**Protect Your Pesto: Strategies to Limit Basil Downy Mildew**

Mary Hausbeck
Department of Plant, Soil, and Microbial Sciences
Michigan State University

Downy mildew is a disease caused by *Peronospora belbahrii* that is very destructive on basil. The MSU Plant Pathology Vegetable and Ornamental lab has been working with downy mildew of basil for several years, including the securing of specialty fungicide labels through the USDA IR-4 Program. Initially, Michigan growers had access to downy mildew fungicides for use on basil via Section 18 emergency exemption labels. Most of these fungicide products have now become registered nationally. In the southern region of Florida, downy mildew on basil is endemic (naturally occurring) and can overwinter due to the lack of a killing frost. In Michigan and other northern states, basil downy mildew does not overwinter outside and the pathogen must be introduced each year. Contaminated seed with the downy mildew pathogen is the most likely means by which disease gets started, especially early in the greenhouse or field growing season. For many crops, seed treatments can include hot water. However, this method for downy mildew on basil seed has proven to be troublesome. When basil seed is treated with hot water there is a gelatinous exudate that oozes out of the seed resulting in issues with handling and sowing. There are efforts to use steam as a seed treatment which could be helpful. A proprietary steam treatment technique has been developed and licensed by the seed company **High Mowing Organic Seeds [https://www.highmowingseeds.com/blog/steam-treatment/]**.

Cultural growing conditions can be adjusted to minimize basil downy mildew and include keeping the foliage dry and the relative humidity low. Limiting the duration of time that the plants are wet is important to reduce the threat that downy mildew poses. Adjusting the watering so that the plants are not oversaturated helps to decrease the relative humidity around the plant zone. While the optimum temperature for downy mildew is around 65ºF, it can produce spores at higher temperatures if the weather is wet. If the humidity is high and the plants are wet for an extended time, basil downy mildew can develop under a range of temperatures.

The dark spores (mildew) that develop on the undersides of the leaves are a key symptom. The spores form in the dark during the evening and early morning hours. Frequent scouting is a critical element of basil downy mildew control programs. A small outbreak of one or two infected plants can go undetected, yet this can enable the pathogen to spread and increase rapidly. Infected plants should be identified early and disposed of immediately in order to limit the infection of other plants in the greenhouse or field.

Early symptoms include sections of the leaves appearing yellowish. When the leaves are turned over, the dark mildew can be seen on the undersides. However, sometimes the leaves can appear entirely green and healthy but when the leaves are turned over the spores are evident. While basil plants with yellow or brown areas of the leaves should be investigated for evidence of the dark mildew, growers should inspect as many plants as possible including those that appear healthy.

Growers have choices for fungicide management of basil downy mildew based on the growing environment (greenhouse or field) and intended use (seedlings for field production or for sale to consumers). Rotating fungicides based on the mode of action is important. Growers concerned about seed contamination should apply a fungicide very early in the production cycle. Subdue Maxx can be used early at seeding because of its soil activity (see the fungicide label for specifics). Other fungicides that can be considered, depending on the specific production system, include Heritage, Ranman, Revus or Micora, Segovis, and phosphorous acid fungicides.
For organic basil production, OMRI-certified coppers and other products can be used for downy mildew.

Resistant basil varieties are the best defense against the aggressive downy mildew. Breeders at Rutgers University and the University of Florida are developing downy mildew-resistant basil varieties. Some of these new basil lines have been released and are commercially available. Dr. James Simon is a professor of plant biology in the School of Environmental and Biological Sciences at Rutgers University in New Brunswick, N.J.. He has developed seed varieties with resistance to downy mildew which include the following: Rutgers Obsession DMR, Rutgers Devotion DMR, and Rutgers Thunderstruck DMR. These varieties are available to commercial growers from **VDF Specialty Seeds [https://www.vdfspecialtyseeds.com/]**. Dr. David Clark is a professor in the Horticultural Biotechnology and Genetics laboratory at the University of Florida in Gainesville, Florida. He has developed the variety ‘Amazel’ for the consumer garden market. This vegetatively-propagated variety is available from **Proven Winners [https://www.provenwinners.com/plants/ocimum/amazel-basil-ocimum-hybrid]**.

# Leafy Vegetables and Herbs (Non-Brassica) – Horticulture

Major update by Ben Phillips, Liz Maynard – Dec 2020
Reviewed by Liz Maynard – Aug 2021

## *Crop Description*

Most leafy vegetables and herbs grow well under the same sunlight, fertility, soil and growing conditions, and cultural techniques similar to many other vegetable crops. Pay special attention to drainage and moisture requirements of certain herbs, as many are very sensitive to soil moisture conditions. Using plastic mulches, trickle irrigation, and raised beds may provide the necessary moisture and drainage requirements for the herb crop.

It is important to know the botanical relationships of leafy greens and herbs because similar pests will go to related plants. Herbs and leafy greens come from at least six botanical families. Within those family groups you can expect similar pests. In this guide we try to provide some precision to this. *However, when using pesticides, you must abide by the EPA Crop Groupings on pesticide labels.*

**Amaranthaceae**, the Goosefoot family, contains Spinach and Swiss chard classified as "leafy green" or "leafy petiole" in EPA Crop Group 4. The pests of plants in this family are shared with Beets (EPA Crop Group 1) in the Root Crops chapter.

**Amaryllidaceae**, the Amaryllis family, contains all the onion-type aromatic plants. However, Chives are classified as a "herb" in EPA Crop Group 19. The pests of plants in this family are shared with the Onions chapter.

**Apiaceae,** the Carrot family, contains Cilantro, Coriander, Dill, Fennel, and Parsley classified as "herbs" or "spices" EPA Crop Group 19. Celery, Parsley and Florence Fennel are also classified as a "leafy green" or "leafy petiole" in EPA Crop Group 4. But this family also includes Carrots, and Parsnips (EPA Crop Group 1). The pests of plants in this family are shared with the Celery, and Root Crops chapters.

**Asteraceae,** the Sunflower family, contains Chicory, Endive, Escarole, Lettuce, and Radicchio classified as "leafy greens" in EPA Crop Group 4. But this family also includes Tarragon, classified as a "herb" in EPA Crop Group 19.

**Brassicaceae,** the Mustard family, contains Arugula and Cress classified as "leafy greens' in EPA Crop Group 4. But this family also includes cole crop and mustard-type plants (EPA Crop Group 5), some of which are root crops (EPA Crop Group 1). The pests of plants in this family are shared with the Cole Crops and Brassica Leafy Greens, and Root Crops chapters.

