do not use a buffering agent.
zeta-cypermethrin	<i>cloverworms</i> : 2.72–4.0 oz *Mustang Max <i>loopers</i> : 3.2–4.0 oz *Mustang Max	1	Apply every 5 days as needed. Do not exceed 24.0 oz/a Mustang Max per season.	
		1		
0.04–0.1 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	3	Do not apply more than 0.266 lb ai/a per season. Wait at least 5 days between applications.	

*Restricted-use pesticide.

(continued)

Pest management

Asparagus

Bean

Carrot

Celery

Cole crops

Cucumber

Insect control in bean—green, lima, navy, red kidney *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Potato leafhopper and plant bug	<i>Treat potato leafhoppers when they exceed an average of one adult/sweep or one nymph/10 leaves. If plants are younger than the two-true-leaf stage, reduce thresholds to one adult/two sweeps (nymphs will not be present yet). Treat tarnished plant bugs when they exceed an average of one bug/sweep.</i>			
	0.5–1.0 lb acephate	8.0–16.0 oz Acephate 97UP	1 (lima) 14 (green)	Do not apply more than 2.1 lb/a of formulated product per season. Do not feed treated vines.
		0.67–1.33 lb Orthene 75WSP 0.49–0.97 lb Orthene 97PE	0 (lima) 14 (dry, green)	Do not exceed 2.0 lb ai/a per season. Do not feed treated vines.
	azadirachtin	1.0–3.5 pt Aza-Direct 10.0–21.0 oz Azatin XL Plus 0.5–2.0 gal Neemix 0.25 0.25–1.0 pt Neemix 4.5EC	0	Apply every 7 days as needed. May treat heavy infestations every 3–4 days.
	0.019–0.025 lb beta-cyfluthrin	2.4–3.2 fl oz *Baythroid XL	7	For dry beans only. Do not exceed four applications or 6.4 fl oz/a per year.
	0.025–0.10 lb bifenthrin	1.6–6.4 fl oz *Capture 2EC, *Discipline 2EC	3	Do not apply more than 12.8 fl oz/a (0.2 lb ai/a) per season.
	0.06–0.086 lb bifenthrin + imidacloprid	3.8–5.5 fl oz *Brigadier	7	Do not apply more than 16.6 fl oz/a (0.26 lb ai/a) per season. No more than 0.2 lb ai/a bifenthrin and 0.13 lb ai/a imidacloprid are allowed per season.
	1.0–2.0 lb carbaryl	4.0 lb Sevin 50WP 2.5 lb Sevin 80S 1.0 qt Sevin XLR Plus	0	See label for rate.
	0.25–0.5 lb dimethoate	0.5–1.0 pt Dimethoate EC	0	Do not use at bloom. Do not feed treated vines to livestock. Also controls mites.
	1.0–2.0 lb disulfoton	*Di-Syston 8–15%	60	Place granules in a 7-inch band directly behind planter shoe in front of the press wheel at planting time only. Apply liquid in a water emulsion or with liquid fertilizer as a soil injection on each side of the seed furrow at planting. Do not apply directly on seed. Do not apply more than once per season. Do not feed vines or hay to livestock. If adequate rainfall does not occur within 10–14 days of treatment, irrigate to activate the product.
	0.015–0.05 lb esfenvalerate	2.9–9.6 fl oz *Asana XL	3 (green) 21 (dry)	Do not exceed 0.2 lb ai/a per season. Do not graze or feed treated vines to livestock.
	0.01–0.015 lb gamma-cyhalothrin	2.56–3.84 oz *Proaxis	7–21	Do not apply more than 0.96 pt/a (0.06 lb ai/a) per season. Do not graze treated area or feed vines to livestock. The 21-day PHI applies only to dried, shelled legumes.
	imidacloprid	1.6–3.2 fl oz Gaucho 600/100 lb seed	—	Green and lima beans only. Apply as a commercial seed treatment before planting. There is a 12-month rotational plantback restriction for crops not listed on the label.
		16.0–24.0 fl oz Admire Pro	21	Apply in a narrow band centered on the plant row 1–2 inches below the seed depth. Apply within 14 days before planting.
		3.5 fl oz Provado 1.6	7	Apply every 7 days as needed. Do not exceed 10.5 fl oz/a Provado per year.

*Restricted-use pesticide.

(continued)

Insect control in bean—green, lima, navy, red kidney *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Potato leaf-hopper and plant bug <i>(cont.)</i>	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	7	Do not apply more than 0.12 lb ai/a per season. Do not feed treated foliage to animals.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Besiege 6.0–9.0 fl oz *Voliam Xpress	7 21 (dry)	Do not apply more than 31.0 fl oz/a Besiege or Voliam Xpress per season and allow at least 5 days between applications.
	1.0–1.25 lb malathion	1.5–2.0 pt Malathion EC	1	
	0.45–0.9 lb methomyl	1.5–3.0 pt *Lannate 2.4LV 0.5 lb *Lannate 90SP	3	Do not graze within 3 days after application or use for hay within 7 days.
	1.0 lb naled	1.0 pt Dibrom EC	1	A short residual contact insecticide. Do not apply more than once every 7 days.
	0.06–0.09 lb/1,000 ft row phorate	4.5–7.0 oz/1,000 ft row *Thimet 20-G	60	Minimum 30-inch row spacing. Apply granules in a band over the row at planting but do not contact seed. Do not graze or feed treated forage to livestock.
	thiamethoxam	0.765–1.28 fl oz Cruiser 5FS/100 lb seed	—	Seed treatment only. There is a 120-day plantback restriction for crops not listed on the label.
	0.017–0.25 lb zeta-cypermethrin	2.72–4.0 oz *Mustang Max	1	Apply every 5 days as needed. Do not exceed 24.0 oz/a Mustang Max per season.
0.04–0.1 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	3	Do not apply more than 0.266 lb ai/a per season. Wait at least 5 days between applications.	
Seed corn maggot	<i>Plant during fly-free periods or use an insecticide at planting. First-generation adults emerge at 200 DD₃₉ while second-generation adults emerge at 600 DD₃₉. Fields with fresh green manure are more attractive for egg laying.</i>			
	0.04–0.08 lb bifenthrin	3.4–6.8 oz *Capture LFR	—	Apply as a 5- to 7-inch band over an open furrow or in-furrow with the seed. Do not apply more than 0.1 lb/a Capture LFR per season as an at-plant application.
	chlorpyrifos			Use seed pretreated with chlorpyrifos (Lorsban) and a fungicide. Seed can be purchased pretreated.
	imidacloprid	1.6–3.2 fl oz Gaucho 600/100 lb seed	—	Green and lima beans only. Preplant commercial seed treatment. There is a 12-month rotational plantback restriction for crops not listed on label.
	0.06–0.09 lb/1,000 ft row phorate	4.5–7.0 oz/1,000 ft row *Thimet 20-G	60	Same as for leafhoppers above.
	thiamethoxam	0.765–1.28 fl oz Cruiser 5FS/100 lb seed	—	Seed treatment only. There is a 120-day plantback restriction for crops not listed on the label.
	0.017–0.25 lb zeta-cypermethrin	2.72–4.0 oz *Mustang Max	1	Apply every 5 days as needed. Do not exceed 24.0 oz/a Mustang Max per season.
	0.04–0.1 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	3	Do not apply more than 0.266 lb ai/a per season. Wait at least 5 days between applications.
Wire-worms	<i>Rotate with nonsusceptible crops to reduce wireworm populations.</i>			
	0.04–0.08 lb bifenthrin	3.4–6.8 oz *Capture LFR	—	Apply as a 5- to 7-inch band over an open furrow or in-furrow with the seed. Do not apply more than 0.1 lb/a Capture LFR per season as an at-plant application.
	3.0–4.0 lb diazinon	Diazinon G, WP, EC, D	—	Preplant broadcast incorporated, 4–8 inches.

*Restricted-use pesticide.

(continued)

Pest management

Asparagus

Bean

Carrot

Celery

Cole crops

Cucumber

Insect control in bean—green, lima, navy, red kidney *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Wire-worms <i>(cont.)</i>	imidacloprid	1.6–3.2 fl oz Gaucho 600/100 lb seed	—	Green and lima beans only. Apply as a commercial seed treatment before planting. There is a 12-month rotational plantback restriction for crops not listed on the label.

*Restricted-use pesticide.

Weed control in bean—green, lima, navy, red kidney

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Weeds	<i>Till several times before planting to control early germinating weeds. After planting, but before beans emerge, kill emerging weeds with a rotary hoe or spike-toothed harrow. Cultivate beans at least twice before plants cover the middle of the row. Do not cultivate when plants are wet because this may spread disease. Several of the following herbicides can be tank mixed with each other or with liquid fertilizer for simultaneous application. Check specific herbicide labels for mixing directions and application details.</i>			
Annual weeds	2.0–3.0 lb alachlor	4.0–6.0 pt *Micro-Tech, *Intro, or registered equivalent		Lima and red kidney beans only. Preplant-incorporated alachlor controls most annual grasses and many broadleaf weeds, including black nightshade, but is weak on velvetleaf, mustards, smartweed, and common lambsquarters. Preplant treatment also provides reasonable yellow nutsedge control. Apply preplant treatment within 7 days before planting and shallowly incorporate. Do not make more than one application per cropping season. Can lower yields if wet, cold conditions prevail.
	0.15–0.25 lb clomazone	0.4–0.67 pt Command 3ME	45	Succulent beans only. For suppression and control of annual grasses and broadleaves, make a single preemergent soil application before seeding or after seeding but before crop emergence. Place seed or roots of transplants below the chemical barrier when planting. Strictly follow all precautions and restrictions on the label to minimize offsite movement and carryover. Read and understand the Vegetable Disclaimer section of the label; the end user of this product assumes all liability for failure to perform and any crop injury resulting from its use.
	dimethenamid-P	10.0–21.0 fl oz Outlook	70	Dry beans only. Outlook controls most annual grasses and pigweed and suppresses nightshade. It is weak on velvetleaf, lambsquarters, ragweed, and smartweed. Can cause stunting if wet, cold conditions occur during bean germination or emergence. Allowed application methods and timing vary by bean type. Preplant-incorporated: Apply to dry soil within 14 days before planting and blend into the top 1–2 inches of soil. Provides reasonable yellow nutsedge control at the highest rate recommended by soil type. Preemergence: Apply before or after planting but before weed emergence. Provides only limited control of yellow nutsedge. Postemergence: Although Outlook will not control emerged grasses, it can be applied to beans with 1–3 trifoliolate leaves. Postemergence applications can speckle bean leaves.

*Restricted-use pesticide.

(continued)

Weed control in bean—green, lima, navy, red kidney *(continued)*

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Annual weeds <i>(cont.)</i>	3.0–4.0 lb EPTC	3.5–4.5 pt Eptam 7E		Dry beans (consult label for allowable types) and succulent green beans only. Preplant-incorporated treatment controls most annual grasses and broadleaf weeds. Weak on smartweed and black nightshade. Incorporate 2–3 inches deep immediately after application. Can stunt beans if cool weather follows application. Do not exceed 3.5 pt/a Eptam 7E when treating green beans on sandy soils or on small white navy bean varieties. Ineffective on peat and muck soils.
	0.56–1.68 lb ethalfluralin	1.5–4.5 pt Sonalan HFP (dry beans) 1.5–2.0 pt (dry peas)		Dry beans and dry peas only. Preplant-incorporated treatment controls annual grasses and broadleaf weeds but is weak on wild mustard, smartweed, common ragweed, and velvetleaf. Some black nightshade suppression. Incorporate 2–3 inches deep within 2 days of application and before planting beans. May carry over in soil. Ineffective on peat or muck soils. Rate varies by soil type.
	fomesafen	Reflex (rate varies by location; check label)	30 (green) 45 (dry beans)	Dry and green beans only. Reflex is rate-restricted by location and prohibited from use in many areas of Wisconsin. Check label to determine if it can be used in your area. Preemergence or preplant surface application controls several broadleaf weeds.
	0.03 lb imazamox	4.0 oz Raptor		Dry beans and dry peas: Apply to dry beans with at least one fully expanded trifoliolate leaf but before the bloom stage, and to dry peas with at least three pairs of leaves but before the bloom stage. Application may reduce crop growth, quality, and yield; cause temporary yellowing; and delay maturity. Raptor applications may be made with or without the addition of a fertilizer. A nitrogen-based fertilizer may improve weed control, but it will also increase the likelihood of crop damage. When nitrogen and/or crop oils are added to the mixture, include 6.0–16.0 oz/a Basagran or 12.0–24.0 oz/a Rezult to minimize injury. For application to dry peas, always include Basagran or Rezult in the Raptor spray mixture, regardless of additives. Only one application of Raptor may be made per crop season. Read the label for more specific directions, precautions, and restrictions. Lima (succulent) and green beans: Apply to lima beans between first- and second-trifoliolate leaf stages or to green beans with at least one fully-expanded trifoliolate but before bloom when weeds are less than 3 inches tall. Treatments made before the first-trifoliolate leaf stage may cause temporary yellowing, stunt growth, and hurt crop quality and yield. Do not apply to beans during flowering. Raptor must be applied as a tank mixture with Basagran to minimize crop response. Using more than 16.0 oz/a of Basagran may reduce grass control. A non-ionic surfactant containing at least 80% active ingredient must be added at a rate of 1.0 qt/100 gal spray solution. Do not tank mix Raptor with any pesticides other than Basagran. Do not apply Raptor more than once per year.

*Restricted-use pesticide.

(continued)

Pest management

Asparagus

Bean

Carrot

Celery

Cole crops

Cucumber

Weed control in bean—green, lima, navy, red kidney *(continued)*

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Annual weeds (<i>cont.</i>)	<i>lima & dry beans:</i> up to 0.0475 lb imazethapyr	up to 3.0 fl oz Pursuit	30 (succulent lima) 60 (dry beans)	<p>Certain dry beans, lima, and green beans only. May reduce crop growth, quality, yield and/or delay maturity. Since maturity may be delayed, timing of harvest may need to be adjusted.</p> <p>Do not apply Pursuit in the following situations: —if cold and/or wet conditions are present or predicted to occur within 1 week of application; —by air or irrigation; —after July 31 for green beans; or —postemergence to lima and green beans. See label for specific instructions for postemergence application information for certain dry beans. Sensitive crops may be injured by this product; spray equipment should be thoroughly cleaned with water before being used to apply other products. Follow rotational crop guidelines printed on the label or injury may result to subsequent crops.</p>
	<i>green beans:</i> 0.0238 lb imazethapyr	1.5 fl oz Pursuit	30 (green)	
	pendimethalin	2.4–3.6 pt Prowl 3.3EC 2.0–3.0 pt Prowl H ₂ O		Controls most annual grasses and certain broadleaf weeds. Rate varies depending on soil texture and organic matter. Make one preplant-incorporated application. Incorporate 1 inch deep using equipment capable of giving uniform incorporation. Incorporating in two passes gives better results.
	s-metolachlor	1.0–2.0 pt Dual II Magnum or Dual Magnum		Apply as a preplant treatment and shallowly incorporate or apply as a preemergence treatment. Controls most annual grasses and annual broadleaf weeds. Weak on velvetleaf, wild mustard, smartweed, and common lambsquarters. Preplant treatment gives reasonable yellow nutsedge control. Can delay maturity and reduce yields if wet, cold conditions occur after planting. Ineffective on peat or muck soils. Choose product rate for specific soil texture, organic matter classification and weed species expected.
	<i>green & lima beans:</i> 0.5–0.75 lb trifluralin	1.0–1.5 pt Treflan HFP or registered equivalent		Controls annual grasses and some broadleaf weeds, but is weak on wild mustard, smartweed, common ragweed, velvetleaf, and black nightshade. Rate varies depending on soil texture and organic matter. Incorporate 2–3 inches deep within 24 hours of application. See label for plantback restrictions. Ineffective on peat or muck soils.
	<i>dry beans:</i> 0.5–1.0 lb trifluralin	1.0–2.0 pt Treflan HFP or registered equivalent		
Nutsedge and some broadleaves	0.023–0.047 lb halosulfuron	0.5–1.0 oz Sandea (rate varies by crop use and application timing—see label)	30 (green, lima)	<p>Preemergence timing (dry beans, green beans, lima beans): Apply after planting but prior to soil cracking. Use the lower rate on lighter texture soils with low organic matter. Apply uniformly with ground equipment in a minimum of 15 gal water/a.</p> <p>Postemergence timing (green and lima beans only): Apply after the crop has reached the two- to four-trifoliate leaf stage, but before flowering.</p> <p>Use the lower rate on lighter texture soils with low organic matter. Directed sprays will limit crop injury. May be applied between rows. Avoid herbicide contact with the planted crop. See restrictions on the label if plastic is used on the planted row. Do not apply more than 1.0 oz/a Sandea per crop cycle (restricted to lesser amounts for some bean types—see label), and 2.0 oz/a Sandea per 12-month period. Use of soil or foliar-applied organophosphate insecticides on Sandea-treated crops may increase potential for and severity of crop injury. Consult label for important usage information and precautions.</p>

*Restricted-use pesticide.

(continued)

Weed control in bean—green, lima, navy, red kidney *(continued)*

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Emerged weeds	glyphosate	several manufacturers and formulations available		See manufacturer's label to assure that the formulation is labeled for this crop and for specific instructions. Glyphosate may be applied any time before crop emerges. Apply before seed germination in coarse sandy soils. If weeds have been mowed or tilled, do not treat until they have resumed active growth and reached the recommended stage on the label. Unless otherwise stated, allow 7 or more days before tilling treated fields. Do not tank mix with soil-residual herbicides unless otherwise specified.
	*paraquat	several manufacturers and formulations available, not all are registered for this use		Prepare seedbed early to allow for maximum weed emergence. Application can be made as a banded or broadcast treatment before, during, or after planting, but before crop emergence. In preplant and preemergence (to the crop) uses, do not apply to soils lacking clay minerals, i.e. muck, pure sand. Use the higher rate for heavy weed infestations. Seeding should be performed with minimal soil disturbance. Always add crop oil concentrate or non-ionic surfactant to spray mixture. Follow precautions on label.
Emerged grasses	0.094–0.25 lb clethodim	6.0–16.0 oz Select 2EC	30	See label for specific bean types. Apply to actively growing grasses. Do not cultivate grasses within 7 days before or after application. Include appropriate surfactant as required by the label. Do not apply if rain is expected within 1 hour. See label for tank mix instructions.
	clethodim	Select Max <i>(see label for rate—varies by bean type)</i>	30 (dry beans) 21 (succulent)	
	0.124–0.375 lb fluazifop-P-butyl	8.0–24.0 fl oz Fusilade DX	60	Dry beans only. Make postemergence application to actively growing grasses; check label for size range, treatment rate, and appropriate spray additive. Do not apply more than 24.0 fl oz/a Fusilade DX per application or more than a total of 48.0 fl oz/a Fusilade DX per season. Maintain a minimum of 14 days between applications.
	0.034–0.08 lb quizalofop	5.0–12.0 oz Assure II or Targa	15 (green) 30 (dry beans)	Apply to actively growing grasses. Check label for specific instruction regarding grasses controlled and application rates. Always add crop oil concentrate or a non-ionic surfactant. Rainfast 1 hour after application. Maximum annual use rate varies by formulation and bean type—see label.
	0.094–0.47 lb sethoxydim	0.5–2.5 pt Poast	15 (green) 30 (dry beans)	Make postemergence applications to actively growing grasses within the size ranges indicated on the label. Check the label for wild proso millet or rescue treatment rates and for information on quackgrass control. Do not exceed 4.0 pt/a Poast per crop season. Always add 2.0 pt/a of oil concentrate. Do not cultivate 5 days prior to or within 7 days following application.

*Restricted-use pesticide.

(continued)

Pest management

Asparagus

Bean

Carrot

Celery

Cole crops

Cucumber

Weed control in bean—green, lima, navy, red kidney *(continued)*

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Emerged annual broadleaves	0.75–1.0 lb bentazon	1.5–2.0 pt Basagran	30	Suggested as a postemergence spray when annual broadleaf weeds escape an earlier treatment. Controls velvetleaf, mustard, and purslane. Partial control of black nightshade, common lambsquarters, and redroot pigweed when applied in the very small seedling stage. Does not control grasses. Green beans are more sensitive to foliar burn than dry beans. Include 1.0–2.0 pt/a of crop oil concentrate in the spray mixture. Some oil concentrates cause excessive leaf burn, particularly during warm, humid weather. Apply when beans have at least the first trifoliolate leaves expanded and annual broadleaf weeds are small and actively growing. Do not cultivate within 5 days before or 7 days after Basagran application. Must thoroughly cover weeds. Use minimum of 10 to 20 gal/a of water and 40 psi pressure. Apply through flat fan or hollow cone nozzles not more than 20 inches apart. Do not apply more than 4.0 pt/a per season. Do not apply to beans under stress or if rainfall is expected within 4 hours of treatment.
	fomesafen	Reflex (rate varies by location; check label)	30 (green beans) 45 (dry beans)	Dry and green beans only. Reflex is rate-restricted by location and prohibited from use in some areas of Wisconsin. Check label to determine if it can be used in your area. Apply postemergence broadcast to control broadleaves, including eastern black nightshade, pigweeds, common ragweed, and common purslane. See label for application timing based on crop and weed growth stage.
Preharvest and spot treatment of emerged weeds	glyphosate	several manufacturers and formulations available	varies by bean type	Certain dry beans only—see label. May be applied as an over-the-top broadcast spray to control labeled weeds before harvest. The crop should be in the hard dough stage (< 30% moisture). Only one application can be made per year. Do not combine spot treatment with a preharvest spray. Do not use if the crop is for seed or will be fed to livestock. Allow 30 days between treatment and replanting with any crop not listed on the herbicide label. Some formulations may also be used as a spot treatment for troublesome weeds such as Canada thistle or quackgrass. Any crop receiving spray in the treated area will be killed.
Dry bean and dry pea harvest aid	*paraquat	several manufacturers and formulations available	7	Treat when at least 80% of the pods are yellowing and mostly ripe, and no more than 40% (bush peas and beans) or 30% (vine peas and beans) of the leaves should be green. For vining beans or bush beans with lush growth, use a single application at the higher rate. Gramoxone Inteon may be applied as a split application, but do not make more than two or exceed a total of 2.0 pt/a. Add non-ionic surfactant at 1.0 qt/100 gallons spray mix. See label for precautions. Not all paraquat formulations are registered for this use.
	0.015–0.03 lb carfentrazone	1.0–2.0 oz Aim EW or EC	0	Applications should be made when the crop is mature and the grain has begun to dry down. Use sufficient spray volume to provide complete foliage coverage. See label for adjuvant recommendations and maximum allowable use rates.

*Restricted-use pesticide.

Pest management

Asparagus

Bean

Carrot

Celery

Cole crops

Cucumber

Carrot

Pest management

Asparagus

Bean

Carrot

Celery

Cole crops

Cucumber

Planting

Mid-April to early June. Treat seed with thiram 75% WP to prevent damping-off. Choose deep, fertile soils and provide adequate drainage. Soils should not be subject to compaction or high water tables during growing season. Excess moisture can cause forked roots, reducing quality. If plow pans are a concern, deep rip below the seed row before planting.

Carrots are susceptible to wind damage when first emerging from the soil. You can protect young seedlings by spreading oat seed over the soil just after planting. When carrots are several inches tall, use a selective postemergence grass herbicide to kill the oats.

Rows: 15–30 inches; use 2–4 lb seed/a (1–2 lb seed/a for Chantenay). Carrots can be grown in raised beds. Beds should be 3–4 feet wide with 3–4 rows per bed.

Lime and fertilizer

Lime: Use dolomitic limestone to maintain a pH of 5.6 or higher in organic soils and at least 5.8 in other soils.

Fertilizer rates: Apply P_2O_5 and K_2O according to soil test recommendations. Use annual nitrogen, P_2O_5 , and K_2O recommendations listed in the table below. Take credits for previous legume crops and manure.

Application: Broadcast and work in before seeding. Where possible, avoid fall potash applications on organic soils.

Nitrogen: Apply preplant or sidedress. Split nitrogen into two or more applications on sandy soils.

Micronutrients: Carrots need moderate amounts of manganese, boron, and copper. Use soil and plant analyses to check for deficiencies of these nutrients. Foliar or banded micronutrient applications will likely be most effective on organic soils. Apply 1–3 lb Mn/a and 1–12 lb Cu/a, depending on soil and method of application.

Irrigation

Early irrigation helps establish stands in hot, dry weather and is particularly important in the seedling stage. Carrots should not be under moisture stress at any time. Be sure to moisten soil to rooting depth when irrigating.

Annual nitrogen, phosphate, and potash recommendations for carrot

Nitrogen		Phosphate and potash		
Organic matter (%)	Amount to apply (lb/a)	Yield goal	Amount P_2O_5 to apply* (lb/a)	Amount K_2O to apply* (lb/a)
<2	120	20–30 t/a	45	240
2.0–9.9	100			
10–20	80			
>20	40			

*Amounts shown are for optimum (O) soil test levels. Apply 50% of this rate if soil test is high (H) and omit if soil test is excessively high (EH). If soil test is low (L) or very low (VL), increase rates according to soil test recommendations.

Resistance/susceptibility of some carrot cultivars to aster yellows & their action thresholds (aster yellows index)

Resistant cultivars (aster yellows index of 100)

Amtou	Gold King	Nanton	Raoleta	Scarlet Nantes ST	Tahoe*
Bercaro*	Growers Choice	Nimrod	Revo*	Sierra*	Texsun*
Charger	GT 26 Dicer	PrimeCut 59	Rona*	Sirocco	Toudo
El Presidente	Hi Color 9	Prospector	Royal Chantenay	Six Pak	Triple Play
Enterprise	Impak	PY 60**	Scarlet Nantes	Spearhead	

Intermediate cultivars (aster yellows index of 75)

Baby 657*	Cupar	Hipak*	Lucky B	Nuggeteer*	Spartan Winner*
Bolero	Cutlass*	Interceptor	Midas Touch	Pakmor	SugarSnax 54
Bradford	Flavor Pak*	Javelin*	Morecuts	Pioneer*	Thor*
Bremen	Florida	Karotan*	Nagadir	Prodigy	Triple Gold
Canada	Goldpak 28, G	King Midas*	Nanco	Prospector	Trophy 301
Casey	Harvestmore*	Lance*	Nikki	Sabre 78*	
Columbia	Heritage	Long Emperor 58	Noveno	Spartan Fancy	

Susceptible cultivars (aster yellows index of 50)

Aristopak*	Carson	Fancipak*	Nandor*	Regina*	Sytan
Arrowhead	Clairon Corona	Fina*	Nantes	Scarla*	Tamino*
Belikumar*	Dandy	Flacaro*	Nantes ST	Spartan Bonus	Tip Top*
Bersky	Danver's Gold*	Flakkese	Nantes Superior	Spartan Bonus 80	Touche
Bonanza	Danvers 126	Giganta	Orlando Gold	Spartan Delite*	Woodland*
Candy Pak	Dessert Danvers*	Goldpak	Red Cored Chantenay	Super Sprite	
Caromba	Early Gold	Lucky's Gold		Sweet N Crisp*	

*Cultivars evaluated for 1 year only.

**In thick stands only.

Disease control in carrot

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Alternaria leaf blight and Cercospora leaf blight	azoxystrobin	<i>Alternaria</i> : 6.0–15.5 fl oz Quadris Flowable	0	Quadris, Quadris Opti, Cabrio, and Flint belong to the Group 11 (strobilurin) fungicide category. Do not exceed one application of these products before alternating with a fungicide having a different mode of action. Do not exceed three applications of Group 11 fungicides per crop per year.
		<i>Cercospora</i> : 9.0–15.5 fl oz Quadris Flowable	0	
	azoxystrobin + chlorothalonil	2.4 pt Quadris Opti	0	
	azoxystrobin + difenoconazole	12.0–14.0 fl oz Quadris Top	7	
	azoxystrobin + propiconazole	14.0 fl oz Quilt Xcel	14	
	pyraclostrobin	8.0–12.0 oz Cabrio EG	0	
	trifloxystrobin	2.0–3.0 oz Flint	7	
	azoxystrobin + propiconazole	14.0 fl oz Quilt	14	Do not apply more than 55.0 fl oz/a per season. Make no more than one application of Quilt before alternating to a non-Group 11 fungicide.

(continued)

Disease control in carrot (continued)

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Alternaria leaf blight and Cercospora leaf blight (cont.)	boscalid	4.5 oz Endura WDG	0	For control of Alternaria leaf blight only. Endura belongs to the Group 7 (anilide) fungicide category. Do not exceed two sequential applications of Endura before alternating to a labeled fungicide with a different mode of action. Do not exceed five applications per season. Do not exceed 22.5 oz/a Endura per season.
	boscalid + pyraclostrobin	8.0–10.5 oz Pristine WDG	0	Pristine belongs to Group 7 (anilide) and 11 (strobilurin) fungicide categories. Do not exceed two sequential applications of Pristine before alternating to a labeled fungicide with a different mode of action. Do not exceed six applications of Pristine or other Group 11 fungicide per season. Do not exceed 63.0 oz/a Pristine per season.
	chlorothalonil	1.5–2.0 pt Bravo Weather Stik, Echo 720, Equus 720 1.4–1.8 lb Bravo Ultrex 82.5WDG, Equus DF 1.25–1.63 lb Echo 90DF 2.25–2.75 pt Bravo Zn, Echo Zn, Equus 500 Zn	0	Apply at first sign of infection. Do not use tops for food or feed. Do not exceed 15.0 lb ai/a chlorothalonil per season.
			0	
			0	
			0	
	copper hydroxide	1.3 pt Champ Formula 2 4.6F 2 lb Kocide 101 77WP, DF 2.6 pt Kocide LF 2.4F 1.3 pt Kocide 4.5 LF 1.5–2.75 lb Kocide 2000 DF 0.75–1.5 lb Kocide 3000	0	
			0	
			0	
			0	
0				
cyprodinil + fludioxonil	11.0–14.0 oz Switch	7	For control of Alternaria leaf blight only. Ground application only. Do not apply more than 56.0 oz of Switch per crop per year.	
iprodione	1.0–2.0 pt Iprodione 4L AG, Meteor, Nevado 4F, Rovral 4F	0	For control of Alternaria leaf blight only. Note label for rotational crop restrictions.	
penthiopyrad	16.0–30.0 fl oz Fontelis	0	Begin applications prior to disease development. Use higher rate and shorter spray interval when disease pressure is high. Make no more than two sequential applications before alternating to an effective fungicide with a different mode of action. Do not apply more than 61.0 fl oz/a per year.	
propiconazole	4.0 fl oz AmTide Propiconazole 41.8% EC, Bumper 41.8 EC, PropiMax EC, Tilt 2.0 fl oz AmTide Propiconazole 41.8% EC, Bumper 41.8 EC, PropiMax EC, Tilt plus 0.75 lb ai chlorothalonil	14	Do not apply more than 16.0 fl oz/a Bumper 41.8 EC per season.	
		14		
trifloxystrobin	1.9–2.9 fl oz Gem 500 SC	7	Do not make more than one foliar application before alternating to an effective fungicide with a different mode of action. Do not apply more than 11.5 fl oz/a per season. Do not make more than four applications/a per season of Gem or other strobilurin-containing fungicide.	

(continued)

Pest management

Asparagus

Bean

Carrot

Celery

Cole crops

Cucumber

Disease control in carrot *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Aster yellows	<i>Use an insecticide recommended for aster leafhopper. Treat from the seedling stage to 30 days before harvest. See treatment index for aster leafhopper.</i>			
Bacterial blight	<i>The best control is prevention. Use hot water treatment of seed at 122°F for 15 minutes.</i>			
Cottony rot, watery soft rot, white mold <i>(Sclerotinia sclerotiorum)</i>	boscalid	7.0–8.0 oz Endura	0	Apply prior to or at first sign of disease to optimize efficacy.
	<i>Coniothyrium minitans</i> strain CON/M/91-08	1.0–4.0 lb Contans WG	0	Make broadcast application and incorporate Contans WG into top 2 inches of soil by implement or by irrigation.
	fluazinam	1.0 pt Omega 500F	7	Do not make more than four applications per crop cycle. Do not apply more than 4.0 pt per growing season. Apply in 30–50 gal water/a as a directed band spray over the crop.
	penthiopyrad	16.0–30.0 fl oz Fontelis	0	Begin applications prior to disease development. Use higher rate and shorter spray interval when disease pressure is high. Make no more than two sequential applications before alternating to an effective fungicide with a different mode of action. Do not apply more than 61.0 fl oz/a per year.
Damping-off, Pythium root die-back, and seed rot	cyazofamid	6.0 fl oz Ranman	14	Do not use more than 30.0 fl oz per season. Do not use adjuvant when applying to carrots.
	fenamidone	8.2 fl oz Reason	14	Do not apply more than 24.6 fl oz per season. Do not make more than one application of Reason without alternating to a different resistance management group.
	fluopicolide	4.0 fl oz Presidio	7	Can be applied as an in-furrow treatment in 5–10 gal/a volume. Can be sidedressed in 20–40 gal/a spray mixture.
	mefenoxam	0.5–1.3 pt Ridomil Gold SL 2.0–4.0 pt Ultra Flourish	—	Preplant-incorporated or at-planting surface application. Rotate with less-susceptible crops. Use raised beds and precision seeding.
		0.32–0.64 fl oz Apron XL LS/100 lb seed	—	Follow manufacturer's directions. Do not use treated seed for feed or food.
	metalaxyl	4.0–8.0 pt MetaStar 2E AG	—	Preplant-incorporated application or surface application at planting. Preplant to top 2 inches of soil.
		0.75 fl oz/100 lb seed Allegiance FL, Metalaxyl 265 ST 0.7 fl oz/100 lb seed Sebring 2.65 ST	—	Follow manufacturer's directions. Do not use treated seed for feed or food.
Rhizoctonia seedling infection and crown rot	azoxystrobin	0.4–0.8 fl oz Quadris Flowable/1,000 ft row	0	Follow manufacturer's directions.
Root-knot nematodes	metam-sodium	Vapam HL, Metam, Sectagon 42		Growing corn or sod for at least 3 years and then growing carrots for 1 year helps starve out root-knot larvae. Soil fumigation is effective but expensive on muck soils. Apply soil fumigants in the fall when soil temperatures are at least 50°F.

Pest management

Asparagus

Bean

Carrot

Celery

Cole crops

Cucumber

Insect control in carrot

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Aphids	<i>Treat when 25% of plants are infested.</i>			
	azadirachtin	1.0–3.5 pt Aza-Direct 10.0–21.0 oz Azatin XL Plus 0.5–2.0 gal Neemix 0.25EC 0.25–1.0 pt Neemix 4.5EC	0	Apply every 7 days as needed.
	0.08–0.1 lb bifenthrin	5.12–6.4 fl oz *Bifenture, *Brigade, *Sniper, or other registered product	21	Do not apply more than 0.5 lb ai/a per crop season. Allow at least 7 days between applications. Apply foliar applications in sufficient water volume.
	0.018–0.028 lb deltamethrin	1.5–2.4 oz *Delta Gold	3	Apply every 3 days as needed.
	0.5 lb diazinon	1 pt Diazinon AG500 1 lb Diazinon 50WP	14	Do not exceed five applications per season. Allow at least 7 days between applications.
	0.5–1.0 lb endosulfan	0.66–1.33 qt Thiodan 3EC 1.0–2.0 lb Thiodan 50WP	7	Only one application per season.
	0.062–0.089 lb flonicamid	2.0–2.8 oz Beleaf SG	0	Begin applications before aphid populations build. Do not exceed 2.8 oz/a Beleaf per application and do not exceed 8.4 oz/a (0.267 lb ai/a) per crop season.
	imidacloprid	0.31–0.74 fl oz Admire Pro/1,000 ft row	21	Admire may only be applied once per season. Apply Provado every 5 days as needed. Do not exceed three applications per season. Maximum imidacloprid use per season is 0.5 lb ai/a from any formulation.
		4.4–10.5 fl oz Admire Pro	21	
		3.5 fl oz Provado	7	
	imidacloprid + beta-cyfluthrin	2.4–2.8 fl oz *Leverage 360	7	Do not apply more than 8.3 fl oz/a per season and allow at least 7 days between applications.
	0.94–1.25 lb malathion	Malathion EC, WP, D	7	See label for rate.
	thiamethoxam	1.5–3.0 fl oz Actara WG	7	Apply before pests reach damaging levels. Use higher rate for heavy infestations. Do not exceed 8.0 oz/a per season.
		5.0–12.0 fl oz Platinum	0–30	Apply as an in-furrow spray or as a surface banded applications, irrigate within 24 hours to seeding depth using trickle or drip irrigation.
	0.02–0.025 lb zeta-cypermethrin	3.2–4.0 oz *Mustang Max	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Max per season.
	0.04–0.1 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	21	Do not apply more than 0.2 lb ai/a or exceed two applications per season.
Aster leafhopper	<i>For treatment thresholds, see "Aster Yellows Index" on page 16.</i>			
	0.0125–0.022 lb beta-cyfluthrin	1.6–2.8 fl oz *Baythroid XL	0	Apply every 7 days; do not exceed five applications.
	1.5 lb carbaryl	Sevin WP, D	7	See label for rate. Apply at 5- to 7-day intervals. Can only be used with mechanical harvest.
	0.018–0.028 lb deltamethrin	1.5–2.4 oz *Delta Gold	3	Apply every 3 days as needed.

*Restricted-use pesticide.

(continued)

Pest management

Asparagus

Bean

Carrot

Celery

Cole crops

Cucumber

Insect control in carrot *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Aster leafhopper <i>(cont.)</i>	0.5–1.0 lb endosulfan	0.66–1.33 qt Thiodan 3EC 1.0–2.0 lb Thiodan 50WP	7	Only one application per season.
	0.03–0.05 lb esfenvalerate	5.8–9.6 fl oz *Asana XL	7	Do not exceed 0.5 lb ai/a per season.
	imidacloprid + beta-cyfluthrin	2.4–2.8 fl oz *Leverage 360	7	Do not apply more than 8.3 fl oz/a per season and allow at least 7 days between applications.
	0.225–0.9 lb methomyl	0.75–3.0 pt *Lannate LV	1	Apply at 5- to 7-day intervals. Do not exceed 6.3 lb/a of product per season.
	thiamethoxam	1.5–3.0 fl oz Actara WG	7	Apply before pests reach damaging levels. Use higher rate for heavy infestations. Do not exceed 8.0 oz/a per season.
		5.0–12.0 fl oz Platinum	0–30	Apply as an in-furrow spray or as a surface band at seeding. For surface-banded applications, irrigate within 24 hours to seeding depth using trickle or drip irrigation.
	0.011–0.025 lb zeta-cypermethrin	1.76–4.0 oz *Mustang Max	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Max per season.
Black cutworms	<i>Spot treat when numbers exceed two larvae per foot of row.</i>			
	azadirachtin	1.0–3.5 pt Aza-Direct 10.0–21.0 oz Azatin XL Plus 0.5–2.0 gal Neemix 0.25EC 0.25–1.0 pt Neemix 4.5EC	0	Apply every 7 days as needed.
	0.0125–0.022 lb beta-cyfluthrin	1.6–2.8 fl oz *Baythroid XL	0	Apply every 7 days; do not exceed five applications.
	1.0–2.0 lb carbaryl	Sevin Bait	7	Broadcast bait formulation. See label for rate. Can only be used with mechanical harvest.
	0.03–0.05 lb esfenvalerate	5.8–9.6 fl oz *Asana XL	7	Do not exceed 0.5 lb ai/a per season.
	imidacloprid + beta-cyfluthrin	2.4–2.8 fl oz *Leverage 360	7	Do not apply more than 8.3 fl oz/a per season and allow at least 7 days between applications.
	0.008–0.025 lb zeta-cypermethrin	1.28–4.0 oz *Mustang Max	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Max per season.
	0.025–0.06 lb zeta-cypermethrin + bifenthrin	2.6–6.1 fl oz *Hero	21	Do not apply more than 0.2 lb ai/a or exceed two applications per season.
Carrot weevil	<i>Carrot weevil populations are easily managed by spraying every 3–5 days for 2 weeks once eggs are found.</i>			
	0.044 lb beta-cyfluthrin	2.8 fl oz *Baythroid XL	0	Apply every 7 days; do not exceed five applications.
	0.03–0.05 lb esfenvalerate	5.8–9.6 fl oz *Asana XL	7	Direct spray at crown. Apply higher rate when weevils are active.
	imidacloprid + beta-cyfluthrin	2.4–2.8 fl oz *Leverage 360	7	Do not apply more than 8.3 fl oz/a per season and allow at least 7 days between applications.
	0.5–1.0 lb oxamyl	2.0–4.0 pt *Vydate L	14	Apply as directed spray. Do not apply more than 4.0 gal/a per season.
Seed corn maggot	imidacloprid	6.4 fl oz Gaucho 600	—	To provide early-season protection of seedlings as a commercial seed treatment.

*Restricted-use pesticide.

Weed control in carrot

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Annual weeds	1.0–2.0 lb prometryn	2.0–4.0 pt Caparol 4L	30	Caparol 4L can be applied preemergence and/or postemergence over the top to carrot. Apply up to three applications of Caparol 4L at the rate of 2.0–4.0 pt/a per application. Do not exceed one preemergence application at up to 4.0 pt/a and two postemergence applications each at up to 2.0 pt/a or one postemergence application at up to 4.0 pt/a per crop cycle. Do not exceed 8.0 pt/a of Caparol 4L per crop cycle. Make postemergence applications through the six-leaf stage of carrot development. See label for adjuvant instructions when making postemergence applications.
Annual broadleaves and some grasses	linuron	Lorox DF <i>(use and rate vary by soil type—see label)</i>	14	Treat after carrots are at least 3 inches tall but before broadleaf weeds are 6 inches tall and before grassy weeds exceed 2 inches. Do not incorporate. Do not apply when temperatures exceed 85°F. Do not tank mix with other pesticides. Additional applications may be made, but do not exceed 4.0 lb/a Lorox DF annually.
	0.5–1.0 lb trifluralin	1.0–2.0 pt Treflan HFP or registered equivalent		Controls annual grasses and some broadleaf weeds, but is weak on wild mustard, smartweed, common ragweed, velvetleaf, and black nightshade. Rate varies depending on soil texture and organic matter. Must be incorporated within 24 hours. See label for plantback restrictions. Ineffective on peat or muck soils.
Annual grasses and some broadleaves	0.95 lb pendimethalin	2.0 pt Prowl H ₂ O	60	Apply preemergence as a broadcast treatment within 2 days after planting or at layby as a directed spray to the soil between rows. Emerged weeds will not be controlled. Do not allow the spray to contact carrot plants or injury may occur.
Marestail or pineapple-weed	linuron	Lorox DF <i>(use and rate vary by soil type—see label)</i>		A single preemergence treatment may be applied after planting but before carrots emerge. Plant seed at least 1/2 inch deep. Excessive rainfall or irrigation may cause carrot injury.
Emerged weeds	glyphosate	several manufacturers and formulations available		See manufacturer's label to assure that the formulation is labeled for this crop and for specific instructions. Glyphosate may be applied any time before crop emerges. Apply before crop seed germination in coarse sandy soils. If weeds have been mowed or tilled, do not treat until they have resumed active growth and reached the recommended stage on the label. Unless otherwise stated, allow 7 or more days before tilling treated fields. Do not tank mix with soil-residual herbicides unless otherwise specified.
	*paraquat	several manufacturers and formulations available, not all are registered for this use		Prepare seedbed early to allow for maximum weed emergence. Application can be made as a banded or broadcast treatment before, during, or after planting, but before crop emergence. In preplant and preemergence (to the crop) uses, do not apply to soils lacking clay minerals, i.e., muck, pure sand. Use the higher rate for heavy weed infestations. Minimize soil disturbance during seeding. Always add crop oil concentrate or non-ionic surfactant to spray mixture. Follow precautions on label.

*Restricted-use pesticide.

(continued)

Pest management

Asparagus

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Carrot

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Cole crops

Cucumber

Weed control in carrot *(continued)*

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Emerged grasses	0.068–0.12 lb clethodim	9.0–16.0 oz Select Max	30	Apply to actively growing grasses. Repeat treatments may be made at 14-day intervals up to the maximum annual use rate. Do not cultivate grasses within 7 days before or after application. Include appropriate surfactant as required by label. Do not apply if rain is expected within 1 hour.
	0.094–0.125 lb clethodim	6.0–8.0 oz Select 2EC	30	
	0.13–0.38 lb fluazifop-P-butyl	0.5–1.5 pt Fusilade DX	45	
	0.094–0.47 lb sethoxydim	0.5–2.5 pt Poast	30	Apply postemergence to actively growing grasses. Always add 1.0 qt/a of crop oil concentrate to the spray mix. Multiple applications may be made allowing 14 days between applications, but do not apply more than 5.0 pt/a of Poast per season. Do not apply if rain is expected within 1 hour.
Emerged annual broadleaves	metribuzin	see label	60	Postemergence applications may be made after carrots have formed five to six true leaves but before weeds are 1 inch in height or diameter. If needed, a second application may be made after an interval of at least 3 weeks but do not exceed 0.5 lb ai/a in one crop season. Check rotational restrictions prior to use. Excessive crop injury may occur if applications are made on very hot days, to drought-stressed carrots, or within 3 days after periods of cool, wet, or cloudy weather. Do not apply metribuzin within 3 days of any other chemical or when carrots are under stress. For carrots with unknown tolerance to metribuzin, treat a small area initially. See label for rotation restrictions.

*Restricted-use pesticide.

Pest management

Asparagus

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Celery

Planting

Plant treated seed in late April or transplants in mid-May. Avoid early planting that would expose young plants to temperatures below 55°F for a week or more. This can cause “bolting” (seed stalk development). Choose deep, fertile soils and provide adequate drainage. Celery needs abundant available moisture during the growing season. Rotate celery with other vegetable crops but not with carrots.

Direct seedings

Rows: 18–40 inches.

Seeds in row: 2 inches apart, later thinned to 6–8 inches apart. Use 6–8 oz seed/a (1 oz seed produces 10,000 plants).

Transplants

Rows: 18–40 inches.

Plants in row: 6–8 inches. Set 30,000–45,000 plants/a.

Lime and fertilizer

Lime: Use dolomitic limestone to maintain a pH of 5.6 or higher in organic soils and at least 6.0 in other soils.

Fertilizer rates: Apply P_2O_5 and K_2O according to soil test recommendations. Use annual nitrogen, P_2O_5 , and K_2O recommendations in table below. Take credits for previous legume crops and manure.

Application: Broadcast and work in lime and fertilizer requirements before planting.

Nitrogen: Apply preplant or sidedress. At higher rates, split recommendations into two or more applications during the season.

Micronutrients: Celery has a high boron requirement and medium requirements for manganese and copper. Use soil and plant analyses to check for deficiencies of these nutrients. Apply 2–3 lb/a of boron with fertilizer each year if boron soil test is very low (VL) or low (L). Omit application if boron test is in the excessively high (EH) range. Apply 1–5 lb Mn/a or 1–12 lb Cu/a, depending on fertilizer source, soil, and method of application.

Annual nitrogen, phosphate, and potash recommendations for celery

Nitrogen		Phosphate and potash		
Organic matter (%)	Amount to apply (lb/a)	Yield goal	Amount P_2O_5 to apply* (lb/a)	Amount K_2O to apply* (lb/a)
<2	140	25–35 t/a	100	300
2.0–9.9	120			
10–20	100			
>20	50			

*Amounts shown are for optimum (O) soil test levels. Apply 50% of this rate if soil test is high (H) and omit if soil test is excessively high (EH). If soil test is low (L) or very low (VL), increase rates according to soil test recommendations.

Disease control in celery

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions	
Aster yellows	<i>Control aster leafhopper. See "Aster Yellows Index" on page 16.</i>				
Basal stalk rot (<i>Rhizoctonia</i>)	azoxystrobin + chlorothalonil	2.4–3.7 pt Quadris Opti	7	Quadris Opti contains Group 11 (strobilurin) and M5 fungicides. Do not apply more than two sequential foliar applications of these materials before alternating with a fungicide with a different mode of action. Do not exceed four foliar applications and 3.0 gal/a Quadris Opti per season.	
	chlorothalonil (7-day spray schedule)	2.0–3.0 pt Bravo Weather Stik, Echo 720, Equus 720	7	Spray before infection occurs. Rotate celery with non-susceptible crops. Do not exceed 18.0 lb ai/a chlorothalonil per season.	
		1.8–2.7 lb Bravo Ultrex 82.5WDG, Equus DF	7		
1.7–2.4 lb Echo 90DF	7				
Bacterial blight (<i>Pseudo-monas</i>)	copper hydroxide	1.3 pt Champ Formula 2 4.6F, Kocide 4.5 LF	0	Use a 2- to 3-year crop rotation and hot water seed treatment (118°F for 30 minutes) to control bacterial diseases. Spray during wet periods and when disease is anticipated.	
		2.3 pt Kocide LF 2.4F	0		
		1.5 lb Kocide 2000 DF	0		
		0.75–1.5 lb Kocide 3000	0		
		2.0 lb Champion 77WP, Kocide 101 77WP, Kocide DF	0		
Cercospora (early blight) and Septoria (late blight)	<i>Hot water seed treatment will eliminate Septoria spores on the seed.</i>				
Carrot	azoxystrobin	9.0–15.5 fl oz Quadris Flowable	0	Quadris, Cabrio, and Flint are Group 11 (strobilurin) fungicides; Quadris Opti contains Group 11 and M5 fungicides. To prevent disease resistance, do not apply more than one application of these products before alternating with a fungicide having a different mode of action. Do not exceed three applications of strobilurin fungicides per crop per year. Do not exceed 2.88 qt/a Quadris, 3.0 gal/a Quadris Opti, 64.0 oz/a Cabrio, or 12.0 oz/a Flint per season.	
	azoxystrobin + chlorothalonil	2.4–3.7 pt Quadris Opti	7		
	azoxystrobin + propiconazole	14.0 fl oz Quilt Xcel	14		
	pyraclostrobin	12.0–16.0 oz Cabrio EG	0		
	trifloxystrobin	2.0–3.0 oz Flint	7		
	azoxystrobin + propiconazole	14.0 fl oz Quilt	14		
	chlorothalonil (3- to 5-day spray schedule)	1.5–2.0 pt Bravo Weather Stik, Echo 720, Equus 720	7		Start sprays when transplants are set in the field. Do not exceed 18.0 lb ai/a chlorothalonil per season.
		1.4–1.8 lb Bravo Ultrex 82.5WDG, Equus DF	7		
		0.9–1.25 lb Echo 90DF	7		
		1.5–2.125 pt Echo Zn, Equus 500 Zn	7		
chlorothalonil (7-day spray schedule)	2.0–3.0 pt Bravo Weather Stik, Echo 720, Equus 720	7	Start sprays when transplants are set in the field. Do not exceed 18.0 lb ai/a chlorothalonil per season.		
	1.8–2.7 lb Bravo Ultrex 82.5WDG, Equus DF	7			
	1.6–2.5 lb Echo 90DF	7			
	3.0–4.25 pt Echo Zn, Equus 500 Zn	7			
chlorothalonil (seedbed)	1.5–2.0 pt/100 gal Bravo Weather Stik, Echo 720, Equus 720			For seedbeds, apply 125 gal of spray suspension weekly or as needed for control.	
	1.4–1.8 lb/100 gal Bravo Ultrex 82.5WDG, Equus DF				

(continued)

Disease control in celery *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Cercospora and Septoria <i>(cont.)</i>	fenamidone	5.5–8.2 fl oz Reason 500 SC	2	Do not apply more than 24.6 fl oz/a per season. Do not make more than one application of Reason without alternating to an effective fungicide with a different mode of action.
	fluofoxastrobin	5.7 fl oz Aftershock, Evito 480 SC	3	Alternate every QoI fungicide application with at least one application of another effective fungicide with a different mode of action.
	penthiopyrad	14.0–24.0 fl oz Fontelis	3	Do not apply more than two sequential applications of Fontelis before alternating to an effective fungicide with a different mode of action. Do not exceed 72.0 fl oz/a per year.
	propiconazole	4.0 fl oz AmTide Propiconazole 41.8% EC, Bumper 41.8 EC, Fitness, Propicure 3.6F, PropiMax EC, Topaz	14	Do not exceed 16.0 fl oz/a per season. Apply when conditions exist for disease development.
		4.0 fl oz Tilt 41.8% EC	14	Do not apply more than 16.0 fl oz/a in four applications per season. Consult the label for crop rotation (plantback) restrictions.
trifloxystrobin	2.0–3.0 oz Flint, Gem 500 SC	7	Do not apply more than 12.0 oz/a per season. Do not apply more than four times per season.	
Damping-off	mefenoxam	1.0–2.0 pt Ridomil Gold SL 2.0–4.0 pt Ultra Flourish	— —	Preplant-incorporated application or surface application at planting. Preplant to top 2 inches of soil.
		0.085–0.64 fl oz Apron XL/100 lb seed	—	Follow manufacturer's directions. Do not use treated seed for feed or food.
	mefenoxam + azoxystrobin	0.34 fl oz Uniform/1,000 ft row	—	Preplant application as an in-furrow spray in a minimum of 5 gal of water per acre at planting.
	metalaxyl	4.0–8.0 pt MetaStar 2E AG	—	Preplant-incorporated application or surface application at planting. Preplant to top 2 inches of soil.
		0.7 fl oz/100 lb seed Sebring 2.65 ST 0.75 fl oz/100 lb seed Allegiance FL, Metalaxyl 265 ST	— —	Follow manufacturer's directions. Do not use treated seed for feed or food.
metam-sodium	Vapam HL, Metam, Sectagon 42		Use disease-free soil. Use steam or chemicals to sterilize contaminated soil.	
Rhizoctonia root rot	azoxystrobin	0.4–0.8 fl oz Quadris Flowable/1,000 ft row	0	Use at planting. Follow manufacturer's directions.

Pest management

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Insect control in celery

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Aphids	acetamiprid	0.8–1.2 oz Assail 70WP 2.0–4.0 oz Assail 30 SG	7 7	Begin treatment when thresholds are reached. Apply every 7 days as needed. Do not exceed five applications or 0.375 lb ai/a per season.
	0.062–0.089 lb flonicamid	2.0–2.8 oz Beleaf SG	0	Begin applications before aphid populations build. Do not exceed 2.8 oz/a Beleaf per application and do not apply more than 8.4 oz/a (0.267 lb ai/a) per season.
Asparagus	0.25–0.37 lb imidacloprid	7.0–10.5 fl oz AdmirePro 4.6F 16.0–24.0 fl oz (several formulations) 2F	21	Apply via chemigation into the root zone, as an in-furrow spray at-planting on or below the seed, or as a post-seeding or transplant drench.
	0.06–0.08 lb spirotetramat	4.0–5.0 fl oz Movento	1	Do not apply more than 10.0 fl oz/a Movento (0.16 lb ai/a) per season.
	0.198–0.257 lb thiamethoxam + chlorantraniliprole	10.0–13.0 fl oz Durivo	30	Do not exceed a total of 13.0 fl oz/a Durivo (0.257 lb ai/a) per growing season. Do not exceed 0.172 lb ai/a of thiamethoxam-containing products or 0.2 lb ai/a of chlorantraniliprole-containing products per season.
Bean	0.014–0.025 lb zeta-cypermethrin	2.24–4.0 oz *Mustang Max	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Max per season.
	Aster leafhopper	<i>Treat celery when the aster yellows index reaches 35. (See "Aster Yellows Index" on page 16 for calculations.)</i>		
Carrot	0.25–0.37 lb imidacloprid	7.0–10.5 fl oz AdmirePro 4.6F 16.0–24.0 fl oz (several formulations) 2F	21	Apply via chemigation into the root zone, as an in-furrow spray at-planting on or below the seed, or as a post-seeding or transplant drench.
	0.225–0.9 lb methomyl	0.75–3.0 pt *Lannate LV	7	Do not apply more than 9.0 lb ai/a per season.
	0.05–0.2 lb permethrin	*Ambush, *Pounce	1	Several formulations; see label for rate. Apply at 3- to 5-day intervals. Do not exceed 2.0 lb ai/a per season.
	0.198–0.257 lb thiamethoxam + chlorantraniliprole	10.0–13.0 fl oz Durivo	30	Do not exceed a total of 13.0 fl oz/a Durivo (0.257 lb ai/a) per growing season. Do not exceed 0.172 lb ai/a of thiamethoxam-containing products or 0.2 lb ai/a of chlorantraniliprole-containing products per season.
Celery	0.014–0.025 lb zeta-cypermethrin	2.24–4.0 oz *Mustang Max	1	Do not exceed 0.15 lb ai/a. Apply every 7 days as needed. Use higher rate for heavy infestations.
	Cutworms	<i>If more than 4 weeks before harvest, treat if you see eggs or larvae. Within 4 weeks of harvest, preventatively treat approximately weekly.</i>		
	0.03–0.045 lb flubendiamide	2.0–3.0 oz Synapse WG	1	Do not apply more than 3.0 oz/a (0.045 lb ai/a) in a 7-day period or exceed 9.0 oz/a per season.
Cole crops	0.05–0.2 lb permethrin	*Ambush, *Pounce	1	Apply at 3- to 5-day intervals. Do not exceed 2.0 lb ai/a per season.
	0.014–0.025 lb zeta-cypermethrin	2.24–4.0 oz *Mustang Max	1	Do not exceed 0.15 lb ai/a. Apply every 7 days as needed. Use higher rate for heavy infestations.
	Leafminers	0.009–0.019 lb abamectin	8.0–16.0 fl oz *Agri-Mek 0.15EC	7
	0.12 lb cyromazine	2.66 oz Trigard 75WP	7	

*Restricted-use pesticide.

(continued)

Insect control in celery (continued)

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Leafminers (cont.)	0.045–0.268 lb dinotefuran	foliar: 1.0–3.0 oz Venom 70SG	7	Use only one application method. See product label for application directions. Foliar applications: Do not exceed 4.5 oz/a per year. Soil applications: Do not follow soil application with foliar treatment of any other neonicotinoid insecticide. Do not exceed 6.0 oz/a per season.
		soil: 5.0–6.0 oz Venom 70SG	—	
	0.05–0.13 lb dinotefuran (foliar)	2.0–5.25 oz Scorpion 35SL	1	
	0.23–0.27 lb dinotefuran (soil)	9.0–10.5 oz Scorpion 35SL	21	
	0.198–0.257 lb thiamethoxam + chlorantraniliprole	10.0–13.0 fl oz Durivo	30	Do not exceed a total of 13.0 fl oz/a Durivo (0.257 lb ai/a) per growing season. Do not exceed 0.172 lb ai/a of thiamethoxam-containing products or 0.2 lb ai/a of chlorantraniliprole-containing products per season.
Loopers	<i>If more than 4 weeks before harvest, treat if you find two or more larvae per 100 plants; within 4 weeks of harvest, preventative cutworm treatments should provide control.</i>			
	0.5–1.0 lb acephate	0.5–1.0 lb Orthene 97S	21	Do not use tops for food or feed. Do not apply more than 2.0 lb ai/a per season.
	<i>Bacillus thuringiensis subsp. kurstaki</i>	1.0–2.0 lb Lepinox WDG	0	Treat early instar larvae before noticeable feeding damage occurs. Repeat treatment as needed.
		Biobit, Cutlass WP, DiPel DF, Javelin WG	0	See label for rate.
	beta-cyfluthrin	2.4–3.2 fl oz *Baythroid XL	0	Maximum Baythroid XL allowed per 7-day interval is 3.2 fl oz/a and season total allowed per crop season is 12.8 fl oz/a.
	chlorantraniliprole	3.5–5.0 fl oz Coragen	1	Do not apply more than 15.4 fl oz/a per season and allow at least 3 days between applications. Do not make more than four applications per acre per crop.
	0.0075–0.015 lb emamectin benzoate	3.2–4.8 oz *Proclaim	7	Apply when larvae first appear. Use higher rate for larger larvae or severe outbreaks. Do not exceed 28.8 oz/a per season. Highly toxic to bees.
	0.5–1.0 lb endosulfan	0.66–1.33 qt Thiodan EC 1.0–2.0 lb Thiodan WP	4	Apply only once per season.
	0.03–0.045 lb flubendiamide	2.0–3.0 oz Synapse WG	1	Do not apply more than 3.0 oz/a (0.045 lb ai/a) in a 7-day period or exceed 9.0 oz/a per season.
	0.225–0.9 lb methomyl	0.75–3.0 pt *Lannate LV 0.25–1.0 lb *Lannate SP	7	Do not exceed 9.0 lb ai/a per season.
	0.06–0.16 lb methoxyfenozide	10.0 oz Intrepid 2F	1	Apply 4.0–8.0 oz only for early applications use higher rates for heavy infestations. Do not exceed 64.0 oz/a.
	0.05–0.2 lb permethrin	*Ambush, *Pounce	1	Several formulations; see label for rate. Apply when needed, but no more than 2.0 lb ai/a per season.
	0.039–0.078 lb spinetoram	5.0–10.0 fl oz Radiant SC	1	Do not apply more than 34.0 fl oz/a or make more than six applications per year. Do not exceed two consecutive applications.

*Restricted-use pesticide.

(continued)

Pest management

Asparagus

Bean

Carrot

Celery

Cole crops

Cucumber

Insect control in celery *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Loopers <i>(cont.)</i>	spinosad	3.0–6.0 fl oz Entrust SC	1	Use higher rate for larger larvae. Apply in adequate spray volume to get good coverage for best control. Do not exceed 0.45 lb ai/a per season. Do not apply to seedlings grown for transplant.
	0.6–0.75 lb thiodicarb	24.0–30.0 fl oz Larvin F	14	Do not exceed 1.5 lb ai/a per season.
	0.02–0.025 lb zeta-cypermethrin	3.2–4.0 oz *Mustang Max	1	Do not exceed 0.15 lb ai/a. Apply every 7 days as needed. Use higher rate for heavy infestations.
Tarnished plant bug	<i>For plants shorter than 4 inches, treat if you find at least 20 insects per 20 plants. For plants taller than 4 inches, treat if you find four or more plant bugs per 20 plants if there are more than 3 weeks until harvest; within 3 weeks of harvest, treat if you find two insects per 20 plants.</i>			
	0.5–2.0 lb carbaryl	Sevin	14	Apply every 5–7 days as needed.
	0.062–0.089 lb flonicamid	2.0–2.8 oz Beleaf SG	0	Begin applications before aphid populations build. Do not exceed 2.8 oz/a Beleaf per application and do not apply more than 8.4 oz/a (0.267 lb ai/a) per season.

*Restricted-use pesticide.

Weed control in celery

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Annual weeds	0.095 lb flumioxazin	3.0 oz Chateau SW		May be applied pretransplant or between 3 and 7 days following transplanting. Do not use an adjuvant or apply as part of a tank mix. Do not apply more than 3.0 oz/a per application or growing season.
	linuron	Lorox DF <i>(use and rate vary by soil type—see label)</i>	45	Make a single post-transplant application after celery is established but less than 8 inches tall. Apply before broadleaf weeds are 6 inches tall or grassy weeds exceed 2 inches. Do not tank mix with surfactants, fertilizer, or other pesticide.
	prometryn	Caparol 4L <i>(use and rate vary—see label)</i>	40	Transplanted celery only. May be applied to direct-seeded or transplanted celery in a single or split application not to exceed a seasonal maximum of 4.0 pt/a. When applying postemergence, do not tank mix with other pesticides. Apply before weeds are 2 inches tall. Use only on fine-textured soils. Do not disturb the soil following treatment.
	0.5–1.0 lb trifluralin	1.0–2.0 pt Treflan HFP or other registered trifluralin formulation		May be applied before, during, or immediately after direct-seeding or transplanting celery. Controls annual grasses and some broadleaves, but is weak on wild mustard, smartweed, common ragweed, velvetleaf, and black nightshade. Rate varies with soil texture and organic matter. Follow recommended soil preparation, application, and incorporation procedures. Must be incorporated within 24 hours. See label for plantback restrictions. Ineffective on peat or muck soils.
Annual grasses	5.0–6.0 lb bensulide	5.0–6.0 qt Prefar 4E		Apply before planting and incorporate 1–2 inches deep to avoid loss due to volatilization. Use on mineral soils only.

(continued)

Weed control in celery *(continued)*

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Emerged weeds	glyphosate	several manufacturers and formulations		See manufacturer's label to assure that the formulation is labeled for this crop and for specific instructions. Glyphosate may be applied any time before crop emerges. Apply before crop seed germination in coarse sandy soils. If weeds have been mowed or tilled, do not treat until they have resumed active growth and reached the recommended stage on the label. Unless otherwise stated, allow 7 or more days before tilling treated fields. Do not tank mix with soil-residual herbicides unless otherwise specified.
Emerged grasses	0.068–0.12 lb clethodim	9.0–16.0 oz Select Max	30	Apply to actively growing grasses. Repeat treatments may be made at 14-day intervals up to the maximum annual use rate. Do not cultivate grasses within 7 days before or after application. Include appropriate surfactant as required by label. Do not apply if rain is expected within 1 hour.
	0.094–0.125 lb clethodim	6.0–8.0 oz Select 2EC	30	
	0.094–0.28 lb sethoxydim	0.5–1.5 pt Poast	30	Make postemergence applications to actively growing grasses within the size ranges indicated on the label. Check the label for early and rescue treatment rates. Do not apply more than 3.0 pt/a Poast in one crop season. Always add 2.0 pt of crop oil concentrate/a. Check the label for additional precautions and restrictions.

Pest management

Asparagus

Bean

Carrot

Celery

Cole crops

Cucumber

Cole crops: broccoli, brussels sprouts, cabbage, cauliflower

Cauliflower is relatively difficult to grow compared to cabbage. Failure to head properly and poor curd quality are common problems. Curds need to be protected from sunlight to ensure good color and quality. For success, cauliflower needs a fertile, moist soil relatively high in organic matter and nitrogen. Good soil drainage and a cool, humid climate are essential. If producing cauliflower on a light-textured soil, it must be irrigated to keep moisture continuously available to the crop. Broccoli and brussels sprouts are not as exacting in their requirements as cauliflower and, therefore, can be produced over a wider range of soil and climatic conditions. Cabbage is the most easily grown of the cole crops. It is adaptable but does best under a temperate climate, ample moisture, and good fertility with a relatively high nitrogen supply.

Planting

From mid-April through mid-June. Cole crops grow best on well-drained, fertile, loam soils with adequate organic matter. Sandy loams are better for early crops. Harrow to control weeds. Do not overwork seedbed.

Transplants

Plant spacing	Between rows (in.)	Between plants (in.)
Broccoli and cauliflower	18–36	12–24
Brussels sprouts	24–30	12–18
Cabbage	24–36	12–24

Transplants: 8,300–29,000/a; depends upon row spacing, variety, soil fertility, pest control methods, irrigation, crop use, and harvesting.

Direct seeding

Plant no deeper than 1/2 inch. Use size-graded seed and select size to fit planter.

Single seeding

Plant single seed 3–4 inches apart. After emergence, remove excess plants by thinning.

Cluster seeding

Plant three seeds per cluster, spacing seed 2 inches apart. Thin to remove all but one plant per cluster. Thin when plants are 2 inches high.

Lime and fertilizer

Lime: Use dolomitic limestone to maintain a pH of 6.0 or higher on mineral soils and 5.6 on organic soils.

Fertilizer rates: Determine fertilizer needs by soil test. Use annual nitrogen, P₂O₅, and K₂O recommendations in table on next page. Take credits for previous legume crops and manure.

Application: Broadcast and work in fertilizer before planting.

Nitrogen: Apply preplant or sidedress early in growing season. On sandy soils, split the nitrogen into two or more applications during the season. Excessive nitrogen can promote tipburn occurrence in susceptible cabbage varieties.

Micronutrients: Cole crops have relatively high or medium boron requirements and medium requirements for copper and manganese. Use soil and plant analyses to check for deficiencies of these nutrients. If boron soil test is very low (VL) or low (L), apply 2–3 lb/a of boron with fertilizer each year cauliflower is grown and 1–2 lb/a of boron for each broccoli, cabbage, or brussels sprouts crop. Omit these applications if the boron soil test is in the excessively high (EH) range. Apply 1–3 lb Mn/a or 1–12 lb Cu/a, depending on soil and application method.

Annual nitrogen, phosphate, and potash recommendations for cole crops

Crop	Nitrogen		Yield goal (t/a)	Phosphate and potash	
	Organic matter (%)	Amount to apply (lb/a)		Amount P ₂ O ₅ to apply* (lb/a)	Amount K ₂ O to apply* (lb/a)
Broccoli	<2	100	4–6	10	20
	2.0–9.9	80			
	10–20	60			
	>20	25			
Brussels sprouts	<2	100	4–6	15	45
	2.0–9.9	80			
	10–20	60			
	>20	25			
Cabbage	<2	180	8–12	15	70
	2.0–9.9	140	12.1–20	25	115
	10–20	100	20.1–30	40	180
	>20	40	30.1–40		
Cauliflower	<2	120	6–8	20	50
	2.0–9.9	100			
	10–20	80			
	>20	40			

*Amounts shown are for optimum (O) soil test levels. Apply 50% of this rate if soil test is high (H) and omit if soil test is excessively high (EH). If soil test is low (L) or very low (VL), increase rates according to soil test recommendations.

Disease control in cole crops—broccoli, brussels sprouts, cabbage, and cauliflower

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions	
Alternaria leaf spot	azoxystrobin	6.0–15.5 fl oz Quadris Flowable	0	Quadris and Cabrio belong to the Group 11 (strobilurin) fungicide category. Do not exceed one application of any of these products before alternating with a fungicide having a different mode of action. Do not exceed three applications of strobilurin fungicides per crop per year. Do not exceed 1.44 qt/a Quadris Flowable or 64.0 oz/a Cabrio per crop per season.	
	pyraclostrobin	12.0–16.0 oz Cabrio EG	0		
	azoxystrobin + difenoconazole	12.0–14.0 fl oz Quadris Top	1		Do not apply more than 56.0 fl oz/a per year. Make no more than one application before alternating to a non-strobilurin fungicide.
	boscalid	6.0–9.0 oz Endura WDG	0		Endura belongs to the Group 7 fungicide category. Do not exceed one application of Endura before alternating to a labeled fungicide with a different mode of action. Do not exceed two applications or 18.0 oz/a Endura per season.
	cyprodinil + fludioxonil	11.0–14.0 Switch 62.5WG	7		Do not apply more than 56.0 fl oz/a per year. Make no more than two applications before alternating to an effective fungicide with a different mode of action.
	penthiopyrad	14.0–30.0 fl oz Fontelis	0		Do not apply more than two sequential applications of Fontelis before alternating to an effective fungicide with a different mode of action. Do not exceed 72.0 fl oz/a per year.
	triflumizole	6.0–8.0 fl oz Procure 480SC	1		Do not apply more than 18.0 fl oz/a Procure per season. Use higher rates for higher disease pressure.

(continued)

Pest management

Asparagus

Bean

Carrot

Celery

Cole crops

Cucumber

Disease control in cole crops—broccoli, brussels sprouts, cabbage, and cauliflower *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions		
Alternaria leaf spot and downy mildew	chlorothalonil	1.5 pt Bravo Weather Stik, Echo 720, Equus 720	7	Apply as foliar spray when conditions favor disease. Do not apply more than 11.7 pt/a (8.8 lb ai/a) during one season.		
		1.4 lb Bravo Ultrex 82.5WDG, Equus DF	7			
		1.25 lb Echo 90DF	7			
	fenamidone	5.5–8.2 fl oz Reason (rate for downy mildew)	2	Do not apply more than 24.6 fl oz per season. Do not use Reason more than one time before alternating to a fungicide of a different resistance management group.		
	mefenoxam/chlorothalonil	1.5 lb Ridomil Gold Bravo	7	Consult the label for crop rotation restrictions before using this product. You may make up to four applications of Ridomil Gold Bravo per crop per season.		
Black rot (bacterial), blackleg (fungal)	<p>☐ Use seed grown in western United States. ☐ Use hot water seed treatment (details below). ☐ Use plant bed sanitation. ☐ Do not use compost from diseased plants or manure from animals that have eaten diseased plants. ☐ Use care in purchase and handling of plants. ☐ Rotate crops (3-year rotation). ☐ Select black-rot resistant cultivars. ☐ Use disease-free soil or treat soil with an approved soil fumigant.</p> <p>Hot water seed treatment: Place the seed in a mesh bag and dip it into water heated to 122°F. Treat cauliflower and broccoli seed for 20 minutes; treat cabbage and brussels sprouts seeds for 25 minutes. Transfer the bag to cold water immediately to cool the seed. There will be some reduction in the germination rate of treated seed. You may wish to sow additional seed to compensate.</p>					
Clubroot	cyazofamid	transplant soil drench: 12.9–25.75 fl oz/100 gal Ranman	0	Do not apply more than 39.5 fl oz/a Ranman per year. See label for specific transplant and soil incorporation specifications.		
		soil incorporation: 20.0 fl oz Ranman				
		fluazinam	transplant: 6.45 fl oz/100 gal Omega 500F soil incorporation: 2.6 pt Omega 500F		20 (leafy greens) 50 (cabbage, broccoli)	Transplant: Soil drench immediately after transplanting. Apply Omega in transplant water. Soil incorporation: Apply in a 9-inch band along the planting row and incorporate 6–8 inches. This product may cause a delay in the start of harvest by up to 8 days, cause stunting, and shorten the length of harvest with no impact on final yield.
PCNB	2.0–6.0 lb PCNB 75% WP/100 gal transplant water; use 0.5–0.75 pt/plant			Add hydrated lime in spring to reach a soil pH of 7.2. PCNB may also be applied as a band or broadcast.		
	3.0 pt/100 gal water, 5.87 gal/a/apply in 25 gal of water/a Blocker 4F	—		May be applied as a transplant solution, banded application, or broadcast application.		
Downy mildew (see also Alternaria leaf spot and downy mildew)	dimethomorph	6.0 oz Forum	0 (leafy greens) 7 (cabbage, broccoli)	Must be applied as a tank mix with another fungicide that has a different mode of action. Do not exceed 30.0 oz/a per growing season.		
		fluopicolide	3.0–4.0 fl oz Presidio		2	Tank mix with another labeled fungicide of a different mode of action on the target pathogen to manage resistance.
		mandipropamid	8.0 fl oz Revus		1	Do not apply more than two consecutive applications of this product before switching to another effective non-Group 40 fungicide. Do not exceed 32.0 fl oz/a of product per season.
Internal tipburn	Avoid overfertilizing, especially with nitrogen. Plant tolerant or resistant cultivars. If you find tipburn, harvest crop before full maturity to reduce losses.					

(continued)

Disease control in cole crops—broccoli, brussels sprouts, cabbage, and cauliflower *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Rhizoctonia basal stem and root rot, wirestem	azoxystrobin	0.4–0.8 fl oz Quadris Flowable/1,000 ft row	0	Use at planting. Follow manufacturer’s directions.
	PCNB	15.0–20.0 lb Blocker 75% WP in 50 gal water/a or 1.0 level tablespoon/gal water/50 sq ft of seedbed 2.8–3.75 gal Blocker 4F in 50 gal water/a	—	Broadcast drench application.
Seed rot	<i>Maintain a disease-free plant bed and use sanitation measures listed for black rot.</i>			

Insect control

Caterpillars cause varying amounts of damage depending on the maturity of the plant, so thresholds change as the crop grows through the different developmental stages (see table below). The three caterpillars—imported cabbage worm, cabbage looper, and diamondback moth

larvae—are considered together as a single caterpillar complex. Weekly crop scouting and treatment based on larval infestation threshold levels provides the most effective management of this pest complex. To monitor, walk along a W-shaped path through the field and examine

randomly-selected plants every few yards; examine 25–50 plants, depending on the field size, and record the percentage of infestation. A plant is infested if the eggs or caterpillars of any species are present.

Treatment thresholds for the caterpillar complex on major cole crops

Crop	Growth stage	Threshold (% infestation)
Cabbage	Seedbed	10
	Transplant to cupping	30
	Cupping to early head	20
	Mature head	10
Broccoli	Seedbed	10
	Transplant to first flower	50
	Flower bud to harvest	10
Cauliflower	Seedbed	10
	Transplant to first curd	50
	Curd present	10

Note: Diamondback moths have developed resistance to insecticides and Bt in areas of the southern United States. Be cautious when using transplants from the South, which may harbor this insect. Bt resistance has been found only in southern Florida so far.

Pest management

Asparagus

Bean

Carrot

Celery

Cole crops

Cucumber

Scouting calendar for insect pests of cole crops

	April			May			June			July			August			September		
	early	mid	late	early	mid	late	early	mid	late	early	mid	late	early	mid	late	early	mid	late
			Seed maggot															
			Cabbage maggot															
		Flea beetles																
			Diamondback moth															
									Imported cabbageworm									
									Cabbage looper									
									Cabbage aphid and turnip aphid									
									Onion thrips									

Insect control in cole crops—broccoli, brussels sprouts, cabbage, and cauliflower

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest**	Remarks and suggestions
Cabbage aphid	<i>Natural enemies will often eliminate this insect, especially if Bacillus thuringiensis (which does not kill beneficial insects) is used for caterpillar control. Treat broccoli and cauliflower before heading if there are more than 100 aphids per plant; after heading, treat if there are more than 5 aphids per plant. Treat cabbage if 1–2% of the plants are infested.</i>			
	acetamiprid	0.8–1.2 oz Assail 70WP 2.0–3.0 oz Assail 30 SG	7 7	Begin treatment when thresholds are reached. Apply every 7 days as needed. Do not exceed five applications or 0.375 lb ai/a per season.
	azadirachtin	1.0–3.5 pt Aza-Direct 10.0–21.0 oz Azatin XL, XL Plus 0.5–2.0 gal Neemix 0.25EC 0.25–1.0 pt Neemix 4.5EC	0	Apply every 7 days as needed.
	bifenthrin	2.1–6.4 fl oz *Brigade 2EC	7	Do not exceed 0.5 lb/a bifenthrin or make more than five applications per year following bloom. Wait at least 7 days between treatments.
		3.4–6.8 fl oz *Capture LFR	16	Do not apply more than 0.1 lb ai/a per season as an at-plant application. Do not apply more than 0.5 lb ai/a per season including other bifenthrin products (e.g., Brigade 2EC).
	0.06–0.095 lb bifenthrin + imidacloprid	3.8–6.1 fl oz *Brigadier	7	Do not apply more than 30.72 fl oz/a (0.48 lb ai/a) per season. A total of 0.24 lb ai/a imidacloprid and 0.5 lb ai/a bifenthrin allowed per season.
	1.0 lb chlorpyrifos	2.0 lb Lorsban 50W 1.33 lb Lorsban 75WG	21	Apply to foliage as insects appear. Repeat as needed but do not exceed more than six applications per season.
	clothianadin	<i>foliar:</i> 3.0–4.0 fl oz Belay	21	Do not apply more than 12.0 fl oz/a per season and allow at least 7 days between applications.
		<i>soil:</i> 9.0–12.0 fl oz Belay	—	Do not apply more than 12.0 fl oz/a per season. Apply as a narrow band centered on the plant row; as an in-furrow spray at planting; as a side dress to both sides of the row; as a transplant water drench; or as chemigation into root zone through drip, trickle or micro-sprinkler, or similar equipment.
	0.25–0.5 lb diazinon	several formulations	5–14	

*Restricted-use pesticide.

(continued)

**Where ranges are given for days to harvest, check product label for specific number of days between insecticide application and harvest of a particular crop.

Insect control in cole crops—broccoli, brussels sprouts, cabbage, and cauliflower *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest**	Remarks and suggestions
Cabbage aphid <i>(cont.)</i>	0.25–0.5 lb dimethoate	0.5–1.0 pt Dimethoate EC	7–14	
	0.045–0.268 lb dinotefuran	<i>foliar:</i> 1.0–4.0 oz Venom 70SG <i>soil:</i> 5.0–6.0 oz Venom 70SG	21	Do not follow applications with foliar application of any other neonicotinoid insecticide. Use only one application method. Do not apply more than 12.0 oz/a per season using soil applications. See product label for application directions.
	0.75–1.0 lb endosulfan	1.5–2.0 lb Thiodan WP 1.0–1.33 qt Phaser EC	7–21	Do not exceed two applications per season. Only one application for kale, collards, chard, and mustard.
		1.0–1.33 qt Thiodan EC	7–21	Do not exceed four applications or 3.0 lb ai/a per season. Only one application for kale, collards, chard, and mustard.
	0.2–0.3 lb fenprothrin	10.66–16.0 fl oz Danitol 2.4EC	7	For use on brussels sprouts and cauliflower only. Treat when pests first appear. May repeat every 7 days as needed. Do not exceed 0.8 lb ai/a per season.
	0.062–0.089 lb flonicamid	2.0–2.8 oz Beleaf SG	0	Begin applications before aphid populations build. Do not exceed 2.8 oz/a Beleaf per application and do not apply more than 8.4 oz/a (0.267 lb ai/a) per season.
	0.0075–0.015 lb gamma-cyhalothrin	1.92–3.84 oz *Proaxis	1	For suppression only. Apply every 5 days as needed. Do not exceed 1.92 pt/a (0.12 lb ai/a) per season.
	imidacloprid	4.4–10.5 fl oz Admire Pro	21	Also controls whitefly. Soil application. Apply Admire in a narrow band centered on the row. Treat within 14 days before planting. Apply Provado every 5 days as needed. Do not exceed 18.75 fl oz/a Provado per season and do not apply more than a total of 0.5 lb/a imidacloprid in any formulation.
		3.75 fl oz Provado F	7–21	
	imidacloprid + beta-cyfluthrin	3.0 fl oz *Leverage 360	7	Do not apply more than 12.8 fl oz/a per season and allow at least 7 days between applications.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4	For suppression only. Do not use on brussels sprouts, kale, collards, chard, or mustard.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Voliam Xpress	3	Do not exceed 31.0 fl oz/a of Voliam Xpress or 0.24 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per growing season.
	lambda-cyhalothrin + thiamethoxam	4.0–4.5 fl oz *Endigo ZC	1	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 7 days between applications.
	0.32–1.0 lb malathion	Malathion EC, WP, D	3–7	See label for rate.
	1.0 lb naled	1.0 pt Dibrom 8E	1	Not for use on kale, collards, chard, or mustard.
0.375–0.75 lb oxydemeton-methyl	1.5–2.0 pt *Metasystox-R, EC	7–10	See label for rate. Do not exceed three applications per season. Not for use on kale, collards, chard, or mustard.	
0.023 lb pymetrozine	2.75 oz Fulfill 50WDG	7		
0.06–0.08 lb spirotetramat	4.0–5.0 fl oz Movento 2SC	7	Do not exceed 10.0 fl oz/a per season.	

*Restricted-use pesticide.

(continued)

**Where ranges are given for days to harvest, check product label for specific number of days between insecticide application and harvest of a particular crop.

Pest management

Asparagus

Bean

Carrot

Celery

Cole crops

Cucumber

Insect control in cole crops—broccoli, brussels sprouts, cabbage, and cauliflower *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest**	Remarks and suggestions
Cabbage aphid <i>(cont.)</i>	thiamethoxam	5.0–11.0 Platinum 2SC 1.5–3.0 oz Actara 25WDG	30	Do not follow applications of Platinum with foliar applications of any other neonicotinoid insecticide. Platinum may be applied to direct seeded crops in-furrow at the seeding or transplant depth, or as a narrow surface band above the seedling and followed by irrigation. Do not apply more than 11.0 oz/a Platinum per season. Actara is applied as a foliar spray.
	0.198–0.257 lb thiamethoxam + chlorantraniliprole	10.0–13.0 fl oz Durivo	30	Do not exceed a total of 13.0 fl oz/a Durivo (0.257 lb ai/a) per growing season. Do not exceed 0.172 lb ai/a of thiamethoxam-containing products or 0.2 lb ai/a of chlorantraniliprole-containing products per season.
	zeta-cypermethrin	3.2–4.0 oz *Mustang Max	1	Apply every 7 days as needed. Use a minimum of 15 gal/a of finished spray. Do not exceed 24.0 oz/a Mustang Max per season.
Cabbage maggot	0.04–0.1 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	7	Do not apply more than 0.45 lb ai/a per season. Wait at least 7 days between applications.
	0.04–0.08 lb bifenthrin	3.4–6.8 oz *Capture LFR	—	Apply as a 5- to 7-inch band over an open furrow or in-furrow with the seed. Do not apply more than 0.1 lb/a Capture LFR per season as an at-plant application.
Carrot	chlorpyrifos <i>(see label for rate limits)</i>	1.6–3.3 oz/1,000 ft row *Lorsban-4E	30	For direct-seeded crops, apply dosage in minimum of 20 gal/a as banded spray over row. Apply ahead of press wheel or planter shoe. For transplants, direct spray at plant base immediately after setting.
		4.6–9.2 oz/1,000 ft row Lorsban 15G		Apply as a 2- to 4-inch band over seed row ahead of planter shoe or in front of press wheel. Not for use on greens.
	0.125–0.25 lb diazinon	several formulations		Apply in transplant water. See label for rate.
Celery	2.0–3.0 lb diazinon	several formulations		See label for rate. Broadcast and incorporate 3–4 inches deep before planting.
	imidacloprid + beta-cyfluthrin	3.0 fl oz *Leverage 360	7	Do not apply more than 12.8 fl oz/a per season and allow at least 7 days between applications.
Caterpillar pests (imported cabbageworm, cabbage looper, diamondback moth larvae)	<i>Apply insecticides only when thresholds are exceeded (see treatment threshold table on page 81).</i>			
	0.5–1.0 lb acephate	0.5–1.0 lb Orthene 975	14	Cauliflower and brussels sprouts only. Do not exceed 2.0 lb ai/a per season.
	acetamiprid	4.0 oz Assail 30 SG	7	To provide suppression of diamondback moth.
	<i>Bacillus thuringiensis</i> subsp. <i>aizawai</i>	1.0–2.0 lb Agree 0.5–1.5 lb Xentari	0	Use lower rate for light infestations and small larvae; use higher rate for heavy infestations and larger larvae.
Cucumber	<i>Bacillus thuringiensis</i> subsp. <i>kurstaki</i>	Biobit, Cutlass, DiPel, Javelin, MVP, Thuricide, and others	0	Rates vary with formulation, check the label. Most effective against young larvae; use other insecticides if larvae are large. Does not kill beneficial insects.
		1.0–2.0 lb Lepinox WDG	0	Treat early instar larvae before noticeable feeding damage occurs. Repeat as needed.