**Lamiaceae,** the Mint family, contains Basil, Lavender, Marjoram, Mint, Oregano, Rosemary, Sage, Savory, and Thyme classified as "herbs" in EPA Crop Group 19.

## *Marketing Herbs*

Fresh herbs certainly make excellent cash crops. However, growers should be cautious before beginning herb production. Establish markets and buyers needs before purchasing any seed. Some of the most popular culinary herbs include basil, chives, dill, French tarragon, mints, oregano, parsley, rosemary, and thyme. However, growers should do their own marketing study to determine which herbs are suited for their areas. Possible outlets for culinary herbs include health food stores, grocery stores, restaurants, farmers markets, and food manufacturing companies. For year-round production greenhouses are recommended. Detailed descriptions and management recommendations for some popular herbs follow.

## *Planting, Spacing, and Harvesting*

**Basil**
Basil, French basil, or sweet basil (*Ocimum basilicum*) is a popular, tender, annual herb native to India and Asia. Basil is commercially grown for its green, aromatic leaves, which are used fresh or dried as a flavoring. The common pests of basil are plant bugs, Japanese beetle, and downy mildew.

Basil can be direct-seeded or transplanted to the field in late spring after all danger of frost is over. Basil seeds normally germinate in 8 to 14 days. Basil requires full sun and prefers moist, well-drained soil with a pH of 6.0. Typical spacing for basil is 12 inches between plants, 24 to 36 inches between rows.

Trickle or overhead irrigation is necessary. Basil grown for dried leaves or essential oil is cut just prior to the appearance of flowers. The foliage should be cut at least four to six leaves above the ground to allow for regrowth and a subsequent crop.

**Chives**
Chives (*Allium schoenoprasum*) are a perennial native to Asia. They were first used by the Chinese and then the ancient Greeks. Fresh leaves are excellent for making herbal vinegars and butter. They are also used in salad, soup, and cheese. Chives are also used to add a mild onion flavor to fish, salads, steamed vegetables, soups, and omelets. No serious pests or diseases are reported, although chives can get downy mildew and rust.

Chives require full sun and well-drained soil with a pH of 6.0. Chive seeds require darkness, constant moisture, and a temperature of 60° F to 70° F for best results. Sow them 1/2 inch deep in pots or flats. Germination occurs in 2 to 3 weeks. Transplant seedlings to the field when they are 4 weeks old. Chives reach a height of 18 inches, a width of 1 to 2 inches the first year from seed, and 10 to 14 inches in subsequent years.

To harvest chives, cut chive leaves 2 inches above the ground.

**Cilantro**

Cilantro (*Coriandrum sativum*) is an herb with a unique scent and flavor. Native to Egypt, cilantro is one of the most ancient herbs still cultivated. It is also known as Mexican parsley, Chinese parsley, or coriander. The dried seedpod is known as coriander and is usually used as a spice in baking and desserts. Cilantro leaves are a well-known salsa ingredient. Cabbage looper and green peach aphid sometimes cause economic damage by curling and twisting leaves, and stunting the plant. Bacterial leaf spot, which is seedborne, and Fusarium wilt are common diseases in cilantro production. Effective management strategies involve using clean seed material and avoiding fields that have a history of Fusarium.

This annual plant does best in cool weather and should be planted in the early spring or in the fall. Optimum growing temperatures are between 50° F to 85° F. Plant seeds 1/2 inch deep and 2 to 3 inches apart. Germination may take 10 to 14 days. Cilantro grows 2 to 3 feet tall and thrives in moderately rich, light, well-drained soil in full to partial sun. Cilantro is highly salt sensitive, and soil electrical conductivity values exceeding 1 dS/m could reduce yields. Plants have shallow root systems, so frequent irrigation is needed.

To harvest, cut cilantro either just below the soil or 1-1/2 to 2 inches above the crown, bunch, and tie together with a rubber band.

**Dill**

Dill (*Anthum graveolens*) is native to the Mediterranean area and southern Russia. It is a hardy annual and sometimes is grown as a biennial. Dill is commonly used as a seasoning for soups, fish, and pickles. Its aromatic leaves, seeds, flowers, and stems can also be used to flavor cabbage, vinegar, butter, apple pie, cakes, and bread. Dill does not have any serious pest or disease problems. However, phoma blight, rusty root, and stem rot have been reported.

Direct-seed in spring at 1/4 to 1/2 inches deep in rows that are 2-3 feet apart. In-row spacing should be 10 to 12 inches. Since dill has long taproots, it should not be transplanted.

Fresh leaves should be harvested before flowering begins. Harvest seeds as soon as seed heads are brown and dry. Stalks with immature seed heads are frequently harvested for direct sales, paired with pickling cucumbers.

**Chicory, Endive, Escarole, Radicchio**

This group of leafy crops come from two species (*Cichorium endivia*, and *C. intybus*), with a diverse appearance and color in immature and mature plants. Some are all green, others are red, and others have white stalks. They are used as a salad green. Witloof, or Belgian endive, is a type of endive that is harvested in the fall as a root, and forced indoors for a tender head of tightly wrapped and blanched leaves, called a chicon. Common pest problems are leafminers and white mold.

Direct seed or transplant in rows 12 to 15 inches apart. Plants 10 to 16 inches apart in row. Seed 1 to 2 pounds per acre. For forcing Belgian endive, seed so that after 150 days roots can be dug and stored in a cool environment.

To harvest, cut whole heads from the base of the plants. Some varieties will regenerate harvestable leaves, for loose leaf mixes. Plants will not regenerate new marketable heads.

To force endive, harvest roots in the late fall when they are 1-1/4 to 2-1/4 inches in diameter and 7 inches long and plant them indoors upright in soil about half as deep as the root. They must go through a cold conditioning of 32° F to 34° F for at least a week before raising the temperature to allow new growth to occur. Maintain soil moisture and harvest when new sprouts are about 3 inches long.

**Fennel**

Fennel (*Foeniculum vulgare*) is a cool-season aromatic herb that originated in the Mediterranean region. It is a perennial but is usually grown as an annual that grows to about 3 to 4 feet tall. Leaves are used as potherbs and for seasoning and garnishing purposes along with the bulb, which could be used as a fresh salad. Leaf blight and stem rot are two major diseases affecting fennel.

Plant in full sun in rich and well-drained soil. Plant seeds 1/4 to 1/2 inches deep in rows that are 2 to 3 feet apart. In-row spacing should be 10 to 12 inches. Transplant to the field early in the spring. The time from planting to harvest could range from 90 to 150 days for direct-seeded fennel; and from 110 to 125 days for transplanted fennel.

Harvest by cutting just above the bulb near the leaf bases. Bulbs are further trimmed by cutting away most of the top growth.

**French Tarragon**

French tarragon (*Artemisia dracunculus*) originates from southern Europe. Do not confuse it with Russian tarragon (*Artemisia dracunculoides*) which is much coarser, and has paler leaves, and a bitter taste. French tarragon is used to flavor vinegar, herbal butter, shellfish, pork, beef, poultry, many vegetables, and rice. Fresh leaves can also be used in salads, tartar sauce, and French dressing. French tarragon is prone to root rot in heavy and wet soils.

It produces few seeds and must be propagated by stem cuttings or division. Plant in full sun in rich, well-drained soil with a pH of 6.9. French tarragon is a woody perennial that eventually grows 2 feet tall. Divide the plants every three to four years.

Two harvests can generally be made each year, the first harvest six to eight weeks after setting out. Harvest until leaves turn yellow in the fall.

**Lettuce**
Lettuce (*Lactucus sativus*) varieties fall into four main types; leaf, romaine/cos, crisphead/iceberg, and butterhead/bibb. They are all used similarly as a fresh green eaten raw, and rarely cooked.

For full size head production, direct-seed or transplant in rows 12 to 15 inches apart. Plants 10 to 16 inches apart in row. Seed 1 to 2 pounds per acre. For harvest of small leaves with one or more cuttings, seed in bands 2 to 4 inches wide with about 60 seeds per foot.

Romaine, crisphead and bibb lettuces form heads that are harvested one time. Leaf lettuces can be harvested as heads once, or leaves can be cut two or three times, with about 4 to 6 weeks between cuttings. Multi-leaf types have a more uniform leaf size and small core that makes it easy to harvest leaves for salad mixes.

**Mint**
Mints (*Mentha* spp.) are a group of perennial herbs that are mostly native to Europe and Asia. Some are indigenous to South America, America, and Australia. Mint is naturalized throughout North America from southern Canada to Mexico. Japanese mint (*M. arvensis* var. *piperascens*), peppermint (*M. x piperita*), and spearmint (*M. spicata*) are the mint species mostly cultivated. Mint is susceptible to verticillium wilt, mint rust, and mint anthracnose. Pests that could bother mint include spider mites, loopers, mint flea beetles, mint root borers, cutworms, root weevils, and aphids.

Mints can be propagated by cuttings or seeds, except peppermint, which can only be propagated through cuttings. Peppermint is a sterile F1 hybrid of *M. aquatica* and *M. spicata* and does not produce seeds. Mints can be planted in full sun or partial shade, and require rich, well-drained soil with a pH of 6.5. Spaced 18 to 24 inches apart, mints can reach a height of 12 to 24 inches and grow into a thick perennial row.

Mint can be harvested almost as soon as it comes up in the spring. Young, tender leaves and stems are the best.

**Oregano**
Oregano (*Origanum vulgare* subsp. *hirtum* or *O. vulgare* subsp. *viridulum*) is native to the Mediterranean region and naturalized in the eastern United States. It is added to tomato sauce for a hot and peppery taste. It adds dimension to yeast breads, marinated vegetables, roasted meats, and fish. Some of the pest and disease problems for oregano include aphids, leafminers, spider mites, and root rot.

Oregano is a perennial that requires a site with full sun and well-drained soil that has a pH of 6.8. Direct-seed in the field and do not cover seeds; oregano seeds need sunlight to germinate. Because flavor can greatly vary among seed propagated plants, it is better to propagate by root divisions or cuttings from plants that are known to have strong flavor. Oregano reaches a height of 12 to 24 inches and a width of 10 to 20 inches.

Oregano sprigs can be cut off when the plant is at least 6 inches high. In June, vigorously growing plants can be cut back to the lowest set of leaves. Plants generally leaf out after two weeks and can be cut back again in August.

**Parsley**
Parsley (*Petroselinum crispum*) is commonly grown for its green leaves, or tops. The curled-leaf and Italian flat-leaf types are the most popular. Popular curled-leaf parsley cultivars include Moss Curled, Dark Moss Curled, Banquet, Decorator, Deep Green, Forest Green, Improved Market Gardener, Sherwood, and Perfection. Flat-leaf cultivars include Plain and Plain Italian Dark Green. Hamburg parsley is grown for its enlarged edible root.

Field-seeding begins in early April and ends in May. Row spacing should be 12 to 16 inches. In-row plant spacing should be 4 to 8 inches. Direct-seeding rate will depend on direct seeding equipment and could require 14 to 30 pounds per acre. Germination is enhanced by presoaking seeds in water for 24 hours and then allowing them to partially dry.

Parsley is cut 1-1/2 to 2 inches from ground level to allow regrowth. About three or four cuttings are made, depending on the length of the growing season.

**Rosemary**
Rosemary (*Rosmarinus officinalis*) is a tender perennial hardy to zones 8 to 10. It is native to the Mediterranean, Portugal, and northeastern Spain. It is pungent, somewhat piney, mint-like yet sweeter, with a slight ginger flavor that harmonizes with poultry, fish, lamb, beef, veal, pork, and game. Rosemary also enhances vegetables, cheese, and eggs. Pest and disease problems include aphids, spider mites, scale, mealybugs, root rot, and Botrytis gray mold.

Plant rosemary in a sunny location with well-drained and slightly acidic soil. Rosemary can be started from seeds, but germination rates are very low. Use fresh seeds, preferably less than two weeks old. Or, start plants from cuttings or by layering from existing plants. Rosemary eventually reaches a height of 72 inches and a width of 36 to 72 inches.

Harvesting can be done throughout the year. Cut about 4-inch pieces from the tips of the branches, being careful not to remove more than 20 percent of the growth at one time.

**Spinach**
Spinach (*Spinacia oleracea*) is a nutritious leafy green made popular as a canned product by the cartoon 'Popeye the Sailor Man.' Currently it is more commonly eaten raw as a salad green. Common problems are white rust, flea beetles, and bolting.