*Restricted-use pesticide.

(continued)

**Where ranges are given for days to harvest, check product label for specific number of days between insecticide application and harvest of a particular crop.

Insect control in cole crops—broccoli, brussels sprouts, cabbage, and cauliflower *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest**	Remarks and suggestions
Caterpillar pests <i>(cont.)</i>	beta-cyfluthrin	1.6–3.2 fl oz *Baythroid XL	0	Maximum Baythroid XL allowed per 7-day interval is 3.2 fl oz/a and season total allowed per crop season is 12.8 fl oz/a.
	0.033–0.10 lb bifenthrin	2.1–6.4 fl oz *Brigade 2EC	7	Do not exceed 0.5 lb ai/a or five applications per season. Wait at least 7 days between applications.
	0.06–0.095 lb bifenthrin + imidacloprid	3.8–6.1 fl oz *Brigadier	7	Do not apply more than 30.72 fl oz/a (0.48 lb ai/a) per season. A total of 0.24 lb ai/a imidacloprid and 0.5 lb ai/a bifenthrin allowed per season.
	0.045–0.065 lb chlorantraniliprole	3.5–5.0 fl oz Coragen	3	Wait at least 3 days between treatments. Do not exceed 15.4 fl oz/a (0.2 lb ai/a) per season.
	0.05–0.1 lb cypermethrin	2.5–5.0 fl oz *Ammo 2.5EC 1–2 bags *Ammo WSB	1	Cabbage only.
	0.0075–0.015 lb emamectin benzoate	2.4–4.8 oz *Proclaim	7	Use higher rate for loopers or larger larvae. Apply when larvae first appear and repeat as necessary for control. Do not exceed 28.8 oz/a per season. Highly toxic to bees.
	0.75–1.0 lb endosulfan	1.5–2.0 lb Thiodan WP 1.0–1.33 qt Phaser EC	7–21	Do not exceed two applications per season.
		1.0–1.33 qt Thiodan EC	7–21	Limit of four applications or 3.0 lb ai/a per season.
	0.015–0.03 lb esfenvaterate	2.9–5.8 fl oz *Asana XL	3	Imported cabbage worm. Do not exceed 0.4 lb ai/a per season.
	0.2–0.3 lb fenpropathrin	10.66–16.0 fl oz Danitol 2.4EC	7	Do not exceed 2.66 pt/a (42.7 oz/a) per season. Apply in spray volume of 25 to 50 gal/a. Adding non-ionic surfactant may improve control.
	0.03–0.045 lb flubendiamide	2.0–3.0 oz Synapse WG	1	Do not apply more than 3.0 oz/a (0.045 lb ai/a) in a 7-day period or more than 9.0 oz/a per season.
	flubendiamide + buprofezin	11.0–13.0 fl oz Vetica	1	Do not apply more than 38.0 fl oz/a per season and allow at least 7 days between applications. Do not make more than two applications per crop season.
	0.0075–0.015 lb gamma-cyhalothrin	1.92–3.84 oz *Proaxis	1	Apply every 5 days as needed. Use the high rate for diamondback moth. Do not exceed 1.92 pt/a (0.12 lb ai/a) per season.
	imidacloprid + beta-cyfluthrin	3.0 fl oz *Leverage 360	7	Do not apply more than 12.8 fl oz/a per season and allow at least 7 days between applications.
	0.045–0.065 lb indoxacarb	2.5–3.5 oz Avaunt	3	Treat when populations reach threshold levels. For diamondback moth control, use higher rate. May repeat every 3 days as needed. Do not exceed 14.0 oz/a per crop.
0.015–0.02 lb lambda-cyhalothrin	0.96–1.6 fl oz *Warrior II	4	Apply every 5 days as needed. Use 0.02–0.03 lb ai/a for diamondback moth larvae.	
lambda-cyhalothrin + chlorantraniliprole	5.0–8.0 fl oz *Voliam Xpress	3	Do not exceed 31.0 fl oz/a of Voliam Xpress or 0.24 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per growing season.	
lambda-cyhalothrin + thiamethoxam	4.0–4.5 fl oz *Endigo ZC	1	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 7 days between applications.	

*Restricted-use pesticide.

(continued)

**Where ranges are given for days to harvest, check product label for specific number of days between insecticide application and harvest of a particular crop.

Pest management

Asparagus

Bean

Carrot

Celery

Cole crops

Cucumber

Insect control in cole crops—broccoli, brussels sprouts, cabbage, and cauliflower (continued)

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest**	Remarks and suggestions
Caterpillar pests (cont.)	0.225–0.9 lb methomyl	0.75–3.0 pt *Lannate LV 0.25–1.0 lb *Lannate SP	1–10	Do not exceed 10 applications per season.
	0.06–0.16 lb methoxyfenozide	<i>early season:</i> 4.0–8.0 fl oz Intrepid 2F <i>mid- to late season:</i> 8.0–16.0 fl oz Intrepid 2F	1 1	Will not control diamondback moth. Do not exceed 64.0 fl oz/a per season. Use the higher rates with higher populations or when spray coverage is difficult. See label for use restrictions in some Wisconsin counties.
Asparagus	0.039–0.078 lb novaluron	6.0–12.0 fl oz Rimon 0.83EC	7	Apply when the majority of the population has hatched up to the second instar larvae stage. Use higher rates and volumes when larvae are large, when populations are at least double the threshold amount, and when the foliage canopy is dense. Do not apply more than three times per crop per season or more than 24.0 oz/a per season.
	0.05–0.2 lb permethrin	*Ambush, *Pounce	1	See label for rate. Do not exceed 0.8 lb ai/a per season. Do not graze or feed treated foliage.
Bean	0.039–0.078 lb spinetoram	5.0–10.0 oz Radiant SC	1	Do not apply more than 34.0 oz/a Radiant (0.266 lb ai/a) per crop and do not exceed six applications per year.
	spinosad	1.5–10.0 fl oz Entrust SC	1	See product label for specific rates. Use higher rates for larger larvae. Apply in adequate spray to get good coverage for best control. Do not exceed 0.45 lb ai/a per season. Do not use a buffering agent.
Carrot	0.09–0.12 lb tebufenozide	6.0–8.0 fl oz Confirm	7	Apply per label directions every 10–14 days as needed. Do not exceed 8.0 oz/a per application or 56.0 oz/a per season. There is a 1- to 12-month plantback restriction depending on the crop.
	0.198–0.257 lb thiamethoxam + chlorantraniliprole	10.0–13.0 fl oz Durivo	30	Do not exceed a total of 13.0 fl oz/a Durivo (0.257 lb ai/a) per growing season. Do not exceed 0.172 lb ai/a of thiamethoxam-containing products or 0.2 lb ai/a of chlorantraniliprole-containing products per season.
Celery	0.4–1.0 lb thiodicarb	16.0–40.0 fl oz Larvin 3.2	7	Do not exceed 4.0 lb ai/a per season for broccoli, cabbage, and cauliflower only. There is a 30-day plantback restriction.
	0.014–0.025 lb zeta-cypermethrin	2.24–4.0 oz *Mustang Max	1	Use higher rates for cabbage looper. Apply every 7 days as needed. Use a minimum of 15 gal/a of finished spray. Do not exceed 24.0 oz/a Mustang Max per season.
Cole crops	0.04–0.1 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	7	Do not apply more than 0.45 lb ai/a per season. Wait at least 7 days between applications.
	Flea beetles	beta-cyfluthrin	1.6–3.2 fl oz *Baythroid XL	0
Cucumber	0.033–0.10 lb bifenthrin	2.1–6.4 fl oz *Brigade 2EC	7	Do not exceed 0.5 lb ai/a or five applications per season. Wait at least 7 days between applications.
	0.5–2.0 lb carbaryl	Sevin WP	—	Can only be applied within 30 days of crop emergence. See label for rate. Do not use on kale or collards.

*Restricted-use pesticide.

(continued)

**Where ranges are given for days to harvest, check product label for specific number of days between insecticide application and harvest of a particular crop.

Insect control in cole crops—broccoli, brussels sprouts, cabbage, and cauliflower *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest**	Remarks and suggestions
Flea beetles (cont.)	clothianadin	foliar: 3.0–4.0 fl oz Belay	21	Do not apply more than 12.0 fl oz/a per season and allow at least 7 days between applications.
		soil: 9.0–12.0 fl oz Belay	—	Do not apply more than 12.0 fl oz/a per season. Apply as a narrow band centered on the plant row; as an in-furrow spray at planting; as a side dress to both sides of the row; as a transplant water drench; or as chemigation into root zone through drip, trickle or micro-sprinkler, or similar equipment.
	0.045–0.268 lb dinotefuran	foliar: 1.0–4.0 oz Venom 70SG	1	Do not follow soil applications with foliar application of any other neonicotinoid insecticide. Use only one application method. Do not exceed 12.0 oz/a per season using soil applications. See product label for application directions.
		soil: 5.0–6.0 oz Venom 70SG	21	
	0.75–1.0 lb endosulfan	1.0–1.33 qt Thiodan WP 1.5–2.0 lb Phaser EC	7–21	Do not exceed two applications per season. Only one application allowed for kale, collards, chard, mustard.
		1.0–1.33 qt Thiodan EC	7–21	Do not exceed four applications or 3.0 lb ai/a per season. Only one application allowed for kale, collards, chard, and mustard.
	0.015–0.05 lb esfenvalerate	2.9–9.6 fl oz *Asana XL	3–7	Do not exceed 0.4 lb ai/a per season (0.2 lb ai/a for greens).
	0.0075–0.015 lb gamma-cyhalothrin	1.92–3.84 oz *Proaxis	1	Apply every 5 days as needed. Do not exceed 1.92 pt/a (0.12 lb ai/a) per season.
	imidacloprid + beta-cyfluthrin	3.0 fl oz *Leverage 360	7	Do not apply more than 12.8 fl oz/a per season and allow at least 7 days between applications.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4	Apply every 5 days as needed. Do not exceed 0.96 pt/a per season.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Voliam Xpress	3	Do not exceed 31.0 fl oz/a of Voliam Xpress or 0.24 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per growing season.
	lambda-cyhalothrin + thiamethoxam	4.0–4.5 fl oz *Endigo ZC	1	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 7 days between applications.
	0.05–0.2 lb permethrin	*Pounce	1	See label for rate. Apply as needed for flea beetle control on cabbage and Chinese cabbage. Do not exceed 1.0 lb ai/a per season.
	thiamethoxam	5.0–11.0 Platinum 2SC 1.5–3.0 oz Actara 25WDG	30	Do not follow applications of Platinum with foliar applications of any other neonicotinoid insecticide. Platinum may be applied to direct-seeded crops in-furrow at seeding or transplant depth, or as a narrow surface band above the seedling and followed by irrigation. Do not apply more than 11.0 oz/a per season. Actara is applied as a foliar spray.
0.198–0.257 lb thiamethoxam + chlorantraniliprole	10.0–13.0 fl oz Durivo	30	Do not exceed a total of 13.0 fl oz/a Durivo (0.257 lb ai/a) per growing season. Do not exceed 0.172 lb ai/a of thiamethoxam-containing products or 0.2 lb ai/a of chlorantraniliprole-containing products per season.	

*Restricted-use pesticide.

(continued)

**Where ranges are given for days to harvest, check product label for specific number of days between insecticide application and harvest of a particular crop.

Pest management

Asparagus

Bean

Carrot

Celery

Cole crops

Cucumber

Insect control in cole crops—broccoli, brussels sprouts, cabbage, and cauliflower *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest**	Remarks and suggestions
Flea beetles <i>(cont.)</i>	0.4–0.8 lb thiodicarb	16.0–32.0 fl oz Larvin F	7–14	Do not exceed 4.0 lb ai/a per season for broccoli, cabbage, and cauliflower only. Do not exceed 1.5 lb ai/a per season for greens.
	0.14–0.25 lb zeta-cypermethrin	2.24–4.0 oz *Mustang Max	1	Apply every 7 days as needed. Use a minimum of 15 gal/a of finished spray. Do not exceed 24.0 oz/a Mustang Max per season.
	0.04–0.1 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	7	Do not apply more than 0.45 lb ai/a per season. Wait at least 7 days between applications.
Onion thrips	<i>Thrips attack only cabbage and brussels sprouts. Plant resistant cabbage varieties to avoid the problem.</i>			
	acetamiprid	4.0 oz Assail 30 SG	7	Apply as part of a resistance management program for control of immature thrips.
	0.06–0.095 lb bifenthrin + imidacloprid	3.8–6.1 fl oz *Brigadier	7	Do not apply more than 30.72 fl oz/a (0.48 lb ai/a) per season. A total of 0.24 lb ai/a imidacloprid and 0.5 lb ai/a bifenthrin allowed per season.
	0.05–0.1 lb cypermethrin	2.5–5.0 fl oz *Ammo 2.5EC	1	Apply when thrips enter cabbage head. There is a 30-day plantback restriction.
	0.0075–0.015 lb gamma-cyhalothrin	1.92–3.84 oz *Proaxis	1	For suppression only. Apply every 5 days as needed beginning when thrips enter cabbage head. Do not exceed 1.92 pt/a (0.12 lb ai/a) per season.
	imidacloprid + beta-cyfluthrin	3.0 fl oz *Leverage 360	7	Do not apply more than 12.8 fl oz/a per season and allow at least 7 days between applications.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4	Apply every 5 days as needed. Do not exceed 0.96 pt/a per season. For suppression only. Apply when thrips enter cabbage head.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Voliam Xpress	3	Do not exceed 31.0 fl oz/a of Voliam Xpress or 0.24 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per growing season. For suppression only.
	lambda-cyhalothrin + thiamethoxam	4.5 fl oz *Endigo ZC	1	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 7 days between applications.
	0.039–0.078 lb novaluron	6.0–12.0 fl oz Rimon 0.83EC	7	For suppression only. Apply when thrips first appear and when they begin to enter the cabbage head. Reapply at 7- to 14-day intervals to protect new growth. Do not apply more than three times per crop per season or more than 24.0 oz/a per season.
	0.004–0.05 lb pyrethrin	1.0–12.0 fl oz Pyrenone	0	Apply as needed.
	0.047–0.078 lb spinetoram	6.0–10.0 fl oz Radiant SC	1	Do not apply more than 30.0 fl oz/a or make more than five applications per year. Do not exceed two consecutive applications.
	spinosad	4.0–10.0 fl oz Entrust SC	1	Apply when thrips first appear. Do not make more than three applications to a single generation or within a 30-day period.

*Restricted-use pesticide.

(continued)

**Where ranges are given for days to harvest, check product label for specific number of days between insecticide application and harvest of a particular crop.

Insect control in cole crops—broccoli, brussels sprouts, cabbage, and cauliflower *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest**	Remarks and suggestions
Onion thrips <i>(cont.)</i>	thiamethoxam	5.0–11.0 Platinum 2SC 3.0–5.5 oz Actara 25WDG	30	Do not follow applications of Platinum with foliar applications of any other neonicotinoid insecticide. Platinum may be applied to direct-seeded crops in-furrow at seeding or transplant depth, or as a narrow surface band above the seedling and followed by irrigation. Do not apply more than 11.0 oz/a per season. Actara is applied as a foliar spray.
	0.198–0.257 lb thiamethoxam + chlorantraniliprole	10.0–13.0 fl oz Durivo	30	Do not exceed a total of 13.0 fl oz/a Durivo (0.257 lb ai/a) per growing season. Do not exceed 0.172 lb ai/a of thiamethoxam-containing products or 0.2 lb ai/a of chlorantraniliprole-containing products per season.
	0.2–0.25 lb zeta-cypermethrin	3.2–4.0 oz *Mustang Max	1	Apply when thrips enter cabbage head. Treat every 7 days as needed. Use a minimum of 15 gal/a of finished spray. Do not exceed 24.0 oz/a Mustang Max per season.
	0.1 lb zeta-cypermethrin + bifenthrin	10.3 fl oz *Hero	7	Do not apply more than 0.45 lb ai/a per season. Wait at least 7 days between applications.

*Restricted-use pesticide.

** Where ranges are given for days to harvest, check product label for specific number of days between insecticide application and harvest of a particular crop.

Weed control in cole crops—broccoli, brussels sprouts, cabbage, and cauliflower

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Annual weeds	0.25–0.50 lb clomazone	<i>direct seeded:</i> 0.67 pt Command 3ME <i>transplant:</i> 0.67–1.3 pt Command 3ME	45	Cabbage only. For suppression and control of annual grasses and broadleaves. Make a single application before seeding or transplanting or after seeding but before crop emergence. Place seed or roots of transplants below the chemical barrier when planting. Strictly follow all precautions and restrictions on the label to minimize offsite movement and carryover. Read the vegetable disclaimer section of the label—the end user assumes all liability for failure to perform and crop injury.
	1.0 lb napropamide	2.0 lb Devrinol 50-DF		Apply and shallowly incorporate before planting or apply after seeding or transplanting and sprinkler irrigate within 24 hours. Use lower rate on light soil. Do not use on soil with more than 10% organic matter.
	0.475–1.0 lb pendimethalin	1.0–2.1 pt Prowl H ₂ O	60 (broccoli) 70 (other cole crops)	Prowl H ₂ O may only be applied as a postemergence-directed spray between the rows to broccoli, brussels sprouts, cabbage, and cauliflower. Apply postemergence-directed to two- to four-leaf transplants at 1–3 days after transplanting or to the two- to four-leaf stage of direct-seeded plants.

*Restricted-use pesticide.

(continued)

Pest management

Asparagus

Bean

Carrot

Celery

Cole crops

Cucumber

Weed control in cole crops—broccoli, brussels sprouts, cabbage, and cauliflower *(continued)*

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Annual weeds <i>(cont.)</i>	0.5–1.0 lb trifluralin	1.0–2.0 pt Treflan HFP or equivalent		Apply before transplanting. Treflan is also registered at lower rates for direct-seeded cole crops. Controls annual grasses and some broadleaves, but is weak on wild mustard, smartweed, common ragweed, velvetleaf, and black nightshade. Rate varies with soil texture and organic matter. Follow recommended soil preparation, application, and incorporation procedures. Must be incorporated within 24 hours. See label for plantback restrictions. Ineffective on peat and muck soils.
Annual grasses	5.0–6.0 lb bensulide	5.0–6.0 qt Prefar 4E		Apply before planting. Incorporate 1–2 inches deep to avoid loss due to volatilization. Use on mineral soils only.
Annual broadleaves	0.25–0.5 lb oxyfluorfen	1.0–2.0 pt Goal 2XL 0.5–1.0 pt GoalTender		For use on transplanted broccoli, cabbage, and cauliflower only. Apply after final tillage but before transplanting. Do not use on direct-seeded cole crops. Use low rate on coarse-textured soils with less than 1% organic matter. If plants contact treated soil, some foliar burn may occur but plants generally outgrow symptoms rapidly. For wider-spectrum weed control, use Goal following preplant-incorporated Treflan. Do not apply if an acetanilide herbicide such as Dual Magnum has been applied during the current growing season.
Annual grasses and some broadleaves	4.5–10.5 lb DCPA	6.0–14.0 lb Dacthal W-75 6.0–14.0 pt Dacthal FL		Make preemergence applications to weed-free soil at seeding or immediately after transplanting. Can be preplant-incorporated. Use only on soils with 5% or less organic matter.
	0.07–0.375 lb sulfentrazone	2.25–12.0 fl oz Spartan 4F		For transplanted processing cabbage only. May be surface-applied in spring before transplanting. It may also be preplant incorporated or applied as a preemergent treatment. When used as a preemergent treatment, Spartan should be applied before transplanting. Banded application to row middles may be made within 72 hours after transplanting. Rate is based on soil texture and organic matter. Do not apply more than 12.0 oz/a per 12-month period.
Emerged weeds	glyphosate	several manufacturers and formulations		See manufacturer's label to assure that the formulation is labeled for this crop and for specific instructions. Glyphosate may be applied any time before crop emerges. Apply before crop germination in coarse sandy soils. If weeds have been mowed or tilled, wait until they have resumed active growth and reached the recommended stage on the label. Allow 7 or more days before tilling treated fields. Do not tank mix with soil-residual herbicides unless otherwise specified.
	*paraquat	several manufacturers and formulations, not all are registered for this use		Prepare seedbed early to allow for maximum weed emergence. Band or broadcast apply before, during, or after planting, but before crop emergence. In preplant and preemergence (to the crop) uses, do not apply to soils lacking clay minerals (i.e., muck, pure sand). Use the higher rate for heavy weed infestations. Seed and transplant with minimal soil disturbance. Always add crop oil concentrate or non-ionic surfactant to spray mixture. Follow precautions on label.
Emerged broadleaves	0.09375–0.187 lb clopyralid	0.25–0.5 pt Stinger	30	Controls many broadleaf weeds including common ragweed, nightshade species, and galinsoga. Suppresses Canada thistle and annual sowthistle. Do not exceed 0.5 pt/a per year. Note rotational crop interval restrictions before use.

*Restricted-use pesticide.

(continued)

Pest management

Asparagus

Bean

Carrot

Celery

Cole crops

Cucumber

Weed control in cole crops—broccoli, brussels sprouts, cabbage, and cauliflower *(continued)*

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Emerged grasses	0.068–0.12 lb clethodim	9.0–16.0 oz Select Max	30	Apply to actively growing grasses. Repeat treatments may be made at 14-day intervals up to the maximum annual use rate. Do not cultivate grasses within 7 days before or after application. Include appropriate surfactant as required by product label. Do not apply if rain is expected within 1 hour.
	0.094–0.125 lb clethodim	6.0–8.0 oz Select 2EC	30	
	0.094–0.28 lb sethoxydim	0.5–1.5 pt Poast	30	Make postemergence applications to actively growing grasses within the size ranges indicated on the label. Check the label for wild proso millet or rescue treatment rates. Do not apply more than 3.0 pt/a Poast in one crop season. Always add 2.0 pt/a of oil concentrate. Check the label for additional precautions and restrictions.

*Restricted-use pesticide.

Pest management

Asparagus

Bean

Carrot

Celery

Cole crops

Cucumber

Cucumber

Pest management

Asparagus

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Cucumber

Planting

Pickling cucumbers

Hand-harvested plantings: **Rows**—36–60 inches; **plants in row**—12–24 inches apart (narrower row spacings), 9–15 inches apart (wider row spacings). The resulting plant population will be 7,000–25,000 plants/a depending on variety.

Machine-harvested plantings: **Rows**—18–28 inches; **seed**—4–6 inches. The resulting plant population will be 50,000–90,000 plants/a.

Slicing cucumbers

Rows: 48–72 inches.

Plants in row: 12–24 inches apart.

Plant seed 0.75–1.5 inches deep, depending on soil type and moisture. Reduce planting depth on heavier soils or when soils are cool and moist at planting.

If hand harvesting, plant seeds with corn or bean planter and use appropriate cucumber plates. For machine harvesting, use precision planting to eliminate thinning.

Cucumbers will grow on a wide variety of soils if they are well drained and have a high fertility level. To use machine harvesting, the fields must be level and stone-free. Avoid excessive tillage, which can cause moisture loss, soil compaction, and crusting.

Cucumbers are a warm season crop and require growing temperatures of 60–75°F. They will not tolerate frost, so avoid fields that have frost pockets. Temperatures above 90°F or below 60°F slow growth. Good seed germination requires soil temperatures of 55–95°F. Because of these requirements, do not plant seed in northern Wisconsin before June 1.

Irrigation

Cucumbers require a constant supply of moisture, especially during blossom and fruit development. Silt and clay soils have a relatively high moisture-holding capacity, so normal rainfall is usually adequate for cucumber production on these soils. Sandy soils do not hold much moisture and irrigation is essential for profitable cucumber production. If the WISP scheduling program is used, the AD value for sands is 1.0 inch. The AD value for silt loams is 2.5 inches.

Lime and fertilizer

Lime: Use dolomitic limestone to maintain a pH of 5.8 on mineral soils and 5.6 on organic soils.

Fertilizer rates: Apply P_2O_5 and K_2O according to soil test recommendations. Use annual nitrogen, P_2O_5 , and K_2O recommendations in table below. Take credits for previous legume crops and manure.

Application: For hand-harvested plantings, apply fertilizer in a band 2 inches below the seed at planting. For destructive, machine-harvested plantings, fertilizer can be planter applied or broadcast and worked in before planting.

Nitrogen: Split nitrogen recommendation into two or more applications during the season. Make the first application when plants have two to three true leaves. Make a second application when vines begin to fill the rows. For hand harvest, apply 15–20 lb N/a at 10–14 day intervals after harvest has begun. These applications can be made through the irrigation system.

Pollinating

Hand-harvested acreage: Typically, the natural bee population provides adequate pollination.

Machine-harvested acreage: Supplement the natural bee population by adding one colony (40,000–60,000 bees)/a in the field at blossoming time. (Note: many beekeepers provide pollinating services.)

Disease control

Many cucumber cultivars are resistant to several important diseases including angular leaf spot, anthracnose, cucumber mosaic virus, downy mildew, powdery mildew, and scab. Use resistant varieties and disease-free seed. Practice a 3- to 4-year rotation. Planting cultivars with multiple disease resistance minimizes the need for fungicide and bactericides on this crop.

Annual nitrogen, phosphate, and potash recommendations for cucumber

Nitrogen		Phosphate and potash		
Organic matter (%)	Amount to apply (lb/a)	Yield goal (bu/a)	Amount P_2O_5 to apply* (lb/a)	Amount K_2O to apply* (lb/a)
<2	100	300–400	10	25
2.0–9.9	80			
10–20	60			
>20	30			

*Amounts shown are for optimum (O) soil test levels. Apply 50% of this rate if soil test is high (H) and omit if soil test is excessively high (EH). If soil test is low (L) or very low (VL), increase rates according to soil test recommendations.

Disease control in cucumber

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Alternaria leaf blight	azoxystrobin	11.0–15.4 fl oz Quadris Flowable	1	<p>Quadris, Cabrio, and Reason belong to the Group 11 (strobilurin) fungicide category. Quadris Opti contains a combination of Group 11 and M5 fungicides. Tanos contains a combination of Group 11 and Group 27 fungicides. Do not exceed one application of any of these products before alternating with a fungicide having a different mode of action. Do not exceed four applications of strobilurin fungicides per crop per year. Do not exceed 92.3 fl oz/a Quadris, 1.0 lb ai/a Quadris Opti, 32.0 oz/a Tanos, 22.0 fl oz/a Reason, or 64.0 oz/a Cabrio per season. Tanos must be tank mixed with a contact fungicide such as mancozeb, chlorothalonil, or a copper-containing fungicide. Following the last application of Reason 500 SC, do not rotate to wheat for 30 days; for all other crops, wait 1 year before rotating.</p> <p>Do not apply more than 26.0 oz/a Endura per year. Do not make more than four applications per year.</p> <p>Pristine belongs to Groups 7 and 11 fungicide categories. Do not exceed one application of Pristine before alternating to a labeled fungicide with a different mode of action. Do not exceed four applications of Pristine or any other Group 7 or 11 fungicides per season. Do not exceed 74.0 oz/a Pristine per season.</p> <p>Apply when conditions favor disease. Do not apply more than 15.75 lb ai/a of chlorothalonil products per year.</p> <p>Do not apply more than 80.0 fl oz/a per year. Make no more than two sequential applications before alternating to an effective fungicide with a different mode of action.</p> <p>Do not apply more than 56.0 fl oz/a per year. Make no more than two sequential applications before alternating to an effective fungicide with a different mode of action.</p> <p>Root and cutting dip treatment, soil drench, and seed treatments are registered. See label for application details. Follow tank-mixing instructions on label; some incompatibility issues exist. Cucurbit section of label for further details among crop grouping. Allowable for use in organic systems.</p> <p>Consult label for seasonal product limits.</p>
	azoxystrobin + chlorothalonil	3.2 pt Quadris Opti	1	
	azoxystrobin + difenoconazole	12.0–14.0 fl oz Quadris Top	1	
	famoxadone + cymoxanil	8.0 oz Tanos	3	
	fenamidone	5.5 fl oz Reason 500 SC	14	
	pyraclostrobin	12.0–16.0 oz Cabrio EG	0	
	boscalid	6.5 oz Endura	0	
	boscalid + pyraclostrobin	12.5–18.5 oz Pristine WDG	0	
	chlorothalonil	2.0–3.0 pt Bravo Weather Stik, Equus 720 1.8–2.7 lb Bravo Ultrex 82.5WDG, Equus DF 2.25–2.75 pt Bravo Zn, Echo Zn, Equus 500 Zn	0	
			0	
			7	
	cyprodinil + difenoconazole	16.0–20.0 fl oz Inspire Super	7	
	cyprodinil + fludioxonil	11.0–14.0 oz Switch 62.5WG	1	
	hydrogen dioxide	1:100–1:2000 dilution rate OxiDate	0	
	mancozeb (<i>Cercospora leaf spot</i>)	1.6–2.4 qt Dithane F-45	5	
2.0–3.0 lb Dithane DF Rainshield		5		
1.6–2.4 qt Manzate Flowable		5		
2.0–3.0 lb Manzate Pro-Stick		5		
1.2–2.4 qt Penncozeb 4FL		5		
1.5–3.0 lb Penncozeb 75DF, 80WP		5		

(continued)

Pest management

Asparagus

Bean

Carrot

Celery

Cole crops

Cucumber

Disease control in cucumber *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions	
Alternaria leaf blight (<i>cont.</i>)	penthioopyrad	12.0–16.0 fl oz Fontelis	1	Make no more than two sequential applications before alternating to an effective fungicide with a different mode of action. Do not exceed 67.0 fl oz/a per year. Can be used on greenhouse-grown cucumbers. See label for specific instructions on greenhouse rates.	
	zoxamide + mancozeb	1.5–2.0 lb Gavel 75DF	5	Do not exceed eight applications or apply more than 16.0 lb/a product (10.67 lb ai/a mancozeb and 1.33 lb ai/a zoxamide) per season.	
Angular leaf spot (<i>Pseudo-monas</i>)	fixed copper	1.3 pt Champ Formula 2	0	Use disease-free seed and rotate crops. Many cultivars are resistant to this disease. If needed, begin applications before fruit appear. Copper sprays are most effective when applied immediately after a rain or wind storm has damaged foliage.	
		1.5–3.0 lb Champion 77WP	0		
		1.5–2.0 lb Kocide 77WP, DF	0		
		2.0–2.3 pt Kocide LF 2.4F	0		
		1.0–2.25 lb Kocide 2000 DF	0		
0.5–1.25 lb Kocide 3000	0				
Anthracnose	azoxystrobin	11.0–15.5 fl oz Quadris Flowable	1	See remarks for these products in the Alternaria leaf blight listing. Make no more than one application of a strobilurin-containing fungicide before alternating to another fungicide with a different mode of action.	
		3.2 pt Quadris Opti	1		
		12.0–14.0 fl oz Quadris Top	1		
		cymoxanil + famoxadone	8.0 oz Tanos		3
		pyraclostrobin	12.0–16.0 oz Cabrio EG		0
Carrot	boscalid + pyraclostrobin	18.5 oz Pristine WDG	0	Pristine belongs to Groups 7 and 11 fungicide categories. Do not exceed two sequential applications of Pristine before alternating to a labeled fungicide with a different mode of action. Do not exceed four applications of Pristine or of any other Group 7 or 11 fungicides per season. Do not exceed 74.0 oz/a Pristine per season.	
		chlorothalonil	1.5–2.0 pt Bravo Weather Stik, Echo 720, Equus 720	0	Apply when conditions favor disease.
			1.4–1.8 lb Bravo Ultrex 82.5WDG, Equus DF	0	
Celery	cyprodinil + difenoconazole	1.3–1.6 lb Echo 90DF	0	Do not apply more than 80.0 fl oz/a per year. Make no more than two sequential applications before alternating to an effective fungicide with a different mode of action.	
		16.0–20.0 fl oz Inspire Super	7		
Cole crops	hydrogen dioxide	1:100–1:2000 dilution rate OxiDate	0	Root and cutting dip treatment, soil drench, and seed treatments are registered. See label for application details. Follow tank-mixing instructions on label; some incompatibility issues exist. See cucurbit section of label for further details among crop grouping. Allowable for use in organic systems.	

(continued)

Pest management

Asparagus

Bean

Carrot

Celery

Cole crops

Cucumber

Disease control in cucumber *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Anthracnose <i>(cont.)</i>	mancozeb	1.6–2.4 qt Dithane F-45	5	Do not apply more than 24.0 lb/a per year. Consult label for seasonal product limitations.
		2.0–3.0 lb Dithane DF Rainshield	5	
		2.0–3.0 lb Koverall	5	
		1.6–2.4 qt Manzate Flowable	5	
		2.0–3.0 lb Manzate Pro-Stick	5	
		1.2–2.4 qt Penncozeb 4FL	5	
		1.5–3.0 lb Penncozeb 75DF, 80WP	5	
thiophanate methyl	10.0 fl oz Topsin 4.5FL 0.5 lb Topsin M 70W, 70WDG, Topsin M WSB 0.2–0.4 lb Thiophanate methyl 85 WDG	0	Apply when disease first appears and repeat if needed every 7–14 days.	
Bacterial wilt <i>(Erwinia)</i>	<i>Eliminate the cucumber beetles that carry this pathogen (see Insect Control table).</i>			
Belly rot	azoxystrobin	11.0–15.5 fl oz Quadris Flowable	1	See remarks for Quadris and Cabrio in the Alternaria leaf blight listing. For belly rot control, the first application should be made at the one- to three-leaf crop stage with a second application just prior to vine tip or 10–14 days later.
	azoxystrobin + difenoconazole	12.0–14.0 fl oz Quadris Top	1	
	pyraclostrobin	12.0–16.0 oz Cabrio EG	0	
Black rot	<i>See fungicide treatments recommended for anthracnose.</i> fixed copper			Use certified disease-free seed. Destroy infected plant refuse.
Downy mildew	azoxystrobin + chlorothalonil	3.2 pt Quadris Opti	1	See remarks for these products in Alternaria leaf blight section.
	cymoxanil + famoxadone	8.0 oz Tanos 50DF	3	
	boscalid + pyraclostrobin	12.5–18.5 Pristine WDG	0	Pristine belongs to Groups 7 and 11 fungicide categories. Do not exceed one application of Pristine before alternating to a labeled fungicide with a different mode of action. Do not exceed four applications of Pristine or other Group 7 or Group 11 fungicides per season. Do not exceed 74.0 oz/a Pristine per season.
	cyazofamid	2.1–2.75 fl oz Ranman	0	Ranman belongs to Group 21 fungicide category. Do not apply more than six sprays of Ranman per crop. Alternate Ranman sprays with a fungicide having a different mode of action. Do not apply more than 16.5 fl oz/a per year.
	cymoxanil	3.2–5.0 oz Curzate	3	Use only in combination with a protectant fungicide such as mancozeb, copper hydroxide, or chlorothalonil. Make no more than nine applications of Curzate in 1 year.
	dimethomorph	6.0 fl oz Forum	0	Do not exceed 30.0 fl oz/a or five applications per season. Do not make more than two sequential applications before alternating to another effective fungicide with a different mode of action for at least one application.
	fenamidone	5.5 fl oz Reason 500 SC	14	Begin applications when conditions favor disease.

(continued)

Pest management

Asparagus

Bean

Carrot

Celery

Cole crops

Cucumber

Disease control in cucumber *(continued)*

	Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions	
Pest management	Downy mildew (cont.)	fixed copper	1.5–3.0 lb Champion 77WP	0	Use disease-free seed and rotate crops. Begin applications before fruit form at less than 7-day intervals. After a rain and wind storm, make two or three applications as soon as possible after the storm at 2- to 3-day intervals.	
			1.3 pt Champ Formula 2	0		
			1.5–2.0 lb Kocide 77WP	0		
			1.5–2.0 lb Kocide DF	0		
			2.6 pt Kocide LF 2.4F	0		
			1.0–2.25 lb Kocide 2000 DF	0		
0.5–1.25 lb Kocide 3000	0					
Asparagus		fluopicolide	3.0–4.0 fl oz Presidio Fungicide	2	Tank mix this product with another labeled non-Group 43 fungicide. Label recommends a 10-day spray interval.	
			fosetyl-al	2.0–5.0 lb Aliette WDG, Linebacker WDG	12 hr	Begin applications when conditions favor disease development (high moisture and moderate temperatures). Repeat at 7- to 14-day intervals. Do not exceed seven applications per season.
Bean		hydrogen dioxide	1:100–1:2000 dilution rate OxiDate	0	Root and cutting dip treatment, soil drench, and seed treatments are registered. See label for application details. Follow tank-mixing instructions on label; some incompatibility issues exist. See cucurbit section of label for further details among crop grouping. Allowable for use in organic systems.	
			mancozeb	1.6–2.4 qt Dithane F-45	5	Do not apply more than 24.0 lb/a per year. Consult label for seasonal product limitations.
2.0–3.0 lb Dithane DF	5					
Rainshield	5					
2.0–3.0 lb Koverall	5					
1.6–2.4 qt Manzate Flowable	5					
2.0–3.0 lb Manzate Pro-Stick	5					
Carrot		mandipropamid	1.2–2.4 qt Penncozeb 4FL	5	Make no more than one application before switching to another effective non-Group 40 fungicide.	
			1.5–3.0 lb Penncozeb 75DF, 80WP	5		
			8.0 fl oz Revus	0		
Celery		phosphorous acid, mono- and dibasic sodium, potassium, and ammonium salts	2.5–5.0 pt Phostrol	0	Do not exceed seven applications per season.	
			potassium phosphite	1.0–3.0 qt Fosphite/100 gal water	0	Do not apply to plants that are stressed due to heat or moisture. Do not apply when leaf wetness periods of more than 4 hours are expected. Do not apply at less than 3-day intervals.
Cole crops		propamocarb hydrochloride	1.2 pt Previcur Flex	2	Do not apply more than 6.0 pt/a Previcur Flex per season. Most effective when applied preventatively.	
			0.6–1.2 pt Previcur Flex + tank-mix partner			
Cucumber		pyraclostrobin	8.0–12.0 oz Cabrio EG	0	See remarks for this product in Alternaria leaf blight section.	
			trifloxystrobin	4.0 oz Flint	0	Do not make more than four applications per crop per year of Flint. Do not make subsequent applications of Flint. Alternate fungicide modes of action to limit development of resistance.
				zoxamide + mancozeb	1.5–2.0 lb Gavel 75DF	5

(continued)

Disease control in cucumber *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Fusarium wilt	<i>The only practical control is to grow wilt-resistant varieties. Rotate with crops other than melons.</i>			
Mosaic	<i>Plant resistant varieties. When possible, control by isolation from the following plants: burdock, catnip, china aster, chrysanthemum, wild cucumber, geranium, gladiolus, wild ground cherry, horse nettle, hyacinth, jimsonweed, larkspur, lily, marigold, milkweed, morning glory, nasturtium, petunia, phlox, pokeweed, salvia, snapdragon, lowering spurge, tulip, white cockle, and zinnia. Control aphids that spread the disease (see Insect Control table).</i>			
Phytophthora blight or crown rot <i>(Phytophthora capsici)</i>	cyazofamid	2.75 fl oz Ranman 400SC	0	Do not apply more than six sprays or 16.5 fl oz/a per year. Alternate Ranman (Group 21) sprays with a fungicide having a different mode of action. Crops not listed on the label should not be planted within 30 days after the last application.
	dimethomorph	6.0 fl oz Forum	0	Do not exceed 30.0 fl oz/a or five applications per season. Do not make more than two sequential applications of Forum before alternating to another effective fungicide with a different mode of action for at least one application.
	famoxadone + cymoxanil	8.0–10.0 oz Tanos	3	Do not make more than one application before alternating with a fungicide having a different mode of action. Do not exceed four applications of Tanos or other Group 11 fungicides per season and do not alternate Tanos with other Group 11 fungicides. Do not exceed 32.0 oz/a Tanos per crop per season. Tanos is helpful for suppressing Phytophthora blight, but it must be tank mixed with a contact fungicide such as mancozeb, chlorothalonil, or a copper-containing fungicide.
	fluopicolide	3.0–4.0 fl oz Presidio Fungicide	2	Tank mix this product with another labeled non-Group 43 fungicide. Label recommends a 10-day spray interval.
	fosetyl-al	2.0–5.0 lb Aliette WDG, Linebacker WDG	12 hr	Begin applications when conditions favor disease development (high moisture and moderate temperatures). Repeat at 7- to 14-day intervals. Do not exceed seven applications per season.
	hydrogen dioxide	1:100–1:2000 dilution rate OxiDate	0	Root and cutting dip treatment, soil drench, and seed treatments are registered. See label for application details. Follow tank-mixing instructions on label; some incompatibility issues exist. See cucurbit section of label for further details among crop grouping. Allowable for use in organic systems.
	mandipropamid	8.0 fl oz Revus	0	Do not exceed one application before switching to another effective non-Group 40 fungicide.
	phosphorous acid, mono- and dibasic sodium, potassium, and ammonium salts	2.5–5.0 pt Phostrol	0	Do not exceed seven applications per season.
	potassium phosphite	1.0–3.0 qt Fosphite/100 gal water	0	Do not apply to plants that are stressed due to heat or moisture. Do not apply when leaf wetness periods of more than 4 hours are expected. Do not apply at less than 3-day intervals.
zoxamide + mancozeb	1.5–2.0 lb Gavel 75DF	5	Do not exceed eight applications or apply more than 16.0 lb/a product (10.67 lb ai/a mancozeb or 1.33 lb ai/a zoxamide) per season.	

(continued)

Pest management

Asparagus

Bean

Carrot

Celery

Cole crops

Cucumber

Disease control in cucumber *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Powdery mildew	azoxystrobin	11.0–15.5 fl oz Quadris Flowable	1	Quadris, Flint, and Cabrio are Group 11 (strobilurin) fungicides. Do not exceed one application of any of these products before alternating with a fungicide having a different mode of action. Do not make more than four applications of Group 11 fungicides or exceed 1.92 qt/a Quadris, 8.0 oz/a Flint, or 64.0 oz/a Cabrio per crop per season. Do not tank mix any of these products with additives or adjuvants. See labels for listing of products that should not be tank mixed with these materials.
	pyraclostrobin	12.0–16.0 oz Cabrio EG	0	
	trifloxystrobin	1.5–2.0 oz Flint	0	
	boscalid + pyraclostrobin	12.5–18.5 oz Pristine WDG	0	Pristine belongs to Group 7 and 11 fungicide categories. Do not exceed two sequential applications of Pristine before alternating to a fungicide with a different mode of action. Do not exceed four applications of Pristine or other Group 7 or Group 11 fungicides per season. Do not exceed 74.0 oz/a Pristine per season.
	clarified hydrophobic extract of neem oil	0.5–1.0% Trilogy in 25–100 gal water or 2.0 pt in at least 5 gal water/a	0	Do not apply more than 2 gal of Trilogy/a. OMRI-approved.
	cyflufenamid	3.4 oz Torino	0	Do not make more than two applications/a per year. Do not exceed a total of 6.8 oz/a per year.
	cyprodinil + difenoconazole	16.0–20.0 fl oz Inspire Super	7	Do not apply more than 80.0 fl oz/a per year. Make no more than two sequential applications before alternating to an effective fungicide with a different mode of action.
	cyprodinil + fludioxonil	11.0–14.0 oz Switch 62.5WG	1	Do not apply more than 56.0 fl oz/a per year. Make no more than two sequential applications before alternating to an effective fungicide with a different mode of action.
	hydrogen dioxide	1:100–1:2000 dilution rate OxiDate	0	Root and cutting dip treatment, soil drench, and seed treatments are registered. See label for application details. Follow tank-mixing instructions on label; some incompatibility issues exist. See cucurbit section of label for further details among crop grouping. Allowable for use in organic systems.
	kresoxim methyl	3.2–4.8 oz Sovran	0	Do not apply more than 19.2 oz/a per season. Begin application prior to onset of disease.
	myclobutanil	2.5–5.0 oz Rally 40WSP	0	Do not exceed 1.5 lb/a product (0.6 lb ai/a) per year. Observe a 30-day plantback interval between last application and planting new crops.
	potassium phosphite	1.0–3.0 qt Fosphite/100 gal water	0	Do not apply to plants that are stressed due to heat or moisture. Do not apply when leaf wetness periods of more than 4 hours are expected. Do not apply at less than 3-day intervals.
	tebuconazole	4.0–6.0 fl oz Folicur 3.6 F, Monsoon, Orius 3.6F, Tebusha 3.6FL, TebuStar 3.6L, Tebuzol 3.6F, Toledo	7	Do not exceed 24.0 fl oz per season. Most effective when applied preventatively.
	thiophanate methyl	0.5 lb Topsin M 70W, Topsin M WSB 10 fl oz Topsin 4.5FL 0.2–0.4 lb Thiophanate methyl 85WDG	0 0 0	Apply when disease first appears and repeat if needed every 7–14 days.

(continued)

Disease control in cucumber *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions	
Powdery mildew <i>(cont.)</i>	triflumizole	4.0–8.0 oz Procure 50WS, Procure 480SC	0	Do not apply more than 40.0 oz of Procure per season. See product label for plantback restrictions for leafy vegetables (30 days), root vegetables (60 days) and all other crops (1 yr).	
Seed rot and damping-off	captan	0.5–1.0 teaspoon Captan 50% WP/lb of dry seed	—	Use disease-free soil. Water plants in morning. Chemical listed is seed treatment. Do not use treated seed for feed or food.	
	mefenoxam	1.0–2.0 pt Ridomil Gold SL	—	Preplant-incorporated application or surface application at planting. Preplant to top 2 inches of soil.	
		2.0–4.0 pt Ultra Flourish	—		
			0.085–0.64 fl oz Apron XL/100 lb seed	—	Follow manufacturer’s directions. Do not use treated seed for feed or food.
	mefenoxam + azoxystrobin		0.34 fl oz Uniform/1,000 ft row	—	Apply Uniform as an in-furrow spray in a minimum of 5 gal of water per acre at planting.
	metalaxyl		4.0–8.0 pt MetaStar 2E AG	—	Preplant-incorporated application or surface application at planting. Preplant to top 2 inches of soil.
			0.7 fl oz Sebring 2.65 ST/100 lb seed	—	
		0.75 fl oz/100 lb seed Allegiance FL, Metalaxyl 265 ST	—		
thiram		0.75 teaspoon Thiram 50%WP/lb seed	—	Use disease-free soil. Water plants in morning. Chemical listed is seed treatment. Do not use treated seed for feed or food.	

Scouting calendar for insect pests in cucumber

	April			May			June			July			August			September		
	early	mid	late	early	mid	late	early	mid	late	early	mid	late	early	mid	late	early	mid	late
Wireworms																		
				Striped and spotted cucumber beetles														
				Seed maggot														
				Aphids						Aphids								
										Mites								

Pest management

Asparagus

Bean

Carrot

Celery

Cole crops

Cucumber

Insect control in cucumber

(Note: heavy applications and certain formulations may be phytotoxic to cucumbers.)

Pest management	Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
	Bean aphid and soybean aphid	spirotetramat	4.0–5.0 fl oz Movento	1 (edible) 7 (dry)	Do not apply more than 10.0 fl oz/a per season and allow at least 7 days between applications.
Asparagus	Cucumber beetles (striped, spotted)	<i>Treat when there are more than 4–5 adults per 50 plants. Cucumber beetles are vectors of bacterial wilt. High beetle populations (more than 20 per plant) may overwhelm the ability of the insecticide to control beetles quickly enough to stop the transmission of the wilt-causing bacterium.</i>			
		0.047–0.10 lb acetamiprid	2.5–5.3 oz Assail 30 SG	0	Do not exceed five applications or 26.5 oz/a product per crop season.
		0.05–0.10 lb acetamiprid	1.1–2.3 oz Assail 70WP	0	Do not exceed five applications or 11.5 oz/a of product per crop season.
Bean		0.019–0.022 lb beta-cyfluthrin	2.4–2.8 fl oz *Baythroid XL	0	Apply every 7 days as needed. Do not exceed 11.2 fl oz/a.
		0.04–0.10 lb bifenthrin	2.6–6.4 fl oz *Brigade 2EC	3	Apply before insects reach threshold levels. May repeat applications after 7 days, but do not make more than two applications after bloom. Do not exceed 0.3 lb ai/a per season.
		0.08–0.10 lb bifenthrin	6.8–8.5 fl oz *Capture LFR	21	Do not apply more than 0.1 lb ai/a per season as an at-plant application. Do not apply more than 0.5 lb ai/a per season including other bifenthrin products (e.g., Brigade 2EC).
		bifenthrin + zeta-cypermethrin	4.0–10.3 fl oz *Hero	3	Do not apply more than 10.3 fl oz/a per season and allow at least 7 days between applications. Do not apply more than 41.2 fl oz of product/a per crop season.
		0.5–1.0 lb carbaryl	2.0 lb Sevin 50WP 1.25 lb Sevin 80S 1.0 qt Sevin XLR Plus	1	See label for rate. Do not apply during maximum flowering or fruit set, or when pollinating bees are in the field. Spray during the evening.
		clothianadin	<i>foliar:</i> 3.0–4.0 fl oz Belay <i>soil:</i> 9.0–12.0 fl oz Belay	21 —	Do not apply more than 12.0 fl oz/a per season and allow at least 7 days between applications. Do not apply more than 12.0 fl oz/a per season. Apply as a narrow band centered on the plant row; as an in-furrow spray at planting; as a side dress to both sides of the row; as a transplant water drench; or as chemigation into root zone through drip, trickle or micro-sprinkler, or similar equipment.
Celery		0.018–0.028 lb deltamethrin	1.5–2.4 fl oz *Delta Gold	3	Apply every 3 days as needed. Do not exceed 14.4 fl oz/a per season.
		0.132–0.179 lb dinotefuran	3.0–4.0 oz Venom 70SG	1	Do not exceed 6.0 oz/a Venom per season.
Cole crops		0.5–1.0 lb endosulfan	0.66–1.33 qt Phaser EC 1.0–2.0 lb Thiodan WP	2	Do not exceed 3.0 lb ai/a or six applications per season.
		0.03–0.05 lb esfenvalerate	5.8–9.6 fl oz *Asana XL	3	Do not exceed 0.25 lb ai/a per season.
		0.2–0.3 lb fenpropathrin	10.66–16.0 oz Danitol 2.4EC	7	Do not exceed 2.66 pt/a per season.
		0.25–0.375 lb imidacloprid	7.0–10.5 fl oz Admire Pro	21	Apply in a narrow band centered on plant row within 14 days before planting or as an in-furrow treatment during planting. Do not exceed 0.38 lb ai/a per year.
Cucumber		0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4	Do not exceed 0.18 lb ai/a per season. Reapply at intervals of 5 or more days.

*Restricted-use pesticide.

(continued)

Insect control in cucumber *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Cucumber beetles <i>(cont.)</i>	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Voliam Xpress	3	Do not exceed 31.0 fl oz/a of Voliam Xpress or 0.24 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per growing season.
	lambda-cyhalothrin + thiamethoxam	4.0–4.5 fl oz *Endigo ZC	1	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 5 days between applications.
	0.9–1.75 lb malathion	several formulations	1	
	0.5–1.0 lb methomyl	1.5–3.0 pt *Lannate LV 0.5–1.0 lb *Lannate SP	1–3	See label for days to harvest.
	0.5–1.0 lb oxamyl	2.0–4.0 pt *Vydate L	1	Make first application 2–4 weeks after planting. Repeat 2–3 weeks later.
	0.1–0.2 lb permethrin	*Ambush, *Pounce	0	See label for rate. Do not apply more than 1.6 lb ai/a per season.
	thiamethoxam	5.0–11.0 Platinum 2SC 3.0–5.5 oz Actara 25WDG	30	Do not follow applications of Platinum with foliar applications of any other neonicotinoid insecticide. Platinum may be applied to direct-seeded crops in-furrow at seeding or transplant depth or as a narrow surface band above the seedling and followed by irrigation. Do not apply more than 11.0 oz/a per season. Actara is applied as a foliar spray.
	0.198–0.257 lb thiamethoxam + chlorantraniliprole	10.0–13.0 fl oz Durivo	30	Do not exceed a total of 13.0 fl oz/a Durivo (0.257 lb ai/a) per growing season. Do not exceed 0.172 lb ai/a of thiamethoxam-containing products or 0.2 lb ai/a of chlorantraniliprole-containing products per season.
	0.018–0.025 lb zeta-cypermethrin	2.8–4.0 oz *Mustang Max	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Max per season.
	Cutworms, cabbage looper	0.0065–0.0125 lb beta-cyfluthrin	0.8–1.6 fl oz *Baythroid XL	0
bifenthrin		2.6–6.4 fl oz *Brigade 2EC	3	Apply before insects reach threshold levels. May repeat applications after 7 days, but do not make more than two applications after bloom. Do not exceed 0.3 lb ai/a per season.
		3.4–6.8 fl oz *Capture LFR	21	Do not apply more than 0.1 lb ai/a per season as an at-plant application. Do not apply more than 0.3 lb ai/a per season including other bifenthrin products (e.g., Brigade 2EC).
bifenthrin + zeta-cypermethrin		4.0–10.3 fl oz *Hero	3	Do not apply more than 10.3 fl oz/a per season and allow at least 7 days between applications. Do not apply more than 41.2 fl oz of product/a per crop season.
1.0 lb carbaryl		Sevin Bait	1	See label for rate. Broadcast when cutworms are present in damaging numbers.
0.045–0.065 lb chlorantraniliprole		3.5–5.0 fl oz Coragen	1	Allow at least 3 days between treatments. Do not exceed 15.4 fl oz/a (0.2 lb ai/a) per season.
0.012–0.028 lb deltamethrin		1.0–2.4 fl oz *Delta Gold	3	Apply every 3 days as needed. Do not exceed 14.4 fl oz/a per season.
0.03–0.05 lb esfenvalerate	5.8–9.6 fl oz *Asana XL	3	Do not exceed 0.25 lb ai/a per season.	

*Restricted-use pesticide.

(continued)

Pest management

Asparagus

Bean

Carrot

Celery

Cole crops

Cucumber

Insect control in cucumber *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Cutworms, cabbage looper <i>(cont.)</i>	0.03–0.045 lb flubendiamide	2.0–3.0 oz Synapse WG	1	Do not exceed 3.0 oz/a (0.045 lb ai/a) in a 7-day period or 9.0 oz/a per season.
	flubendiamide + buprofezin	12.0–17.0 fl oz Vetica	7	Do not apply more than 38.0 fl oz/a per season and allow at least 7 days between applications. Do not make more than three applications per crop season.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Voliam Xpress	3	Do not exceed 31.0 fl oz/a of Voliam Xpress or 0.24 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per growing season.
	lambda-cyhalothrin + thiamethoxam	4.0–4.5 fl oz *Endigo ZC	1	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 5 days between applications.
	0.1–0.2 lb permethrin	*Ambush EC, WP	0	See label for rate. Do not apply more than 1.6 lb ai/a per season.
	0.008–0.025 lb zeta-cypermethrin	1.28–4.0 oz *Mustang Max	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Max per season.
Melon aphid	0.047–0.075 lb acetamiprid	2.5–4.0 oz Assail 30 SG	0	Do not exceed five applications or 26.5 oz/a of product per crop season.
	0.05–0.10 lb acetamiprid	1.1–1.7 oz Assail 70WP	0	Do not exceed five applications or 11.5 oz/a of product per crop season.
	0.04–0.10 lb bifenthrin	2.6–6.4 fl oz *Brigade 2EC	3	Apply before insects reach threshold levels. May repeat applications after 7 days, but do not make more than two applications after bloom. Do not exceed 0.3 lb ai/a per season.
	bifenthrin + zeta-cypermethrin	4.0–10.3 fl oz *Hero	3	Do not apply more than 10.3 fl oz/a per season and allow at least 7 days between applications. Do not apply more than 41.2 fl oz of product/a per crop season.
	clothianadin	<i>foliar:</i> 3.0–4.0 fl oz Belay	21	Do not apply more than 12.0 fl oz/a per season and allow at least 7 days between applications.
		<i>soil:</i> 9.0–12.0 fl oz Belay	—	Do not apply more than 12.0 fl oz/a per season. Apply as a narrow band centered on the plant row; as an in-furrow spray at planting; as a side dress to both sides of the row; as a transplant water drench; or as chemigation into root zone through drip, trickle or micro-sprinkler, or similar equipment.
	0.25–0.75 lb diazinon	several formulations	3	Apply as soon as aphids are noticed. Apply no more than five applications per season.
	0.045–0.268 lb dinotefuran	<i>foliar:</i> 1.0–4.0 oz Venom 70SG	1	Do not follow soil applications with foliar applications of any other neonicotinoid insecticide. Use only one application method. Do not apply more than 12.0 oz/a per season using soil applications. See product label for application directions.
		<i>soil:</i> 5.0–6.0 oz Venom 70SG	21	
	0.05–0.18 lb dinotefuran (<i>foliar</i>)	2.0–7.0 oz Scorpion 35SL	1	Can repeat at 7-day intervals. Do not apply more than 10.5 oz per year. Use only one application method.
	0.23–0.27 lb dinotefuran (<i>soil</i>)	9.0–10.5 oz Scorpion 35SL	21	Do not apply more than 21.0 oz per year. Use only one application method.
	0.5–1.0 lb endosulfan	0.66–1.33 qt Phaser EC 1.0–2.0 lb Thiodan WP	2	Do not exceed 3.0 lb ai/a per year.

*Restricted-use pesticide.

(continued)

Insect control in cucumber *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions	
Melon aphid <i>(cont.)</i>	0.062–0.089 lb flonicamid	2.0–2.8 oz Beleaf SG	0	Begin applications before aphid populations build. Do not exceed 2.8 oz/a Beleaf per application and do not apply more than 8.4 oz/a (0.267 lb ai/a) per season.	
	0.25–0.38 lb imidacloprid	7.0–10.5 fl oz Admire Pro	21	Apply in a narrow band centered on plant row within 14 days before planting or as an in-furrow treatment during planting. Do not exceed 0.38 lb ai/a per year.	
	0.03 lb lambda-cyhalothrin	1.92 fl oz *Warrior II	4	Do not exceed 0.18 lb ai/a per season. Reapply at intervals of 5 or more days. For suppression only.	
	lambda-cyhalothrin + chlorantraniliprole	9.0 fl oz *Voliam Xpress	1	Do not exceed 31.0 fl oz/a of Voliam Xpress or 0.18 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per growing season.	
	lambda-cyhalothrin + thiamethoxam	4.0–4.5 fl oz *Endigo ZC	1	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 5 days between applications.	
	1.0–2.0 lb malathion	several formulations	1	Do not apply before vining or to wet plants.	
	0.45–0.9 lb methomyl	1.5–3.0 pt *Lannate LV 0.5–1.0 lb *Lannate SP	1	See label for days to harvest. Do not exceed 5.4 lb ai/a per season.	
	0.375–0.5 lb oxydemeton-methyl	1.5–2.0 pt *Metasystox-R	3	Do not apply more than two applications per season.	
	0.86 lb pymetrozine	2.75 oz Fulfill	14	Controls melon and green peach aphids. Treat when aphids first appear. May repeat in 7 days. Do not exceed 5.5 oz/a per season or more than two applications per crop.	
	thiamethoxam	1.5–3.0 oz Actara 25WDG 5.0–11.0 fl oz Platinum 2SC	30	Do not follow applications of Platinum with foliar applications of any other neonicotinoid insecticide. Platinum may be applied to direct-seeded crops in-furrow at the seeding or transplant depth or as a narrow surface band above the seedling and followed by irrigation. Do not apply more than 11.0 oz/a Platinum per season. Actara is applied as a foliar spray.	
	0.198–0.257 lb thiamethoxam + chlorantraniliprole	10.0–13.0 fl oz Durivo	30	Do not exceed a total of 13.0 fl oz/a Durivo (0.257 lb ai/a) per growing season. Do not exceed 0.172 lb ai/a of thiamethoxam-containing products or 0.2 lb ai/a of chlorantraniliprole-containing products per season.	
	0.02–0.025 lb zeta-cypermethrin	3.2–4.0 oz *Mustang Max	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Max per season.	
	Seed corn maggot	0.04–0.08 lb bifenthrin	3.4–6.8 oz *Capture LFR		Apply as a 5- to 7-inch band over an open furrow or in-furrow with the seed. Do not apply more than 0.1 lb/a Capture LFR per season as an at-plant application.
	Spider mite	0.938–1.88 lb abamectin	8.0–16.0 fl oz *Agri-Mek 0.15EC	7	May repeat after 7 days, but do not make more than two sequential treatments or exceed 5.64 lb ai/a per year.
0.375–0.5 lb bifenazate		0.75–1.0 lb Acramite 50WS	1	Do not exceed one application per season.	

*Restricted-use pesticide.

(continued)

Pest management

Asparagus

Bean

Carrot

Celery

Cole crops

Cucumber

Insect control in cucumber *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Spider mite <i>(cont.)</i>	0.08–0.10 lb bifenthrin	5.12–6.4 fl oz *Brigade 2EC	3	Apply before insects reach threshold levels. May repeat applications after 7 days, but do not make more than two applications after bloom. Do not exceed 0.3 lb ai/a per season.
	bifenthrin + zeta-cypermethrin	10.3 fl oz *Hero	3	Do not apply more than 10.3 fl oz/a per season and allow at least 7 days between applications. Do not apply more than 41.2 fl oz of product/a per crop season.
	0.625 lb dicofol	20.0 oz Dicofol 4E	2	Do not make more than one application per season. Do not use in mixtures with other materials.
	0.2 lb fenpropathrin	10.0–66.0 fl oz Danitol 2.4EC	7	Treat when mites first appear and repeat every 7 days as needed. Do not exceed 0.8 lb ai/a per season.
	lambda-cyhalothrin + thiamethoxam	4.0–4.5 fl oz *Endigo ZC	1	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 5 days between applications.
Squash bug	1.5–2.0 lb malathion	several formulations	1	Do not apply before vining or to wet plants.
	0.11–0.13 lb spiromesifen	7.0–8.5 fl oz Oberon 2SC	7	Apply every 7 days as needed. Do not exceed 25.5 fl oz/a per season.
	<i>Check undersides of leaves for squash bug eggs laid in neat rows. Eggs hatch within 1–2 weeks. Treat when squash bugs are young; they are difficult to control as older nymphs or adults. Destroy crop residue in fall to reduce overwinter survival of this pest.</i>			
Squash bug	0.10 lb acetamiprid	2.3 oz Assail 70WP	0	Do not exceed five applications or 11.5 oz/a of product per crop season.
		5.3 oz Assail 30 SG	0	Do not exceed five applications or 26.5 oz/a of product per crop season.
	0.04–0.10 lb bifenthrin	2.6–6.4 fl oz *Brigade 2EC	3	Apply before insects reach threshold levels. May repeat applications after 7 days, but do not make more than two applications after bloom. Do not exceed 0.3 lb ai/a per season.
Squash bug	0.5–1.0 lb carbaryl	Sevin WP	3	See label for rate.
	bifenthrin + zeta-cypermethrin	4.0–10.3 fl oz *Hero	3	Do not apply more than 10.3 fl oz/a per season and allow at least 7 days between applications. Do not apply more than 41.2 fl oz of product/a per crop season.
	clothianadin	<i>foliar:</i> 3.0–4.0 fl oz Belay	21	Do not apply more than 12.0 fl oz/a per season and allow at least 7 days between applications.
Squash bug		<i>soil:</i> 9.0–12.0 fl oz Belay	—	Do not apply more than 12.0 fl oz/a per season. Apply as a narrow band centered on the plant row; as an in-furrow spray at planting; as a side dress to both sides of the row; as a transplant water drench; or as chemigation into root zone through drip, trickle or micro-sprinkler, or similar equipment.
	0.5–1.0 lb endosulfan	0.66–1.33 qt Phaser EC 1.0–2.0 lb Thiodan WP	2	Do not exceed 3.0 lb ai/a per year.
	0.03–0.05 lb esfenvalerate	5.8–9.6 fl oz *Asana XL	3	Do not exceed 0.25 lb ai/a per season.
Squash bug	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4	Do not exceed 0.18 lb ai/a per season. Reapply at intervals of 5 or more days.

*Restricted-use pesticide.

(continued)

Insect control in cucumber *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Squash bug <i>(cont.)</i>	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Voliam Xpress	1	Do not exceed 31.0 fl oz/a of Voliam Xpress or 0.24 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per growing season.
	lambda-cyhalothrin + thiamethoxam	4.0–4.5 fl oz *Endigo ZC	1	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 5 days between applications.
	0.1–0.2 lb permethrin	*Ambush, *Pounce	0	Will kill adult squash bugs. See label for rate.
	0.018–0.025 lb zeta-cypermethrin	2.8–4.0 oz *Mustang Max	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Max per season.
Squash vine borer	<i>Treat when adults are observed (900 DD₅₀ or when chicory is in bloom), especially when runners are less than 2 feet long. Larvae boring in the main stem can kill the entire plant; while loss of a runner or two when the plant is larger will not cause economic damage. Look for sawdust-like excrement coming from holes in the stems, and open the stems to confirm the presence of squash vine borer larvae. Repeat applications at 5- to 7-day intervals throughout the 3-week egg-laying period.</i>			
	0.10 lb acetamiprid	2.3 oz Assail 70WP	0	Do not exceed five applications or 11.5 oz/a of product per crop season.
		5.3 oz Assail 30 SG	0	Do not exceed five applications or 26.5 oz/a of product per crop season.
	0.04–0.10 lb bifenthrin	2.6–6.4 fl oz *Brigade 2EC	3	Apply before insects reach threshold levels. May repeat applications after 7 days, but do not make more than two applications after bloom. Do not exceed 0.3 lb ai/a per season.
	bifenthrin + zeta-cypermethrin	4.0–10.3 fl oz *Hero	3	Do not apply more than 10.3 fl oz/a per season and allow at least 7 days between applications. Do not apply more than 41.2 fl oz of product/a per crop season.
	0.5–1.0 lb carbaryl	Sevin (several formulations)	3	Do not apply during maximum flowering or fruit set, or when pollinating bees are in the field. Spray during the evening.
	0.5–1.0 lb endosulfan	0.66–1.33 qt Phaser EC 1.0–2.0 lb Thiodan WP	2	Apply weekly to flower buds, stems, and vines beginning when moths first appear.
	0.03–0.05 lb esfenvalerate	5.8–9.6 fl oz *Asana XL	3	Do not exceed 0.25 lb ai/a per season.
	flubendiamide + buprofezin	12.0–17.0 fl oz Vetica	7	Do not apply more than 38.0 fl oz/a per season and allow at least 7 days between applications. Do not make more than three applications per crop season.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4	Do not exceed 0.18 lb ai/a per season. Reapply at intervals of 5 or more days.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Voliam Xpress	1	Do not exceed 31.0 fl oz/a of Voliam Xpress or 0.24 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per growing season.
	lambda-cyhalothrin + thiamethoxam	4.0–4.5 fl oz *Endigo ZC	1	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 5 days between applications.
	0.1–0.2 lb permethrin	*Ambush, *Pounce	0	Several formulations; see label for rate. Do not apply more than 1.6 lb ai/a per season.
0.018–0.025 lb zeta-cypermethrin	2.8–4.0 oz *Mustang Max	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Max per season.	

*Restricted-use pesticide.

Pest management

Asparagus

Bean

Carrot

Celery

Cole crops

Cucumber

Weed control in cucumber

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Annual weeds	0.15–0.38 lb clomazone	0.4–1.0 pt Command 3ME	45	For suppression and control of annual grasses and broadleaves, make a single preemergent soil application before seeding or transplanting, or after seeding but prior to crop emergence. Place seed or roots of transplants below the chemical barrier when planting. Strictly follow all precautions and restrictions on the label to minimize offsite movement and carryover. Read and understand the vegetable disclaimer section of the label—the end user assumes all liability for failure to perform and crop injury resulting from its use.
	1.1–1.7 lb ethalfluralin	3.0–4.5 pt Curbit 3EC		Make a single broadcast application within 2 days after seeding. Rate varies with soil texture and organic matter. A shallow cultivation or ½ inch of water is needed to activate the herbicide. Heavy rain following application or shallow seeding may result in crop injury. Do not incorporate prior to planting or use under plastic mulch, broadcast over transplants, or apply through irrigation. Do not use on soils with more than 10% organic matter.
	0.4–1.2 lb ethalfluralin + 0.125–0.375 lb clomazone	2.0–6.0 pt Strategy	45	Use only as a postplant surface-applied herbicide. Make one application before crop and weeds emerge or apply as a banded spray between rows following crop emergence or transplanting. Strategy requires rainfall, irrigation, or a shallow cultivation within 2–5 days after application for activation. Because of the potential for offsite movement and severe crop injury, strictly follow all precautions and restrictions on the label.
	0.5–1.0 lb trifluralin	1.0–2.0 pt Treflan HFP or equivalent	30	Direct-spray between rows when plants have reached the three- to four-leaf stage. Set incorporation equipment to move treated soil around the base of plants. Controls annual grasses and some broadleaf weeds, but is weak on wild mustard, smartweed, common ragweed, velvetleaf, and black nightshade. Rate varies with soil texture and organic matter. Follow recommended soil preparation, application, and incorporation procedures. Must be incorporated within 24 hours. See label for plantback restrictions. Ineffective on peat and muck soils.
Annual grasses	5.0–6.0 lb bensulide	5.0–6.0 qt Prefar 4E		Apply preplant or preemergence. Follow application instructions on label. Use on mineral soils only.
Nut-sedge and some broad-leaves	0.023–0.047 lb halosulfuron	0.5–1.0 oz Sandea	30	Sandea controls several broadleaf weeds and nutsedge. It will not control grasses. Sandea has both pre- and postemergence activity and can be used under plastic mulch. Do not exceed two applications per crop cycle or 2.0 oz/a per 12-month period. See label for organophosphate insecticide restrictions. Consult label for rate, application timing, and other important usage information and precautions.

*Restricted-use pesticide.

(continued)

Pest management

Asparagus

Bean

Carrot

Celery

Cole crops

Cucumber

Weed control in cucumber *(continued)*

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Emerged weeds	glyphosate	several manufacturers and formulations		See manufacturer's label to assure that the formulation is labeled for this crop and for specific instructions. Some formulations require a wait of 3 days between application and seeding. Crop contact will result in severe injury or death. If weeds have been mowed or tilled, do not treat until they have resumed active growth and reached the recommended stage on the label. Unless otherwise stated, allow 7 or more days before tilling treated fields. Do not tank mix with soil-residual herbicides unless otherwise specified.
	*paraquat	several manufacturers and formulations, not all are registered for this use		Prepare seedbed early to allow for maximum weed emergence. Application can be made as a banded or broadcast treatment before, during, or after planting, but before crop emergence. In preplant and preemergence (to the crop) uses, do not apply to soils lacking clay minerals (i.e., muck, pure sand). Use the higher rate for heavy weed infestations. Seeding should be performed with minimal soil disturbance. Always add crop oil concentrate or non-ionic surfactant to spray mixture. Follow precautions on label.
Emerged grasses	0.068–0.12 lb clethodim	9.0–16.0 oz Select Max	14	Apply to actively growing grasses. Repeat treatments may be made at 14-day intervals up to the maximum annual use rate. Do not cultivate grasses within 7 days before or after application. Include appropriate surfactant as required by product label. Do not apply if rain is expected within 1 hour.
	0.094–0.125 lb clethodim	6.0–8.0 oz Select 2EC	14	
	0.094–0.28 lb sethoxydim	0.5–1.5 pt Poast	14	Make postemergence applications to actively growing grasses within the size ranges indicated on the label. Check the label for wild proso millet or rescue treatment rates. Do not apply more than 3.0 pt/a Poast in one crop season. Always add 2.0 pt/a crop oil concentrate. Check the label for additional precautions and restrictions.

*Restricted-use pesticide.

Pest management

Asparagus

Bean

Carrot

Celery

Cole crops

Cucumber

Eggplant

Planting

Choose well-drained, moderately fertile, sandy loam soils. Seeds germinate best at soil temperatures of 75–90°F. Set medium-sized, vigorous 6- to 8-week-old plants outside about June 1, or after danger of frost and chilling. Before transplanting, harden the plants by holding them at 60–65°F for a few days or place them in covered beds outside the greenhouse. To lessen the shock from transplanting, use a starter solution high in phosphorus.

Rows: 24–48 inches.

Plants in row: 18–30 inches apart. Use 2.0 oz seed/a. (1.0 oz produces 2,500 plants.)

Lime and fertilizer

Lime: Use dolomitic limestone to maintain a pH of 6.6–6.9.

Fertilizer rates: Apply 60–100 lb N/a, 60 lb P₂O₅/a, and 60 lb K₂O/a. Take credits for previous legume crops and manure.

Application: Broadcast and work in before planting.

Nitrogen: On sandy soils, use the higher nitrogen rate and split the recommendation into two or more applications during the season, preferably at 2–3 week intervals.

Disease control in eggplant

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Alternaria blight, anthracnose, and Phomopsis fruit rot	boscalid	2.5–3.5 oz Endura	0	Do not make more than six applications of Endura per season. Do not apply more than 21.0 oz Endura/a per season.
	fenamidone	<i>Altnernaria</i> : 5.5–8.2 fl oz Reason 500 SC	14	Do not apply more than 24.6 fl oz/a per year. Do not apply more than one time before alternating to an effective fungicide with a different mode of action.
	fixed copper	2.0 lb Champion 77WP	0	Rotate with crops other than eggplant, tomato, or pepper; use disease-free seed; and grow resistant varieties. Florida Market and Florida Beauty are resistant to Phomopsis fruit rot, though they are very late for Wisconsin. Begin applications prior to disease onset.
		1.33 pt Champ Formula 2 Flowable	0	
2.0 lb Kocide 77WP, DF		0		
1.5 lb Kocide 2000 DF		0		
0.75–1.5 lb Kocide 3000	0			
fluoxastrobin	3.8–5.7 fl oz Evito 480 SC <i>Alternaria</i> : 2.0–5.7 fl oz Aftershock	3	For optimum results, apply preventatively. Alternate every application with an effective fungicide of a different mode of action. Do not apply to fruiting vegetables grown in the greenhouse. Maximum of four applications/a per year.	
fluxapyroxad + pyraclostrobin	4.0–8.0 fl oz Priaxor	7	Do not use more than 24.0 fl oz/a per year. Do not apply more than three times/a per year. See label for specific tank-mix restrictions, which include no tank mixes with EC (emulsifiable concentrates) or solvent-based formulations.	

(continued)

Disease control in eggplant *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Alternaria blight, anthracnose, and Phomopsis fruit rot <i>(cont.)</i>	penthiopyrad	10.0–24.0 fl oz Fontelis (24.0 fl oz rate for anthracnose suppression)	0	Do not exceed 72.0 fl oz/a per year. Labeled for use on greenhouse-grown fruiting vegetables. See label for rate and application details.
	pyraclostrobin	8.0–12.0 oz Cabrio EG	0	Begin application prior to disease onset. Use higher rate and shorter interval when disease pressure is high.
	trifloxystrobin	<i>Alternaria</i> : 2.0–3.0 oz Flint <i>Anthracnose</i> : 3.0–4.0 oz Flint	3	Do not apply more than 16.0 oz/a per season. Alternate fungicide modes of action. Tank mix with a protective fungicide.
Anthracnose	azoxystrobin	6.0–15.5 fl oz Quadris Flowable	0	Quadris and Cabrio belong to the Group 11 (strobilurin) category of fungicides. Do not exceed one application of a strobilurin product before alternating with a fungicide having a different mode of action. Do not exceed four applications of strobilurin fungicides per crop per acre per year. Do not exceed 1.92 qt/a Quadris or 96.0 oz/a Cabrio per season.
	azoxystrobin + difenoconazole	8.0–14.0 fl oz Quadris Top	0	
	chlorothalonil	1.5 pt Echo 720, Equus 720 SST	3	Begin application when disease is anticipated.
		1.4 lb Bravo Ultrex	3	Do not use more than 10.9 lb Bravo Ultrex/a per year.
1.5 pt Bravo Weather Stik		3	Do not apply more than 12.0 pt/a per season.	
Phytophthora blight, ripe rot	cyazofamid	2.75 fl oz Ranman	0	Should be tank mixed with a surfactant when disease is severe. Do not apply more than 16.5 fl oz/a per year.
	dimethomorph	6.0 oz Forum	0	Disease suppression only. Tank mix with another fungicide active against Phytophthora blight and having a different mode of activity. Do not make more than two sequential applications of Forum before alternating to another effective fungicide. Do not make more than five applications per season or apply more than 32.0 oz/a per season. (Formerly Acrobat.)
	fenamidone	8.2 fl oz Reason 500 SC	14	Do not apply more than 24.6 fl oz/a per year. Do not apply more than one time before alternating to an effective fungicide with a different mode of action.
	fluopicolide	3.0–4.0 fl oz Presidio	2	Tank mix with another fungicide having different mode of action must be used for resistance management.
	pyraclostrobin	8.0–16.0 oz Cabrio EG	0	Begin application prior to disease onset. Use higher rate and shorter interval when disease pressure is high.
	trifloxystrobin	4.0 oz Flint	3	Do not apply more than 16.0 oz/a per season. Alternate fungicide modes of action.
	Seed rot and damping-off	azoxystrobin	<i>Rhizoctonia seedling rot</i> : 0.4–0.8 fl oz Quadris Flowable/1,000 ft row	—
mefenoxam		1.0–2.0 pt Ridomil Gold SL	—	Preplant-incorporated application or surface application at planting. Preplant to top 2 inches of soil.

(continued)

Eggplant

Horse radish

Leafy greens

Melon

Mint

Onion

Pea

Disease control in eggplant *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Seed rot and damping-off <i>(cont.)</i>	mefenoxam <i>(cont.)</i>	0.085–0.64 fl oz Apron XL/100 lb seed	—	Follow manufacturer's directions. Do not use treated seed for feed or food.
	metalaxyl	4.0–8.0 pt MetaStar 2E AG	—	Preplant-incorporated application or surface application at planting. Preplant to top 2 inches of soil.
		0.75 fl oz/100 lb seed Allegiance FL, Metalaxyl 265 ST	—	Follow manufacturer's directions. Do not use treated seed for feed or food.
Verticillium wilt	metam-sodium	Vapam HL, Metam, Sectagon 42		Use long rotations with non-susceptible crops and eradicate weeds. Plant in well-drained soils. Steam sterilization can also be used.

Insect control in eggplant

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Aphids	acetamiprid	0.8–1.2 oz Assail 70WP	7	Begin treatment when thresholds are reached. Apply every 7 days as needed. Do not exceed 0.375 lb ai/a per season.
		2.0–4.0 oz Assail 30 SG	7	
	0.06–0.15 lb bifenthrin + imidacloprid	3.9–9.85 fl oz *Brigadier	7	Do not apply more than 25.6 fl oz/a (0.4 lb ai/a) per season. No more than 0.2 lb ai/a bifenthrin and 0.24 lb ai/a imidacloprid are allowed per season.
	0.5–1.0 lb endosulfan	1.0–2.0 lb Thiodan WP, Phaser WSB 0.66–1.33 qt Thiodan EC, Phaser EC	1	Do not exceed 0.5 lb ai/year.
	0.018–0.028 lb deltamethrin	1.5–2.4 fl oz *Delta Gold	1	Apply every 5 days as needed. Do not exceed 14.4 fl oz/a.
	0.045–0.268 lb dinotefuran	<i>foliar</i> : 1.0–4.0 oz Venom 70SG <i>soil</i> : 5.0–6.0 oz Venom 70SG	1	Do not follow soil applications with foliar application of any other neonicotinoid insecticide. Use only one application method. Do not apply more than 6.0 oz/a per year using foliar applications, or 12.0 oz/a per season using soil applications. See product label for application directions.
			21	
	0.05–0.18 lb dinotefuran (<i>foliar</i>)	2.0–7.0 oz Scorpion 35SL	1	Can repeat at 7-day intervals. Do not apply more than 10.5 oz per year. Use only one application method.
	0.23–0.27 lb dinotefuran (<i>soil</i>)	9.0–10.5 oz Scorpion 35SL	21	Do not apply more than 21.0 oz per year. Use only one application method.
	0.062–0.089 lb flonicamid	2.0–2.8 oz Beleaf SG	0	Begin applications before aphid populations build. Do not exceed 2.8 oz/a Beleaf per application and do not apply more than 8.4 oz/a (0.267 lb ai/a) per season.
	0.01–0.015 lb gamma-cyhalothrin	2.56–3.84 oz *Proaxis	5	For suppression of aphids only. Apply every 5 days as needed. Do not apply more than 2.88 pt/a (0.18 lb ai/a) per season.
	0.25–0.38 lb imidacloprid	7.0–10.5 fl oz Admire Pro	21	Systemic at planting.
			0	
	3.75 fl oz Provado 1.6	0	Foliar spray. Do not exceed 18.75 fl oz/a Provado per season.	

*Restricted-use pesticide.

(continued)

Insect control in eggplant *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Aphids <i>(cont.)</i>	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4	Do not exceed 0.18 lb ai/a per season. Reapply at intervals of 5 or more days.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Voliam Xpress	5	Do not exceed 31.0 fl oz/a of Voliam Xpress or 0.36 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per growing season. For suppression only.
	lambda-cyhalothrin + thiamethoxam	4.0–4.5 fl oz *Endigo ZC	5	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 5 days between applications.
	0.63–1.0 lb malathion	several formulations	3	
	0.225–0.90 lb methomyl	0.25–1.0 lb *Lannate SP 0.75–3.0 pt *Lannate LV	5	Do not exceed 4.5 lb ai/a per season.
	0.5 lb oxydemeton-methyl	2.0 pt *Metasystox-R	7	Do not apply more than three times per season.
	pymetrozine	2.75 oz Fulfill WDG	14	Treat when aphids first appear. Controls potato and green peach aphids. May repeat application in 7 days. Do not exceed 5.5 oz/a per season or two applications per crop.
	0.06–0.08 lb spirotetramat	4.0–5.0 fl oz Movento	1	Do not apply more than 10.0 fl oz/a (0.16 lb ai/a) per season.
	thiamethoxam	2.0–3.0 oz Actara WG	0	Apply before pests reach damaging levels. Repeat as needed every 5 days. Do not exceed 8.0 oz/a of product per season.
			5.0–11.0 fl oz Platinum	30
	0.198–0.257 lb thiamethoxam + chlorantraniliprole	10.0–13.0 fl oz Durivo	30	Do not exceed a total of 13.0 fl oz/a Durivo (0.257 lb ai/a) per growing season. Do not exceed 0.172 lb ai/a of thiamethoxam-containing products or 0.2 lb ai/a of chlorantraniliprole-containing products per season.
	zeta-cypermethrin	3.2–4.0 oz *Mustang Max	1	Apply every 7 days as needed. Use higher rate for heavy infestations. Do not exceed 24.0 oz/a Mustang Max per season.
Colorado potato beetle	<i>When plants are smaller than 6 inches, treat if you find two small larvae or one large larvae or adult per plant. For plants taller than 6 inches, treat if you find four small larvae or two large larvae or adults per plant.</i>			
	0.009–0.019 lb abamectin	8.0–16.0 fl oz *Agri-Mek 0.15EC	7	Begin treatments at thresholds. Use high rates for resistance management.
	acetamiprid	0.16–1.1 oz Assail 70WP 1.5–2.5 oz Assail 30 SG	7 7	Begin treatment when thresholds are reached. Apply every 7 days as needed. Do not exceed 0.375 lb ai/a per season.
	<i>Bacillus thuringiensis</i> subsp. <i>tenebrionis</i>	1.0–3.0 qt Novador	0	Make initial spray when small larvae are first observed.
	0.033–0.10 lb bifenthrin	2.1–6.4 fl oz *Brigade 2EC	7	Apply every 7 days as needed. Do not exceed 0.2 lb ai/a per season.
	0.08–0.15 lb bifenthrin + imidacloprid	5.1–9.85 fl oz *Brigadier	7	Do not apply more than 25.6 fl oz/a (0.4 lb ai/a) per season. No more than 0.2 lb ai/a bifenthrin and 0.24 lb ai/a imidacloprid are allowed per season.
	0.5–2.0 lb carbaryl	Sevin	3	Several formulations; see label for rate.

*Restricted-use pesticide.

(continued)

Eggplant

Horseradish

Leafy greens

Melon

Mint

Onion

Pea

Insect control in eggplant *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Colorado potato beetle <i>(cont.)</i>	0.045–0.065 lb chlorantraniliprole	3.5–5.0 fl oz Coragen	1	Allow at least 3 days between treatments. Do not exceed 15.4 fl oz/a (0.2 lb ai/a) per season.
	0.018–0.028 lb deltamethrin	1.5–2.4 fl oz *Delta Gold	1	Apply every 5 days as needed. Do not exceed 14.4 fl oz/a.
	0.045–0.268 lb dinotefuran	<i>foliar</i> : 1.0–4.0 oz Venom 70SG <i>soil</i> : 5.0–6.0 oz Venom 70SG	1 21	Do not follow soil applications with foliar application of any other neonicotinoid insecticide. Use only one application method. Do not apply more than 12.0 oz/a per season using soil applications. See product label for application directions.
	0.05–0.18 lb dinotefuran (<i>foliar</i>)	2.0–7.0 oz Scorpion 35SL	1	Can repeat at 7-day intervals. Do not apply more than 10.5 oz per year. Use only one application method.
	0.23–0.27 lb dinotefuran (<i>soil</i>)	9.0–10.5 oz Scorpion 35SL	21	Do not apply more than 21.0 oz per year. Use only one application method.
	0.5–1.0 lb endosulfan	1.0–2.0 lb Thiodan WP, Phaser WSB 0.66–1.33 qt Thiodan EC, Phaser EC	1	Do not exceed 1.0 lb ai/a per year.
	0.03–0.05 lb esfenvalerate	5.8–9.6 fl oz *Asana XL	7	Do not exceed 0.35 lb ai/a per season.
	0.01–0.015 lb gamma-cyhalothrin	2.56–3.84 oz *Proaxis	5	Apply every 5 days as needed. Do not apply more than 2.88 pt/a (0.18 lb ai/a) per season.
	0.25–0.38 lb imidacloprid	7.0–10.5 fl oz Admire Pro	21	Systemic at planting.
		3.75 fl oz Provado 1.6	0	Foliar spray.
	imidacloprid + beta-cyfluthrin	3.8–4.1 fl oz *Leverage 360	7	Minimum interval between applications is 7 days and maximum allowable crop use per season is 15.4 fl oz/a.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4	Do not exceed 0.18 lb ai/a per season. Reapply at intervals of 5 or more days.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Voliam Xpress	5	Do not exceed 31.0 fl oz/a of Voliam Xpress or 0.36 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per growing season.
	lambda-cyhalothrin + thiamethoxam	4.0–4.5 fl oz *Endigo ZC	5	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 5 days between applications.
	0.1–0.2 lb permethrin	*Ambush, *Pounce	3	Apply no more than 2 lb ai/a per season.
	0.039–0.078 lb spinetoram	5.0–10.0 oz Radiant SC	1	Do not apply more than 34.0 oz/a Radiant (0.266 lb ai/a) per crop and do not exceed six applications per year.
	spinosad	3.0–10.0 fl oz Entrust SC	1	Use higher rate for larger insects. Do not exceed 0.45 lb ai/a per season. Do not use a buffering agent. Spray thoroughly for control.
	thiamethoxam	2.0–3.0 oz Actara WG	0	Apply before pests reach damaging levels. Repeat as needed every 5 days. Do not exceed 6.0 oz/a of product per season.
		5.0–11.0 fl oz Platinum	30	Apply as an in-furrow spray at planting or as a post-seeding transplant or hill drench. Irrigate sufficiently to move the chemical into the root zone. Use the higher rate for long residual control. Do not apply less than 5.0 fl oz/a or more than 11.0 fl oz/a of Platinum per season.

*Restricted-use pesticide.

(continued)

Insect control in eggplant *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Colorado potato beetle <i>(cont.)</i>	0.198–0.257 lb thiamethoxam + chlorantraniliprole	10.0–13.0 fl oz Durivo	30	Do not exceed a total of 13.0 fl oz/a Durivo (0.257 lb ai/a) per growing season. Do not exceed 0.172 lb ai/a of thiamethoxam-containing products or 0.2 lb ai/a of chlorantraniliprole-containing products per season.
	zeta-cypermethrin	2.24–4.0 oz *Mustang Max	1	Apply every 7 days as needed. Use higher rate for heavy infestations. Do not exceed 24.0 oz/a Mustang Max per season.
	0.04–0.1 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	7	Do not apply more than 0.266 lb ai/a per season. Wait at least 7 days between applications.
European corn borer	beta-cyfluthrin	1.6–2.8 fl oz *Baythroid XL	0	Maximum Baythroid XL allowed per 7-day interval is 2.8 fl oz/a and season total allowed per crop season is 16.8 fl oz/a.
	0.08–0.15 lb bifenthrin + imidacloprid	5.1–9.85 fl oz *Brigadier	7	Do not apply more than 25.6 fl oz/a (0.4 lb ai/a) per season. No more than 0.2 lb ai/a bifenthrin and 0.24 lb ai/a imidacloprid are allowed per season.
	0.045–0.065 lb chlorantraniliprole	3.5–5.0 fl oz Coragen	1	Allow at least 3 days between treatments. Do not exceed 15.4 fl oz/a (0.2 lb ai/a) per season.
	0.018–0.028 lb deltamethrin	1.5–2.4 fl oz *Delta Gold	1	Apply every 5 days as needed. Do not exceed 14.4 fl oz/a.
	0.03–0.045 lb flubendiamide	2.0–3.0 oz Synapse WG	1	Do not exceed 3.0 oz/a (0.045 lb ai/a) in a 7-day period or 9.0 oz/a per season.
	imidacloprid + beta-cyfluthrin	3.8–4.1 fl oz *Leverage 360	7	Minimum interval between applications is 7 days and maximum allowable crop use per season is 15.4 fl oz/a.
	0.065–0.11 lb indoxacarb	3.5–6.0 oz Avaunt	7	Do not exceed 0.26 lb ai/a per season.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4	Do not exceed 0.18 lb ai/a per season. Reapply at intervals of 5 or more days.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Voliam Xpress	5	Do not exceed 31.0 fl oz/a of Voliam Xpress or 0.36 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per growing season.
	lambda-cyhalothrin + thiamethoxam	4.0–4.5 fl oz *Endigo ZC	5	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 5 days between applications.
	0.063–0.25 lb methoxyfenozide	4.0–16.0 fl oz Intrepid 2F	1	Will not control Colorado potato beetle. Do not exceed 64.0 fl oz/a per season. Use higher rate with higher populations or when spray coverage is difficult. See label for use restrictions in some Wisconsin counties.
	0.039–0.078 lb spinetoram	5.0–10.0 oz Radiant SC	1	Do not apply more than 34.0 oz/a Radiant (0.266 lb ai/a) per crop and do not exceed six applications per year.
	spinosad	3.0–10.0 fl oz Entrust SC	1	Use higher rate for larger insects. Do not exceed 0.45 lb ai/a per season. Do not use a buffering agent. Spray thoroughly for control.
0.014–0.025 lb zeta-cypermethrin	2.24–4.0 oz *Mustang Max	1	Apply every 7 days as needed. Use higher rate for heavy infestations. Do not exceed 24.0 oz/a Mustang Max per season.	
0.04–0.1 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	7	Do not apply more than 0.266 lb ai/a per season. Wait at least 7 days between applications.	

*Restricted-use pesticide.

(continued)

Eggplant

Horse radish

Leafy greens

Melon

Mint

Onion

Pea

Insect control in eggplant *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions	
Flea beetles (striped, spotted)	<i>When eggplants are less than 3 inches tall, treat if you find two beetles per plant. At a plant height of 3–6 inches, treat if there are four beetles per plant. For plants taller than 6 inches, treat if you find eight or more beetles per plant.</i>				
	beta-cyfluthrin	2.8 fl oz *Baythroid XL	0	Maximum Baythroid XL allowed per 7-day interval is 2.8 fl oz/a and season total allowed per crop season is 16.8 fl oz/a.	
	0.033–0.10 lb bifenthrin	2.1–6.4 fl oz *Brigade 2EC	7	Apply every 7 days as needed. Do not exceed 0.2 lb ai/a per season.	
	0.08–0.15 lb bifenthrin + imidacloprid	5.1–9.85 fl oz *Brigadier	7	Do not apply more than 25.6 fl oz/a (0.4 lb ai/a) per season. No more than 0.2 lb ai/a bifenthrin and 0.24 lb ai/a imidacloprid are allowed per season.	
	0.5–1.0 lb carbaryl	2.0 lb Sevin 50WP 1.25 lb Sevin 80S 1 qt Sevin XLR Plus	3	See label for rate.	
	0.018–0.028 lb deltamethrin	1.5–2.4 fl oz *Delta Gold	1	Apply every 5 days as needed. Do not exceed 14.4 fl oz/a.	
	0.045–0.268 lb dinotefuran	<i>foliar:</i> 1.0–4.0 oz Venom 70SG <i>soil:</i> 5.0–6.0 oz Venom 70SG	1 21	Do not follow soil applications with foliar application of any other neonicotinoid insecticide. Use only one application method. Do not apply more than 12.0 oz/a per season using soil applications. See product label for application directions.	
	0.05–0.18 lb dinotefuran (<i>foliar</i>)	2.0–7.0 oz Scorpion 35SL	1	Can repeat at 7-day intervals. Do not apply more than 10.5 oz per year. Use only one application method.	
	0.23–0.27 lb dinotefuran (<i>soil</i>)	9.0–10.5 oz Scorpion 35SL	21	Do not apply more than 21.0 oz per year. Use only one application method.	
	0.01–0.015 lb gamma-cyhalothrin	2.56–3.84 oz *Proaxis	5	Apply every 5 days as needed. Do not apply more than 2.88 pt/a (0.18 lb ai/a) per season.	
Eggplant	imidacloprid	7.0–10.5 fl oz Admire Pro	21	Systemic at planting.	
	imidacloprid + beta-cyfluthrin	4.1 fl oz *Leverage 360	7	Minimum interval between applications is 7 days and maximum allowable crop use per season is 15.4 fl oz/a.	
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4	Do not exceed 0.18 lb ai/a per season. Reapply at intervals of 5 or more days.	
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Voliam Xpress	5	Do not exceed 31.0 fl oz/a of Voliam Xpress or 0.36 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per growing season. For suppression only.	
	lambda-cyhalothrin + thiamethoxam	4.0–4.5 fl oz *Endigo ZC	5	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 5 days between applications.	
	0.1–0.2 lb permethrin	*Ambush, *Pounce	3	Apply no more than 2.0 lb ai/a per season.	
	thiamethoxam	2.0–3.0 oz Actara WG	0	Apply before pests reach damaging levels. Repeat as needed every 5 days. Do not exceed 8.0 oz/a of product per season.	
		5.0–11.0 fl oz Platinum	30	Apply as an in-furrow spray at planting or as a post-seeding transplant or hill drench. Irrigate sufficiently to move the chemical into the root zone. Use the higher rate for long residual control. Do not apply less than 5.0 fl oz/a or more than 11.0 fl oz/a of Platinum per season.	
	Horseradish				
Leafy greens					
Melon					
Mint					
Onion					
Pea					

*Restricted-use pesticide.

(continued)

Insect control in eggplant *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Flea beetles <i>(cont.)</i>	0.198–0.257 lb thiamethoxam + chlorantraniliprole	10.0–13.0 fl oz Durivo	30	Do not exceed a total of 13.0 fl oz/a Durivo (0.257 lb ai/a) per growing season. Do not exceed 0.172 lb ai/a of thiamethoxam-containing products or 0.2 lb ai/a of chlorantraniliprole-containing products per season.
	0.014–0.025 lb zeta-cypermethrin	2.24–4.0 oz *Mustang Max	1	Apply every 7 days as needed. Use higher rate for heavy infestations. Do not exceed 24.0 oz/a Mustang Max per season.
	0.04–0.1 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	7	Do not apply more than 0.266 lb ai/a per season. Wait at least 7 days between applications.

*Restricted-use pesticide.

Weed control in eggplant

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Annual weeds	<i>transplants only:</i> 1.0–2.0 lb napropamide	2.0–4.0 lb Devrinol 50-DF		Apply to weed-free soil before transplanting. Incorporate 1–2 inches. Use the lower rate on coarse, sandy soils. Carryover the following year may affect sensitive crops, especially small grains.
	0.48–1.43 lb pendimethalin	1.0–3.0 pt Prowl H ₂ O	70	Apply as a broadcast preplant-incorporated or as a broadcast surface application before transplanting, or as a post-directed application to transplanted or established direct-seeded eggplant. Do not apply postemergence over the top of eggplant foliage. Rate varies by soil type. Do not exceed 3.0 pt/a per season or allow treated soil to come in contact with transplants.
	0.5–0.75 lb trifluralin	1.0–1.5 pt Treflan HFP or equivalent		Apply before transplanting or as a directed spray to the soil between rows after transplanting. Tolerance of eggplant to trifluralin is marginal. Controls annual grasses and some broadleaf weeds, but is weak on wild mustard, smartweed, common ragweed, velvetleaf, and black nightshade. Rate varies with soil texture and organic matter. Follow recommended soil preparation, application, and incorporation procedures. Incorporate within 24 hours. See label for plantback restrictions. Ineffective on peat and muck soils.
Annual grasses	5.0–6.0 lb bensulide	5.0–6.0 qt Prefar 4E		Apply before planting and incorporate 1–2 inches deep to avoid loss due to volatilization. Use on mineral soils only.
Annual grasses and some broad-leaves	4.5–10.5 lb DCPA	6.0–14.0 lb Dacthal W-75 6.0–14.0 pt Dacthal FL		Make preemergence applications to weed-free soil 4–6 weeks after transplanting or to crop seedlings that are 4–6 inches tall. Use only on soils with 5% or less organic matter.

*Restricted-use pesticide.

(continued)

Eggplant

Horseradish

Leafy greens

Melon

Mint

Onion

Pea

Weed control in eggplant *(continued)*

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Nutsedge and some broad-leaves	0.023–0.047 lb halosulfuron	0.5–1.0 oz Sandea	30	Sandea controls several broadleaf weeds and nutsedge. It will not control grasses. Sandea may be applied between rows of direct-seeded or transplanted eggplant as a directed or shielded spray. Avoid contact of the spray with the crop. If plastic was used on the planted row, adjust equipment to keep application off the plastic. Do not apply more than 2.0 oz/a per crop cycle or 12-month period. Soil or foliar applications of organophosphate insecticides to Sandea-treated crops may increase potential for and severity of crop injury. Consult label for additional usage information and other precautions.
Emerged weeds	glyphosate	several manufacturers and formulations		See manufacturer's label to assure that the formulation is labeled for this crop and for specific instructions. Some formulations require a wait of 3 days between application and planting. Contact with the crop will result in severe injury or death. If weeds have been mowed or tilled, do not treat until they have resumed active growth and reached the recommended stage on the label. Unless otherwise stated, allow 7 or more days before tilling treated fields. Do not tank mix with soil-residual herbicides unless otherwise specified.
	*paraquat	several manufacturers and formulations, not all are registered for this use		Prepare seedbed early to allow for maximum weed emergence. Application can be made as a banded or broadcast treatment before, during, or after planting, but before crop emergence. In preplant and preemergence (to the crop) uses, do not apply to soils lacking clay minerals (i.e., muck, pure sand). Use the higher rate for heavy weed infestations. Seeding and transplanting should be performed with minimal soil disturbance. Up to three directed/shielded treatments may be made per season using precision equipment to prevent spray contact with the crop. Always add crop oil concentrate or non-ionic surfactant to spray mixture. Follow precautions on label.
Emerged grasses	0.068–0.12 lb clethodim	9.0–16.0 oz Select Max	20	Apply to actively growing grasses. Repeat treatments may be made at 14-day intervals up to the maximum annual use rate. Do not cultivate grasses within 7 days before or after application. Include appropriate surfactant as required by product label. Do not apply if rain is expected within 1 hour.
	0.094–0.125 lb clethodim	6.0–8.0 oz Select 2EC	20	
	0.094–0.28 lb sethoxydim	0.5–1.5 pt Poast	20	Make postemergence applications to actively growing grasses within the size ranges indicated on the label. Check the label for early and rescue treatment rates as well as additional precautions and restrictions. Do not exceed 4.5 pt/a Poast per season. Always add 2.0 pt/a crop oil concentrate.

*Restricted-use pesticide.

Eggplant

Horseradish

Leafy greens

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Horseradish

Horseradish is usually grown commercially as an annual in Wisconsin. One-year-old secondary roots are selected and detached from primary roots at harvest for planting the following year. When grown as a perennial, the main roots are harvested, and secondary roots broken off during harvest will provide root material for the next year's crop.

In Wisconsin, horseradish is grown on sands, sandy loams, and organic soils. Such soils should be well drained and stone free. Irrigation is recommended for profitable horseradish production on very sandy soils.

Planting

Rows: 30–36 inches.

Plants in row: 12–18 inches apart.

Use set roots that are 1/4–1/2 inch thick and 12–14 inches long. Lay roots flat in shallow furrows with the crown end resting slightly higher than the basal end. Cover the sets with 2–4 inches of soil, then firm the soil using a roller.

After the plant is established, lift the crown end slightly to break off the new secondary roots from the upper portion. The remaining secondary roots at the basal end will nourish the set and young plant. Removing the secondary crown roots allows enlargement of the set root, yielding high-quality primary roots.

Lime and fertilizer

Lime: Use dolomitic lime to maintain a pH of 6.8.

Fertilizer rates: On sands/sandy loams with a pH of 6.5 or higher, the soil test value for phosphorous should be in the range of 60 ppm. The potassium soil test should be in the range of 140 ppm. Use annual nitrogen, P₂O₅, and K₂O recommendations listed in the table below.

Application: Broadcast lime and fertilizer and work in before planting. Sidedress annual applications at planting.

Nitrogen: On irrigated sands, apply 25% of the nitrogen at planting. Apply the remainder in at least two applications after crop emergence. Split applications reduce the potential for nitrate leaching.

Micronutrients: Irrigated sands may require additional sulfur and boron.

Annual nitrogen, phosphate, and potash recommendations for horseradish

Nitrogen		Phosphate and potash		
Organic matter (%)	Amount to apply (lb/a)	Yield goal (t/a)	Amount P ₂ O ₅ to apply* (lb/a)	Amount K ₂ O to apply* (lb/a)
<2	160	6	50	160
2.0–9.9	120			
10–20	100			
>20	75			

*Amounts shown are for optimum (O) soil test levels. Apply 50% of this rate if soil test is high (H) and omit if soil test is excessively high (EH). If soil test is low (L) or very low (VL), increase rates according to soil test recommendations.

Disease control in horseradish

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions	
Alternaria leaf spot and white rust	azoxystrobin	6.0–15.5 fl oz Quadris Flowable	0	Quadris and Cabrio belong to the Group 11 (strobilurin) category of fungicides. Do not exceed one application of any of these products before alternating with a fungicide having a different mode of action. Do not exceed three applications of strobilurin fungicides per year. Do not exceed 123.0 fl oz/a per season Quadris or 48.0 oz/a Cabrio per season.	
	pyraclostrobin	<i>Alternaria</i> : 8.0–12.0 oz Cabrio EG <i>white rust</i> : 8.0–16.0 oz Cabrio EG	0		
	boscalid	4.5 oz Endura	0		Do not make more than five applications per season. Do not apply more than 22.5 oz/a Endura per season.
	cyprodinil + fludioxonil	11.0–14.0 oz Switch 62.5WG	7		Ground application only. Do not apply more than 56.0 oz/a per season.
	penthiopyrad	16.0–30.0 fl oz Fontelis	0		Do not apply more than 61.0 fl oz/a per year. Do not apply more than two times before alternating to an effective fungicide with a different mode of action.
	trifloxystrobin	2.0–3.0 oz Flint 1.9–2.9 fl oz Gem 500 SC	7		Do not apply more than 12.0 oz/a per year of Flint. Alternate fungicide modes of action for resistance management. Do not apply more than 11.5 fl oz/a per season of Gem 500 SC. Do not graze or feed foliage of treated crops.
Pythium and Phytophthora root rot	azoxystrobin	0.4–0.8 fl oz Quadris/1,000 ft row		For soilborne/seedling disease control, see general information section on label.	
	fenamidone	8.2 fl oz Reason 500 SC	14	Do not apply more than 24.6 fl oz/a per year. Do not apply more than one time before alternating to an effective fungicide with a different mode of action.	
	fluopicolide	3.0–4.0 fl oz Presidio	7	Tank mix with another effective, labeled fungicide of another mode of action for resistance management. Recommended spray interval is 10 days.	
	mefenoxam	1.0–2.0 pt Ridomil Gold SL	—	Preplant-incorporated application or surface application at planting. Preplant to top 2 inches of soil.	
	mefenoxam + azoxystrobin	0.34 fl oz Uniform/1,000 ft row	—	For Pythium damping off and root rots. Also manages Rhizoctonia seedling blight. Apply Uniform as an in-furrow spray in minimum of 5 gal water per acre spray volume.	
	metalaxyl	0.75 fl oz/100 lb seed Allegiance FL, Metalaxyl 265 ST	—	Follow manufacturer's directions. Do not use treated seed for feed or food.	
Verticillium wilt root rot pathogens	metam-sodium	50.0 gal Vapam HL, Metam, Setaagon 42		Knife into plow layer of soil at a rate of 50.0 gal/a or on sandy soils only apply through the irrigation system in 0.6–1.0 inches of water in the fall. An approved backflow prevention valve must be used when applying fumigant through irrigation system. Do not apply if significant rainfall is forecast in the next 24 hours. Fields must be monitored during and after application. Soil temperature must be below 75°F. Fumigant cannot be applied through an irrigation system within 1/4 mile of an institution such as a hospital, school, or prison.	

Eggplant

Horseradish

Leafy greens

Melon

Mint

Onion

Pea

Insect control in horseradish^a

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions	
Aphids	imidacloprid	0.31–0.74 fl oz Admire Pro/1,000 ft row	21	Admire may only be applied once per season. Apply Provado every 5 days as needed. Do not exceed three applications per season. Maximum imidacloprid use per season is 0.5 lb ai/a from any formulation.	
		4.4–10.5 fl oz Admire Pro	21		
		3.5 fl oz Provado	7		
	0.94–1.25 lb malathion	several formulations	7		
	0.45 lb methomyl	1.5 pt *Lannate LV 0.5 lb *Lannate SP	65		Do not exceed 1.8 lb ai/a per season.
	thiamethoxam	1.5–3.0 fl oz Actara WG	7		Apply before pests reach damaging levels. Use higher rate for heavy infestations. Do not exceed 8.0 oz/a per season.
		5.0–12.0 fl oz Platinum	0–30		Apply as an in-furrow spray or as a surface band at seeding. For surface-banded applications, irrigate within 24 hours to seeding depth using trickle or drip watering.
0.02–0.025 lb zeta-cypermethrin	3.2–4.0 oz *Mustang Max	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Max per season.		
	0.04–0.1 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	21	Do not apply more than 0.2 lb ai/a per season. Do not make more than two applications per season.	
	Beet leaf-hopper	imidacloprid	0.31–0.74 fl oz Admire Pro/1,000 ft row	21	Admire may only be applied once per season. Apply Provado every 5 days as needed. Do not exceed three applications per season. Maximum imidacloprid use per season is 0.5 lb ai/a from any formulation.
4.4–10.5 fl oz Admire Pro			21		
3.5 fl oz Provado			7		
0.45 lb methomyl		1.5 pt *Lannate LV 0.5 lb *Lannate SP	65	Treat when migrating beet leafhoppers are collected (usually July–August) or when brittle root disease is detected in fields.	
0.1 lb permethrin		*Ambush, *Pounce	22	Several formulations; see label for rate. Do not exceed three foliar applications per season.	
thiamethoxam		1.5–3.0 fl oz Actara WG	7	Apply before pests reach damaging levels. Use higher rate for heavy infestations. Do not exceed 8.0 oz/a per season.	
		5.0–12.0 fl oz Platinum	0–30	Apply as an in-furrow spray or as a surface band at seeding. For surface-banded applications, irrigate within 24 hours to seeding depth using trickle or drip watering.	
0.011–0.025 lb zeta-cypermethrin	1.76–4.0 oz *Mustang Max	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Max per season		
Diamond-back moth (DBM)	<i>Bacillus thuringiensis</i> subsp. <i>kurstaki</i>	Cutlass, DiPel, Javelin, and others	0	Rates vary with formulation; check the label. Must be eaten by caterpillars to be effective. Thorough coverage is necessary; some labels recommend wetting agents.	
		1.0–2.0 lb Lepinox WDG	0	Treat early instar larvae before noticeable feeding damage occurs. Repeat as needed.	
	0.5–1.5 lb <i>Bacillus thuringiensis</i> subsp. <i>tenebrionis</i>	Xentari		Treat early instar larvae before noticeable feeding damage occurs. Must be eaten to be effective. Thorough coverage is necessary. Repeat as needed.	
	imidacloprid	0.31–0.74 fl oz Admire Pro/1,000 ft row	21	Admire may only be applied once per season. Apply Provado every 5 days as needed. Do not exceed three applications per season. Maximum imidacloprid use per season is 0.5 lb ai/a from any formulation.	
4.4–10.5 fl oz Admire Pro		21			
3.5 fl oz Provado		7			

*Restricted-use pesticide.

(continued)

^aAdapted from Illinois pest control recommendations.

Eggplant

Horseradish

Leafy greens

Melon

Mint

Onion

Pea

Insect control in horseradish^a (continued)

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Diamond-back moth (DBM) (cont.)	0.1 lb permethrin	*Ambush, *Pounce	22	Treat when larvae are small. Several formulations; see label for rate. Do not exceed three foliar applications per season. In some areas, DBM has become resistant to permethrin and other compounds; resistance levels vary within the state and locally. Use Bt products where resistance to these compounds has developed or to slow development of resistance.
Flea beetles	<i>Treat only if you find large populations early in the season.</i>			
	0.5–2.0 lb carbaryl	Sevin	3	Several formulations; see label for rate.
	imidacloprid	0.31–0.74 fl oz Admire Pro/1,000 ft row	21	Admire may only be applied once per season. Apply Provado every 5 days as needed. Do not exceed three applications per season. Maximum imidacloprid use per season is 0.5 lb ai/a from any formulation.
		4.4–10.5 fl oz Admire Pro	21	
		3.5 fl oz Provado	7	
	0.046–0.063 lb spinetoram	6.0–8.0 oz Radiant SC	3	For suppression only. Do not apply more than 28.0 oz/a Radiant (0.219 lb ai) per crop and do not exceed three applications per year.
	thiamethoxam	1.5–3.0 oz Actara 25WDG	0–30	Apply as an in-furrow spray or as a narrow surface band above the seedling and followed by irrigation. Do not apply more than 12.0 oz/a per season. Actara is applied as a foliar spray.
		5.0–12.0 Platinum 2SC		
	0.011–0.025 lb zeta-cypermethrin	1.76–4.0 oz *Mustang Max	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Max per season.
	0.04–0.1 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	21	Do not apply more than 0.2 lb ai/a per season. Do not make more than two applications per season.
Imported crucifer weevil	<i>Crop rotation, destroying volunteers, use of insecticide dips for sets, and foliar insecticide sprays will help reduce weevil populations.</i>			
	0.1% solution permethrin	*Ambush (several formulations)	30	At planting. Soak sets 30 minutes and air dry before planting to kill eggs and larvae.
	0.2 lb permethrin	*Ambush, *Pounce	30	Apply if needed when adults are present on foliage (usually August). Several formulations; see label for rate. Do not exceed three foliar applications per season.
	0.011–0.025 lb zeta-cypermethrin	1.76–4.0 oz *Mustang Max	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Max per season.

*Restricted-use pesticide.

^aAdapted from Illinois pest control recommendations.

Eggplant

Horseradish

Leafy greens

Melon

Mint

Onion

Pea

Weed control in horseradish

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Annual weeds	0.56–0.98 lb dimethenamid-P	12.0–21.0 fl oz Outlook	40	Apply only when horseradish is between the two-leaf and eight-leaf stage. Outlook will not control emerged weeds. Injury may occur when cool weather follows application. Use rate varies by soil type.
	s-metolachlor	1.0–1.33 pt Dual Magnum or Dual II Magnum		Apply once after planting but before weed or crop emergence. Use lower rates on relatively coarse-textured soils and higher rates on fine-textured soils.
Annual broadleaves	0.5 lb oxyfluorfen	2.0 pt Goal 2XL 1.0 pt GoalTender		Controls common lambsquarters, redroot pigweed, common purslane, shepherd's purse, and Pennsylvania smartweed. Apply after planting but before emergence of crop or annual weeds. Use flat fan nozzles in a minimum of 20 gal/a of water. For maximum activity, soil surface should be smooth and free of weed and crop residue. Avoid disturbing the soil surface after application for as long as weed control is desired. Cultural practices that redistribute or disturb the soil surface will decrease herbicidal activity. Rainfall or irrigation of 1/4 inch after application is necessary for herbicide activation. Do not apply through irrigation. Do not use when horseradish plantings are weak or stressed.
Annual grasses and some broadleaves	4.5–10.5 lb DCPA	6.0–14.0 lb Dacthal W-75 6.0–14.0 pt Dacthal FL		Make preemergence applications to weed-free soil immediately after planting. Use only on soils with 5% or less organic matter.
	0.07–0.25 lb sulfentrazone	2.25–8.0 oz Spartan 4F		Broadcast applications can be made in the fall, in the spring before planting, or after planting up to 5 days before crop emergence. Banded applications to row middles are permitted following crop emergence. Use rate is based on soil texture and organic matter. Do not exceed maximum annual use rate. See label for weeds controlled and other precautions.
Emerged weeds	glyphosate	several manufacturers and formulations		See manufacturer's label to assure that the formulation is labeled for this crop and for specific instructions. May be applied at any time before the crop emerges. Apply before crop germination/growth on coarse sandy soils. Do not treat mowed or tilled weeds until they have resumed active growth and reached the recommended stage on the label. Unless otherwise stated, allow at least 7 days before tilling treated fields. Do not tank mix with soil-residual herbicides unless otherwise specified.
Emerged grasses	0.068–0.12 lb clethodim	9.0–16.0 oz Select Max	30	Apply to actively growing grasses. Repeat treatments may be made at 14-day intervals up to the maximum annual use rate. Do not cultivate grasses within 7 days before or after application. Include appropriate surfactant as required by product label. Do not apply if rain is expected within 1 hour.
	0.094–0.125 lb clethodim	6.0–8.0 oz Select 2EC	30	
	0.094–0.47 lb sethoxydim	0.5–2.5 pt Poast	60	Make postemergence applications to actively growing grasses within the size ranges indicated on the label. Check the label for wild proso millet or rescue treatment rate and for information on quackgrass control. Do not exceed 2.5 pt per application or 5 pt/a per season. Always add 2 pt/a of crop oil concentrate. Do not cultivate within 5 days before or 7 days after application.

Eggplant

Horseradish

Leafy greens

Melon

Mint

Onion

Pea

Leafy greens: lettuce, chicory, endive, escarole, and others

Planting

Make successive plantings from April to mid-July. Irrigate after seeding in dry weather. Choose deep, fertile soils with an abundance of available moisture during the growing season. Rotate leafy greens with other vegetable crops. Break up fresh leafy greens residue and allow it to dry for several days before plowing or working the residue into the soil. Crisp-head-lettuce types are difficult to grow in Wisconsin. Some varieties will not germinate in warm soils (above 40–50°F).

Rows: 12–36 inches.

Plants in row: 2–12 inches. Use 0.5–1.0 lb seed/a (use only mosaic-free seed).

Lime and fertilizer

Lime: Use dolomitic limestone to maintain a pH of 5.6 or higher in organic soils and at least 5.8 in other soils.

Fertilizer rates: Apply P_2O_5 and K_2O according to soil test recommendations. Use annual nitrogen, P_2O_5 , and K_2O recommendations in table below. Take credits for previous legume crops and manure.

Application: Broadcast and work in before planting. For most efficient use of nitrogen, split the recommendation into two or more applications during the season.

Micronutrients: Leafy greens need relatively high amounts of manganese, molybdenum, and copper. Use soil and plant analyses to check for deficiencies of these nutrients.

Annual nitrogen, phosphate, and potash recommendations for leafy greens

Nitrogen		Phosphate and potash		
Organic matter (%)	Amount to apply (lb/a)	Yield goal (t/a)	Amount P_2O_5 to apply* (lb/a)	Amount K_2O to apply* (lb/a)
<2	120	15–20	40	160
2.0–9.9	100			
10–20	60			
>20	40			

*Amounts shown are for optimum (O) soil test levels. Apply 50% of this rate if soil test is high (H) and omit if soil test is excessively high (EH). If soil test is low (L) or very low (VL), increase rates according to soil test recommendations.

Disease control in leafy greens

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Aster yellows	<i>Control aster leafhopper (see Insect Control table); also see "Aster Yellows Index" section on page 16.</i>			
Bottom rot (Rhizoctonia) and drop (Sclerotinia)	<i>Use long rotations with resistant crops such as corn, grasses, or small grains. Good weed control is important because these disease pathogens attack a wide range of plants. Maintain good soil fertility—healthy plants will be more resistant to disease. Also improve soil aeration at the base of plants by pairing the rows on raised beds and thinning plants to allow optimum growth. Chop debris with Rotobeater or flail-type machine. This will encourage rapid breakdown of plant materials and reduce potential of pathogens overwintering.</i>			
	azoxystrobin	<i>Rhizoctonia:</i> 0.4–0.8 fl oz Quadris/1,000 ft row	0	Do not apply more than 92.3 fl oz/a per season. See label for details on use for soilborne disease control.
	boscalid	8.0–11.0 oz Endura	14	Do not apply more than 22.0 oz/a per year. Only two applications can be made per season.
	<i>Coniothyrium minitans</i> strain CON/M/91-08	<i>drop caused by Sclerotinia:</i> 2.0 lb Contans WG	0	Incorporate in top 2 inches of soil by light mechanical incorporation or by irrigation. See label for specific application program post lettuce thinning. Approved for use on certified organic farms.
	cyprodinil + fludioxonil	<i>drop caused by Sclerotinia:</i> 11.0–14.0 oz Switch 62.5WG	0	Do not apply more than 56.0 oz/a per year. For lettuce, make first application at thinning and 2 weeks later.
	fludioxonil	<i>drop caused by Sclerotinia:</i> 7.0 oz Cannonball WP	0	Do not apply more than 28.0 oz/a per year. Do not apply more than two times before alternating to an effective fungicide with a different mode of action.
	iprodione	1.5–2.0 pt Iprodione 4L AG, Nevado 4F, Rovral 4FL	14	Lettuce only. Spray at the three-leaf stage and again 10 days later. Use a tractor-mounted boom with hollow cone or flat fan nozzles. Direct spray to the base of plants.
	penthiopyrad	<i>Drop caused by Sclerotinia:</i> 16.0–24.0 fl oz Fontelis	3	Do not apply more than 72.0 fl oz/a per year. Do not apply more than two times before alternating to an effective fungicide with a different mode of action.
Damping-off (Pythium)	<i>Avoid growing lettuce on wet, poorly drained soil.</i>			
	mefenoxam	1.0–2.0 pt Ridomil Gold SL 1.0–2.0 lb Ridomil Gold WSP		Lettuce and endive only. Preplant incorporated application or surface application after planting.
	propamocarb hydrochloride	2.0 pt Previcur Flex	2	Do not apply more than 8.0 pt/a per season. Apply when conditions become favorable for disease. Can be applied in transplant water, through drip irrigation, or directed nozzles to lower plant parts and surrounding soil.
Downy mildew	azoxystrobin	12.0–15.5 fl oz Quadris	0	Do not apply more than 92.3 fl oz/a per season.
	cymoxanil	3.2–5.0 oz Curzate	3	Use high rate for severe disease pressure and for spinach downy mildew. Do not apply more than 30.0 oz/a per year.
	cymoxanil + femoxadone	8.0–10.0 oz Tanos	1	Must be tank mixed with an appropriate contact fungicide such as chlorothalonil, mancozeb, or copper. Do not make more than one application without alternating to an effective fungicide with a different mode of action.
	dimethomorph	6.0 fl oz Forum	0	Do not make more than five applications per season. Do not exceed 30.0 fl oz per season.

(continued)

Eggplant

Horseradish

Leafy greens

Melon

Mint

Onion

Pea

Disease control in leafy greens *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Downy mildew <i>(cont.)</i>	fenamidone	5.5–8.2 fl oz Reason 500 SC	2	Do not apply more than 24.6 oz/a per year. Do not make more than one application without alternating to an effective fungicide with a different mode of action.
	fixed copper	1.0–2.0 lb Champion 77WP 0.6–1.3 pt Champ Formula 2 Flowable	0 0	Lettuce, endive, and escarole only.
	fluopicolide	3.0–4.0 fl oz Presidio	2	Lettuce, chicory, endive, and escarole. May be applied through sprinkler or drip irrigation system. Tank mix with another fungicide having different mode of action for resistance management.
	fosetyl-al	2.0–5.0 lb Aliette WDG, Linebacker WDG	3	Lettuce, arugula, celery, cress, endive, spinach, Swiss chard, fennel, escarole, and chicory only.
	mandipropamid	8.0 fl oz Revus	1	Lettuce and endive. Make no more than two consecutive applications before switching to another effective non-Group 40 fungicide. The addition of an adjuvant is recommended.
	propamocarb hydrochloride	2.0 pt Previcur Flex <i>or</i> 1.33–2.0 pt Previcur Flex with tank-mix partner	2	Do not apply more than 8.0 pt/a per season. Apply when conditions become favorable for disease.
	pyraclostrobin	12.0–16.0 oz Cabrio EG	0	Do not apply more than 64.0 oz/a per year. Do not apply more than two times before alternating to an effective fungicide with a different mode of action.
Lettuce mosaic	<i>Use seed certified mosaic free.</i>			
Root rot	<i>Thoroughly work old plant refuse into the soil. Only grow one lettuce crop per season on a field.</i>			

Scouting calendar for insect pests of leafy greens

	April			May			June			July			August			September		
	early	mid	late	early	mid	late	early	mid	late	early	mid	late	early	mid	late	early	mid	late
Flea beetles																		
Leafminers																		
Aster leafhopper																		
Aphids																		
Loopers																		
Leafminers																		

Insect control in leafy greens

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Aphids	<i>Treat seedlings if one or more aphids per plant; treat established plants if 10 or more aphids per plant.</i>			
	0.5–1.0 lb acephate	0.5–1.0 lb Orthene 97	14	Head lettuce only. Do not exceed 2.66 lb ai/a per season.
	acetamiprid	0.8–1.2 oz Assail 70WP 2.0–4.0 oz Assail 30 SG	7	Begin treatment when thresholds are reached. Apply every 7 days as needed. Do not exceed five applications or 0.375 lb ai/a per season.
			7	
	0.033–0.10 lb bifenthrin	2.1–6.4 fl oz *Brigade 2EC	7	Apply to head lettuce every 7 days as needed. Do not exceed 0.5 lb ai/a per season.
	0.066–0.095 lb bifenthrin + imidacloprid	4.24–6.1 fl oz *Brigadier	7	Do not apply more than 30.72 fl oz/a (0.48 lb ai/a) per season. No more than 0.5 lb ai/a bifenthrin and 0.24 lb ai/a imidacloprid are allowed per season.
	clothianadin	foliar: 3.0–4.0 fl oz Belay	21	Do not apply more than 12.0 fl oz/a per season and allow at least 7 days between applications.
		soil: 9.0–12.0 fl oz Belay	—	Do not apply more than 12.0 fl oz/a per season. Apply as a narrow band centered on the plant row; as an in-furrow spray at planting; as a side-dress to both sides of the row; as a transplant water drench; or as chemigation into root zone through drip, trickle or micro-sprinkler, or similar equipment.
	0.25–0.5 lb diazinon	several formulations	14	
	0.25 lb dimethoate	0.5 pt Dimethoate EC	7 (head)	
			14 (leaf)	
	0.062–0.089 lb flonicamid	2.0–2.8 oz Beleaf SG	0	Begin applications before aphid populations build. Do not exceed 2.8 oz/a Beleaf per application and do not apply more than 8.4 oz/a (0.267 lb ai/a) per season.
	imidacloprid	4.4–10.5 fl oz Admire Pro	21	Systemic at planting. Do not exceed 24.0 fl oz/a Admire per season.
		3.75 fl oz Provado F	7	Foliar spray. Apply before populations become damaging. Do not exceed 18.75 fl oz/a Provado per season.
	imidacloprid + beta-cyfluthrin	3.0 fl oz *Leverage 360	7	Do not apply more than 12.8 fl oz/a per season and allow at least 7 days between applications.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4	Do not apply more than 0.3 lb ai/a per season. Do not feed treated foliage to animals.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Voliam Xpress	1	Do not exceed 31.0 fl oz/a of Voliam Xpress or 0.3 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per growing season.
1.25–1.9 lb malathion	several formulations	7–14	Apply twice a week. Check label for crop.	
0.375–0.5 lb oxydemeton-methyl	1.5–2.0 pt *Metasystox-R	21	Head lettuce only. Maximum of three applications per season.	
0.1–0.2 lb permethrin	*Pounce (several formulations)	1	Apply every 3–5 days as needed. Do not exceed 2.0 lb ai/a per season; for spinach do not apply more than 1.0 lb ai/a per season.	
0.086 lb pymetrozine	2.75 oz Fulfill 50WDG	0	Apply before aphids reach damaging levels. Do not exceed 5.5 oz/a per season.	
0.06–0.08 lb spirotetramat	4.0–5.0 fl oz Movento	1	Do not apply more than 10.0 fl oz/a (0.16 lb ai/a) per season.	

*Restricted-use pesticide.

(continued)

Eggplant

Horseradish

Leafy greens

Melon

Mint

Onion

Pea

Insect control in leafy greens *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Aphids <i>(cont.)</i>	thiamethoxam	1.5–3.0 oz Actara 25WDG 5.0–11.0 Platinum 2SC	0–30	Do not follow applications of Platinum with foliar applications of any other neonicotinoid insecticide. Platinum may be applied to direct seeded crops in-furrow at seeding or transplant depth, or as a narrow surface band above the seedling and followed by irrigation. Do not apply more than 11.0 oz/a per season. Actara is applied as a foliar spray.
	0.198–0.257 lb thiamethoxam + chlorantraniliprole	10.0–13.0 fl oz Durivo	30	Do not exceed a total of 13.0 fl oz/a Durivo (0.257 lb ai/a) per growing season. Do not exceed 0.172 lb ai/a of thiamethoxam-containing products or 0.2 lb ai/a of chlorantraniliprole-containing products per season.
	0.014–0.025 lb zeta-cypermethrin	2.24–4.0 oz *Mustang Max	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Max per season.
Aster leafhopper and tarnished plant bug	0.5–1.0 lb acephate	0.5–1.0 lb Orthene 97	21	Head lettuce only. See label for feeding restrictions. Do not exceed 2.66 lb ai/a per season.
	<i>leafhopper</i> : 0.033–0.10 lb bifenthrin	2.1–6.4 fl oz *Brigade 2EC	7	Apply to head lettuce every 7 days as needed. Do not exceed 0.5 lb ai/a per season.
	<i>tarnished plant bug</i> : 0.08–0.10 lb bifenthrin	5.12–6.4 fl oz *Brigade 2EC	7	
	0.066–0.095 lb bifenthrin + imidacloprid	4.24–6.1 fl oz *Brigadier	7	Do not apply more than 30.72 fl oz/a (0.48 lb ai/a) per season. No more than 0.5 lb ai/a bifenthrin and 0.24 lb ai/a imidacloprid are allowed per season.
	1.0–2.0 lb carbaryl	Sevin (several formulations)	3	Apply at 5- to 7-day intervals.
clothianadin	<i>foliar</i> : 3.0–4.0 fl oz Belay		21	Do not apply more than 12.0 fl oz/a per season and allow at least 7 days between applications.
	<i>soil</i> : 9.0–12.0 fl oz Belay		—	Do not apply more than 12.0 fl oz/a per season. Apply as a narrow band centered on the plant row; as an in-furrow spray at planting; as a side-dress to both sides of the row; as a transplant water drench; or as chemigation into root zone through drip, trickle or micro-sprinkler, or similar equipment.
0.25 lb dimethoate	0.5 pt Dimethoate EC	7 (head) 14 (leaf)		Apply weekly as needed.
flubendiamide + buprofezin	12.0–17.0 fl oz Vetica	7		Do not apply more than 38.0 fl oz/a per season and allow at least 7 days between applications. Do not apply more than three applications per crop season.
imidacloprid + beta-cyfluthrin	3.0 fl oz *Leverage 360	7		Do not apply more than 12.8 fl oz/a per season and allow at least 7 days between applications.
0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4		Do not apply more than 0.3 lb ai/a per season. Do not feed treated foliage to animals.
lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Voliam Xpress	1		Do not exceed 31.0 fl oz/a of Voliam Xpress or 0.3 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per growing season.

*Restricted-use pesticide.

(continued)

Insect control in leafy greens *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Aster leafhopper and tarnished plant bug <i>(cont.)</i>	0.225–0.9 lb methomyl	0.75–3.0 pt *Lannate LV 0.25–1.0 lb *Lannate SP	10 (lettuce) 80 (chicory)	Refer to label for application limits.
	0.1–0.2 lb permethrin	*Ambush (several formulations)	1	See label for specific restrictions.
	zeta-cypermethrin	2.24–4.0 fl oz *Mustang Max	1	Apply every 7 days as needed. Do not exceed 24.0 oz/a Mustang Max per season.
	0.04–0.1 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	7	Do not apply more than 0.45 lb ai/a per season. Wait at least 7 days between applications.
Leafhoppers only	0.066–0.095 lb bifenthrin + imidacloprid	4.24–6.1 fl oz *Brigadier	7	Do not apply more than 30.72 fl oz/a (0.48 lb ai/a) per season. No more than 0.5 lb ai/a bifenthrin and 0.24 lb ai/a imidacloprid are allowed per season.
	clothianadin	<i>foliar:</i> 3.0–4.0 fl oz Belay	21	Do not apply more than 12.0 fl oz/a per season and allow at least 7 days between applications.
		<i>soil:</i> 9.0–12.0 fl oz Belay	—	Do not apply more than 12.0 fl oz/a per season. Apply as a narrow band centered on the plant row; as an in-furrow spray at planting; as a side-dress to both sides of the row; as a transplant water drench; or as chemigation into root zone through drip, trickle or micro-sprinkler, or similar equipment.
	0.05–0.1 lb cypermethrin	2.5–5.0 fl oz *Ammo EC	5	Apply no more than 0.6 lb ai/a per season.
	0.045–0.268 lb dinotefuran	<i>foliar:</i> 1.0–4.0 oz Venom 70SG <i>soil:</i> 5.0–6.0 oz Venom 70SG	1 21	Do not follow soil applications with foliar application of any other neonicotinoid insecticide. Use only one application method. Do not apply more than 12.0 oz/a per season using soil applications. See product label for application directions.
	0.05–0.13 lb dinotefuran (<i>foliar</i>)	2.0–5.25 oz Scorpion 35SL	1	Can repeat at 7-day intervals. Do not apply more than 10.5 oz per year. Use only one application method.
	0.23–0.27 lb dinotefuran (<i>soil</i>)	9.0–10.5 oz Scorpion 35SL	21	Do not apply more than 21.0 oz per year. Use only one application method.
	flubendiamide + buprofezin	12.0–17.0 fl oz Vetica	7	Do not apply more than 38.0 fl oz/a per season and allow at least 7 days between applications. Do not apply more than three applications per crop season.
	imidacloprid	4.4–10.5 fl oz Admire Pro	21	Systemic at planting. Do not exceed 24.0 fl oz/a Admire per season.
	imidacloprid + beta-cyfluthrin	3.0 fl oz *Leverage 360	7	Do not apply more than 12.8 fl oz/a per season and allow at least 7 days between applications.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4	Do not apply more than 0.3 lb ai/a per season. Do not feed treated foliage to animals.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Voliam Xpress	1	Do not exceed 31.0 fl oz/a of Voliam Xpress or 0.3 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per growing season.
	0.25–0.5 lb malathion	several formulations	7–14	Apply twice a week.
0.1–0.2 lb permethrin	*Ambush, *Pounce	1	Several formulations; see label for rate. Do not exceed 2.0 lb ai/a per season.	

*Restricted-use pesticide.

(continued)

Eggplant

Horseradish

Leafy greens

Melon

Mint

Onion

Pea

Insect control in leafy greens *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Leafhoppers only <i>(cont.)</i>	thiamethoxam	3.0–5.5 oz Actara 25WDG 5.0–11.0 Platinum 2SC	30	Do not follow applications of Platinum with foliar applications of any other neonicotinoid insecticide. Platinum may be applied to direct seeded crops in-furrow at seeding or transplant depth, or as a narrow surface band above the seedling and followed by irrigation. Do not apply more than 11.0 oz/a per season. Actara is applied as a foliar spray.
	0.04–0.1 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	7	Do not apply more than 0.45 lb ai/a per season. Wait at least 7 days between applications.
Loopers	<i>For damage-free produce in mass-harvested crops, treat when 5% of the plants are infested. If selectively harvesting only healthy plants, more damage can be tolerated; treat when 15% of plants are infested.</i>			
	0.5–1.0 lb acephate	0.5–1.0 lb Orthene SP, 97	21	Head lettuce only. Do not exceed 2.66 lb ai/a per season.
	<i>Bacillus thuringiensis</i>	Biobit FL, WP; Cutlass; DiPel 2DF; Javelin; MVP	0	Rates vary with formulation; check the label.
	1.0–2.0 lb <i>Bacillus thuringiensis</i> subsp. <i>kurstaki</i>	1.0–2.0 lb Lepinox WDG	0	Treat early instar larvae before noticeable feeding damage occurs. Repeat as needed.
	0.033–0.10 lb bifenthrin	2.1–6.4 fl oz *Brigade 2EC	7	Apply to head lettuce every 7 days as needed. Do not exceed 0.5 lb ai/a per season.
	0.066–0.095 lb bifenthrin + imidacloprid	4.24–6.1 fl oz *Brigadier	7	Do not apply more than 30.72 fl oz/a (0.48 lb ai/a) per season. No more than 0.5 lb ai/a bifenthrin and 0.24 lb ai/a imidacloprid are allowed per season.
	0.045–0.065 lb chlorantraniliprole	3.5–5.0 fl oz Coragen	1	Allow at least 3 days between treatments. Do not exceed 15.4 fl oz/a (0.2 lb ai/a) per season. Consult the label for the use of adjuvants on leafy greens.
	0.025–0.1 lb cypermethrin	*Ammo WSB, EC *Cymbush EC	5 5	Do not exceed 0.6 lb ai/a per season.
	0.0075–0.015 lb emamectin benzoate	3.2–4.8 oz *Proclaim	7	Apply when larvae first appear. Use higher rate for larger larvae or severe outbreaks. Do not exceed 28.8 oz ai/a per season. Highly toxic to bees.
	0.75–1.0 lb endosulfan	1.0–1.33 qt Thiodan, Phaser EC 1.5–2.0 lb Thiodan WP	14	Do not feed crop waste to livestock. Limit of three applications after thinning. Remove wrapper leaves at harvest.
	0.03–0.045 lb flubendiamide	2.0–3.0 oz Synapse WG	1	Do not exceed 3.0 oz/a (0.045 lb ai/a) in a 7-day period or more than 9.0 oz/a per season.
	flubendiamide + buprofezin	12.0–17.0 fl oz Vetica	7	Do not apply more than 38.0 fl oz/a per season and allow at least 7 days between applications. Do not make more than three applications per crop season.
	imidacloprid + beta-cyfluthrin	3.0 fl oz *Leverage 360	7	Do not apply more than 12.8 fl oz/a per season and allow at least 7 days between applications.
	0.045–0.065 lb indoxacarb	2.5–3.5 oz Avaunt	3	For use on head and leaf lettuces only. Apply when insect populations reach threshold levels. Do not exceed 0.25 lb ai/a per crop.
	0.015–0.025 lb lambda-cyhalothrin	0.96–1.6 fl oz *Warrior II	4	Do not apply more than 0.3 lb ai/a per season. Do not feed treated foliage to animals.

*Restricted-use pesticide.

(continued)

Insect control in leafy greens *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Loopers <i>(cont.)</i>	lambda-cyhalothrin + chlorantraniliprole	5.0–8.0 fl oz *Voliam Xpress	1	Do not exceed 31.0 fl oz/a of Voliam Xpress or 0.3 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per growing season.
	1.25–1.9 lb malathion	several formulations	7–14	
	0.45–0.9 lb methomyl	1.5–3.0 pt *Lannate LV 0.5–1.0 lb *Lannate SP		See label for days to harvest.
	0.06–0.16 lb methoxyfenozide	<i>early season:</i> 4.0–8.0 fl oz Intrepid 2F <i>mid- to late season:</i> 8.0–16.0 fl oz Intrepid 2F	1	Do not exceed 64.0 fl oz/a per season. Use the higher rates with higher populations or when spray coverage is difficult. See label for use restrictions in some Wisconsin counties.
			1	
	0.1–0.2 lb permethrin	*Ambush, *Pounce (several formulations)	1	Do not exceed 1.0 lb ai/a for spinach and 2.0 lb ai/a for all other leafy greens per season.
	0.039–0.078 lb spinetoram	5.0–10.0 oz Radiant SC	1	Do not apply more than 34.0 oz/a Radiant (0.266 lb ai/a) per crop and do not exceed six applications per year.
	spinosad	3.0–6.0 fl oz Entrust SC	1	Use higher rate for larger larvae. Apply in adequate spray volume to get good coverage for best control. Do not exceed 0.45 lb ai/a per season. Do not apply to seedlings grown for transplant.
	0.09–0.12 lb tebufenozide	6.0–8.0 fl oz Confirm 2F	7	Apply per label directions every 10–14 days as needed. Do not exceed 56.0 oz/season or 8.0 oz/application. There is a 1- to 12-month plantback restriction depending on the crop.
	0.198–0.257 lb thiamethoxam + chlorantraniliprole	10.0–13.0 fl oz Durivo	30	Do not exceed a total of 13.0 fl oz/a Durivo (0.257 lb ai/a) per growing season. Do not exceed 0.172 lb ai/a of thiamethoxam-containing products or 0.2 lb ai/a of chlorantraniliprole-containing products per season.
zeta-cypermethrin	2.24–4.0 fl oz *Mustang Max EC	1	Apply every 7 days as needed. Do not exceed 24.0 oz/a Mustang Max per season.	
0.04–0.1 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	7	Do not apply more than 0.45 lb ai/a per season. Wait at least 7 days between applications.	

*Restricted-use pesticide.

Weed control in leafy greens (see label for specific crop species)

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Annual weeds	1.0–2.0 lb *pronamide	2.0–4.0 lb Kerb 50W 2.5–5.0 pt Kerb SC	55	Rate depends on soil texture and method of irrigation. Not recommended for high organic (muck) soils. Application can be made before or after planting, but prior to emergence of weeds. Do not apply to leaf lettuce. Do not use more than 3.0 lb/a Kerb 50W on certain varieties of crisp lettuce or on endive or escarole or make more than one application per season. Kerb should be incorporated mechanically or with rainfall or irrigation within 2–3 days of application.

*Restricted-use pesticide.

(continued)

Eggplant

Horseradish

Leafy greens

Melon

Mint

Onion

Pea

Weed control in leafy greens (See label for specific crop species.) *(continued)*

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Annual weeds <i>(cont.)</i>	trifluralin	Treflan HFP or other registered trifluralin formulation		See label for allowable leafy greens and rates. Controls annual grasses and some broadleaf weeds, but is weak on wild mustard, smartweed, common ragweed, velvetleaf, and black nightshade. Rate varies with soil texture and organic matter. Follow recommended soil preparation, application, and incorporation procedures. Must be incorporated within 24 hours. See label for plantback restrictions. Ineffective on peat and muck soils.
Annual broad-leaves	0.094–0.187 lb clopyralid	0.25–0.5 pt Stinger	21 (spinach) 30 (brassica leafy greens)	Apply to spinach in the two- to five-leaf growth stage, making one to two broadcast applications per crop year, not to exceed a total of 0.5 pt/a. Some leaf curling may be observed.
Annual grasses	5.0–6.0 lb bensulide	5.0–6.0 qt Prefar 4E		See label for allowable leafy greens. Apply before planting. Incorporate 1–2 inches deep to avoid loss due to volatilization. Use on mineral soils only.
Annual grasses and some broad-leaves	4.5–10.5 lb DCPA	6.0–14.0 lb Dacthal W-75 6.0–14.0 pt Dacthal FL		Make preemergence applications to weed-free soil at seeding. Can be preplant incorporated. Use only on soils with 5% or less organic matter.
Emerged weeds	glyphosate	several manufacturers and formulations		See manufacturer's label to assure that the formulation is labeled for this crop and for specific instructions. Glyphosate may be applied anytime before crop emerges. Apply before crop seed germination in coarse sandy soils. If weeds have been mowed or tilled, do not treat until they have resumed active growth and reached the recommended stage on the label. Unless otherwise stated, allow 7 or more days before tilling treated fields. Do not tank mix with soil-residual herbicides unless otherwise specified.
	*paraquat	several manufacturers and formulations, not all are registered for this use		Prepare seedbed early to allow for maximum weed emergence. Application can be made as a banded or broadcast treatment before, during, or after planting, but before crop emergence. In preplant and preemergence (to the crop) uses, do not apply to soils lacking clay minerals (i.e., muck, pure sand). Use the higher rate for heavy weed infestations. Seeding and transplanting should be performed with minimal soil disturbance. Always add crop oil concentrate or non-ionic surfactant to spray mixture. Follow precautions on label.
Emerged grasses	0.068–0.12 lb clethodim	9.0–16.0 oz Select Max	14 (leaf lettuce) 30 (chicory)	Apply to actively growing grasses. Repeat treatments may be made at 14-day intervals up to the maximum annual use rate. Do not cultivate grasses within 7 days before or after application. Include appropriate surfactant as required by product label. Do not apply if rain is expected within 1 hour.
	0.094–0.125 lb clethodim	6.0–8.0 oz Select 2EC		
	0.094–0.28 lb sethoxydim	0.5–1.5 pt Poast	30 (head lettuce) 15 (leaf lettuce, endive, escarole)	Make postemergence applications to actively growing grasses within the size ranges indicated on the label. Check the label for early and rescue treatment rates. Do not apply more than 3.0 pt/a Poast in one crop season. Always add 2.0 pt/a of crop oil concentrate. Do not use on chicory.

*Restricted-use pesticide.

Melon: muskmelon (cantaloupe), watermelon

Planting

Melons need a long growing season of relatively high temperatures (averaging 70–80°F) for optimal growth. Vine crops are susceptible to frost, and seeds will not germinate in soils colder than 60°F. Planting generally begins around May 10 in southern Wisconsin and June 1 in northern Wisconsin.

Use tillage practices that create a level, firm seedbed with adequate moisture for germination. Melons grown on sandy soil will need irrigation.

Muskmelon

Rows: 60–84 inches.

Plants in row: 8–12 inches apart.

Watermelon

Rows: 60–96 inches.

Plants in row: 36–96 inches apart.

Transplants can and often should be used to start plantings. Vine crops are sensitive to transplanting and should be seeded in individual containers about 3–4 weeks before putting in the field. Move plants to the field starting around May 20 in southern Wisconsin and June 1 in northern counties. Vine crops do well when grown on black plastic mulch or under floating row covers in spring and early summer.

Lime and fertilizer

Lime: Use dolomitic limestone to maintain a pH of 5.8 on mineral soils and 5.6 on organic soils.

Fertilizer rates: Apply P_2O_5 and K_2O according to soil test recommendations. Use annual nitrogen, P_2O_5 , and K_2O recommendations in the table below. Take credits for previous legume crops and manure.

Application: Broadcast lime and fertilizer and work into the soil before planting. Apply fertilizer at planting time in a band 2 inches to the side and 2 inches below seed level.

Nitrogen: Split nitrogen recommendation into two or more applications during the season. Make the first application when plants have two or more true leaves. Make a second application when vines begin to fill the rows. Subsequent applications (15–20 lb N/a each) can be made at 10- to 14-day intervals after harvest has started.

Annual nitrogen, phosphate, and potash recommendations for melon

Nitrogen		Phosphate and potash		
Organic matter (%)	Amount to apply (lb/a)	Yield goal (t/a)	Amount P_2O_5 to apply* (lb/a)	Amount K_2O to apply* (lb/a)
<2	100	8–10	40	145
2.0–9.9	80			
10–20	60			
>20	30			

*Amounts shown are for optimum (O) soil test levels. Apply 50% of this rate if soil test is high (H) and omit if soil test is excessively high (EH). If soil test is low (L) or very low (VL), increase rates according to soil test recommendations.

Disease management

Try to grow crop under ideal conditions for fertility, soil texture, soil moisture, and pH. Use disease-free seed. Avoid fruit injury. Rotate crops with non-cucurbits

and eradicate cucurbit weeds. Follow a 7-day fungicide spray schedule, starting before the disease occurs. Apply the selected fungicide in at least 50 gal

water/a when using ground equipment or in 5–10 gal water/a with aerial application.

Disease control in melon—muskmelon, watermelon

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Alternaria leaf blight	azoxystrobin	10.0–15.5 fl oz Quadris Flowable	1	Quadris, Cabrio, and Reason belong to the Group 11 (strobilurin) fungicide category. Quadris Opti contains Groups 11 and M5 fungicides. Tanos contains Groups 11 and 27 fungicides. Do not exceed one application of any of these products before alternating with a fungicide having a different mode of action. Do not exceed four applications of strobilurin fungicides per crop per year. Do not apply more than 26.0 oz/a Endura per year. Do not make more than four applications per year. Pristine belongs to Groups 7 and 11 fungicide categories. Do not exceed one application of Pristine before alternating to a labeled fungicide with a different mode of action and not belonging to Groups 7 or 11. Do not exceed four applications of Pristine or other Group 7 or Group 11 fungicides per season. Do not exceed 74.0 oz/a Pristine per season. Consult label directions, especially for use on watermelons. Application can result in sunburn on surface of fruit. Do not apply more than 80.0 fl oz/a per year. Make no more than two sequential applications before alternating to an effective fungicide with a different mode of action. Do not apply more than 56.0 fl oz/a per year. Make no more than two sequential applications before alternating to an effective fungicide with a different mode of action. Root and cutting dip treatment, soil drench, and seed treatments are registered. See label for application details. Follow tank-mixing instructions on label; some incompatibility issues exist. See cucurbit section of label for further details among crop grouping. Allowable for use in organic systems.
	azoxystrobin + chlorothalonil	3.2 pt Quadris Opti	1	
	azoxystrobin + difenoconazole	12.0–14.0 fl oz Quadris Top	1	
	cymoxanil + famoxadone	8.0 oz Tanos 50DF	3	
	fenamidone	5.5 fl oz Reason 500 SC	14	
	pyraclostrobin	12.0–16.0 oz Cabrio EG	0	
	boscalid	6.5 oz Endura	0	
	boscalid + pyraclostrobin	12.5–18.5 oz Pristine WDG	0	
	chlorothalonil	2.0–3.0 pt Bravo Weather Stik, Equus 720 1.8–2.7 lb Bravo Ultrex 82.5WDG, Equus DF	0 0	
	cyprodinil + difenoconazole	16.0–20.0 fl oz Inspire Super	7	
cyprodinil + fludioxonil	11.0–14.0 oz Switch 62.5WG	1		
hydrogen dioxide	1:100–1:2000 dilution rate OxiDate	0		

(continued)

Disease control in melon—muskmelon, watermelon *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions	
Alternaria leaf blight <i>(cont.)</i>	mancozeb	1.6–2.4 qt Dithane F-45	5	Consult label for seasonal product limits. Apply when conditions favor disease. Use higher rates and shorter intervals when disease pressure is high.	
		2.0–3.0 lb Dithane DF Rainshield	5		
		1.6–2.4 qt Manzate Flowable	5		
		2.0–3.0 lb Manzate Pro-Stick	5		
		1.2–2.4 qt Penncozeb 4FL	5		
		2.0–3.0 lb Penncozeb 75DF, 80WP	5		
	penthiopyrad	12.0–16.0 fl oz Fontelis	1	Make no more than two sequential applications before alternating to an effective fungicide with a different mode of action. Do not exceed 67.0 fl oz/a per year. Can be used on greenhouse-grown cucumbers. See label for specific instructions on greenhouse rates.	
	zoxamide + mancozeb	1.5–2.0 lb Gavel 75DF	5	Do not exceed eight applications or apply more than 16.0 lb/a Gavel (10.67 lb ai/a mancozeb and 1.33 lb ai/a zoxamide) per season.	
Anthracnose	azoxystrobin	10.0–15.5 fl oz Quadris Flowable	1	See remarks for Quadris, Tanos, and Cabrio in Alternaria leaf blight section. If disease pressure is high, use the shortest interval and highest rate.	
	azoxystrobin + chlorothalonil	3.2 pt Quadris Opti	1		
	azoxystrobin + difenoconazole	12.0–14.0 fl oz Quadris Top	1		
	cymoxanil + famoxadone	8.0 oz Tanos 50DF	3		
	pyraclostrobin	12.0–16.0 oz Cabrio EG	0		
	boscalid + pyraclostrobin	18.5 oz Pristine WDG	0		Pristine belongs to Group 7 and 11 fungicide categories. Do not exceed one application of Pristine before alternating to a labeled fungicide with a different mode of action. Do not exceed four applications of Pristine or other Group 7 or Group 11 fungicides per season. Do not exceed 74.0 oz/a Pristine per season.
	chlorothalonil	1.5–2.0 pt Bravo Weather Stik, Echo 720	0		Apply when conditions are favorable for disease onset. Do not apply chlorothalonil to watermelon when any of the following conditions are present: 1) intense heat and sunlight; 2) drought conditions; 3) poor vine canopy; 4) other conditions favoring sunburn.
		1.4–1.8 lb Bravo Ultrex 82.5WDG	0		
		1.25–1.625 lb Echo 90DF	0		
cyprodinil + difenoconazole	16.0–20.0 fl oz Inspire Super	7	Do not apply more than 80.0 fl oz/a per year. Make no more than two sequential applications before alternating to an effective fungicide with a different mode of action.		
hydrogen dioxide	1:100–1:2000 dilution rate OxiDate	0	Root and cutting dip treatment, soil drench, and seed treatments are registered. See label for application details. Follow tank-mixing instructions on label; some incompatibility issues exist. See cucurbit section of label for further details among crop grouping. Allowable for use in organic systems.		

(continued)

Eggplant

Horseradish

Leafy greens

Melon

Mint

Onion

Pea

Disease control in melon—muskmelon, watermelon *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Anthracnose <i>(cont.)</i>	mancozeb	1.6–2.4 qt Dithane F-45	5	Do not apply more than 24.0 lb/a per year. Consult label for seasonal product limitations.
		2.0–3.0 lb Dithane DF	5	
		Rainshield	5	
		2.0–3.0 lb Koverall	5	
		1.6–2.4 qt Manzate Flowable	5	
		2.0–3.0 lb Manzate Pro-Stick	5	
		1.2–2.4 qt Penncozeb 4FL	5	
	2.0–3.0 lb Penncozeb 75DF, 80WP	5		
	thiophanate methyl	0.5 lb Topsin M 70W, Topsin M WSB 10.0 fl oz Topsin 4.5FL	0	Apply when disease first appears and repeat if needed every 7–14 days. See label for resistance management guidelines. Do not apply more than 60.0 fl oz of product/a per year.
Bacterial wilt <i>(Erwinia)</i>	<i>Eliminate the cucumber beetles that carry this pathogen (see Insect Control table).</i>			
Black rot	<i>See fungicide treatments recommended for anthracnose.</i>			Use certified disease-free seed. Destroy infected plant refuse.
Downy mildew	azoxystrobin + chlorothalonil	3.2 pt Quadris Opti	1	See remarks for these products in Alternaria leaf blight section.
	cymoxanil + famoxadone	8.0 oz Tanos 50DF	3	
	boscalid + pyraclostrobin	12.5–18.5 oz Pristine WDG	0	Pristine belongs to Groups 7 and 11 fungicide categories. Do not exceed one application of Pristine before alternating to a labeled fungicide with a different mode of action. Do not exceed four applications of Pristine or other Group 7 or Group 11 fungicides per season. Do not exceed 74.0 oz/a Pristine per season.
	chlorothalonil	1.4–1.8 lb Bravo Ultrex	0	Do not apply more than 19.1 lb/a.
	cyazofamid	2.1–2.75 fl oz Ranman	0	Ranman belongs to Group 21 fungicide category. Do not apply more than six sprays of Ranman per crop. Alternate Ranman sprays with a fungicide having a different mode of action. Do not apply more than 16.5 fl oz/a per year.
	cymoxanil	3.2–5.0 oz Curzate	3	Use only with a protectant as a tank mix partner, such as chlorothalonil, mancozeb, or copper hydroxide. Do not make more than nine applications per year.
	dimethomorph	6.0 fl oz Forum	0	Do not exceed 30.0 fl oz/a per growing season. Do not make more than five applications per season. Do not make more than two sequential applications of Forum before alternating to another effective fungicide with a different mode of action for at least one application.
	famoxadone + cymoxanil	8.0 oz Tanos	3	Do not make more than one application of Tanos before alternating with a fungicide having a different mode of action. Do not make more than four applications of Tanos or other Group 11 fungicides per season. Do not exceed 32.0 oz/a Tanos per crop per season. Tanos is helpful for suppressing Phytophthora blight. Tanos must be tank mixed with a contact fungicide such as mancozeb, chlorothalonil, or copper-containing fungicide.
	fenamidone	5.5 fl oz Reason 500 SC	14	Do not apply more than 22.0 fl oz Reason 500 SC (0.71 lb ai/a per year).

(continued)

Disease control in melon—muskmelon, watermelon *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Downy mildew <i>(cont.)</i>	fixed copper	1.5–3.0 lb Champion 77WP	0	Use disease-free seed and rotate crops. Begin applications before fruit form at less than 7-day intervals. After a rain and wind storm, make two or three applications as soon as possible after the storm at 2- to 3-day intervals.
		1.0–1.3 pt Champ Formula 2	0	
		1.5–2.0 lb Kocide 101 77WP	0	
		1.5–2.0 lb Kocide DF	0	
		2.6 pt Kocide LF 2.4F	0	
		1.0–2.25 lb Kocide 2000 DF	0	
		0.5–1.25 lb Kocide 3000	0	
fluopicolide	3.0–4.0 fl oz Presidio	2	Tank mix this product with another labeled non-Group 43 fungicide. May be applied through irrigation.	
fosetyl-al	2.0–5.0 lb Aliette WDG	12 hr	Begin applications when conditions favor disease development (high moisture and moderate temperatures). Repeat at 7- to 14-day intervals. Do not exceed seven applications per season.	
hydrogen dioxide	1:100–1:2000 dilution rate OxiDate	0	Root and cutting dip treatment, soil drench, and seed treatments are registered. See label for application details. Follow tank-mixing instructions on label; some incompatibility issues exist. See cucurbit section of label for further details among crop grouping. Allowable for use in organic systems.	
mancozeb	1.6–2.4 qt Dithane F-45 2.0–3.0 lb Dithane DF Rainshield 2.0–3.0 lb Koverall 1.6–2.4 qt Manzate Flowable 2.0–3.0 lb Manzate Pro-Stick 1.2–2.4 qt Penncozeb 4FL 2.0–3.0 lb Penncozeb 75DF, 80WP	5	Do not apply more than 24.0 lb/a per year. Consult label for seasonal product limitations.	
		5		
		5		
		5		
		5		
		5		
mandipropamid	8.0 fl oz Revus	0	Do not exceed one application before switching to another effective non-Group 40 fungicide. Must be applied with an adjuvant.	
phosphorous acid, mono- and dibasic sodium, potassium, and ammonium salts	2.5–5.0 pt Phostrol	0	Do not exceed seven applications per season.	
potassium phosphite	1.0–3.0 qt Fosphite/100 gal water	0	Do not apply to plants that are stressed due to heat or moisture. Do not apply when leaf wetness periods of more than 4 hours are expected. Do not apply at less than 3-day intervals.	
propamocarb hydrochloride	1.2 pt Previcur Flex OR 0.6–1.2 pt Previcur Flex <i>plus</i> tank-mix partner	2	Use as a foliar spray in a preventive program. Begin applications when conditions are favorable for disease, but before infection. Continue at 7- to 14-day intervals until the threat of disease is over. When applying at intervals longer than 7 days, alternate with an application of a contact fungicide midway between applications. Do not apply more than 6.0 pt/a Previcur Flex per season.	
pyraclostrobrin	8.0–12.0 oz Cabrio EG		Do not exceed four applications of strobilurin fungicides per crop per year.	
zoxamide + mancozeb	1.5–2.0 lb Gavel 75DF	5	Do not exceed eight applications or apply more than 16 lb/a product (10.67 lb ai mancozeb or 1.33 lb zoxamide) per season.	

(continued)

Eggplant

Horseradish

Leafy greens

Melon

Mint

Onion

Pea

Disease control in melon—muskmelon, watermelon *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Fusarium wilt	<i>The only practical control is to grow wilt-resistant varieties. A lone crop rotation with crops other than melons can be beneficial.</i>			
Mosaic	<i>Plant resistant varieties. When possible, control by isolation from the following plants: burdock, catnip, china aster, chrysanthemum, wild cucumber, geranium, gladiolus, wild ground cherry, horse nettle, hyacinth, jimsonweed, larkspur, lily, marigold, milkweed, morning glory, nasturtium, petunia, phlox, pokeweed, salvia, snapdragon, flowering spurge, tulip, white cockle, and zinnia. Control aphids that spread the disease (see Insect Control table).</i>			
Phytophthora blight or crown rot <i>(Phytophthora capsici)</i>	cyazofamid	2.75 fl oz Ranman 400SC	0	Do not apply more than six sprays or 16.5 fl oz/a of Ranman per year. Alternate Ranman (Group 21) sprays with a fungicide having a different mode of action. Crops not listed on the label should not be planted within 30 days after the last application.
	dimethomorph	6.0 fl oz Forum	0	Do not exceed 30.0 fl oz/a per growing season. Do not make more than five applications per season. Do not make more than two sequential applications of Forum before alternating to another effective fungicide with a different mode of action for at least one application.
Leafy greens	famoxadone + cymoxanil	8.0–10.0 oz Tanos	3	Do not make more than one application of Tanos before alternating with a fungicide having a different mode of action. Do not make more than four applications of Tanos or other Group 11 fungicides per season. Do not exceed 32.0 oz/a Tanos per crop per season. Tanos is helpful for suppressing Phytophthora blight. Tanos must be tank mixed with a contact fungicide such as mancozeb, chlorothalonil, or copper-containing fungicide.
	flupicolide	3.0–4.0 fl oz Presidio	2	Tank mix this product with another labeled non-Group 43 fungicide. May be applied through irrigation.
Melon	fosetyl-al	2.0–5.0 lb Aliette WDG	12 hr	Begin applications when conditions favor disease development (high moisture and moderate temperatures). Repeat at 7- to 14-day intervals. Do not exceed seven applications per season.
Mint	hydrogen dioxide	1:100–1:2000 dilution rate OxiDate	0	Root and cutting dip treatment, soil drench, and seed treatments are registered. See label for application details. Follow tank-mixing instructions on label; some incompatibility issues exist. See cucurbit section of label for further details among crop grouping. Allowable for use in organic systems.
	mandipropamid	8.0 fl oz Revus	0	Do not exceed one application before switching to another effective non-Group 40 fungicide. An adjuvant must be applied with Revus.
Onion	phosphorous acid, mono- and dibasic sodium, potassium, and ammonium salts	2.5–5.0 pt Phostrol	0	Do not exceed seven applications per season.
	potassium phosphite	1.0–3.0 qt Fosphite/100 gal water	0	Do not apply to plants that are stressed due to heat or moisture. Do not apply when leaf wetness periods of more than 4 hours are expected. Do not apply at less than 3-day intervals.

(continued)

Disease control in melon—muskmelon, watermelon *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Phytophthora blight or crown rot <i>(cont.)</i>	zoxamide + mancozeb	1.5–2.0 lb Gavel 75DF	5	Do not exceed eight applications or apply more than 16.0 lb/a Gavel (10.67 lb ai/a mancozeb or 1.33 lb ai/a zoxamide) per season.
Powdery mildew	azoxystrobin	10.0–15.5 fl oz Quadris Flowable	1	Quadris, Cabrio, and Flint belong to the Group 11 (strobilurin) fungicide category. Quadris Opti contains a combination of Group 11 and Group M fungicides. Do not exceed one application of any of these products before alternating with a fungicide having a different mode of action. Do not exceed four applications of strobilurin fungicides per crop per year. Do not exceed 1.92 qt/a Quadris, 64.0 oz/a Cabrio, 8.0 oz/a Flint, or 2.0 gal/a Quadris Opti per season. Do not tank mix Quadris, Cabrio, Flint, or Quadris Opti with additives or adjuvants. Pristine belongs to Group 7 and 11 fungicide categories. Do not exceed one application of Pristine before alternating to a labeled fungicide with a different mode of action. Do not exceed four applications of Pristine or other Group 7 or Group 11 fungicides per season. Do not exceed 74.0 oz/a Pristine per season. Apply when conditions favor disease. See further instruction in the anthracnose section. Do not apply more than 2 gal/a of Trilogy. OMRI-approved. Do not make more than two applications/a per year. Do not exceed a total of 6.8 oz/a per year. Do not apply more than 80.0 fl oz/a per year. Make no more than two sequential applications before alternating to an effective fungicide with a different mode of action. Do not apply more than 56.0 fl oz/a per year. Make no more than two sequential applications before alternating to an effective fungicide with a different mode of action. Root and cutting dip treatment, soil drench, and seed treatments are registered. See label for application details. Follow tank-mixing instructions on label; some incompatibility issues exist. See cucurbit section of label for further details among crop grouping. Allowable for use in organic systems. Not labeled for use in the greenhouse. This is a Group 11 strobilurin fungicide. Do not make more than four applications of Sovran or other strobilurin fungicides per acre per year. Do not exceed 1.5 lb/a product (0.6 lb ai/a) per year. Observe a 30-day plantback interval between last application and planting new crops. Do not apply to plants that are stressed due to heat or moisture. Do not apply when leaf wetness periods of more than 4 hours are expected. Do not apply at less than 3-day intervals.
	azoxystrobin + chlorothalonil	3.2 pt Quadris Opti	1	
	pyraclostrobin	12.0–16.0 oz Cabrio EG	0	
	trifloxystrobin	1.5–2.0 oz Flint	0	
	boscalid + pyraclostrobin	12.5–18.5 oz Pristine WDG	0	
	chlorothalonil	1.8–2.7 lb Bravo Ultrex	0	
	clarified hydrophobic extract of neem oil	0.5–1.0% Trilogy in 25–100 gal water or 2.0 pt in at least 5 gal water/a	0	
	cyflufenamid	3.4 oz Torino	0	
	cyprodinil + difenoconazole	16.0–20.0 fl oz Inspire Super	7	
	cyprodinil + fludioxonil	11.0–14.0 oz Switch 62.5WG	1	
hydrogen dioxide	1:100–1:2000 dilution rate OxiDate	0		
kresoxim methyl	3.2–4.8 oz Sovran	0		
myclobutanil	2.5–5.0 oz Rally 40WSP	0		
potassium phosphite	1.0–3.0 qt Fosphite/100 gal water	0		

(continued)

Eggplant

Horseradish

Leafy greens

Melon

Mint

Onion

Pea

Disease control in melon—muskmelon, watermelon *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Powdery mildew <i>(cont.)</i>	quinoxyfen	4.0–6.0 fl oz Quintec	3	Do not apply more than 24.0 fl oz/a per year. Do not apply more than two consecutive applications before alternating to an effective fungicide with a different mode of action.
	tebuconazole	4.0–6.0 fl oz Folicur 3.6 F, Monsoon, Onset 3.6L, Orius 3.6F, Tebusha 3.6FL, TebuStar 3.6L, Tebuzol 3.6F, Toledo	7	Do not exceed 24.0 fl oz/a per season.
	thiophanate methyl	0.5 lb Topsin M 70W, Topsin M WSB 10.0 fl oz Topsin 4.5FL 0.2–0.4 lb Thiophanate methyl 85WDG	0	Apply when disease first appears and repeat if needed every 7–14 days.
	triflumizole	4.0–8.0 oz Procure 50WS, Procure 480SC	0	Do not apply more than 40.0 oz/a Procure per season. See product label for plantback restrictions for leafy vegetables (30 days), root vegetables (60 days) and all other crops (1 yr). For greenhouse melon production, 4.0–8.0 fl oz in 100 gal water.
Seed rot and damping off	captan	0.5–1.0 teaspoon Captan 50% WP/lb of dry seed	—	Use disease-free soil. Water plants in morning. Chemicals listed are seed treatments. Do not use treated seed for feed or food.
	mefenoxam	1.0–2.0 pt Ridomil Gold SL 2.0–4.0 pt Ultra Flourish	— —	Preplant-incorporated application or surface application at planting. Preplant to top 2 inches of soil.
		0.085–0.64 fl oz Apron XL/100 lb seed	—	Follow manufacturer's directions. Do not use treated seed for feed or food.
	mefenoxam + azoxystrobin	0.34 fl oz Uniform/1,000 ft row	—	Apply Uniform as an in-furrow spray in a minimum of 5 gal of water per acre at planting.
	metalaxyl	4.0–8.0 pt MetaStar 2E AG	—	Preplant-incorporated application or surface application at planting. Preplant to top 2 inches of soil.
		0.7 fl oz/100 lb seed Sebring 2.65 ST 0.75 fl oz/100 lb seed Allegiance FL, Metalaxyl 265 ST	— —	Follow manufacturer's directions. Do not use treated seed for feed or food.
	thiram	0.75 teaspoon Thiram 50% WP/lb seed	—	Use disease-free soil. Water plants in morning. Chemicals listed are seed treatments. Do not use treated seed for feed or food.

Eggplant

Horseradish

Leafy greens

Melon

Mint

Onion

Pea

Scouting calendar for insect pests of melon

April			May			June			July			August			September			
early	mid	late	early	mid	late	early	mid	late	early	mid	late	early	mid	late	early	mid	late	
Wireworms																		
	Aphids						Aphids											
	Striped and spotted cucumber beetles																	
	Seed maggot																	
							Mites											

Insect control in melon—muskmelon, watermelon

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Bean aphid and soybean aphid	spirotetramat	4.0–5.0 fl oz Movento	1 (edible) 7 (dry)	Do not apply more than 10.0 fl oz/a per season and allow at least 7 days between applications.
Caterpillar pests (cutworms, cabbage looper, diamond-back moth)	0.0065–0.0125 lb beta-cyfluthrin	0.8–1.6 fl oz *Baythroid XL	0	Apply every 7 days as needed. Do not exceed 11.2 fl oz/a.
	bifenthrin	2.1–6.4 fl oz *Brigade 2EC	7	Do not exceed 0.5 lb ai/a or five applications per season. Wait at least 7 days between treatments.
		3.4–6.8 fl oz *Capture LFR	16	Do not exceed 0.1 lb ai/a as an at-plant application; do not exceed 0.5 lb ai/a per season of all bifenthrin products.
	bifenthrin + zeta-cypermethrin	4.0–10.3 fl oz *Hero	3	Do not apply more than 10.3 fl oz/a per season and allow at least 7 days between applications. Do not apply more than 41.2 fl oz of product/a per crop season.
	1.0 lb carbaryl	Sevin Bait (several formulations)	1	Broadcast when cutworms are present in damaging numbers.
	0.045–0.065 lb chlorantraniliprole	3.5–5.0 fl oz Coragen	1	Wait at least 5 days between treatments. Do not exceed 15.4 fl oz/a (0.2 lb ai/a) per season.
	0.012–0.028 lb deltamethrin	1.0–2.4 fl oz *Delta Gold	3	Apply every 3 days as needed. Do not exceed 14.4 fl oz/a per season.
	0.03–0.05 lb esfenvalerate	5.8–9.6 fl oz *Asana XL	3	Use as a rescue treatment when worms are present.
	0.03–0.045 lb flubendiamide	2.0–3.0 oz Synapse WG	1	Do not apply more than 3.0 oz/a (0.045 lb ai/a) in a 7-day period or more than 9.0 oz/a per season.
	flubendiamide + buprofezin	12.0–17.0 fl oz Vetica	7	Do not apply more than 38.0 fl oz/a per season and allow at least 7 days between applications. Do not make more than three applications per crop season.
0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4	Do not exceed 0.18 lb ai/a per season. Reapply at intervals of 5 or more days.	
lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Voliam Xpress	1	Do not exceed 31.0 fl oz/a of Voliam Xpress or 0.18 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per growing season.	
lambda-cyhalothrin + thiamethoxam	4.0–4.5 fl oz *Endigo ZC	1	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 5 days between applications.	
0.1–0.2 lb permethrin	*Ambush	0	See label for rate. Do not exceed 1.6 lb ai/a per year.	

*Restricted-use pesticide.

(continued)

Eggplant

Horseradish

Leafy greens

Melon

Mint

Onion

Pea

Insect control in melon—muskmelon, watermelon *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Caterpillar pests (<i>cont.</i>)	spiromesifen	7.0–8.5 fl oz Oberon 2SC	7	Apply every 7 days as needed. Do not exceed 25.5 fl oz/a per season.
	0.01–0.025 lb zeta-cypermethrin	1.28–4.0 oz *Mustang Max	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Max per season.
Cucumber beetles (striped, spotted)	<i>Treat when there are more than four to five adults per 50 plants.</i>			
	0.047–0.10 lb acetamiprid	2.5–5.3 oz Assail 30 SG	0	Do not exceed five applications or 26.5 oz/a of product per crop season.
	0.05–0.10 lb acetamiprid	1.1–2.3 oz Assail 70WP	0	Do not exceed five applications or 11.5 oz/a of product per crop season.
	0.019–0.022 lb beta-cyfluthrin	2.4–2.8 fl oz *Baythroid XL	0	Apply every 7 days as needed. Do not exceed 11.2 fl oz/a.
	0.033–0.10 lb bifenthrin	2.1–6.4 fl oz *Brigade 2EC	7	Do not exceed 0.5 lb ai/a or five applications per season. Wait at least 7 days between treatments.
		6.8–8.5 fl oz *Capture LFR	16	Do not exceed 0.1 lb ai/a as an at-plant application; do not exceed 0.5 lb ai/a per season of all bifenthrin products.
	bifenthrin + zeta-cypermethrin	4.0–10.3 fl oz *Hero	3	Do not apply more than 10.3 fl oz/a per season and allow at least 7 days between applications. Do not apply more than 41.2 fl oz of product/a per crop season.
	0.5–1.0 lb carbaryl	Sevin (several formulations)	0	Do not apply during maximum flowering or fruit set, or when pollinating bees are in the field. Spray during the evening.
	clothianadin	<i>foliar</i> : 3.0–4.0 fl oz Belay	21	Do not apply more than 12.0 fl oz/a per season and allow at least 7 days between applications.
		<i>soil</i> : 9.0–12.0 fl oz Belay	—	Do not apply more than 12.0 fl oz/a per season. Apply as a narrow band centered on the plant row; as an in-furrow spray at planting; as a sidedress to both sides of the row; as a transplant water drench; or as chemigation into root zone through drip, trickle or micro-sprinkler, or similar equipment.
	0.018–0.024 lb deltamethrin	1.5–2.4 fl oz *Delta Gold	3	Apply every 3 days as needed. Do not exceed 14.4 fl oz/a per season.
	0.05–0.18 lb dinotefuran (<i>foliar</i>)	2.0–7.0 oz Scorpion 35SL	1	Can repeat at 7-day intervals. Do not apply more than 10.5 oz per year.
	0.132–0.179 lb dinotefuran	3.0–4.0 oz Venom 70SG	1	Do not apply more than 62.0 oz/a per season.
	0.5–1.0 lb endosulfan	1.0–2.0 lb Thiodan WP 0.66–1.33 qt Phaser EC	2	Do not exceed 3.0 lb ai/a per year.
	0.03–0.05 lb esfenvalerate	5.8–9.6 fl oz *Asana XL	3	Do not exceed 0.25 lb ai/a per year.
	0.2–0.3 lb fenpropathrin	10.66–16.0 oz Danitol 2.4EC	7	Do not exceed 2.66 pt/a per season.
	imidacloprid	7.0–10.5 fl oz Admire Pro	21	Apply in a narrow band centered on plant row within 14 days before planting or as an in-furrow treatment during planting. Do not exceed 0.38 lb ai/a per year.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4	Do not exceed 0.18 lb ai/a per season. Reapply at intervals of 5 or more days.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Voliam Xpress	1	Do not exceed a total of 31.0 fl oz/a of Voliam Xpress or 0.18 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per season.