In the Midwest, spinach is commonly seeded in late summer or fall, and grown through the winter under row cover or in hoophouses. Late winter and early spring plantings are also successful. Direct seed or transplant in rows 12 to 18 inches apart, with 2 to 6 plants per foot of row. Or for baby leaf spinach seed in bands 2 to 4 inches wide with about 40 seeds per foot. Seed 12 to 20 pounds per acre. Plants bolt in response to increasing daylength so overwintered and spring crops are usually finished by late spring.

Harvest spinach with sequential cuttings when leaves are 4 to 6 inches long, or desired length for your market. Depending on the time of year, they will be ready for another harvest in 4 to 6 weeks. Or do a once-over harvest when plants reach full size.

**Thyme**
Thyme (*Thymus vulgaris*) is native to the western Mediterranean region. It is a small, many-branched, and perennial shrub. Thyme tastes delicately green with a faint clover aftertaste. It ranks as one of the finest herbs of French cuisine. Thyme leaves and sprigs are used in clam chowder, meats, herbal butter, and vinegar. Use it with vegetables, cheese, eggs, and rice. The pest and disease problems include spider mites and root rot.

Start seeds indoors and transplant seedlings into the field once the danger of frost is over. Thyme reaches a height of 12 inches and a width of 10 to 12 inches. Thyme can be propagated from cuttings, by layering, and division.

Harvest the entire plant by cutting it back to 2 inches above ground in midsummer. One more harvest can be expected before the season ends.

## *Fertilizing*

**pH:** Maintain a soil pH of 6.5 to 6.8 for **leafy greens**, and 6.0 to 7.0 for **herbs**. On muck soils maintain the pH at 5.5 to 6.0. Spinach is particularly sensitive to soil acidity.

Before planting apply 40 to 60 pounds N per acre, 0 to 150 pounds $P_2O_5$ per acre, and 0 to 200 pounds $K_2O$ per acre. Adjust according to soil type, previous management, and soil test results for your state. For direct-seeded crops band an additional 40 pounds N and 40 pounds $P_2O_5$ per acre 2 inches to the side and 2 inches below the seed.

Sidedress with 30 to 60 pounds N per acre three to four weeks after thinning or transplanting, and again after each cutting.

Reduce the total amount of fertilizer N applied by the value of N credits from green manures, legume crops grown in the previous year, compost and animal manures, and soils with more than 3 percent organic matter. The total amount of N from fertilizer (including starter) and other credits should be 90 to 120 pounds N per acre for culinary herbs, up to 140 pounds N per acre for lettuce, and up to 170 pounds N per acre for spinach. For herbs grown for seeds, such as coriander, fennel, and dill, use 60 to 90 pounds N per acre.

# Leafy Vegetables and Herbs (Non-Brassica) – Diseases

Reviewed by Dan Egel – Sept 2021

## *Recommended Controls*

### Aster Yellows (Purple-Top Wilt) of Multiple Crops - Phytoplasma Mollicutes

This pathogen is transmitted by leafhoppers. Infection rates can jump when adjacent crops are harvested mid-season, such as alfalfa or wheat.

#### Pesticide

**Insecticides** *Head Lettuce, Leaf Lettuce* | Use an insecticide to control leafhoppers that transmit the disease. Leafhoppers must be controlled before they feed. See Insect section.

### Bottom Rot of Lettuce - Rhizoctonia Fungus

#### Non-Pesticide

*Chicory, Endive, Escarole, Head Lettuce, Leaf Lettuce, Radicchio* | Clean and sanitize transplant trays, benches, and tools. Rogue infected transplants. Avoid working field under wet conditions. Prompt destruction of the finished crop with tillage to rapidly breakdown tissue is an important method to prevent disease build-up.

#### Pesticide

**azoxystrobin products (azoxystrobin)** *Head Lettuce, Leaf Lettuce* | 0.4-0.8 fl. oz. per 1000 row feet. REI: 4-hour. PHI: 0-day. FRAC 11.

**Endura (WG) (boscalid)** *Head Lettuce, Leaf Lettuce* | 8-11 oz. per acre. Suppresses Bottom Rot. REI: 12-hour. PHI: 14-day. FRAC 07.

**iprodione products (iprodione)** *Head Lettuce, Leaf Lettuce* | 1.5-2 pts. per acre. Formulations of iprodione include Nevado and Rovral. REI: 24-hour. PHI: 14-day. FRAC 02.

**Luna Sensation (fluopyram, trifloxystrobin)** *Chicory, Endive, Escarole, Head Lettuce, Leaf Lettuce, Radicchio* | 7.6 fl. oz. per acre. Bottom rot and downy mildew suppression only. Can be applied as a band over lettuce. REI: 12-hour. PHI: 0-day. FRAC 07, FRAC 11.

# Damping-Off Seed and Seedling Rots of Multiple Crops - Multiple Pathogens

## Non-Pesticide

*Arugula, Basil, Chicory, Chive, Cilantro, Coriander, Cress, Dill, Endive, Escarole, Fennel, Florence Fennel, Head Lettuce, Lavender, Leaf Lettuce, Marjoram, Oregano, Parsley, Radicchio, Rosemary, Sage, Savory, Spinach, Swiss Chard, Tarragon, Thyme* | Practice good greenhouse sanitation of equipment, tools propagation trays/pots, and surfaces. Avoid excess moisture to the transplants in the greenhouse by monitoring irrigation frequency. Plant in warm field soils. The fungi responsible for damping-off in field soils cause more loss when the seedling is slow to emerge.

## Pesticide

**Orondis Gold (DC) (oxathiapiprolin, mefenoxam)** *Head Lettuce, Leaf Lettuce* | 13.9-27.8 fl. oz. per acre. Use as an at-plant soil drench, banded spray in furrow, or through drip irrigation. Do not follow soil applications of Orondis Gold with foliar applications of Orondis Opti, or Orondis Ultra. REI: 4-hour. PHI: 7-day. FRAC 49, FRAC 04.

**Previcur Flex (6) (propamocarb)** *Head Lettuce, Leaf Lettuce* | For damping-off of lettuce caused by Pythium and Phytophthora only. REI: 12-hour. FRAC 28.