*Restricted-use pesticide.

(continued)

Insect control in melon—muskmelon, watermelon *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Cucumber beetles <i>(cont.)</i>	lambda-cyhalothrin + thiamethoxam	4.0–4.5 fl oz *Endigo ZC	1	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 5 days between applications.
	0.94–1.9 lb malathion	several formulations	1	Do not apply before vining or to wet plants.
	0.45–0.9 lb methomyl	1.5–3.0 pt *Lannate LV 0.5–1.0 lb *Lannate SP	1–3	See label for days to harvest.
	0.5–1.0 lb oxamyl	2.0–4.0 pt *Vydate L	1	Make first application 2–4 weeks after planting. Repeat 2–3 weeks later.
	0.1–0.2 lb permethrin	*Ambush, *Pounce	0	Several formulations; see label for rate. Do not exceed 1.6 lb ai/a per year.
	thiamethoxam	3.0–5.5 oz Actara 25WDG 5.0–11.0 Platinum 2SC	30	Do not follow applications of Platinum with foliar applications of any other neonicotinoid insecticide. Platinum may be applied to direct seeded crops in-furrow at seeding or transplant depth, or as a narrow surface band above the seedling and followed by irrigation. Do not apply more than 11.0 oz/a per season. Actara is applied as a foliar spray.
	0.198–0.257 lb thiamethoxam + chlorantraniliprole	10.0–13.0 fl oz Durivo	30	Do not exceed a total of 13.0 fl oz/a Durivo (0.257 lb ai/a) per growing season. Do not exceed 0.172 lb ai/a of thiamethoxam-containing products or 0.2 lb ai/a of chlorantraniliprole-containing products per season.
0.02–0.025 lb zeta-cypermethrin	2.8–4.0 oz *Mustang Max	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Max per season.	
Melon aphid	0.047–0.075 lb acetamiprid	2.5–4.0 oz Assail 30 SG	0	Do not exceed five applications or 26.5 oz/a of product per crop season.
	0.05–0.10 lb acetamiprid	1.1–1.7 oz Assail 70WP	0	Do not exceed five applications or 11.5 oz/a of product per crop season.
	0.04–0.10 lb bifenthrin	2.6–6.4 fl oz *Brigade 2EC	3	Apply every 7 days as needed. Do not exceed 0.3 lb ai/a per season. Do not make more than two applications after bloom.
	bifenthrin + zeta-cypermethrin	4.0–10.3 fl oz *Hero	3	Do not apply more than 10.3 fl oz/a per season and allow at least 7 days between applications. Do not apply more than 41.2 fl oz of product/a per crop season.
	clothianadin	<i>foliar</i> : 3.0–4.0 fl oz Belay	21	Do not apply more than 12.0 fl oz/a per season and allow at least 7 days between applications.
		<i>soil</i> : 9.0–12.0 fl oz Belay	—	Do not apply more than 12.0 fl oz/a per season. Apply as a narrow band centered on the plant row; as an in-furrow spray at planting; as a side dress to both sides of the row; as a transplant water drench; or as chemigation into root zone through drip, trickle or micro-sprinkler, or similar equipment.
	0.25–0.75 lb diazinon	several formulations	3	Apply as soon as aphids are noticed.
	0.5 lb dimethoate	1.0 pt Dimethoate EC	3	
	0.045–0.268 lb dinotefuran	<i>foliar</i> : 1.0–4.0 oz Venom 70SG	1	Do not follow soil applications with foliar application of any other neonicotinoid insecticide. Use only one application method. Do not apply more than 12.0 oz/a per season using soil applications. See product label for application directions.
		<i>soil</i> : 5.0–6.0 oz Venom 70SG	21	
0.05–0.18 lb dinotefuran (<i>foliar</i>)	2.0–7.0 oz Scorpion 35SL	1	Can repeat at 7-day intervals. Do not apply more than 10.5 oz per year. Use only one application method.	
0.23–0.27 lb dinotefuran (<i>soil</i>)	9.0–10.5 oz Scorpion 35SL	21	Do not apply more than 21.0 oz per year. Use only one application method.	

*Restricted-use pesticide.

(continued)

Eggplant

Horseradish

Leafy greens

Melon

Mint

Onion

Pea

Insect control in melon—muskmelon, watermelon *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions	
Melon aphid <i>(cont.)</i>	0.5–1.0 lb endosulfan	1.0–2.0 lb Thiodan WP 0.66–1.33 qt Phaser EC	2	Do not exceed 3.0 lb ai/a per season.	
	0.062–0.089 lb flonicamid	2.0–2.8 oz Beleaf SG	0	Begin applications before aphid populations build. Do not exceed 2.8 oz/a Beleaf per application and do not apply more than 8.4 oz/a (0.267 lb ai/a) per season.	
Horseradish	imidacloprid	7.0–10.5 fl oz Admire Pro	21	Apply in a narrow band centered on plant row within 14 days before planting or as an in-furrow treatment during planting. Do not exceed 0.38 lb ai/a per year.	
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4	Do not exceed 0.18 lb ai/a per season. Reapply at intervals of 5 or more days.	
	lambda-cyhalothrin + chlorantraniliprole	9.0 fl oz *Voliam Xpress	1	Do not exceed 31.0 fl oz/a of Voliam Xpress or 0.18 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per growing season.	
	lambda-cyhalothrin + thiamethoxam	4.0–4.5 fl oz *Endigo ZC	1	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 5 days between applications.	
Leafy greens	1.0–2.0 lb malathion	several formulations	1	Do not apply before vining or to wet plants.	
	0.45–0.9 lb methomyl	1.5–3.0 pt *Lannate LV 0.5–1.0 lb *Lannate SP	1–3	Do not exceed 5.4 lb ai/a per season.	
	0.375–0.5 lb oxydemeton-methyl	1.5–2.0 pt *Metasystox-R	14 <small>(muskmelon)</small> 7 <small>(watermelon)</small>	Apply no more than three times per season to muskmelon and no more than twice per season to watermelon.	
Melon	pymetrozine	2.75 oz Fulfill 50WDG	14	Controls melon and green peach aphids. Treat when aphids first appear. May repeat in 7 days. Do not exceed 5.5 oz/a per season or more than two applications per crop.	
	thiamethoxam	2.0–3.0 oz Actara WG	0	Apply before pests reach damaging levels. Repeat as needed every 5 days. Do not exceed 8.0 oz/a of product per season.	
		5.0–11.0 fl oz Platinum	30	Apply as an in-furrow spray at planting or as a post-seeding transplant or hill drench. Irrigate sufficiently to move the chemical into the root zone. Use the higher rate for long residual control. Do not apply less than 5.0 fl oz/a or more than 11.0 fl oz/a of Platinum per season.	
Mint	0.198–0.257 lb thiamethoxam + chlorantraniliprole	10.0–13.0 fl oz Durivo	30	Do not exceed a total of 13.0 fl oz/a Durivo (0.257 lb ai/a) per growing season. Do not exceed 0.172 lb ai/a of thiamethoxam-containing products or 0.2 lb ai/a of chlorantraniliprole-containing products per season.	
	0.02–0.025 lb zeta-cypermethrin	3.2–4.0 oz *Mustang Max	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Max per season.	
	Seed corn maggot	0.04–0.08 lb bifenthrin	3.4–6.8 oz *Capture LFR		Apply as a 5- to 7-inch band over an open furrow or in-furrow with the seed. Do not exceed 0.1 lb/a per season as an at-plant application.
Onion	0.01–0.025 lb zeta-cypermethrin	1.28–4.0 oz *Mustang Max	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Max per season.	
	Spider mite	0.938–1.88 lb abamectin	8.0–16.0 fl oz *Agri-Mek 0.15EC	7	May repeat after 7 days, but do not make more than two sequential treatments or exceed 5.64 lb ai/a per year.
		bifenazate	0.75–1.0 lb Acramite 50WS	3	Do not exceed one application per season.

*Restricted-use pesticide.

(continued)

Insect control in melon—muskmelon, watermelon *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Spider mite <i>(cont.)</i>	0.08–0.10 lb bifenthrin	5.12–6.4 fl oz *Brigade 2EC	3	Apply before insects reach threshold levels. May repeat applications after 7 days, but do not make more than two applications after bloom. Do not exceed 0.3 lb ai/a per season.
	bifenthrin + zeta-cypermethrin	10.3 fl oz *Hero	3	Do not apply more than 10.3 fl oz/a per season and allow at least 7 days between applications. Do not apply more than 41.2 fl oz of product/a per crop season.
	0.25–0.5 lb dimethoate	0.5–1.0 pt Dimethoate EC	3	
	0.09–0.14 lb etoxazole	2.0–3.0 oz Zeal	7	Do not make more than one application of Zeal or exceed 0.14 lb ai/a per season.
	0.2 lb fenpropathrin	10.66 fl oz Danitol 2.4EC	7	Treat when mites first appear and repeat every 7 days as needed. Do not exceed 0.8 lb ai/a per season.
	lambda-cyhalothrin + thiamethoxam	4.5 fl oz *Endigo ZC	1	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 5 days between applications.
	spiromesifen	7.0–8.5 fl oz Oberon 2SC	7	Apply every 7 days as needed. Do not exceed 25.5 fl oz/a per season.
Squash bug	<i>Check undersides of leaves for squash bug eggs laid in neat rows. Eggs hatch within 1–2 weeks. Treat when squash bugs are young; they are difficult to control as older nymphs or adults. Destroy crop residue in fall to reduce overwinter survival of this pest.</i>			
	0.10 lb acetamiprid	2.3 oz Assail 70WP	0	Do exceed five applications or 11.5 oz/a of product per crop season.
		5.3 oz Assail 30 SG	0	Do exceed five applications or 26.5 oz/a of product per crop season.
	0.04–0.10 lb bifenthrin	2.6–6.4 fl oz *Brigade 2EC	3	Apply every 7 days as needed. Do not exceed 0.3 lb ai/a per season. Do not make more than two applications after bloom.
	bifenthrin + zeta-cypermethrin	4.0–10.3 fl oz *Hero	3	Do not apply more than 10.3 fl oz/a per season and allow at least 7 days between applications. Do not apply more than 41.2 fl oz of product/a per crop season.
	0.5–1.0 lb carbaryl	Sevin (several formulations)	0	Do not apply during maximum flowering or fruit set, or when pollinating bees are in the field. Spray during the evening.
	clothianadin	<i>foliar:</i> 3.0–4.0 fl oz Belay	21	Do not apply more than 12.0 fl oz/a per season and allow at least 7 days between applications.
		<i>soil:</i> 9.0–12.0 fl oz Belay	—	Do not apply more than 12.0 fl oz/a per season. Apply as a narrow band centered on the plant row; as an in-furrow spray at planting; as a side dress to both sides of the row; as a transplant water drench; or as chemigation into root zone through drip, trickle or micro-sprinkler, or similar equipment.
	0.5–1.0 lb endosulfan	1.0–2.0 lb Thiodan WP 0.66–1.33 qt Phaser EC	2	Do not exceed 3.0 lb ai/a per year.
	0.03–0.05 lb esfenvalerate	5.8–9.6 fl oz *Asana XL	3	Do not exceed 0.25 lb ai/a per year.
0.05–0.18 lb dinotefuran	2.0–7.0 oz Scorpion 35SL	1	Can repeat at 7-day intervals. Do not apply more than 10.5 oz per year.	
0.132–0.179 lb dinotefuran	3.0–4.0 oz Venom 70SG	1	Do not apply more than 6.0 oz/a per season.	

*Restricted-use pesticide.

(continued)

Eggplant

Horseradish

Leafy greens

Melon

Mint

Onion

Pea

Insect control in melon—muskmelon, watermelon *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Squash bug <i>(cont.)</i>	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4	Do not exceed 0.18 lb ai/a per season. Reapply at intervals of 5 or more days.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Voliam Xpress	1	Do not exceed 31.0 fl oz/a of Voliam Xpress or 0.18 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per growing season.
	lambda-cyhalothrin + thiamethoxam	4.0–4.5 fl oz *Endigo ZC	1	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 5 days between applications.
	0.1–0.2 lb permethrin	*Ambush, *Pounce	0	Will kill adult squash bugs. Several formulations; see label for rate.
	0.02–0.025 lb zeta-cypermethrin	2.8–4.0 oz *Mustang Max	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Max per season.
Squash vine borer	<i>Treat when adults are observed (900 DD₅₀ or when chicory is in bloom), especially when runners are less than 2 feet long. Larvae boring in the main stem can kill the entire plant, while loss of a runner or two when the plant is larger will not cause economic damage. Look for sawdust-like excrement coming from holes in the stems, and open the stems to confirm the presence of squash vine borer larvae. Repeat applications at 5- to 7-day intervals throughout the 3-week egg-laying period.</i>			
0.10 lb acetamiprid	2.3 oz Assail 70WP	0	Do not exceed five applications or 11.5 oz/a of product per crop season.	
	5.3 oz Assail 30 SG	0	Do not exceed five applications or 26.5 oz/a of product per crop season.	
0.04–0.10 lb bifenthrin	2.6–6.4 fl oz *Brigade 2EC	3	Apply every 7 days as needed. Do not exceed 0.3 lb ai/a per season. Do not make more than two applications after bloom.	
bifenthrin + zeta-cypermethrin	4.0–10.3 fl oz *Hero	3	Do not apply more than 10.3 fl oz/a per season and allow at least 7 days between applications. Do not apply more than 41.2 fl oz of product/a per crop season.	
0.5–1.0 lb endosulfan	1.0–2.0 lb Thiodan WP 0.66–1.33 qt Phaser EC	2	Apply weekly to flower buds, stems, and vines beginning when moths first appear. Do not exceed three applications per season.	
0.03–0.05 lb esfenvalerate	5.8–9.6 fl oz *Asana XL	3	Do not exceed 0.25 lb ai/a per season.	
flubendiamide + buprofezin	12.0–17.0 fl oz Vetica	7	Do not apply more than 38.0 fl oz/a per season and allow at least 7 days between applications. Do not make more than three applications per crop season.	
0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4	Do not exceed 0.18 lb ai/a per season. Reapply at intervals of 5 or more days.	
lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Voliam Xpress	1	Do not exceed 31.0 fl oz/a of Voliam Xpress or 0.18 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per growing season.	
lambda-cyhalothrin + thiamethoxam	4.0–4.5 fl oz *Endigo ZC	1	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 5 days between applications.	
0.1–0.2 lb permethrin	*Ambush, *Pounce	0	Several formulations; see label for rate. Do not apply more than 1.6 lb ai/a per season.	
0.02–0.025 lb zeta-cypermethrin	2.8–4.0 oz *Mustang Max	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Max per season.	

*Restricted-use pesticide.

Weed control in melon—muskmelon, watermelon

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Annual weeds	0.15–0.25 lb clomazone	0.4–0.67 pt Command 3ME		For suppression and control of annual grasses and broadleaves, make a single preemergent soil application before seeding or transplanting, or after seeding but prior to crop emergence. Place seed or roots of transplants below the chemical barrier when planting. Strictly follow all precautions and restrictions on the label to minimize offsite movement and carryover. Read and understand the vegetable disclaimer section of the label—the end user assumes all liability for failure to perform and crop injury resulting from its use.
	1.1–1.7 lb ethalfluralin	3.0–4.5 pt Curbit 3EC		Make a single broadcast application within 2 days after seeding. Rate varies with soil texture and organic matter. A shallow cultivation or 1/2-inch of water is needed to activate the herbicide. Heavy rain following application or shallow seeding may result in crop injury. Do not incorporate prior to planting, use under plastic mulch, broadcast over transplants, or apply through irrigation. Do not use on soils with more than 10% organic matter.
	0.4–1.2 lb ethalfluralin + 0.125–0.375 lb clomazone	2.0–6.0 pt Strategy	45	Use only as a postplant surface-applied herbicide. Make one application before crop and weeds emerge or apply as a banded spray between rows following crop emergence or transplanting. Do not make broadcast applications to transplants or use under plastic mulch. Strategy requires rainfall, irrigation, or a shallow cultivation within 2–5 days after application for activation. Because of the potential for offsite movement and severe crop injury, strictly follow all precautions and restrictions on the label.
	0.5–1.0 lb trifluralin	1.0–2.0 pt Treflan HFP or registered equivalent	60 (water-melon) 30 (all other cucurbits)	Direct spray between rows when plants have reached the three- to four-leaf stage. Set incorporation equipment to move treated soil around the base of plants. Controls annual grasses and some broadleaf weeds, but is weak on wild mustard, smartweed, common ragweed, velvetleaf, and black nightshade. Rate varies with soil texture and organic matter. Follow recommended soil preparation, application, and incorporation procedures. Must be incorporated within 24 hours. See label for plantback restrictions. Ineffective on peat and muck soils.
Annual grasses	5.0–6.0 lb bensulide	5.0–6.0 qt Prefar 4E		Apply preplant or preemergence. Follow application and applicable incorporation instructions on label. Use on mineral soils only.
Annual grasses and some broad-leaves	4.5–10.5 lb DCPA	6.0–14.0 lb Dacthal W-75 6.0–14.0 pt Dacthal FL		Apply to weed-free soil. Treat only if plants have four to five true leaves and are well established, and growing conditions are favorable or severe crop injury may result. Use only on soils with 5% or less organic matter.
Nutsedge and some broad-leaves	0.023–0.047 lb halosulfuron	0.5–1.0 oz Sandea (Rate varies by melon type, application type, and timing. See label for appropriate rate.)	57	Sandea controls several broadleaf weeds and nutsedge. It will not control grasses. Sandea has both pre- and postemergence activity and can be used under plastic mulch. Broadcast application to watermelon should not exceed 0.75 oz/a Sandea. Do not exceed two applications or apply more than 2.0 oz/a per 12-month period. Soil or foliar applications of organophosphate insecticides to Sandea-treated crops may cause severe crop injury. Consult label for application timing, maximum Sandea use per crop cycle, and other important usage information and precautions.

*Restricted-use pesticide.

(continued)

Eggplant

Horseradish

Leafy greens

Melon

Mint

Onion

Pea

Weed control in melon—muskmelon, watermelon *(continued)*

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Emerged weeds	glyphosate	several manufacturers and formulations		See manufacturer's label to assure that the formulation is labeled for this crop and for specific instructions. Some formulations require a wait of 3 days between application and seeding. Crop contact will result in severe injury or death. If weeds have been mowed or tilled, do not treat until they have resumed active growth and reached the recommended stage on the label. Unless otherwise stated, allow 7 or more days before tilling treated fields. Do not tank mix with soil-residual herbicides unless otherwise specified.
	*paraquat	several manufacturers and formulations, not all are registered for this use		Prepare seedbed early to allow for maximum weed emergence. Application can be made as a banded or broadcast treatment before, during, or after planting, but before crop emergence. In preplant and preemergence (to the crop) uses, do not apply to soils lacking clay minerals (i.e., muck, pure sand). Use the higher rate for heavy weed infestations. Seeding and transplanting should be performed with minimal soil disturbance. Always add crop oil concentrate or non-ionic surfactant to spray mixture. Follow precautions on label.
Emerged grasses	0.068–0.12 lb clethodim	9.0–16.0 oz Select Max	14	Apply to actively growing grasses. Repeat treatments may be made at 14-day intervals up to the maximum annual use rate. Do not cultivate grasses within 7 days before or after application. Include appropriate surfactant as required by product label. Do not apply if rain is expected within 1 hour.
	0.094–0.125 lb clethodim	6.0–8.0 oz Select 2EC	14	
	0.094–0.28 lb sethoxydim	0.5–1.5 pt Poast	3 (cantaloupe) 14 (all other melons)	Make postemergence applications to actively growing grasses within the size ranges indicated on the label. Check the label for wild proso millet or rescue treatment rates. Do not apply more than 3.0 pt/a Poast in one crop season. Always add 2.0 pt/a of crop oil concentrate. Check the label for additional precautions and restrictions.

*Restricted-use pesticide.

Eggplant

Horseradish

Leafy greens

Melon

Mint

Onion

Pea

Mint

Wisconsin mint is grown on high organic or muck soils with high water tables or on fine-textured soils. Since mint is a shallow-rooted crop, irrigation is desirable.

Planting

Mint is grown as a vegetatively propagated perennial. New fields are planted in the spring with stolons dug from an existing planting known to be free of pathogens and perennial weeds with a digger similar to a potato digger. First-year plantings are known as “row mint,” as the stolons are planted in rows with special planters. One acre of well-established mint will usually yield enough stolons to plant 10–15 acres. Given good growing conditions, the stolons quickly spread, covering the entire field with plants. This solid stand, called “meadow mint,” contributes to the spread of disease and some perennial weed problems but is important in helping control soil erosion and annual weeds. Weeds, insects, and diseases can reduce quality and yield.

Mint is usually plowed shallow after the first killing frost to protect the crop from winterkill and to help control pests that might otherwise overwinter on the mint stubble. To maintain profitable production, short rotations of 3 years of mint should be followed by 3 years of another crop.

Lime and fertilizer

Lime: Use dolomitic limestone to maintain a pH of 5.6 or higher on organic soils and 5.8 on mineral soils.

Fertilizer rates: Apply 50 lb/a phosphate and 200 lb/a potash when soil tests P and K are in the optimum range. Optimum nitrogen rates may vary between soils, organic nutrients, and locations. Apply 100–150 lb N/a on mineral soils or 50–80 lb N/a on organic soils depending on muck depth, quality, and length of time the field has been farmed. At least some of the nitrogen should be applied prior to the rapid growth phase in May.

Application: Broadcast applications are commonly used.

Micronutrients: Mint has relatively low micronutrient requirements. It is unlikely that this crop will respond to micronutrient additions.

Harvest

Mint harvest in Wisconsin generally begins about mid-July. Mint fields are usually cut before the plants reach 10% of full bloom. Harvesting at a later growth stage can result in lower quality oil and lower yields. The cut hay is left in windrows for 24–36 hours, until mint leaves begin to dry. If the hay gets too dry, the

leaves will shatter during pickup, reducing yield. If too green when collected, the hay will require more time and energy to distill. Rain while the cut hay is still in the field can result in significant yield loss due to leaf loss and oil washed from the plants. The mint is chopped directly into custom-built distilling tubs. A typical mint tub holds hay from 0.75 to 1.25 acres of land. The hay is carried from the field in the distillation tubs to the mint still. There, steam is applied to the mint through a series of tubes located in the bottom of the tub. Boiler size, for supplying the steam, depends on the number of tubs that will be distilled at one time. As a general rule, 100 horsepower is required for each tub. The vaporized oil passes through a condenser where the oil and water condense for collection in the receiver. The temperature of the condensate leaving the condenser should be maintained at 110°F. The lighter oil floats on top of the water in the receiver and is periodically drained off into clean barrels. The distillation process takes about 1 hour per tub, depending on tub size, condition of the hay, and steam pressure. Improper distillation can result in yield loss, lower oil quality, and increased energy costs.

Annual nitrogen, phosphate, and potash recommendations for mint

Nitrogen		Phosphate and potash		
Organic matter (%)	Amount to apply (lb/a)	Yield goal (lb/a)	Amount P ₂ O ₅ to apply* (lb/a)	Amount K ₂ O to apply* (lb/a)
<2	120	35–55 (oil)	50	200
2.0–9.9	100			
10–20	80			
>20	50			

*Amounts shown are for optimum (O) soil test levels. Apply 50% of this rate if soil test is high (H) and omit if soil test is excessively high (EH). If soil test is low (L) or very low (VL), increase rates according to soil test recommendations.

Eggplant

Horseradish

Leafy greens

Melon

Mint

Onion

Pea

Disease control in mint

Disease	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Mint stolon decay	<i>Early spring tillage hastens soil warming, which creates unfavorable conditions for disease development. Clipping the regrowth before plowdown in the fall reduces later losses to stolon decay. Application of fungicides for control is not feasible at this time.</i>			
Rust, powdery mildew	azoxystrobin	6.0–15.5 fl oz Quadris Flowable	7	Quadris Flowable and Headline belong to the Group 11 (strobilurin) fungicide category. Do not apply more than one foliar spray of any strobilurin product before alternating with a fungicide having a different mode of action. Do not exceed three applications of strobilurin fungicides per year. Do not exceed 1.44 qt/a Quadris or 48.0 fl oz/a Headline per season.
	azoxystrobin + propiconazole	14.0 fl oz Quilt	30	
	pyraclostrobin	9.0–12.0 fl oz Headline	14	
	chlorothalonil	1.2 lb Bravo Ultrex 82.5WDG, Equus DF	80	
		1.38 pt Bravo Weather Stik, Echo 720, Equus 720 1.2 lb Echo 90DF	80	
	myclobutanil	4.0–5.0 oz Rally 40WSP	30	Treat in early spring when plants break dormancy and continue applications on a 14- to 21-day schedule. Do not apply more than 15.0 oz/a product (0.375 lb ai/a) per season.
	propiconazole	4.0 fl oz AmTide Propiconazole 41.8% EC, PropiMax EC, Tilt, Topaz	30	Do not apply more than 78.0 fl oz/a per season.
Verticillium wilt	<i>Ideally, mint plantings should be kept in production for no longer than 4–6 years. Rotate to nonsusceptible crops for as long as possible between mint crops. The following cultivars are listed in order of increasing susceptibility: Native Spearmint, Scotch Spearmint, Murray Mitcham and Todd Mitcham Peppermint, and Black Mitcham Peppermint.</i>			

Insect control in mint

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Armyworms, cutworms, and loopers	<i>Many species of armyworms, cutworms, and loopers may occur together in the field. Small larvae may be collected in sweep net samples. Estimate larger instars by inspecting the soil surface (one square foot) after vigorously shaking the foliage in the area. Use the total number of all foliage-feeding worms to determine if treatment is necessary. Thresholds vary from 1.5 to 3.0 larvae/sq ft.</i>			
	0.5–1.0 lb acephate	16.0 oz Acephate 97UP	14	Do not apply more than 2.66 lb/a of formulated product per season. Do not feed or graze on treated areas.
	1.0–1.33 lb acephate	Orthene 97	14	Do not apply more than 2.66 lb/a.
	0.5–2.0 lb <i>Bacillus thuringiensis</i> subsp. <i>aizawai</i>	XenTari	0	Treat when larvae are young. Use another type of product to control older larvae.
	<i>Bacillus thuringiensis</i> subsp. <i>kurstaki</i>	Biobit WP, DiPel DF, Gut Buster BT, Javelin WG	0	See label for rate. Treat when larvae are young.
	1.0–2.0 lb <i>Bacillus thuringiensis</i> subsp. <i>kurstaki</i>	Lepinox WDG	0	Treat early instar larvae before noticeable feeding damage occurs. Repeat as needed.
	chlorantraniliprole	3.5–5.0 fl oz Coragen	3	Do not apply more than 15.4 fl oz/a per season and allow at least 14 days between applications. Do not make more than four applications/a per crop.
	1.0–2.0 lb chlorpyrifos	*Lorsban Advanced	90	Use the lower rate when larvae are less than 3/4 inch long, and the higher rate when larger. The long interval to harvest for this product limits its use to very early season applications.

*Restricted-use pesticide.

(continued)

Insect control in mint (continued)

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Armyworms, cutworms, and loopers (cont.)	0.065 lb indoxcarb	3.5 oz Avaunt 30DG	7	The minimum interval between applications is 5 days. Do not apply more than 24.0 oz/a Avaunt (0.44 lb ai/a) per crop.
	0.675–0.9 lb methomyl	*Lannate LV, SP	14	Do not apply more than 1.8 lb ai/a.
	pyrethrin	1.0–2.0 pt Pyrenone E.C.	0	
	0.031–0.093 lb spinetoram	4.0–12.0 oz Radiant SC	7	Do not apply more than 60.5 oz/a Radiant (0.48 lb ai/a) per crop and do not make more than four applications per crop. Must wait at least 4 days before repeating applications.
	spinosad	4.0–10.0 fl oz Entrust SC	7	Apply when small larvae appear. Treat larger larvae at higher rate or retreat. Do not exceed 29.0 oz/a or four applications per year.
Floridotarso-nemus mite	<i>Determine mite populations from bud samples. Examine at least 20 buds per field at several sites throughout the field. Open each bud and examine a single leaf surface with a 10–15X hand lens. Count the number of adult (brown) mites. Treatment is recommended if there is an average of more than one mite per bud.</i>			
	0.05–0.1 lb fenpyroximate	1.0–2.0 pt Fujimite 5EC	1	Apply Fujimite in 25–50 gallons of water to ensure uniform coverage and canopy penetration. Do not exceed 2.0 pt/a per year.
	2.25 lb propargite	Omite 6E, Comite	14	Apply in large volume of water and high pressure for good penetration. Apply up to two applications at 7- to 10-day intervals.
Mint aphid	<i>No treatment thresholds have been established, but relative populations can be estimated from sweep net samples taken when sampling for other pests. Damage occurs only when aphids are so numerous that leaves are coated with honeydew.</i>			
	0.5–1.0 lb acephate	16.0 oz Acephate 97UP	14	Do not apply more than 2.66 lb/a of formulated product per season. Do not feed or graze on treated areas.
	1.0 lb acephate	Orthene 97	14	Do not apply more than 2.66 lb/a.
	0.7–1.0 lb malathion	Malathion	7	
	pyrethrin	1.0–2.0 pt Pyrenone E.C.	0	May be combined with other insecticides.
	thiamethoxam	1.5–3.0 oz Actara WG	7	Apply every 14 days as needed. Do not exceed 8.0 oz/a per season.
Mint flea beetle	<i>Direct control measures at adults since no materials are registered for larval control. Adults emerge in late July (1100 DD, soil temperature at 6-inch depth, 40°F base) and begin laying eggs 2 weeks later. Treat before egg laying when adults are present if the following thresholds are exceeded: (1) larval damage—stunting, purpling in June—is visible; (2) no larval damage is visible, but more than 25 adults/100 sweeps are collected in standing mint; or (3) fewer than 25 adults/100 sweeps are present in standing mint, but more than 25/100 sweeps are collected from stubble after harvest.</i>			
	0.7–1.0 lb malathion	Malathion	7	
	0.675–0.9 lb methomyl	*Lannate LV, SP	14	Do not apply more than 1.8 lb ai/a.
	thiamethoxam	1.5–3.0 oz Actara WG	7	Apply every 14 days as needed. Do not exceed 8.0 oz/a per season.
Two-spotted spider mite	<i>Determine mite populations from leaf samples. Examine a total of 45 leaves (15 leaves each from the bottom, middle, and top of the canopy) at several locations throughout the field. For each 30 acres, monitor 15 individual field sites. Classify the leaves as “infested” (5 or more mites) or “uninfested” (fewer than 5 mites). Treat if 18 or more of the leaves in the 45-leaf sample at each site are “infested.”</i>			
	0.009–0.014 lb abamectin	8.0–12.0 oz *Agri-Mek 0.15EC	28	Treat when mites first appear and have exceeded thresholds.
	0.375–0.75 lb bifentazate	0.75–1.5 lb Acramite 50WS	7	Apply Acramite in at least 50 gallons of water to ensure uniform coverage and canopy penetration. Do not apply more than once per year.

*Restricted-use pesticide.

(continued)

Eggplant

Horseradish

Leafy greens

Melon

Mint

Onion

Pea

Insect control in mint *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Two-spotted spider mite <i>(cont.)</i>	0.438–0.625 lb dicofol	1.75–2.5 pt Dicofol 4E	30	Do not make more than one application of Dicofol per crop per year.
	0.05–0.1 lb fenpyroximate	1.0–2.0 pt Fujimite 5EC	1	Apply Fujimite in 25–50 gallons of water to ensure uniform coverage and canopy penetration. Do not exceed 2.0 pt/a per year.
	0.75 lb oxydemeton-methyl	*Metasystox-R	14	Primarily an aphicide, but also suppresses mites.
	1.5–2.25 lb propargite	Omite 6E, Comite	14	Do not apply more than twice per year. Most effective when temperatures are above 70°F.

*Restricted-use pesticide.

Weed control in mint

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Annual weeds	0.5 lb clomazone	1.3 pt Command 3ME	84	For suppression and control of annual grasses and broadleaves, make a single broadcast application to the soil before weeds emerge and before mint plants begin any new growth. Strictly follow all precautions and restrictions on the label to minimize offsite movement and carryover. Read and understand the vegetable disclaimer section of the label —the end user assumes all liability for failure to perform and crop injury resulting from use of this product.
	flumioxazin	Chateau SW	80	The supplemental label states that Chateau cannot be applied before November 25 or after March 1, limiting its use in Wisconsin. Apply only to dormant established meadow mint. Do not apply to stands established longer than 3 years. See label for additional restrictions and instructions prior to use.
	0.71–1.9 lb pendimethalin	1.5–4.0 pt Prowl H2O (based on soil texture—see label)	90	Make a single application to dormant established mint before weed emergence. Do not apply to mint during the first year of establishment or to mint that has broken dormancy.
	0.14–0.375 lb sulfentrazone	4.5–12.0 oz Spartan 4F		Apply Spartan to dormant mint following cultivation and before mint emergence. Rate is based on soil texture and organic matter. Split applications may be used for preemergent sequential control of winter and summer annuals. May be applied before crop emergence to newly planted mint, but application should be reduced 25%. Do not apply more than 12.0 oz/a per 12-month period. Rainfall or irrigation after application is required for herbicide activation. See label for weeds controlled and other precautions.
	<i>labeled rates:</i> 0.8–1.6 lb terbacil <i>recommended rates</i> <i>(see note in Remarks):</i> 0.125–0.25 lb terbacil	<i>labeled rates:</i> 1.0–2.0 lb Sinbar 80WDG <i>recommended rates</i> <i>(see note in Remarks):</i> 0.16–0.3 lb Sinbar 80WDG	60	Preemergence: Apply before weeds and mint emerge, after last cultivation. Postemergence: Apply before broadleaves are 2 inches tall and before grasses are 1 inch tall. Do not exceed 2.0 lb/a per season. Do not plant to crops other than mint within 2 years after last application. Note: Wisconsin recommends using less than 0.5 lb/a of Sinbar per year due to its long residual activity. Low rates may give inadequate weed control.

*Restricted-use pesticide.

(continued)

Weed control in mint *(continued)*

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Annual weeds <i>(cont.)</i>	0.5–0.75 lb trifluralin	1.0–1.5 pt Treflan HFP or other registered trifluralin formulations		Controls annual grasses and some broadleaf weeds, but is weak on wild mustard, smartweed, common ragweed, velvetleaf, and black nightshade. Rate varies depending on soil texture and organic matter. Follow recommended soil preparation, application, and incorporation procedures. Must be incorporated. See the label for plantback restrictions. Ineffective on peat and muck soils.
Germinating annuals	1.0–1.5 lb oxyfluorfen	4.0–6.0 pt Goal 2XL 2.0–3.0 pt GoalTender		Apply Goal only to mint grown on muck soils with at least 20% organic matter. Make one preemergence application in the spring after the last tillage operation before new mint growth emerges. May cause temporary stunting of mint. See label for application timing in new mint.
Emerged weeds	glyphosate	several manufacturers and formulations	7	See manufacturer's label to assure that the formulation is labeled for spot treatment in mint. Use handheld equipment to direct the spray solution. The spray will kill all plants it contacts. Do not treat more than 1/10 of any acre at any time. Treatment may be repeated at 30-day intervals.
	*paraquat <i>(rate varies by label)</i>	several manufacturers and formulations		Apply to dormant mint before emergence. May be mixed with Sinbar. Always add crop oil concentrate or non-ionic surfactant to spray mixture. Follow precautions on the label.
Emerged grasses	0.068–0.24 lb clethodim	9.0–32.0 oz Select Max	21	Apply to actively growing grasses. Repeat treatments may be made at 14-day intervals up to the maximum annual use rate. Do not cultivate grasses within 7 days before or after application. Include appropriate surfactant as required by product label. Do not apply if rain is expected within 1 hour.
	0.094–0.25 lb clethodim	6.0–16.0 oz Select 2EC	21	
	0.034–0.08 lb quizalofop	5.0–12.0 oz Assure II or Targa	30	Apply postemergence to actively growing grasses. Add COC or NIS to spray mixture. Do not make more than two applications per season. Wait a minimum of 24 hours following application before applying a post broadleaf herbicide. Do not apply Assure II or Targa following a post broadleaf herbicide until grass plants begin to develop new leaves. See label for maximum annual use rate.
	0.094–0.47 lb sethoxydim	0.5–2.5 pt Poast	20	Apply postemergence to actively growing grasses. Include 1.0 pt/a Dash HC or 1.0 qt/a crop oil concentrate. Do not apply more than 5.0 pt/a Poast or make more than two applications per season. Do not apply if rain is expected within 1 hour.
Emerged annual broadleaves, some perennials	1.0–2.0 lb bentazon	2.0–4.0 pt Basagran		Apply early postemergence when weeds are small and actively growing. Do not apply more than 4.0 pt/a per year. May cause leaf burn under some conditions, but the mint will generally outgrow this condition within 10 days.
	0.125–0.38 lb acid equivalent clopyralid	0.33–1.0 pt Stinger	45	Controls specific annual and perennial weeds. Apply early postemergence to actively growing annuals before they send up a flower stalk. For Canada thistle, apply when most basal leaves are formed but before bud stage. May cause temporary injury, but should not reduce oil yields. Read label carefully for follow crop restrictions. Do not make aerial applications.

*Restricted-use pesticide.

(continued)

Eggplant

Horse radish

Leafy greens

Melon

Mint

Onion

Pea

Weed control in mint *(continued)*

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Emerged annual broadleaves	0.25–0.38 lb bromoxynil	1.0–1.5 pt Buctril 2E 0.5–0.75 pt Buctril 4EC 2.0–4.0 oz Buctril 2E 1.0–2.0 oz Buctril 4EC (<i>see note in Remarks</i>)	70	Apply postemergence to actively growing weed seedlings before weeds have more than four leaves, are 2 inches in height, or are 1 inch in diameter, whichever comes first. See label for list of susceptible weeds. Do not apply in spring or to newly planted mint. Buctril can cause temporary stunting and discoloration of the mint. Buctril may cause unacceptable injury if temperatures exceed 70°F following application, if mint is under stress, or if mint has been treated with Sinbar. Do not apply more than 6.0 pt/a Buctril 2E or 3.0 pt/a Buctril 4EC per season or by aerial application. Under Wisconsin conditions, using the label rate may result in unacceptable mint injury. Previous experience suggests that 2.0–4.0 oz/a Buctril 2E or 1.0–2.0 oz/a Buctril 4EC may be more appropriate.

*Restricted-use pesticide.

Eggplant

Horseradish

Leafy greens

Melon

Mint

Onion

Pea

Onion: dry bulb onion on high organic soils

Planting

Plant seeds, transplants, or “sets” in April to early May. Choose deep, fertile soils and provide adequate drainage. Rotate onions with other vegetable crops. Onions work well in rotation with potatoes or carrots.

In the field

Rows: Direct-seeded onions are usually planted in paired rows, 16–24 inches apart.

Plants in row: 6–12/ft (120,000–160,000 seeds/a). For transplants, set 4–6 inches apart (60,000–100,000 plants/a).

In beds

Rows: 6–9 inches with 6–8 rows/bed.

Plants in row: 6–12/ft.

Lime and fertilizer

Lime: Use dolomitic limestone to maintain a pH of 5.4 or higher in organic soils and at least 5.6 in other soils.

Fertilizer rates: Apply P_2O_5 and K_2O according to soil test recommendations. Use annual nitrogen, P_2O_5 , and K_2O

recommendations in table below. Take credits for previous legume crops and manure.

Application: Broadcast and work in before planting. For most efficient use of nitrogen, split recommended rate into two or more applications during the season.

Micronutrients: Onions need relatively high amounts of manganese, copper, zinc, and molybdenum. Use soil and plant analyses to check for deficiencies of these nutrients. Specific recommendations vary with fertilizer sources, soil, and method of application.

Annual nitrogen, phosphate, and potash recommendations for onion

Nitrogen		Phosphate and potash		
Organic matter (%)	Amount to apply (lb/a)	Yield goal (cwt/a)	Amount P_2O_5 to apply* (lb/a)	Amount K_2O to apply* (lb/a)
<2	150	400–600	60	130
2.0–9.9	140			
10–20	130			
>20	120			

*Amounts shown are for optimum (O) soil test levels. Apply 50% of this rate if soil test is high (H) and omit if soil test is excessively high (EH). If soil test is low (L) or very low (VL), increase rates according to soil test recommendations.

Disease control in onion

	Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions	
Eggplant	Bacterial blight	copper hydroxide	0.67–1.0 pt Champ Formula II Flowable	0	Can aid in limiting spread of bacterial pathogens of onion. May cause phytotoxicity if rate is high, low sprayer volumes are used, and/or temperatures are high.	
			0.75–1.5 lb Kocide 3000 1.5 lb Kocide 2000			
Horseradish	Downy mildew	azoxystrobin	9.0–15.5 fl oz Quadris Flowable	0	Quadris and Cabrio belong to the Group 11 (strobilurin) fungicide category. Do not exceed one application of any of these products before alternating with a fungicide having a different mode of action. Do not exceed four applications of strobilurin fungicides per year.	
			pyraclostrobin	12.0 oz Cabrio EG		7
			azoxystrobin + chlorothalonil	2.4–3.7 pt Quadris Opti		14
			boscalid + pyraclostrobin	18.5 oz Pristine WDG		7
Leafy greens	Downy mildew	cymoxanil + famoxadone	8.0 oz Tanos	3	Alternate applications with fungicides of different modes of action for fungicide resistance management. Do not apply more than 84.0 oz/a per season Tanos.	
			dimethomorph	6.0 oz Forum	0	Tank mix Forum with another fungicide active against downy mildew and having a different mode of action. Do not make more than two sequential applications of Forum before alternating to another effective fungicide. Do not make more than five applications or use more than 30.0 oz/a per season.
			fluazinam	1.0 pt Omega	7	Do not make more than six applications/a per year. Do not use with an adjuvant.
Melon	Downy mildew	fluopicolide	3.0–4.0 fl oz Presidio	2	Tank mix with a fungicide of a different mode of action for fungicide resistance management.	
			fosetyl-al	2.0–3.0 lb Aliette WDG	7	Begin applications when conditions favor disease development (high moisture and moderate temperatures). Repeat at 7- to 14-day intervals. If disease is already present, treat at 3.0 lb/a and repeat at 7-day intervals. Do not exceed seven sprays per year.
Mint	Downy mildew	mancozeb	2.4 qt Dithane F-45	7	Consult labels for seasonal product limits. Do not apply to exposed bulbs. Spray every 7–10 days depending on weather conditions.	
			3.0 lb Dithane DF Rainshield	7		
			3.0 lb Koverall	7		
			2.4 qt Manzate Flowable	7		
			3.0 lb Manzate Pro-Stick	7		
			1.6–2.4 qt Penncozeb 4FL	7		
			2.0–3.0 lb Penncozeb 75DF, 80WP	7		
Onion	Downy mildew	mandipropamid	8.0 fl oz Revus	7	Do not make more than two consecutive applications before switching to another effective non-Group 40 fungicide. Do not exceed 32.0 fl oz/a of product per season.	
			mefenoxam	2.5 lb Ridomil Gold Bravo	7 (dry bulb) 14 (green)	Spray at 14-day intervals when conditions are favorable for disease, alternating sprays with other protective fungicides. Limit of four applications on dry bulb onions and three applications on green onions.

(continued)

Disease control in onion (continued)

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Downy mildew (cont.)	mefenoxam (cont.)	2.5 lb Ridomil Gold MZ	7 (dry bulb)	Spray at 14-day intervals when conditions are favorable for disease, alternating sprays with other protective fungicides. Use up to four applications on dry bulb onions.
	potassium phosphite	1.0–3.0 qt Fosphite/100 gal water	0	Do not apply at intervals less than 3 days. Do not apply to heat- or moisture-stressed plants.
Fusarium basal rot	<i>Plant resistant varieties such as Fusario 24, Nugget, Hickory, and Nutmeg. Harvestmore has some tolerance to basal rot.</i>			
Leaf blight (<i>Botrytis</i>) and purple blotch (<i>Alternaria</i>)	azoxystrobin + chlorothalonil	1.6–3.2 pt Quadris Opti	14	Do not apply more than one foliar application without alternating to a fungicide with a different mode of action. See label for specifications on tank mixing.
	azoxystrobin + difenoconazole	12.0–14.0 fl oz Quadris Top	7	Quadris Top and Cabrio belong to the Group 11 (strobilurin) fungicide category. Do not exceed one application of Group 11 products before alternating with a fungicide having a different mode of action. Do not exceed four applications of strobilurin fungicides per year. Do not exceed 56.0 fl oz Quadris Top (dry bulb) and 72.0 oz/a Cabrio per season.
	pyraclostrobin	8.0–12.0 oz Cabrio EG	7	
	boscalid	6.8 oz Endura WDG	7	Endura belongs to the Group 7 (anilide) fungicide category. Do not exceed two sequential applications of Endura before alternating to a labeled fungicide with a different mode of action. Do not exceed six applications per season. Do not exceed 41.0 oz/a Endura per season. Note comments on Pristine below.
	boscalid + pyraclostrobin	10.5–18.5 oz Pristine WDG	7	Pristine belongs to Groups 7 and 11 fungicide categories. Do not exceed two sequential applications of Pristine before alternating to a labeled fungicide with a different mode of action. Do not exceed four applications of Pristine or other Group 11 fungicide per season. Do not exceed 111.0 oz/a Pristine per season.
	chlorothalonil	1.0–3.0 pt Bravo Weather Stik, Echo 720, Equus 720	7	Do not exceed 15.0 lb ai/a chlorothalonil per season. Spray every 7–10 days during the growing season (more frequently during periods favoring the disease). You can alternate chlorothalonil with mancozeb. Do not use on Sweet Spanish onions. Excessive use can reduce yields.
		0.9–2.7 lb Bravo Ultrex 82.5WDG, Equus DF	7	
		0.875–1.625 lb Echo 90DF	7	
	1.5–4.25 pt Bravo Zn, Echo Zn	7		
	1.5–4.25 pt Equus 500 Zn	7		
	cyprodinil	10.0 oz Vanguard WG	7	Do not apply more than 28.0 oz/a per plot per year of Vanguard. Do not exceed two sequential applications of Vanguard before alternating to a labeled fungicide with a different mode of action.
	cyprodinil + fludioxonil	11.0–14.0 oz Switch 62.5WG	7	Do not exceed 56.0 oz product per year per acre. Do not plant rotational crops other than strawberries or onions for 12 months following the last application.
	difenoconazole + cyprodinil	16.0–20.0 fl oz Inspire Super		For bulb onions, do not apply within 7 days of harvest. For green onions, do not apply within 14 days of harvest.
	fluazinam	1.0 pt Omega	7	Do not make more than six applications/a per year. Do not use with an adjuvant.
	iprodione	1.5 pt Iprodione 4L AG, Meteor, Nevado 4F, Rovral 4F	7	Spray every 7 days during the growing season (more often during periods favoring the disease).

(continued)

Eggplant

Horseradish

Leafy greens

Melon

Mint

Onion

Pea

Disease control in onion *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Leaf blight and purple blotch <i>(cont.)</i>	mancozeb	2.4 qt Dithane F-45	7	Consult labels for seasonal product limits. Do not apply to exposed bulbs. Spray every 7–10 days depending on weather conditions. Mancozeb will also control downy mildew.
		3.0 lb Dithane DF Rainshield	7	
		2.4 qt Manzate Flowable	7	
		3.0 lb Manzate Pro-Stick	7	
		1.6–2.4 qt Penncozeb 4FL	7	
		2.0–3.0 lb Penncozeb 75DF, 80WP	7	
	penthiopyrad	16.0–24.0 fl oz Fontelis	3	Do not apply more than 72.0 fl oz/a per season. Make no more than two sequential applications before alternating to a fungicide with a different mode of action.
	pyrimethanil	18.0 fl oz Scala SC alone 9.0–18.0 fl oz Scala SC in tank mix	7	Scala belongs to the Group 9 fungicide category. Use the 9.0 fl oz rate of Scala in a tank mix with a broad-spectrum fungicide. Alternating the tank mix combination with a broad-spectrum fungicide is a resistance management strategy.
Neck rot	<i>Plant varieties that mature properly so neck tissues dry before storage; undercut and windrow onions until inside neck tissues are dry before topping and storing. Forced heated air at 93–95°F for 5 days at the beginning of the storage period may help.</i>			
Ozone injury	No treatment.			
Pink root	<i>Long rotation with unrelated crops and use good crop management to promote healthy plant growth.</i>			
Purple blotch	azoxystrobin	6.0–12.0 fl oz Quadris Flowable	0	Quadris and Cabrio belong to the strobilurin group of fungicides. Do not exceed one application of these products before alternating with a fungicide having a different mode of action. Do not exceed four applications of strobilurin fungicides per year. Do not exceed 2.88 qt/a Quadris or 72.0 oz/a Cabrio per season.
	pyraclostrobin	8.0–12.0 oz Cabrio EG	7	
	azoxystrobin + propiconazole	14.0–27.5 fl oz Quilt	14 (dry bulb) 0 (green)	Do not apply more than 55.3 fl oz/a per season of Quilt.
	cymoxanil + famoxadone	8.0 oz Tanos	3	Alternate applications with fungicides of different modes of action for fungicide resistance management. Do not apply more than 84.0 oz/a per season Tanos.
	propiconazole	4.0–8.0 fl oz AmTide Propiconazole 41.8% EC, Bumper 41.8 EC, Propicure 3.6F, PropiMax EC, Tilt, Topaz <i>or</i> 2.0–4.0 fl oz AmTide Propiconazole 41.8% EC, Bumper 41.8 EC, Propicure 3.6F, PropiMax EC, Tilt, Topaz, with tank-mix partner	0 (green onions)	Do not apply more than 16.0 fl oz/a per season. Use a wetting agent for optimum control.
			14 (dry bulb)	
	tebuconazole	4.0–6.0 fl oz Folicur 3.6 F, Monsoon, Onset 3.6L, Orius 3.6F, Tebusha 3.6FL, TebuStar 3.6L, Tebuzol, Toledo	7	Do not exceed 12.0 fl oz/a per season. To optimize result, apply preventatively.
Purple blotch and downy mildew	azoxystrobin + propiconazole	<i>purple blotch</i> : 14.0–21.0 fl oz Quilt Xcel <i>downy mildew</i> : 17.5–26.0 fl oz Quilt Xcel	0 (green onions) 14 (dry bulb onions)	Do not apply more than 56.0 fl oz/a of Quilt Xcel per crop. Mixing with products formulated as an EC may result in phytotoxicity.

(continued)

Disease control in onion *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Purple blotch and downy mildew <i>(cont.)</i>	copper	1.3 pt Champ Formula 2	0	May be useful to reduce losses to bacterial infections during periods of wet weather.
	hydroxide	2.0 lb Kocide 101 77WP, DF	0	
		2.6 pt Kocide LF 2.4F	0	
		0.75–1.5 lb Kocide 3000	0	
	fenamidone	5.5 fl oz Reason 500 SC	7	Reason belongs to the Group 11 (strobilurin) fungicide category. Do not exceed one application of any strobilurin products before alternating with a fungicide having a different mode of action. Do not exceed four applications of strobilurin fungicides per year. Do not exceed 22.0 fl oz/a Reason per season. Allow 30 days after the last application before rotating to wheat and 1 year for all other crops.
Smut	carboxin/thiram	Pro-Gro seed treatment		While there is no Wisconsin label for treating seed, it is legal to purchase and plant pretreated seed.
	mancozeb	2.4 qt Dithane F-45	7	Apply as a furrow drench when planting seeds. Use 75–125 gal water/a.
		3.0 lb Dithane DF Rainshield	7	
		2.4 qt Manzate Flowable	7	
		3.0 lb Manzate Pro-Stick	7	
		2.4 qt Penncozeb 4FL	7	
3.0 lb Penncozeb 75DF, 80WP		7		
Tipburn	<i>This is not a disease but a condition that can result from high concentrations of ozone in the air—often associated with thunderstorms.</i>			

Scouting calendar for insect pests of onion

April			May			June			July			August			September		
early	mid	late	early	mid	late	early	mid	late	early	mid	late	early	mid	late	early	mid	late
			Onion maggots						Onion maggots						Onion maggots		
						Onion thrips											

Insect control in onion

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Maggot	<i>A preventive treatment at planting is usually necessary; foliar treatments to suppress adults are usually not successful. Continuous planting of onions on the same ground increases onion maggot problems. Rotate with other crops to reduce populations. Destroy cull piles and crop debris to prevent onion maggot buildup.</i>			
Maggot— furrow treatments	chlorpyrifos	*Lorsban Advanced, Lorsban 15G		Apply Lorsban Advanced in furrow. Use minimum of 40 gal drench/a. Direct seeded; bulb onions only. Do not exceed one application of Lorsban 15G per year.
	cyromazine	6.6 lb Trigard OMC, 75%OMC/100 lb seed	60	Section 18 registration. Seed treatment in California only. Trigard has limited activity against seed corn maggot.

*Restricted-use pesticide.

(continued)

^aSome onion maggots in other midwestern states have shown resistance to diazinon. Use a different insecticide if satisfactory control has not been obtained in recent years.

Insect control in onion *(continued)*

	Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Eggplant	Maggot— furrow treatments <i>(cont.)</i>	2.0–4.0 lb diazinon ^a	several formulations		Apply diazinon in furrow. Use minimum of 40 gal drench/a. Direct seeded; bulb onions only.
	Horseradish	Maggot— foliar treatments	0.5 lb diazinon ^a	several formulations	10
		0.0075–0.0125 lb gamma-cyhalothrin	1.92–3.84 oz *Proaxis	14	Apply every 5 days as needed. Do not apply more than 1.92 pt/a (0.12 lb ai/a) per season.
		0.015–0.025 lb lambda-cyhalothrin	0.96–1.6 fl oz *Warrior II	14	Do not exceed 0.24 lb ai/a per season. Do not feed treated foliage to animals.
		0.1–0.3 lb permethrin	*Ambush	1	Several formulations; see label for rate. Do not exceed 2.4 lb ai/a per season.
		spinosad	3.0–6.0 fl oz Entrust SC	1	Apply to small larvae. Do not exceed 29.0 fl oz/a Entrust SC or five applications per year.
Leafy greens		zeta-cypermethrin	2.24–4.0 oz *Mustang Max	7	Apply every 7 days as needed. Use higher rates as populations escalate to avoid rescue treatments. Do not exceed 20.0 oz/a Mustang Max per year.
	Thrips	<i>Treat when there are seven or more thrips per plant. Tolerant varieties such as El Charo, Snow White, Vega, White Keeper, and Zapotec can handle more than 45 thrips per plant. Direct the spray down the center of the plants. Thrips populations in other states have shown resistance to several organophosphate insecticides; spray only when necessary and alternate two or more materials each season to minimize potential for resistance.</i>			
Melon	abamectin		8.0–16.0 fl oz *Agri-Mek 0.15 EC, *Epi-Mek 0.15 EC	30	Add a non-ionic type activator or wetting agent and do not use a binder sticker. Apply when pests reach or exceed established thresholds. Do not apply more than 48.0 fl oz/a Agri-Mek 0.15 EC or Epi-Mek 0.15 EC per crop season and allow at least 7 days between applications.
			1.75–3.5 fl oz *Agri-Mek SC	30	To avoid illegal residues, Agri-Mek SC must be mixed with a non-ionic activator type wetting agent and do not use a binder sticker. Apply when pests reach or exceed established thresholds. Do not apply more than 10.25 fl oz/a Agri-Mek SC per crop season and allow at least 7 days between applications.
Mint	0.094–0.15 lb acetamiprid		2.1–3.4 oz Assail 70WP	7	Do not exceed four applications or 13.7 oz/a of product per crop season.
			5.0–8.0 oz Assail 30 SG	7	Do not exceed four applications or 32.0 oz/a of product per crop season.
Onion	0.04–0.10 lb cypermethrin		2.0–5.0 fl oz *Ammo EC	7	
	0.018–0.028 lb deltamethrin		1.5–2.4 fl oz *Delta Gold	1	Apply every 5 days as needed. Do not exceed 9.6 fl oz/a per season.
	0.5 lb diazinon ^a		several formulations	14	Do not exceed three applications per season.
	0.01–0.015 lb gamma-cyhalothrin		2.56–3.84 oz *Proaxis	14	Apply every 5 days as needed. Do not apply more than 2.88 pt/a (0.18 lb ai/a) per season.
	0.02–0.03 lb lambda-cyhalothrin		1.28–1.92 fl oz *Warrior II	14	Do not exceed 0.24 lb ai/a per season. Do not feed treated foliage to animals.
	1.0–1.6 lb malathion		several formulations	3–7	
	0.45–0.9 lb methomyl		1.5–3.0 pt *Lannate LV 0.5–1.0 lb *Lannate SP	7	

*Restricted-use pesticide.

(continued)

^aSome onion maggots in other midwestern states have shown resistance to diazinon. Use a different insecticide if satisfactory control has not been obtained in recent years.

Insect control in onion *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Thrips <i>(cont.)</i>	0.25–0.5 lb methyl parathion	1.0–2.0 pt *PennCap-M, F 0.5–1.0 pt *Methyl Parathion, EC	15	Do not apply when onions bloom.
	0.25–0.5 lb oxamyl	1.0–2.0 pt *Vydate L	14	Vydate L has a 24c label for thrips and suppression of aster leafhopper as a foliar spray. Higher rates may be applied at planting for stubby root nematode control.
	0.15–0.3 lb permethrin	*Ambush	1	Several formulations; see label for rate. Do not apply more than 2.0 lb ai/a per season.
	0.047–0.078 lb spinetoram	6.0–10.0 oz Radiant SC	1	Do not apply more than 30.0 oz/a Radiant (0.234 lb ai/a) per crop and do not make more than five applications per crop.
	spinosad	4.0–8.0 fl oz Entrust SC	1	Treat every 4 days as needed. Do not exceed 29.0 fl oz per year.
	zeta-cypermethrin	2.88–4.0 oz *Mustang Max	7	Apply every 7 days as needed. Use higher rates as populations escalate to avoid rescue treatments. Do not exceed 20.0 oz/a Mustang Max per year.

*Restricted-use pesticide.

³Some onion maggots in other midwestern states have shown resistance to diazinon. Use a different insecticide if satisfactory control has not been obtained in recent years.

Weed control in dry bulb onion

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Annual weeds	0.25–0.375 lb bromoxynil	1.0–1.5 pt Buctril 2E 0.5–0.75 pt Buctril 4EC		Preemergence use restricted to muck soils only. Apply at least 3–4 days prior to emergence. Rainfall or irrigation within 2 days following preemergence application or 3 days prior to crop emergence may result in unacceptable crop injury—do not irrigate during this time. Do not apply more than 1.5 pt/a Buctril 2E or 0.75 pt/a Buctril 4EC per growing season.
	0.56–0.98 lb dimethenamid-P	<i>coarse soils:</i> 12.0–18.0 fl oz Outlook <i>medium- and fine-textured soils:</i> 18.0–21.0 fl oz Outlook	30	For use in direct seeded and transplanted dry bulb onions. Apply only after onion has reached the two-true-leaf stage. Applications to transplants should be delayed several days until soil has settled around the plants. Do not exceed 21.0 fl oz/a in a growing season and allow at least 14 days between applications.
	0.5–1.0 lb ethofumesate	<i>preemergence, coarse soils:</i> 1.0 pt Ethotron SC or Nortron SC <i>preemergence, medium and fine soils:</i> 2.0 pt Ethotron SC or Nortron SC <i>postemergence:</i> 1.0 pt Ethotron SC or Nortron SC	30	Controls selected broadleaf and grass weeds and suppresses yellow and purple nutsedge in dry bulb onions. Maximum number of applications and seasonal use rate varies by application timing and soil type. Do not use on muck or peat soils.

*Restricted-use pesticide.

(continued)

Eggplant

Horseradish

Leafy greens

Melon

Mint

Onion

Pea

Weed control in dry bulb onion *(continued)*

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Annual weeds <i>(cont.)</i>	0.25–0.5 lb oxyfluorfen	1.0–2.0 pt Goal 2XL 0.5–1.0 pt GoalTender		Pretransplant application: Transplanted onions only. Apply as a broadcast or band application after completion of tillage operations and prior to transplanting. If less than 0.5 lb ai/a oxyfluorfen is used pretransplant, postemergence applications may be made, up to the seasonal maximum of 0.5 lb ai/a oxyfluorfen. Post-transplant: An application of up to 0.5 lb ai/a oxyfluorfen may be made within 2 days of transplanting. If less than 0.5 lb ai/a oxyfluorfen is applied, a second application can be made 2 or more weeks after transplanting. Do not exceed a seasonal maximum of 0.5 lb ai/a oxyfluorfen.
	0.375–0.625 lb trifluralin	0.75–1.25 pt Treflan HFP or other registered trifluralin formulations	60	Spray and incorporate between onion rows. Avoid covering onions with treated soil during incorporation as injury may occur. Do not apply as a preplant or preemergence treatment. Controls annual grasses and some broadleaf weeds, but is weak on wild mustard, smartweed, common ragweed, velvetleaf, and black nightshade. Rate varies with soil texture and organic matter. Follow recommended soil preparation, application, and incorporation procedures. Must be incorporated within 24 hours. See label for plantback restrictions. Ineffective on peat and muck soils.
Annual grasses	5.0–6.0 lb bensulide	5.0–6.0 qt Prefar 4E		Apply preplant or preemergence. Application instructions on label. Use on mineral soils only.
Annual grasses and some broad-leaves	4.5–10.5 lb DCPA	6.0–14.0 pt Dacthal FL 6.0–14.0 lb Dacthal W-75		Make preemergence applications to weed-free soil at seeding or transplanting and/or at layby. See label for rate limitations when used on sandy soils. Ineffective on muck soils.
	glyphosate	several manufacturers and formulations		See label to assure that the formulation is labeled for this crop and for specific instructions. Crop contact will result in severe injury or death. If weeds have been mowed or tilled, do not treat until they have resumed active growth and reached the recommended stage on the label. Unless otherwise stated, allow 7 or more days before tilling treated fields. Do not tank mix with soil-residual herbicides unless otherwise specified.
	*paraquat <i>(rate varies by label)</i>	several manufacturers and formulations, not all are registered for this use	60	Treat when a maximum number of grasses and broadleaves have emerged, but before the crop has emerged. In preplant and preemergence (to the crop) uses, do not apply to soils lacking clay minerals (i.e., muck, pure sand). Always add crop oil concentrate or non-ionic surfactant to the spray mixture. Follow precautions on the label.
	0.71–1.9 lb pendimethalin	1.5–4.0 pt Prowl H ₂ O	45	For use in direct-seeded and transplanted dry bulb onions, but not green (bunching) onions. Rate depends on soil texture, classification, organic matter and herbicide formulation. May be applied sequentially on muck soils. See label for additional instructions and restrictions.
	0.74–2.0 lb pendimethalin	1.8–4.8 pt Prowl 3.3 EC	45	

*Restricted-use pesticide.

(continued)

Weed control in dry bulb onion (continued)

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Emerged grasses	0.068–0.24 lb clethodim	9.0–32.0 oz Select Max	45	Make postemergence applications when actively growing grasses are in the size ranges specified on the label. Do not apply more than 0.5 lb ai/a clethodim in one crop season. Include appropriate surfactant as required by product label. Requires a 1-hour rain-free period.
	0.094–0.25 lb clethodim	6.0–16.0 fl oz Select 2EC	45	
	0.13–0.38 lb fluazifop-P-butyl	0.5–1.5 pt Fusilade DX	45	Make postemergence applications to actively growing grasses in the size ranges specified on the label. Always add to the spray volume 1% crop oil concentrate or 0.25% non-ionic surfactant. Multiple applications may be made to control late germinating grasses, but do not exceed 3.0 pt/a Fusilade DX per crop season.
	0.094–0.28 lb sethoxydim	0.5–1.5 pt Poast	30	Make postemergence applications to actively growing grasses. Check label grass size ranges and wild proso millet or rescue treatment rates. Do not exceed 4.5 pt/a Poast per crop season. Always add 2.0 pt/a of crop oil concentrate.
Emerged annual broad-leaves	0.25–0.375 lb bromoxynil	1.0–1.5 pt Buctril 2E 0.5–0.75 pt Buctril 4EC		Apply when onions are in the two- to five-true-leaf stage and weeds are less than 2 inches tall— younger or older onions may be injured. Do not exceed 1.5 pt/a Buctril 2E or 0.75 pt/a Buctril 4EC per growing season. Apply in at least 50 gal water/a to avoid crop injury; do not add surfactant. Apply when soil and onion leaves are dry. Do not treat onions damaged by insects or blowing sand.
	<i>dry bulb onions only:</i> 0.12 lb oxyfluorfen	0.5 pt Goal 2XL 0.25 pt GoalTender	45	For seeded onions, apply postemergence when onions have at least two true leaves and weeds are in the two- to four-leaf stage. Do not exceed 0.5 lb ai/a oxyfluorfen per season. Do not apply when onion plants are stressed. Do not mix with pesticides, oils, surfactants, or fertilizers. Check the label for application to transplanted onions.

*Restricted-use pesticide.

Eggplant

Horseradish

Leafy greens

Melon

Mint

Onion

Pea

Pea

Eggplant

Horseradish

Leafy greens

Melon

Mint

Onion

Pea

Peas grow best in cool, moist early spring weather. To avoid all peas maturing at once, planting dates and varieties are chosen on the basis of degree days (DD). The base temperature used in computing degree days is 40°F. The number of degree days needed for a variety to reach the processing stage is fairly constant. Within a variety, temperature records are commonly used to predict the maturation or harvest date. Because of the large difference in spring and summer temperatures, several days separation at planting time may be required to separate harvests by only 1 or 2 days. Planting dates are determined using growing degree day requirements for maturation and on historical weather records.

Select fields with uniform fertility, soil type, slope, and drainage. Silt loams, sandy loams, or clay loams are best. High organic matter improves tilth and makes soil less droughty. Peas grown on sands and mucks require careful irrigation management.

Peas need adequate soil moisture but too much or too little reduces yield. Inadequate drainage starves the root zone of oxygen so that normal root respiration cannot occur, nitrogen-fixing bacteria cannot function efficiently, and root rot organisms become more destructive.

Peas typically follow corn in a rotation. Other crops such as small grains and hay also work well. The usual sequence is corn, peas, small grain, hay. Rotations with potatoes do not work well unless soil pH is above 6.6. Peas are sometimes grown in a double crop system. Green beans, soybeans, or silage corn may be planted after the peas are harvested. Double cropping can increase risks from diseases and insects.

Frequent pea culture increases disease and insect problems, especially common root rot. To avoid buildup of these

problems, peas should not be grown on the same field more than once every 4 or 5 years.

Peas do not compete well with weeds. The best time to control weeds is before planting. Canada thistles are particularly troublesome because their buds are hard to remove from shelled peas and greatly reduce the pea grade. Choose fields without major weed problems. Check that previous herbicides will not damage peas, since some chemicals persist in the soil.

Planting

The best yields can be expected from the earliest planted peas. Till seedbed 4–5 inches deep, but do not work the soil too fine, or crusting will cause problems in emergence. Grain drills are generally used to plant peas. Seeding rates vary depending on cultivar. Plant seeds 2 inches deep in firm moist soil to promote fast, uniform germination and seedling emergence. Plant shallower if soil is heavy or very moist. Plant deeper (but no more than 3 inches) on light soils or if soil is dry or cloddy.

Good yields require adequate stands. Full stands of strong vigorous plants provide needed competition against weeds and make full use of soil moisture and nutrients. The problem is more apt to be one of too few plants rather than too many.

Early and light-vined varieties, such as Alsweet, should have at least 672,000 plants/a (nine plants/ft in 7-inch rows). Later varieties need a minimum population of 500,000 plants/a (six plants/ft in 7-inch rows). There are indications that populations higher than these minimums may be profitable. Base seeding rates on the final plant population desired. Large seeds require heavier rates than small

seeds. Poor germinating seeds or unfavorable conditions at planting require heavier rates.

Seed treatment

Most pea seeds for commercial production are treated with a fungicide and dyed to make them stand out. The fungicide coating helps protect seed and seedling from soil fungi until emergence. Treated seeds are poisonous and must not be used for food or feed.

Seed inoculation

Peas in association with the proper nitrogen-fixing bacteria can fix their own nitrogen from the air, therefore it may be beneficial to inoculate the seeds before planting. This is especially important if peas have not been grown in that field for more than 5 years.

Lime and fertilizer

Determine fertilizer and lime needs with a soil test.

Lime: Adjust pH to 6.0 or higher on mineral soils and 5.6 on organic soils for maximum yields.

Fertilizer rates: Apply annual nitrogen, P₂O₅, and K₂O rates shown in the table below. Take credits for previous legume crops and manure.

Application: Broadcast and work in lime and fertilizer before planting. Small amounts of fertilizer (up to 200 lb/a) can be applied with the drill at planting time. Additional required fertilizer should be broadcast and incorporated before planting. Drill-applied fertilizer should be placed 2 inches to the side and slightly below the seed. Starter fertilizer is especially important for early peas on cool, wet soils because nitrogen-fixing bacteria are less active.

Annual nitrogen, phosphate, and potash recommendations for peas

Nitrogen		Phosphate and potash		
Organic matter (%)	Amount to apply (lb/a)	Yield goal (lb/a)	Amount P ₂ O ₅ to apply* (lb/a)	Amount K ₂ O to apply* (lb/a)
<2	40	1,000–2,500	10	15
2.0–9.9	30	2,501–4,000	15	30
10–20	20	4,001–6,000	25	45
>20	0			

*Amounts shown are for optimum (O) soil test levels. Apply 50% of this rate if soil test is high (H) and omit if soil test is excessively high (EH). If soil test is low (L) or very low (VL), increase rates according to soil test recommendations.

Disease control in pea

Disease	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Ascochyta blight	<i>Use clean, disease-free seed and a 3-year rotation.</i>			
	azoxystrobin	6.0–15.5 fl oz Quadris Flowable	0	Quadris and Headline belong to the strobilurin group of fungicides. Do not exceed one application of any of these products before alternating with a fungicide having a different mode of action. Do not exceed two applications of strobilurin fungicides per crop per year. Do not exceed 2.88 qt/a Quadris or 18.0 fl oz/a Headline per crop per season.
	pyraclostrobin	6.0–9.0 fl oz Headline SC	7	
	boscalid	8.0–11.0 oz Endura	21 (dried beans) 7 (succulent)	Use no more than 22.0 oz/a per season. Apply at beginning of flowering and again at full bloom for maximum efficacy. Do not make more than two applications/a per season.
	flupyroxad + pyraclostrobin	4.0–8.0 fl oz Priaxor	7	See label and follow instructions for limitations in tank mixing to avoid crop injury. Do not apply more than 16.0 fl oz/a per season.
	penthiopyrad	14.0–30.0 fl oz Fontelis	0	Do not exceed 72.0 fl oz/a per season. Do not make more than two sequential applications without alternating to a fungicide with a different mode of action.
Bacterial blight ("syringae" blight)	Use clean, disease-free seed. Avoid planting after green and lima beans. Don't over-irrigate.			
Common root rot (<i>Aphanomyces</i>)	<i>There are no disease-resistant cultivars. Rotations with non-legumes slow the buildup of disease problems. A test from the UW-Madison Dept. of Plant Pathology predicts the potential for root rot. Trifluralin herbicide gives some protection against Aphanomyces root rot.</i>			
Fusarium near wilt	<i>Cultivars resistant to near wilt are the only effective control.</i>			
Fusarium root rot	<i>Avoid close cropping of peas. Plant peas in a 4-year rotation with other crops.</i>			
Fusarium wilt	<i>Use resistant varieties.</i>			
Powdery mildew	8.0–10.0 lb wettable sulfur in 100 gal water or dust on 325 mesh dusting sulfur			Use mildew-resistant varieties. Begin applications at first sign of mildew. Do not apply when plants are wet or when temperatures are above 85°F.
Rhizoctonia root rot	azoxystrobin	0.40–0.80 fl oz Quadris Flowable/ 1,000 ft row	0	Use at planting. Follow manufacturer's directions.

(continued)

Eggplant

Horseradish

Leafy greens

Melon

Mint

Onion

Pea

Disease control in pea *(continued)*

Disease	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Seed rot and damping-off	captan thiram			Seed treatment. Follow manufacturer's instructions. Combination fungicides-insecticides are available. If using inoculum, apply it just before planting. Plant disease-free seed.
Virus diseases	<i>Virus diseases such as enation virus, mosaic seed-borne virus, mosaic pea streak virus, and pea stunt are spread by aphids. Good aphid control is the most effective control measure.</i>			

Scouting calendar for insect pests of peas

	April			May			June			July			August			September			
	early	mid	late	early	mid	late	early	mid	late	early	mid	late	early	mid	late	early	mid	late	
	Aphids																		
	Caterpillar contaminants																		

Insect control in pea^a

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Alfalfa caterpillar	<i>Treat if you find one caterpillar per 25 sweeps.</i>			
	0.033–0.1 lb bifenthrin	2.1–6.4 fl oz *Brigade 2EC	3	Do not exceed 12.8 oz/a (0.2 lb ai/a) per season.
	0.03–0.05 lb esfenvalerate	5.8–9.6 fl oz *Asana XL	3	Foliar treatment. Do not exceed 0.1 lb ai/a per season. Do not feed treated forage to livestock.
	0.01–0.015 lb gamma-cyhalothrin	2.56–3.84 fl oz *Proaxis	7	Apply every 5 days as needed. Do not apply more than 0.96 pt/a (0.06 lb ai/a) per season.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	7	Apply every 5 days as needed. Do not exceed 7.68 fl oz/a (0.12 lb ai/a) per season.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Besiege	7	Do not exceed a total of 31.0 fl oz of Besiege or 0.12 lb ai of lambda-cyhalothrin containing products or 0.2 lb ai of chlorantraniliprole containing products per acre per year.
	0.225–0.9 lb methomyl	0.75–3.0 pt *Lannate LV	1 ^b	Foliar treatment.
	0.017–0.025 lb zeta-cypermethrin	2.72–4.0 oz *Mustang Max	1	Wait at least 5 days between applications. Do not exceed 24.0 oz/a (0.15 lb ai/a) per season.
	0.04–0.10 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	3	Do not apply more than 0.266 lb ai/a per season. Wait at least 5 days between applications.
zeta-cypermethrin + bifenthrin + imidacloprid	4.5 fl oz *Triple Crown	7 (succulent peas) 21 (dried shelled peas)	Maximum amount of Triple Crown insecticide allowed per crop season is 13.1 fl oz/a (0.23 lb ai/a). Refer to the maximum usage tables when applying more than one product containing either zeta-cypermethrin or bifenthrin or imidacloprid to this crop.	

*Restricted-use pesticide.

(continued)

^a EPA-approved insecticides for pea insects. Usually honeybees do not work pea blossoms, but weed blossoms in the field or in the fencerow might attract bees. Avoid using Sevin sprays if bee yards are located within 2.0–2.5 miles of pea fields. Apply insecticides in the evening to avoid excessive kill of foraging bees.

^b Harvest time is 5 days for forage and 14 days for hay.

Insect control in pea^a (continued)

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Aphids	<i>Treatment is recommended if you find one aphid per small pod or 10 per sweep.</i>			
azadirachtin		Aza-Direct, Neemazad EC, Neemix 4.5, Trilogy	0	See label for rate. Suppression and adult feeding deterrence. Apply every 7–10 days.
0.025 lb beta-cyfluthrin		3.2 fl oz *Baythroid XL	7	Suppression only. Maximum Baythroid XL allowed per 14-day interval: 3.2 fl oz/a (0.025 lb ai/a). Maximum Baythroid XL allowed per crop season: 6.4 fl oz/a (0.05 lb ai/a).
0.033–0.1 lb bifenthrin		2.1–6.4 fl oz *Brigade 2EC	3	Do not exceed 12.8 fl oz/a (0.2 lb ai/a) per season.
dimethoate		0.33–1.0 pt Dimethoate EC	3	Foliar treatment. Do not feed or graze forage within 21 days of last application. Make only one application per season. Do not apply if bees are visiting the areas to be treated when crops or weeds are in bloom.
0.015–0.03 lb esfenvalerate		2.9–5.8 fl oz *Asana XL	3	Foliar treatment. Do not exceed 0.1 lb ai/a per season. Do not feed treated forage to livestock.
0.01–0.015 lb gamma-cyhalothrin		2.56–3.84 fl oz *Proaxis	7	For suppression of aphids only. Apply every 5 days as needed. Do not apply more than 0.96 pt/a (0.06 lb ai/a) per season. See resistance statement under “General Use Precautions and Restrictions” on label.
imidacloprid		7.0–10.5 fl oz Admire Pro	21	Soil application in furrow, seed line. See label for various application methods and timing.
		1.6–3.2 fl oz Gaucho 600/100 lb seed	seed treatment	Early season protection. Purchase treated seed from seed dealer or seed treatment representative.
		3.5 fl oz Provado 1.6F	7	Foliar application. Wait at least 7 days between applications. Do not exceed 10.5 fl oz/a Provado per season and do not exceed 0.5 lb ai/a imidacloprid per season (any formulation).
imidacloprid + beta-cyfluthrin		2.4–2.8 fl oz *Leverage 360	7	Maximum Leverage 360 insecticide allowed per crop season: 6.4 fl oz/a (0.05 lb ai/a beta-cyfluthrin, 0.10 lb ai/a imidacloprid). Do not feed treated vines or hay to livestock.
0.02–0.03 lb lambda-cyhalothrin		1.28–1.92 fl oz *Warrior II	7	Apply every 5 days as needed. Do not exceed 7.68 fl oz/a (0.12 lb ai/a) per season. See resistance statement under “General Directions for Use” on label.
lambda-cyhalothrin + chlorantraniliprole		6.0–9.0 fl oz *Besiege	1	Refer to resistance management section of label. Do not exceed a total of 31.0 fl oz of Besiege or 0.12 lb ai of lambda-cyhalothrin containing products or 0.2 lb ai of chlorantraniliprole containing products per acre per year.
0.225–0.9 lb methomyl		0.75–3.0 pt *Lannate LV	1 ^b	Foliar treatment.
thiamethoxam		1.28 fl oz Cruiser 5FS/100 lb seed	30	Early season protection. Purchase treated seed from seed dealer or seed treatment representative.
0.017–0.025 lb zeta-cypermethrin		2.72–4.0 oz *Mustang Max	1	Wait at least 5 days between applications. Do not exceed 24.0 oz/a (0.15 lb ai/a) per season.

*Restricted-use pesticide.

(continued)

^a EPA-approved insecticides for pea insects. Usually honeybees do not work pea blossoms, but weed blossoms in the field or in the fencerow might attract bees. Avoid using Sevin sprays if bee yards are located within 2.0–2.5 miles of pea fields. Apply insecticides in the evening to avoid excessive kill of foraging bees.

^b Harvest time is 5 days for forage and 14 days for hay.

Eggplant

Horseradish

Leafy greens

Melon

Mint

Onion

Pea

Insect control in pea^a (continued)

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Aphids (cont.)	0.04–0.10 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	3	Do not apply more than 0.266 lb ai/a per season. Wait at least 5 days between applications.
	zeta-cypermethrin + bifenthrin + imidacloprid	4.5 fl oz *Triple Crown	7 (succulent peas) 21 (dried shelled peas)	<i>Labeled for soybean aphid on peas.</i> Maximum amount of Triple Crown insecticide allowed per crop season is 13.1 fl oz/a (0.23 lb ai/a). Refer to the maximum usage tables when applying more than one product containing either zeta-cypermethrin or bifenthrin or imidacloprid to this crop.
Armyworms	0.5–2.0 lb <i>Bacillus thuringiensis</i> subsp. <i>kurstaki</i>	Agree WG, DiPel DF, Javelin, Lepinox WDG	0	See label for rate. Treat early instar larvae before noticeable feeding damage occurs. Repeat as needed.
	0.019–0.025 lb beta-cyfluthrin	2.4–3.2 fl oz *Baythroid XL	7	Apply to small armyworms, first and second instars. Maximum Baythroid XL allowed per 14-day interval: 3.2 fl oz/a (0.025 lb ai/a). Maximum Baythroid XL allowed per crop season: 6.4 fl oz/a (0.05 lb ai/a).
Leafy greens	0.033–0.1 lb bifenthrin	2.1–6.4 fl oz *Brigade 2EC	3	Do not exceed 12.8 oz/a (0.2 lb ai/a) per season.
	carbaryl	1.0–1.5 qt Sevin XLR Plus	3	Do not exceed 6.0 qt/a per crop. Do not apply within 14 days of grazing or harvest of forage or within 3 days of harvest of fresh peas or within 21 days of harvest of dried peas.
	0.045–0.065 lb chlorantraniliprole	3.5–5.0 fl oz Coragen	1	Do not apply more than 15.4 fl oz Coragen or 0.2 lb ai of chlorantraniliprole containing products per acre per crop.
Melon	0.03–0.05 lb esfenvalerate	5.8–9.6 fl oz *Asana XL	3	Foliar treatment. Do not exceed 0.1 lb ai/a per season. Do not feed treated forage to livestock.
	0.01–0.015 lb gamma-cyhalothrin	2.56–3.84 fl oz *Proaxis	7	For control of first and second instars only. Apply every 5 days as needed. Do not apply more than 0.96 pt/a (0.06 lb ai/a) per season.
	imidacloprid + beta-cyfluthrin	2.4–2.8 fl oz *Leverage 360	7	Apply to small larvae, first and second instar armyworms. Maximum Leverage 360 insecticide allowed per crop season: 6.4 fl oz/a (0.05 lb ai/a beta-cyfluthrin, 0.10 lb ai/a imidacloprid). Do not feed treated vines or hay to livestock.
Mint	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	7	Use higher rates for large larvae. Apply every 5 days as needed. Do not exceed 7.68 fl oz/a (0.12 lb ai/a) per season.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Besiege	1	Use higher rates within the listed rate range for large larvae. Do not exceed a total of 31.0 fl oz of Besiege or 0.12 lb ai of lambda-cyhalothrin containing products or 0.2 lb ai of chlorantraniliprole containing products per acre per year.
	0.225–0.9 lb methomyl	0.75–3.0 pt *Lannate LV	1 ^b	Foliar treatment.
Onion	0.031–0.063 lb spinetoram	4.0–8.0 fl oz Radiant SC	3	Do not make more than six applications per crop. Do not exceed 0.219 lb ai/a per season. Wait at least 4 days between applications.

*Restricted-use pesticide.

(continued)

^a EPA-approved insecticides for pea insects. Usually honeybees do not work pea blossoms, but weed blossoms in the field or in the fencerow might attract bees. Avoid using Sevin sprays if bee yards are located within 2.0–2.5 miles of pea fields. Apply insecticides in the evening to avoid excessive kill of foraging bees.

^b Harvest time is 5 days for forage and 14 days for hay.

Eggplant

Horseradish

Leafy greens

Melon

Mint

Onion

Pea

Insect control in pea^a (continued)

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Army-worms (cont.)	spinosad	2.2–3.3 fl oz Blackhawk 4.0–6.0 fl oz Entrust SC	3 (succulent peas) 28 (dried peas)	Scout with enough regularity to monitor the population size. Heavy infestations may require repeat applications, but follow resistance management guidelines. Do not make more than two applications of Group 5 insecticides (spinetoram and spinosad). For succulent peas, do not apply more than a total of 0.45 lb ai of spinosad (20.0 fl oz of Blackhawk or 29.0 fl oz of Entrust SC) per acre per season. For dried peas, do not apply more than a total of 0.188 lb ai of spinosad (8.3 fl oz of Blackhawk or 12.0 fl oz of Entrust SC) per acre per season. For dried peas, do not feed treated forage or hay to meat or dairy animals.
	0.017–0.025 lb zeta-cypermethrin	2.72–4.0 oz *Mustang Max	1	Wait at least 5 days between applications. Do not exceed 24.0 oz/a (0.15 lb ai/a) per season.
	0.04–0.10 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	3	Do not apply more than 0.266 lb ai/a per season. Wait at least 5 days between applications.
	zeta-cypermethrin + bifenthrin + imidacloprid	4.5 fl oz *Triple Crown	7 (succulent peas) 21 (dried shelled peas)	Maximum amount of Triple Crown insecticide allowed per crop season is 13.1 fl oz/a (0.23 lb ai/a). Refer to the maximum usage tables when applying more than one product containing either zeta-cypermethrin or bifenthrin or imidacloprid to this crop.
Cutworms	0.007–0.013 lb beta-cyfluthrin	0.8–1.6 fl oz *Baythroid XL	7	Maximum Baythroid XL allowed per 14-day interval: 3.2 fl oz/a (0.025 lb ai/a). Maximum Baythroid XL allowed per crop season: 6.4 fl oz/a (0.05 lb ai/a).
	0.033–0.1 lb bifenthrin	2.1–6.4 fl oz *Brigade 2EC	3	Do not exceed 12.8 oz/a (0.2 lb ai/a) per season.
	1.5 lb carbaryl	30 lb Sevin bait	3	Broadcast treatment.
	0.03–0.05 lb esfenvalerate	5.8–9.6 fl oz *Asana XL	3	Foliar treatment. Do not exceed 0.1 lb ai/a per season. Do not feed treated forage to livestock.
	0.0075–0.0125 lb gamma-cyhalothrin	1.92–3.20 fl oz *Proaxis	7	Do not apply more than 0.96 pt/a (0.06 lb ai/a) per season.
	imidacloprid + beta-cyfluthrin	2.4–2.8 fl oz *Leverage 360	7	Maximum Leverage 360 insecticide allowed per crop season: 6.4 fl oz/a (0.05 lb ai/a beta-cyfluthrin, 0.10 lb ai/a imidacloprid). Do not feed treated vines or hay to livestock.
	0.015–0.025 lb lambda-cyhalothrin	0.96–1.6 fl oz *Warrior II	7	Do not exceed 7.68 fl oz/a (0.12 lb ai/a) per season.
	lambda-cyhalothrin + chlorantraniliprole	5.0–8.0 fl oz *Besiege	1	Do not exceed a total of 31.0 fl oz of Besiege or 0.12 lb ai of lambda-cyhalothrin containing products or 0.2 lb ai of chlorantraniliprole containing products per acre per year.
	0.008–0.025 lb zeta-cypermethrin	1.28–4.0 oz *Mustang Max	1	Wait at least 5 days between applications. Do not exceed 24.0 oz/a (0.15 lb ai/a) per season.
0.04–0.10 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	3	Do not apply more than 0.266 lb ai/a per season. Wait at least 5 days between applications.	

*Restricted-use pesticide.

(continued)

^a EPA-approved insecticides for pea insects. Usually honeybees do not work pea blossoms, but weed blossoms in the field or in the fencerow might attract bees. Avoid using Sevin sprays if bee yards are located within 2.0–2.5 miles of pea fields. Apply insecticides in the evening to avoid excessive kill of foraging bees.

^b Harvest time is 5 days for forage and 14 days for hay.

Egplant

Horseradish

Leafy greens

Melon

Mint

Onion

Pea

Insect control in pea^a (continued)

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Cutworms (cont.)	zeta-cypermethrin + bifenthrin + imidacloprid	3.5–4.5 fl oz *Triple Crown	7 (succu- lent peas)	Maximum amount of Triple Crown insecticide allowed per crop season is 13.1 fl oz/a (0.23 lb ai/a). Refer to the maximum usage tables when applying more than one product containing either zeta-cypermethrin or bifenthrin or imidacloprid to this crop.
			21 (dried shelled peas)	
Loopers	<i>Treat if you find one looper per 25 sweeps.</i>			
	0.5–2.0 lb <i>Bacillus thuringiensis</i> subsp. <i>kurstaki</i>	Agree WG, DiPel DF, Javelin, Lepinox WDG	0	See label for rate. Treat early instar larvae before noticeable feeding damage occurs. Repeat as needed.
Horseradish	0.019–0.025 lb beta-cyfluthrin	2.4–3.2 fl oz *Baythroid XL	7	Maximum Baythroid XL allowed per 14-day interval: 3.2 fl oz/a (0.025 lb ai/a). Maximum Baythroid XL allowed per crop season: 6.4 fl oz/a (0.05 lb ai/a).
	0.033–0.10 lb bifenthrin	2.1–6.4 fl oz *Brigade 2EC	3	Do not exceed 12.8 fl oz/a (0.2 ai/a) per season.
Leafy greens	0.03–0.05 lb esfenvalerate	5.8–9.6 fl oz *Asana XL	3	Foliar treatment. Do not exceed 0.1 lb ai/a per season. Do not feed treated forage to livestock.
	0.01–0.015 lb gamma-cyhalothrin	2.56–3.84 fl oz *Proaxis	7	Wait at least 5 days between applications. Do not exceed 0.96 pt/a (0.06 lb ai/a) per season.
	imidacloprid + beta-cyfluthrin	2.4–2.8 fl oz *Leverage 360	7	Maximum Leverage 360 insecticide allowed per crop season: 6.4 fl oz/a (0.05 lb ai/a beta-cyfluthrin, 0.10 lb ai/a imidacloprid). Do not feed treated vines or hay to livestock.
Melon	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	7	Wait at least 5 days between applications. Do not exceed 7.68 fl oz/a (0.12 lb ai/a) per season.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Besiege	1	Do not exceed a total of 31.0 fl oz of Besiege or 0.12 lb ai of lambda-cyhalothrin containing products or 0.2 lb ai of chlorantraniliprole containing products per acre per year.
	0.225–0.9 lb methomyl	0.75–3.0 pt *Lannate LV	1 ^b	Foliar treatment.
Mint	0.031–0.063 lb spinetoram	4.0–8.0 fl oz Radiant SC	3	Do not make more than six applications per crop. Do not exceed 0.219 lb ai/a per season. Wait at least 4 days between applications.
	spinosad	2.2–3.3 fl oz Blackhawk 4.0–6.0 fl oz Entrust SC	3 (succu- lent peas)	Scout with enough regularity to monitor the population size. Heavy infestations may require repeat applications, but follow resistance management guidelines. Do not make more than two applications of Group 5 insecticides (spinetoram and spinosad). For succulent peas, do not apply more than a total of 0.45 lb ai of spinosad (20.0 fl oz of Blackhawk or 29.0 fl oz of Entrust SC) per acre per season. For dried peas, do not apply more than a total of 0.188 lb ai of spinosad (8.3 fl oz of Blackhawk or 12.0 fl oz of Entrust SC) per acre per season. For dried peas, do not feed treated forage or hay to meat or dairy animals.
			28 (dried peas)	
Onion	0.017–0.025 lb zeta-cypermethrin	2.72–4.0 oz *Mustang Max	1	Wait at least 5 days between applications. Do not exceed 24.0 oz/a (0.15 lb ai/a) per season.

*Restricted-use pesticide.

(continued)

^a EPA-approved insecticides for pea insects. Usually honeybees do not work pea blossoms, but weed blossoms in the field or in the fencerow might attract bees. Avoid using Sevin sprays if bee yards are located within 2.0–2.5 miles of pea fields. Apply insecticides in the evening to avoid excessive kill of foraging bees.

^b Harvest time is 5 days for forage and 14 days for hay.

Eggplant

Horseradish

Leafy greens

Melon

Mint

Onion

Pea

Insect control in pea^a (continued)

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Loopers (cont.)	0.04–0.10 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	3	Do not apply more than 0.266 lb ai/a per season. Wait at least 5 days between applications.
	zeta-cypermethrin + bifenthrin + imidacloprid	4.5 fl oz *Triple Crown	7 (succulent peas) 21 (dried shelled peas)	Maximum amount of Triple Crown insecticide allowed per crop season is 13.1 fl oz/a (0.23 lb ai/a). Refer to the maximum usage tables when applying more than one product containing either zeta-cypermethrin or bifenthrin or imidacloprid to this crop. Pyrethroid resistance is common for this pest. Refer to the resistance management section of the label.
Seed maggot	thiamethoxam	1.28 fl oz Cruiser 5FS/100 lb seed	seed treatment	Early season protection. Purchase treated seed from seed dealer or seed treatment representative.

*Restricted-use pesticide.

^a EPA-approved insecticides for pea insects. Usually honeybees do not work pea blossoms, but weed blossoms in the field or in the fencerow might attract bees. Avoid using Sevin sprays if bee yards are located within 2.0–2.5 miles of pea fields. Apply insecticides in the evening to avoid excessive kill of foraging bees.

^b Harvest time is 5 days for forage and 14 days for hay.

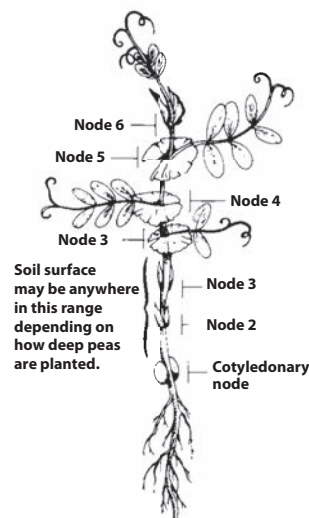
Weed control

Postemergence herbicides need to be applied at the correct stage of growth to avoid injury and prevent yield losses. Correctly counting leaves or nodes on pea plants is critical in timing herbicide applications.

To count nodes, refer to the drawing of the pea plant. The point where the cotyledons (seed) are attached to the plant is the cotyledonary node. The root forms below this node and the stem above. The two nodes above this point produce incomplete or stipular leaves.

These leaves can be above or below the soil surface and can be difficult to detect.

Count the first two nodes above the cotyledonary node as one and two. The third node has normal stipules and usually a leaf with two leaflets. The rest of the nodes produce normal stipules and a leaf with four leaflets. The uppermost node from which a leaf extends is the last developed node to be counted. Within the folded stipules of this node are the growing point of the pea plant and stipules and leaves of still more nodes.



Eggplant

Horseradish

Leafy greens

Melon

Mint

Onion

Pea

Weed control in pea

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Annuals	0.5 lb clomazone	1.3 pt Command 3ME		Command provides fair control of annual grasses and several broadleaf weeds but is weak on pigweed and black nightshade. Command is ineffective on peat and muck soils. The 3ME formulation is labeled for preemergence applications, but shallow incorporation is permitted, which should prevent volatility. Off-site movement through drift or vapors can cause bleaching of sensitive plants and must be avoided. Application is prohibited within 1,200 feet of housing, greenhouses, and nurseries and within 300 feet of desirable sensitive plants. Do not apply if wind exceeds 10 mph. Cabbage, soybeans, and tobacco can be replanted anytime after application. Beans, field and sweet corn, cucurbits, potatoes, and transplant tomatoes can be planted 9 months after application. Wheat can be planted 12 months after application, but small-seeded legumes and other small grains should not be planted for 16 months. Treated pea vines cannot be fed to livestock.
	0.047 lb imazethapyr	3.0 fl oz Pursuit	30	<p>Apply as a preplant treatment within 7 days of planting and incorporate 1–2 inches deep or as a preemergence treatment within 3 days after planting. Ineffective on peat or muck soils.</p> <p>Or apply postemergence when weeds are less than 2 inches tall and after peas are at least 3 inches tall but prior to five nodes before flowering. Include 2 pt/100 gal of non-ionic surfactant in the final spray mixture. Do not use crop oil as an adjuvant. Tank mixing Pursuit with postemergence grass herbicides may reduce grass control. Apply Pursuit at least 7 days before or 3 days after a postemergence grass herbicide.</p> <p>Pursuit controls several annual broadleaf weeds, including black nightshade, and some annual grasses. It can stunt peas if cool and/or wet weather follows treatment. Pursuit at 2.0 fl oz/a can be applied postemergence after a trifluralin treatment to suppress nightshade, but the risk of injury increases.</p> <p>The following crop rotation restrictions apply to fields treated with 3.0 oz/a Pursuit. Soybeans, lima beans, peas, and Clearfield corn may be planted anytime after application. Wait 3 months before planting green beans or wheat; 4 months before planting alfalfa, barley, edible beans, or rye; 8.5 months before planting conventional field corn or seed corn; 9.5 months before planting tobacco; 18 months before planting oats, sorghum, or sweet corn; 26 months before planting potatoes; and 40 months for all other crops. Treated pea vines cannot be fed to livestock.</p>
	0.5–1.5 lb pendimethalin	1.5–3.0 pt Prowl H2O		Preplant-incorporated treatment controls annual grasses, lambsquarters, and pigweed but is weak on wild mustard, smartweed, common ragweed, velvetleaf, and black nightshade. Incorporate 1–2 inches deep within 7 days after application. Can be tank mixed with Pursuit. Can delay maturity of early-maturing pea cultivars. Pea injury is more severe on wet soils. Ineffective on peat or muck soils. Some suppression of common root rot. Crops that allow preplant-incorporated pendimethalin use can be double cropped after peas. Do not plant winter wheat until 120 days after application; any crop may be planted the following year. Treated pea vines cannot be fed to livestock.

(continued)

Weed control in pea *(continued)*

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Annuals <i>(cont.)</i>	0.95–1.9 lb s-metolachlor	1.0–2.0 pt Dual II Magnum		Apply preemergence for good to excellent control of foxtails and other annual grasses, good control of black nightshade and pigweed, and partial control of nutsedge. Does not control most other broadleaf weeds. Can cause significant pea injury. Residues will not carry over to the fall or next season. Pea vines can be cut for hay 120 days after application. Ineffective on peat or muck soils.
	0.017 lb saflufenacil	0.75 fl oz Sharpen		Sharpen may be applied preplant-incorporated or preemergence for residual suppression of select broadleaf weeds such as black nightshade, common lambsquarters, redroot pigweed, and velvetleaf. Check the supplemental label for pea-related information, and check with your seed supplier for information regarding sensitive varieties. Sharpen may be preplant-incorporated up to 1 week prior to planting, but do not incorporate deeper than 3 inches. It can be applied preemergence up to 3 days after planting but prior to cracking stage (emergence) or severe crop injury may result. Also, make sure peas were planted at least ½-inch deep and soil conditions allowed furrows to close properly. Do not apply if cold and/or wet soil conditions are present or predicted within 1 week of application, and do not apply with any other products containing Group 14/Group E herbicides within 30 days. Do not feed or graze as forage for 65 days.
	0.017 lb saflufenacil + 0.047 lb imazethapyr	1.5 oz OpTill		OpTill is a combination of Sharpen and Pursuit. It will control a broad spectrum of annual broadleaf and grassy weeds. Check the label for specifics. It may be applied preplant up to 30 days prior to planting but is more reliable if applied not more than 14 days prior to planting. OpTill may be preplant-incorporated up to 1 week prior to planting. Do not incorporate more than 3 inches deep. Preemergence applications may be made up to 3 days after planting but before emergence. Do not apply if crop is cracking. OpTill may be used in burndown applications as a tank mix with products containing glyphosate. Check labels for tank mix directions. Check product labels for additional cropping and plantback restrictions.
	0.5–0.75 lb trifluralin	1.0–1.5 pt Treflan MTF or comparable trifluralin formulation		Preplant-incorporated treatment controls annual grasses, lambsquarters, and pigweed but is weak on wild mustard, smartweed, common ragweed, velvetleaf, and black nightshade. Incorporate 2–3 inches deep within 24 hours of application. Can delay maturity of early-maturing pea cultivars. Pea injury is more severe on wet soils. May carry over in soil. Ineffective on peat or muck soils. Some suppression of common root rot.
Emerged annual broad-leaves	0.75–1.0 lb bentazon	1.5–2.0 pt Basagran	10	Excellent control of velvetleaf and wild mustard. Partial control of black nightshade, common lambsquarters, and redroot pigweed when applied to very small seedlings. Some burndown of yellow nutsedge and Canada thistle. Does not control grasses. Apply when broadleaf weeds are small and actively growing, but only after three pairs of pea leaves (usually four nodes) are present. Do not include spray oil in the spray mixture. Spray to thoroughly cover weeds. Use minimum of 20 gal/a of water and 40 psi pressure and apply through flat fan or hollow cone nozzles no more than 20 inches apart. Do not apply if peas are stressed. Do not tank mix with other pesticides. Rain within 4 hours reduces effectiveness.

(continued)

Figplant

Horseradish

Leafy greens

Melon

Mint

Onion

Pea

Weed control in pea (continued)

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Emerged annual broad-leaves (cont.)	0.023 lb imazamox	3.0 fl oz Raptor		Controls eastern black and hairy nightshade, wild mustard, field pennycress, shepherd's purse, and pigweed. Apply before weeds exceed 3 inches in height. Peas must be at least 3 inches tall, but five nodes before flowering. Add 0.25% non-ionic surfactant to the spray mixture. Weed control can be improved by adding 2.5% of liquid nitrogen fertilizer (28%) or 12–15 lb of ammonium sulfate per 100 gal of mix. Suppression of annual grasses will be increased if 1% crop oil concentrate is used instead of surfactant. When using crop oil concentrate or nitrogen fertilizer as an adjuvant, always add 6.0–16.0 oz/a of Basagran to reduce crop injury. Rain within 1 hour will reduce control. The following crop rotation restrictions apply to fields treated with Raptor. Soybeans and edible legumes can be planted anytime after application. Alfalfa and wheat can be planted after 3 months and barley and rye after 4 months. All types of corn can be planted after 8.5 months, and carrot, onion, oats, and many other crops can be planted after 9 months. Beets can be planted after 18 months if the soil pH is 6.2 or greater.
	0.5–1.0 lb acid equivalent MCPB	2.0–4.0 pt/a Thistrol		Controls many annual broadleaf weeds and inhibits Canada thistle flower bud formation. Weak on smartweed, mustards, and black nightshade. Lower rate controls only young weeds less than 3 inches tall. Apply 3.0–4.0 pt/a for thistle inhibition. Apply no later than three nodes before pea flowering. Usually delays pea maturity 1–4 days. Do not apply when soils are waterlogged or during drought. Do not apply if temperatures are over 90°F. Treated pea vines cannot be fed to livestock.
Emerged annual grasses	0.034–0.083 lb quizalofop	5.0–12.0 oz Assure II or Targa plus 1% oil concentrate or 0.25% non-ionic surfactant	30	Controls most annual and perennial grasses but does not control broadleaves. Apply 5.0–8.0 oz/a for wild proso millet, 7.0–8.0 oz/a for foxtails, 8.0–10.0 oz/a for crabgrass, 9.0–10.0 oz/a for woolly cupgrass, and 10.0–12.0 oz/a for quackgrass. To avoid antagonizing activity, apply broadleaf herbicides either 7 days before or 24 hours after Assure II or Targa. If tank mixing with Basagran, increase the Assure II or Targa rate by 2.0 oz to minimize grass antagonism. Apply in 10.0–20.0 gal/a of water with flat fan or hollow cone nozzles. Rainfall within 1 hour reduces effectiveness. Treated pea vines cannot be fed to livestock.
	0.094–0.188 lb sethoxydim	0.5–1.0 pt Poast plus 2.0 pt of oil concentrate	15	Apply the higher rate when foxtails, fall panicum, barnyardgrass and woolly cupgrass are up to 8 inches tall and actively growing. The same treatment will control shattercane that is up to 18 inches tall and volunteer corn that is up to 20 inches tall. The lower rate will control 10 inch tall wild proso millet. Controls most annual and perennial grasses but does not control broadleaf weeds or sedges. Thoroughly cover weeds. Use 5.0–20.0 gal/a of water and 40 psi pressure and apply through flat fan or hollow cone nozzles. Rainfall within 1 hour reduces effectiveness.
Perennial weeds	0.75–2.25 lb acid equivalent glyphosate	0.7–2.0 qt Roundup WeatherMax or equivalent glyphosate rate		Excellent control of quackgrass, good control of Canada thistle and other perennial weeds. Apply preplow before planting peas. Don't till or mow target weeds for several months before treatment. Don't till fields in fall that you plan to treat in spring. For quackgrass control, treat with 1.5 lb ae/a in fall or spring when quackgrass is 6–8 inches tall and actively growing, or apply 0.75 lb ae/a in 3.0–10.0 gal/a of spray using flat fan or hollow cone spray nozzles. For Canada thistle control, treat with 2.0 lb ae/a when thistles are in the bud to early bloom stage and actively growing. Do not mow or till treated quackgrass or Canada thistle for 3 days. Rain within 2 hours of application can reduce effectiveness.

Eggplant

Horseradish

Leafy greens

Melon

Mint

Onion

Pea

Pepper

Planting

Transplants

Rows: 18–36 inches.

Plants in row: 18–24 inches. Use 24 lb/a seed (1 oz produces 215 plants).

Set transplants May 20–June 1 in the southern half of Wisconsin and 7–10 days later in the northern counties after danger of frost is past. Plants stop growing below 55°F. Poor fruit set may occur below 60°F or above 75°F.

Transplants should be 6–8 weeks old, vigorous, slightly hardened (held at 60–65°F several days), stocky, dark green, and without disease or insect injury. Handle

transplants carefully. Use a starter solution high in nitrogen and phosphorus as transplants are set out.

Irrigation

Irrigation is essential on sandy soils and may help on heavier soils during prolonged dry periods. Approximately 1.0–1.5 inches of water is needed every 5–7 days. If maximum daily temperatures exceed 85°F, more frequent irrigation may be necessary.

Lime and fertilizer

Lime: Use dolomitic limestone to maintain a pH of 6.0 on mineral soils and 5.6 on organic soils.

Fertilizer rates: Apply P_2O_5 and K_2O according to soil test recommendations. Use annual nitrogen, P_2O_5 , and K_2O recommendations in the table below. Take credits for previous legume crops and manure.

Application: Broadcast recommended fertilizer and plow or disk under before setting transplants.

Nitrogen: Apply preplant or sidedress. Split nitrogen into two or three applications, especially on sandy soils.

Annual nitrogen, phosphate, and potash recommendations for peppers

Nitrogen		Phosphate and potash		
Organic matter (%)	Amount to apply (lb/a)	Yield goal (t/a)	Amount P_2O_5 to apply* (lb/a)	Amount K_2O to apply* (lb/a)
<2	100	8–10	10	50
2.0–9.9	80			
10–20	60			
>20	30			

*Amounts shown are for optimum (O) soil test levels. Apply 50% of this rate if soil test is high (H) and omit if soil test is excessively high (EH). If soil test is low (L) or very low (VL), increase rates according to soil test recommendations.

Pepper

Potato

Pumpkin & squash

Sweet corn

Table beet

Tomato

Insect keys

Disease control in pepper

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Anthracnose (<i>Colletotrichum</i> spp.)	azoxystrobin	6.0–15.5 fl oz Quadris	0	Do not apply more than 61.5 fl oz/a per season. Do not make more than one application without alternating to a fungicide with a different mode of action.
	azoxystrobin + difenoconazole	8.0–14.0 fl oz Quadris Top	0	Do not apply more than 55.3 fl oz/a per season. Do not make more than two consecutive applications before alternating to a fungicide with a different mode of action.
	chlorothalonil	1.5 pt Bravo Weather Stik, Chloronil 720, Echo 720, Equus 720	3	Do not apply more than 12.0 pt/a per season.
	fluxapyroxad + pyraclostrobin	4.0–8.0 fl oz Priaxor	7	See label and follow instructions for limitations in tank mixing to avoid crop injury. Do not apply more than 24.0 fl oz/a per season.
	pyraclostrobin	8.0–12.0 oz Cabrio	0	Do not apply more than 96.0 fl oz/a per season. The use of adjuvants may enhance efficacy of this product. Do not make more than one application before alternating to a fungicide with a different mode of action.
Bacterial spot	<i>Plant cultivars with resistance to bacterial spot. Several cultivars have field tolerance to races of the pathogen. A hot water seed treatment will help prevent bacterial spot. Place the seed in a mesh bag and dip it into water heated to 122°F; treat for 25 minutes. Immediately transfer the bag to cold water to cool the seed. There will be some reduction in the germination rate of treated seed. You may wish to sow additional seed to compensate.</i>			
copper ammonium complex	1.5–3.0 qt Copper-Count-N	0	Spray every 7 days.	
	copper hydroxide	2.0–3.0 lb Champion 77WP	0	
		1.3–2.0 pt Champ Formula 2	0	
		2.0–3.0 lb Kocide DF	0	
		2.6–4.0 pt Kocide LF 2.4F	0	
		1.5–2.25 lb Kocide 2000 DF	0	
0.75–1.25 lb Kocide 3000	0			
copper sulfate	0.75–2.0 lb Cuprofix Ultra 40 Dispers	0		
streptomycin sulfate	200 ppm solution of 21.2% streptomycin sulfate		Spray every 4–5 days in the plant bed, but do not use after transplanting.	
Botrytis leaf mold (<i>Botrytis cinerea</i>)	chlorothalonil	1.5 pt Bravo Weather Stik, Chloronil 720	3	Do not apply more than 12.0 pt/a per season.
Cercospora leaf spot (<i>Cercospora</i> spp.)	chlorothalonil	1.5 pt Bravo Weather Stik, Chloronil 720	3	Do not apply more than 12.0 pt/a per season.
Damping off, crown rot	mefenoxam	1.0 pt Ridomil Gold SL	—	Preplant-incorporated application or surface application at planting. Preplant to top 2 inches of soil.
		2.0 pt Ultra Flourish	—	
		0.085–0.64 fl oz Apron XL/100 lb seed	—	Follow manufacturer's directions. Do not use treated seed for feed or food.
metalaxyl	4.0–8.0 pt MetaStar 2E AG	—	Preplant-incorporated application or surface application at planting. Preplant to top 2 inches of soil.	
	0.7 fl oz/100 lb seed Sebring 2.65 ST	—	Follow manufacturer's directions. Do not use treated seed for feed or food.	
	0.75 fl oz/100 lb seed Allegiance FL, Metalaxyl 265 ST	—		

(continued)

Disease control in pepper *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Damping off, crown rot <i>(cont.)</i>	propamocarb hydrochloride	1.2 pt Previcur Flex	5	Do not apply more than 6.0 pt/a per season. Can be applied to lower portions of plants and soil by directed nozzles. Can be applied through drip irrigation or transplant water.
Phytophthora blight, ripe rot	cyazofamid	2.75 fl oz Ranman	0	Do not make more than six applications/a per year. Do not apply more than 16.5 fl oz/a per year.
	cymoxanil + famoxadone	8.0–10.0 oz Tanos 50DF	3	Disease suppression only. Do not make more than one application of Tanos before alternating with a fungicide having a different mode of action. Do not exceed 72.0 oz/a Tanos per season.
	dimethomorph	6.0 oz Forum	0	Disease suppression only. Tank mix Forum with another fungicide active against Phytophthora blight and having a different mode of activity. Do not make more than two sequential applications of Forum before alternating to another effective fungicide. Do not exceed five applications per season or 30.0 oz/a per season.
	fenamidone	8.2 fl oz Reason 500 SC	14	Do not apply more than 24.6 fl oz/a per year. Do not make more than one application before alternating to a fungicide with a different mode of action (non-Group 11, non-strobilurin).
	fluopicolide	3.0–4.0 fl oz Presidio	2	Tank mix this product with another labeled non-Group 43 fungicide.
	mandipropamid	8.0 fl oz Revus	1	Apply as a foliar spray in a mixture with a copper-based fungicide. Alternate with another effective non-Group 40 fungicide.
Powdery mildew <i>(Leveillula taurica)</i>	chlorothalonil	1.5 pt Bravo Weather Stik, Chloronil 720	3	Do not apply more than 12.0 pt/a per season.
Virus diseases (alfalfa mosaic, cucumber mosaic, tobacco mosaic, potato viruses X & Y, tobacco etch)	<i>Be sure transplants are free from virus infections. Plant peppers far from potatoes, tomatoes, squash, cucumbers, melons, alfalfa. Eliminate all perennial weed hosts within 150 ft of field. Plant varieties resistant to tobacco mosaic virus.</i>			

Insect control in pepper

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
European corn borer	<i>Treat when eggs or larvae are observed OR when female European corn borer moths in nearby blacklight traps exceed four per night on three consecutive nights when peppers are forming. Repeat applications at 5- to 7-day intervals while moth flights continue or until harvest.</i>			
	0.24–0.97 lb acephate	0.25–1.0 lb Orthene 97	7	Sweet bell peppers only. Do not exceed 2.66 lb ai/a per season.
	0.5–1.0 lb acephate	12.0–16.0 oz Acephate 97UP	7	Sweet bell peppers only. Do not apply more than 2.66 lb/a of formulated product per season.
	<i>Bacillus thuringiensis</i> subsp. <i>kurstaki</i>	1.0–2.0 lb Lepinox WDG	0	Treat early instar larvae before noticeable feeding damage occurs. Repeat as needed.

*Restricted-use pesticide.

(continued)

Pepper

Potato

Pumpkin & squash

Sweet corn

Table beet

Tomato

Insect keys

Insect control in pepper *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
European corn borer <i>(cont.)</i>	0.0125–0.022 lb beta-cyfluthrin	1.6–2.8 fl oz *Baythroid XL	7	Do not use when peppers are grown for seed. Ground applications only. Do not exceed 16.8 fl oz/a Baythroid XL per season. Allow 7 days between applications.
	0.033–0.1 lb bifenthrin	2.1–6.4 fl oz *Brigade 2EC	7	Apply every 7 days as needed. Do not exceed 12.8 fl oz/a (0.2 lb ai/a) per season.
Potato	1.0–2.0 lb carbaryl	Sevin	3	Several formulations; see label for rate.
	0.045–0.065 lb chlorantraniliprole	3.5–5.0 fl oz Coragen	1	Wait at least 3 days between treatments. Do not exceed 15.4 fl oz/a (0.2 lb ai/a) per season. Do not use adjuvants on chili pepper or pimento.
	0.018–0.028 lb deltamethrin	1.5–2.4 fl oz *Delta Gold	1	Apply every 5 days as needed. Do not exceed 14.4 fl oz/a.
Pumpkin & squash	0.03–0.05 lb esfenvalerate	5.8–9.6 fl oz *Asana L	7	Do not exceed 0.35 lb ai/season.
	0.03–0.045 lb flubendiamide	2.0–3.0 oz Synapse WG	1	Do not exceed 3.0 oz (0.045 lb ai/a) in a 7-day period or 9.0 oz/a per season.
	flubendiamide + buprofezin	12.0–17.0 fl oz Vetica	1	Do not apply more than 38.0 fl oz/a per season and allow at least 7 days between applications. Do not make more than three applications per crop season.
	0.01–0.015 lb gamma-cyhalothrin	2.56–3.84 oz *Proaxis	5	Apply every 5 days as needed. Do not apply more than 2.88 pt/a (0.18 lb ai/a) per season.
Sweet corn	imidacloprid + beta-cyfluthrin	3.8–4.1 fl oz *Leverage 360	7	Do not apply more than 12.8 fl oz/a per season and allow at least 7 days between applications.
	0.065 lb indoxcarb	3.5 oz Avaunt 30DG	3	Wait at least 5 days between applications. Do not exceed 24.0 oz/a Avaunt (0.44 lb ai/a) per crop.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4	Reapply at intervals of 5 days or more. Do not exceed 0.18 lb ai/a per year.
Table beet	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Voliam Xpress	5	Do not exceed a total of 31.0 fl oz/a of Voliam Xpress or 0.36 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per season.
	lambda-cyhalothrin + thiamethoxam	4.0–4.5 fl oz *Endigo ZC	5	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 5 days between applications.
	0.06–0.16 lb methoxyfenozide	<i>early season:</i> 4.0–8.0 fl oz Intrepid 2F <i>mid- to late season:</i> 8.0–16.0 fl oz Intrepid 2F	1 1	Will not control flea beetles. Do not exceed 64.0 fl oz/a per season. Use the higher rates with higher populations or when spray coverage is difficult. See label for use restrictions in some Wisconsin counties.
Tomato	0.1–0.2 lb permethrin	*Ambush, *Pounce	3	Sweet bell peppers only. See label for rate. Do not exceed 1.6 lb ai/a per season.
	0.039–0.078 lb spinetoram	5.0–10.0 oz Radiant SC	1	Do not apply more than 34.0 oz/a Radiant (0.266 lb ai/a) per crop and do not exceed four applications per year.
	spinosad	3.0–6.0 fl oz Entrust SC	1	Use higher rate for larger insects. Apply adequate spray to get good coverage for best control. Do not exceed 0.45 lb ai/a per season. Do not use a buffering agent.
Insect keys	0.09–0.12 lb tebufenozide	6.0–16.0 fl oz Confirm 2F	7	Apply at first sign of feeding or when populations exceed threshold levels. Do not exceed 64.0 fl oz per season. There is a 1–12 month plantback restriction depending on the crop.

*Restricted-use pesticide.

(continued)

Insect control in pepper (continued)

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
European corn borer (cont.)	zeta-cypermethrin	2.24–4.0 oz *Mustang Max	1	Apply every 7 days as needed. Use higher rate for heavy infestations. Do not exceed 24.0 oz/a Mustang Max per season.
	0.04–0.1 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	7	Do not apply more than 0.266 lb ai/a per season. Wait at least 7 days between applications.
Green peach aphid	0.24–0.97 lb acephate	0.25–1.0 lb Orthene 97	7	Sweet bell peppers only: Do not exceed 2.66 lb ai/a per season. Non-bell peppers: Do not exceed 1.33 lb ai/a per season.
	acetamiprid	0.8–1.2 oz Assail 70WP	7	Begin treatment when thresholds are reached. Apply every 7 days as needed. Do not exceed 0.3 lb ai/a per season.
		2.0–4.0 oz Assail 30 SG	7	
	0.033–0.1 lb bifenthrin	2.1–6.4 fl oz *Brigade 2EC	7	Apply every 7 days as needed. Do not exceed 0.2 lb ai/a per season.
	0.06–0.15 lb bifenthrin + imidacloprid	3.8–9.8 fl oz *Brigadier	7	Do not apply more than 25.6 fl oz/a (0.4 lb ai/a) per season. No more than 0.2 lb ai/a bifenthrin and 0.24 lb ai/a imidacloprid are allowed per season.
	clothianadin	foliar: 3.0–4.0 fl oz Belay	21	Do not apply more than 12.0 fl oz/a per season and allow at least 7 days between applications.
		soil: 9.0–12.0 fl oz Belay	—	Do not apply more than 12.0 fl oz/a per season. Apply as a narrow band centered on the plant row; as an in-furrow spray at planting; as a sidedress to both sides of the row; as a transplant water drench; or as chemigation into root zone through drip, trickle or micro-sprinkler, or similar equipment.
	0.018–0.028 lb deltamethrin	1.5–2.4 fl oz *Delta Gold	1	Apply every 5 days as needed. Do not exceed 14.4 fl oz/a.
	0.25–0.33 lb dimethoate	0.5–0.66 pt Dimethoate EC	0	
	0.045–0.268 lb dinotefuran	foliar: 1.0–4.0 oz Venom 70SG soil: 5.0–6.0 oz Venom 70SG	1	Do not follow soil applications with foliar application of any other neonicotinoid insecticide. Use only one application method. Do not apply more than 6.0 oz/a per year using foliar applications, or 12.0 oz/a per season using soil applications. See product label for application directions.
			21	
	0.5–1.0 lb endosulfan	1.0–2.0 lb Thiodan WP 0.66–1.33 qt Phaser EC	1–4	Do not exceed two applications per season.
	0.062–0.089 lb flonicamid	2.0–2.8 oz Beleaf SG	0	Begin applications before aphid populations build. Do not exceed 2.8 oz/a Beleaf per application and do not apply more than 8.4 oz/a (0.267 lb ai/a) per season.
0.01–0.015 lb gamma-cyhalothrin	2.56–3.84 oz *Proaxis	5	Apply every 5 days as needed. Do not apply more than 2.88 pt/a (0.18 lb ai/a) per season.	
imidacloprid	7.0–14.0 fl oz Admire Pro	21	Systemic at planting. Do not exceed 32.0 fl oz/a Admire per season.	
0.05 lb imidacloprid	3.75 fl oz Provado 1.6	0	Foliar spray. Do not exceed 18.75 fl oz/a Provado per season.	
imidacloprid + beta-cyfluthrin	3.8–4.1 fl oz *Leverage 360	7	Do not apply more than 12.8 fl oz/a per season and allow at least 7 days between applications.	
0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4	Reapply at intervals of 5 days or more. Do not exceed 0.18 lb ai/a per year.	

*Restricted-use pesticide.

(continued)

Pepper

Potato

Pumpkin & squash

Sweet corn

Table beet

Tomato

Insect keys

Insect control in pepper *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Green peach aphid <i>(cont.)</i>	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Voliam Xpress	5	Do not exceed a total of 31.0 fl oz/a of Voliam Xpress or 0.36 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per season.
	lambda-cyhalothrin + thiamethoxam	4.0–4.5 fl oz *Endigo ZC	5	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 5 days between applications.
Potato	0.625–1.5 lb malathion	several formulations	3	
	0.225–0.45 lb methomyl	0.75–1.5 pt *Lannate LV 0.25–0.5 lb *Lannate SP	3	
	0.5–1.0 lb oxamyl	2.0–4.0 pt *Vydate L	7	Sweet bell peppers only. Repeat at 1- to 2-week intervals or as needed.
Pumpkin & squash	0.5 lb oxydemeton-methyl	2.0 pt *Metasystox-R	3	Do not exceed two applications per season.
	pymetrozine	2.75 oz Fulfill 50WDG	14	May be used on bell, chili, cooking, and pimento peppers. Controls melon and green peach aphids. Treat when aphids first appear. May repeat in 7 days. Do not exceed 5.5 oz/a per season or more than two applications per crop.
	0.06–0.08 lb spirotetramat	4.0–5.0 fl oz Movento	1	Do not apply more than 10.0 fl oz/a (0.16 lb ai/a) per season.
Sweet corn	thiamethoxam	2.0–3.0 oz Actara WG	0	Apply before pests reach damaging levels. Repeat as needed every 5 days. Do not exceed 8.0 oz/a of product per season.
		5.0–11.0 fl oz Platinum	30	Apply as an in-furrow spray at planting or as a post-seeding transplant or hill drench. Irrigate sufficiently to move the chemical into the root zone. Use the higher rate for long residual control. Do not apply less than 5.0 fl oz/a or more than 11.0 fl oz/a of Platinum per season.
Table beet	0.198–0.257 lb thiamethoxam + chlorantraniliprole	10.0–13.0 fl oz Durivo	30	Do not exceed a total of 13.0 fl oz/a Durivo (0.257 lb ai/a) per growing season. Do not exceed 0.172 lb ai/a of thiamethoxam-containing products or 0.2 lb ai/a of chlorantraniliprole-containing products per season.
	zeta-cypermethrin	3.2–4.0 oz *Mustang Max	1	Apply every 7 days as needed. Use higher rate for heavy infestations. Do not exceed 24.0 oz/a Mustang Max per season.

*Restricted-use pesticide.

Weed control in pepper

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
All weeds	<i>Even where you use herbicides, shallow cultivation will help control weeds. Cultivate as needed when weeds are less than 2–3 inches tall.</i>			

*Restricted-use pesticide.

(continued)

Weed control in pepper *(continued)*

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Annual weeds	0.25–1.0 lb clomazone	0.67–2.67 pt Command 3ME		Do not use on banana peppers. For suppression and control of annual grasses and broadleaves, make a single preemergent soil application before seeding or transplanting, or after seeding but prior to crop emergence. Place seed or roots of transplants below the chemical barrier when planting. Strictly follow all precautions and restrictions on the label to minimize offsite movement and carryover. Read and understand the vegetable disclaimer section of the label—the end user of this product assumes all liability for failure to perform and crop injury resulting from its use.
	1.0–2.0 lb napropamide	2.0–4.0 lb Devrinol 50-DF		Apply before planting to weed-free soil surface. Incorporate 1–2 inches deep the same day. Can be applied to direct-seeded or transplanted peppers.
	0.48–1.43 lb pendimethalin	1.0–3.0 pt Prowl H ₂ O	70	Apply as a broadcast preplant-incorporated or as a broadcast surface application before transplanting, or as a post directed application to transplanted or established direct-seeded peppers. Do not apply postemergence over the top of or to pepper foliage. Rate varies by soil type. Do not exceed 3.0 pt/a per season or allow treated soil to come in contact with transplants.
	0.5–1.0 lb trifluralin	1.0–2.0 pt Treflan HFP or registered equivalent		Controls annual grasses and some broadleaf weeds, but is weak on wild mustard, smartweed, common ragweed, velvetleaf, and black nightshade. Rate varies with soil texture and organic matter. Follow recommended soil preparation, application, and incorporation procedures. Must be incorporated within 24 hours. See label for plantback restrictions. Ineffective on peat and muck soils.
Annual grasses	5.0–6.0 lb bensulide	5.0–6.0 qt Prefar 4E		Apply preplant or preemergence. Follow application and applicable incorporation instructions on label. Use on mineral soils only.
Nutsedge and some broad-leaves	0.023–0.047 lb halosulfuron	0.5–1.0 oz Sandea	30	Sandea controls several broadleaf weeds and nutsedge. It will not control grasses. Sandea may be applied between rows of direct-seeded or transplanted peppers as a directed or shielded spray. Avoid contact of the spray with the crop. If plastic was used on the planted row, adjust equipment to keep application off the plastic. Do not apply more than 2.0 oz/a per crop cycle or 12-month period. Soil or foliar applications of organophosphate insecticides to Sandea-treated crops may cause severe crop injury. Consult label for additional usage information and other precautions.
Emerged weeds	glyphosate	several manufacturers and formulations		See manufacturer's label to assure that the formulation is labeled for this crop and for specific instructions. Some formulations require a wait of 3 days between application and planting. Crop contact will result in severe injury or death. If weeds have been mowed or tilled, do not treat until they have resumed active growth and reached the recommended stage on the label. Unless otherwise stated, allow 7 or more days before tilling treated fields. Do not tank mix with soil-residual herbicides unless otherwise specified.

*Restricted-use pesticide.

(continued)

Pepper

Potato

Pumpkin & squash

Sweet corn

Table beet

Tomato

Insect keys

Weed control in pepper *(continued)*

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Emerged weeds <i>(cont.)</i>	*paraquat	several manufacturers and formulations, not all are registered for this use		Prepare seedbed early to allow for maximum weed emergence. Application can be made as a banded or broadcast treatment before, during, or after planting but before crop emergence. In preplant and preemergence (to the crop) uses, do not apply to soils lacking clay minerals (i.e., muck, pure sand). Use the higher rate for heavy weed infestations. Seeding and transplanting should be performed with minimal soil disturbance. Up to three directed/shielded treatments may be made per season using precision equipment to prevent spray contact with the crop. Always add crop oil concentrate or non-ionic surfactant to spray mixture. Follow precautions on label.
Emerged grasses	0.068–0.12 lb clethodim	9.0–16.0 oz Select Max	20	Apply to actively growing grasses. Repeat treatments may be made at 14-day intervals up to the maximum annual use rate. Do not cultivate grasses within 7 days before or after application. Include appropriate surfactant as required by product label. Do not apply if rain is expected within 1 hour.
	0.094–0.125 lb clethodim	6.0–8.0 oz Select 2EC	20	
	0.094–0.28 lb sethoxydim	0.5–1.5 pt Poast	7	Make postemergence applications to actively growing grasses within the size ranges indicated on the label. Check the label for wild proso millet and rescue treatment rates. Do not apply more than 4.5 pt/a of Poast in one crop season. Always add 2.0 pt/a of crop oil concentrate. Do not treat bell peppers during hot, humid weather or unacceptable leaf injury may occur. Check the label for additional precautions and restrictions.

*Restricted-use pesticide.

Pepper

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Tomato

Insect keys

Potato

Planting

Choose fertile, well-drained sands, sandy loams, or silt loams for best production. Prepare a deep, loose seedbed using minimum tillage. Deep tillage may be beneficial in soils with compacted layers resistant to rooting. Deep tillage should be done at an angle to planting operations to ensure straight rows. Potatoes should be planted from early April through early May on sandy soils, and from mid-April through late May in northern Wisconsin. Potatoes can be planted from late April through early July on muck soils depending on soil moisture conditions and intended market.

Potatoes should be planted when soil temperatures are similar to the pulp temperature of the seed piece (50–55°F). Temperature differences of more than 10°F between soil and seed pieces can lead to condensation on seed piece surfaces, leading to decay. In addition, soils should be near field capacity for moisture at planting. When seed pieces are planted in dry soils and then irrigated or rained upon, they're more vulnerable to decay. Sandy soils dry relatively quickly, especially when tilled and in windy conditions.

Rows: 30–36 inches.

Seed piece spacing in row: 8–16 inches apart, depending on variety and market goals. Seed pieces should be blocky and weigh 1.5–2.0 oz; use 12–24 cwt/a, depending on variety and spacing. Plant 2–6 inches deep.

Seed-piece treatment

Condition seed potatoes prior to planting. Seed potatoes should be warmed slowly to 50–55°F for several days before handling and cutting to minimize bruising. After cutting, store seed at 50–55°F for 3–4 days with good air circulation and high relative humidity to promote wound healing. Treatment of cut and whole seed pieces with a fungicide may help to reduce seed piece decay as well as tuber-borne and soil-borne problems

caused by fungi. Fungicides include formulations of captan (5.0–7.5D) and mancozeb (6.0–6.4D), and combination products containing mancozeb + fludioxonil, mancozeb + flutolanil, mancozeb + thiophanate-methyl, and mancozeb + thiophanate-methyl + cymoxanil. For seedlots where a risk of late blight infection exists, the use of the combination product containing cymoxanil should be considered. Treatment of cut seed pieces with fungicide will not, by itself, control seed piece decay caused by bacteria.

Hilling

Potatoes are generally grown in hills that are 15–20 inches across and 6–8 inches tall. Hilling prevents tubers from being exposed to sunlight and greening of tuber ends. Hilling is done at planting and sometimes again shortly after plants emerge. Delaying hilling too long after emergence can prune roots, which stresses plants and could lead to disease infection.

Irrigation

Potatoes require a constant supply of water, especially during tuber formation and growth. With some varieties, such as Russet Burbank, moisture stress not only reduces yields but can significantly lower tuber quality. To ensure good yields and tuber quality most potatoes are irrigated. If the WISP scheduling program is used, the AD for irrigated sands is 0.7 inch. The AD for silt loams is 1.5 inches. These low AD values reflect the shallow rooting system of potatoes. Research and grower experience has shown that frequent irrigation of small amounts is best. See "Irrigation Management for Vegetables" on page 3.

Lime and fertilizer

Lime: Maintain a pH of 5.2 for scab-susceptible potatoes on organic and mineral soils, 5.6 for scab-resistant varieties on organic soils, and 6.0 for scab-resistant varieties on mineral soils.

Fertilizer rates: Recommended rates are shown in the following tables. Apply amounts recommended by soil test by banding starter fertilizer with the planter (not exceeding 800 lb/a on sands) and broadcasting the remainder before seeding. Recent research on medium-textured, acid soils in northeastern Wisconsin shows response to 120–150 lb/a P₂O₅ even on soils testing more than 100 ppm soil test phosphorous (P). Sandy soils showed few responses when soil test P was higher than 75 ppm. Potassium should be broadcast in spring on highly leachable sandy and organic soils. Some row-placed starter fertilizer (30-30-30) is recommended even when soils test in the EH range.

Nitrogen: On sandy soils, apply 25–50% of the supplemental nitrogen (N) at emergence and the remainder at tuberization, or apply it in multiple split applications. During years with high precipitation, multiple split applications improve yield and quality, but during years with normal to low precipitation, splitting N applications at emergence and at tuberization consistently produces high-yielding, high-quality potatoes. Excessive N splitting may increase the percentage of cull potatoes. Late N can be applied up to 60 days after emergence. Applications after this do not improve yield or quality and may delay crop maturity. On medium to heavily textured soils, there is no advantage to splitting applications. When potatoes follow a legume crop, reduce the N recommendation by 40–190 lb/a (see table below). Take appropriate credits if manure has been used. For help determining credits, see Extension publication *Credit What You Spread—and Reap the Profits* (A3580). Broadcasting or applying N with the irrigation water, especially early in the season, results in less efficient N use because most water moves downward in the furrows, therefore the N bypasses the plant roots. Petiole nitrate (NO₃) levels can help determine the need for late N application. The table below provides optimum petiole NO₃-N levels for several varieties and stages of growth.

If levels are below optimum and the crop has at least 45 days to vine kill, apply 30–50 lb N/a. If you will be monitoring N levels through petiole $\text{NO}_3\text{-N}$ testing, early season supplemental N rates can

be reduced by 25–30%. Additional N may be applied when needed through fertigation.

Secondary nutrients and micronutrients: Calcium, magnesium, sulfur, and micronutrients should only be added

when the need is clearly indicated by soil test, plant analysis, or confirmed deficiency symptoms. Row magnesium (10 lb Mg/a) is recommended where soil test potassium (K) exceeds 140 lb/a.

Optimum petiole nitrate-nitrogen levels for several varieties at different growth stages

Stage of growth (days after emergence)	Dry weight basis (% $\text{NO}_3\text{-N}$)			Sap basis (ppm $\text{NO}_3\text{-N}$)		
	Norkotah Norland Atlantic Kennebec	Shepody R. Burbank Snowden	Onaway Superior	Norkotah Norland Atlantic Kennebec	Shepody R. Burbank Snowden	Onaway Superior
30	2.5–2.8	2.0–2.3	2.3–2.5	1900–2100	1600–1800	1800–1900
40	2.3–2.5	1.7–2.2	2.0–2.3	1800–2000	1600–1700	1600–1800
50	1.8–2.3	1.2–1.6	1.5–1.9	1400–1800	1000–1300	1200–1500
60	1.3–1.9	0.8–1.1	0.9–1.2	1100–1500	700–900	500–1000
70	0.8–1.1	0.5–0.8	0.4–0.6	700–900	500–700	400–600

Annual nitrogen, phosphate, and potash recommendations for potato^a

Yield goal (cwt/a)	Amount nitrogen to apply (lb/a)				Phosphate and potash ^b	
	Organic matter %				Amount P_2O_5 to apply (lb/a)	Amount K_2O to apply (lb/a)
	<2	2.0–9.9	10–20	>20		
250–350	145	120	100	60	10	50
351–450	180	155	130	75		
451–550	220	180	150	85		
551–650	250	210	175	95		

^a The nutrient application rates include starter fertilizer and are the total amount of nutrient to apply.

^b Amounts shown are for optimum (O) soil test levels. Apply half the listed rate plus 30 lb/a for soils testing high (H). If soils test excessively high (EH), apply only 30 lb/a. If soil test is low (L) or very low (VL), increase rates according to soil test recommendations.

Nitrogen replacement credits for previous legume crops

Legume	Credit—sandy soils	Credit—non-sandy soils
Forages^a		
Alfalfa		
poor stands (<1.5 plants/sq ft)	80 lb/a	130 lb/a
fair stands (1.5–4.0 plants/sq ft)	110 lb/a	160 lb/a
good stands (>4.0 plants/sq ft)	140 lb/a	190 lb/a
Red clover or trefoil	Use 80% of alfalfa credit	Use 80% of alfalfa credit
Soybeans	No credit	40 lb/a
Vegetable legumes	No credit	20 lb/a where residue remains on field
Green manure crops		
Sweet clover	30–60 lb/a	80–120 lb/a
Alfalfa	10–50 lb/a	60–100 lb/a
Red clover	0–30 lb/a	50–80 lb/a

^a If harvesting forage crops after September 10, reduce credit by 40 lb/a.

Color enhancement for red potatoes

Properly timed applications of 2,4-D enhance color in red potatoes, aid in storage retention of color, improve skin appearance, increase tuber set, and improve tuber size uniformity. Crop response may vary depending on variety, stress factor, and local conditions. For example, Dark Red Norland has minimal response to 2,4-D while Red Norland turns darker and holds its color. Make first application when potatoes are in the prebud stage (about 7–10 inches high) and make a second application about 10–14 days later. Allow 45 days to harvest. **Only certain 2,4-D products are labeled for this use in Wisconsin.**

Tuber shape

The shape of potato tubers can be improved with the application of maleic hydrazide (Royal MH-30). While maleic hydrazide may reduce total yield, it should increase the marketable yield. Apply at least 2 weeks before vine desiccation. However, typical applications are made around the first week of August, when tubers are 1.5–2.0 inches in diameter. Optimal timing will vary depending on variety. Avoid making applications during hot, dry weather to minimize the potential for phytotoxicity.

Potato vine killing

Apply 3.2 qt/a of Defol 750 (sodium chlorate) mixed with a non-ionic surfactant in 10–20 gal water/a for ground application or 5–10 gal water/a via air 10 days before harvest. Do not mix with insecticides or other organic materials because of a potential fire and explosion hazard. Do not spray if rain is anticipated within 24 hours. Fully mature vines will die back fastest if clear, calm, sunny days with high temperature and humidity follow application. Crops under stress, incomplete coverage, and cool temperatures can yield slow or erratic results.

Diquat (multiple trade names) with a suggested surfactant kills potato vines adequately. Apply at least 7 days before harvest. Three weeks between vine killing

and harvest is recommended. Where vine growth is dense, make a second application at the same rate. Allow a minimum of 5 days between applications. Do not apply Diquat to drought-stressed potatoes. Do not feed vines treated with Diquat to livestock.

Vida (pyraflufen ethyl) is labeled for vine desiccation in Wisconsin. When applied to potatoes in the early stages of senescence, it will hasten desiccation of potato vines and foliage as well as burn down late-season broadleaf weeds. Make one or two applications of 2.75–5.5 oz/a in 20–50 gal/a. Do not apply within 7 days of harvest. Vines are typically dried within 14 days after the first treatment. Two applications are allowed, but do not exceed 11.0 oz/a per crop season. Use an approved agricultural buffering agent buffering to pH 5.0 or less if using Vida in a water source of pH 5.0 or greater. Always buffer the water source before adding Vida to the spray tank.

Selected formulations of paraquat are also registered as vine dessiccants for fresh market potatoes only; do not use on seed or stored potatoes. Directions are generally the same as for diquat, except the preharvest interval is often only 3 days. As with diquat, two split applications made 5 days apart usually give better results than a single treatment. Not all paraquat formulations are registered for this use. Restricted use pesticide.

Rely (glufosinate-ammonium) is another nonselective, broad-spectrum herbicide labeled as a potato desiccant. Make a single application in 20–100 gallons of water if applying with ground equipment or in 5–10 gallons of water if applying by air. Where the crop canopy is dense, use higher spray volumes for best results. Wait at least 9 days following application before harvesting. Do not use on potatoes grown for seed stock. See label for rotation restrictions.

Aim EW can be used alone or in combination with other herbicides (if allowed by the tank-mix partner label) to desiccate potatoes. Apply Aim EW as a broadcast spray at a rate of 3.2–5.8 oz/a product (0.05–0.09 lb ai/a) with an appropriate spray adjuvant in a spray volume sufficient for complete potato foliage

coverage. Thorough coverage is essential. Aim can be applied to potato foliage in the later stages of senescence. If plants are still actively growing, two applications may be required to adequately kill leaves and stems. Wait 7–14 days after the first application before making a second treatment. Allow at least 7 days before harvest. See the Aim EW label for specific application and adjuvant instructions and restrictions.

Harvest

To reduce the chances of tuber infection by early and late blight fungi, do not begin digging until vines are dead either from a vine burner, a chemical vine killer, or frost. Vines should be killed 14–21 days before harvest. (Do not use TPTH fungicides within 21 days of harvest.) This interval allows proper maturity and skin set. Allowing tubers to remain in the soil for several weeks after vines are dead increases the risk of silver scurf, a disease that affects the visual appearance and storability of infected tubers.

Avoid bruising or injuring tubers during harvesting, grading, packaging, and storing. Tuber breakdown organisms generally start where there is a bruise or other mechanical injury.

Proper operation of windrowing and harvesting equipment will minimize tuber damage, especially bruising. Harvester chain and boom drops should be 6 inches or less. Harvester blade angle should cause potatoes to flow onto primary chain. Adjust ground and chain speeds to keep chains as full of potatoes as possible without rollback. All loads of potatoes should be covered during transport from field to grading–storing locations.

Early-maturing potatoes should not be harvested in hot, windy conditions because of increased potential for breakdown. For late-maturing varieties, harvest when soil temperatures are 45–65°F. At colder temperatures, tubers are more susceptible to black spot bruising; higher temperatures increase tuber water loss and may promote development of pressure bruising.

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Storage

Storage management

Do not store injured, diseased, or immature potatoes. Do not wash potatoes before storage unless they are sound and disease-free. All washed potatoes must be completely dried before storage. When loading bins, allow several feet between the top of the pile and ceiling for adequate air circulation.

Before storage

Remove old refuse and potatoes from storage. Spray inside surfaces of storage with a quaternary ammonium compound or another disinfectant. Except for seed storage, rinse surfaces with clean water after ammonium treatment.

Make sure ventilation system is in proper operation and that insulation and vapor barriers are properly maintained. One week before storage, open doors at night and close them during the day to cool the storage space. Operate air systems and humidifiers in preparation for harvest. The floors can be watered to build up humidity.

Storage operation

Storage operation is divided into three stages: curing, holding, and removal.

1) Curing. Curing promotes suberization (healing of bruises, cuts, and skinned surfaces). Curing takes place over 2–4 weeks immediately after harvest. Cure potatoes at 50–55°F and a relative humidity of 90–95°F. Tubers that are stressed from disease or are excessively wet can be cured at 85% relative humidity, but the lower humidity levels will increase the potential for pressure bruising.

2) Holding. Long-term storage temperatures are based on intended use: 38–40°F for seed and table stocks, 42–47°F for frozen and dehydration stocks and for cultivars used for both table and processing, 50°F for chipping stock and potatoes stored 3 months or less.

Slowly lower storage temperature 1° per 5–7 days, to prevent reducing sugar accumulation. Relative humidity should be 90–95% unless potatoes are damaged by rot, frost, or late blight. Ventilating airflow rates of 0.5–0.8 cfm/cwt should prevent excessive moisture loss and pressure bruising.

Monitor temperatures. Temperatures at the top of the pile should be 1.0–1.5°F higher than the temperature at the bottom of the pile. If temperatures are the same, too much air is moving through the pile.

Monitor relative humidity. At high relative humidities, a drop in outside temperature can cause condensation at the ceiling. This can wet the potatoes and increase the potential for tuber breakdown by soft rot bacteria.

Long-term storage of potatoes will require use of a sprout inhibitor. Sprout inhibitors can be applied either in the field (MH-30 during the growing season) or in storage (such as CPIC) after curing has been completed.

3) Removal. Before removing potatoes, storage should be warmed to 55–65°F for 2–3 weeks. This is essential for reconditioning potatoes for quality chips and french fries. Warming also reduces the possibility of tuber injury. Cold tubers are easily bruised.

Disease control—late blight

Late blight appears periodically in Wisconsin when cool, wet conditions prevail and the disease inoculum is present. From 1996 to 2002, the US#8 genotype was the only pathogen genotype observed in Wisconsin. In 2009, the US#22 genotype was present and responsible for disease on tomato and potato. In 2010 and 2011, US#22 was again present along with some US#23 and US#24 genotypes on tomato and potato. US#22 can be controlled with mefenoxam-containing fungicides. Mefenoxam does not control the US#8, 23, or 24 genotypes. Protective fungicides (chlorothalonil, mancozeb, metiram, fixed coppers, and triphenyltin hydroxide) used before infection, give much better control of late blight and also control early blight. Because several genotypes of the late blight fungus currently exist in the United States, we urge growers observing late blight on seed potatoes or in production fields to submit samples for genotype analysis to the Vegetable Pathology Laboratory, Department of Plant Pathology, 693 Russell Laboratories, UW–Madison, Madison, WI 53706, phone 608-890-3072. Knowing the genotype of the late blight fungus helps with long-term management.

Research has shown that temperature, relative humidity, and rainfall or irrigation play an important role in determining when or if late blight appears, and the timing of influxes in airborne spores of the early blight fungus. A computer program, WISDOM, is available from the UW-Extension to warn growers of the potential development of early and late blight. The programs recommend a schedule of fungicide applications to prevent or control these diseases. For further details, contact the Department of Plant Pathology, UW–Madison, Madison, WI 53706.

Disease control in potato

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Black dot	azoxystrobin	6.0–15.5 fl oz Quadris Flowable	14	Quadris and Headline belong to the Group 11 (strobilurin) fungicide category. Quadris Opti contains a combination of Group 11 and Group M fungicides. Do not exceed one application of a Group 11 fungicide before alternating with a fungicide having a different mode of action.
	azoxystrobin + chlorothalonil	1.6 pt Quadris Opti	14	
	azoxystrobin + difenoconazole	8.0–14.0 fl oz Quadris Top	14	
	pyraclostrobin	6.0–9.0 fl oz Headline SC, EC	3	
	fluopyram + pyrimethanil	11.2 fl oz Luna Tranquility (for suppression)	7	Begin fungicide applications preventatively. Do not apply more than 43.6 fl oz/a per season. Do not make more than two sequential applications of any Group 7 or 9 fungicide before rotating with a fungicide from a different group.
	flutolanil	0.71–1.1 lb Moncut 70DF	in-furrow, at-plant treatment	Direct spray uniformly around and over seed piece in a 4- to 8-inch band prior to covering with soil.
	fluxapyroxad + pyraclostrobin	4.0–8.0 fl oz Priaxor	7	Make no more than three applications/a per season. Apply no more than 24.0 fl oz/a per season.
	metconazole	2.5–4.0 oz Quash	1	Do not make more than four applications per season. Do not make more than two sequential applications. Do not apply more than 16.0 oz/a per season.
	penthiopyrad	10.0–24.0 fl oz Vertisan	7	Do not exceed 72.0 fl oz/a per year. Make no more than two sequential applications of Vertisan before switching to a fungicide with a different mode of action.
pyraclostrobin + metiram	2.0–2.9 lb Cabrio Plus	3	Do not make more than two sequential applications before alternating to a non-Group 11 or M3 fungicide.	
Black leg	0.5% calcium or sodium hypochlorite	Hilex Clorox 1 gal Lysol 50%/10 gal water		Disinfect machinery, warehouse, planters, and seed cutters.
	formaldehyde	4 cups 40% solution/10 gal water		
	phenol	1–3% solution		
Early blight (<i>Alternaria solani</i>) and brown spot (<i>Alternaria alternata</i>)	fluopyram + pyrimethanil	<i>early blight</i> : 11.2 fl oz Luna Tranquility	7	Begin fungicide applications preventatively. Do not apply more than 43.6 fl oz/a per season. Do not make more than two sequential applications of any Group 7 or 9 fungicide before rotating with a fungicide from a different group.
	fluxapyroxad + pyraclostrobin	4.0–8.0 fl oz Priaxor	7	
	metconazole	2.5–4.0 oz Quash	1	
	penthiopyrad	10.0–24.0 fl oz Vertisan	7	

*Restricted-use pesticide.

(continued)

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Disease control in potato (continued)

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Early blight and late blight	azoxystrobin	6.0–15.5 fl oz Quadris Flowable	14	Evito, Gem, Headline, Quadris, Reason, and Tanos belong to the Group 11 (strobilurin) fungicide category. Quadris Opti contains a combination of Groups 11 and M5 fungicides. Do not exceed one application of any of these products before alternating with a fungicide having a different mode of action. Tanos must be tank mixed with a contact fungicide having a different mode of action. Following the final application of Reason 500 SC, wait 30 days before rotating to wheat; wait 1 year before rotating to all other crops. Use higher rates and shorter intervals when disease pressure is severe. For control of early blight only. Endura belongs to the Group 7 fungicide category. Do not exceed two sequential applications of Endura before alternating to a labeled fungicide with a different mode of action. Do not exceed four applications per season. Do not exceed 20.5 oz/a Endura per season. Note seasonal use limitations on label. Current labeling for annual use of chlorothalonil products in Wisconsin allows 11.2 lb ai/a Equus products and 16.0 lb ai/a Bravo products (Ultrex, WeatherStik, Zn)—special WI registration expires 12/31/12; and 16.0 lb ai/a Echo products (720 and Zn)—special WI registration expires 12/31/14. Gives fair control of early blight and good control of late blight. Can be tank mixed with mancozeb, or chlorothalonil for broad-spectrum disease control. Tank mixing with insecticides such as Monitor may reduce effectiveness of the insecticide.
	azoxystrobin + chlorothalonil	1.6 pt Quadris Opti	14	
azoxystrobin + difenoconazole	8.0–14.0 fl oz Quadris Top	14		
cymoxanil + famoxadone	<i>early blight</i> : 6.0 oz Tanos 50DF <i>late blight</i> : 6.0–8.0 oz Tanos 50DF	14 14		
fenamidone	5.5–8.2 fl oz Reason 500 SC	14		
fluoxastrobin	2.0–3.8 fl oz Aftershock, Evito 480 SC	7		
pyraclostrobin	<i>early blight</i> : 6.0–9.0 fl oz Headline SC, EC <i>late blight</i> : 6.0–12.0 fl oz Headline SC, EC	3 3		
pyraclostrobin + metiram	2.9 lb Cabrio Plus	3		
boscalid	2.5–4.5 oz Endura WDG	10		
chlorothalonil	1.0–1.5 pt Bravo Weather Stik, Echo 720, Equus 720	7		
	0.9–1.36 lb Bravo Ultrex 82.5WDG, Equus DF	7		
	1.5–2.25 pt Bravo Zn, Equus 500 Zn	7		
	0.875–1.25 lb Echo 90DF, Echo Zn	7		
copper hydroxide	0.66–2.66 pt Champ Formula 2	0		
	1.0–4.0 lb Champion 77WP	0		
	1.0–4.0 lb Kocide 101, DF	0		
	1.3–5.3 pt Kocide LF	0		
	0.67–2.67 pt Kocide 4.5 LF	0		
	0.75–3.0 lb Kocide 2000 DF 0.5–1.75 lb Kocide 3000	0 0		
cymoxanil	3.2 oz Curzate 60DF	14		

*Restricted-use pesticide.

(continued)

Disease control in potato *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Early blight and late blight <i>(cont.)</i>	mancozeb	1.0–2.0 lb Dithane 75DF	3	Do not exceed a total of 11.2 lb ai/a EBDC per growing season. EBDC materials include maneb, mancozeb, and metiram.
		Rainshield NT, Koverall	3	
		0.4–1.6 qt Dithane F45 4F	3	
		1.0–2.0 lb Manzate 200 75DF	3	
		0.5–2.0 lb Dithane M45, Penncozeb 80WP, 75DF	3	
	mandipropamid/difenoconazole	5.5–7.0 fl oz Revus Top	14	Make no more than two consecutive applications before switching to a non-Group 40/3 fungicide. Do not exceed 28.0 fl oz/a Revus Top per season. The addition of a spreading/penetrating type adjuvant, such as non-ionic surfactant, is recommended.
	pyrimethanil	7.0 fl oz Scala SC in combination with broad spectrum fungicide	7	Scala belongs to the Group 9 fungicide category and controls only early blight. If used alone, Scala does not control late blight. Use the 7.0 fl oz/a rate of Scala only in a tank mix with a broad-spectrum fungicide. Alternating the tank-mix combination with a broad-spectrum fungicide is a resistance management strategy.
	trifloxystrobin	<i>early blight:</i> 2.9–3.8 fl oz Gem 500 SC <i>late blight:</i> 3.8 fl oz Gem 500 SC tank mixed with a registered protectant fungicide	7	
			7	
	triphenyltin hydroxide (TPTH)	4.0–6.0 fl oz *Super Tin 4L 2.5–3.75 oz *Super Tin 80WP 2.5–3.75 oz *Agri Tin 80WP	7	Do not exceed 18.0 fl oz/a Super Tin 4L, 11.25 oz/a Super Tin 80WP, or 11.5 oz/a Agri Tin 80WP per season. Combination of TPTH fungicides with MH-30 and some emulsifiable concentrate insecticides can cause serious crop injury. High rates may injure foliage of sensitive varieties such as Superior and Norland. Observe 24-hour field re-entry period as specified on label. Note label information regarding mixing, loading, and application.
7				
7				
triphenyltin hydroxide (TPTH) plus mancozeb or metiram	3.0 fl oz *Super Tin 4L or 1.87 oz *Super Tin 80WP or 1.87 oz *Agri Tin 80WP plus one of the following: 1.5 lb Dithane M45 80WP, 75DF, WSP or 1.2 qt Manex F4 or 1.5 lb Manzate 200 75DF or 1.5 lb Penncozeb 80WP, 75DF or 1.5 lb Polyram 80DF	7	Combining TPTH with maneb, mancozeb, or metiram reduces foliage injury while providing improved control of early blight. See comments on TPTH above. Do not exceed a total of 11.2 lb ai/a EBDC per growing season. EBDC materials include maneb, mancozeb, and metiram.	
		7		
		7		
		7		
zoxamide + mancozeb	1.5–2.0 lb Gavel 75DFp	3	Begin treatment before the onset of late blight. This product contains mancozeb, an active ingredient of EBDC. If using other EBDC-containing fungicides, do not exceed 11.2 lb ai/a EBDC per growing season. Do not make more than six applications per season or exceed 12.0 lb/a of Gavel 75DF.	

*Restricted-use pesticide.

(continued)

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Potato

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Disease control in potato *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Early dying complex	<i>A soil test to determine the presence of Verticillium and/or nematodes is recommended prior to treatment since other agents that are not controlled by soil fumigation may cause early senescence of a potato crop. If Verticillium propagules, root lesion nematodes, or root knot nematodes are present in significant numbers, treatment with a soil fumigant may provide acceptable disease control.</i>			
	metam-sodium	50 gal Vapam HL, Metam, Sectagon 42		<p>Knife into plow layer of soil at a rate of 50.0 gal/a or on sandy soils only apply through the irrigation system in 0.6–1.0 inch water in the fall. An approved backflow prevention valve must be used when applying fumigant through irrigation system. Do not apply if significant rainfall is forecast in the next 24 hours. Fields must be monitored during and after application.</p> <p>Soil temperature must be below 75°F. Treatment should not be applied immediately following a potato crop. Potato vine debris should be decomposed at the time of fumigant application for best results. A 2- to 3-year rotation between potato crops is recommended.</p> <p>Fumigant cannot be applied through an irrigation system within 1/4 mile of an institution such as a hospital, school, or prison.</p>
Fusarium	cymoxanil + mancozeb + thiophanate-methyl	0.75 lb Evolve/100 lb seed pieces	seed treatment	Thoroughly cover seed pieces with treatment mixture.
	fludioxonil	0.08–0.16 fl oz Maxim 4FS/100 lb seed potatoes	seed treatment	If applied to potatoes being grown for seed, either a labeled rate of mancozeb or an in-furrow application of Quadris (azoxystrobin) at 0.40 fl oz/1,000 ft row must be applied after Maxim 4FS.
	fludioxonil + mancozeb	0.5 lb Maxim MZ/100 lb seed pieces	seed treatment	Apply using equipment that ensures uniform and thorough coverage of each seed piece.
	flutolanil + mancozeb	0.75–1.0 lb MonCoat MZ/100 lb cut seed pieces	seed treatment	Apply immediately after seed cutting for thorough coverage of dust to the cut seed piece surfaces.
	penflufen + prothioconazole	0.31 fl oz Emesto Silver/100 lb seed pieces	seed dressing applied at-plant	Do not apply more than 2.5 fl oz of slurry treatment/100 lb seed pieces. Application of an inert absorbent ingredient is recommended to improve suberization.
	thiabendazole	0.42 fl oz Mertect 340-F/2000 lb of tuber		Mist unwashed tubers entering storage with 0.42 fl oz Mertect 340-F per 2000 lb of tubers in sufficient water for complete coverage. Additional treatment may be made before shipping by misting the tubers at the same rate or dipping the tubers for 20 seconds in a solution containing 0.42 fl oz of Mertect per gallon of water. Do not treat seed potatoes after cutting.
Late blight	cyazofamid	1.4–2.75 fl oz Ranman 400SC	7	Do not apply more than 10 sprays or 27.5 fl oz/a per year. Alternate Ranman (Group 21) sprays with a fungicide having a different mode of action. Crops not listed on the label should not be planted within 30 days after the last application.

*Restricted-use pesticide.

(continued)

Disease control in potato *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Late blight <i>(cont.)</i>	cymoxanil + mancozeb + thiophanate-methyl	0.75 lb Evolve/100 lb seed pieces	seed treatment	Thoroughly cover seed pieces with treatment mixture.
	dimethomorph	6.0 oz Forum	4	Begin treatment before the onset of late blight. Forum should be used as a tank mix with other protectant fungicides, but do not mix with mfenoxam or metalaxyl. Adjust rates and timing according to late blight conditions. Do not exceed 30.0 oz/a of product per season. Consult the label for rotational crop restrictions. May be used after vine kill for control of late blight tuber infection.
	fluazinam	5.5 fl oz Omega 500F	14	Application should begin prior to onset of disease. Do not apply more than 3.5 pt/a per season. Tank mix with other fungicides such as chlorothalonil, maneb, or mancozeb. REI = 4 days for high-exposure activities.
	fludioxonil + mancozeb	0.5 lb Maxim MZ/100 lb seed pieces	seed treatment	Apply using equipment that ensures uniform and thorough coverage of each seed piece.
	fluopicolide	4.0 fl oz Presidio	7	Presidio must be tank mixed with a labeled rate of another fungicide that is active against the target pathogen but has a different mode of action.
	flutolanil + mancozeb	0.75–1.0 lb MonCoat MZ/100 lb cut seed pieces	seed treatment	Apply immediately after seed cutting for thorough coverage of dust to the cut seed piece surfaces.
	propamocarb hydrochloride	0.7–1.2 pt Previcur Flex	14	Begin treatment before the onset of late blight. Tank mix with other fungicides such as chlorothalonil, maneb, or mancozeb. Adjust rates and timing according to late blight conditions. Do not exceed 6 pt/a of Previcur Flex per season.
Rhizoctonia	azoxystrobin	0.4–0.8 fl oz Quadris Flowable/1,000 ft row	—	Apply in-furrow at planting.
	fludioxonil	0.08–0.16 fl oz Maxim 4FS/100 lb seed potatoes	seed treatment	If applied to potatoes being grown for seed, either a labeled rate of mancozeb or an in-furrow application of Quadris (azoxystrobin) at 0.40 fl oz/1,000 ft row must be applied after Maxim 4FS.
	fludioxonil + mancozeb	0.5 lb Maxim MZ/100 lb seed pieces	seed treatment	Apply using equipment that ensures uniform and thorough coverage of each seed piece.
	flutolanil	0.71–1.1 lb Moncut 70DF	in-furrow, at-plant treatment	Direct spray uniformly around and over seed piece in a 4- to 8-inch band prior to covering with soil.
	flutolanil + mancozeb	0.75–1.0 lb MonCoat MZ/100 lb cut seed pieces	seed treatment	Apply immediately after seed cutting for thorough coverage of dust to the cut seed piece surfaces.
	PCNB (pentachloro-nitrobenzene)	1.65 lb Blocker 10 G/1,000 ft row	45	Direct 8.5-inch band into the furrow over the seed and cover as part of the hilling operation at planting.
	penthiopyrad	10.0–24.0 fl oz Vertisan	7	Do not exceed 72.0 fl oz/a per year. Make no more than two sequential applications of Vertisan before switching to a fungicide with a different mode of action.

*Restricted-use pesticide.

(continued)

Pepper

Potato

Pumpkin & squash

Sweet corn

Table beet

Tomato

Insect keys

Disease control in potato (continued)

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Rhizoctonia (cont.)	pyraclostrobin	0.4–0.8 fl oz Headline SC/1,000 ft row	—	Apply in-furrow at planting.
Root lesion and root knot nematodes	metam-sodium	Vapam HL, Metam, Sectagon 42		Generally double mineral soil rates for muck soils. More effective when soils are warmer than 55°F. A minimum of 3 weeks is necessary between fumigation and planting to prevent phytotoxicity.
Scab	<i>Grow scab-resistant varieties. Maintain pH between 5.2–5.8, plow down cover crops, maintain adequate soil moisture especially during tuber initiation and early growth. Early season stress favors scab.</i>			
Silver scurf (<i>Helminthosporium solani</i>) and black scurf (<i>Rhizoctonia solani</i>)	azoxystrobin	0.4–0.8 fl oz Quadris Flowable/1,000 ft row	0	Apply at planting just before covering seedpieces with soil. Application of Quadris at planting does not appear to control early blight or late blight on the foliage later in the season. Do not exceed 2.88 qt/a Quadris per season.
	cymoxanil + mancozeb + thiophanate-methyl	0.75 lb Evolve/100 lb seed pieces	seed treatment	Thoroughly cover seed pieces with treatment mixture.
	fludioxonil	0.08–0.16 fl oz Maxim 4FS/100 lb seed potatoes	seed treatment	If applied to potatoes being grown for seed, either a labeled rate of mancozeb or an in-furrow application of Quadris (azoxystrobin) at 0.40 fl oz/1,000 ft row must be applied after Maxim 4FS.
	fludioxonil + mancozeb	0.5 lb Maxim MZ/100 lb seed pieces	seed treatment	Apply using equipment that ensures uniform and thorough coverage of each seed piece.
	flutolanil + mancozeb	0.75–1.0 lb MonCoat MZ/100 lb cut seed pieces	seed treatment	Apply immediately after seed cutting for thorough coverage of dust to the cut seed piece surfaces.
	penflufen + prothioconazole	0.31 fl oz Emesto Silver/100 lb seed pieces	seed dressing applied at-plant	Do not apply more than 2.5 fl oz of slurry treatment/100 lb seed pieces. Application of an inert absorbent ingredient is recommended to improve suberization.
Tuber rot, pythium leak, and pink rot	cyazofamid	<i>at planting:</i> 0.42 fl oz Ranman/1,000 ft row (6.1 fl oz/a on 36-inch row spacing) <i>lay-by hilling:</i> 2.75 fl oz Ranman		Do not use reduced rates as incomplete control can promote resistance.
	fluopicolide	4.0 fl oz Presidio	7	For pink rot control. Can be applied in-furrow in 5–10 gal/acre spray mixture OR can be applied as a sidedress in 20–40 gal/a spray mixture.
	mefenoxam	0.42 oz Ridomil Gold SL/1,000 ft row at planting 0.84 fl oz Ultra Flourish/1,000 ft row at planting	—	Mix Ridomil Gold SL or Ultra Flourish in a minimum of 3 gal/a of water and apply in a 6- to 8-inch band over the potato seedpiece at planting.
	mefenoxam + chlorothalonil	2.5 pt Ridomil Gold Bravo	14	A total of up to three applications at 14-day intervals may be made beginning at flowering.
	mefenoxam + copper hydroxide	2.0 lb Ridomil Gold Copper	14	
	mefenoxam + mancozeb	2.5 lb Ridomil Gold MZ	3	

*Restricted-use pesticide.

(continued)

Disease control in potato *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Tuber rot, pythium leak, and pink rot <i>(cont.)</i>	phosphorous acid	<i>foliar:</i> 2.5–10.0 pt Phostrol <i>in-furrow:</i> 3.75–10.0 pt Phostrol <i>postharvest:</i> 0.1 gal Phostrol in 0.5 gal water/1 ton tubers	0	For control of pink rot, late blight, and Pythium leak. First foliar treatment should begin at tuber initiation at the 10 pt/a rate, followed by a second and third application timed 2 weeks apart. Use adequate spray mixture volumes when applying to avoid phytotoxicity. In-furrow application aids in control of pink rot, late blight, and Pythium leak. Postharvest application can limit advancement and spread of pink rot, late blight, and Pythium leak. Use adequate spray mixture volumes when applying to avoid tuber damage.
	White mold <i>(Sclerotinia sclerotiorum)</i>	boscalid	5.5–10.0 oz Endura WDG	30
	fluazinam	5.5–8.0 fl oz Omega 500F	14	Application should begin prior to onset of disease. Do not apply more than 3.5 pt/a per season. Tank mix with other fungicides such as chlorothalonil, maneb, or mancozeb.
	iprodione	2.0 lb Rovral 50WP	14	Treat when warm, wet weather conditions favor disease development. Up to four applications at 7- to 10-day intervals may be made. Note crop rotation information on label. All crops on the Rovral label may be grown after treated potatoes. Root crops, cereal grains, soybeans, and tomatoes may be grown the year following treated potatoes.
		2.0 pt Rovral 4F, Iprodione 4L, Nevado 4F	14	
	metconazole	4.0 oz Quash	1	Make first application prior to infection at row closure and 14 days later if conditions promote disease. Do not make more than four applications per season. Do not make more than two sequential applications. Do not apply more than 16.0 oz/a per season.
	thiophanate-methyl	1.0–1.5 lb Topsin M WSB, 70 WP	21	Make first application just before row closure. Subsequent applications may be made at 7- to 14-day intervals if conditions warrant. Application at peak bloom provides best control. Do not apply more than 4.0 lb/a Topsin M WSB or 80.0 fl oz/a Topsin 4.5FL per season.
		20.0–30.0 fl oz Topsin 4.5FL	21	

*Restricted-use pesticide.

Pepper

Potato

Pumpkin & squash

Sweet corn

Table beet

Tomato

Insect keys

Scouting calendar for insect pests of potato

	April			May			June			July			August			September		
	early	mid	late	early	mid	late	early	mid	late	early	mid	late	early	mid	late	early	mid	late
Pepper	Aster leafhopper																	
	Colorado potato beetle, 1st gen. only						both generations			2nd generation only								
	Potato leafhopper																	
	Potato aphid																	
	Tarnished plant bug																	
Potato	Green peach aphid																	

Insect control in potato

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Pumpkin & squash	<i>Aphid, leafhopper, flea beetle, Colorado potato beetle:</i>			
	0.1–0.2 lb clothianadin	7.2–12.0 fl oz Belay	—	Apply specified rate in sufficient carrier volume to ensure uniform coverage and incorporate into soil using either (1) narrow-band application centered over the plant row, (2) direct, in-furrow spray on the seed pieces, or (3) sidedress to both sides of the row or as directed spray at ground-cracking over the row. Cover immediately with soil.
	0.2–0.3 lb imidacloprid	5.7–8.7 fl oz Admire Pro	21	Apply as band below seed furrow within 7 days before planting or spray in furrow at planting. Use higher rate on muck soils or for seed production. Do not exceed 8.7 fl oz/a per season.
Sweet corn	<i>Aphid, leafhopper, flea beetle, and suppression of Colorado potato beetle:</i>			
	<i>broadcast rate:</i> 2.0–3.0 lb phorate	<i>banded rate:</i> heavy soil—17.3 oz *Thimet 20G, *Phorate 20G	90	Apply as band in furrow at planting or apply sidedress postemergence at hilling; do not use both. Use the lower rate only on sandy soils and for all emergence applications.
	<i>banded rate:</i> heavy soil—0.22 lb/1,000 ft row light soil—0.14 lb/1,000 ft row	light soil—11.3 oz *Thimet 20G, *Phorate 20G		
thiamethoxam	5.0–8.0 fl oz Platinum 0.11–0.16 fl oz Cruiser FS/100 lb seed pieces	30 30	For best results, spray directly on seed pieces. Or apply as an in-furrow spray at planting or at crop emergence. Irrigate within 24 hours of application to move chemical into the root zone. For Platinum, do not apply less than 5.0 oz/a or more than 8.0 oz/a per season. For Cruiser FS, do not exceed 4.0 fl oz/100 lb seed.	
Table beet	<i>Seed piece treatment</i>			
	<i>Use a seed dusting metering applicator to assure thorough coverage. Plant seed pieces as soon as possible after treatment.</i>			
Tomato	clothianadin	0.4–0.6 fl oz Belay/100 lb cut seed pieces	—	Apply as a diluted spray to ensure uniform coverage over whole or cut seed pieces. Liquid fungicides can be applied with Belay. If using a dust formulation of fungicide, apply Belay first, then the dust application. Plant seed as soon as possible after treatment. Do not use treated seed pieces as food, feed, or fodder. Do not apply a neonicotinoid (MoA Class 4) compound following Belay seed treatment.

*Restricted-use pesticide.

(continued)

Insect control in potato *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Seed piece treatment <i>(cont.)</i>	imidacloprid + thiophanate-methyl + zinc + manganese	0.75–1.0 lb Tops-MZ-Gaucho/100 lb cut seed pieces		Regardless of the type of application, do not exceed 0.31 lb ai/a imidacloprid (Admire or Provado) per year. There is a 12-month rotational plantback interval for all crops except those registered.
Colorado potato beetle	<i>Need for control is based on percent defoliation at different plant growth stages. When plants are 6–8 inches tall and pre-flowering, plants can have 20–30% defoliation by Colorado potato beetle adults and larvae before plants should be treated. Flowering plants can have only 5–10% defoliation while tuber-forming plants can withstand up to 30% defoliation before control is needed.</i>			
	<i>Apply treatments for first-generation larval control at 240–250 DD₅₂ to target third instar larvae. Use spot treatments when appropriate; beetles are often clustered near field edges. Treat adults in mid-July if needed based on percent defoliation and plant growth stage.</i>			
	Note: A high proportion of populations are resistant to pyrethroid insecticides. Do not use esfenvalerate or permethrin if resistance is suspected.			
	abamectin	8.0–16.0 fl oz Agrimek	14	Target first-generation larvae.
	acetamiprid	1.5–4.0 fl oz Assail 30 SG	7	For heavy pest pressure, use higher label rates. Do not make more than four applications or exceed 0.3 lb ai/a per season. Do not apply more than once every 7 days.
		0.6–1.7 fl oz Assail 70WP	7	
	<i>Bacillus thuringiensis subsp. tenebrionis</i>	Raven	0	Make initial spray when you first observe eggs and small larvae. Rates vary with formulation.
	0.0125–0.022 lb beta-cyfluthrin	1.6–2.8 fl oz *Baythroid XL	0	Apply every 5 days as needed. Do not exceed six applications per year. Do not exceed 0.125 lb ai/a cyfluthrin including Baythroid and Leverage 360.
	0.075–0.096 lb bifenthrin + imidacloprid	4.8–6.14 fl oz *Brigadier	21	Do not apply more than 25.6 fl oz/a (0.4 lb ai/a) per season. No more than 0.5 lb ai/a bifenthrin and 0.2 lb ai/a imidacloprid are allowed per season.
	0.045–0.065 lb chlorantraniliprole	3.5–5.0 fl oz Coragen	14	Minimum interval between treatments is 5 days. Do not apply more than 15.4 fl oz/a Coragen per crop season. Do not apply more than 9.0 oz/a (0.2 lb ai/a) per season.
	0.03–0.05 lb clothianadin	1.9–2.8 fl oz Belay	14	Do not exceed three applications of Belay. Allow at least 7 days between applications. Do not make a foliar application of Belay following an at-plant application of a neonicotinoid (MoA Class 4) compound.
	0.12–0.24 lb cyromazine	2.66–5.32 oz Trigard 75WP	7	Do not apply more than 1.0 lb/a Trigard per crop. Repeat applications 7 days apart.
	0.018–0.028 lb deltamethrin	1.5–2.4 oz *Delta Gold	3	Apply every 3 days as needed.
	0.05–0.33 lb dinotefuran	<i>foliar:</i> 1.0–1.5 oz Venom 70SG <i>soil:</i> 6.5–7.5 oz Venom 70SG	7 —	Do not follow soil applications with foliar application of any other neonicotinoid insecticide. Use only one application method. Do not apply more than 4.5 oz/a per year using foliar applications, or 7.5 oz/a per season using soil applications. See product label for application directions.
	0.05–0.07 lb dinotefuran (<i>foliar</i>)	2.0–2.75 oz Scorpion 35SL	7	Can repeat at 14-day intervals. Do not apply more than 7.75 oz per year. Use only one application method.
	0.28–0.33 lb dinotefuran (<i>soil</i>)	11.0–13.0 oz Scorpion 35SL		Do not apply more than 13.0 oz per year. Apply either as a preplant, preemergence, or at ground crack. Do not follow soil applications with foliar applications; use only one application method.