# Downy Mildew of Lettuce - Bremia Oomycete

## Non-Pesticide

*Chicory, Endive, Escarole, Head Lettuce, Leaf Lettuce, Radicchio* | Use disease-free seed and transplants. Hot water seed treatment may reduce this seedborne disease. Use temperatures and times of 118 F for 30 minutes for lettuce. Rotate to non-host crops for 3 years. Varieties with partial resistance are available. Use raised beds and adequate plant spacing to improve drainage, air flow. Monitor humidity in the hoophouse and vent appropriately. Good weed control of Aster weeds like dandelion, groundsel, and thistles is important to limit other hosts near the crop.

## Pesticide

**Actigard (0.5WDG) (acibenzolar-s-methyl)** *Head Lettuce, Leaf Lettuce* | 0.75-1 oz. per acre. REI: 12-hour. PHI: 7-day. FRAC P01.

**azoxystrobin products (azoxystrobin)** *Head Lettuce, Leaf Lettuce* | 12-15.5 fl. oz. per acre. REI: 4-hour. PHI: 0-day. FRAC 11.

**Curzate 60DF (cymoxanil)** *Head Lettuce, Leaf Lettuce* | 5.0 oz. per acre. Head lettuce 3.2-5.0 oz. per acre. leaf lettuce 5.0 oz. per acre. REI: 12-hour. PHI: 1-day. FRAC 27.

**Luna Sensation (fluopyram, trifloxystrobin)** *Chicory, Endive, Escarole, Head Lettuce, Leaf Lettuce, Radicchio* | 7.6 fl. oz. per acre. Bottom rot and downy mildew suppression only. Can be applied as a band over lettuce. REI: 12-hour. PHI: 0-day. FRAC 07, FRAC 11.

**mancozeb products (mancozeb)** *Head Lettuce, Leaf Lettuce* | Several formulations of mancozeb (Dithane, Manzate, Penncozeb) are labeled at various rates. See label for directions. REI: 24-hour. PHI: 10-day for head lettuce, 14-day for leaf lettuce. FRAC M03.

**Merivon (fluxapyroxad, pyraclostrobin)** *Head Lettuce, Leaf Lettuce* | 6-11 fl. oz. per acre. Downy mildew suppression only. REI: 12-hour. PHI: 1-day. FRAC 07, FRAC 11.

**Orondis Ultra Premix (SC) (oxathiapiprolin, mandipropamid)** *Head Lettuce, Leaf Lettuce* | 5.5-8.0 fl. oz. per acre. REI: 4-hour. PHI: 1-day. FRAC 49, FRAC 40.

**phosphite and phosphorous acid products (phosphorous acid, potassium phosphite, mono-dipotassium salts of phosphorous acid, mono- and dibasic sodium, potassium, and ammonium phosphites, fosetyl-aluminum)** *Chicory, Endive, Escarole, Head Lettuce, Leaf Lettuce, Radicchio* | Several phosphite or phosphorus acid products (Aliette, Phostrol, ProPhyt, Rampart) are labeled at various rates. Label includes different crops, PHIs, resistance instructions, and other important information. Some manufacturers recommend tank-mixing. These products may be used in a preventative program until the disease is observed. Check label carefully for presence of crop of interest, especially herbs. REI: 4 to 12-hour. FRAC 33.

**Presidio (4SC) (fluopicolide)** *Chicory, Endive, Escarole, Head Lettuce, Leaf Lettuce, Radicchio* | 3-4 fl. oz. per acre. REI: 12-hour. PHI: 2-day. FRAC 43.

**Previcur Flex (6) (propamocarb)** *Head Lettuce, Leaf Lettuce* | 2 pts. per acre. REI: 12-hour. PHI: 2-day. FRAC 28.

**Ranman 400SC (34.5) (cyazofamid)** *Chicory, Endive, Escarole, Head Lettuce, Leaf Lettuce, Radicchio* | 2.75 fl. oz. per acre. REI: 12-hour. PHI: 0-day. FRAC 21.

**Revus (2.08SC) (mandipropamid)** *Head Lettuce, Leaf Lettuce* | 8 fl. oz. per acre. REI: 4-hour. PHI: 1-day. FRAC 40.

**Tanos (DF) (famoxadone, cymoxanil)** *Chicory, Endive, Escarole, Head Lettuce, Leaf Lettuce, Radicchio* | 8-10 oz. per acre. REI: 12-hour. PHI: 1-day. FRAC 11, FRAC 27.

**Topguard EQ (SC) (flutriafol, azoxystrobin)** *Chicory, Endive, Escarole, Head Lettuce, Leaf Lettuce, Radicchio* | 6-8 fl. oz. per acre. REI: 12-hour to 3-day. PHI: 7-day. FRAC 03, FRAC 11.

**Zampro (SC) (ametoctradin, dimethomorph)** *Chicory, Endive, Escarole, Head Lettuce, Leaf Lettuce, Radicchio* | 14 fl. oz. per acre. REI: 12-hour. PHI: 0-day. FRAC 45, FRAC 40.

## Downy Mildew of Multiple Crops - Peronospora Oomycete

### Non-Pesticide

*Arugula, Basil, Cress* | Use disease-free seed and transplants. Hot water seed treatment may reduce this seedborne disease. Use temperatures and times of 122 F for 25 minutes for spinach, and 122 for 15 minutes for cress. Rotate to non-host crops for 3 years. Varieties with partial resistance are available. Use raised beds and adequate plant spacing to improve drainage, air flow. Monitor humidity in the hoophouse and vent appropriately.

### Pesticide

**azoxystrobin products (azoxystrobin)** *Arugula, Endive, Parsley, Radicchio, Spinach* | 12-15.5 fl. oz. per acre. REI: 4-hour. PHI: 0-day. FRAC 11.

**Curzate 60DF (cymoxanil)** *Spinach* | 5.0 oz. per acre. REI: 12-hour. PHI: 1-day. FRAC 27.

**Merivon (fluxapyroxad, pyraclostrobin)** *Chive, Spinach* | 6-11 fl. oz. per acre. Downy mildew suppression only. REI: 12-hour. PHI: 1-day. FRAC 07, FRAC 11.

**Orondis Ultra Premix (SC) (oxathiapiprolin, mandipropamid)** *Chive, Spinach* | 5.5-8.0 fl. oz. per acre. REI: 4-hour. PHI: 1-day. FRAC 49, FRAC 40.

**phosphite and phosphorous acid products (phosphorous acid, potassium phosphite, mono-dipotassium salts of phosphorous acid, mono- and dibasic sodium, potassium, and ammonium phosphites, fosetyl-aluminum)** *Basil, Chive, Spinach* | Several phosphite or phosphorus acid products (Aliette, Phostrol, ProPhyt, Rampart) are labeled at various rates. Label includes different crops, PHIs, resistance instructions, and other important information. Some manufacturers recommend tank-mixing. These products may be used in a preventative program until the disease is observed. Check label carefully for presence of crop of interest, especially herbs. REI: 4 to 12-hour. FRAC 33.

**Presidio (4SC) (fluopicolide)** *Basil, Chive, Spinach* | 3-4 fl. oz. per acre. REI: 12-hour. PHI: 2-day. FRAC 43.

**Ranman 400SC (34.5) (cyazofamid)** *Basil, Chive, Spinach* | 2.75-3.0 fl. oz. per acre. High rate only allowed on basil. REI: 12-hour. PHI: 0-day. FRAC 21.

**Reason 500SC (4.13) (fenamidone)** *Basil, Head Lettuce, Leaf Lettuce* | Rate depends on crop. For example, lettuce is 5.5-8.2 fl oz. per acre. Basil is 6.0 fl. oz. per acre. REI: 12-hour. PHI: 2-day. FRAC 11.

**Revus (2.08SC) (mandipropamid)** *Basil, Chive, Spinach* | 8 fl. oz. per acre. REI: 4-hour. PHI: 1-day. FRAC 40.

**Tanos (DF) (famoxadone, cymoxanil)** *Chive, Spinach* | 8-10 oz. per acre. REI: 12-hour. PHI: 1-day. FRAC 11, FRAC 27.

**Topguard EQ (SC) (flutriafol, azoxystrobin)** *Spinach* | 6-8 fl. oz. per acre. REI: 12-hour to 3-day. PHI: 7-day. FRAC 03, FRAC 11.

**Zampro (SC) (ametoctradin, dimethomorph)** *Spinach* | 14 fl. oz. per acre. REI: 12-hour. PHI: 0-day. FRAC 45, FRAC 40.

## Gray Mold of Multiple Crops - Botrytis Fungus

This disease often occurs in greenhouse production with high humidity.

### Non-Pesticide

*Arugula, Basil, Chicory, Chive, Cilantro, Coriander, Cress, Dill, Endive, Escarole, Fennel, Florence Fennel, Head Lettuce, Lavender, Leaf Lettuce, Marjoram, Oregano, Parsley, Radicchio, Rosemary, Sage, Savory, Spinach, Swiss Chard, Tarragon, Thyme* | Use raised beds and adequate plant spacing to improve drainage, air flow. Monitor humidity in the hoophouse and vent appropriately. Prompt destruction of the finished crop with tillage to rapidly breakdown tissue is an important method to prevent disease build-up.

### Pesticide

**Botran 75W (dichloro-nitroaniline)** *Endive, Head Lettuce, Leaf Lettuce* | Rate depends on crop and application method. Flowable formulations may be available. REI: 12-hour. PHI: 14-day. FRAC 14.

**Endura (WG) (boscalid)** *Head Lettuce, Leaf Lettuce* | 8-11 oz. per acre. Suppresses Bottom Rot. REI: 12-hour. PHI: 14-day. FRAC 07.

**Fontelis (1.67SC) (penthiopyrad)** *Basil, Chicory, Chive, Cilantro, Coriander, Cress, Dill, Endive, Escarole, Fennel, Florence Fennel, Head Lettuce, Lavender, Leaf Lettuce, Marjoram, Oregano, Parsley, Radicchio, Rosemary, Sage, Savory, Spinach, Swiss Chard, Tarragon, Thyme* | 14-24 fl. oz. per acre. REI: 12-hour. PHI: 3-day. FRAC 07.

**iprodione products (iprodione)** *Head Lettuce, Leaf Lettuce* | 1.5-2 pts. per acre. Formulations of iprodione include Nevado and Rovral. REI: 24-hour. PHI: 14-day. FRAC 02.

**Switch 62.5WG (cyprodinil, fludioxonil)** *Arugula, Basil, Chicory, Chive, Cilantro, Coriander, Cress, Dill, Endive, Escarole, Fennel, Florence Fennel, Head Lettuce, Lavender, Leaf Lettuce, Marjoram, Oregano, Parsley, Radicchio, Rosemary, Sage, Savory, Spinach, Swiss Chard, Tarragon, Thyme* | 11-14 oz. per acre. Powdery mildew suppression only. REI: 12-hour. PHI: 0-day. FRAC 09, FRAC 12.

## Nematodes

### Non-Pesticide

*Head Lettuce, Leaf Lettuce* | Collect soil samples for nematodes in the fall and avoid fields with high numbers. Rotate to a non-broadleaf crop, such as grass grains or sweet corn for >3 years. Prompt destruction of the finished crop with tillage to rapidly breakdown tissue and displace nematodes is an important method to prevent nematode build-up. Anaerobic soil disinfestation (ASD) is an effective sterilization method for greenhouse and high tunnel soils that contain nematodes.

## Powdery Mildew of Multiple Crops - Erysiphe Fungus

Powdery mildew is more likely to be a problem in greenhouse lettuce than in open fields.

### Non-Pesticide

*Arugula, Basil, Chicory, Cilantro, Coriander, Cress, Dill, Endive, Escarole, Fennel, Florence Fennel, Head Lettuce, Lavender, Leaf Lettuce, Marjoram, Oregano, Parsley, Radicchio, Rosemary, Sage, Savory, Spinach, Swiss Chard, Tarragon, Thyme* | Rotate to non-host crops for 2 years. Use raised beds and adequate plant spacing to improve drainage, air flow. Monitor humidity in the hoophouse and vent appropriately. Prompt destruction of the finished crop with tillage to rapidly breakdown tissue is an important method to prevent disease build-up.

### Pesticide

**Fontelis (1.67SC) (penthiopyrad)** *Basil, Chicory, Chive, Cilantro, Coriander, Cress, Dill, Endive, Escarole, Fennel, Florence Fennel, Head Lettuce, Lavender, Leaf Lettuce, Marjoram, Oregano, Parsley, Radicchio, Rosemary, Sage, Savory, Spinach, Swiss Chard, Tarragon, Thyme* | 14-24 fl. oz. per acre. REI: 12-hour. PHI: 3-day. FRAC 07.