*Restricted-use pesticide.

(continued)

Pepper

Potato

Pumpkin & squash

Sweet corn

Table beet

Tomato

Insect keys

Insect control in potato *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Colorado potato beetle <i>(cont.)</i>	0.5–1.0 lb endosulfan	0.66–1.33 qt Thiodan EC, Phaser EC 1.0–2.0 lb Thiodan WP	1	Do not exceed six applications per season.
	0.025–0.05 lb esfenvalerate	5.8–9.6 fl oz *Asana XL	7	Do not exceed 0.35 lb ai/a per season. CPB has developed resistance in some areas.
	0.047 lb imidacloprid	3.75 fl oz Provado 1.6	7	Foliar application: Use ground equipment only. Allow at least 7 days between applications. Regardless of the type of application, do not exceed 0.31 lb ai/a imidacloprid (Admire, Leverage 360, or Provado) per year. There is a 12-month rotational plantback interval for all crops except those registered.
	imidacloprid + beta-cyfluthrin	3.8–4.1 fl oz *Leverage 360	0	Do not apply more than 15.4 fl oz/a per season and allow at least 7 days between applications.
	0.11 lb indoxiacarb	6.0 oz Avaunt 30 DG	7	Wait at least 5 days between applications. Do not apply more than 24.0 oz/a Avaunt (0.44 lb ai/a) per crop. In areas where Colorado potato beetles are resistant to other insecticides, addition of piperonyl butoxide (PBO) as a tank mix with Avaunt may be required. Adult beetles will cease to feed following exposure to Avaunt but may not die for several days.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	7	Do not apply more than 0.12 lb ai/a per season. Do not feed treated foliage to animals.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Besiege 6.0–9.0 fl oz *Voliam Xpress	14	Do not apply more than 27.0 fl oz/a Besiege or Voliam Xpress per season and allow at least 7 days between applications.
	0.017–0.03 lb lambda-cyhalothrin + thiamethoxam	3.5–4.5 fl oz *Endigo ZC	14	Do not follow soil applications with foliar application of any other neonicotinoid insecticide. Do not exceed 10.0 fl oz/a Endigo ZC, or 0.12 lb ai/a of products containing lambda-cyhalothrin or 0.094 lb ai/a of products containing thiamethoxam.
	0.058–0.078 lb novaluron	9.0–12.0 fl oz Rimon 0.83EC	14	Apply when population is between egg hatch and second instar. Use higher rates for larger larvae. Do not apply more than twice to a single generation of Colorado potato beetles and do not apply to successive generations. Do not apply more than 24.0 oz/a per season.
	0.5–1.0 lb oxamyl	2.0–4.0 pt *Vydate L	7	Treat first-generation larvae. Use low rates for light infestation; higher rates for severe infestation.
0.05–0.2 lb permethrin	*Ambush, *Pounce	14	Several formulations; see label for rate. Do not exceed 1.6 lb ai/a per season.	
1.0 lb phosmet	1.33 lb Imidan WP	7	Use only on potatoes to be machine harvested.	
9.6–11.5 lb sodium aluminofluoride	10.0–12.0 lb Prokil Cryolite 96, Kryocide	0	Treat beginning at 20% egg hatch at a minimum of 7-day intervals. Do not exceed 96.0 lb per season. Mortality does not occur for 2–4 days. Does not affect beneficial insects. Cryolite can be abrasive to equipment; check the label.	
0.047–0.094 lb spinetoram	6.0–8.0 oz Radiant SC	7	Do not apply more than 32.0 oz/a Radiant (0.25 lb ai/a) per crop and do not make more than four applications per crop.	

*Restricted-use pesticide.

(continued)

Insect control in potato *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Colorado potato beetle <i>(cont.)</i>	spinosad	1.7–3.3 oz Blackhawk	3	Apply when pests reach or exceed established thresholds. Do not make more than two successive applications of a Group 5 material and do not apply more than 14.4 oz/a Blackhawk per crop season in potato. Do not exceed four applications in a year.
		3.0–10.0 fl oz Entrust SC	7	Target application for eggs at hatching and small larvae. Use higher rates for heavier infestations and for older larvae. Do not apply more than 21.0 fl oz/a per crop.
	thiamethoxam	1.5–3.0 oz Actara WG	14	Apply before pests reach damaging levels. Allow at least 7 days between applications. Do not exceed 3.0 oz/a per season.
		0.11–0.16 fl oz Cruiser 5FS/100 lb seed pieces	0–30	Use rate chart on label to select proper application rate. Do not exceed 0.125 lb ai/a.
	0.047 lb thiamethoxam + chlorantraniliprole	4.0 oz Voliam Flexi	14	Do not exceed a total of 8.0 fl oz/a Voliam Flexi or 0.094 lb ai/a of thiamethoxam-containing products or 0.2 lb ai/a of chlorantraniliprole-containing products per growing season.
	0.02–0.025 lb zeta-cypermethrin	3.2–4.0 oz *Mustang Max	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Max per season. May provide inadequate control in areas where CPB are resistant to other synthetic pyrethroids.
	0.04–0.1 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	21	Do not exceed 0.2 lb ai/a per season or make more than two applications per season.
Cutworms, loopers	<i>Before July 25 treat when counts exceed four per row foot; after July 25 treat when counts exceed eight per row foot. Use spot treatments if infestations are patchy.</i>			
	<i>Bacillus thuringiensis subsp. kurstaki</i>	Agree, Biobit, DiPel	0	Rates vary with formulations for loopers.
	1.0–2.0 lb <i>Bacillus thuringiensis subsp. kurstaki</i>	1.0–2.0 lb Lepinox WDG	0	Treat early instar larvae before noticeable feeding damage occurs. Repeat as needed.
	0.0125–0.022 lb beta-cyfluthrin	1.6–2.8 fl oz *Baythroid XL	0	Apply every 5 days as needed. Do not exceed six applications per year.
	0.5–2.0 lb carbaryl	Sevin	0	Several formulations; see label for rate.
	0.045–0.065 lb chlorantraniliprole	3.5–5.0 fl oz Coragen	14	Minimum interval between treatments is 5 days. Do not apply more than 15.4 fl oz/a Coragen (0.2 lb ai/a) per season.
	0.012–0.028 lb deltamethrin	1.0–2.4 oz *Delta Gold	3	Apply every 3 days as needed.
	0.025–0.05 lb esfenvalerate	2.8–9.6 fl oz *Asana XL	7	Do not exceed 0.35 lb ai/a per season.
	imidacloprid + beta-cyfluthrin	3.8–4.1 fl oz *Leverage 360	0	Do not apply more than 15.4 fl oz/a per season and allow at least 7 days between applications.
	0.015–0.025 lb lambda-cyhalothrin	0.96–1.6 fl oz *Warrior II	7	Do not apply more than 0.12 lb ai/a per season. Do not feed treated foliage to animals.
	lambda-cyhalothrin + chlorantraniliprole	5.0–8.0 fl oz *Besiege 5.0–8.0 fl oz *Voliam Xpress	14	Do not apply more than 27.0 fl oz/a Besiege or Voliam Xpress per season and allow at least 7 days between applications.

*Restricted-use pesticide.

(continued)

Pepper

Potato

Pumpkin & squash

Sweet corn

Table beet

Tomato

Insect keys

Insect control in potato *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Cutworms, loopers <i>(cont.)</i>	0.017–0.03 lb lambda-cyhalothrin + thiamethoxam	2.5–4.5 fl oz *Endigo ZC	14	Do not follow soil applications with foliar application of any other neonicotinoid insecticide. Do not exceed 10.0 fl oz/a Endigo ZC, or 0.12 lb ai/a of products containing lambda-cyhalothrin or 0.094 lb ai/a of products containing thiamethoxam.
	0.058–0.078 lb novaluron	9.0–12.0 fl oz Rimon 0.83EC	14	Apply when population is between egg hatch and second instar. Use higher rates for larger larvae. Do not make more than two applications or exceed 24.0 oz/a per season.
Pumpkin & squash	0.1–0.2 lb permethrin	*Ambush, *Pounce	14	Do not exceed 1.6 lb ai/a per season.
	0.047–0.094 lb spinetoram	6.0–8.0 oz Radiant SC	7	Do not apply more than 32.0 oz/a Radiant (0.25 lb ai/a) per crop and do not exceed four applications per crop.
	spinosad	1.7–3.5 oz Blackhawk	3	Apply when pests reach or exceed established thresholds. Do not make more than two successive applications of a Group 5 material and do not apply more than 14.4 oz/a Blackhawk per crop season in potato. Do not exceed four applications in a year.
		4.5–10.0 fl oz Entrust SC	7	Target application for eggs at hatching and small larvae. Use higher rates for heavier infestations and for older larvae. Do not apply more than 21.0 fl oz/a per crop.
	0.047 lb thiamethoxam + chlorantraniliprole	4.0 oz Voliam Flexi	14	Do not exceed a total of 8.0 fl oz/a Voliam Flexi or 0.094 lb ai/a of thiamethoxam-containing products or 0.2 lb ai/a of chlorantraniliprole-containing products per growing season.
Sweet corn	0.01–0.025 lb zeta-cypermethrin	1.76–4.0 oz *Mustang Max	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Max per season.
	0.04–0.1 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	21	Do not exceed 0.2 lb ai/a per season or make more than two applications per season.
	European corn borer	acetamiprid	1.5–2.5 fl oz Assail 30 SG	7
		1.1 fl oz Assail 70WP	7	
Table beet	1.0–2.0 lb <i>Bacillus thuringiensis</i> subsp. <i>kurstaki</i>	1.0–2.0 lb Lepinox WDG	0	Treat early instar larvae before noticeable feeding damage occurs. Repeat as needed.
	0.0125–0.022 lb beta-cyfluthrin	1.6–2.8 fl oz *Baythroid XL	0	Apply every 5 days as needed. Do not exceed six applications per year.
	0.5–2.0 lb carbaryl	Sevin	0	Several formulations; see label for rate.
Tomato	0.045–0.065 lb chlorantraniliprole	3.5–5.0 fl oz Coragen	14	Minimum interval between treatments is 5 days. Do not apply more than 15.4 fl oz/a Coragen (0.2 lb ai/a) per season.
	0.018–0.028 lb deltamethrin	1.5–2.4 oz *Delta Gold	3	Apply every 3 days as needed.
	0.015–0.05 lb esfenvalerate	2.9–9.6 fl oz *Asana XL	7	Do not exceed 0.35 lb ai/a per season.
	imidacloprid + beta-cyfluthrin	2.8 fl oz *Leverage 360	7	Minimum interval between applications is 7 days and maximum allowable crop use per season is 12.8 fl oz/a.
	0.065–0.11 lb indoxacarb	3.5–6.0 oz Avaunt	7	Do not exceed 0.26 lb ai/a per season.

*Restricted-use pesticide.

(continued)

Insect control in potato *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
European corn borer <i>(cont.)</i>	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	7	Do not apply more than 0.12 lb ai/a per season. Do not feed treated foliage to animals.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Besiege 6.0–9.0 fl oz *Voliam Xpress	14	Do not apply more than 27.0 fl oz/a Besiege or Voliam Xpress per season and allow at least 7 days between applications.
	0.02–0.027 lb lambda-cyhalothrin + thiamethoxam	3.0–4.0 fl oz *Endigo ZC	14	Do not follow soil applications with foliar application of any other neonicotinoid insecticide. Do not exceed 10.0 fl oz/a Endigo ZC, or 0.12 lb ai/a of products containing lambda-cyhalothrin or 0.094 lb ai/a of products containing thiamethoxam.
	0.1–0.2 lb permethrin	*Pounce	14	Several formulations; see label for rate. Do not exceed 1.6 lb ai/a per season.
	0.047–0.094 lb spinetoram	6.0–8.0 oz Radiant SC	7	Do not apply more than 32.0 oz/a Radiant (0.25 lb ai/a) per crop and do not exceed four applications per crop.
	spinosad	1.7–3.3 oz Blackhawk	3	Apply when pests reach or exceed established thresholds. Do not make more than two successive applications of a Group 5 material and do not apply more than 14.4 oz/a Blackhawk per crop season in potato. Do not exceed four applications in a year.
		3.0–10.0 fl oz Entrust SC	7	Target application for eggs at hatching and small larvae. Use higher rates for heavier infestations and for older larvae. Do not make more than two applications per generation. Do not apply more than 21.0 fl oz/a per crop.
	0.047 lb thiamethoxam + chlorantraniliprole	4.0 oz Voliam Flexi	14	Do not exceed a total of 8.0 fl oz/a Voliam Flexi or 0.094 lb ai/a of thiamethoxam-containing products or 0.2 lb ai/a of chlorantraniliprole-containing products per growing season.
	0.01–0.025 lb zeta-cypermethrin	1.76–4.0 oz *Mustang Max	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Max per season.
	0.04–0.1 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	21	Do not exceed 0.2 lb ai/a per season or make more than two applications per season.
Grass-hoppers	<i>Treat when defoliation exceeds 10%.</i>			
	2.0 lb carbaryl	Sevin Bait	0	Broadcast. See label for rate.
	0.25–0.5 lb dimethoate	0.5–1.0 pt Dimethoate EC	0	
	0.015–0.05 lb esfenvalerate	2.9–9.6 fl oz *Asana XL	7	Do not exceed 0.35 lb ai/a per season.
	imidacloprid + beta-cyfluthrin	3.8–4.1 fl oz *Leverage 360	0	Do not apply more than 15.4 fl oz/a per season and allow at least 7 days between applications.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	7	Do not apply more than 0.12 lb ai/a per season. Do not feed treated foliage to animals.
lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Voliam Xpress	14	Do not apply more than 27.0 fl oz/a per season and allow at least 7 days between applications.	
Green peach aphid, potato aphid	<i>Control when green peach aphids exceed one per 10 leaves for seed production or three aphids per 10 leaves for table stock.</i>			
	acetamiprid	1.5–4.0 fl oz Assail 30 SG	7	For heavy pest pressure, use higher label rates. Do not make more than four applications or exceed 0.3 lb ai/a per season. Do not apply more than once every 7 days.
		1.0–1.7 fl oz Assail 70WP	7	

*Restricted-use pesticide.

(continued)

Pepper

Potato

Pumpkin & squash

Sweet corn

Table beet

Tomato

Insect keys

Insect control in potato *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Green peach aphid, potato aphid <i>(cont.)</i>	0.022 lb beta-cyfluthrin	2.8 fl oz *Baythroid XL	0	Maximum Baythroid XL allowed per 7-day interval is 2.8 fl oz/a and season total allowed per crop season is 16.8 fl oz/a.
	0.075–0.096 lb bifenthrin + imidacloprid	4.8–6.14 fl oz *Brigadier	21	Do not apply more than 25.6 fl oz/a (0.4 lb ai/a) per season. No more than 0.5 lb ai/a bifenthrin and 0.2 lb ai/a imidacloprid are allowed per season.
	0.03–0.05 lb clothianadin	1.9–2.8 fl oz Belay	14	Do not exceed three applications of Belay. Allow at least 7 days between applications. Do not make a foliar application of Belay following an at-plant application of a neonicotinoid (MoA Class 4) compound.
	0.018–0.028 lb deltamethrin	1.5–2.4 oz *Delta Gold	3	Apply every 3 days as needed.
	0.25–0.5 lb diazinon	several formulations	35	Repeat applications as necessary. Allow at least 7 days between applications. Do not use on potatoes that will be hand harvested. Limit of five applications per season.
	0.25–0.5 lb dimethoate	0.5–1.0 pt Dimethoate EC	0	
	0.5–1.0 lb endosulfan	0.66–1.33 qt Thiodan EC 1.0–2.0 lb Thiodan WP	1	Do not exceed six applications per season.
	0.025–0.05 lb esfenvalerate	5.8–9.6 fl oz *Asana XL	7	For potato aphid only. Do not exceed 0.35 lb ai/a per season.
	0.062–0.089 lb flonicamid	2.0–2.8 oz Beleaf 50SG	7	Thorough coverage is required for optimal control. Do not apply more than 2.8 oz/a Beleaf 50SG (0.089 lb ai/a) per treatment and do not exceed 8.4 oz/a (0.267 lb ai/a) per season. Allow at least 7 days between applications; rapidly growing plants often require retreatment. Limit of three applications per year.
	0.047 lb imidacloprid	3.75 fl oz Provado 1.6F	7	Foliar application: Use ground equipment only. Allow at least 7 days between applications. Regardless of the type of application, do not exceed 0.31 lb ai/a imidacloprid (Admire or Provado) per year. There is a 12-month rotational plantback interval for all crops except those registered.
imidacloprid + beta-cyfluthrin	3.8–4.1 fl oz *Leverage 360	0	Do not apply more than 15.4 fl oz/a per season and allow at least 7 days between applications.	
0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	7	Do not apply more than 0.12 lb ai/a per season. Do not feed treated foliage to animals.	
lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Besiege 6.0–9.0 fl oz *Voliam Xpress	14	Do not apply more than 27.0 fl oz/a Besiege or Voliam Xpress per season and allow at least 7 days between applications.	
0.027–0.03 lb lambda-cyhalothrin + thiamethoxam	4.0–4.5 fl oz *Endigo ZC	14	Do not follow soil applications with foliar application of any other neonicotinoid insecticide. Do not exceed 10.0 fl oz/a Endigo ZC, or 0.12 lb ai/a of products containing lambda-cyhalothrin or 0.094 lb ai/a of products containing thiamethoxam.	
0.6–0.9 lb malathion	several formulations	0	Short residual.	
0.45–0.9 lb methomyl	1.5–3.0 pt *Lannate LV 0.5–1.0 lb *Lannate SP	6	Do not exceed 10 applications per season.	

*Restricted-use pesticide.

(continued)

Insect control in potato *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Green peach aphid, potato aphid <i>(cont.)</i>	0.5–1.0 lb oxamyl	2.0–4.0 pt *Vydate L	7	Foliar application. Do not exceed six applications per season.
	0.1–0.2 lb permethrin	*Ambush, *Pounce	14	Several formulations; see label for rate. Do not exceed 1.6 lb ai/a per season.
	pymetrozine	2.75 oz Fulfill 50WDG	14	Apply according to label directions when aphids first appear. May repeat treatment in 7 days. Do not exceed two applications per crop or 5.5 oz ai/a per season. May be applied through chemigation.
	thiamethoxam	3.0 oz Actara WG	14	Apply every 7–10 days as needed. Do not exceed 6.0 oz/a per season.
		0.11–0.16 fl oz Cruiser 5FS/100 lb seed pieces	0–30	Use rate chart on label to select proper application rate. Do not exceed 0.125 lb ai/a.
	0.047 lb thiamethoxam + chlorantraniliprole	4.0 oz Voliam Flexi	14	Do not exceed a total of 8.0 fl oz/a Voliam Flexi or 0.094 lb ai/a of thiamethoxam-containing products or 0.2 lb ai/a of chlorantraniliprole-containing products per growing season.
	0.02–0.025 lb zeta-cypermethrin	3.2–4.0 oz *Mustang Max	1	Apply Mustang Max only after populations have exceeded thresholds and do not exceed 24.0 oz/a per season.
0.04–0.1 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	21	Do not exceed 0.2 lb ai/a per season or make more than two applications per season.	
Potato flea beetle	acetamiprid	1.5–2.5 fl oz Assail 30 SG	7	For heavy pest pressure, use higher label rates. Do not make more than four applications or exceed 0.3 lb ai/a per season. Do not apply more than once every 7 days.
		0.6–1.1 fl oz Assail 70WP	7	
	0.0125–0.022 lb beta-cyfluthrin	1.6–2.8 fl oz *Baythroid XL	0	Apply every 5 days as needed. Do not exceed six applications per year.
	0.075–0.096 lb bifenthrin + imidacloprid	4.8–6.14 fl oz *Brigadier	21	Do not apply more than 25.6 fl oz/a (0.4 lb ai/a) per season. No more than 0.5 lb ai/a bifenthrin and 0.2 lb ai/a imidacloprid are allowed per season.
	0.5–2.0 lb carbaryl	Sevin (several formulations)	0	See label for limitations on crops that follow.
	0.03–0.05 lb clothianadin	1.9–2.8 fl oz Belay	14	Do not exceed three applications of Belay. Allow at least 7 days between treatments. Do not make a foliar application of Belay following an at-plant application of a neonicotinoid (MoA Class 4) compound.
	0.018–0.028 lb deltamethrin	1.5–2.4 oz *Delta Gold	3	Apply every 3 days as needed.
	0.25–0.5 lb diazinon	several formulations	35	Repeat applications as necessary. Allow at least 7 days between applications. Do not use on potatoes that will be hand harvested.
	0.05–0.33 lb dinotefuran	<i>foliar:</i> 1.0–1.5 oz Venom 70SG <i>soil:</i> 6.5–7.5 oz Venom 70SG	7	Do not follow soil applications with foliar application of any other neonicotinoid insecticide. Use only one application method. Do not apply more than 4.5 oz/a per year using foliar applications, or 7.5 oz/a per season using soil applications. See product label for directions.
—				
0.05–0.07 lb dinotefuran (<i>foliar</i>)	2.0–2.75 oz Scorpion 35SL	7	Can repeat at 14-day intervals. Do not apply more than 7.75 oz per year. Use only one application method.	

*Restricted-use pesticide.

(continued)

Pepper

Potato

Pumpkin & squash

Sweet corn

Table beet

Tomato

Insect keys

Insect control in potato *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Potato flea beetle <i>(cont.)</i>	0.28–0.33 lb dinotefuran <i>(soil)</i>	11.0–13.0 oz Scorpion 35SL		Do not apply more than 13.0 oz per year. Apply either as a preplant, preemergence, or at ground crack. Do not follow soil applications with foliar applications; use only one application method.
	0.5–1.0 lb endosulfan	0.66–1.33 qt Thiodan EC 1.0–2.0 lb Thiodan WP	1	Do not exceed six applications per season.
Potato	0.025–0.05 lb esfenvalerate	5.8–9.6 fl oz *Asana XL	7	Do not exceed 0.35 lb ai/a per season.
	0.047 lb imidacloprid	3.75 fl oz Provado 1.6F	7	Use ground equipment only. Allow at least 7 days between applications. Regardless of the type of application, do not exceed 0.31 lb ai/a imidacloprid (Admire, Leverage 360, or Provado) per year. There is a 12-month rotational plantback interval for all crops except those registered.
Pumpkin & squash	imidacloprid + beta-cyfluthrin	3.8–4.1 fl oz *Leverage 360	0	Do not apply more than 15.4 fl oz/a per season and allow at least 7 days between applications.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	7	Do not apply more than 0.12 lb ai/a per season. Do not feed treated foliage to animals.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Besiege 6.0–9.0 fl oz *Voliam Xpress	14	Do not apply more than 27.0 fl oz/a Besiege or Voliam Xpress per season and allow at least 7 days between applications.
Sweet corn	0.017–0.03 lb lambda-cyhalothrin + thiamethoxam	2.5–4.5 fl oz *Endigo ZC	14	Do not follow soil applications with foliar application of any other neonicotinoid insecticide. Do not exceed 10.0 fl oz/a Endigo ZC, or 0.12 lb ai/a of products containing lambda-cyhalothrin or 0.094 lb ai/a of products containing thiamethoxam.
	0.05–0.2 lb permethrin	*Ambush, *Pounce	14	Several formulations; see label for rate. Do not exceed 1.6 lb ai/a per season.
	spinosad	1.7–3.3 oz Blackhawk	3	Apply when pests reach or exceed established thresholds. Do not make more than two successive applications of a Group 5 material and do not apply more than 14.4 oz/a Blackhawk per crop season in potato. Do not exceed four applications in a year.
Table beet	thiamethoxam	0.11–0.16 fl oz Cruiser 5FS/100 lb seed pieces	0–30	Use rate chart on label to select proper application rate. Do not exceed 0.125 lb ai/a.
	0.047 lb thiamethoxam + chlorantraniliprole	4.0 oz Voliam Flexi	14	Do not exceed a total of 8.0 fl oz/a Voliam Flexi or 0.094 lb ai/a of thiamethoxam-containing products or 0.2 lb ai/a of chlorantraniliprole-containing products per growing season.
Tomato	0.01–0.025 lb zeta-cypermethrin	1.76–4.0 oz *Mustang Max	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Max per season.
	0.04–0.1 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	21	Do not exceed 0.2 lb ai/a per season or make more than two applications per season.
Potato leafhopper	<i>Sample nymphs and adults. Do not treat if fewer than 0.5 adults per sweep unless there are more than 2.5 nymphs per 25 leaves. If 0.5–1.0 adults per sweep, treat if they remain at the same level for 10–14 days or if nymphs are present. If 1.0–1.5 adults per sweep, treat within 5–7 days or immediately if nymphs are present. If more than 1.5 adults per sweep, treat immediately.</i>			
Insect keys	acetamiprid	1.5–4.0 fl oz Assail 30 SG	7	For heavy pest pressure, use higher label rates. Do not make more than four applications or exceed 0.3 lb ai/a per season. Do not apply more than once every 7 days.
		0.6–1.7 fl oz Assail 70WP	7	

*Restricted-use pesticide.

(continued)

Insect control in potato *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Potato leafhopper <i>(cont.)</i>	0.0125–0.022 lb beta-cyfluthrin	1.6–2.8 fl oz *Baythroid XL	0	Apply every 5 days as needed. Do not exceed six applications per year.
	0.075–0.096 lb bifenthrin + imidacloprid	4.8–6.14 fl oz *Brigadier	21	Do not apply more than 25.6 fl oz/a (0.4 lb ai/a) per season. No more than 0.5 lb ai/a bifenthrin and 0.2 lb ai/a imidacloprid are allowed per season.
	0.5–2.0 lb carbaryl	Sevin (several formulations)	0	See label for limitations on crops that follow.
	0.03–0.05 lb clothianadin	1.9–2.8 fl oz Belay	14	Do not exceed three applications of Belay. Allow at least 7 days between treatments. Do not make a foliar application of Belay following an at-plant application of a neonicotinoid (MoA Class 4) compound.
	0.018–0.028 lb deltamethrin	1.5–2.4 oz *Delta Gold	3	Apply every 3 days as needed.
	0.25–0.5 lb dimethoate	0.5–1.0 pt Dimethoate EC	0	
	0.05–0.33 lb dinotefuran	<i>foliar:</i> 1.0–1.5 oz Venom 70SG <i>soil:</i> 6.5–7.5 oz Venom 70SG	7 —	Do not follow soil applications with foliar application of any other neonicotinoid insecticide. Use only one application method. Do not apply more than 4.5 oz/a per year using foliar applications, or 7.5 oz/a per season using soil applications. See product label for directions.
	0.05–0.07 lb dinotefuran (<i>foliar</i>)	2.0–2.75 oz Scorpion 35SL	7	Can repeat at 14-day intervals. Do not apply more than 7.75 oz per year. Use only one application method.
	0.28–0.33 lb dinotefuran (<i>soil</i>)	11.0–13.0 oz Scorpion 35SL		Do not apply more than 13.0 oz per year. Apply either as a preplant, preemergence, or at ground crack. Do not follow soil applications with foliar applications; use only one application method.
	0.5–1.0 lb endosulfan	0.66–1.33 qt Thiodan EC 1.0–2.0 lb Thiodan WP	1	Do not exceed 6 applications per season.
	0.015–0.05 lb esfenvalerate	2.9–9.6 fl oz *Asana XL	7	Do not exceed 0.35 lb ai/a per season.
	0.047 lb imidacloprid	3.75 fl oz Provado 1.6F	7	<i>Foliar application:</i> Use ground equipment only. Allow at least 7 days between applications. Regardless of the type of application, do not exceed 0.31 lb ai/a imidacloprid (Admire or Provado) per year. There is a 12-month rotational plantback interval for all crops except those registered.
	imidacloprid + beta-cyfluthrin	3.8–4.1 fl oz *Leverage 360	0	Do not apply more than 15.4 fl oz/a per season and allow at least 7 days between applications.
	0.015–0.025 lb lambda-cyhalothrin	0.96–1.6 fl oz *Warrior II	7	Do not apply more than 0.12 lb ai/a per season. Do not feed treated foliage to animals.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Besiege 6.0–9.0 fl oz *Voliam Xpress	14	Do not apply more than 27.0 fl oz/a Besiege or Voliam Xpress per season and allow at least 7 days between applications.
0.017–0.03 lb lambda-cyhalothrin + thiamethoxam	2.5–4.5 fl oz *Endigo ZC	14	Do not follow soil applications with foliar application of any other neonicotinoid insecticide. Do not exceed 10.0 fl oz/a Endigo ZC, or 0.12 lb ai/a of products containing lambda-cyhalothrin or 0.094 lb ai/a of products containing thiamethoxam.	
0.6–0.9 lb malathion	several formulations	0	Short residual will protect beneficial insects.	

*Restricted-use pesticide.

(continued)

Pepper

Potato

Pumpkin & squash

Sweet corn

Table beet

Tomato

Insect keys

Insect control in potato *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Potato leafhopper <i>(cont.)</i>	0.45–0.9 lb methomyl	1.5–3.0 pt *Lannate LV 0.5–1.0 lb *Lannate SP	6	
	0.05–0.2 lb permethrin	*Ambush, *Pounce	14	Several formulations; see label for rate. Do not exceed 1.6 lb ai/a per season.
	1.0 lb phosmet	1.33 lb Imidan WP	7	Use only on potatoes to be machine harvested.
	thiamethoxam	1.5–3.0 oz Actara WG	14	Apply every 7–10 days as needed. Do not exceed 6.0 oz/a per season.
		0.11–0.16 fl oz Cruiser 5FS/100 lb seed pieces	0–30	Use rate chart on label to select proper application rate. Do not exceed 0.125 lb ai/a.
	0.047 lb thiamethoxam + chlorantraniliprole	4.0 oz Voliam Flexi	14	Do not exceed a total of 8.0 fl oz/a Voliam Flexi or 0.094 lb ai/a of thiamethoxam-containing products or 0.2 lb ai/a of chlorantraniliprole-containing products per growing season.
	0.01–0.025 lb zeta-cypermethrin	1.76–4.0 oz *Mustang Max	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Max per season.
0.04–0.1 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	21	Do not exceed 0.2 lb ai/a per season or make more than two applications per season.	
Tarnished plant bug	<i>Treat when insect sweep net counts exceed an average of 1 bug/sweep.</i>			
	0.0125–0.022 lb beta-cyfluthrin	1.6–2.8 fl oz *Baythroid XL	0	Apply every 5 days as needed. Do not exceed six applications per year.
	0.5–2.0 lb carbaryl	Sevin (several formulations)	0	See label for limitations on crops that follow.
	0.018–0.028 lb deltamethrin	1.5–2.4 oz *Delta Gold	3	Apply every 3 days as needed.
	0.025–0.05 lb esfenvalerate	5.8–9.6 fl oz *Asana XL	7	Do not exceed 12 applications per season.
	imidacloprid + beta-cyfluthrin	3.8–4.1 fl oz *Leverage 360	0	Do not apply more than 15.4 fl oz/a per season and allow at least 7 days between applications.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	7	Do not apply more than 0.12 lb ai/a per season. Do not feed treated foliage to animals.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Besiege 6.0–9.0 fl oz *Voliam Xpress	14	Do not apply more than 27.0 fl oz/a Besiege or Voliam Xpress per season and allow at least 7 days between applications.
	0.02–0.027 lb lambda-cyhalothrin + thiamethoxam	3.0–4.0 fl oz *Endigo ZC	14	Do not follow soil applications with foliar application of any other neonicotinoid insecticide. Do not exceed 10.0 fl oz/a Endigo ZC, or 0.12 lb ai/a of products containing lambda-cyhalothrin or 0.094 lb ai/a of products containing thiamethoxam.
	0.1–0.2 lb permethrin	*Ambush, *Pounce	14	Several formulations; see label for rate. Do not exceed 1.6 lb ai/a per season.
	0.01–0.025 lb zeta-cypermethrin	1.76–4.0 oz *Mustang Max	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Max per season.
	0.1 lb zeta-cypermethrin + bifenthrin	10.3 fl oz *Hero	21	Do not exceed 0.2 lb ai/a per season or make more than two applications per season.
Two-spotted spider mite	0.125–0.25 lb bifenazate	16.0–24.0 oz Acramite 4SC	14	Apply in at least 50 gallons of water to ensure uniform coverage and canopy penetration. Do not apply more than once per year.

*Restricted-use pesticide.

(continued)

Insect control in potato *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Wireworms (soil treatments)	bifenthrin	<i>at-plant</i> : 19.2 oz *Brigade 2EC <i>lay-by</i> : 3.2–9.6 oz *Brigade 2EC		Apply as an in-furrow spray or T-band spray at planting. May be applied as a lay-by treatment as a banded spray over the drilled area.
		12.75–25.5 oz *Capture LFR	34 (at-plant) 35 (lay-by)	Do not exceed 0.3 lb ai/a per season as an at-plant application. Do not apply more than 0.5 lb ai/a per season including other bifenthrin products.
	4–6 lb ethoprop	2.1 lb/1,000 ft row *Mocap EC		Band in row at planting.
		40.0–60.0 lb *Mocap G		Preplant broadcast if severe infestation is likely.
	0.09–0.1 lb fipronil	2.9–3.2 oz Regent 4SC	90	Make only one in-furrow treatment. Apply as a 5- to 7-inch-wide band and cover thoroughly. See label for plantback restrictions.
	banded rate: <i>heavy soil</i> : 0.22 lb/1,000 ft row phorate <i>light soil</i> : 0.14 lb/1,000 ft row phorate	<i>heavy soil</i> : 17.3 oz *Thimet 20G, *Phorate 20G <i>light soil</i> : 11.3 oz *Thimet 20G, *Phorate 20G	90	Apply as fertilizer band treatment at planting.

*Restricted-use pesticide.

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Weed control

Control potato weeds with timely cultivation and use of herbicides. Many herbicide application options exist, including preplant, drag-off, preemergence, and postemergence applications. If you hill early, spray-hill and hill-spray options

are also available. Hill-spray refers to applying the herbicide immediately after hilling when potatoes are beginning to emerge. Any preemergence herbicide can be used. Spray-hill refers to application made at cracking but before

emergence. Application is made at cracking and followed immediately by hilling. Herbicides requiring incorporation can be used in this option.

Relative effectiveness of potato herbicides

Target species	Dual pre	Eptam pre	Lorox pre	Matrix pre, post	Metribuzin pre, post	Poast post	Prowl pre	Treflan pre
Annual broadleaf weeds								
Black nightshade	E*	F*	G	P	P	N	P	P
Carpetweed	—	—*	—*	—	E^a	N	—	—*
Lady's thumb	P	F	E	F	E	N	—	P
Lambsquarters	F	G*	E*	F*	E*	N	G*	G*
Pigweed, redroot	G*	G*	E*	E*	E*	N	G*	G*
Pigweed, prostrate	—	G*	—	E*	— ^a	N	G*	G*
Purslane, common	G	—*	E*	F*	G^b	N	—*	E*
Ragweed, common	F	F	E*	F*	E*	N	P	P
Shepherd's purse	—	—*	—	E*	— ^a	N	—	—
Smartweed, Pennsylvania	F	F	E*	F*	E*	N	P	P
Velvetleaf	P	G	G	F*	E*	N	P	P
Wild buckwheat	P	F	F	F	—	N	—	P
Annual grasses								
Barnyard grass	E*	F*	G*	E*	P	E	G*	E*
Crabgrass, large	E*	E*	G*	F*	G	E	E*	E*
Foxtail, green	E*	E*	G*	E*	G*	E	E*	E*
Sandbur	F	—*	—	—	P	E	G*	—*
Witchgrass	—*	E*	F	—	P	E	E*	E
Perennial grass								
Quackgrass	P	F	P	G*	P	G*	P	P

*Weeds listed as controlled on the herbicide's label.

Abbreviations: E = excellent; G = good; F = fair; P = poor; N = none; — = data not available; pre = preemergence treatment, post = postemergence treatment. Good and excellent ratings are set boldface.

Note: Because the performance of herbicides is affected by many variables, these ratings can only indicate the relative effectiveness. The actual performance may be better or worse than indicated in the chart.

^a Metribuzin label lists carpetweed, jimsonweed, wild mustard, prostrate pigweed, and shepherd's purse as controlled by preemergence sprays only.

^b Metribuzin label states preemergence treatment will suppress purslane.

Weed control in potato (See preceding table of relative effectiveness of potato herbicides.)

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Annual weeds	0.56–0.98 lb dimethenamid-P	<i>coarse soils:</i> 12.0–18.0 fl oz Outlook <i>medium- and fine-textured soils:</i> 18.0–21.0 fl oz Outlook	40	Make preemergence applications after drag-off or after hilling, but before weeds emerge. In cold and wet conditions, Outlook may delay emergence or stunt potatoes.
	fomesafen	Reflex	70	Reflex is prohibited from use in many areas of Wisconsin and is rate-restricted by location. Check label to determine if it can be used in your area and for use instructions.
Annual grasses and some broadleaves	EPTC	Eptam 7E or registered equivalent	30	Rate varies by application timing—see label for details. May be applied and incorporated with various methods before or at planting, or postemergence. Superior may suffer early season stunting if the crop is stressed.
	0.71–1.43 lb pendimethalin	1.5–3.0 pt Prowl H ₂ O		Make one preemergence application after potatoes are planted but before weeds or crop emerge. Use rate is based on soil texture. Pendimethalin is most effective if adequate rainfall or irrigation occurs within 1 week of treatment. Incorporate if moisture is inadequate. May also be applied postemergence from crop emergence to 6-inch stage and through chemigation. Do not make applications to potatoes under stress from cold/wet or hot/dry weather.
	0.74–1.49 lb pendimethalin	1.8–3.6 pt Prowl 3.3EC		
	s-metolachlor	1.0–2.0 pt Dual Magnum or Dual II Magnum		Make preemergence applications after drag-off or after hilling but before weeds emerge. Use rates vary with soil organic matter and formulation. PHI varies with type of application, so read the label carefully. Do not use on peat or muck soils. If cool wet soil conditions occur after treatment, Dual may delay maturity or reduce yield of early-maturing varieties.
	0.5–1.0 lb trifluralin	1.0–2.0 pt Treflan HFP or registered equivalent		Treat after planting but before emergence, following dragoff or after potatoes have fully emerged. May also be applied through chemigation. Controls annual grasses and some broadleaf weeds, but is weak on wild mustard, smartweed, common ragweed, velvetleaf, and black nightshade. Rate varies with soil texture and organic matter. Follow recommended soil preparation, application, and incorporation procedures. May injure potatoes if improperly incorporated. Must be incorporated within 24 hours. See label for plantback restrictions. Ineffective on peat and muck soils.
Annual broadleaves and some grasses	linuron	Lorox DF (use and rate vary by soil type—see label)		Apply delayed preemergence after planting but just before potatoes emerge. Linuron can be applied in a hill-spray operation. Apply before grasses are 2 inches tall and broadleaf weeds are 6 inches tall, preferably just before or when weed seedlings emerge. If weeds are present, add 1 pt surfactant/25 gal spray mixture. In irrigated areas, apply linuron to moist soil and follow with sprinkler irrigation or rainfall within 2 weeks. Do not incorporate. More effective on annual broadleaf weeds than grasses.

*Restricted-use pesticide.

(continued)

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Weed control in potato *(continued)*

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Annual broadleaves and some grasses <i>(cont.)</i>	metribuzin	See label—rate and use instructions vary.	60	Apply delayed preemergence after drag-off or hilling. Do not incorporate. Early postemergence applications are labeled for russet-type or white-skinned varieties that are not early maturing. Can be applied with sprinkler irrigation systems. Do not apply within 3 days after periods of cool, wet, or cloudy weather, or to weeds taller than 1 inch. Do not apply within 24 hours of other pesticide applications. Postemergence metribuzin treatment is not recommended for red-skinned varieties or Atlantic, Shepody, Chip Bell, Bellchip, or Centennial. Preemergence application to these varieties may also cause injury. Split applications (preemergence and early postemergence) at reduced rates are often effective and reduce potential for leaching. See label for rotation restrictions.
Annual weeds and some perennial weeds	0.0156–0.02 lb rimsulfuron	1.0–1.5 oz Matrix or Solida	60	Apply 1.0–1.5 oz/a immediately after hilling or dragoff, or postemergence to young, actively growing weeds. Depending on soil type, rainfall or irrigation of 1/3 to 1 inch is needed within 5 days after application for activation. For postemergence applications, allow at least 4 hours drying time after application. Sequential applications are allowed up to a total of 2.5 oz/a. Check the label for crop rotation guidelines.
Emerged weeds	glyphosate	several manufacturers and formulations		See manufacturer's label to assure that the formulation is labeled for this crop and for specific instructions. Glyphosate may be applied any time before crop emerges. Apply before crop germination in coarse sandy soils. If weeds have been mowed or tilled, wait until they resume active growth and reach the recommended stage on the label. Unless otherwise stated, allow 7 or more days before tilling treated fields. Do not tank mix with soil-residual herbicides unless otherwise specified.
	*paraquat <i>(rate varies by label)</i>	several manufacturers and formulations, not all are registered for this use		Make application up to cracking. Always add crop oil concentrate or non-ionic surfactant to spray mixture. Follow precautions on label. In preplant and preemergence (to the crop) uses, do not apply to soils lacking clay minerals (i.e., muck, pure sand).
Emerged grasses	0.068–0.24 lb clethodim	9.0–32.0 oz Select Max	30	Apply to actively growing grasses. Repeat treatments may be made at 14-day intervals up to the maximum annual use rate. Do not cultivate grasses within 7 days before or after application. Include appropriate surfactant as required by product label. Do not apply if rain is expected within 1 hour.
	0.094–0.25 lb clethodim	6.0–16.0 oz Select 2EC	30	
	0.19–0.48 lb sethoxydim	1.0–2.5 pt Poast	30	Make postemergence applications to actively growing grasses within the size ranges indicated on the label. Check the label for wild proso millet and rescue treatment rates. Do not exceed 5 pt/a Poast in one crop season. Always add 2 pt/a of crop oil concentrate. Specific tank-mix restrictions for potato included on label, including longer preharvest intervals.

*Restricted-use pesticide.

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Pumpkin & squash

Planting

Most commercial growers start pumpkin and squash from seed. Delay planting until danger of frost is past and soils have warmed to at least 60°F. Planting generally begins around May 10 in southern Wisconsin and June 1 in northern Wisconsin. Pumpkin and squash are sensitive to transplanting. Plants are typically started in individual containers 3–4 weeks before transplanting in the field—May 20 in southern Wisconsin and June 1 in northern counties. Using too small a container or allowing the plants to grow too large before transplanting can impair root growth in the field.

Bush types

Rows: 24–48 inches.

Plants in row: 36–60 inches apart.

Vine types

Rows: 36–96 inches.

Plants in row: 36–60 inches apart.

Pollination

Pumpkins and squash have male and female flowers that are pollinated by insects, typically bees. To protect pollinators, insecticide applications should not be made during the day while they are active.

Lime and fertilizer

Lime: Use dolomitic limestone to maintain a pH of 6.0 on mineral soils and 5.6 on organic soils.

Fertilizer rates: Apply P_2O_5 and K_2O according to soil test recommendations. Use annual nitrogen, P_2O_5 , and K_2O recommendations in the table below.

Increase the rates shown below by 20% for high-yielding pumpkins. Take credits for previous legume crops and manure.

Application: Broadcast lime and fertilizer and work into the soil before planting. Apply fertilizer at planting time in a band 2 inches to the side and 2 inches below seed level.

Nitrogen: Split nitrogen recommendation into two or more applications during the season. Make the first application when plants have two or more true leaves. Make a second application when vines begin to fill the rows. Subsequent applications (15–20 lb N/a each) can be made at 10- to 14-day intervals after harvest has started. Excess nitrogen can delay maturity and result in green pumpkins.

Annual nitrogen, phosphate, and potash recommendations for pumpkin and squash

Crop	Nitrogen		Yield goal (t/a)	Phosphate and potash	
	Organic matter (%)	Amount to apply (lb/a)		Amount P_2O_5 to apply* (lb/a)	Amount K_2O to apply* (lb/a)
Pumpkin	<2	100	15–20	50	110
	2.0–9.9	80			
	10–20	60			
	>20	30			
Squash	<2	80	12–16	40	90
	2.0–9.9	60			
	10–20	40			
	>20	20			

*Amounts shown are for optimum (O) soil test levels. Apply 50% of this rate if soil test is high (H) and omit if soil test is excessively high (EH). If soil test is low (L) or very low (VL), increase rates according to soil test recommendations.

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Disease control in pumpkin and squash

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions	
Angular leaf spot (<i>Pseudomonas</i>)	copper hydroxide	1.33 pt Champ Formula 2 Flowable	0	Do not apply more than 14.4 pt product per year.	
	fixed copper	1.5–2.0 qt Copper-Count-N	0	Use disease-free seed and rotate crops.	
		1.0–2.25 lb Kocide 2000 DF	0		
		0.5–1.25 lb Kocide 3000	0		
Anthracnose and other foliar diseases (see label)	azoxystrobin	11.0–15.5 fl oz Quadris Flowable	1	Quadris and Cabrio belong to the Group 11 (strobilurin) category of fungicides; Quadris Opti contains Groups 11 and M5 fungicides; and Tanos contains Groups 11 and 27 fungicides. Do not exceed one application of any of these products before alternating with a fungicide having a different mode of action. Do not exceed four applications of strobilurin fungicides per year. Do not exceed 1.92 qt/a Quadris, 2 gal/a Quadris Opti, 32.0 oz/a Tanos, or 64.0 oz/a Cabrio per season. Tanos must be tank mixed with a contact fungicide such as mancozeb, chlorothalonil, or a copper-containing fungicide. Do not tank mix Quadris, Quadris Opti, or Cabrio with additives or adjuvants.	
	azoxystrobin + chlorothalonil	3.2 pt Quadris Opti	1		
	azoxystrobin + difenoconazole	12.0–14.0 fl oz Quadris Top	1		
	famoxadone + cymoxanil	8.0 oz Tanos	3		
	pyraclostrobin	12.0–16.0 oz Cabrio EG	0		
	boscalid + pyraclostrobin	12.5–18.5 oz Pristine WDG	0		Pristine belongs to Groups 7 (anilide) and 11 (strobilurin) fungicide categories. Do not exceed one application of Pristine before alternating to a labeled fungicide with a different mode of action not in Group 7 or 11. Do not exceed four applications of Pristine or other Group 7 or Group 11 fungicides per season. Do not exceed 74.0 oz/a Pristine per season.
	chlorothalonil	<i>Anthracnose:</i> 1.5–2.0 pt Bravo Weather Stik, Echo 720, Equus 720 1.4–1.8 lb Bravo Ultrex 82.5WDG, Equus DF 1.3–1.6 lb Echo 90DF 2.25–2.75 pt Bravo Zn, Echo Zn, Equus 500 Zn	0 0 0 0		Use in sufficient water to obtain adequate coverage. Begin application when plants are in first true leaf stage or when conditions are favorable for disease development.
	<i>Alternaria:</i> 2.0–3.0 pt Bravo Weather Stik, Echo 720, Equus 720 1.8–2.7 pt Bravo Ultrex WDG, Equus DF 1.6–2.5 lb Echo 90DF 2.75–4.25 pt Bravo Zn, Echo Zn, Equus 500 Zn	0 0 0 0			
	cyprodinil + difenoconazole	16.0–20.0 fl oz Inspire Super	7	Apply no more than 80.0 fl oz/a per season. Make no more than two sequential applications before alternating to a fungicide with a different mode of action.	

(continued)

Disease control in pumpkin and squash *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Anthracnose and other foliar diseases <i>(cont.)</i>	fenamidone	5.5 fl oz Reason 500 SC	14	For Alternaria leaf blight only. Reason belongs to the Group 11 (strobilurin) fungicide category. Do not exceed one application of Reason or other Group 11 materials before alternating with a fungicide having a different mode of action. Do not exceed four applications of Group 11 fungicides per year. Do not exceed 22.0 fl oz/a Reason per season. Following the last application of Reason 500 SC, wait 30 days before planting wheat and 1 year for all other crops.
	hydrogen dioxide	1:100–1:2000 dilution OxiDate	0	See label for specific cucurbit application instructions. Can be used on certified organic operations.
	mancozeb	1.6–2.4 qt Dithane F-45	5	For use on summer squash only. Consult label for seasonal product use limits. Spray every 5–10 days depending on disease and weather pressures.
		2.0–3.0 lb Dithane DF Rainshield, M45	5	
		1.6–2.4 qt Manzate Flowable	5	
		2.0–3.0 lb Manzate Pro-Stick	5	
		1.6–2.4 qt Penncozeb 4FL	5	
1.5–3.0 lb Penncozeb 75DF, 80WP	5			
thiophanate methyl	0.2–0.4 lb Thiophanate methyl 85WDG 0.5 lb Topsin M 70WSB	0		
Bacterial wilt <i>(Erwinia)</i>	<i>Control the cucumber beetles that carry this pathogen (see Insect Control table).</i>			
Black rot <i>(Didymella)</i>	<i>See chemical recommendations for anthracnose. Use disease-free seed and practice long rotations with crops other than cucurbits. Destroy infected plant refuse at the end of the growing season. Handle storage squash and pumpkins carefully to avoid scratches or injuries to the rind.</i>			
Downy mildew <i>(Pseudoperonospora cubensis)</i> and Phytophthora blight or crown rot <i>(Phytophthora capsici)</i>	cyazofamid	2.75 fl oz Ranman 400SC	0	Do not apply more than six sprays or 16.5 fl oz/a per year. Alternate Ranman (Group 21) sprays with a fungicide having a different mode of action. Crops not listed on the label should not be planted within 30 days after the last application.
	cymoxanil	<i>downy mildew:</i> 3.2–5.0 oz Curzate 60DF	3	Apply no more than 30.0 oz per 12-month period. Use Curzate only in combination with a labeled rate of a protectant fungicide such as products containing mancozeb, copper hydroxide, or chlorothalonil.
		dimethomorph	6.0 oz Forum	
	famoxadone + cymoxanil	<i>downy mildew:</i> 8.0 oz Tanos	3	Do not make more than one application of Tanos before alternating with a fungicide having a different mode of action. Do not make more than four applications of Tanos or other Group 11 fungicides per season and do not alternate Tanos with other Group 11 fungicides. Do not exceed 32.0 oz/a Tanos per crop per season. Tanos is helpful for suppressing Phytophthora blight. Tanos must be tank mixed with a contact fungicide such as mancozeb, chlorothalonil, or a copper-containing fungicide.
		<i>Phytophthora:</i> 8.0–10.0 oz Tanos	3	

(continued)

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Disease control in pumpkin and squash *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Downy mildew and Phytophthora blight or crown rot <i>(cont.)</i>	fluopicolide	3.0–4.0 fl oz Presidio	2	Tank mix this product with another labeled non-Group 43 fungicide.
	fosetyl-al	2.5–5.0 lb Aliette WDG, Linebacker	12 hr	Begin applications when conditions favor disease. The lower rates of Aliette WDG (2.0–3.0 lb) can be used when tank mixed with another fungicide (other than copper) labeled for downy mildew control.
	mandipropamid	8.0 fl oz Revus	0	Make no more than one application before switching to another effective non-Group 40 fungicide.
	phosphorous acid, mono- and dibasic sodium, potassium, and ammonium salts	2.5–5.0 pt Phostrol	0	Do not exceed seven applications/a per season. Begin applications when conditions favor disease.
	potassium phosphite	1.0–3.0 qt Fosphite/100 gal water	0	Do not apply at intervals less than 3 days. Do not apply to heat- or moisture-stressed plants.
	propamocarb hydrochloride	1.2 pt Previcur Flex or 0.6–1.2 pt Previcur Flex <i>plus</i> tank-mix partner (protectant)	2	Do not apply more than 6 pt/a Previcur Flex per season.
	zoxamide + mancozeb	1.5–2.0 lb Gavel 75DF	5	For use on squash and pumpkin. Do not exceed eight applications or apply more than 16.0 lb/a product (10.67 lb mancozeb or 1.33 lb zoxamide) per season.
Mosaic	<i>Plant resistant varieties.</i>			
Powdery mildew	azoxystrobin	11.0–15.5 fl oz Quadris Flowable	1	Cabrio, Flint, and Quadris belong to the Group 11 (strobilurin) category of fungicides. Quadris Opti contains a combination of Groups 11 and M5 fungicides. Do not exceed one application of any of these products before alternating with a fungicide having a different mode of action. Do not exceed four applications of strobilurin fungicides per year. Do not exceed 64.0 oz/a Cabrio, 8.0 oz/a Flint, 1.92 qt/a Quadris, or 2 gal/a Quadris Opti per season. Do not tank mix Cabrio, Flint, Quadris, or Quadris Opti with additives or adjuvants.
	azoxystrobin + chlorothalonil	3.2 pt Quadris Opti	1	
	pyraclostrobin	12.0–16.0 oz Cabrio EG	0	
	trifloxystrobin	1.5–2.0 oz Flint	0	
	boscalid + pyraclostrobin	12.5–18.5 oz Pristine WDG	0	Pristine belongs to Group 7 and Group 11 (strobilurin) fungicide categories. Do not exceed two sequential applications before alternating to a labeled fungicide with a different mode of action. Do not exceed four applications of Pristine or other Group 7 or 11 fungicides per season. Limit of 74.0 oz/a per season.
	clarified hydrophobic extract of neem oil	0.5–1.0% Trilogy in 25–100 gal water <i>or</i> 2.0 pt in at least 5 gal water	0	Do not apply more than 2 gal of Trilogy/a. OMRI-approved.
	cyflufenamid	3.4 oz Torino	0	Do not make more than two applications per year. Do not apply more than once every 7 days. Do not exceed total of 6.8 oz/a product per year.
	cyprodinil + fludioxonil	11.0–14.0 oz Switch 62.5WG	1	Do not apply more than 56.0 oz/a Switch per season. After two applications, alternate with a fungicide with a different mode of action for two applications.
	kresoxim-methyl	3.2–4.8 oz Sovran	0	Do not exceed 19.2 oz/a per season. Consult label for comments on adjuvant usage.

(continued)

Disease control in pumpkin and squash *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Powdery mildew <i>(cont.)</i>	myclobutanil	2.5–5.0 oz Rally 40WSP	0	Do not exceed 1.5 lb/a product (0.6 lb ai/a) per year. Observe a 30-day plantback interval between the last application and planting new crops. (Formerly Nova.)
	penthiopyrad	12.0–16.0 fl oz Fontelis	1	For disease control in greenhouse cucurbits, use at a rate range of 0.375–0.5 fl oz per gallon of spray per 1,360 sq ft. These rates equal field rates of 12.0–16.0 fl oz/a. Make no more than two sequential applications before switching to a fungicide with a different mode of action. Do not apply more than 67.0 fl oz/a per year.
	quinoxifen	4.0–6.0 fl oz Quintec	3	Do not apply more than 32.0 fl oz Quintec per calendar year. Under certain environmental conditions, Quintec may cause leaf spotting or chlorosis. If symptoms occur after applying Quintec, discontinue use.
	tebuconazole	4.0–6.0 fl oz Folicur 3.6 F, Monsoon, Onset 3.6L, Orius 3.6F, Tebusa 3.6FL, TebuStar 3.6L, Tebuzol 3.6F, Toledo	7	Do not exceed 24.0 fl oz/a per season.
	thiophanate methyl	0.5 lb Topsin M 70W, Topsin M WSB 10.0 fl oz Topsin 4.5FL 0.2–0.4 lb Thiophanate methyl WDG	0 0	Apply when disease first appears and repeat if needed every 7–14 days.
	triflumizole	4.0–8.0 oz Procure 50WS 4.0–8.0 fl oz Procure 480 SC	0	Do not exceed 40.0 oz/a of Procure 50WS or 40.0 fl oz/a of Procure 480 SC per season. See product label for plantback restrictions for leafy vegetables (30 days), root vegetables (60 days), and all other crops (1 yr).
Seed rot and damping-off	captan thiram			Plant seed that has been pre-treated with Captan or Thiram.

Scouting calendar for insect pests of pumpkin and squash

April			May			June			July			August			September		
early	mid	late	early	mid	late	early	mid	late	early	mid	late	early	mid	late	early	mid	late

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Insect control in pumpkin and squash

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Bean aphid and soybean aphid	spirotetramat	4.0–5.0 fl oz Movento	1 (edible) 7 (dry)	Do not apply more than 10.0 fl oz/a per season and allow at least 7 days between applications.
Cucumber beetle (striped, spotted)	<i>Treat when there are more than four to five adults per 50 plants. If the plants are not touching within the row, treatment is justified if the field averages more than five beetles per plant.</i>			
	0.047–0.10 lb acetamiprid	2.5–5.3 oz Assail 30 SG	0	Do not exceed five applications or 26.5 oz/a of product per crop season.
	0.05–0.10 lb acetamiprid	1.1–2.3 oz Assail 70WP	0	Do not exceed five applications or 11.5 oz/a of product per crop season.
	beta-cyfluthrin	2.4–2.8 fl oz *Baythroid XL	0	Maximum Baythroid XL allowed per 7-day interval is 2.8 fl oz/a and season total allowed per crop season is 16.8 fl oz/a.
	bifenthrin	2.6–6.4 fl oz *Brigade 2EC	3	Treat every 7 days as needed. Do not exceed 0.3 lb ai/a per season. Do not make more than two applications after bloom.
		6.8–8.5 fl oz *Capture LFR	21	Do not exceed 0.1 lb ai/a as an at-plant application; do not exceed 0.3 lb ai/a per season of all bifenthrin products.
	bifenthrin + zeta-cypermethrin	4.0–10.3 fl oz *Hero	3	Do not apply more than 10.3 fl oz/a per season and allow at least 7 days between applications. Do not apply more than 41.2 fl oz of product/a per crop season.
	0.5–1.0 lb carbaryl	Sevin (several formulations)	0	Do not apply during maximum flowering or fruit set, or when pollinating bees are in the field. Make applications after 8 p.m.
	clothianadin	<i>foliar:</i> 3.0–4.0 fl oz Belay	21	Do not apply more than 12.0 fl oz/a per season and allow at least 7 days between applications.
		<i>soil:</i> 9.0–12.0 fl oz Belay	—	Do not apply more than 12.0 fl oz/a per season. Apply as a narrow band centered on the plant row; as an in-furrow spray at planting; as a side dress to both sides of the row; as a transplant water drench; or as chemigation into root zone through drip, trickle or micro-sprinkler, or similar equipment.
	0.018–0.028 lb deltamethrin	1.5–2.4 fl oz *Delta Gold	3	Apply every 3 days as needed. Do not exceed 14.4 fl oz/a per season.
	0.045–0.268 lb dinotefuran	<i>foliar:</i> 1.0–4.0 oz Venom 70SG <i>soil:</i> 5.0–6.0 oz Venom 70SG	1 21	Do not follow soil applications with foliar application of any other neonicotinoid insecticide. Use only one application method. Do not apply more than 6.0 oz/a per year using foliar applications, or 12.0 oz/a per season using soil applications. See product label for application directions.
	0.5–1.0 lb endosulfan	0.66–1.33 qt Phaser EC 1.0–2.0 lb Thiodan WP	2	Do not exceed 3.0 lb ai/a per season or more than six applications per season.
	0.2–0.3 lb fenpropathrin	10.66–16.0 oz Danitol 2.4EC	7	Do not exceed 2.66 pt/a Danitol (0.8 lb ai/a) per season. Control may be improved by the addition of a non-ionic surfactant.
	imidacloprid	7.0–10.5 fl oz Admire Pro	21	Apply in a narrow band centered on plant row within 14 days before planting or as an in-furrow treatment during planting. Do not exceed 0.38 lb ai/a per season.

*Restricted-use pesticide.

(continued)

Insect control in pumpkin and squash *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Cucumber beetle <i>(cont.)</i>	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4	Do not exceed 0.18 lb ai/a per season. Reapply at intervals of 5 or more days.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Voliam Xpress	1	Do not exceed a total of 31.0 fl oz/a of Voliam Xpress or 0.18 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per season.
	lambda-cyhalothrin + thiamethoxam	4.0–4.5 fl oz *Endigo ZC	1	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 5 days between applications.
	0.9–1.75 lb malathion	several formulations	3 (pumpkin) 1 (squash)	Do not apply before vining or to wet plants.
	0.5–1.0 lb methomyl	1.5–3.0 pt *Lannate LV 0.5–1.0 lb *Lannate SP		See label for days to harvest.
	0.1–0.2 lb permethrin	*Ambush, *Pounce	0	Several formulations; see label for rate. Spray during the evening. No more than 1.6 lb total.
	thiamethoxam	3.0–5.5 oz Actara 25WDG 5.0–11.0 Platinum 2SC	30	Do not follow applications of Platinum with foliar applications of any other neonicotinoid insecticide. Platinum may be applied to direct seeded crops in-furrow at the seeding or transplant depth, or as a narrow surface band above the seedling and followed by irrigation. Do not apply more than 11.0 oz/a per season. Actara is applied as a foliar spray.
0.198–0.257 lb thiamethoxam + chlorantraniliprole	10.0–13.0 fl oz Durivo	30	Do not exceed a total of 13.0 fl oz/a Durivo (0.257 lb ai/a) per growing season. Do not exceed 0.172 lb ai/a of products containing thiamethoxam or 0.2 lb ai/a of products containing chlorantraniliprole per season.	
0.02–0.025 lb zeta-cypermethrin	2.8–4.0 oz *Mustang Max	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Max per season.	
Cutworms and loopers	beta-cyfluthrin	0.8–2.4 fl oz *Baythroid XL	0	Maximum Baythroid XL allowed per 7-day interval is 2.8 fl oz/a and season total allowed per crop season is 16.8 fl oz/a.
	bifenthrin	2.6–6.4 fl oz *Brigade 2EC	3	Treat every 7 days as needed. Do not exceed 0.3 lb ai/a per season. Do not make more than two applications after bloom.
		6.8–8.5 fl oz *Capture LFR	21	Do not exceed 0.1 lb ai/a as an at-plant application; do not exceed 0.3 lb ai/a per season of all bifenthrin products.
	bifenthrin + zeta-cypermethrin	4.0–10.3 fl oz *Hero	3	Do not apply more than 10.3 fl oz/a per season and allow at least 7 days between applications. Do not apply more than 41.2 fl oz of product/a per crop season.
	1.0 lb carbaryl	Sevin Bait (several formulations)	0	Broadcast when cutworms are present in damaging numbers.
0.045–0.065 lb chlorantraniliprole	3.5–5.0 fl oz Coragen	1	Minimum interval between treatments is 5 days. Do not exceed 15.4 fl oz/a (0.2 lb ai/a) per season.	

*Restricted-use pesticide.

(continued)

Pepper

Potato

Pumpkin & squash

Sweet corn

Table beet

Tomato

Insect keys

Insect control in pumpkin and squash *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Cutworms and loopers <i>(cont.)</i>	0.012–0.028 lb deltamethrin	1.0–2.4 fl oz *Delta Gold	3	Apply every 3 days as needed. Do not exceed 14.4 fl oz/a per season.
	0.05–0.18 lb dinotefuran <i>(foliar)</i>	2.0–7.0 oz Scorpion SL	1	Can repeat at 7-day intervals. Do not apply more than 10.5 oz per year.
	0.132–0.179 lb dinotefuran	3.0–4.0 oz Venom 70SG	1	Do not apply more than 6.0 oz/a per year using foliar applications. See product label for application directions.
Potato	0.03–0.05 lb esfenvalerate	5.8–9.6 fl oz *Asana XL	3	Spray when cutworms are present in damaging numbers.
	0.03–0.045 lb flubendiamide	2.0–3.0 oz Synapse WG	1	Do not apply more than 3.0 oz/a (0.045 lb ai/a) in a 7-day period or 9.0 oz/a per season.
	flubendiamide + buprofezin	12.0–17.0 fl oz Vetica	7	Do not apply more than 38.0 fl oz/a per season and allow at least 7 days between applications. Do not make more than three applications per crop season.
Pumpkin & squash	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4	Do not exceed 0.18 lb ai/a per season. Reapply at intervals of 5 or more days.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Voliam Xpress	1	Do not exceed a total of 31.0 fl oz/a of Voliam Xpress or 0.18 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per season.
	lambda-cyhalothrin + thiamethoxam	4.0–4.5 fl oz *Endigo ZC	1	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 5 days between applications.
Sweet corn	0.1–0.2 lb permethrin	*Ambush, *Pounce	0	Several formulations; see label for rate. No more than 1.6 lb total.
	0.01–0.025 lb zeta-cypermethrin	1.28–4.0 oz *Mustang Max	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Max per season.
	Melon aphid	0.047–0.075 lb acetamiprid	2.5–4.0 oz Assail 30 SG	0
0.05–0.10 lb acetamiprid		1.1–1.7 oz Assail 70WP	0	Do not exceed five applications or 11.5 oz/a of product per crop season.
0.04–0.10 lb bifenthrin		2.6–6.4 fl oz *Brigade 2EC	3	Treat every 7 days as needed. Do not exceed 0.3 lb ai/a per season. Do not make more than two applications after bloom.
bifenthrin + zeta-cypermethrin		4.0–10.3 fl oz *Hero	3	Do not apply more than 10.3 fl oz/a per season and allow at least 7 days between applications. Do not apply more than 41.2 fl oz of product/a per crop season.
Tomato	clothianadin	<i>foliar</i> : 3.0–4.0 fl oz Belay	21	Do not apply more than 12.0 fl oz/a per season and allow at least 7 days between applications.
		<i>soil</i> : 9.0–12.0 fl oz Belay	—	Do not apply more than 12.0 fl oz/a per season. Apply as a narrow band centered on the plant row; as an in-furrow spray at planting; as a side dress to both sides of the row; as a transplant water drench; or as chemigation into root zone through drip, trickle or micro-sprinkler, or similar equipment.

*Restricted-use pesticide.

(continued)

Insect control in pumpkin and squash *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Melon aphid <i>(cont.)</i>	0.25–0.75 lb diazinon	several formulations	3 (winter squash) 7 (summer squash)	Apply as soon as aphids are noticed.
	0.5–1.0 lb endosulfan	0.66–1.33 qt Phaser EC 1.0–2.0 lb Thiodan WP	1 (pumpkin) 2 (squash)	Do not exceed 3.0 lb ai/a per season.
	0.062–0.089 lb flonicamid	2.0–2.8 oz Beleaf SG	0	Begin applications before aphid populations build. Do not exceed 2.8 oz/a Beleaf per application and do not apply more than 8.4 oz/a (0.267 lb ai/a) per season.
	imidacloprid	7.0–10.5 fl oz Admire Pro	21	Apply in a narrow band centered on plant row within 14 days before planting or as an in-furrow treatment during planting. Do not exceed 0.38 lb ai/a per season.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4	Do not exceed 0.18 lb ai/a per season. Reapply at intervals of 5 or more days.
	lambda-cyhalothrin + chlorantraniliprole	9.0 fl oz *Voliam Xpress	1	Do not exceed a total of 31.0 fl oz/a of Voliam Xpress or 0.18 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per season.
	lambda-cyhalothrin + thiamethoxam	4.0–4.5 fl oz *Endigo ZC	1	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 5 days between applications.
	1.0–2.0 lb malathion	several formulations	3 (pumpkin) 1 (squash)	Do not apply before vining or when plants are wet.
	0.375–0.5 oxydemeton-methyl	1.5–2.0 pt *Metasystox-R S	3 (summer squash) 14 (pumpkin, winter squash)	Summer squash only. Also suppresses spider mites. Do not make more than one application per season.
	pymetrozine	2.75 oz Fulfill 50WDG	14	Controls melon and green peach aphids. Treat when aphids first appear. May repeat in 7 days. Do not exceed 5.5 oz/a per season or more than two applications per crop.
thiamethoxam	1.5–3.0 oz Actara WG 5.0–8.0 fl oz Platinum	0 30	Apply before pests reach damaging levels. Repeat as needed every 7–10 days. Apply higher rates for heavy infestations, or for long residual with Platinum. Do not exceed 8.0 oz/a of either product per season. Do not apply less than 5.0 oz/a of Platinum per season.	

*Restricted-use pesticide.

(continued)

Pepper

Potato

Pumpkin & squash

Sweet corn

Table beet

Tomato

Insect keys

Insect control in pumpkin and squash *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Melon aphid <i>(cont.)</i>	0.198–0.257 lb thiamethoxam + chlorantraniliprole	10.0–13.0 fl oz Durivo	30	Do not exceed a total of 13.0 fl oz/a Durivo (0.257 lb ai/a) per growing season. Do not exceed 0.172 lb ai/a of products containing thiamethoxam or 0.2 lb ai/a of products containing chlorantraniliprole per season.
	0.02–0.025 lb zeta-cypermethrin	2.8–4.0 oz *Mustang Max	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Max per season.
Seed corn maggot	0.04–0.08 lb bifenthrin	3.4–6.8 oz *Capture LFR	—	Apply as a 5- to 7-inch band over an open furrow or in-furrow with the seed. Do not apply more than 0.1 lb/a Capture LFR per season as an at-plant application.
Spider mite	0.938–1.88 lb abamectin	8.0–16.0 fl oz *Agri-Mek 0.15EC	7	May repeat after 7 days, but do not make more than two sequential treatments or exceed 5.64 lb ai/a per year.
	bifenazate	0.75–1.0 lb Acramite 50WS	3	Limit of one application per season.
	0.08–0.10 lb bifenthrin	5.12–6.4 fl oz *Brigade 2EC	3	Apply before insects reach threshold levels. May repeat after 7 days. Do not apply more than twice after bloom or exceed 0.3 lb ai/a per season.
	bifenthrin + zeta-cypermethrin	10.3 fl oz *Hero	3	Do not apply more than 10.3 fl oz/a per season and allow at least 7 days between applications. Do not apply more than 41.2 fl oz of product/a per crop season.
	0.2 lb fenpropathrin	10.0–66.0 fl oz Danitol 2.4EC	7	Treat when mites first appear and repeat every 7 days as needed. Do not exceed 0.8 lb ai/a per season.
Squash bug	lambda-cyhalothrin + thiamethoxam	4.5 fl oz *Endigo ZC	1	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 5 days between applications.
	1.5–2.0 lb malathion	several formulations	3 (pumpkin) 1 (squash)	Do not apply before vining or to wet plants.
	spiromesifen	7.0–8.5 fl oz Oberon 2SC	7	Apply every 7 days as needed. Do not exceed 25.5 fl oz/a per season.
Squash bug	<i>Check undersides of leaves for squash bug eggs laid in neat rows. Eggs hatch within 1–2 weeks. Treat when squash bugs are young; they are difficult to control as older nymphs or adults. At early flowering, treat if you find more than one egg mass per plant. Destroy crop residue in fall to reduce overwinter survival of this pest.</i>			
Tomato	0.10 lb acetamiprid	2.3 oz Assail 70WP	0	Do not exceed five applications or 11.5 oz/a of product per crop season.
		5.3 oz Assail 30 SG	0	Do not exceed five applications or 26.5 oz/a of product per crop season.
	0.04–0.10 lb bifenthrin	2.6–6.4 fl oz *Brigade 2EC	3	Treat every 7 days as needed. Do not exceed 0.3 lb ai/a per season. Do not make more than two applications after bloom.
	bifenthrin + zeta-cypermethrin	4.0–10.3 fl oz *Hero	3	Do not apply more than 10.3 fl oz/a per season and allow at least 7 days between applications. Do not apply more than 41.2 fl oz of product/a per crop season.

*Restricted-use pesticide.

(continued)

Insect control in pumpkin and squash *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Squash bug <i>(cont.)</i>	0.5–1.0 lb carbaryl	Sevin (several formulations)	0	Do not apply to wet foliage or when rain or high humidity is expected within 2 days of treatment.
	clothianadin	<i>foliar</i> : 3.0–4.0 fl oz Belay	21	Do not apply more than 12.0 fl oz/a per season and allow at least 7 days between applications.
		<i>soil</i> : 9.0–12.0 fl oz Belay	—	Do not apply more than 12.0 fl oz/a per season. Apply as a narrow band centered on the plant row; as an in-furrow spray at planting; as a side dress to both sides of the row; as a transplant water drench; or as chemigation into root zone through drip, trickle or micro-sprinkler, or similar equipment.
	0.05–0.18 lb dinotefuran <i>(foliar)</i>	2.0–7.0 oz Scorpion 35SL	1	Can repeat at 7-day intervals. Do not apply more than 10.5 oz per year.
	0.132–0.179 lb dinotefuran	3.0–4.0 oz Venom 70SG	1	Do not exceed 6.0 oz/a per year using foliar applications. See label for application directions.
	0.5–1.0 lb endosulfan	0.66–1.33 qt Phaser EC 1.0–2.0 lb Thiodan WP	2	
	0.03–0.05 lb esfenvalerate	5.8–9.6 fl oz *Asana XL	3	Do not exceed 0.25 lb ai/a per year.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4	Do not exceed 0.18 lb ai/a per season. Reapply at intervals of 5 or more days.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Voliam Xpress	1	Do not exceed a total of 31.0 fl oz/a of Voliam Xpress or 0.18 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per season.
	lambda-cyhalothrin + thiamethoxam	4.0–4.5 fl oz *Endigo ZC	1	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 5 days between applications.
0.2 lb permethrin	*Ambush, *Pounce	0	Will kill adult squash bugs. See label for rate. Do not exceed 1.6 lb ai/a per season.	
0.02–0.025 lb zeta-cypermethrin	2.8–4.0 oz *Mustang Max	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Max per season.	
Squash vine borer	<i>Treat when adults are observed (around 900DD₅₀), especially when runners are less than 2 feet long. Larvae boring in the main stem can kill the entire plant, while loss of a runner or two when the plant is larger will not cause economic damage. Look for sawdust-like excrement coming from holes in the stems, and open the stems to confirm the presence of squash vine borer larvae. Repeat applications at 5- to 7-day intervals throughout the 3-week egg-laying period. Once larvae are inside the vine, little can be done to control this pest.</i>			
0.10 lb acetamiprid	2.3 oz Assail 70WP	0	Do not exceed five applications or 11.5 oz/a of product per crop season.	
	5.3 oz Assail 30 SG	0	Do not exceed five applications or 26.5 oz/a of product per crop season.	
0.04–0.10 lb bifenthrin	2.6–6.4 fl oz *Brigade 2EC	3	Treat every 7 days as needed. Do not exceed 0.3 lb ai/a per season. Do not make more than two applications after bloom.	

*Restricted-use pesticide.

(continued)

Pepper

Potato

Pumpkin & squash

Sweet corn

Table beet

Tomato

Insect keys

Insect control in pumpkin and squash *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Squash vine borer <i>(cont.)</i>	bifenthrin + zeta-cypermethrin	4.0–10.3 fl oz *Hero	3	Do not apply more than 10.3 fl oz/a per season and allow at least 7 days between applications. Do not apply more than 41.2 fl oz of product/a per crop season.
	0.5–1.5 lb carbaryl	Sevin (several formulations)	0	Do not apply to wet foliage or when rain or high humidity is expected within 2 days of treatment.
Potato	0.5–1.0 lb endosulfan	0.66–1.33 qt Phaser EC 1.0–2.0 lb Thiodan WP	2	Apply weekly to flower buds, stems, and vines beginning when moths first appear. Do not exceed three applications per season (squash) or six applications per season (pumpkin).
	0.03–0.05 lb esfenvalerate	5.8–9.6 fl oz *Asana XL	3	Do not exceed 0.25 lb ai/a per season
Pumpkin & squash	flubendiamide + buprofezin	12.0–17.0 fl oz Vetica	7	Do not apply more than 38.0 fl oz/a per season and allow at least 7 days between applications. Do not make more than three applications per crop season.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4	Do not exceed 0.18 lb ai/a per season. Reapply at intervals of 5 or more days.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Voliam Xpress	1	Do not exceed a total of 31.0 fl oz/a of Voliam Xpress or 0.18 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per season.
Sweet corn	lambda-cyhalothrin + thiamethoxam	4.0–4.5 fl oz *Endigo ZC	1	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 5 days between applications.
	0.1–0.2 lb permethrin	*Ambush, *Pounce	0	Several formulations; see label for rate. Do not apply more than 1.6 lb ai/a per season.
Table beet	0.02–0.025 lb zeta-cypermethrin	2.8–4.0 oz *Mustang Max	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Max per season.

*Restricted-use pesticide.

Weed control in pumpkin and squash

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Annual weeds	0.25–0.75 lb clomazone	<i>pumpkins and winter squash</i> : 0.67–2.0 pt Command 3ME <i>summer squash</i> : 0.67–1.33 pt Command 3ME	45	Pumpkin (processed only), winter squash, and summer squash only. For suppression and control of annual grasses and broadleaves, make a single preemergent soil application before seeding or transplanting. Place seed or roots of transplants below the chemical barrier when planting. Consult variety restrictions on label. Strictly follow all precautions and restrictions on the label to minimize offsite movement and carryover. Read and understand the vegetable disclaimer section of the label—the end user of this product assumes all liability for failure to perform and crop injury resulting from its use.
	1.1–1.7 lb ethalfluralin	3.0–4.5 pt Curbit EC		Make a single broadcast application within 2 days after seeding. Rate varies with soil texture and organic matter. A shallow cultivation or 1/2 inch of water is needed for activation. Heavy rain following application or seeding may result in crop injury. Do not incorporate prior to planting, use under plastic mulch, broadcast over transplants, or apply through irrigation. Do not use on soils with more than 10% organic matter.
	0.4–1.2 lb ethalfluralin + 0.125–0.375 lb clomazone	2.0–6.0 pt Strategy	45	Use only as a postplant surface-applied herbicide before weed emergence. Rate varies by squash type. Make one application before crop emergence or apply as a banded spray between rows following emergence or transplanting. Do not make broadcast applications to transplants or use under plastic mulch. Rainfall, irrigation, or a shallow cultivation 2–5 days after application required for activation. Because of the potential for offsite movement and severe crop injury, strictly follow all precautions and restrictions listed on the label.
	s-metolachlor	1.0–1.33 pt Dual Magnum or Dual II Magnum	30	Apply preemergence as an inter-row or inter-hill application in pumpkin only. Leave 1 foot of untreated area over the row, or 6 inches to each side of the planted hill and/or any emerged pumpkin foliage. Broadcast sprays over the planted row or hill, and applications made directly to crop foliage will increase the risk of stand loss, delayed maturity, and yield loss. Rate depends on soil type.
Annual grasses	5.0–6.0 lb bensulide	5.0–6.0 qt Prefar 4E		Apply before planting and incorporate 1–2 inches deep to avoid losses due to volatilization. Use on mineral soils only.
Nutsedge and some broad-leaves	0.023–0.047 lb halosulfuron	0.5–1.0 oz Sandea (rate varies by crop use and application timing—see label)	30	Sandea controls several broadleaf weeds and nutsedge. It will not control grasses. Sandea has both pre- and postemergence activity. Broadcast applications to non-processing crops should not exceed 0.75 oz/a Sandea. Application of Sandea to summer squash is limited to directed spray to row middles, avoiding contact with the crop. Do not exceed two applications or apply more than 2.0 oz per 12-month period. Soil or foliar applications of organophosphate insecticides to Sandea-treated crops may cause severe crop injury. Consult label for rate, maximum Sandea use per crop cycle, application timing, and other important usage information and precautions.

*Restricted-use pesticide.

(continued)

Pepper

Potato

Pumpkin & squash

Sweet corn

Table beet

Tomato

Insect keys

Weed control in pumpkin and squash *(continued)*

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Emerged weeds	glyphosate	several manufacturers and formulations		See label to assure that the formulation is labeled for this crop and for specific instructions. Some formulations require a wait of 3 days between application and planting. Crop contact will result in severe injury or death. If weeds have been mowed or tilled, do not treat until they have resumed active growth and reached the recommended stage on the label. Unless otherwise stated, allow 7 or more days before tilling treated fields. Do not tank mix with soil-residual herbicides unless otherwise specified.
	*paraquat	several manufacturers and formulations— not all are registered for this use		Prepare seedbed early to allow for maximum weed emergence. Application can be made as a banded or broadcast treatment before, during, or after planting but before crop emergence. In preplant and preemergence (to the crop) uses, do not apply to soils lacking clay minerals (i.e., muck, pure sand). Use the higher rate for heavy weed infestations. Seeding and transplanting should be performed with minimal soil disturbance. Always add crop oil concentrate or non-ionic surfactant to spray mixture. Follow precautions on label.
Emerged grasses	0.068–0.12 lb clethodim	9.0–16.0 oz Select Max	14	Apply to actively growing grasses. Repeat treatments may be made at 14-day intervals up to the maximum annual use rate. Do not cultivate grasses within 7 days before or after application. Include appropriate surfactant as required by product label. Do not apply if rain is expected within 1 hour.
	0.094–0.125 lb clethodim	6.0–8.0 oz Select 2EC	14	
	0.094–0.28 lb sethoxydim	0.5–1.5 pt Poast	14	Make postemergence applications to actively growing grasses at the sizes indicated on the label. Check the label for wild proso millet or rescue treatment rates as well as precautions and restrictions. Do not exceed 3.0 pt/a Poast per season. Always add 2.0 pt/a of oil concentrate.

*Restricted-use pesticide.

Pepper

Potato

Pumpkin & squash

Sweet corn

Table beet

Tomato

Insect keys

Sweet corn

Since sweet corn is harvested in the immature or milk stage, it requires a shorter growing season than other types of corn. Nonetheless, it is a warm weather crop. Average temperatures of 65–70°F, with a minimum of 50°F, are required during June, July, and August. On the other hand, high temperatures above 80°F hasten maturity and often result in inferior quality. Temperature also greatly affects the length of time that sweet corn kernels remain sweet and tender. At high temperatures, they pass the best eating stage quickly.

The relationship of growth and maturity to temperature may be expressed more accurately in terms of degree days than calendar days. Since sweet corn does not grow at temperatures below 50°F, daily degree days are computed by subtracting 50°F from the average daily temperature. Scheduling of planting and harvest for nearly 75% of the processing sweet corn in the nation is based on degree days computed by this method or modifications. For more information, see “Calculating Degree Days” on page 14.

Sweet corn does best where annual rainfall is 30 inches or more, and April through September rainfall is 20 inches or more. The crop is especially susceptible to lack of moisture and to hot dry winds during the reproductive period. After the appearance of tassels the plants need rain every week. For this reason supplemental irrigation is increasingly important in the production of processing sweet corn. The water added may increase snapped weight by 0.5 t/a per inch of irrigation water, resulting in yields of 10–12 t/a in the humid North Central states.

Most sweet corn varieties were based on the sugary gene and had yellow kernels. Sugary hybrids have between 10% and 15% sugar at harvest time. Recently, new hybrids based on other genes have become available. The most important of these new gene types are the supersweet types based on the *shrunk-2* gene and the SE types based on the *sugary enhancer* gene. Both of these genes result

in elevated sugar levels of 25–35% at harvest. The supersweet types also convert sugar to starch more slowly resulting in a longer harvest period and longer shelf life. However, the pericarp of the supersweets will toughen with increased maturity resulting in decreased quality just as it does in the other types.

White kernel and bicolor (yellow and white kernels) hybrids are also becoming increasingly common. While the kernel color does not affect taste they may be of interest to consumers due to their attractiveness or novelty.

Supersweets must be isolated from sugary enhancer and sugary hybrids. To obtain the best results, sugary enhancer hybrids should be isolated from sugary hybrids and white hybrids should be isolated from bicolor and yellow. Isolation may be either in space or time. Different gene types should be grown at least 100 feet apart or they should flower at least 10 days apart.

Planting

Rows: 30–40 inches.

Plants in row: 7–20 inches (depends on row width and acre population).

For maximum yields, there should be 16,000–20,000 plants/a. Thus, actual seeding rates must be 18,000–22,000 plants/a—12–16 lb/a seed depending upon the grade or seed size for sugary hybrids. Supersweet seed is lighter and therefore only 5–8 lb/a seed is required.

Plant sweet corn for processing during May and June. Market gardeners may plant on light soils in mid-April. Supersweets are more sensitive to cold soils and should be planted when the soil temperature is over 60°F.

Uniform plant growth and maturity is important for processing sweet corn plantings since fields must be harvested at one time for market and processing. Plant uniform-size seed using a dependable planter with plates designed for that specific seed grade.

A deep firm seedbed free of clods, trash, and surface irregularities is necessary for uniform germination, good stands, and uniform maturity. You can fall plow moderately heavy soils that are unlikely to erode and leave them rough over the winter to permit earlier spring planting. You should plow light soils early in the spring.

Plow under stubble or green manure crops that precede sweet corn, and disk the soil 3–4 weeks before planting. Disk as many times as necessary to prepare a uniform seedbed and keep weeds under control. However, a crust can form if you work the soil too much.

In heavy soils, do not plant seed deeper than 1 inch. On sandy loams, plant seed 1.5 inches deep, and plant seed 2 inches deep on light sandy soils. Deeper planting may interfere with germination and prevent emergence if packing and crusting follow hard rains. In case of packing or crusting, use a rotary hoe to break the crust.

To extend the length of harvest, you can use successive plantings of the same hybrid at intervals of a week or less; or plant early-, medium-, and late-maturing hybrids at the same time. Late plantings of early varieties usually are less productive than early plantings of late varieties. If you plant different hybrids that will be used for processing, they should have a similar ear and similar kernel type and color because of overlap at harvest. Late plantings often have more serious problems with diseases and insects.

Continuous corn production in the same field increases the danger of corn rootworm damage. To avoid this problem, rotate crops. You can rotate sweet corn with other vegetable processing crops such as green beans, lima beans, peas, and cabbage. You can use early hybrids in multiple cropping systems following canning peas.

Pepper

Potato

Pumpkin & squash

Sweet corn

Table beet

Tomato

Insect keys

Irrigation

Sweet corn is sensitive to the moisture supply, especially during the 10 days before silking and the 20 days between silking and harvest. Irrigation rates depend upon soil type, temperature, relative humidity, and rainfall. Apply 2–3 inches of water when needed.