**Luna Sensation (fluopyram, trifloxystrobin)** *Arugula, Chicory, Cress, Endive, Escarole, Head Lettuce, Leaf Lettuce, Parsley, Radicchio, Spinach* | 7.6 fl. oz. per acre. Can be applied as a band over lettuce. REI: 12-hour. PHI: 0-day. FRAC 07, FRAC 11.

**Merivon (fluxapyroxad, pyraclostrobin)** *Basil, Cilantro, Coriander, Dill, Fennel, Florence Fennel, Marjoram, Oregano, Parsley, Rosemary, Sage, Savory, Thyme* | 4-11 fl. oz. per acre. REI: 12-hour. PHI: 1-day. FRAC 07, FRAC 11.

**Procure 480SC (4) (triflumizole)** *Head Lettuce, Leaf Lettuce* | 6-8 fl. oz. per acre. REI: 12-hour. PHI: 0-day. FRAC 03.

**Quintec (2.08) (quinoxyfen)** *Head Lettuce, Leaf Lettuce* | 4-6 fl. oz. per acre. REI: 12-hour. PHI: 1-day. FRAC 13.

**Switch 62.5WG (cyprodinil, fludioxonil)** *Arugula, Basil, Chicory, Chive, Cilantro, Coriander, Cress, Dill, Endive, Escarole, Fennel, Florence Fennel, Head Lettuce, Lavender, Leaf Lettuce, Marjoram, Oregano, Parsley, Radicchio, Rosemary, Sage, Savory, Spinach, Swiss Chard, Tarragon, Thyme* | 11-14 oz. per acre. Powdery mildew suppression only. REI: 12-hour. PHI: 0-day. FRAC 09, FRAC 12.

**Topguard EQ (SC) (flutriafol, azoxystrobin)** *Fennel, Florence Fennel, Parsley* | 6-8 fl. oz. per acre. REI: 12-hour to 3-day. PHI: 7-day. FRAC 03, FRAC 11.

## Viruses of Multiple Crops - Multiple Pathogens

Lettuce Mosaic Virus (LMV) can be carried in infected seed and is spread by aphids.

### Non-Pesticide

*Chicory, Endive, Escarole, Head Lettuce, Leaf Lettuce, Radicchio* | For **LMV:** use only mosaic-free indexed seed

(sold as MTO). Greenhouse sanitation and good weed control of Aster weeds like dandelion, groundsel, and thistles is important to limit other hosts near the crop. Use a monitoring program to time the release of natural enemies of aphids (see insect section). Keep new lettuce plantings as far as possible with the previous production area. Remove infected transplants and do not plant them out into fields. Prompt destruction of the finished crop with tillage to rapidly breakdown tissue is an important method to prevent disease build-up.

### Pesticide

**Insecticides** *Chicory, Endive, Escarole, Head Lettuce, Leaf Lettuce, Radicchio* | For **LMV:** use aphid-specific insecticides to lower the population without also reducing the population of natural enemies. See insect section.

## White Mold (Timber Rot, Drop, Stem Rot) of Multiple Crops - Sclerotinia Fungus

This soil pathogen is long-lived in the soil, and has a wide host range on broadleaved crops and weeds, including beans, vine crops, lettuce, tomatoes, peppers, and cole crops. It goes by other names in other crops, such as Drop, White Mold, Stem Rot, and Timber Rot.

It is more commonly found in greenhouses and high tunnels where humidity and temperatures are high. The fungus often infects flowers, which then drop off and infect the stems that they land on. The stems take on a woody appearance and can split open. On lettuce, the pathogen infects the root crown and heart of the plant, which makes the leaves drop and rot. Inspection of the stems, or lettuce hearts, will reveal small black pellets that are the overwintering body of the pathogen.

### Non-Pesticide

*Arugula, Basil, Chicory, Chive, Cilantro, Coriander, Cress, Dill, Endive, Escarole, Fennel, Florence Fennel, Head Lettuce, Lavender, Leaf Lettuce, Marjoram, Oregano, Parsley, Radicchio, Rosemary, Sage, Savory, Spinach, Swiss Chard, Tarragon, Thyme* | Avoid fields with a history of the problem. Rotate to a non-broadleaf crop, such as grass grains or sweet corn for >6 years. Prompt destruction of the finished crop with tillage to rapidly breakdown tissue is an important method to prevent disease build-up. Anaerobic soil disinfestation (ASD) is an effective sterilization method for greenhouse and high tunnel soils that contain this pathogen.

### Pesticide

**Botran 75W (dichloro-nitroaniline)** *Endive, Head Lettuce, Leaf Lettuce* | Rate depends on crop and application method. Flowable formulations may be available. REI: 12-hour. PHI: 14-day. FRAC 14.

**Contans WG (5) (Coniothyrium minitans strain CON/M/91-08)** *Head Lettuce, Leaf Lettuce* | 1-6 lbs. per acre. Apply immediately after harvest or 3-4 months before planting. REI: 4-hour. FRAC NC. *OMRI-listed.*

**Endura (WG) (boscalid)** *Head Lettuce, Leaf Lettuce* | 8-11 oz. per acre. Suppresses Bottom Rot. REI: 12-hour. PHI: 14-day. FRAC 07.

**Fontelis (1.67SC) (penthiopyrad)** *Basil, Chicory, Chive, Cilantro, Coriander, Cress, Dill, Endive, Escarole, Fennel, Florence Fennel, Head Lettuce, Lavender, Leaf Lettuce, Marjoram, Oregano, Parsley, Radicchio, Rosemary, Sage, Savory, Spinach, Swiss Chard, Tarragon, Thyme* | 14-24 fl. oz. per acre. REI: 12-hour. PHI: 3-day. FRAC 07.

**iprodione products (iprodione)** *Head Lettuce, Leaf Lettuce* | 1.5-2 pts. per acre. Formulations of iprodione include Nevado and Rovral. REI: 24-hour. PHI: 14-day. FRAC 02.

**Kenja 400SC (3.33) (isofetamid)** *Head Lettuce, Leaf Lettuce* | 12.3 fl. oz. per acre. REI: 12-hour. PHI: 14-day. FRAC 07.

**Luna Sensation (fluopyram, trifloxystrobin)** *Arugula, Chicory, Cress, Endive, Escarole, Head Lettuce, Leaf Lettuce, Parsley, Radicchio, Spinach* | 7.6 fl. oz. per acre. Can be applied as a band over lettuce. REI: 12-hour. PHI: 0-day. FRAC 07, FRAC 11.