Lime and fertilizer

Lime: Use dolomitic limestone to maintain a pH of 6.0 or higher on mineral soils and 5.6 on organic soils.

Fertilizer rates: Apply fertilizer according to soil test recommendations. Use annual nitrogen, P₂O₅, and K₂O recommendations in the table below. Take credits for previous legume crops and manure. Sowing 1.5–2.0 bu/a of rye or wheat after the corn harvest in late August or September may help capture some mobile soil nutrients.

Application: Broadcast lime and fertilizer and disc or plow under before seeding. Apply fertilizer to the side and below the seed.

Nitrogen: Apply sidedress or split the rate into two or three applications during the growing season on sandy soils. You can apply nitrogen through the irrigation system.

Micronutrients: If the soil test is low or very low for zinc, apply 2–4 lb Zn/a with the starter fertilizer.

Annual nitrogen, phosphate, and potash recommendations for sweet corn

Nitrogen		Phosphate and potash		
Organic matter (%)	Amount to apply (lb/a)	Yield goal (t/a)	Amount P ₂ O ₅ to apply* (lb/a)	Amount K ₂ O to apply* (lb/a)
<2	150	2.0–4.0	10	20
2.0–9.9	130	4.1–6.0	15	30
10–20	110	6.1–8.0	25	40
>20	70	8.1–10.0	30	55

*Amounts shown are for optimum (O) soil test levels. Apply 50% of this rate if soil test is high (H) and omit if soil test is excessively high (EH). If soil test is low (L) or very low (VL), increase rates according to soil test recommendations.

Disease control in sweet corn

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Anthracnose	<i>Rotate crops or use deep-incorporation of debris from previous year's corn crop.</i>			
Leaf rust, foliar diseases (gray leaf spot, northern corn leaf blight, and northern corn leaf spot)	azoxystrobin	<i>leaf rust:</i> 6.0–9.0 fl oz Quadris Flowable <i>other foliar diseases:</i> 6.0–15.5 fl oz Quadris Flowable	7	Headline and Quadris belong to the Group 11 (strobilurin) fungicide category. Quilt and Stratego contain Group 11 and Group 3 fungicides. Do not exceed one application of Headline, Quadris, Quilt, or Stratego before alternating to a labeled fungicide with a different mode of action. The number of applications using Group 11 fungicides should not exceed half of the total fungicide applications per season. Treat when disease first appears; continue fungicide applications on a 7- to 14-day interval if conditions favorable for disease development persist.
	azoxystrobin + propiconazole	<i>leaf rust, gray leaf spot, eyespot:</i> 10.5–14.0 fl oz Quilt 10.5–14.0 fl oz Quilt Excel <i>other foliar diseases:</i> 7.0–14.0 fl oz Quilt	14	
	prothioconazole + triflozystrobin	4.0–5.0 fl oz Stratego YLD	14 (fodder) 0 (forage & ears)	
	pyraclostrobin	6.0–12.0 fl oz Headline	7	

(continued)

Disease control in sweet corn *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions	
Leaf rust, foliar diseases <i>(cont.)</i>	chlorothalonil	0.75–2 pt Bravo Weather Stik, Echo 720, Equus 720	14 (fresh market only)	Plant tolerant or resistant varieties. Early detection is critical for fungicide use. Early plantings are less susceptible to these diseases. Do not exceed 9.0 lb ai/a chlorothalonil per season. Spray at 4- to 7-day intervals when symptoms first appear. Do not graze treated fields or use treated corn for livestock feed.	
		0.7–1.8 lb Bravo Ultrex 82.5WDG, Equus DF	14 (fresh market only)		
		1.25–1.625 lb Echo 90DF	14 (fresh market only)		
	fluoxastrobin	2.0–3.8 fl oz Aftershock, Evito 480 SC	30		Do not apply more than 11.4 fl oz/a per year. Maximum of two applications per season, with a minimum interval of 7 days between applications.
	fluxapyroxad + pyraclostrobin	4.0–8.0 fl oz Priaxor	7 (for sweet corn only)		Do not apply more than 16.0 fl oz/a per season. Do not make more than two consecutive applications of Priaxor before alternating to a labeled fungicide with a different mode of action.
	mancozeb	1.2 qt Dithane F-45	7		Consult label for product use limits. Spray every 5–10 days depending on disease and weather pressures. Do not feed treated forage to livestock.
		1.5 lb Dithane DF Rainshield	7		
1.5 lb Koverall		7			
1.5 lb Manzate 200 75DF		7			
0.8–1.2 qt Penncozeb 4FL		7			
1.0–1.5 lb Penncozeb 80WP, 75DF	7				
penthiopyrad	10.0–24.0 fl oz Vertisan	7 (grain and stover harvest) 0 (grazing or forage)	Make no more than two sequential applications before switching to a fungicide with a different mode of action. Do not exceed 48.0 fl oz/a per year.		
propiconazole	<i>eye spot, gray leaf spot, rusts:</i> 4.0 fl oz AmTide Propiconazole 41.8% EC, Bumper 41.8 EC, Propicure 3.6F, PropiMax EC, Tilt, Topaz <i>Helminthosporium leaf blights, northern corn leaf blight, northern corn leaf spot, southern corn leaf blight:</i> 2.0–4.0 fl oz AmTide Propiconazole 41.8% EC, Bumper 41.8 EC, Propicure 3.6F, PropiMax EC, Tilt, Topaz	14	Apply when disease first appears and continue at 7- to 14-day intervals. Do not apply more than 16.0 fl oz/a per season. Do not harvest sweet corn for forage within 14 days of application.		
		14			
tebuconazole	4.0–6.0 fl oz Folicur 3.6 F, Monsoon, Onset 3.6L, Orius 3.6F, TebuStar 3.6L, Tebusha 3.6FL, Tebuzol, Toledo	7	Do not exceed 24.0 fl oz/a per season. Restricted entry interval is 19 days. May be applied up to 7 days before the harvest of ears or forage, and 49 days before the harvest of fodder.		
Maize dwarf mosaic	<i>Plant tolerant or resistant varieties. Early plantings generally are less susceptible to this disease.</i>				
Seed rot and damping-off	captan	Seed corn should always be treated with a fungicide. Follow manufacturer's directions for rate and use. Do not use treated seed for feed or food.			
	thiram				

(continued)

Pepper

Potato

Pumpkin & squash

Sweet corn

Table beet

Tomato

Insect keys

Disease control in sweet corn (continued)

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Smut	There is no satisfactory control for smut. Later, larger-growing varieties tend to have less infection than early, small varieties. Avoid excessive nitrogen or manure. Not poisonous to livestock or people.			
White line mosaic	Occurs more in soils that have high moisture content. Varieties resistant to this virus have not been identified.			

Scouting calendar for insect pests of sweet corn

	April			May			June			July			August			September		
	early	mid	late	early	mid	late	early	mid	late	early	mid	late	early	mid	late	early	mid	late
Armyworms	[Active]												[Active]			[Active]		
Cutworms	[Active]						[Active]			[Active]			[Active]			[Active]		
Flea beetles	[Active]									[Active]			[Active]			[Active]		
	[Active]						European corn borer, 1st gen.			European corn borer, 2nd gen.			[Active]			[Active]		
	[Active]						Corn leaf aphids											
	[Active]						Stalk borer larvae						[Active]			[Active]		
	[Active]						Hop vine borer larvae						[Active]			[Active]		
	[Active]						Corn rootworm, larvae			adults			←egg laying begins			[Active]		
	[Active]						Western bean cutworm						[Active]			[Active]		
	[Active]						[Active]						Corn earworm			[Active]		
	[Active]						[Active]						[Active]			Fall armyworm		

Spray schedule for corn earworm (CEW) based on nightly trap catches of moths

CEW moths per night		
in blacklight trap	in pheromone trap*	Treatment
<5	<10	No treatment needed.
5–24	10–99	Treat vulnerable corn (row tassel to 100% silk) with an effective CEW insecticide, reapplying every 2–5 days until brown silks appear.
25–100	100–500	Treat silking corn until brown silk. Corn should be treated on a 2- to 3-day schedule as long as trap catches remain high.
>100	>500	Treat silking corn with most effective CEW insecticide until brown silk. Corn should be treated on a 1- to 2-day schedule as long as trap catches remain high.

Adapted from Foster and Flood (eds.), *Vegetable Insect Management* (Willoughby, OH: Meister Publishing, 2005).

*Pheromone traps and lures for CEW can be ordered at Great Lakes IPM: www.greatlakesipm.com.

Spray schedule for European corn borer (ECB) based on blacklight trap catches of moths

ECB moths trapped per night	Treatment
<10	No treatment needed. Moths probably not laying enough eggs to justify a treatment program, but keep monitoring silking sweet corn for egg laying. Be aware that catches may increase in near future.
10–100 for 3 consecutive nights	Moths are laying eggs. Sweet corn is in a vulnerable stage (pre-row tassel to brown silk). Treat with insecticide. If you are catching female ECB moths in blacklight trap, eggs are already in the field.
>100	This is a reinfestation flight. Moths are laying high numbers of eggs in the field. If sweet corn is in vulnerable stage, apply an insecticide, even if previously treated. Repeat treatment every 5–7 days (depending on temperature) until brown silk.

Adapted from Foster and Flood (eds.), *Vegetable Insect Management* (Willoughby, OH: Meister Publishing, 2005); and R. Foster, *Managing Insects in Commercially Grown Sweet Corn* (Purdue Extension Publication E-98-W, 2008).

Insect control in sweet corn

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Aphids	<i>Corn leaf aphids can occur in large numbers on tassels of sweet corn plants. Treat fields if field is less than 50% pollinated and at least 50% of the plants are infested with at least 50 aphids per plant.</i>			
	azadirachtin	Neemazad EC, Neemix 4.5, Trilogy	0	See label for rate. Suppression and adult feeding deterrence; apply every 7–10 days.
	0.033–0.10 lb bifenthrin	2.1–6.4 fl oz *Brigade 2EC	1	Do not exceed 12.8 fl oz/a (0.2 lb ai/a) per season. Do not graze or use treated crops for feed within 1 day of last application.
	0.5–1.0 lb chlorpyrifos	1.0–2.0 pt *Lorsban Advanced	21	Do not make more than three applications of any product containing chlorpyrifos per season. Do not apply more than 6.0 pt/a Lorsban (3.0 lb ai/a) per season. Do not make a sequential application of a chlorpyrifos-containing product within 10 days of previous application.
	chlorpyrifos + lambda-cyhalothrin	11.0–26.0 fl oz *Cobalt Advanced	21	Do not exceed 129.0 fl oz Cobalt Advanced (2.5 lb ai chlorpyrifos and 0.13 lb ai lambda-cyhalothrin) per acre per season. Do not make more than three applications of Cobalt Advanced or other products containing chlorpyrifos per season.
	0.25 mg clothianidin/ kernel	1.13 fl oz Poncho 600/80,000 seeds	seed treatment	Early season protection. Purchase treated seed from seed dealer or seed treatment representative.
	0.018–0.028 lb deltamethrin	1.5–2.4 fl oz *Delta Gold 1.5EC	1	For suppression only. Do not exceed 38.4 fl oz/a (0.45 lb ai/a) per season. See label for grazing and feed restrictions.
	0.03–0.05 lb esfenvalerate	5.8–9.6 fl oz *Asana XL	1	Do not exceed 0.5 lb ai/a per season.
	0.01–0.015 lb gamma-cyhalothrin	2.56–3.84 fl oz *Proaxis	1	Suppression only. Do not apply more than 3.84 pt/a (0.24 lb ai/a) per season. See label for resistance statement plus grazing and forage feed restrictions.
	3.2–6.4 fl oz imidacloprid/ 100 lb seed	16–20 fl oz Gaucho 600/100 lb seed	seed treatment	Early season protection. Purchase treated seed from seed dealer or seed treatment representative.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4	Suppression only. Do not exceed 0.48 lb ai/a. See label for resistance statement plus grazing and forage feed restrictions.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Besiege	1	For suppression only. Do not apply more than 31.0 fl oz of Besiege or 0.48 lb ai of lambda-cyhalothrin containing products or 0.2 lb ai of chlorantraniliprole containing products per acre per year.
	methyl parathion	2.0–3.0 pt *PennCap-M 2FL	4 (ears) 12 (forage)	Do not apply if bees are foraging in the areas to be treated. Do not exceed 12.0 pt/a per year.
	0.0175–0.025 lb zeta-cypermethrin	2.8–4.0 oz *Mustang Max	3	Do not exceed 24.0 fl oz/a Mustang Max (0.15 lb ai/a) per season.

*Restricted-use pesticide.

(continued)

Pepper

Potato

Pumpkin & squash

Sweet corn

Table beet

Tomato

Insect keys

Insect control in sweet corn *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Aphids <i>(cont.)</i>	zeta-cypermethrin + bifenthrin + imidacloprid	3.5–10.3 fl oz *Triple Crown	3	Do not apply more than 20.5 fl oz/a Triple Crown (0.36 lb ai/a) per crop season. Refer to the maximum usage tables when applying more than one product containing either zeta-cypermethrin or bifenthrin or imidacloprid to this crop. Do not graze livestock in treated area or cut treated crops for feed within 30 days of treatment.
	zeta-cypermethrin + chlorpyrifos	9.25–11.75 fl oz *Stallion	21	Aphid control may be variable depending on species present and host-plant relationships. A maximum of 11.75 fl oz of product may be applied per acre (0.025 lb/a zeta-cypermethrin + 0.25 lb/a chlorpyrifos). Refer to the maximum usage tables on the label when applying more than one product containing either zeta-cypermethrin or chlorpyrifos to this crop.
Armyworms	<i>Treat when there are two or more armyworms per plant on 25% of plants or there is one per plant on 75% of the plants and armyworms are 3/4 inch or smaller in length.</i>			
	<i>Bacillus thuringiensis</i> (granular formulations)	Agree WG, Biobit, DiPel, Javelin, others	0	See label for rate. Apply as needed to maintain control.
	0.013–0.022 lb beta-cyfluthrin	1.6–2.8 fl oz *Baythroid XL	0	For control of first and second instar larvae. Do not exceed 28.0 fl oz/a (0.22 lb ai/a) per season.
	0.033–0.10 lb bifenthrin	2.1–6.4 fl oz *Brigade 2EC	1	Do not exceed 12.8 fl oz/a (0.2 lb ai/a) per season. Do not graze or use treated crops for feed within 1 day of last application.
	carbaryl	1.0–2.0 qt Sevin XLR Plus	2 (ears) 14 (forage) 48 (fodder)	Highly toxic to bees; see label for details on protecting them. Do not exceed 16.0 qt/a per season.
	0.045–0.065 lb chlorantraniliprole	3.5–5.0 fl oz Coragen	1	Do not apply more than 15.4 fl oz Coragen or 0.2 lb ai of chlorantraniliprole containing products per acre per crop.
	0.5–1.0 lb chlorpyrifos	1.0–2.0 pt *Lorsban Advanced	21	Do not make more than three applications of any product containing chlorpyrifos per season. Do not apply more than 6.0 pt/a Lorsban (3.0 lb ai/a) per season. Do not make a sequential application of a chlorpyrifos-containing product within 10 days of previous application.
	chlorpyrifos + lambda-cyhalothrin	11.0–26.0 fl oz *Cobalt Advanced	21	Do not exceed 129.0 fl oz Cobalt Advanced (2.5 lb ai chlorpyrifos and 0.13 lb ai lambda-cyhalothrin) per acre per season. Do not make more than three applications of Cobalt Advanced or other products containing chlorpyrifos per season.
	0.018–0.028 lb deltamethrin	1.5–2.4 fl oz *Delta Gold 1.5EC	1	Apply to early instar larvae. Do not exceed 38.4 fl oz/a (0.45 lb ai/a) per season. See label for grazing and feed restrictions.
	0.03–0.05 lb esfenvalerate	5.8–9.6 fl oz *Asana XL	1	Do not exceed 0.5 lb ai/a per season.
	flubendiamide	2.0–3.0 fl oz Belt SC	1	Do not apply more than 12.0 fl oz/a (0.375 lb ai/a) per crop season.

*Restricted-use pesticide.

(continued)

Insect control in sweet corn *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Armyworms <i>(cont.)</i>	0.01–0.015 lb gamma-cyhalothrin	2.56–3.84 fl oz *Proaxis	1	For control of first and second instars only. Do not apply more than 3.84 pt/a (0.24 lb ai/a) per season. See label for grazing and forage feed restrictions.
	0.045–0.065 lb indoxacarb	2.5–3.5 fl oz Avaunt	3 (food) 35 (forage)	For use on fall armyworm. Apply from whorl stage through tassel emergence (before silking). Do not apply more than 14.0 oz/a (0.26 lb ai/a) per crop. Do not exceed four applications per season. Allow at least 3 days between sprays. Re-entry interval is 12 hours; 14 days for hand harvesting. See label for grazing and forage use restrictions.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4	Use higher rates for large larvae. Do not apply more than 0.48 lb ai/a per crop. See label for grazing and forage feed restrictions.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Besiege	1	Use higher rates within the listed rate range for large larvae. Do not apply more than 31.0 fl oz of Besiege or 0.48 lb ai of lambda-cyhalothrin containing products or 0.2 lb ai of chlorantraniliprole containing products per acre per year.
	0.225–0.45 lb methomyl	0.75–1.5 pt *Lannate LV	0 (ears) 3 (forage) 21 (stover)	Certain hybrids are susceptible to methomyl injury. Treat a small area to determine crop safety before full-scale spraying. Do not apply more than 21.0 pt/a or make more than 28 applications per crop. Allow at least 1 day between treatments.
	0.06–0.12 lb methoxyfenozide	4.0–8.0 fl oz Intrepid 2F	3 (ears, green chop) 21 (fodder)	Apply when infestations have reached economic threshold. For heavy infestations, reapply at 5- to 10-day intervals. Do not exceed 16.0 fl oz/a per application or 64.0 fl oz/a (1.0 lb ai/a) per season.
	methyl parathion	2.0–3.0 pt *PennCap-M	4 (ears) 12 (forage)	Do not apply if bees are foraging in areas to be treated. Do not apply more than 12.0 pt/a per year.
	0.1–0.2 lb permethrin	*Ambush, *Pounce	1	Several formulations; see label for rate. Do not exceed 1.2 lb ai/a per season.
	0.023–0.047 lb spinetoram	3.0–6.0 fl oz Radiant SC	1	Do not make more than six applications per crop or exceed 0.281 lb ai/a per season. Wait at least 4 days between treatments and 3 days before harvesting for forage or fodder.
	spinosad	1.67–3.3 fl oz Blackhawk 1.5–6.0 fl oz Entrust SC	1 (grain) 7 (forage) 28 (fodder)	Scout for armyworms with enough regularity to monitor egg laying and egg hatch. Time applications to coincide with peak egg hatch of each generation. A 5- to 7-day re-treatment schedule may be necessary if the crop is growing rapidly or if there is heavy pest pressure. Do not apply more than a total of 0.45 lb ai of spinosad (20.0 fl oz of Blackhawk or 29.0 fl oz of Entrust SC). Do not make more than six applications per calendar year.

*Restricted-use pesticide.

(continued)

Pepper

Potato

Pumpkin & squash

Sweet corn

Table beet

Tomato

Insect keys

Insect control in sweet corn *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Armyworms <i>(cont.)</i>	0.0175–0.025 lb zeta-cypermethrin	2.8–4.0 oz *Mustang Max	3	Do not exceed 24.0 oz/a Mustang Max (0.15 lb ai/a) per season.
	0.04–0.10 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	3	Do not exceed 0.266 lb ai/a per season.
	zeta-cypermethrin + bifenthrin + imidacloprid	4.5–10.3 fl oz *Triple Crown	3	Do not apply more than 20.5 fl oz/a Triple Crown (0.36 lb ai/a) per crop season. Refer to the maximum usage tables when applying more than one product containing either zeta-cypermethrin or bifenthrin or imidacloprid to this crop. Do not graze livestock in treated area or cut treated crops for feed within 30 days of treatment.
	zeta-cypermethrin + chlorpyrifos	9.25–11.75 fl oz *Stallion	21	A maximum of 11.75 fl oz of product may be applied per acre (0.025 lb/a zeta-cypermethrin + 0.25 lb/a chlorpyrifos). Refer to the maximum usage tables on the label when applying more than one product containing either zeta-cypermethrin or chlorpyrifos to this crop.
Corn earworm	<i>Treat as soon as silks begin to appear and pheromone trap catches indicate threshold levels have been exceeded. Check traps at least every other day when moths are present. Refer to spray schedule above for timing recommendations. Make ground application in 25 gal of water/a with at least 100 psi. Direct nozzles at silks from each side of the row. Make aerial applications in 4–5 gal water/a.</i>			
	<i>Bacillus thuringiensis</i> (granular formulations)	Agree WG, Biobit, DiPel, Javelin, others (see label rates)	0	First generation larvae. Larvae must be actively feeding on treated, exposed plant surfaces. Thorough spray coverage is needed. Repeat as needed every 3–14 days, depending on plant growth rate, moth activity, rainfall, and other factors.
	0.013–0.022 lb beta-cyfluthrin	1.6–2.8 fl oz *Baythroid XL	0	Application must be made before larvae bore into plants. Do not exceed 28.0 fl oz/a (0.22 lb ai/a) per season.
	0.033–0.10 lb bifenthrin	2.1–6.4 fl oz *Brigade 2EC	1	Do not exceed 12.8 fl oz/a (0.2 lb ai/a) per season. Do not graze or use treated crops for feed within 1 day of last application.
	0.045–0.065 lb chlorantraniliprole	3.5–5.0 fl oz Coragen	1	Do not apply more than 15.4 fl oz Coragen or 0.2 lb ai of chlorantraniliprole containing products per acre per crop.
	chlorpyrifos + lambda-cyhalothrin	16.0–38.0 fl oz *Cobalt Advanced	21	Do not exceed 129.0 fl oz Cobalt Advanced (2.5 lb ai chlorpyrifos and 0.13 lb ai lambda-cyhalothrin) per acre per season. Do not make more than three applications of Cobalt Advanced or other products containing chlorpyrifos per season.
	0.018–0.028 lb deltamethrin	1.5–2.4 fl oz *Delta Gold 1.5EC	1	Apply to early instar before larvae bore into plants. Apply as needed from tassel emergence to silk dry down. Do not exceed 38.4 fl oz/a (0.45 lb ai/a) per season. See label for grazing and feed restrictions.
	0.03–0.05 lb esfenvalerate	5.8–9.6 fl oz *Asana XL	1	Do not exceed 0.5 lb ai/a per season.
	flubendiamide	2.0–3.0 fl oz Belt SC	1	Do not apply more than 12.0 fl oz/a (0.375 lb ai/a) per crop season.

*Restricted-use pesticide.

(continued)

Insect control in sweet corn *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Corn earworm <i>(cont.)</i>	0.01–0.015 lb gamma-cyhalothrin	2.56–3.84 oz *Proaxis	1	Do not apply more than 3.84 pt/a (0.24 lb ai/a) per season. See label for grazing and forage feed restrictions.
	0.045–0.065 lb indoxacarb	2.5–3.5 fl oz Avaunt	3 (ears) 35 (forage)	Do not exceed four applications per season. Apply from whorl stage through tassel push (prior to silking) only. Do not apply more than 14.0 oz/a (0.26 lb ai/a) per crop. Allow at least 3 days between sprays.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4	Treat if populations reach economic threshold and before larvae enter the stalk or ear. Do not apply more than 0.48 lb ai/a per crop. See label for grazing and forage feed restrictions.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Besiege	1	Do not apply more than 31.0 fl oz of Besiege or 0.48 lb ai of lambda-cyhalothrin containing products or 0.2 lb ai of chlorantraniliprole containing products per acre per year.
	0.225–0.45 lb methomyl	0.75–1.5 pt *Lannate LV	0 (ears) 3 (forage) 21 (stover)	Certain hybrids are susceptible to methomyl injury. Treat a small area to determine crop safety before full-scale spraying. Do not apply more than 21.0 pt/a or make more than 28 applications per crop. Allow at least 1 day between treatments.
	nuclear polyhedrosis insecticidal virus	4.0–10.0 fl oz Gemstar LC	0	Application should be made from early vegetative growth stage to tasseling and before silks emerge. Retreatment may be required at 2- to 3-day intervals.
	0.1–0.2 lb permethrin	*Ambush, *Pounce	1	Several formulations; see label for rate. Do not exceed 1.2 lb ai/a per season.
	0.023–0.047 lb spinetoram	3.0–6.0 fl oz Radiant SC	1 (food) 3 (forage, fodder)	Do not make more than six applications per crop. Do not exceed 0.281 lb ai/a per season. Wait at least 4 days between treatments.
	spinosad	2.2–3.3 fl oz Blackhawk 3.0–6.0 fl oz Entrust SC	1 (grain) 7 (forage) 28 (fodder)	Time applications of Blackhawk to coincide with peak egg hatch of each generation. Frequent treatments may be necessary when the crop is growing rapidly, during silking, or under heavy pressure. For corn earworm control, a 1- to 2-day re-treatment schedule may be necessary at silking. Do not apply more than a total of 0.45 lb ai of spinosad (20.0 fl oz of Blackhawk or 29.0 fl oz of Entrust SC). Do not make more than six applications per calendar year.
	0.0175–0.025 lb zeta-cypermethrin	2.8–4.0 oz *Mustang Max	3	Do not exceed 24.0 oz/a Mustang Max (0.15 lb ai/a) per season.
0.04–0.10 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	3	Do not exceed 0.266 lb ai/a per season.	

*Restricted-use pesticide.

(continued)

Pepper

Potato

Pumpkin & squash

Sweet corn

Table beet

Tomato

Insect keys

Insect control in sweet corn *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Corn earworm <i>(cont.)</i>	zeta-cypermethrin + bifenthrin + imidacloprid	4.5–10.3 fl oz *Triple Crown	3	Do not apply more than 20.5 fl oz/a Triple Crown (0.36 lb ai/a) per crop season. Refer to the maximum usage tables when applying more than one product containing either zeta-cypermethrin or bifenthrin or imidacloprid to this crop. Do not graze livestock in treated area or cut treated crops for feed within 30 days of treatment. Pyrethroid resistance is common for this pest. Contact your Extension specialist, certified crop consultant, or manufacturer for the latest resistance management information to determine if resistant pest populations are in your area. If so, refer to the resistance management section of this label.
	zeta-cypermethrin + chlorpyrifos	9.25–11.75 fl oz *Stallion	21	For control before the larva bores into the plant stalk or ear. A maximum of 11.75 fl oz of product may be applied per acre (0.025 lb/a zeta-cypermethrin + 0.25 lb/a chlorpyrifos). Refer to the maximum usage tables on the label when applying more than one product containing either zeta-cypermethrin or chlorpyrifos to this crop.
Corn flea beetle	<i>These tiny (less than 1/16 inch), black beetles transmit the bacterial disease Stewart's wilt. The pathogen overwinters in beetles, plant residue, and soil. During mild winters, enough flea beetles may survive in Wisconsin to lead to significant incidence of Stewart's wilt in the southern tier or two of counties.</i>			
	<i>To predict disease risk—and the need to scout for beetles—add the monthly average temperatures for December, January, and February. Scout seedling corn intensively if the total is greater than 90°F. Treatment may be warranted if you find an average of six or more beetles per 100 plants. Beetles readily jump from plants when disturbed.</i>			
	azadirachtin	Aza-Direct, Neemazad EC, Neemix 4.5, Trilogy	0	See label for rate. Apply every 7–10 days.
	0.007–0.013 lb beta-cyfluthrin	0.8–1.6 fl oz *Baythroid XL	0	
	0.033–0.10 lb bifenthrin	2.1–6.4 fl oz *Brigade 2EC	1	Do not exceed 12.8 fl oz/a (0.2 lb ai/a) per season. Do not graze or use crops for feed within 1 day of last treatment.
	carbaryl	1.0–2.0 qt Sevin XLR Plus	2 (ears) 14 (forage) 48 (fodder)	Highly toxic to bees; see label for details on protecting them. Do not exceed 16.0 qt/a per season.
	0.5–1.0 lb chlorpyrifos	1.0–2.0 pt *Lorsban Advanced	21	Do not make more than three applications of any product containing chlorpyrifos per season. Do not apply more than 6.0 pt/a Lorsban (3.0 lb ai/a) per season. Do not make a sequential application of a chlorpyrifos-containing product within 10 days of previous application.
	chlorpyrifos + lambda-cyhalothrin	11.0–26.0 fl oz *Cobalt Advanced	21	Do not exceed 129.0 fl oz Cobalt Advanced (2.5 lb ai chlorpyrifos and 0.13 lb ai lambda-cyhalothrin) per acre per season. Do not make more than three applications of Cobalt Advanced or other products containing chlorpyrifos per season.

*Restricted-use pesticide.

(continued)

Insect control in sweet corn *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Corn flea beetle <i>(cont.)</i>	0.25 mg clothianidin/ kernel	1.13 fl oz Poncho 600/80,000 seeds	seed treatment	Early season protection. Purchase treated seed from seed dealer or seed treatment representative.
	0.012–0.018 lb deltamethrin	1.0–1.5 fl oz *Delta Gold 1.5EC	1	Do not exceed 38.4 fl oz/a per season. See label for grazing and feed restrictions.
	0.03–0.05 lb esfenvalerate	5.8–9.6 fl oz *Asana XL	1	Do not exceed 0.5 lb ai/a per season.
	0.01–0.015 lb gamma-cyhalothrin	2.56–3.84 oz *Proaxis	1	Do not apply more than 3.84 pt/a (0.24 lb ai/a) per season. See label for grazing and forage use restrictions.
	3.2–6.4 fl oz imidacloprid/100 lb seed	16–20 fl oz Gaucho 600/100 lb seed	seed treatment	Early season protection. Purchase treated seed from seed dealer or seed treatment representative.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4	Do not exceed 0.48 lb ai/a per season. See label for grazing and forage feed restrictions.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Besiege	1	Do not apply more than 31.0 fl oz of Besiege or 0.48 lb ai of lambda-cyhalothrin containing products or 0.2 lb ai of chlorantraniliprole containing products per acre per year.
	methyl parathion	2.0–3.0 pt *PennCap-M	4 (ears) 12 (forage)	Do not apply if bees are foraging in the areas to be treated. Do not exceed 12.0 pt/a per year.
	0.125–0.80 mg thiamethoxam/kernel	Cruiser	seed treatment	Early season protection. Purchase treated seed from seed dealer or seed treatment representative.
	0.014–0.025 lb zeta-cypermethrin	2.24–4.0 fl oz *Mustang Max	3	Do not exceed 24.0 oz/a Mustang Max (0.15 lb ai/a) per season.
	0.04–0.10 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	3	Do not exceed 0.266 lb ai/a per season.
	zeta-cypermethrin + bifenthrin + imidacloprid	3.5–10.3 fl oz *Triple Crown	3	Do not apply more than 20.5 fl oz/a Triple Crown (0.36 lb ai/a) per crop season. Refer to the maximum usage tables when applying more than one product containing either zeta-cypermethrin or bifenthrin or imidacloprid to this crop. Do not graze livestock in treated area or cut treated crops for feed within 30 days of treatment.
	zeta-cypermethrin + chlorpyrifos	9.25–11.75 fl oz *Stallion	21	A maximum of 11.75 fl oz of product may be applied per acre (0.025 lb/a zeta-cypermethrin + 0.25 lb/a chlorpyrifos). Refer to the maximum usage tables on the label when applying more than one product containing either zeta-cypermethrin or chlorpyrifos to this crop.
Cutworms	<i>Treat when 5% of plants are cut.</i>			
	<i>Lorsban 15G, *Counter 15G, and *Mocap 15G soil insecticides are labeled for planting-time application for cutworm control. These products are relatively effective in controlling or suppressing light to moderate infestations. However, data for heavy infestations are limited and reports of unacceptable levels of damage from heavy infestations have occurred. Because of these factors and the difficulty of predicting cutworm outbreaks, do not use the "preventive approach." Field scouting and application of banded sprays is a better approach.</i>			
	0.007–0.013 lb beta-cyfluthrin	0.8–1.6 fl oz *Baythroid XL	0	Do not exceed 28.0 fl oz/a (0.22 lb ai/a) per season.

*Restricted-use pesticide.

(continued)

Pepper

Potato

Pumpkin &
squash

Sweet corn

Table beet

Tomato

Insect keys

Insect control in sweet corn *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Cutworms <i>(cont.)</i>	0.033–0.10 lb bifenthrin	2.1–6.4 fl oz *Brigade 2EC	1	Do not exceed 12.8 fl oz/a (0.2 lb ai/a) per season. Do not graze or use treated crops for feed within 1 day of last application.
	0.5–1.0 lb chlorpyrifos	1.0–2.0 pt *Lorsban Advanced	21	Do not make more than three applications of any product containing chlorpyrifos per season. Do not apply more than 6.0 pt/a (3.0 lb ai/a) per season. Do not make a sequential application of a chlorpyrifos-containing product within 10 days of previous application.
	chlorpyrifos + lambda-cyhalothrin	11.0–26.0 fl oz *Cobalt Advanced	21	Do not exceed 129.0 fl oz Cobalt Advanced (2.5 lb ai chlorpyrifos and 0.13 lb ai lambda-cyhalothrin) per acre per season. Do not make more than three applications of Cobalt Advanced or other products containing chlorpyrifos per season.
	0.25 mg clothianidin/kernel	1.13 fl oz Poncho 600/80,000 seeds	seed treatment	Early season protection. Purchase treated seed from seed dealer or seed treatment representative.
	0.010–0.018 lb deltamethrin	0.8–1.5 fl oz *Delta Gold 1.5EC	1	Do not exceed 38.4 fl oz/a (0.45 lb ai/a) per season. See label for grazing and feed restrictions.
	0.03–0.05 lb esfenvalerate	5.8–9.6 fl oz *Asana XL	1	Broadcast spray. Do not exceed 0.5 lb ai/a per season.
	flubendiamide	2.0–3.0 fl oz Belt SC	1	Do not apply more than 12.0 fl oz/a (0.375 lb ai/a) per crop season.
	0.01–0.015 lb gamma-cyhalothrin	2.56–3.84 oz *Proaxis	1	Do not apply more than 3.84 pt/a (0.24 lb ai/a) per season. See label for grazing and forage use restrictions.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4	Do not apply more than 0.48 lb ai/a per crop. See label for grazing and forage feed restrictions.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Besiege	1	Do not apply more than 31.0 fl oz of Besiege or 0.48 lb ai of lambda-cyhalothrin containing products or 0.2 lb ai of chlorantraniliprole containing products per acre per year.
	0.1–0.2 lb permethrin	*Ambush, *Pounce	1	Several formulations; see label for rate. Broadcast spray. Do not exceed 1.2 lb ai/a per season.
	0.125–0.80 mg thiamethoxam/kernel	Cruiser	seed treatment	Early season protection. Purchase treated seed from seed dealer or seed treatment representative.
	0.014–0.025 lb zeta-cypermethrin	2.24–4.0 fl oz *Mustang Max	3	Do not exceed 24.0 oz/a Mustang Max (0.15 lb ai/a) per season.
	0.04–0.10 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	3	Do not exceed 0.266 lb ai/a per season.

*Restricted-use pesticide.

(continued)

Insect control in sweet corn *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Cutworms <i>(cont.)</i>	zeta-cypermethrin + bifenthrin + imidacloprid	3.5–10.3 fl oz *Triple Crown	3	Do not apply more than 20.5 fl oz/a Triple Crown (0.36 lb ai/a) per crop season. Refer to the maximum usage tables when applying more than one product containing either zeta-cypermethrin or bifenthrin or imidacloprid to this crop. Do not graze livestock in treated area or cut treated crops for feed within 30 days of treatment.
	zeta-cypermethrin + chlorpyrifos	3.75–11.75 fl oz *Stallion	21	A maximum of 11.75 fl oz of product may be applied per acre (0.025 lb/a zeta-cypermethrin + 0.25 lb/a chlorpyrifos). Refer to the maximum usage tables on the label when applying more than one product containing either zeta-cypermethrin or chlorpyrifos to this crop.
European corn borer	<i>Scout every 5–7 days and sample at least five consecutive plants in 10 areas of a field. Treat if there is an average of one egg mass per 10 plants. Check traps at least every 2–3 days when moths are present. Refer to the spray schedule table above for treatment frequency based on trap catches.</i>			
	<i>Bacillus thuringiensis</i> (granular formulations)	Agree WG, Biobit, DiPel, Javelin, others (see label rates)	0	First generation larvae. Larvae must be actively feeding on treated, exposed plant surfaces. Thorough spray coverage is needed. Repeat as needed every 3–14 days, depending on plant growth rate, moth activity, rainfall, and other factors.
	0.013–0.022 lb beta-cyfluthrin	1.6–2.8 fl oz *Baythroid XL	0	Application must be made before larvae bore into plants. Do not exceed 28.0 fl oz/a (0.22 lb ai/a) per season.
	0.033–0.10 lb bifenthrin	2.1–6.4 fl oz *Brigade 2EC	1	Do not exceed 12.8 fl oz/a (0.2 lb ai/a) per season. Do not graze or use crops for feed within 1 day of last treatment.
	carbaryl	1.5–2.0 qt Sevin XLR Plus	2 (ears) 14 (forage) 48 (fodder)	Highly toxic to bees; see label for details on protecting them. Do not exceed 16.0 qt/a per season.
	0.045–0.065 lb chlorantraniliprole	3.5–5.0 fl oz Coragen	1	Do not apply more than 15.4 fl oz Coragen or 0.2 lb ai of chlorantraniliprole containing products per acre per crop.
	chlorpyrifos	Lorsban 15G	21	Recommended for first generation. See label for rates. Do not make more than three applications of any product containing chlorpyrifos per season, including the maximum allowed of two granular applications, at the 1.0 lb ai/a chlorpyrifos rate. Do not exceed 3.0 lb ai/a chlorpyrifos per season.
	1.0–2.0 pt *Lorsban Advanced	21	Do not make more than three applications of any product containing chlorpyrifos per season. Do not apply more than 6.0 pt/a Lorsban (3.0 lb ai/a) per season. Do not make a sequential application of a chlorpyrifos-containing product within 10 days of previous application.	

*Restricted-use pesticide.

(continued)

Pepper

Potato

Pumpkin & squash

Sweet corn

Table beet

Tomato

Insect keys

Insect control in sweet corn *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
European corn borer <i>(cont.)</i>	chlorpyrifos + lambda-cyhalothrin	16.0–38.0 fl oz *Cobalt Advanced	21	Do not exceed 129.0 fl oz Cobalt Advanced (2.5 lb ai chlorpyrifos and 0.13 lb ai lambda-cyhalothrin) per acre per season. Do not make more than three applications of Cobalt Advanced or other products containing chlorpyrifos per season.
	0.018–0.028 lb deltamethrin	1.5–2.4 fl oz *Delta Gold 1.5EC	1	Application must be made before larvae bore into plants. Do not exceed 38.4 fl oz/a (0.45 lb ai/a) per season. See label for grazing and feed restrictions.
Potato	0.03–0.05 lb esfenvalerate	5.8–9.6 fl oz *Asana XL	1	Second generation only. Do not exceed 0.5 lb ai/a per season.
	flubendiamide	2.0–3.0 fl oz Belt SC	1	Do not apply more than 12.0 fl oz/a (0.375 lb ai/a) per crop season.
Pumpkin & squash	0.01–0.015 lb gamma-cyhalothrin	2.56–3.84 oz *Proaxis	1	Do not apply more than 3.84 pt/a (0.24 lb ai/a) per season. See label for grazing and forage feed restrictions.
	0.045–0.065 lb indoxacarb	2.5–3.5 fl oz Avaunt	3 (food) 35 (forage)	Apply from whorl stage through tassel emergence (before silking). Do not apply more than 14.0 oz/a (0.26 lb ai/a) per crop. Do not exceed four applications per season. Allow at least 3 days between sprays. Re-entry interval is 12 hours; 14 days for hand harvesting. See label for grazing and forage use restrictions.
Sweet corn	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4	Treat if populations reach economic threshold and before larvae enter the stalk or ear. Do not apply more than 0.48 lb ai/a per crop. See label for grazing and forage feed restrictions.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Besiege	1	Do not apply more than 31.0 fl oz of Besiege or 0.48 lb ai of lambda-cyhalothrin containing products or 0.2 lb ai of chlorantraniliprole containing products per acre per year.
Table beet	0.22–0.45 lb methomyl	0.75–1.5 pt *Lannate LV	0 (ears) 3 (forage) 21 (stover)	Certain hybrids are susceptible to methomyl injury. Treat a small area to determine crop safety before full-scale spraying. Do not apply more than 21.0 pt/a or make more than 28 applications per crop. Allow at least 1 day between treatments.
	0.06–0.12 lb methoxyfenozide	4.0–8.0 fl oz Intrepid 2F	3 (ears, green chop) 21 (fodder)	Apply at egg hatch when infestations reach economic threshold levels. For early season (first-generation) infestations, direct application at the whorl. For mid- and late-season (second-generation) infestations, broadcast over the row. Do not exceed 16.0 fl oz/a per application or 64.0 fl oz/a (1.0 lb ai/a) per season.
Tomato	methyl parathion	2.0–3.0 pt *PennCap-M	4 (ears) 12 (forage)	Do not apply if bees are foraging in areas to be treated. Do not apply more than 12.0 pt/a per year.
Insect keys	0.1–0.2 lb permethrin	6.7–13.3 lb *Pounce 1.5G	1	Apply when eggs begin to hatch. Do not apply more than 1.2 lb ai/a per season.

*Restricted-use pesticide.

(continued)

Insect control in sweet corn *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
European corn borer <i>(cont.)</i>	0.1–0.25 lb permethrin	*Ambush, *Pounce	1	Second generation only. Several formulations; see label for rate. Do not exceed 1.2 lb ai/a per season.
	0.023–0.047 lb spinetoram	3.0–6.0 fl oz Radiant SC	1 (food) 3 (forage, fodder)	Do not make more than six applications per crop. Do not exceed 0.281 lb ai/a per season. Wait at least 4 days between treatments.
	spinosad	1.67–3.3 fl oz Blackhawk 1.5–6.0 fl oz Entrust SC	1 (grain) 7 (forage) 28 (fodder)	Time applications of Blackhawk to coincide with peak egg hatch of each generation. A 5- to 7-day re-treatment schedule may be necessary if the crop is growing rapidly or if there is heavy pest pressure. Do not apply more than a total of 0.45 lb ai of spinosad (20.0 fl oz of Blackhawk or 29.0 fl oz of Entrust SC). Do not make more than six applications per calendar year.
	0.0175–0.025 lb zeta-cypermethrin	2.8–4.0 oz *Mustang Max	3	Do not exceed 24.0 oz/a Mustang Max (0.15 lb ai/a) per season.
	0.04–0.10 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	3	Do not exceed 0.266 lb ai/a per season.
	zeta-cypermethrin + bifenthrin + imidacloprid	4.5–10.3 fl oz *Triple Crown	3	Do not apply more than 20.5 fl oz/a Triple Crown (0.36 lb ai/a) per crop season. Refer to the maximum usage tables when applying more than one product containing either zeta-cypermethrin or bifenthrin or imidacloprid to this crop. Do not graze livestock in treated area or cut treated crops for feed within 30 days of treatment.
	zeta-cypermethrin + chlorpyrifos	9.25–11.75 fl oz *Stallion	21	For control before the larva bores into the plant stalk or ear. A maximum of 11.75 fl oz of product may be applied per acre (0.025 lb/a zeta-cypermethrin + 0.25 lb/a chlorpyrifos). Refer to the maximum usage tables on the label when applying more than one product containing either zeta-cypermethrin or chlorpyrifos to this crop.
Grass-hoppers	<i>Treat fencerows adjacent to cornfields to prevent injury.</i>			
	0.016–0.022 lb beta-cyfluthrin	2.0–2.8 fl oz *Baythroid XL	0	Do not exceed 28.0 fl oz/a (0.22 lb ai/a) per season.
	0.25–0.50 lb chlorpyrifos	0.5–1.0 pt *Lorsban Advanced	21	Do not make more than three applications of any product containing chlorpyrifos per season. Do not apply more than 6.0 pt/a Lorsban (3.0 lb ai/a) per season. Do not make a sequential application of a chlorpyrifos-containing product within 10 days of previous application.
chlorpyrifos + lambda-cyhalothrin	6.0–13.0 fl oz *Cobalt Advanced	21	Do not exceed 129.0 fl oz Cobalt Advanced (2.5 lb ai chlorpyrifos and 0.13 lb ai lambda-cyhalothrin) per acre per season. Do not make more than three applications of Cobalt Advanced or other products containing chlorpyrifos per season.	

*Restricted-use pesticide.

(continued)

Pepper

Potato

Pumpkin & squash

Sweet corn

Table beet

Tomato

Insect keys

Insect control in sweet corn *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Grasshoppers (cont.)	0.012–0.018 lb deltamethrin	1.0–1.5 fl oz *Delta Gold 1.5EC	1	Do not exceed 38.4 fl oz/a per season. See label for grazing and feed restrictions.
	0.03–0.05 lb esfenvalerate	5.8–9.6 fl oz *Asana XL	1	Do not exceed 0.5 lb ai/a per season.
	0.01–0.015 lb gamma-cyhalothrin	2.56–3.84 oz *Proaxis	1	Do not apply more than 3.84 pt/a (0.24 lb ai/a) per season. See label for grazing and forage use restrictions.
Potato	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4	Do not exceed 0.48 lb ai/a. See label for grazing and forage feed restrictions.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Besiege	1	Do not apply more than 31.0 fl oz of Besiege or 0.48 lb ai of lambda-cyhalothrin containing products or 0.2 lb ai of chlorantraniliprole containing products per acre per year.
Pumpkin & squash	methyl parathion	2.0–3.0 pt *PennCap-M	4 (ears) 12 (forage)	Use higher rates if the majority of grasshoppers are large or the weather is cool. Do not apply if bees are foraging in the areas to be treated. Do not exceed 12.0 pt/a per year.
	0.0175–0.025 lb zeta-cypermethrin	2.8–4.0 fl oz *Mustang Max	3	Do not exceed 24.0 oz/a Mustang Max (0.15 lb ai/a) per season.
Sweet corn	0.04–0.10 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	3	Do not exceed 0.266 lb ai/a per season.
	zeta-cypermethrin + bifenthrin + imidacloprid	4.5–10.3 fl oz *Triple Crown	3	Do not apply more than 20.5 fl oz/a Triple Crown (0.36 lb ai/a) per crop season. Refer to the maximum usage tables when applying more than one product containing either zeta-cypermethrin or bifenthrin or imidacloprid to this crop. Do not graze livestock in treated area or cut treated crops for feed within 30 days of treatment.
	zeta-cypermethrin + chlorpyrifos	9.25–11.75 fl oz *Stallion	21	A maximum of 11.75 fl oz of product may be applied per acre (0.025 lb/a zeta-cypermethrin + 0.25 lb/a chlorpyrifos). Refer to the maximum usage tables on the label when applying more than one product containing either zeta-cypermethrin or chlorpyrifos to this crop.
Rootworm larvae	<p><i>Spread insecticide granules or spray in a 7-inch band over the corn row in front of the packing wheel. Only chlorethoxyfos, chlorpyrifos, tebupirimphos, and terbufos may be placed in the seed furrows. Cover spilled granules with soil to reduce chance of bird and mammal exposure.</i></p> <p><i>For postemergence row treatment, *Counter, Lorsban, or *Thimet granules can be applied at the base of stalks with a cultivator applicator at labeled rates and covered lightly with soil. This treatment should be made by mid-June and is suggested only as a rescue treatment because dry weather following application can limit insecticide activation giving marginal control. Planting time treatments are preferred.</i></p>			
Tomato	0.0046 lb bifenthrin/1,000 ft row	0.3 fl oz/1,000 ft row *Brigade 2EC	30	Apply as a 5- to 7-inch T-band treatment over open seed furrow.
	0.0046–0.0057 lb bifenthrin/1,000 ft row	0.39–0.49 fl oz *Capture LFR	30	Apply as a 5- to 7-inch T-band treatment over open seed furrow.

*Restricted-use pesticide.

(continued)

Insect control in sweet corn *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Rootworm larvae <i>(cont.)</i>	1.0–1.3 lb chlorpyrifos	6.0–8.0 oz Lorsban 15G/1,000 ft row	21	Do not exceed 8.0 oz/1,000 ft of row (1.3 lb ai/a) at planting. Do not make more than three applications of any product containing chlorpyrifos per season. Do not exceed 3.0 lb ai/a chlorpyrifos per season.
	0.005 lb lambda-cyhalothrin/1,000 ft row	0.33 fl oz/1,000 ft row *Warrior II	21	Do not apply more than 0.09 lb ai (5.76 fl oz or 0.36 pt) per acre per crop at plant.
	phorate	4.5–6.0 oz *Thimet 20-G/1,000 ft row	30	Apply in a 7-inch band in seed furrow.
	tebupirimphos + cyfluthrin	6.7 oz *Aztec 2.1G/1,000 ft row		Apply in 7-inch band or seed furrow. Within 20 yards of aquatic areas, make in-furrow applications only.
	tefluthrin	4.0–5.0 oz *Force 3G/1,000 ft row 0.46–0.57 oz *Force CS/1,000 ft row		Apply in 7-inch band or seed furrow.
	terbufos	8.0 oz *Counter 15G/1,000 ft row	60	Do not exceed 8.7 lb/a Counter per season. If application is made at planting, do not apply postemergence or at cultivation. Do not use ALS-inhibiting herbicides if using Counter at planting.
Rootworm beetle	<i>Treat if five or more beetles per plant (check silks) before 75% silking, and silks are being pruned to within 1/2 inch of the husk.</i>			
	0.013–0.022 lb beta-cyfluthrin	1.6–2.8 fl oz *Baythroid XL	0	Do not exceed 28.0 fl oz/a (0.22 lb ai/a) per season.
	0.033–0.10 lb bifenthrin	2.1–6.4 fl oz *Brigade 2EC	1	Do not exceed 12.8 fl oz/a (0.2 lb ai/a) per season. Do not graze or use crops for feed within 1 day of last treatment.
	carbaryl	1.0–2.0 qt Sevin XLR Plus	2 (ears) 14 (forage) 48 (fodder)	Highly toxic to bees; see label for details on protecting them. Do not exceed 16.0 qt/a per season.
	1.0 lb chlorpyrifos	2.0 pt *Lorsban Advanced	21	Do not make more than three applications of any product containing chlorpyrifos per season. Do not apply more than 6.0 pt/a (3.0 lb ai/a) per season. Do not make a sequential application of a chlorpyrifos-containing product within 10 days of previous application.
	chlorpyrifos + lambda-cyhalothrin	11.0–26.0 fl oz *Cobalt Advanced	21	Do not exceed 129.0 fl oz Cobalt Advanced (2.5 lb ai chlorpyrifos and 0.13 lb ai lambda-cyhalothrin) per acre per season. Do not make more than three applications of Cobalt Advanced or other products containing chlorpyrifos per season.
	0.018–0.028 lb deltamethrin	1.5–2.4 fl oz *Delta Gold 1.5EC	1	For suppression only. Do not exceed 38.4 fl oz/a (0.45 lb ai/a) per season. See label for grazing and feed restrictions.
	0.03–0.05 lb esfenvalerate	5.8–9.6 fl oz *Asana XL	1	Do not exceed 0.5 lb ai/a per season.
	0.01–0.015 lb gamma-cyhalothrin	2.56–3.84 oz *Proaxis	1	Do not exceed 3.84 pt/a (0.24 lb ai/a) per season. See label for grazing and forage use restrictions.

*Restricted-use pesticide.

(continued)

Pepper

Potato

Pumpkin & squash

Sweet corn

Table beet

Tomato

Insect keys

Insect control in sweet corn *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Rootworm beetle <i>(cont.)</i>	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4	Apply as required by scouting and insect populations reaching economic threshold. Do not exceed 0.48 lb ai/a. See label for grazing and forage feed restrictions.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Besiege	1	Do not apply more than 31.0 fl oz of Besiege or 0.48 lb ai of lambda-cyhalothrin containing products or 0.2 lb ai of chlorantraniliprole containing products per acre per year.
	0.22–0.45 lb methomyl	0.75–1.5 pt *Lannate LV	0 (ears) 3 (forage) 21 (stover)	Certain hybrids are susceptible to methomyl injury. Treat a small area to determine crop safety before full-scale spraying. Do not apply more than 21.0 pt/a or make more than 28 applications per crop. Allow at least 1 day between treatments.
Sap (picnic) beetles	0.25–0.5 lb methyl parathion	1.0–2.0 pt *Penncap-M	4 (ears) 12 (forage)	Do not apply if bees are foraging in areas to be treated. Do not apply more than 12.0 pt/a per year.
	0.1–0.2 lb permethrin	*Ambush EC, *Pounce EC	1	Several formulations; see label for rate. Do not exceed 1.2 lb ai/a per season.
	0.014–0.025 lb zeta-cypermethrin	2.24–4.0 fl oz *Mustang Max	3	Do not exceed 24.0 oz/a Mustang Max (0.15 lb ai/a) per season.
Table beet	0.04–0.10 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	3	Do not exceed 0.266 lb ai/a per season.
	zeta-cypermethrin + bifenthrin + imidacloprid	4.5–10.3 fl oz *Triple Crown	3	Do not apply more than 20.5 fl oz/a Triple Crown (0.36 lb ai/a) per crop season. Refer to the maximum usage tables when applying more than one product containing either zeta-cypermethrin or bifenthrin or imidacloprid to this crop. Do not graze livestock in treated area or cut treated crops for feed within 30 days of treatment.
	zeta-cypermethrin + chlorpyrifos	9.25–11.75 fl oz *Stallion	21	A maximum of 11.75 fl oz of product may be applied per acre (0.025 lb/a zeta-cypermethrin + 0.25 lb/a chlorpyrifos). Refer to the maximum usage tables on the label when applying more than one product containing either zeta-cypermethrin or chlorpyrifos to this crop.
Tomato	carbaryl	1.0–2.0 qt Sevin XLR Plus	2 (ears) 14 (forage) 48 (fodder)	Highly toxic to bees; see label for details on protecting them. Do not exceed 16.0 qt/a per season.
	chlorpyrifos + lambda-cyhalothrin	16.0–38.0 fl oz *Cobalt Advanced	21	Do not exceed 129.0 fl oz Cobalt Advanced (2.5 lb ai chlorpyrifos and 0.13 lb ai lambda-cyhalothrin) per acre per season. Do not make more than three applications of Cobalt Advanced or other products containing chlorpyrifos per season.
Insect keys	0.03–0.05 lb esfenvalerate	5.8–9.6 fl oz *Asana XL	1	Do not exceed 0.5 lb ai/a per season.

*Restricted-use pesticide.

(continued)

Insect control in sweet corn *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Sap (picnic) beetles <i>(cont.)</i>	0.01–0.015 lb gamma-cyhalothrin	2.56–3.84 oz *Proaxis	1	Do not apply more than 3.84 pt/a (0.24 lb ai/a) per season. See label for grazing and forage use restrictions.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4	Apply when insect populations reach economic thresholds and before larvae enter the plant. Do not exceed 0.48 lb ai/a. See label for grazing and forage feed restrictions.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Besiege	1	Do not apply more than 31.0 fl oz of Besiege or 0.48 lb ai of lambda-cyhalothrin containing products or 0.2 lb ai of chlorantraniliprole containing products per acre per year.
	0.22–0.45 lb methomyl	0.75–1.5 pt *Lannate LV	0 (ears) 3 (forage) 21 (stover)	Certain hybrids are susceptible to methomyl injury. Treat a small area to determine crop safety before full-scale spraying. Do not apply more than 21.0 pt/a or make more than 28 applications per crop. Allow at least 1 day between treatments.
	methyl parathion	2.0–3.0 pt *PennCap-M	4 (ears) 12 (forage)	Do not apply if bees are foraging in areas to be treated. Do not apply more than 12.0 pt/a per year.
	0.014–0.025 lb zeta-cypermethrin	2.24–4.0 fl oz *Mustang Max	3	Do not exceed 24.0 oz/a Mustang Max (0.15 lb ai/a) per season.
	0.04–0.10 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	3	Do not exceed 0.266 lb ai/a per season.
	zeta-cypermethrin + bifenthrin + imidacloprid	4.5–10.3 fl oz *Triple Crown	3	Do not apply more than 20.5 fl oz/a Triple Crown (0.36 lb ai/a) per crop season. Refer to the maximum usage tables when applying more than one product containing either zeta-cypermethrin or bifenthrin or imidacloprid to this crop. Do not graze livestock in treated area or cut treated crops for feed within 30 days of treatment.
	zeta-cypermethrin + chlorpyrifos	9.25–11.75 fl oz *Stallion	21	A maximum of 11.75 fl oz of product may be applied per acre (0.025 lb/a zeta-cypermethrin + 0.25 lb/a chlorpyrifos). Refer to the maximum usage tables on the label when applying more than one product containing either zeta-cypermethrin or chlorpyrifos to this crop.
Seed beetles	1.3 lb chlorpyrifos	8.0 oz Lorsban 15G/1,000 ft row	21	Do not exceed 8.0 oz/1,000 ft row or 1.3 lb ai/a at-plant. Do not make more than three applications of any product containing chlorpyrifos per season. Do not apply more than 3.0 lb/a chlorpyrifos per season.
	chlorpyrifos + lambda-cyhalothrin	2.87 fl oz *Cobalt Advanced/1,000 ft row	21	Do not exceed 129.0 fl oz Cobalt Advanced (2.5 lb ai chlorpyrifos and 0.13 lb ai lambda-cyhalothrin) per acre per season. Do not make more than three applications of Cobalt Advanced or other products containing chlorpyrifos per season.

*Restricted-use pesticide.

(continued)

Pepper

Potato

Pumpkin & squash

Sweet corn

Table beet

Tomato

Insect keys

Insect control in sweet corn *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Seed beetles <i>(cont.)</i>	permethrin	1.5 oz Kernel Guard Supreme/42 lb seed	0	Planter box treatment.
	phorate	4.5–6.0 oz *Thimet 20-G/1,000 ft row	30	Apply in 7-inch band.
	tebupirimphos + cyfluthrin	6.7 oz *Aztec 2.1G/1,000 ft row		Apply in 7-inch band or seed furrow. Within 20 yards of aquatic areas, make in-furrow applications only.
	terbufos	8.0 oz *Counter 15G/1,000 ft row	60	Do not exceed 8.7 lb/a per season. If application is made at planting, do not apply postemergence or at cultivation. DO NOT use ALS-inhibiting herbicides if Counter has been applied at planting.
	zeta-cypermethrin + bifenthrin + imidacloprid	0.64 fl oz *Triple Crown/1,000 ft row	3	Do not apply to soil where there is greater than 30% cover of crop residue remaining. Do not graze livestock in treated area or cut treated crops for feed within 30 days of treatment. Do not apply more than 0.2 lb ai/a per season as an at-plant application.
Seed maggots	2.0–2.8 oz beta-cyfluthrin	0.12–0.16 oz *Baythroid XL/1,000 ft row	0	Do not exceed 28.0 fl oz/a (0.22 lb ai/a) per season.
	1.3 lb chlorpyrifos	8.0 oz Lorsban 15G/ 1,000 ft row	21	Do not exceed 8.0 oz/1,000 ft row (1.3 lb ai/a) at-plant. Do not make more than three applications of a chlorpyrifos-containing product/season. Do not exceed 3.0 lb ai/a chlorpyrifos per season.
	chlorpyrifos + lambda-cyhalothrin	2.87 fl oz *Cobalt Advanced/ 1,000 ft row	21	Do not exceed 129.0 fl oz Cobalt Advanced (2.5 lb ai chlorpyrifos and 0.13 lb ai lambda-cyhalothrin) per acre per season. Do not make more than three applications of Cobalt Advanced or other products containing chlorpyrifos per season.
Table beet	0.25 mg clothianidin/ kernel	1.13 fl oz Poncho 600/80,000 seeds	seed treatment	Early season protection. Purchase treated seed from seed dealer or seed treatment representative.
	3.2–6.4 fl oz imidacloprid/100 lb seed	16–20 fl oz Gaucho 600/100 lb seed	seed treatment	Early season protection. Purchase treated seed from seed dealer or seed treatment representative.
	permethrin	1.5 oz Kernel Guard Supreme/42 lb seed	seed treatment	Planter box treatment.
	phorate	4.5–6.0 oz *Thimet 20-G/1,000 ft row	30	Apply in 7-inch band over the row. Do not use in-furrow application.
Tomato	tebupirimphos + cyfluthrin	6.7 oz *Aztec 2.1G/1,000 ft row		Apply in 7-inch band or seed furrow. Within 20 yards of aquatic areas, make in-furrow applications only.
	tefluthrin	4.0–5.0 oz *Force 3G/1,000 ft row 0.46–0.57 oz *Force CS/1,000 ft row		Apply in 7-inch band or seed furrow.
	terbufos	8.0 oz *Counter 15G/1,000 ft row	60	Do not exceed 8.7 lb/a of Counter per season. If application is made at planting, do not apply postemergence or at cultivation. ALS-inhibiting herbicides should not be used if Counter has been applied to corn at the time of planting.

*Restricted-use pesticide.

(continued)

Insect control in sweet corn *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Seed maggots <i>(cont.)</i>	0.125–0.80 mg thiamethoxam/kernel	Cruiser 5FS	seed treatment	Early season protection. Purchase treated seed from seed dealer or seed treatment representative.
	zeta-cypermethrin + bifenthrin + imidacloprid	0.64 fl oz *Triple Crown/1,000 ft row	3	Do not apply to soil where there is greater than 30% cover of crop residue remaining. Do not graze livestock in treated area or cut treated crops for feed within 30 days of treatment. Do not apply more than 0.2 lb ai/a per season as an at-plant application.
Stalk borers	<i>Small corn is most susceptible to injury. Control is most effective when larvae are small and before wilted plants are common. Begin scouting border rows at 1300–1400 degree days (DD). The Wisconsin Crop Manager newsletter and DATCP's Pest Survey Bulletin provide degree day information (base 41°F) during the stalk borer season. Iowa State University studies indicate that 10% of the larvae move into corn from adjacent host weeds by 1400 DD and 50% will have migrated by 1700 DD. Larvae originating within the field from last year's weed patches will damage corn earlier. Map weedy areas during fall harvest so that you can check them the following year, starting at about 900–1000 DD.</i>			
	0.013–0.022 lb beta-cyfluthrin	1.6–2.8 fl oz *Baythroid XL	0	Application must be made before larvae bore into the plant. Do not exceed 28.0 fl oz/a (0.22 lb ai/a) per season.
	1.0 lb chlorpyrifos	2.0 pt *Lorsban Advanced	21	Do not apply more than 6.0 pt/a (3.0 lb ai/a) per season. Do not make more than three applications of any chlorpyrifos-containing product per season, including granular application of chlorpyrifos at-plant.
	chlorpyrifos + lambda-cyhalothrin	16.0–38.0 fl oz *Cobalt Advanced	21	Do not exceed 129.0 fl oz Cobalt Advanced (2.5 lb ai chlorpyrifos and 0.13 lb ai lambda-cyhalothrin) per acre per season. Do not make more than three applications of Cobalt Advanced or other products containing chlorpyrifos per season.
	0.018–0.028 lb deltamethrin	1.5–2.4 fl oz *Delta Gold 1.5EC	1	Apply to early instar larvae before they bore into stalks. Do not exceed 38.4 fl oz/a (0.45 lb ai/a) per season. See label for grazing and feed restrictions.
	0.03–0.05 lb esfenvalerate	5.8–9.6 fl oz *Asana XL	1	Do not exceed 0.5 lb ai/a per season.
	flubendiamide	2.0–3.0 fl oz Belt SC	1	Do not apply more than 12.0 fl oz/a (0.375 lb ai/a) per crop season.
	0.01–0.015 lb gamma-cyhalothrin	2.56–3.84 oz *Proaxis	1	Do not exceed 3.84 pt/a (0.24 lb ai/a) per season. See label for grazing and forage use restrictions.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Besiege	1	Do not apply more than 31.0 fl oz of Besiege or 0.48 lb ai of lambda-cyhalothrin containing products or 0.2 lb ai of chlorantraniliprole containing products per acre per year.
	0.1–0.2 lb permethrin	*Ambush, *Pounce	1	See label for rate. Do not exceed 1.2 lb ai/a per season.
	zeta-cypermethrin + bifenthrin + imidacloprid	3.5–10.3 fl oz *Triple Crown	3	Do not apply more than 20.5 fl oz/a Triple Crown (0.36 lb ai/a) per crop season. Refer to the maximum usage tables when applying more than one product containing either zeta-cypermethrin or bifenthrin or imidacloprid to this crop. Do not graze livestock in treated area or cut treated crops for feed within 30 days of treatment.

*Restricted-use pesticide.

(continued)

Insect control in sweet corn *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Stalk borers <i>(cont.)</i>	zeta-cypermethrin + chlorpyrifos	9.25–11.75 fl oz *Stallion	21	A maximum of 11.75 fl oz of product may be applied per acre (0.025 lb/a zeta-cypermethrin + 0.25 lb/a chlorpyrifos). Refer to the maximum usage tables on the label when applying more than one product containing either zeta-cypermethrin or chlorpyrifos to this crop.
Western bean cutworm	<p><i>Western bean cutworm (WBC) moth flight begins late June to early July, depending on location and temperatures. Pheromone traps should be in place throughout Wisconsin by July 1 each year to detect first moth emergence in your area.</i></p> <p><i>WBC pheromone traps placed at or near sweet corn fields is the best indicator of when to start scouting. Begin scouting as soon as first moth is captured in pheromone trap. Alternatively, using the WBC phenology model, begin scouting sweet corn no later than 1,320 degree-days (Base 50F) when 25% of moth population will be in flight. Egg laying will peak at 50% emergence (1,422 degree-days).</i></p> <p><i>Scout sweet corn for WBC egg masses and small larvae BEFORE larvae enter the ear. Sample five areas throughout field, 20 plants at each location, for a representative 100-plant sample. Continue to scout sweet corn fields throughout moth flight until trap captures diminish. There is one generation per year, and only one moth flight.</i></p> <p><i>Treatment threshold for sweet corn is 4% field infestation with egg masses and/or small larvae.</i></p> <p><i>For more information on WBC pheromone trapping and scouting in-season, please refer to the Wisconsin Crop Manager newsletter (ipcm.wisc.edu/wcm) and the Wisconsin Pest Bulletin (pestbulletin.wi.gov).</i></p>			
	0.013–0.022 lb beta-cyfluthrin	1.6–2.8 fl oz *Baythroid XL	0	Do not exceed 28.0 fl oz/a (0.22 lb ai/a) per season.
	0.033–0.10 lb bifenthrin	2.1–6.4 fl oz *Brigade 2EC	1	Do not exceed 12.8 fl oz/a (0.2 lb ai/a) per season.
	carbaryl	2.0 qt. Sevin XLR Plus	2 (ears)	Highly toxic to bees; see label for details on protecting them. Do not exceed 16.0 qt/a per season.
	0.5–1.0 lb chlorpyrifos	1.0–2.0 pt *Lorsban Advanced	21	Do not make more than three applications of any product containing chlorpyrifos per season. Do not apply more than 6.0 pt/a Lorsban (3.0 lb ai/a) per season. Do not make a sequential application of a chlorpyrifos-containing product within 10 days of previous application.
	chlorpyrifos + lambda-cyhalothrin	11.0–26.0 fl oz *Cobalt Advanced	21	Do not exceed 129.0 fl oz Cobalt Advanced (2.5 lb ai chlorpyrifos and 0.13 lb ai lambda-cyhalothrin) per acre per season. Do not make more than three applications of Cobalt Advanced or other products containing chlorpyrifos per season.
	0.015–0.03 lb esfenvalerate	2.9–5.8 fl oz *Asana XL	1	Do not exceed 0.5 lb ai/a per season.
	flubendiamide	2.0–3.0 fl oz Belt SC	1	Do not apply more than 12.0 fl oz/a (0.375 lb ai/a) per crop season.
	0.01–0.015 lb gamma-cyhalothrin	2.56–3.85 fl oz *Proaxis	1	For control of small larvae. Do not apply more than 3.84 pt/a (0.24 lb ai/a) per season.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4	Do not apply more than 0.48 lb ai/a per crop.

*Restricted-use pesticide.

(continued)

Insect control in sweet corn *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Western bean cutworm <i>(cont.)</i>	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Besiege	1	Do not apply more than 31.0 fl oz of Besiege or 0.48 lb ai of lambda-cyhalothrin containing products or 0.2 lb ai of chlorantraniliprole containing products per acre per year.
	0.06–0.12 lb methoxyfenozide	4.0–8.0 fl oz Intrepid 2F	3	Do not exceed 16.0 fl oz/a per application or 64.0 fl oz/a (1.0 lb ai/a) per season.
	methyl parathion	2.0–3.0 pt *PennCap-M	4	Do not apply if bees are foraging in areas to be treated. Do not apply more than 12.0 pt/a per year.
	0.023–0.047 lb spinetoram	3.0–6.0 fl oz Radiant SC	1	Do not make more than six applications per crop or exceed 0.281 lb ai/a per season. Wait at least 4 days between treatments.
	spinosad	2.2–3.3 fl oz Blackhawk 3.0–6.0 fl oz Entrust SC	1 (grain) 7 (forage) 28 (fodder)	Do not apply more than a total of 0.45 lb ai of spinosad (20.0 fl oz of Blackhawk or 29.0 fl oz of Entrust SC). Do not make more than six applications per calendar year.
	0.04–0.10 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	3	Do not exceed 0.266 lb ai/a per season.
	zeta-cypermethrin + bifenthrin + imidacloprid	4.5–10.3 fl oz *Triple Crown	3	Do not apply more than 20.5 fl oz/a Triple Crown (0.36 lb ai/a) per crop season. Refer to the maximum usage tables when applying more than one product containing either zeta-cypermethrin or bifenthrin or imidacloprid to this crop. Do not graze livestock in treated area or cut treated crops for feed within 30 days of treatment.
zeta-cypermethrin + chlorpyrifos	5.0–11.75 fl oz *Stallion	21	For control before the larva bores into the ear. A maximum of 11.75 fl oz of product may be applied per acre (0.025 lb/a zeta-cypermethrin + 0.25 lb/a chlorpyrifos). Refer to the maximum usage tables on the label when applying more than one product containing either zeta-cypermethrin or chlorpyrifos to this crop.	
White grubs	2.5–2.8 oz beta-cyfluthrin	0.14–0.16 oz *Baythroid XL/1,000 ft row	0	Apply in 7-inch band or in seed furrow. Do not exceed 28.0 fl oz/a (0.22 lb ai/a) per season.
	1.3 lb chlorpyrifos	8.0 oz Lorsban 15G/1,000 ft row	21	Do not make more than three applications of any product containing chlorpyrifos per season. Do not apply more than 8.0 oz/1,000 ft row or 1.3 lb ai/a at-plant. Do not exceed 3.0 lb/a chlorpyrifos per season.
	chlorpyrifos + lambda-cyhalothrin	2.87 fl oz *Cobalt Advanced/1,000 ft row	21	Do not exceed 129.0 fl oz Cobalt Advanced (2.5 lb ai chlorpyrifos and 0.13 lb ai lambda-cyhalothrin) per acre per season. Do not make more than three applications of Cobalt Advanced or other products containing chlorpyrifos per season.

*Restricted-use pesticide.

(continued)

Pepper

Potato

Pumpkin & squash

Sweet corn

Table beet

Tomato

Insect keys

Insect control in sweet corn *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
White grubs <i>(cont.)</i>	0.25 mg clothianidin/ kernel	1.13 fl oz Poncho 600/80,000 seeds	seed treatment	Early season protection. Purchase treated seed from seed dealer or seed treatment representative.
	3.2–6.4 fl oz imidacloprid/100 lb seed	16–20 fl oz Gaucho 600/100 lb seed	seed treatment	Early season protection. Purchase treated seed from seed dealer or seed treatment representative.
	phorate	4.5–6.0 oz *Thimet 20-G/1,000 ft row	30	Apply in 7-inch band over the row. Do not use in furrow application.
	tebupirimphos + cyfluthrin	6.7 oz *Aztec 2.1G/1,000 ft row		Apply in 7-inch band over the row. Do not use in furrow application.
	tefluthrin	4.0–5.0 oz *Force 3G/1,000 ft row 0.46–0.57 oz *Force CS/1,000 ft row		Apply in 7-inch band or seed furrow. Use 0.57 fl oz Force CS per 1,000 feet of row for heavy infestations. For best wireworm and/or white grub control, apply the liquid as an in-furrow treatment.
	terbufos	8.0 oz/1,000 ft row *Counter 15G	60	Do not exceed 8.7 lb/a of Counter per season. If application is made at planting, do not apply postemergence or at cultivation. ALS-inhibiting herbicides should not be used if Counter has been applied to corn at the time of planting.
	0.125–0.80 mg thiamethoxam/kernel	Cruiser 5FS	seed treatment	Early season protection. Purchase treated seed from seed dealer or seed treatment representative.
Wireworms	2.0–2.8 oz beta-cyfluthrin	0.12–0.16 oz/1,000 ft row *Baythroid XL	0	Apply in 7-inch band or in seed furrow. Do not exceed 28.0 fl oz/a (0.22 lb ai/a) per season.
	1.3 lb chlorpyrifos	8.0 oz Lorsban 15G/1,000 ft row	21	Do not exceed 8.0 oz/1,000 ft row (1.3 lb ai/a) at-plant. Do not make more than three applications of any product containing chlorpyrifos per season. Do not apply more than 3.0 lb/a chlorpyrifos per season.
	chlorpyrifos + lambda-cyhalothrin	2.87 fl oz *Cobalt Advanced/1,000 ft row	21	Do not exceed 129.0 fl oz Cobalt Advanced (2.5 lb ai chlorpyrifos and 0.13 lb ai lambda-cyhalothrin) per acre per season. Do not make more than three applications of Cobalt Advanced or other products containing chlorpyrifos per season.
	0.25 mg clothianidin/ kernel	1.13 fl oz Poncho 600/80,000 seeds	seed treatment	Early season protection. Purchase treated seed from seed dealer or seed treatment representative.
	3.2–6.4 fl oz imidacloprid/100 lb seed	16–20 fl oz Gaucho 600/100 lb seed	seed treatment	Early season protection. Purchase treated seed from seed dealer or seed treatment representative.
Tomato	phorate	4.5–6.0 oz *Thimet 20-G/1,000 ft row	30	Apply in 7-inch band over the row. Do not use in furrow application.
	tebupirimphos + cyfluthrin	6.7 oz *Aztec 2.1G/1,000 ft row		Apply in 7-inch band or seed furrow. Within 20 yards of aquatic areas, make in-furrow applications only.
	tefluthrin	4.0–5.0 oz *Force 3G/1,000 ft row 0.46–0.57 oz *Force CS/1,000 ft row		Apply in 7-inch band or seed furrow. Use 0.57 fl oz Force CS per 1,000 feet of row for heavy infestations. For best wireworm and/or white grub control, apply the liquid as an in-furrow treatment.

*Restricted-use pesticide.

(continued)

Insect control in sweet corn *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Wireworms <i>(cont.)</i>	terbufos	8.0 oz *Counter 15G/1,000 ft row		Do not exceed 8.7 lb/a of Counter per season. If application is made at planting, do not apply postemergence or at cultivation. ALS-inhibiting herbicides should not be used if Counter has been applied to corn at the time of planting.
	0.125–0.80 mg thiamethoxam/kernel	Cruiser 5FS	seed treatment	Early season protection. Purchase treated seed from seed dealer or seed treatment representative.
	zeta-cypermethrin + bifenthrin + imidacloprid	0.64 fl oz *Triple Crown/1,000 ft row	3	Do not apply to soil where there is greater than 30% cover of crop residue remaining. Do not graze livestock in treated area or cut treated crops for feed within 30 days of treatment. Do not apply more than 0.2 lb ai/a per season as an at-plant application.

*Restricted-use pesticide.

Weed control

Due to concern about groundwater contamination, Wisconsin has enacted atrazine rate restrictions based on surface soil texture, prior atrazine use, and geographic location relative to atrazine detections in groundwater. Wisconsin's Atrazine Rule (ATCP 30) imposes a 0.75–1.5 lb/a rate limit on atrazine use statewide. An exception is allowed for growers who find it necessary to use atrazine postemergence to “rescue” seed or sweet corn from weed competition. This exception applies only to seed and sweet corn and the total amount of atrazine used at planting and postemergence may not exceed 1.5 lb/a on coarse soils and 2.0 lb/a on medium or fine soil. In addition, atrazine use is prohibited in extensive areas of Dane County and the entire Lower Wisconsin River valley extending downstream from the Highway 60 bridge at Prairie du Sac to the confluence of the Wisconsin and Mississippi Rivers. Localized areas of Adams, Brown, Calumet, Chippewa, Columbia, Dodge, Eau Claire, Grant, Green, Green Lake, Iowa, Jackson, Juneau, Lafayette, Manitowoc, Marathon, Marinette, Marquette, Monroe, Outagamie, Pierce, Portage, Richland, Rock, St. Croix, Sauk, Trempealeau, Vernon, Walworth, Waupaca, Waushara, Winnebago, and Wood Counties have a

total prohibition on atrazine use. Contact your county Extension office for detailed maps of atrazine prohibition areas or visit datcp.wi.gov/Environment/Water_Quality/Atrazine/Atrazine_Prohibition_Areas/index.aspx.

The following table lists atrazine active ingredient rate limits for various management situations in Wisconsin. Be certain to reduce the use rates of atrazine and atrazine-containing products according to the Wisconsin Atrazine Rule. Wisconsin ATCP 30 also specifies that atrazine can be applied only from April 1 through July 31. It also prohibits atrazine application through irrigation systems and prohibits irrigation for 2 years after atrazine application unless such irrigation is practiced via an irrigation scheduling program that does not allow the water content of the soil in the crop root zone to exceed field moisture capacity.

Atrazine active ingredient rate limits

Surface soil texture	Statewide atrazine limits (lb ai/a)	
	Atrazine used last year	No atrazine used last year
Coarse	0.75	0.75
Medium and fine	1.0	1.5

State and federal rules have also established setbacks for mixing, loading, and applying atrazine and atrazine-containing herbicides. Heed the following guidelines to minimize ground and surface water contamination by atrazine.

- No mixing or loading within 100 feet of wells, sinkholes, streams, lakes, or reservoirs unless such mixing or loading occurs over a spill containment pad constructed in compliance with Wisconsin ATCP 29. (Note: In Wisconsin, this rule applies for all pesticides. Federal rules require a 50-foot setback for atrazine only.)
- No application within 50 feet of a well or sinkhole or within 200 feet of the shoreline of natural or impounded lakes or reservoirs.
- No application within 66 feet of where field runoff enters streams (perennial or intermittent) and rivers.

Pepper

Potato

Pumpkin & squash

Sweet corn

Table beet

Tomato

Insect keys

Weed control in sweet corn

Weed	Active ingredient	Rate/a of commercial product	Remarks and suggestions
Annual weeds (soil-applied herbicides)	acetochlor + safener	1.25–2.75 pt Harness 1.25–3.0 pt Surpass (or equivalent)	Acetochlor provides good to excellent control of foxtails, crabgrass, and fall panicum, but will only suppress wild proso millet and has no effect on quackgrass. It controls nightshade and pigweed, suppresses lambsquarters, but several other broadleaf weeds escape control. Do not use on sands with less than 3% organic matter, on loamy sands with less than 2% organic matter, or on sandy loams with less than 1% organic matter when depth to ground water is less than 30 feet. Alfalfa, barley, potato, oat, soybeans, and tobacco may be planted the following spring and wheat may be planted after 4 months, but peas and green bean are not allowed as rotational crops. Preplant-incorporated: Apply to dry soil within 2 weeks before planting and incorporate into the top 1–2 inches of soil. Preemergence: Apply after planting but before weed emergence.
	*acetochlor + atrazine + safener	1.8–2.3 qt Harness Xtra 1.6–3.0 qt Keystone LA (or equivalent)	These premixes provide good to excellent control of foxtails, crabgrass, fall panicum, and several annual broadleaf weeds, but will only suppress wild proso millet and have no effect on quackgrass. Some velvetleaf may escape. Do not use on sands with less than 3% organic matter, on loamy sands with less than 2% organic matter, or on sandy loams with less than 1% organic matter when depth to ground water is less than 30 feet. Only corn, soybean, or sorghum may be planted the spring after application. Certain labels allow other rotational crops after 15 months. Preplant-incorporated: Apply to dry soil within 2 weeks before planting and incorporate into the top 1–2 inches of soil. Preemergence: Apply after planting but before weed emergence.
	*alachlor	<i>preplant-incorporated:</i> 2.5–3.5 qt Micro-Tech <i>preemergence:</i> 2.0–3.25 pt Micro-Tech	Alachlor provides good to excellent control of foxtails, crabgrass, and fall panicum, but will only suppress wild proso millet and has no effect on quackgrass. It also does not control velvetleaf and several other broadleaf weeds. Up to 4.0 qt/a may be applied to soils with greater than 10% organic matter. Preplant-incorporated: Apply to dry soil within the 7 days before planting and blend into the top 1–2 inches of soil. Provides reasonable yellow nutsedge control at 3–4 qt/a alachlor. Preemergence: Apply after planting but within 5 days after the last tillage for weed control. Provides only limited control of yellow nutsedge.
	*alachlor + atrazine	2.5–4.0 qt Bullet or Lariat	These premixes provide good to excellent control of foxtails, crabgrass, fall panicum, and several broadleaf weeds, but they will only suppress wild proso millet and will have little effect on quackgrass. Some velvetleaf may escape. They are ineffective on peat or muck soils. Only corn, soybean, dry bean, or sorghum may be planted the year after application. Preplant-incorporated: Apply to dry soil within the 7 days before planting, blending it into the top 1–2 inches of soil. Gives reasonable yellow nutsedge control at the higher rate. Preemergence: Apply after planting but within 5 days after last tillage for weed control. Provides only limited control of yellow nutsedge.

*Restricted-use pesticide.

(continued)

Pepper

Potato

Pumpkin & squash

Sweet corn

Table beet

Tomato

Insect keys

Weed control in sweet corn *(continued)*

Weed	Active ingredient	Rate/a of commercial product	Remarks and suggestions
Annual weeds (soil-applied herbicides) <i>(cont.)</i>	*atrazine	1.5–3.0 pt Atrazine 4L (or equivalent)	<p>Many annual broadleaf weeds are controlled but permissible rates are generally inadequate for annual grass control except on very coarse-textured, low organic matter soils and when combined with rotary hoeing and/or row cultivation. Atrazine can be tank mixed with Alachlor 4EC, Dual II Magnum, Eradicane, Micro-Tech, Outlook, or Prowl/Pendimax to improve control of annual grasses. Triazine-resistant velvetleaf, common lambsquarters, smooth pigweed, and kochia are not controlled. Only corn, soybean, or sorghum may be planted the year after application.</p> <p>Preplant-incorporated: Work into soil within the 2 weeks before planting. Ineffective on peat or muck soils.</p> <p>Preemergence: Apply after planting but before annual weeds emerge. Ineffective on peat or muck soils.</p>
	dimethenamid-P	10.0–21.0 fl oz Outlook 6.0	<p>Outlook provides good to excellent control of foxtails, crabgrass, and fall panicum but will only suppress wild proso millet and has no effect on quackgrass. It also does not control velvetleaf and several other broadleaf weeds.</p> <p>Preplant-incorporated: Apply to dry soil within 14 days before planting and blend into the top 1–2 inches of soil. Provides reasonable yellow nutsedge control at the highest rate recommended by soil type.</p> <p>Preemergence: Apply after planting but before weed emergence. Provides only limited control of yellow nutsedge.</p> <p>Postemergence: Although Outlook will not control emerged grasses, it can be applied to sweet corn up to 12 inches tall in single or sequential treatments. Do not harvest within 50 days or feed to livestock within 40 days after application.</p>
	*dimethenamid + atrazine	2.0–3.5 pt G-Max Lite	<p>This premix provides good to excellent control of foxtails, crabgrass, fall panicum, and several annual broadleaves but will only suppress wild proso millet and has little effect on quackgrass. Some velvetleaf may escape. It is not recommended on soils with more than 20% organic matter. Only corn, soybean, or sorghum may be planted the year after application.</p> <p>Preplant-incorporated: Apply to dry soil within 14 days before planting and blend into the top 1–2 inches of soil. Provides reasonable yellow nutsedge control at the higher rate for a soil type.</p> <p>Preemergence: Apply after planting but before weed emergence. Provides only limited control of yellow nutsedge.</p> <p>Postemergence: This premix can be applied to sweet corn up to 12 inches tall. Apply while broadleaf weeds are less than 1.5 inches tall and before grasses emerge. Best results are obtained when rainfall occurs within 5–7 days after this delayed application.</p>
mesotrione	6.0–7.7 oz Callisto	<p>Preemergence: Controls many annual broadleaf weeds including lambsquarters, nightshade, pigweed, common ragweed, and velvetleaf, but not annual grasses. Callisto can be tank mixed with a preemergence grass herbicide for annual grass control. If tank mixed with a herbicide containing atrazine, the Callisto rate can be reduced to 5.0–6.0 oz/a. To avoid injury, do not apply with emulsifiable concentrate grass herbicides after corn has spiked. Do not apply if wind speed exceeds 10 mph. Small grains can be planted after 120 days; and alfalfa, soybeans, and potatoes can be planted after 10 months. Most other crops can be planted after 18 months.</p>	

*Restricted-use pesticide.

(continued)

Pepper

Potato

Pumpkin & squash

Sweet corn

Table beet

Tomato

Insect keys

Weed control in sweet corn *(continued)*

Weed	Active ingredient	Rate/a of commercial product	Remarks and suggestions
Annual weeds (soil-applied herbicides) <i>(cont.)</i>	pendimethalin	% organic matter: less than 1.5%: 2.0–3.0 pt Prowl H ₂ O more than 1.5%: 3.0–4.0 pt Prowl H ₂ O	Preemergence: Apply after planting and before weeds emerge. Do not soil incorporate. Provides excellent control of foxtails, crabgrass, and fall panicum, but has no effect on quackgrass, ragweeds, and mustards. Do not use on peat or muck soils. Plant sweet corn at least 1.5 inches deep. Postemergence: Will not control emerged grasses, but it can be applied postemergence for residual grass control before sweet corn reaches 24 inches tall or the 8-collar stage. Do not plant winter wheat or barley within 120 days of application.
	s-metolachlor + safener	1.0–2.0 pt Dual II Magnum	S-metolachlor provides good to excellent control of foxtails, crabgrass, and fall panicum but will only suppress wild proso millet and has no effect on quackgrass. It does not control velvetleaf and several other annual broadleaf weeds. Ineffective on peat or muck soils. Preplant-incorporated: Apply within 2 weeks before planting and blend into the top 2 inches. Treatment at 2.0 pt/a will control yellow nutsedge. Preemergence: Apply after planting but before weeds or sweet corn emerge. Offers limited control of yellow nutsedge. Postemergence: Although s-metolachlor will not control emerged grasses, it can be applied on sweet corn up to 40 inches tall for residual grass control. Do not harvest ears for 30 days after application.
Sweet corn	*s-metolachlor + atrazine + safener	0.9–2.2 qt Bicep Lite II	Provides good to excellent control of foxtails, crabgrass, fall panicum, and several broadleaf weeds, but will only suppress wild proso millet and has little effect on quackgrass. Some velvetleaf may escape. Ineffective on peat or muck soils. Only corn, soybean, or sorghum may be planted the year after application. Preplant-incorporated: Apply within the 2 weeks before planting and blend into top 2 inches of soil. Gives reasonable nutsedge control at the higher rate. Preemergence: Apply after planting but before weeds emerge. Provides limited control of yellow nutsedge. Early postemergence: Apply before weeds reach the two-leaf stage and before sweet corn is 5 inches tall. Best results when rain occurs 5–7 days after this application.
	s-metolachlor + mesotrione + safener	2.0–2.4 qt Zemax	Zemax provides good to excellent control of foxtails, crabgrass, fall panicum, and most annual broadleaf weeds, but will only suppress wild proso millet and has no effect on quackgrass. The mesotrione in this premix improves velvetleaf control compared to Bicep Lite II Magnum or similar premixes. Zemax can be tank mixed with Princep in atrazine prohibition areas. Yellow nutsedge will be suppressed. Do not apply if wind speed exceeds 10 mph. Winter wheat can be planted 4.5 months after application; potatoes, small grains, and soybeans can be planted the year after application. Other crops should not be planted for 18 months. Only corn and sorghum can be planted the following year if applied after June 1. Preplant: Apply up to 14 days before planting. Preemergence: Apply after planting but before sweet corn and grass weeds emerge.

*Restricted-use pesticide.

(continued)

Weed control in sweet corn (continued)

Weed	Active ingredient	Rate/a of commercial product	Remarks and suggestions
Annual weeds (soil-applied herbicides) (cont.)	*s-metolachlor + mesotrione + atrazine + safener	2.7–3.25 qt Lumax EZ	Lumax provides good to excellent control of foxtails, crabgrass, fall panicum, and most annual broadleaf weeds, but will only suppress wild proso millet and has no effect on quackgrass. The mesotrione in this premix improves velvetleaf control compared to Bicep Lite II Magnum or similar premixes. Lumax is similar to Zemax except it also contains atrazine, which increases the consistency of control of some broadleaf weeds. Do not apply if wind speed exceeds 10 mph. Winter wheat can be planted 4.5 months after application and small grains and soybeans can be planted the following year. Other crops should not be planted the year after application. If applied after June 1, only corn or sorghum can be planted the following year. Preplant: Apply up to 14 days before planting. Preemergence: Apply after planting but before sweet corn and grass weeds emerge.
	simazine	4.0 pt Princep 4L (or equivalent)	Princep controls many annual broadleaf weeds, but grasses will only be controlled at higher rates. Quackgrass will not be controlled. Princep will persist and injure crops other than corn the next year; only plant corn or soybeans the year after application. Preplant-incorporated: Apply within 2 weeks before planting and blend into the top 2 inches. Preemergence: Apply after planting but before sweet corn and weeds emerge. Princep requires more rainfall than atrazine to make it effective. Preplant-incorporated applications will be more effective in dry springs.
Emerged annual broadleaves	*atrazine	1.5–3.0 pt Atrazine 4L (or equivalent) plus 2.0 pt oil concentrate	Early postemergence: Use after earlier annual grass control treatment before redroot pigweed and common lambsquarters are 6 inches tall and before all other broadleaf weeds reach 4 inches but before corn is more than 12 inches tall. Check Wisconsin atrazine rate limits before using this treatment. Triazine-resistant velvetleaf, common lambsquarters, smooth pigweed, and kochia are not controlled. Only corn, soybean, or sorghum may be planted the year after application.
	bentazon	1.5–2.0 pt Basagran plus 2.0 pt oil concentrate	Postemergence: Apply when broadleaf weeds are small and sweet corn has one to five leaves. If velvetleaf is the primary problem, substitute 1 gal/a of 28% nitrogen solution or 2.5 lb/a of spray grade ammonium sulfate for the oil concentrate. If both velvetleaf and common lambsquarters and/or common ragweed are a problem, include both oil concentrate and nitrogen solution or ammonium sulfate. Use a minimum of 20 gal/a of water and 40 psi. Rain within 4 hours reduces effectiveness. Also provides good control of yellow nutsedge; treat when 6–8 inches tall. There are no rotational restrictions following a Basagran application.
	clopyralid	0.33–0.66 pt Stinger	Postemergence: Stinger has good activity on weeds in the legume and sunflower families, including Canada thistle, common and giant ragweed, and cocklebur. For Canada thistle, apply when most plants have emerged and are 6–8 inches tall but before the pre-bud stage. For annual weeds, apply before weeds exceed the five-leaf stage. Apply before sweet corn exceeds 18 inches in height as a broadcast or directed spray in 10–20 gal/a. Stinger may be tank mixed with other herbicides labeled for use on sweet corn. Rain within 6 hours reduces effectiveness. Do not harvest ears or forage within 30 days after application, or stover within 60 days. Stinger-treated fields can be planted to corn, small grains, and beets anytime after application. Do not plant alfalfa, dry beans, or soybeans for 10.5 months, or peas, potatoes, or green beans for 18 months after application.

*Restricted-use pesticide.

(continued)

Pepper

Potato

Pumpkin & squash

Sweet corn

Table beet

Tomato

Insect keys

Weed control in sweet corn *(continued)*

Weed	Active ingredient	Rate/a of commercial product	Remarks and suggestions
Emerged annual broadleaves <i>(cont.)</i>	fluroxypyr	0.4 pt Starane Ultra	Postemergence: Starane controls cocklebur, ragweeds, velvetleaf, hemp dogbane, and suppresses volunteer potato. It is poor on lambsquarters and pigweed when used alone. Starane can be tank mixed with atrazine to control these and other broadleaf weeds. Apply before annual weeds are 8 inches tall. Apply to sweet corn through the four-leaf collar stage in broadcast or directed spray in 10–20 gal/a. Drop nozzle applications can be made after this stage. Rain within 1 hour reduces effectiveness. Apply at least 31 days before harvesting ears or feeding forage to livestock. Small grains and corn can be planted anytime after application and other crops can be planted after 120 days.
	fluthiacet	0.6–0.9 oz Cadet plus 0.25% non-ionic surfactant or 1.0–2.0 pt/a crop oil concentrate	Postemergence: Cadet is primarily a velvetleaf herbicide with little residual activity. It may be applied from the 2-collar stage to 48 inches tall or tasseling corn, whichever occurs first. Cadet provides excellent control of velvetleaf up to 36 inches tall, but is only labeled to control small lambsquarters, waterhemp, and pigweed at the 0.9 oz/a rate. It may cause temporary spotting of corn leaves. It is an option when targeting velvetleaf alone or to improve the control of other broadleaf herbicides. Cadet has contact activity and requires a minimum of 15 gallons per acre spray volume and 20 psi spray pressure. It can be mixed with other grass or broadleaf herbicides. Do not apply if wind speed exceeds 10 mph. Do not harvest sweet corn until 40 days after application. Corn or soybeans can be replanted anytime if the crop is lost; other crops should not be planted until the following year.
	mesotrione	3.0 oz Callisto plus 0.25% non-ionic surfactant	Postemergence: Callisto controls many annual broadleaf weeds, but will not control most grasses. Callisto may cause bleaching of sweet corn leaves, but the injury generally does not affect sweet corn growth. Hybrid tolerance ratings to Callisto are available at ipcm.wisc.edu (search the publications for “sweet corn”). To minimize the risk of injury, non-ionic surfactant is the recommended adjuvant. Crop oil concentrate at 1% may be used, but the risk of injury increases. Do not add ammonium sulfate or a liquid nitrogen fertilizer. Because less-active adjuvants are used in sweet corn versus field corn, broadleaf weeds should be sprayed before 5 inches tall. Tank mixing 0.25 lb/a atrazine with Callisto is synergistic and will compensate for the less-active adjuvants in general and will specifically improve common ragweed control. Callisto plus atrazine must be applied before the sweet corn exceeds 12 inches. Callisto alone must be applied before sweet corn exceeds 30 inches or the V8 stage. Rain within 1 hour may reduce effectiveness. Do not apply Callisto if Counter or Lorsban were applied. Do not apply if wind speed exceeds 10 mph. Treated fields can be planted to corn anytime; small grains can be planted after 120 days; and alfalfa, soybeans, and potatoes can be planted after 10 months. Most other crops can be planted after 18 months.

*Restricted-use pesticide.

(continued)

Weed control in sweet corn *(continued)*

Weed	Active ingredient	Rate/a of commercial product	Remarks and suggestions
Emerged annual broadleaves <i>(cont.)</i>	tembotrione + safener	3.0 oz Laudis plus 1% methylated seed oil (preferred) or 1% crop oil concentrate plus 1.5 qt 28% nitrogen solution or 1.5 lb ammonium sulfate	Postemergence: Laudis controls many annual broadleaf weeds including lambsquarters, nightshade, pigweed, ragweeds, and velvetleaf, as well as several annual grasses including large crabgrass, giant and yellow foxtail, and wild proso millet. Broadleaf weeds should be treated before they are 6-inches tall. Grass weed heights are shorter and vary by species. Tank mixing with 0.5 lb/a atrazine is synergistic and will improve control of broadleaf weeds and will control larger grass weeds. Laudis can be applied to sweet corn up to the 7-collar growth stage, except for atrazine tank mixtures which must be applied before corn exceeds 12 inches. Most hybrids have excellent tolerance to Laudis; however, a few hybrids, like Merit, are highly sensitive and will be killed. Rain within 1 hour may reduce effectiveness. Treated fields can be planted to corn anytime; small grains can be planted after 4 months; soybeans can be planted after 8 months; and alfalfa, peas, potatoes, green beans can be planted after 10 months. Most other crops can be planted after 18 months.
Emerged annual grasses	foramsulfuron + safener	1.5 oz Option plus 1.5 pt/a methylated seed oil plus 1.5–2.0 qt/a nitrogen fertilizer or 1.5–3.0 lb/a ammonium sulfate	Postemergence: Option can be applied to sweet corn from the one- to 6-collar stages for annual grass and quackgrass control. Option will not control crabgrass. Option can be tank mixed with atrazine or Permit for improved broadleaf weed control. Sweet corn hybrids tend to be injured more by Option than by Accent Q. Do not apply if Counter (in-furrow), Dyfonate, or Thimet was applied due to risk of crop injury. Lorsban or Counter (T-band) may also cause injury. Do not harvest until 45 days after application. Corn can be replanted 7 days after applications and soybeans can be planted 14 days after application; all other crops can be planted 60 days after application.
	nicosulfuron + safener	0.9 oz/a Accent Q plus 1.0% oil concentrate or 0.25% surfactant plus 2.0 qt 28% nitrogen fertilizer or 2.0 lb ammonium sulfate	Postemergence: Apply broadcast to processing or fresh-market sweet corn up to 12 inches tall or with drop nozzles to sweet corn up to 18 inches tall. Do not treat if sweet corn has 6 or more collars (V6 stage). Accent Q may injure certain sweet corn hybrids. Contact a DuPont representative for hybrid tolerance information. Accent Q will kill highly sensitive hybrids. Apply before foxtails, barnyardgrass, fall panicum, and wild proso millet exceed 4 inches or quackgrass exceeds 10 inches. Accent Q will not control crabgrass. Rain within 4 hours reduces effectiveness. Do not cultivate 10 days before or 7 days after application. Accent Q can be tank mixed with atrazine. Do not apply Accent Q if Counter has been used. Accent Q's interaction with other organophosphate soil insecticides may cause unacceptable injury. Do not apply an organophosphate insecticide within 7 days before or 3 days after applying Accent Q. Treated fields can be planted to field corn anytime; to soybeans after 15 days; to winter cereals after 4 months; to spring cereals after 8 months; or to alfalfa, beans, peas, potatoes, or sweet corn after 10 months.

*Restricted-use pesticide.

(continued)

Pepper

Potato

Pumpkin & squash

Sweet corn

Table beet

Tomato

Insect keys

Weed control in sweet corn *(continued)*

Weed	Active ingredient	Rate/a of commercial product	Remarks and suggestions
Emerged annual grasses (cont.)	sethoxydim	0.75–2.25 pt Poast Plus plus 1.0 qt/a crop oil concentrate	<p>Poast/Poast Plus can only be applied to Poast-protected sweet corn; other hybrids will be severely injured.</p> <p>Postemergence: Poast Plus will control annual grass weeds and suppress quackgrass. Apply Poast Plus at 0.75 pt/a to control wild proso millet up to 10 inches tall, 1.5 pt/a for crabgrass up to 6 inches tall and foxtails up to 8 inches tall, and 2.25 pt/a for quackgrass when 8 inches tall. (Equivalent rates of Poast are 67% of the Poast Plus rate.) The addition of 2.5 lb/a ammonium sulfate or 2–4 qt/a 28% nitrogen solution may improve control of certain grass weeds. Tank mixtures with atrazine, Basagran, or Laddok S-12 are labeled to control emerged broadleaf weeds. Poast has minimal residual activity on grass weeds. Labeled tank mixtures with Outlook or G-Max Lite would provide residual weed control. Poast applications can be made until before pollen shed. Up to two applications can be made at an interval of 10 days. Rain within 1 hour may reduce effectiveness. Sweet corn can be harvested 30 days after application. Crops on which Poast is labeled can be planted anytime after application; other crops can be planted 30 days after application.</p>
		0.5–1.5 pt Poast plus 1.0 qt/a crop oil concentrate	
Emerged annual and perennial broadleaves	2,4-D	<p><i>broadcast:</i> 0.5–1.0 pt 2,4-D amine or 0.33–0.66 pt 2,4-D low volatile ester</p> <p><i>drop nozzle:</i> 1.0 pt 2,4-D amine or low volatile ester</p>	<p>Sweet corn may be injured by 2,4-D; use only when essential. Do not cultivate for 8–10 days to allow sweet corn to recover from stalk brittleness. Smartweeds and wild buckwheat are tolerant to 2,4-D, especially the amine form.</p> <p>Broadcast early postemergence: Apply when sweet corn is 4–6 inches tall. Use the lower rate in hot, humid weather.</p> <p>Drop nozzle postemergence: Apply when sweet corn is at least 8 inches tall. Direct spray toward base of sweet corn. Do not apply 2,4-D from a week before tassel emergence until after silks turn brown.</p>
Directed applications	*paraquat	1.0–2.0 pt *Gramoxone Inteon	<p>Apply as directed spray when corn is at least 10 inches tall and before weeds reach 6 inches tall. Corn plants shorter than 10 inches may be injured beyond recovery. Add 1 qt of non-ionic surfactant per 100 gal of final spray mixture.</p> <p>Arrange nozzles to spray no higher than the lower 3 inches of corn stalks to provide maximum weed contact with minimum corn contact. Do not spray over the top of corn. Do not mix this herbicide with liquid fertilizer for simultaneous application. For improved control of broadleaf annual weeds include 1–2 pt/a of the atrazine 4L formulation or an equivalent in the spray mixture. Use Gramoxone only when there is enough height difference between the corn and weeds to thoroughly spray the weed foliage without contacting the upper corn leaves by spray or drift. Such contact may cause crop injury. This treatment provides excellent annual weed control and temporary burn on the topgrowth of perennial weeds. However, an earlier herbicide treatment, rotary hoeing, or row cultivation is usually necessary to establish the proper height differential between corn and weeds.</p>

*Restricted-use pesticide.

Pepper

Potato

Pumpkin & squash

Sweet corn

Table beet

Tomato

Insect keys

Table beet

Planting

Plant in well-drained soil that is high in organic matter. Use minimum tillage to maintain good soil structure. Crusting seriously reduces seedling emergence. Rotating crops will help prevent damping-off.

Rows: 12–30 inches; 15–20 plants/ft of row.

Seed: 10–15 lb/a.

Table beets can be planted in paired rows 14 inches apart with 1.5 inches between paired rows. Use size-graded seed of monogerm varieties or multigerm varieties spaced 1 inch apart in each paired row. Smaller seed sizes of multigerm varieties are recommended, since a relatively

higher percentage of the “seedballs” will contain a single germ as compared to the larger seed sizes. Use 16–20 lb/a of seed. Plant seed no deeper than 0.5–0.75 inch in moist soil.

Lime and fertilizer

Lime: Use dolomitic limestone to maintain a pH of 6.0 on mineral soils and 5.6 on organic soils.

Fertilizer rates: Apply P_2O_5 and K_2O according to soil test recommendations before planting. Annual nitrogen, P_2O_5 , and K_2O recommendations are shown in the table below. Take credits for previous legume crops and manure.

Application: Broadcast fertilizer or apply in a band 2 inches to the side of the row and 2 inches below seed depth.

Nitrogen: Apply before planting or side-dress early in the growing season. On sandy soils, split the nitrogen into two or three applications over the growing season.

Boron: Apply 2–3 lb/a of boron with broadcast fertilizer before planting if boron soil test is very low (VL) or low (L). Omit application if boron soil test is in the excessively high (EH) range. During extended periods of dry weather, make foliar applications of boron (see *black spot* in Disease Control table).

Annual nitrogen, phosphate, and potash recommendations for table beet

Nitrogen		Phosphate and potash		
Organic matter (%)	Amount to apply (lb/a)	Yield goal (t/a)	Amount P_2O_5 to apply* (lb/a)	Amount K_2O to apply* (lb/a)
<2	120	5.0–10.0	10	30
2.0–9.9	100	10.1–15.0	15	50
10–20	80	15.1–20.0	25	70
>20	30			

*Amounts shown are for optimum (O) soil test levels. Apply 50% of this rate if soil test is high (H) and omit if soil test is excessively high (EH). If soil test is low (L) or very low (VL), increase rates according to soil test recommendations.

Pepper

Potato

Pumpkin & squash

Sweet corn

Table beet

Tomato

Insect keys

Disease control in table beet

Disease	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Aphanomyces root rot	<i>Poor soil structure and compaction contribute to this problem. Well-drained soil in good tilth and rotation aid in control. Grass sod, cover crops, and plant residue (especially corn stubble) improve soil structure.</i>			
Black spot (boron deficiency)	18.0–20.0 lb borax	8.0–12.0 lb Solubor		Apply at planting. Also make two applications 2–4 weeks apart, beginning before midseason (spray with 10.0–20.0 lb borax or 6.0–11.0 lb Solubor/100 gal water per acre).
Cercospora leaf spot	azoxystrobin	9.0–15.5 fl oz Quadris Flowable	0	Quadris, Cabrio, and Flint belong to the strobilurin group of fungicides. Do not exceed one application from this group before alternating with a fungicide that has a different mode of action. Do not exceed four applications of strobilurin fungicide per crop per year.
	pyraclostrobin	8.0–12.0 oz Cabrio EG	0	
	trifloxystrobin	2.0–3.0 oz Flint	7	
	copper hydroxide	1.33–2.66 pt Champ Formula 2 Flowable	0	Apply when conditions favor disease. Do not apply more than 21.6 pt/a per year.
	copper hydroxide copper sulfate	2.0–5.0 lb Kocide 101 77WP, DF	0	Spray weekly at first sign of infection. Follow a 3-year rotation between table beet crops.
		1.5–3.74 Kocide 2000 DF	0	
		0.75–2.0 lb Kocide 3000	0	
		1.3–3.3 pt Kocide 4.5 LF	0	
		2.0–4.0 lb Basic Copper Sulfate	0	
	penthiopyrad	16.0–30.0 fl oz Fontelis	0	Make no more than two sequential applications before switching to a fungicide with a different mode of action. Do not exceed 61.0 fl oz/a per year.
propiconazole	3.0–4.0 fl oz Bumper 41.8 EC	14	Do not apply more than 12.0 fl oz of Bumper 41.8 EC/a per season or 16.0 fl oz of Tilt/a per season.	
	3.0–4.0 fl oz Tilt	14		
tebuconazole	3.0–7.2 fl oz Monsoon, Orius 3.6F, Tebuzol 3.6, Toledo	7	Do not exceed 28.8 fl oz/a per season. Begin applications as soon as crop and/or environmental conditions become favorable for disease.	
Pythium damping-off	mefenoxam	1.0–2.0 pt Ridomil Gold SL		Preplant-incorporated application or surface application at planting. Preplant to top 2 inches of soil.
		2.0–4.0 pt Ultra Flourish		
	metalaxyl	0.085–0.64 fl oz Apron XL/100 lb seed		Follow manufacturer's directions. Do not use treated seed for feed or food.
		4.0–8.0 pt MetaStar 2E AG		
Rhizoctonia dry rot and seed rot	thiram captan	0.7 fl oz/100 lb seed Sebring 2.65 ST		Follow manufacturer's directions. Do not use treated seed for feed or food.
		0.75 fl oz/100 lb seed Allegiance FL, Metalaxyl 265 ST		
	azoxystrobin	0.4–0.8 fl oz Quadris Flowable/1,000 ft row	0	

Insect control in table beet

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Aphids	azadirachtin	1.0–3.5 pt Aza-Direct 10.0–21.0 oz Azatin XL Plus 0.5–2.0 gal Neemix 0.25EC 0.25–1.0 pt Neemix 4.5EC	0	Apply every 7 days as needed.
	0.012–0.028 lb deltamethrin	1.5–2.4 oz *Delta Gold	3	Apply every 3 days as needed.
	0.25–0.5 lb dimethoate	0.5–1.0 pt Dimethoate EC	7	
	imidacloprid	0.31–0.74 fl oz Admire Pro/1,000 ft row 4.4–10.5 fl oz Admire Pro 3.5 fl oz Provado	21	Admire may only be applied once per season. Apply Provado every 5 days as needed. Do not exceed three applications per season. Maximum imidacloprid use per season is 0.5 lb ai/a from any formulation.
			7	
	thiamethoxam	1.5–3.0 fl oz Actara WG 5.0–12.0 fl oz Platinum	7	Apply before pests reach damaging levels. Use higher rate for heavy infestations. Do not exceed 8.0 oz/a per season. Apply as an in-furrow spray or as a surface band at seeding. For surface-banded applications, irrigate within 24 hours to seeding depth using trickle or drip watering.
			0–30	
0.04–0.1 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	21	Do not apply more than 0.2 lb ai/a or exceed two applications per season.	
Cutworms	azadirachtin	1.0–3.5 pt Aza-Direct 10.0–21.0 oz Azatin XL Plus 0.5–2.0 gal Neemix 0.25EC 0.25–1.0 pt Neemix 4.5EC	0	Apply every 7 days as needed.
	1.0–2.0 lb carbaryl	Sevin Bait, WP, SP	3	Fourteen days to harvest if tops used for food or feed. Can only be used with mechanical harvest.
	2.0–4.0 lb diazinon	several formulations	14	Preplant broadcast application. Work into top 2–6 inches of soil before planting.
	0.225–0.9 lb methomyl	0.75–3.0 pt *Lannate LV	0	If tops are used for food or feed, 14 days.
	0.05 lb zeta-cypermethrin	4.3 oz *Mustang Max	50	Apply at planting to the soil surface in a 5- to 7-inch band or broadcast in a minimum of 3–5 gal/a. Do not exceed 0.15 lb ai/a per season.
	0.025–0.06 lb zeta-cypermethrin + bifenthrin	2.6–6.1 fl oz *Hero	21	Do not apply more than 0.2 lb ai/a or exceed two applications per season.
Flea beetles	<i>Treat when flea beetles are so numerous on small plants that feeding is causing stand reduction.</i>			
	1.0 lb carbaryl	Sevin (several)	3	If tops used for food or feed, 14 days. Can only be used with mechanical harvest.
	0.018–0.028 lb deltamethrin	*Delta Gold	3	Apply every 3 days as needed.
	imidacloprid	0.7–1.7 fl oz Admire Pro/1,000 ft row 7.0–10.0 fl oz Admire Pro 3.5 fl oz Provado	21	Admire may only be applied once per season. Apply Provado every 5 days as needed. Do not exceed three applications per season. Maximum imidacloprid use per season is 0.5 lb ai/a from any formulation.
			7	
	thiamethoxam	1.4–3.0 fl oz Actara WG	7	Apply before pests reach damaging levels. Use higher rate for heavy infestations. Do not exceed 8.0 oz/a per season.
	0.028–0.05 lb zeta-cypermethrin	2.4–4.3 oz *Mustang Max	50	Do not exceed 0.15 lb ai/a per season.

*Restricted-use pesticide.

(continued)

Pepper

Potato

Pumpkin & squash

Sweet corn

Table beet

Tomato

Insect keys

Insect control in table beet *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Flea beetles <i>(cont.)</i>	0.04–0.1 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	21	Do not apply more than 0.2 lb ai/a or exceed two applications per season.
Leafminers	<i>Plants past the eight-leaf stage can compensate for damage caused by average leafminer populations.</i>			
	0.25–0.5 lb diazinon	several formulations	14	Will not control organophosphate-resistant leafminers.
	0.25–0.5 lb dimethoate	0.5–1.0 pt Dimethoate EC	7	
	0.047–0.062 lb spinetoram	6.0–8.0 fl oz Radiant SC	7	Do not apply more than 32.0 fl oz/a or make more than four applications per year. Do not exceed two consecutive applications.
	spinosad	4.5–10.0 fl oz Entrust SC	3	Apply to small larvae or at egg hatch. Do not exceed four applications a crop year. Do not exceed 21.0 fl oz/a Entrust SC per season.
	thiamethoxam	5.0–8.0 fl oz Platinum	0–30	Apply as an in-furrow spray or as a surface band at seeding. For surface-banded applications, irrigate within 24 hours to seeding depth using trickle or drip watering.
	0.028–0.05 lb zeta-cypermethrin	2.4–4.3 oz *Mustang Max	50	Do not exceed 0.15 lb ai/a per season.

*Restricted-use pesticide.

Weed control in table beet

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Annual grasses and some broadleaf weeds	3.0–4.0 lb cycloate	0.5–0.66 gal Ro-Neet 6E		Rate varies by soil type. Apply before planting and incorporate immediately, preferably by double disking. (Use on mineral soils only.)
	1.88 lb ethofumesate	60.0 fl oz Nortron SC or Ethotron SC		Apply alone or in a tank mix preemergence at time of planting or shortly after, but before weed germination. Where table beets are grown in beds, apply after bedding and incorporate. Do not exceed a total of 96 fl oz/a Nortron SC in a single growing season. Do not use on muck or peat soils.
Annual broadleaves	*phenmedipham	Spin-Aid (see label for rates)	60	Controls small annual broadleaves but not redroot pigweed. Do not apply if table beets are under stress. Do not spray if dew is present. Rainfall within 6 hours may reduce effectiveness.
Emerged broadleaves	0.094–0.187 lb clopyralid	0.25–0.5 pt Stinger	30	Effective on common ragweed and eastern black, cutleaf, and hairy nightshade. Apply to table beet in the two- to eight-leaf stage of crop growth. Do not apply more than twice per crop year and do not exceed a total of 0.5 pt/a.

*Restricted-use pesticide.

(continued)

Weed control in table beet *(continued)*

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Emerged broadleaves <i>(cont.)</i>	0.24–0.49 lb desmedipham	1.5–3.0 pt Alphanex	14 (table beet tops) 50 (table beet roots)	Controls several early-germinating broadleaf weeds. Rate varies based on table beet growth stage. Do not apply until table beets have reached at least the two-leaf stage. Do not add wetting agents or other spray adjuvants. Must follow all applicable directions, restrictions, and precautions on supplemental and federal label.
	0.164–0.328 lb ethofumesate	5.25–10.5 fl oz Nortron SC or Ethotron SC		Apply postemergence for enhanced weed control. Use lower rates for table beets with two to four leaves; apply at 10.5 fl oz/a rate for table beets with six to eight leaves.
	0.016 lb triflurosulfuron methyl	0.5 oz UpBeet	30	Apply postemergence to small weeds when table beets are in the two- to four-leaf stage. Additional applications may be made at the four- to six-leaf stage and the six- to eight-leaf stage. Combined applications must not exceed 1.5 oz/a UpBeet per growing season.
Emerged weeds	glyphosate	several manufacturers and formulations available		See manufacturer's label to assure that the formulation is labeled for this crop and for specific instructions. Glyphosate may be applied any time before crop emerges. Apply before crop seed germination in coarse sandy soils. If weeds have been mowed or tilled, do not treat until they have resumed active growth and reached the recommended stage on the label. Unless otherwise stated, allow 7 or more days before tilling treated fields. Do not tank mix with soil-residual herbicides unless otherwise specified.
Emerged grasses	0.068–0.12 lb clethodim	9.0–16.0 oz Select Max	30	Apply to actively growing grasses. Repeat treatments may be made at 14-day intervals up to seasonal maximum. Do not cultivate grasses within 7 days before or after application. Include appropriate surfactant as required by label. Do not apply if rain is expected within 1 hour.
	0.094–0.125 lb clethodim	6.0–8.0 oz Select 2EC	30	
	0.164–0.328 lb ethofumesate	5.25–10.5 fl oz Nortron SC or Ethotron SC		Apply postemergence for enhanced weed control. Use lower rates for table beets with two to four leaves; apply at 10.5 fl oz/a rate for table beets with six to eight leaves.
	0.094–0.47 lb sethoxydim	0.5–2.5 pt Poast	60	Make postemergence applications to actively growing grasses within the size ranges indicated on the label. Check the label for wild proso millet or rescue treatment rate and for information on quackgrass control. Do not exceed 2.5 pt per application or 5.0 pt/a per season. Always add 2.0 pt/a of crop oil concentrate. Do not cultivate within 5 days before or 7 days after treatment.

*Restricted-use pesticide.

Pepper

Potato

Pumpkin & squash

Sweet corn

Table beet

Tomato

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Tomato

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Planting

Don't grow tomatoes in the same spot 2 years in succession. Rotate them with other crops—but not pepper, eggplant, or potato. Prepare bed 7–8 inches deep. The bed should be smoothed and free of weeds. Wisconsin's growing season is too short to allow direct planting of tomato seed. Instead, seed should be planted indoors around March 25 and transferred to a cold frame or hotbed May 1. Transplant after all danger of frost—about May 20–25 in southern Wisconsin and after June 1 in northern Wisconsin. Cultivate or hoe to control weeds. Do not cultivate after vines cover the ground. To avoid spreading plant diseases, do not hoe or cultivate when plants are wet. Alternatively, plastic mulch can be used to suppress weeds in the row. In addition, mulches increase tomato yield as compared to plants grown in bare soil.

Should plants be staked, caged, or left to sprawl? If cultivars are indeterminate (the terminal bud is vegetative), they should be caged or staked. If they are determinate (the terminal bud is a flower bud), you can cage them or let them sprawl. Each method has advantages and disadvantages.

Staked plants give a slightly earlier harvest, are cleaner, have somewhat larger fruit and are easier to harvest. However, extra labor is needed for weekly pruning and tying; fruit is more prone to cracking and sunscald; and more plants are needed to give the same yield.

Caged plants give higher quality, cleaner, and more abundant fruit compared to ordinary ground-type culture. They ripen later but are less susceptible to sunscald than staked plants. Caged plants do not need to be pruned.

Ground plants are the easiest to care for. However, they occupy the most space and fruit quality is compromised, especially for fruit touching the soil.

Pruned and staked

Rows: 36–48 inches.

Plants in row: 12–24 inches apart.

Caged

Rows: 36–48 inches.

Plants in row: 36 inches apart.

Use 10–12 ft² per plant for early varieties; use 15–20 ft² per plant for late or main crop varieties. Set 8-week-old plants 5–7 inches deep. Trench-in plants with long

stems. Water plants several hours before they are set to ensure that a “ball” of soil adheres to the roots at transplanting.

Lime and fertilizer

Lime: Apply aglime to maintain a pH of 6.0 on mineral soils and 5.6 on organic soils.

Fertilizer rates: Apply P₂O₅ and K₂O according to soil test recommendations. Use annual nitrogen, P₂O₅, and K₂O recommendations in table below. Take credits for previous legume crops and manure. Adequate K₂O fertilization is important for prevention of gray wall.

Application: Broadcast lime, P₂O₅, and K₂O and work into soil before planting.

Nitrogen: On heavier soils, broadcast and incorporate with fertilizer before planting. On sandy soils, apply 20–40 lb N/a before setting plants and sidedress the balance of the nitrogen recommended in one or more applications after the first fruits set. Overapplication of nitrogen can lead to excess vegetative growth, delaying maturity and reducing yield.

Micronutrients: Tomato has relatively high requirements for most micronutrients. Use plant analysis to confirm if these nutrients may be in short supply.

Annual nitrogen, phosphate, and potash recommendations for tomato

Nitrogen		Phosphate and potash		
Organic matter (%)	Amount to apply (lb/a)	Yield goal (t/a)	Amount P ₂ O ₅ to apply* (lb/a)	Amount K ₂ O to apply* (lb/a)
<2	140	20–25	40	180
2.0–9.9	120			
10–20	100			
>20	50			

*Amounts shown are for optimum (O) soil test levels. Apply 50% of this rate if soil test is high (H) and omit if soil test is excessively high (EH). If soil test is low (L) or very low (VL), increase rates according to soil test recommendations.

Disease control in tomato

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Bacterial spot	<i>A hot water seed treatment will help prevent bacterial spot. Place the seed in a mesh bag and dip it into water heated to 122°F. Treat seed for 25 minutes. Immediately transfer the bag to cold water to cool the seed. There will be some reduction in the germination rate of treated seed. You may wish to sow additional seed to compensate.</i>			
	fixed copper	3.0–4.0 lb Tri-Basic Copper Sulfate	0	Use disease-free plants. Only certified disease-free transplants should be used. Spray every 7 days in the plant bed and continue to spray in the field. Before transplanting, examine transplants carefully for bacterial spot lesions on the leaves and stems, especially when using southern-grown transplants.
		2.0 qt Top Cop Tri-Basic	0	
		2.0–4.0 lb Kocide 77WP	0	
		2.0–4.0 lb Champion 77WP	0	
		1.3–2.6 pt Champ Formula 2 4.6F	0	
		2.0–4.0 lb Kocide DF	0	
		2.6–5.3 pt Kocide LF 2.4F	0	
		1.5 lb Kocide 2000 DF	0	
		0.75–1.75 lb Kocide 3000	0	
streptomycin sulfate	200 ppm streptomycin	0	Spray every 4–5 days in the seedbed up to transplanting.	
Blossom-end rot	<i>Maintain uniform moisture supply by mulching and irrigating. Avoid excessive use of ammonia nitrogen and highly soluble potassium salts. Also work a superphosphate fertilizer or hydrated lime into the soil before planting. Do not cultivate too close to plants.</i>			
Botrytis (gray mold)	<i>Cultural management in greenhouses: keep ventilators partly open while the outside temperature is at least 45°F. This practice reduces relative humidity and the duration of periods favorable to spread of the fungus.</i>			
Early blight and Botrytis (gray mold)	boscalid	<i>early blight:</i> 2.5–3.5 oz Endura	0	Endura belongs to the Group 7 fungicide category. If used alone, Endura does not control late blight. Use only in a tank mix with a broad-spectrum fungicide. Do not make more than two sequential applications of Endura before switching to a fungicide having a different mode of action. Do not make more than six applications of Endura per growing season. Do not exceed 21.0 oz/a per season when treating for early blight or 25.0 oz/a per season when treating for gray mold.
		<i>Botrytis (gray mold):</i> 9.0–12.5 oz Endura		
	pyrimethanil	7.0 fl oz Scala SC in combination with a broad-spectrum fungicide	1	Scala SC belongs to the Group 9 fungicide category. Use only in a tank mix with a broad-spectrum fungicide. Alternating the tank-mix combination with a broad-spectrum fungicide is a resistance management strategy. Scala SC can be used in a well-ventilated plastic tunnel house or glass house. Ventilate for at least 2 hours after application.
Fruit anthracnose	<i>See Septoria leaf blight for chemical recommendations. When conditions are favorable for fruit anthracnose, use higher label rates of chlorothalonil formulations.</i>			
Fusarium and Verticillium wilts	<i>Plant only wilt-resistant varieties and follow a rotation that does not include wilt-susceptible crops.</i>			
	metam-sodium	Vapam HL		
Late blight	cyazofamid	2.1–2.75 fl oz Ranman 400SC	0	Do not apply more than six sprays or 16.5 fl oz/a per year. Alternate Ranman (Group 21) sprays with a fungicide having a different mode of action. Crops not listed on the label should not be planted within 30 days after the last application.
	cymoxanil	3.2–5.0 oz Curzate 60DF	3	If late blight is present, use the 5.0 oz rate. Use only in combination with a labeled rate of a protectant fungicide, such as mancozeb, chlorothalonil, or copper hydroxide.

(continued)

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Disease control in tomato *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Late blight <i>(cont.)</i>	dimethomorph	6.0 oz Forum	0	Begin treatment before the onset of late blight. Apply every 7–10 days; when cool, wet conditions are conducive for disease or when late blight has been detected in a field or nearby, apply every 5–7 days. Forum must be used in a tank mix with other protectant fungicides other than mefenoxam or metalaxyl. Do not exceed 30.0 oz/a Forum per season.
	fixed copper	2.0–3.0 lb Kocide 101, DF	0	Begin treatment before symptoms appear.
		2.6–4.0 pt Kocide LF 2.4F	0	
		1.5 lb Kocide 2000 DF	0	
		0.75–1.75 lb Kocide 3000	0	
		3.0–4.0 lb Tri-Basic Copper Sulfate	0	
	fluopicolide	3.0–4.0 fl oz Presidio	2	Tank mix this product with another labeled non-Group 43 fungicide.
	mandipropamid/difenoconazole	5.5–7.0 fl oz Revus Top	1	Make no more than two consecutive applications before switching to another non-Group 40/3 fungicide. Do not exceed 28.0 fl oz/a Revus Top per season.
	potassium phosphite	1.0–3.0 qt Fosphite/100 gal water	0	Do not apply Fosphite at intervals less than 3 days. Do not apply to plants that are heat- or moisture-stressed.
	propamocarb hydrochloride	0.7–1.5 pt Previcur Flex	5	Begin treatment before the onset of late blight. Tank mix with other fungicides such as chlorothalonil, maneb, or mancozeb. Adjust rates and timing according to late blight conditions. Do not exceed 7.5 pt/a Previcur Flex per growing season.
Seed rot, root rot, and damping-off	captan thiram			Plant seed treated with Captan or Thiram fungicide.
	fosetyl-al	2.5–5.0 lb Aliette, Linebacker	14	Do not exceed 20.0 lb product/a per season. Do not apply in less than 10.0 gal/a application volume. Apply at two- to four-leaf stage for direct-seeded tomatoes or immediately after transplanting to the field.

(continued)

Pepper

Potato

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Sweet corn

Table beet

Tomato

Insect keys

Disease control in tomato (continued)

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Septoria leaf blight, early blight, and late blight	azoxystrobin	6.2 fl oz Quadris Flowable	14	Cabrio, Evito, Quadris, Reason, and Tanos belong to the Group 11 (strobilurin) fungicide category. Quadris Opti contains a combination of Groups 11 and M5 fungicides. Do not exceed one application of any of these Group 11 products before alternating with a fungicide having a different mode of action. Do not exceed four applications of Evito or six applications of other Group 11 fungicides per year. Do not exceed 96.0 oz/a Cabrio, 22.8 fl oz/a Evito, 1.0 qt/a Quadris, 1 gal/a Quadris Opti, 24.6 fl oz/a Reason, or 72.0 oz/a Tanos per season. Following the last application of Reason 500 SC, wait 30 days before rotating to wheat and 1 year for all other crops. Do not apply Quadris or Tanos with an adjuvant. Do not apply Quadris or Tanos until 21 days after transplanting or 35 days after seeding. Do not apply Quadris or Tanos within 6 days before or after a postemergence application of metribuzan herbicide. Tanos must be tank mixed with a contact fungicide having a different mode of action. Begin spraying when the first fruit clusters start to develop and continue on a 7-day schedule throughout the season. Do not exceed 15.1 lb ai/a chlorothalonil per season. Adjust spray intervals when conditions favor disease development. Also targets leaf mold (<i>Fulvia fulvum</i>) common in high tunnels and greenhouses. Do not apply more than 47.0 fl oz/a season. Do not use on varieties of tomatoes in which mature fruit are less than 2 inches (such as cherry or grape). Do not apply more than 56.0 oz/a per year. Do not apply to small tomatoes such as cherry- or grape-type tomatoes in the greenhouse. Do not mix Priaxor with emulsifiable concentrate (EC) formulation or solvent-based formulation products, or crop oil concentrate, methylated seed oil, organosilicone, or MSO/OS blended adjuvant products. Do not make more than two applications before alternating to a fungicide with a different mode of action. Can be used on certified organic farms. Multiple use patterns for tomato. See label for details.
	azoxystrobin + chlorothalonil	1.6 pt Quadris Opti	0	
	azoxystrobin + difenoconazole	8.0–14.0 fl oz Quadris Top	0	
	cymoxanil + famoxadone	<i>early blight</i> : 6.0–8.0 oz Tanos 50DF <i>late blight, fruit anthracnose</i> : 8.0 oz Tanos 50DF	3	
			3	
	fenamidone	5.5–8.2 fl oz Reason 500 SC	14	
	fluoastrobilin	3.8–5.7 fl oz Evito 480 SC, Aftershock	3	
	chlorothalonil	1.3–1.8 lb Bravo Ultrex 82.5WDG, Equus DF 1.375–2.0 pt Bravo Weather Stik, Echo 720, Equus 720 1.2–1.7 lb Echo 90DF 2.0–3.0 pt Echo Zn 2.0–2.75 pt Bravo Zn 1.9–2.8 pt Equus 500 Zn	0	
			0	
			0	
0				
0				
0				
cyprodinil + difenoconazole	<i>Septoria leaf blight, early blight</i> : 16.0–20.0 fl oz Inspire Super	0		
cyprodinil + fludioxonil	<i>early blight</i> : 11.0–14.0 oz Switch 62.5WG	0		
fluxapyroxad + pyraclostrobin	4.0–8.0 fl oz Priaxor	7		
hydrogen dioxide	1:100–1:2000 OxiDate dilution rate	0		

(continued)

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Insect keys

Disease control in tomato *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Septoria leaf blight, early blight, and late blight <i>(cont.)</i>	mancozeb	1.2–2.4 qt Dithane F-45	5	Consult label for product use limits. Spray every 5–10 days depending on disease and weather pressures.
		1.5–3.0 lb Dithane DF	5	
		Rainshield	5	
		0.75–1.5 lb Koverall	5	
		0.6–2.4 qt Manzate Flowable	5	
		1.0–2.0 lb Manzate Pro-Stick	3	
		0.6–2.4 qt Penncozeb 4FL	5	
	0.75–3.0 lb Penncozeb 75DF, 80WP	5		
	penthiopyrad	10.0–24.0 fl oz Fontelis	0	Make no more than two sequential applications before switching to a fungicide with a different mode of action. Do not exceed 72.0 fl oz/a per year.
	pyraclostrobin	<i>early blight, fruit anthracnose, Septoria leaf blight:</i> 8.0–12.0 oz Cabrio EG		0
<i>late blight:</i> 8.0–16.0 oz Cabrio EG		0		
trifloxystrobin	<i>Septoria suppression:</i> 3.0–4.0 oz Flint <i>late blight:</i> 4.0 oz Flint and tank mix with 75% of labeled rate of a protectant fungicide		3	Do not apply more than 16.0 oz/a per season. Do not apply more than five applications/a per season. Alternate every Group 11 application with at least one application from a different group.
zoxamide + mancozeb	1.5–2.0 lb Gavel 75DF		5	Do not make more than four applications or apply more than 8.0 lb/a product (5.33 lb ai mancozeb or 0.66 lb zoxamide) per season. See label for other diseases controlled.
Soil rot	<i>Avoid by staking or mulching plants.</i>			
Walnut wilt	<i>Symptoms are similar to Fusarium wilt. Plant tomatoes at a distance from the base of black walnut trees that is greater than the tree height.</i>			
White mold (<i>Sclerotinia sclerotiorum</i>)	<i>Coniothyrium minitans</i>	1.0–4.0 lb Contans WG	0	Broadcast apply into top 2 inches of soil and incorporate with light mechanical incorporation or irrigation. See label for additional use patterns. Can be used in greenhouses and high-tunnel structures.

Scouting calendar for insect pests of tomato

	April			May			June			July			August			September		
	early	mid	late	early	mid	late	early	mid	late	early	mid	late	early	mid	late	early	mid	late
				Black cutworm														
				Flea beetles														
										Variegated cutworm								
										Tomato hornworm (European corn borer)								

Insect control in tomato

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Aphids	acetamiprid	0.8–1.2 oz Assail 70WP 2.0–4.0 oz Assail 30 SG	7 7	Begin treatment when thresholds are reached. Apply every 7 days as needed. Do not exceed 6.8 oz/a Assail 70WP or 16.0 oz/a Assail 30 SG per season.
	0.025–0.044 lb beta-cyfluthrin	1.6–2.8 fl oz *Baythroid XL	0	Ground applications only.
	0.033–0.08 lb bifenthrin	2.1–5.2 fl oz *Brigade 2EC	1	Do not exceed four applications per season.
	0.06–0.15 lb bifenthrin + imidacloprid	3.8–9.85 fl oz *Brigadier	1	Do not apply more than 30.72 fl oz/a (0.48 lb ai/a) per season. No more than 0.32 lb ai/a bifenthrin and 0.24 lb ai/a imidacloprid are allowed per season.
	clothianadin	<i>foliar</i> : 3.0–4.0 fl oz Belay	21	Do not apply more than 12.0 fl oz/a per season and allow at least 7 days between applications.
		<i>soil</i> : 9.0–12.0 fl oz Belay	—	Do not apply more than 12.0 fl oz/a per season. Apply as a narrow band centered on the plant row; as an in-furrow spray at planting; as a side dress to both sides of the row; as a transplant water drench; or as chemigation into root zone through drip, trickle or micro-sprinkler, or similar equipment.
	0.018–0.028 lb deltamethrin	1.5–2.4 fl oz *Delta Gold	1	Apply every 5 days as needed. Do not exceed 14.4 fl oz/a Delta Gold.
	0.045–0.268 lb dinotefuran	<i>foliar</i> : 1.0–4.0 oz Venom 70SG	1	Do not follow soil applications with foliar application of any other neonicotinoid insecticide. Use only one application method. Do not apply more than 6.0 oz/a per year using foliar applications, or 12.0 oz/a per season using soil applications. See product label for application directions. Do not apply to tomatoes less than 2 inches tall.
		<i>soil</i> : 5.0–6.0 oz Venom 70SG	21	
	0.05–0.18 lb dinotefuran (foliar)	2.0–7.0 oz Scorpion 35SL	1	Can repeat at 7-day intervals. Do not apply more than 10.5 oz per year. Use only one application method.
	0.23–0.27 lb dinotefuran (soil)	9.0–10.5 oz Scorpion 35SL	21	Do not apply more than 21.0 oz per year. Use only one application method.
	0.25–0.5 lb dimethoate	0.5–1.0 pt Dimethoate EC	7	
	0.5–1.0 lb endosulfan	0.66–1.33 qt Thiodan EC 1.0–2.0 lb Thiodan WP	2	Do not exceed six applications per season.
	0.2 lb fenpropathrin	10.67 oz Danitol 2.4EC	3	Do not exceed 2.66 pt/a Danitol (0.8 lb ai/a) per season. Control may be improved by the addition of a non-ionic surfactant.
	0.062–0.089 lb flonicamid	2.0–2.8 oz Beleaf SG	0	Begin applications before aphid populations build. Do not exceed 2.8 oz/a per application or 8.4 oz/a (0.267 lb ai/a) per season.
	imidacloprid	7.0–10.5 fl oz Admire Pro	21	Systemic at planting. Do not exceed 24.0 fl oz/a Admire per season.
0.05 lb imidacloprid	Provado 1.6	0	Foliar spray. Also controls whitefly. Do not exceed 18.75 fl oz/a Provado per season.	
imidacloprid + beta-cyfluthrin	3.8–4.1 fl oz *Leverage 360	0	Do not apply more than 12.8 fl oz/a per season and allow at least 7 days between applications.	
0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4	Reapply at intervals of 5 days or more. Do not exceed 0.18 lb ai/a per year.	

*Restricted-use pesticide.

(continued)

Pepper

Potato

Pumpkin & squash

Sweet corn

Table beet

Tomato

Insect keys

Insect control in tomato *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Aphids <i>(cont.)</i>	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Voliam Xpress	5	Do not exceed a total of 31.0 fl oz/a of Voliam Xpress or 0.36 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per season.
	lambda-cyhalothrin + thiamethoxam	4.0–4.5 fl oz *Endigo ZC	5	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 5 days between applications.
Potato	0.9–1.5 lb malathion	several formulations	1	
	0.75–1.0 lb methamidophos	1.5–2.0 pt *Monitor 4E	7	
	0.225–0.9 lb methomyl	0.75–3.0 pt *Lannate LV 0.25–1.0 lb *Lannate SP	1	
	pymetrozine	2.75 oz Fulfill 50WDG	14	Controls melon and green peach aphids. Treat when aphids first appear. May repeat in 7 days. Do not exceed 5.5 oz/a per season or more than two applications per crop.
	0.06–0.08 spirotetramat	4.0–5.0 Movento	1	Do not apply more than 10.0 fl oz/a (0.16 lb ai/a) per season.
Pumpkin & squash	thiamethoxam	2.0–3.0 oz Actara WG 5.0–11.0 fl oz Platinum	0 30	Apply before pests reach damaging levels. Repeat as needed every 7–10 days. Apply higher rates for heavy infestations, or for long residual with Platinum. Do not exceed 8.0 oz/a of either product per season. Do not apply less than 11.0 oz/a of Platinum per season.
	0.198–0.257 lb thiamethoxam + chlorantraniliprole	10.0–13.0 fl oz Durivo	30	Do not exceed a total of 13.0 fl oz/a Durivo (0.257 lb ai/a) per growing season. Do not exceed 0.172 lb ai/a of thiamethoxam-containing products or 0.2 lb ai/a of chlorantraniliprole-containing products per season.
	zeta-cypermethrin	3.2–4.0 oz *Mustang Max	1	Apply every 7 days as needed. Use higher rate for heavy infestations. Do not exceed 24.0 oz/a Mustang Max per season.
Sweet corn	Cutworms and loopers	<i>Treat when larvae exceed one per 10 plants.</i>		
	0.033–0.044 lb beta-cyfluthrin	2.1–2.8 fl oz *Baythroid XL	0	Ground applications only. Apply every 7 days as needed. Do not apply more than 16.8 fl oz/a of Baythroid per season.
	bifenthrin	2.1–5.2 fl oz *Brigade 2EC 3.4–6.8 fl oz *Capture LFR	1 33	Do not exceed four applications per season. Do not exceed 0.1 lb ai/a as an at-plant application; do not exceed 0.32 lb ai/a per season of all bifenthrin products.
Table beet	0.04–0.15 lb bifenthrin + imidacloprid	5.1–9.85 fl oz *Brigadier	1	Do not apply more than 30.72 fl oz/a (0.48 lb ai/a) per season. No more than 0.32 lb ai/a bifenthrin and 0.24 lb ai/a imidacloprid are allowed per season.
	1.0–2.0 lb carbaryl	Sevin (several formulations)	0	Broadcast bait formulation. Can only be used with mechanical harvest.
	0.045–0.065 lb chlorantraniliprole	3.5–5.0 fl oz Coragen	1	Wait at least 5 days between treatments. Do not exceed 15.4 fl oz/a (0.2 lb ai/a) per season.
	0.018–0.028 lb deltamethrin	1.5–2.4 fl oz *Delta Gold	1	Apply every 5 days as needed. Do not exceed 14.4 fl oz/a Delta Gold.
	0.0075–0.015 lb emamectin benzoate	2.4–4.8 oz Proclaim 5 WDG	7	
Tomato	0.015–0.05 lb esfenvalerate	2.9–9.6 fl oz *Asana XL	1	Do not exceed 0.5 lb ai/a per season.

Insect control in tomato *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Cutworms and loopers <i>(cont.)</i>	0.2 lb fenpropathrin	10.67 oz Danitol 2.4EC	3	Do not exceed 2.66 pt/a Danitol (0.8 lb ai/a) per season. Control may be improved by the addition of a non-ionic surfactant.
	0.03–0.045 lb flubendiamide	2.0–3.0 oz Synapse WG	1	Do not apply more than 3.0 oz/a (0.045 lb ai/a) in a 7-day period or more than 9.0 oz/a per season.
	flubendiamide + buprofezin	12.0–17.0 fl oz Vetica	1	Do not apply more than 38.0 fl oz/a per season and allow at least 7 days between applications. Do not make more than three applications per crop season.
	imidacloprid + beta-cyfluthrin	3.8–4.1 fl oz *Leverage 360	0	Do not apply more than 12.8 fl oz/a per season and allow at least 7 days between applications.
	0.015–0.025 lb lambda-cyhalothrin	0.96–1.6 fl oz *Warrior II	4	Do not exceed 0.36 lb ai/a per season. Reapply at intervals of 5 or more days.
	lambda-cyhalothrin + chlorantraniliprole	5.0–8.0 fl oz *Voliam Xpress	5	Do not exceed 31.0 fl oz/a of Voliam Xpress or 0.36 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per growing season.
	lambda-cyhalothrin + thiamethoxam	4.0–4.5 fl oz *Endigo ZC	5	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 5 days between applications.
	0.06–0.16 lb methoxyfenozide	4.0–10.0 fl oz Intrepid 2F	1	Do not exceed 64.0 fl oz/a per season. Use the higher rates with higher populations or when spray coverage is difficult. See label for use restrictions in some Wisconsin counties.
	0.039–0.063 lb spinetoram	5.0–8.0 oz Radiant SC	7	Do not apply more than 34.0 oz/a Radiant (0.266 lb ai/a) or make more than six applications per season.
	spinosad	3.0–6.0 fl oz Entrust SC	1	Use higher rate for larger insects. Do not exceed 0.45 lb ai/a per season. Do not use a buffering agent. Spray thoroughly for control.
	tebufenozide	6.0–16.0 fl oz Confirm 2F	7	Apply per label directions when populations reach threshold levels. Do not exceed 64.0 fl oz ai/a per season. There is a 1–12 month plantback restriction depending on crop.
	0.198–0.257 lb thiamethoxam + chlorantraniliprole	10.0–13.0 fl oz Durivo	30	Do not exceed a total of 13.0 fl oz/a Durivo (0.257 lb ai/a) per growing season. Do not exceed 0.172 lb ai/a of thiamethoxam-containing products or 0.2 lb ai/a of chlorantraniliprole-containing products per season.
	0.01–0.025 lb zeta-cypermethrin	2.24–4.0 oz *Mustang Max	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Max per season.
0.04–0.1 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	1	Do not apply more than 0.42 lb ai/a per season. Wait at least 10 days between applications.	
Flea beetles	<i>Treat when numbers exceed two beetles per 10 leaves.</i>			
	beta-cyfluthrin	2.8 fl oz *Baythroid XL	0	Maximum Baythroid XL allowed per 7-day interval is 2.8 fl oz/a and season total allowed per crop season is 16.8 fl oz/a.

*Restricted-use pesticide.

(continued)

Pepper

Potato

Pumpkin & squash

Sweet corn

Table beet

Tomato

Insect keys

Insect control in tomato *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Flea beetles <i>(cont.)</i>	bifenthrin	2.1–5.2 fl oz *Brigade 2EC	1	Do not exceed four applications per season.
		3.4–6.8 fl oz *Capture LFR	33	Do not exceed 0.1 lb ai/a as an at-plant application; do not exceed 0.32 lb ai/a per season of all bifenthrin products.
Potato	0.04–0.15 lb bifenthrin + imidacloprid	5.1–9.85 fl oz *Brigadier	1	Do not apply more than 30.72 fl oz/a (0.48 lb ai/a) per season. No more than 0.32 lb ai/a bifenthrin and 0.24 lb ai/a imidacloprid are allowed per season.
	0.8 lb carbaryl	Sevin	0	Several formulations; see label for rate. Can only be used with mechanical harvest.
	clothianadin	<i>foliar</i> : 3.0–4.0 fl oz Belay <i>soil</i> : 9.0–12.0 fl oz Belay	21 —	Do not apply more than 12.0 fl oz/a per season and allow at least 7 days between applications. Do not apply more than 12.0 fl oz/a per season. Apply as a narrow band centered on the plant row; as an in-furrow spray at planting; as a side dress to both sides of the row; as a transplant water drench; or as chemigation into root zone through drip, trickle or micro-sprinkler, or similar equipment.
Pumpkin & squash	0.018–0.028 lb deltamethrin	1.5–2.4 fl oz *Delta Gold	1	Apply every 5 days as needed. Do not exceed 14.4 fl oz/a Delta Gold.
	0.045–0.268 lb dinotefuran	<i>foliar</i> : 1.0–4.0 oz Venom 70SG <i>soil</i> : 5.0–6.0 oz Venom 70SG	1 21	Do not follow soil applications with foliar application of any other neonicotinoid insecticide. Use only one application method. Do not apply more than 6.0 oz/a per year using foliar applications, or 12.0 oz/a per season using soil applications. See product label for application directions. Do not apply to tomatoes less than 2 inches tall.
Sweet corn	0.05–0.18 lb dinotefuran <i>(foliar)</i>	2.0–7.0 oz Scorpion 35SL	1	Can repeat at 7-day intervals. Do not apply more than 10.5 oz per year. Use only one application method. Do not apply to tomatoes less than 2 inches tall.
	0.23–0.27 lb dinotefuran <i>(soil)</i>	9.0–10.5 oz Scorpion 35SL	21	Do not apply more than 21.0 oz per year. Use only one application method. Do not apply to tomatoes less than 2 inches tall.
Table beet	0.5–1.0 lb endosulfan	0.66–1.33 qt Thiodan EC 1.0–2.0 lb Thiodan WP	1	
	0.015–0.05 lb esfenvalerate	2.9–9.6 fl oz *Asana XL	1	Do not exceed 0.5 lb ai/a per season.
	0.01–0.015 lb gamma-cyhalothrin	2.56–3.84 oz *Proaxis	5	Apply every 5 days as needed. Do not apply more than 2.88 pt/a (0.18 lb ai/a) per season.
Tomato	imidacloprid	7.0–10.5 fl oz Admire Pro	21	Systemic at planting.
	imidacloprid + beta-cyfluthrin	3.8–4.1 fl oz *Leverage 360	0	Do not apply more than 12.8 fl oz/a per season and allow at least 7 days between applications.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4	Reapply at intervals of 5 days or more. Do not exceed 0.36 lb ai/a per year.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Voliam Xpress	5	Do not exceed a total of 31.0 fl oz/a of Voliam Xpress or 0.36 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per season.

*Restricted-use pesticide.

(continued)

Insect control in tomato *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Flea beetles <i>(cont.)</i>	lambda-cyhalothrin + thiamethoxam	4.0–4.5 fl oz *Endigo ZC	5	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 5 days between applications.
	thiamethoxam	2.0–3.0 oz Actara WG	0	Apply before pests reach damaging levels. Repeat as needed every 5 days. Do not exceed 8.0 oz/a of product per season.
		5.0–11.0 fl oz Platinum	30	Apply as an in-furrow spray at planting or as a post-seeding transplant or hill drench. Irrigate sufficiently to move the chemical into the root zone. Use the higher rate for long residual control. Do not apply less than 5.0 fl oz/a or more than 11.0 fl oz/a of Platinum per season.
	0.198–0.257 lb thiamethoxam + chlorantraniliprole	10.0–13.0 fl oz Durivo	30	Do not exceed a total of 13.0 fl oz/a Durivo (0.257 lb ai/a) per growing season. Do not exceed 0.172 lb ai/a of thiamethoxam-containing products or 0.2 lb ai/a of chlorantraniliprole-containing products per season.
	0.01–0.025 lb zeta-cypermethrin	2.24–4.0 oz *Mustang Max	1	Apply every 7 days as needed. Use higher rate for heavy infestations. Do not exceed 24.0 oz/a Mustang Max per season.
	0.04–0.1 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	1	Do not apply more than 0.42 lb ai/a per season. Wait at least 10 days between applications.
Hornworm and tomato fruitworm	<i>Treat when there is an average of at least two hornworms per plant.</i>			
	<i>Bacillus thuringiensis</i>	DiPel DF, Javelin, MVP	0	Rates vary with formulation. Apply when larvae are small.
	<i>Bacillus thuringiensis</i> subsp. <i>kurstaki</i>	1.0–2.0 lb Lepinox WDG	0	Treat early instar larvae before noticeable feeding damage occurs. Repeat as needed.
	0.025–0.044 lb beta-cyfluthrin	1.6–2.8 fl oz *Baythroid XL	0	Ground applications only. Apply every 7 days as needed. Do not apply more than 16.8 fl oz/a of Baythroid XL per season.
	0.033–0.08 lb bifenthrin	2.1–5.2 fl oz *Brigade 2EC	1	Do not exceed four applications per season.
	0.04–0.15 lb bifenthrin + imidacloprid	5.1–9.85 fl oz *Brigadier	1	Do not apply more than 30.72 fl oz/a (0.48 lb ai/a) per season. No more than 0.32 lb ai/a bifenthrin and 0.24 lb ai/a imidacloprid are allowed per season.
	0.5–2.0 lb carbaryl	Sevin (several formulations)	0	Can only be used with mechanical harvest.
	0.045–0.065 lb chlorantraniliprole	3.5–5.0 fl oz Coragen	1	Wait at least 5 days between treatments. Do not exceed 15.4 fl oz/a (0.2 lb ai/a) per season.
	0.012–0.028 lb deltamethrin	1.0–2.4 fl oz *Delta Gold	1	Apply every 5 days as needed. Do not exceed 14.4 fl oz/a Delta Gold.
	0.0075–0.015 lb emamectin benzoate	2.4–4.8 oz Proclaim 5 WDG	7	
	0.015–0.05 lb esfenvaterate	2.9–9.6 fl oz *Asana XL	1	Do not exceed 0.5 lb ai/a per season.
	0.2 lb fenpropathrin	10.67 oz Danitol 2.4EC	3	Do not exceed 2.66 pt/a Danitol (0.8 lb ai/a) per season. Control may be improved by the addition of a non-ionic surfactant.
	0.03–0.045 lb flubendiamide	2.0–3.0 oz Synapse WG	1	Do not apply more than 3.0 oz/a (0.045 lb ai/a) in a 7-day period or more than 9.0 oz/a per season.

*Restricted-use pesticide.

(continued)

Pepper

Potato

Pumpkin & squash

Sweet corn

Table beet

Tomato

Insect keys

Insect control in tomato *(continued)*

	Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Pepper	Hornworm and tomato fruitworm <i>(cont.)</i>	flubendiamide + buprofezin	12.0–17.0 fl oz Vetica	1	Do not apply more than 38.0 fl oz/a per season and allow at least 7 days between applications. Do not make more than three applications per crop season.
		0.0075–0.0125 lb gamma-cyhalothrin	1.92–3.20 oz *Proaxis	5	Apply every 5 days as needed. Do not apply more than 2.88 pt/a (0.18 lb ai/a) per season.
Potato		imidacloprid + beta-cyfluthrin	3.8–4.1 fl oz *Leverage 360	0	Do not apply more than 12.8 fl oz/a per season and allow at least 7 days between applications.
		0.045–0.065 lb indoxacarb	2.5–3.5 oz Avaunt	3	Apply when insect populations reach threshold levels. May repeat treatment every 5 days. Do not apply more than 0.26 lb ai/a per crop. Apply higher rate for tomato fruitworm control.
		0.015–0.025 lb lambda-cyhalothrin	0.96–1.6 fl oz *Warrior II	4	Reapply at intervals of 5 days or more. Do not exceed 0.36 lb ai/a per year.
Pumpkin & squash		lambda-cyhalothrin + chlorantraniliprole	5.0–8.0 fl oz *Voliam Xpress	5	Do not exceed a total of 31.0 fl oz/a of Voliam Xpress or 0.36 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per season.
		lambda-cyhalothrin + thiamethoxam	4.0–4.5 fl oz *Endigo ZC	5	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 5 days between applications.
Sweet corn		0.225–0.9 lb methomyl	0.75–3.0 pt *Lannate LV 0.25–1.0 lb *Lannate SP	1	
		0.16–0.25 lb methoxyfenozide	10.0–16.0 fl oz Intrepid 2F	1	Do not exceed 64.0 fl oz/a per season. Use the higher rates with higher populations or when spray coverage is difficult. See label for use restrictions in some Wisconsin counties. May only provide partial control of fruitworms in heavy infestations.
		0.05–0.2 lb permethrin	*Ambush, *Pounce	0	Several formulations; see label for rate and seasonal use limits. Do not apply to cherry tomatoes.
Table beet		0.039–0.063 lb spinetoram	5.0–8.0 oz Radiant SC	7	Do not apply more than 34.0 oz/a Radiant (0.266 lb ai/a) per crop and do not make more than six applications per crop.
		spinosad	3.0–6.0 fl oz Entrust SC	1	Use higher rate for larger insects. Apply adequate spray to get good coverage for best control. Do not exceed 0.45 lb ai/a per season. Do not use a buffering agent.
Tomato		0.09–0.25 lb tebufenozide	6.0–16.0 fl oz Confirm 2F	7	Apply per label directions when populations reach threshold levels. Do not exceed 64.0 fl oz ai/a per season. There is a 1–12 month plantback restriction depending on crop.
		0.198–0.257 lb thiamethoxam + chlorantraniliprole	10.0–13.0 fl oz Durivo	30	Do not exceed a total of 13.0 fl oz/a Durivo (0.257 lb ai/a) per growing season. Do not exceed 0.172 lb ai/a of thiamethoxam-containing products or 0.2 lb ai/a of chlorantraniliprole-containing products per season.
		0.01–0.025 lb zeta-cypermethrin	2.24–4.0 oz *Mustang Max	1	Apply every 7 days as needed. Use higher rate for heavy infestations. Do not exceed 24.0 oz/a Mustang Max per season.

*Restricted-use pesticide.

(continued)

Insect control in tomato *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Hornworm and tomato fruitworm <i>(cont.)</i>	0.04–0.1 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	1	Do not apply more than 0.42 lb ai/a per season. Wait at least 10 days between applications.
Spider mite	0.938–1.88 lb abamectin	8.0–16.0 fl oz *Agri-Mek 0.15EC	7	May repeat after 7 days, but do not make more than two sequential treatments or exceed 5.64 lb ai/a per year.
	bifenazate	0.75–1.0 lb Acramite 50WS	3	Limit one application per season.
	0.033–0.08 lb bifenthrin	2.1–5.2 fl oz *Brigade 2EC	1	Do not exceed four applications per season.
	0.2 lb fenpropathrin	10.66 fl oz Danitol 2.4EC	3	Treat when mites first appear and repeat every 7 days as needed. Do not exceed 0.8 lb ai/a per season.
	lambda-cyhalothrin + thiamethoxam	4.5 fl oz *Endigo ZC	5	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 5 days between applications.
	1.5–2.0 lb malathion	several formulations	1–5	
	spiromesifen	7.0–8.5 fl oz Oberon 2SC	7	Apply every 7 days as needed. Do not exceed 25.5 fl oz/a per season.
	0.1 lb zeta-cypermethrin + bifenthrin	10.3 fl oz *Hero	1	Do not apply more than 0.42 lb ai/a per season. Wait at least 10 days between applications.

*Restricted-use pesticide.

Weed control in tomato

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Annual weeds	0.48–1.43 lb pendimethalin	1.0–3.0 pt Prowl H ₂ O	21	Apply as a broadcast preplant-incorporated application, or as a broadcast preplant surface application before transplanting, or as a post-directed application to transplanted or established direct-seeded tomatoes. Do not apply postemergence over the top of or to foliage of tomatoes. Use rate varies by soil type. Do not apply more than 3.0 pt/a per season. Do not allow treated soil to come in contact with the transplant area.
	s-metolachlor	1.0–2.0 pt Dual Magnum or Dual II Magnum	varies	Transplanted tomatoes: Apply as a preplant incorporated, preplant before transplanting, or post-directed following the first settling rain or irrigation. Dual Magnum may also be used under plastic mulch or to treat row middles in bedded tomatoes. Dual Magnum will not control emerged weeds. Adjust rate according to soil texture and expected weed pressure. Do not apply to cultivars with unknown tolerance. Preharvest interval varies with application rate. Consult label for specific rate-dependent preharvest intervals. See label for additional directions and precautions.
	0.07–0.25 lb sulfentrazone	2.25–8.0 oz Spartan 4F		Pre-transplant broadcast or banded applications to transplanted tomatoes only. Use rate is based on soil texture and organic matter. Do not apply to soils classified as sand with less than 1% organic matter.

*Restricted-use pesticide.

(continued)

Pepper

Potato

Pumpkin & squash

Sweet corn

Table beet

Tomato

Insect keys

Weed control in tomato *(continued)*

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Annual grasses and some broadleaves	4.5–10.5 lb DCPA	6.0–14.0 lb Dacthal W-75 6.0–14.0 pt Dacthal FL		Make preemergence applications to weed-free soil 4–6 weeks after transplanting and to seeded tomatoes when they are 4–6 inches tall. Use only on soils with 5% or less organic matter.
	1.0–2.0 lb napropamide	2.0–4.0 lb Devrinol 50-DF		Apply before planting to a weed-free soil surface. Incorporate 1–2 inches deep the same day. Napropamide can be applied to direct-seeded or transplanted tomatoes.
	0.5–1.0 lb trifluralin	1.0–2.0 pt Treflan HFP or registered equivalent		For transplants, apply and incorporate before transplanting or apply post-plant as a directed spray to the soil between the rows and beneath plants and incorporate. On direct-seeded tomatoes, apply as a directed spray between rows and under plants at thinning. May cause early stunting of tomatoes, especially under poor growing conditions. Controls annual grasses and some broadleaf weeds, but is weak on wild mustard, smartweed, common ragweed, velvetleaf, and black nightshade. Rate varies with soil texture and organic matter. Follow recommended soil preparation application, and incorporation procedures. Must be incorporated within 24 hours. See label for plantback restrictions. Ineffective on peat and muck soils.
Annual broadleaves and some grasses	metribuzin	<i>preplant-incorporated</i>	7	Incorporate 2–4 inches deep before transplanting.
		<i>postemergence broadcast</i>	7	For postemergence broadcast spray to established tomatoes, apply before weeds are 1 inch tall. Minimum of 14 days between applications. Do not treat seeded tomatoes until they have five to six leaves. Do not apply until transplants have recovered from transplant shock and new growth is evident. Do not apply within 3 days after cool, wet, or cloudy weather, or injury may result. Do not apply within 24 hours of other chemical treatments.
		<i>postemergence directed</i>	7	Use postemergence directed spray application on fields with a history of severe weed pressure or fields infested with hard-to-kill weeds. Use in limited trials on new varieties. If making multiple applications, do not exceed the maximum annual rate. See label for additional precautions on this use.
Annual weeds and some perennial weeds	0.0156–0.624 lb rimsulfuron	<i>preemergence</i> : 2.0–4.0 oz Matrix or Solida	45	Requires rainfall or irrigation for activation; see label for timing and amount. For postemergence applications, use 1.0–2.0 oz/a product to control young, actively growing weeds. See label for adjuvant instructions. Do not exceed 4.0 oz/a per season.
		<i>postemergence</i> : 1.0–2.0 oz Matrix or Solida	45	
Nutsedge and some broadleaves	0.023–0.047 lb halosulfuron	0.5–1.0 oz Sandea (rate varies by crop use and application timing—see label)	30	Sandea controls several broadleaf weeds and nutsedge, but no grasses. Sandea has both pre- and postemergence activity and can be used under plastic mulch. A broadcast postemergent treatment can be sprayed 14 days after transplanting but before first bloom, or directed between rows of a seeded or transplanted crop at any time. If plastic is used on the planted row, adjust equipment to keep spray off the plastic. Do not exceed two applications or apply more than 2.0 oz/a per crop cycle or 12-month period. Soil or foliar applications of organophosphate insecticides to Sandea-treated crops may cause severe crop injury. Consult label for additional usage information and other precautions.

*Restricted-use pesticide.

(continued)

Weed control in tomato *(continued)*

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Emerged weeds	glyphosate	several manufacturers and formulations		See manufacturer's label to assure that the formulation is labeled for this crop and for specific instructions. Some formulations require a wait of 3 days between application and planting. If allowed, glyphosate may be applied any time before crop emerges. If preemergence application is allowed, apply before crop seed germination in coarse sandy soils. If weeds have been mowed or tilled, do not treat until they have resumed active growth and reached the recommended stage on the label. Unless otherwise stated, allow 7 or more days before tilling treated fields. Do not tank mix with soil-residual herbicides unless otherwise specified. Do not make hooded or shielded applications to row middles on sandy soils.
	*paraquat	several manufacturers and formulations— not all are registered for this use	30	Prepare seedbed early to allow for maximum weed emergence. Application can be made as a banded or broadcast treatment before, during, or after planting, but before crop emergence. In preplant and pre-emergence (to the crop) uses, do not apply to soils lacking clay minerals (i.e., muck, pure sand). Use the higher rate for heavy weed infestations. Seeding and transplanting should be performed with minimal soil disturbance. Up to three directed/shielded treatments may be made per season using precision equipment to prevent spray contact with the crop. Always add crop oil concentrate or non-ionic surfactant to spray mixture. Follow precautions on label.
Emerged grasses	0.068–0.24 lb clethodim	9.0–32.0 oz Select Max	20	Apply to actively growing grasses. Repeat treatments may be made at 14-day intervals up to the maximum annual use rate. Do not cultivate grasses within 7 days before or after application. Include appropriate surfactant as required by product label. Do not apply if rain is expected within 1 hour.
	0.094–0.25 lb clethodim	6.0–16.0 oz Select 2EC	20	
	0.094–0.28 lb sethoxydim	0.5–1.5 pt Poast	20	Make postemergence applications to actively growing grasses within the size ranges indicated on the label. Check the label for other (wild proso millet, rescue) treatment rates. Do not apply more than 4.5 pt/a Poast in one crop season. Always add 2.0 pt/a of crop oil concentrate. Follow precautions on label, including tank mix restrictions.

*Restricted-use pesticide.

Pepper

Potato

Pumpkin & squash

Sweet corn

Table beet

Tomato

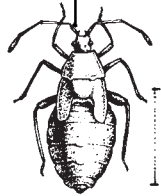
Insect keys

Immature key

Nymphs

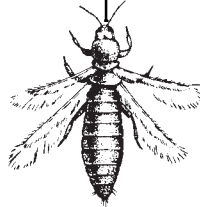
Not worm-shaped (without wings)

No tail pipe extending from rear of body.



Squash bug and leaf-footed bug

½-inch long. Oblong, greenish brown body often has two black spots on abdomen.



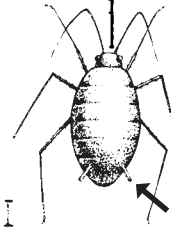
Onion thrips

Thrips about the size and shape of the exclamation mark "!"; yellow to brown in color.



Leafhopper

⅓-inch, green, wedge-shaped nymph. Like adults but smaller.



Plant lice (aphids)

Tail pipes extending from rear of body.

6 true legs (3 pairs) prolegs present; caterpillars.



White grub

Fat, soft, C-shaped, white grubworms.

Green, brown or black larvae without horn at rear of body



Cabbage looper

2 pairs of prolegs. Light-green larvae up to 1½ inches long, body makes a looping motion while moving.



Diamond moth caterpillar

3 pairs of prolegs. Light green, cigar-shaped larvae less than ¾-inch long.

4 pairs of prolegs



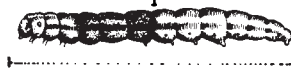
Hornworms

Red or black horn at rear of body.



European corn borer

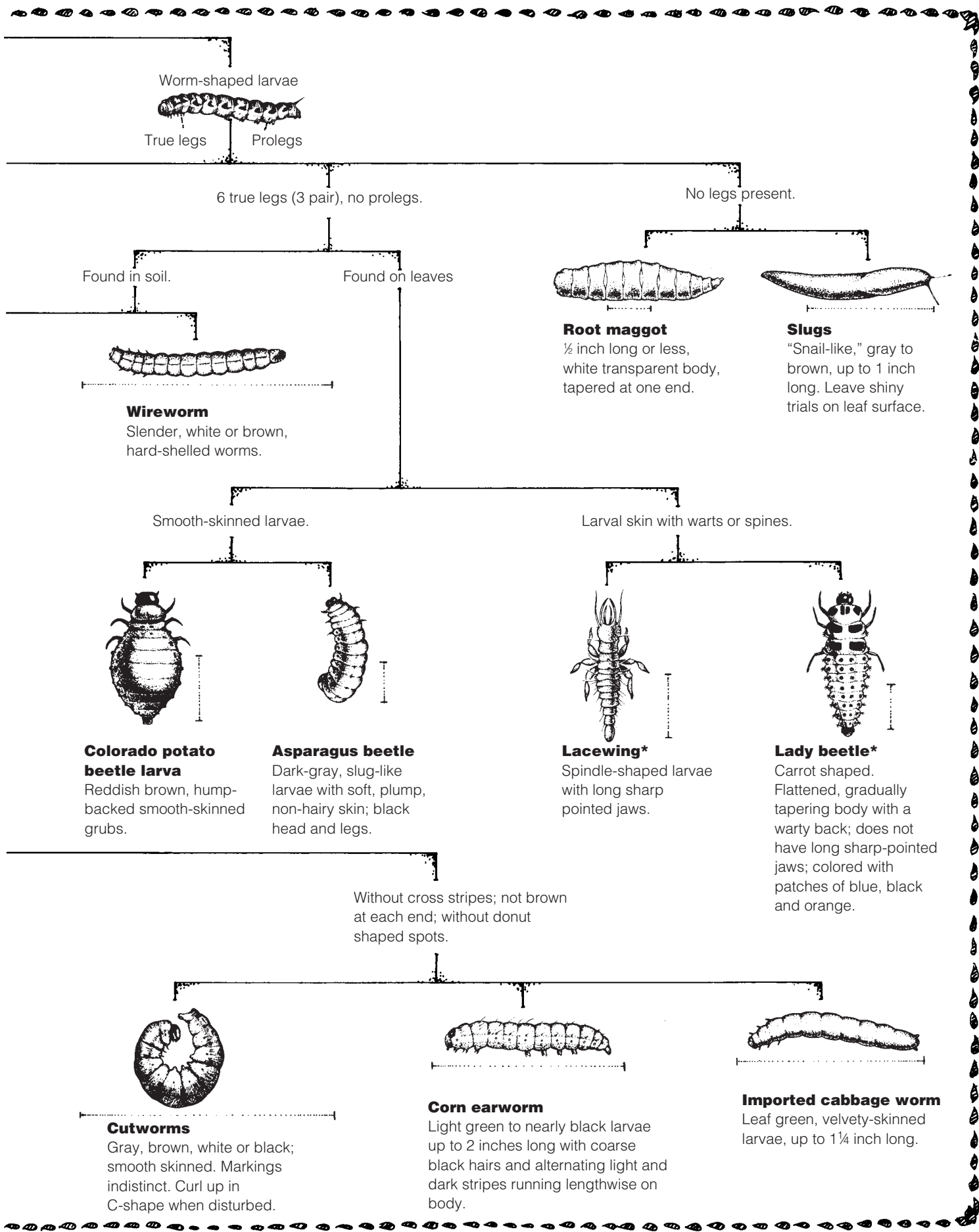
Without cross stripes; not brown at each end; flesh-colored caterpillars up to 1-inch long with small donut-shaped brown spots over the body.



Common stalk borer

Brown and white stripes run lengthwise on body. Yellow head. Bores into stems of many vegetables.

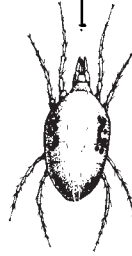
* Beneficial insect



Adult key

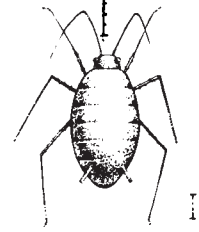
Spider mites

Barely visible—about the size of a period. Adults have 8 legs.



Aphids

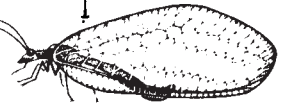
1/8–1/10 inch long, small, soft bodied, 2 tail pipes, usually no wings, pear-shaped bodies.



Wings overlap on back, base of front wing may be leathery; Not hard shelled.

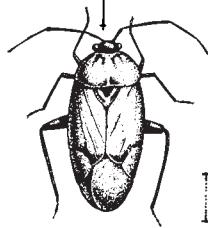
Lacewing*

Front wings entirely membrane-like. Finely netted, held tent-like over body. Green in color. Hair-like antenna.



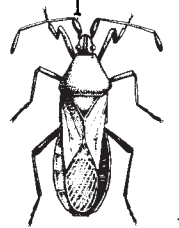
Leafhopper

1/8 inch long, wedge shaped. Hop when disturbed.



Plant bug

1/4 inch long, actively fly.



Squash bug

1 inch long, dark brown.

Antenna longer than length of head and thorax



Asparagus beetle

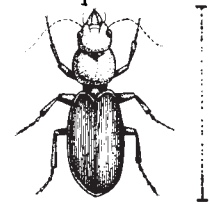
Metallic blue to back, orange to yellow marking.

Usually entirely one color—black, brown, blue or green



Flea beetle

About 1/8–1/4 inch long.



Ground beetle*

1/4 inch or longer.

* Beneficial insect

Larger than a period;
adults have 6 legs

Wings present; no
tail pipes

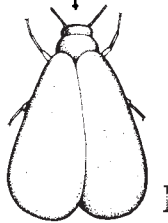
2 pairs of wings
present

Beetles

Front wings entirely
hard shelled, meeting
down the middle in
straight line.

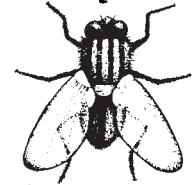
White fly

Tiny ($\frac{1}{8}$ inch), moth-like
insects. Wings covered
with whitish dust. Wings
overlap when resting.



Moths and butterflies

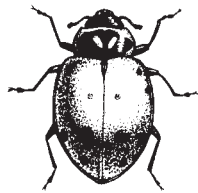
Wing covered with fine
powder-like scales.
Various sizes.



**True flies and
root maggot
adults**

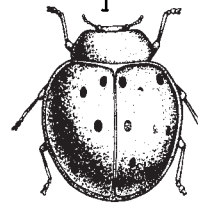
Only 1 pair of
wings present.

Antenna shorter than length
of head and thorax



Lady beetle*

Usually yellow, orange, or
red beetles; usually with
one or more spots per
front wing—but not 8.



**Mexican bean
beetle**

Yellow to copper brown;
8 black spots on each
front wing.



Picnic beetle

Dark brown-black
with 4 orange-yellow
spots on back.

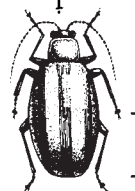
Spots or strips on
front wings



**Spotted
cucumber beetle**

Yellow-green with 6 black
spots on each front wing.

Front wings with
stripes



**Striped
cucumber beetle**

Yellow with 2 black
striped on each front
wing, elongate body.

**Colorado
potato beetle**

Yellow with 4 black
stripes on each front
wing; fat, round body.



Abbreviations

a = acre	ft = foot	PHI = preharvest interval
AD = allowable depletion	G = granular	ppm = parts per million
ae = acid equivalent	gal = gallon	psi = pounds per square inch
ai = active ingredient	IPM = integrated pest management	pt = pint
BMP = best management practices	K ₂ O = potash	qt = quart
bu = bushel	K = potassium	REI = restricted entry interval
Ca = calcium	kg = kilogram	RUP = restricted-use pesticide
cfm = cubic feet per minute	L = liquid	S = sulfur
CS = capsule suspension	lb = pound	SC = soluble concentrate
CT = conservation tillage	LC = liquid concentrate	SP = soluble powder
Cu = copper	LS = liquid sprayable	sq ft = square feet
cwt = hundredweight (100 lb)	M or ME = microencapsulated	t = ton
D = dust	mg = milligram	ULV = ultra low volume
DD = degree day	Mg = magnesium	W or WP = wettable powder
DF = dry flowable	Mn = manganese	WDATCP = Wisconsin Department of Agriculture, Trade, and Consumer Protection
DG = dispersible granule	N = nitrogen	WDG = water dispersible granule
DS = dry soluble	NO ₃ = nitrate	WISP = Wisconsin Irrigation Scheduling Program
E or EC = emulsifiable concentrate	oz = ounce	WSB = water-soluble bag
ET = evapotranspiration	P ₂ O ₅ = phosphate	WSP = water-soluble pouch
F = flowable	P = phosphorus	Zn = zinc
FC = flowable concentrate	PAT = Pesticide Applicator Training	
fl oz = fluid ounce	pH = a measure of acidity and alkalinity	

Related websites

Extension publications—

learningstore.uwex.edu

Pesticide labels—www.cdms.net

Pesticide resistance management—

fungicides: www.frac.info

insecticides: www.illac-online.org

herbicides: www.hraccglobal.com

Vegetable diseases—

www.plantpath.wisc.edu/wivegdis

Vegetable insects—

[www.entomology.wisc.edu/vegento/
people/groves.html](http://www.entomology.wisc.edu/vegento/people/groves.html)

Weed profiles—

fyi.uwex.edu/weedsci



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