**Merivon (fluxapyroxad, pyraclostrobin)** *Arugula, Basil, Chicory, Chive, Cilantro, Coriander, Cress, Dill, Endive, Escarole, Fennel, Florence Fennel, Head Lettuce, Lavender, Leaf Lettuce, Marjoram, Oregano, Parsley, Radicchio, Rosemary, Sage, Savory, Spinach, Swiss Chard, Tarragon, Thyme* | 8-11 fl. oz. per acre. Suppression only. REI: 12-hour. PHI: 1-day. FRAC 07, FRAC 11.

**Switch 62.5WG (cyprodinil, fludioxonil)** *Arugula, Basil, Chicory, Chive, Cilantro, Coriander, Cress, Dill, Endive, Escarole, Fennel, Florence Fennel, Head Lettuce, Lavender, Leaf Lettuce, Marjoram, Oregano, Parsley, Radicchio, Rosemary, Sage, Savory, Spinach, Swiss Chard, Tarragon, Thyme* | 11-14 oz. per acre. Powdery mildew suppression only. REI: 12-hour. PHI: 0-day. FRAC 09, FRAC 12.

## White Rust of Multiple Crops - Albugo Oomycete

### Non-Pesticide

*Arugula, Cress, Spinach* | Use disease-free seed and transplants. Hot water seed treatment may reduce this seedborne disease. Use temperatures and times of 122 F for 25 minutes for spinach. Rotate to non-host crops for 3 years. Varieties with partial resistance are available. Use raised beds

and adequate plant spacing to improve drainage, air flow. Monitor humidity in the hoophouse and vent appropriately.

### Pesticide

**Merivon (fluxapyroxad, pyraclostrobin)** *Arugula, Cress, Spinach* | 4-11 fl. oz. per acre. REI: 12-hour. PHI: 1-day. FRAC 07, FRAC 11.

**Presidio (4SC) (fluopicolide)** *Arugula, Cress, Spinach* | 3-4 fl. oz. per acre. REI: 12-hour. PHI: 2-day. FRAC 43.

**Reason 500SC (4.13) (fenamidone)** *Basil, Head Lettuce, Leaf Lettuce* | Rate depends on crop. For example, lettuce is 5.5-8.2 fl oz. per acre. Basil is 6.0 fl. oz. per acre. REI: 12-hour. PHI: 2-day. FRAC 11.

**Tanos (DF) (famoxadone, cymoxanil)** *Arugula, Cress, Spinach* | 8-10 oz. per acre. REI: 12-hour. PHI: 1-day. FRAC 11, FRAC 27.

**Topguard EQ (SC) (flutriafol, azoxystrobin)** *Arugula, Cress, Spinach* | 6-8 fl. oz. per acre. REI: 12-hour to 3-day. PHI: 7-day. FRAC 03, FRAC 11.

## Wilt of Multiple Crops - Fusarium Fungus

### Non-Pesticide

*Basil* | Avoid fields with a history of the disease. Rotate to non-host crops for >6 years. Varieties with Fusarium wilt resistance are available. Prompt destruction of the finished crop with tillage to rapidly breakdown tissue is an important method to prevent disease build-up. Anaerobic soil disinfestation (ASD) is an effective sterilization method for greenhouse and high tunnel soils that contain this pathogen.

# Leafy Vegetables and Herbs (Non-Brassica) – Insects

Reviewed by Laura Ingwell, Raymond Cloyd, Luis Cañas – Sept 2021

## *Recommended Controls*

## Aphids

*Seedlings:* 2 aphids per plant.

*Established Plants:* 7 aphids per plant.

### Pesticide

**Actara (25WDG) (thiamethoxam)** *Arugula, Chicory, Cress, Endive, Escarole, Florence Fennel, Head Lettuce, Leaf Lettuce, Parsley, Radicchio, Spinach, Swiss Chard* | 1.5-3.0 oz. per acre. Apply as a foliar spray. Do not exceed 11 oz. per acre per season. Allow 7 days between applications. REI: 12-hour. PHI: 7-day. IRAC 04A.

**Admire Pro (4.6SC) (imidacloprid)** *Arugula, Basil, Chicory, Chive, Cilantro, Coriander, Cress, Dill, Endive, Escarole, Fennel, Florence Fennel, Head Lettuce, Lavender, Leaf Lettuce, Marjoram, Oregano, Parsley, Radicchio, Rosemary, Sage, Savory, Spinach, Swiss Chard, Tarragon, Thyme* | 4.4-10.5 fl. oz. per acre soil application, or 1.3 fl oz. per acre foliar application on leafy greens. 4.4-10.5 fl. oz. per acre soil application for fennel and swiss chard. 7.0-10.5 fl. oz. per acre soil application, or 1.2 fl oz. per acre foliar application on herbs. Do not exceed 10.5 fl. oz. per acre per season from soil applications. Do not exceed 3.6 fl. oz. per acre per season from foliar applications. REI: 12-hour. PHI: 45-day for soil application on fennel and swiss chard, 14-day for soil application on herbs, 21-day for soil application on leafy greens, 7-day for foliar applications on leafy greens and herbs IRAC 04A.

**Assail 30SG (acetamiprid)** *Arugula, Chicory, Cress, Endive, Escarole, Florence Fennel, Head Lettuce, Leaf Lettuce, Parsley, Radicchio, Spinach, Swiss Chard* | Use 30SG formulations at 2.0-4.0 oz. per acre and do not exceed 20 oz. per acre per season. Use 70WP formulations at 0.8-1.7 oz. per acre and do not exceed 8.5 oz. per acre per season. Allow 7 days between applications. REI: 12-hour. PHI: 7-day. IRAC 04A.

**Belay (2.13SC) (clothianidin)** *Arugula, Chicory, Cress, Endive, Escarole, Florence Fennel, Head Lettuce, Leaf Lettuce, Parsley, Radicchio, Spinach, Swiss Chard* | *Soil applications*: 9-12 fl. oz. per acre. *Foliar applications*: 3-4 fl. oz. per acre. Do not exceed 12 fl. oz. per acre per season.

REI: 12-hour. PHI: 21-day for soil application, or 7-day for foliar application. IRAC 04A.

**Beleaf (50SG) (flonicamid)** *Arugula, Chicory, Cress, Endive, Escarole, Florence Fennel, Head Lettuce, Leaf Lettuce, Parsley, Radicchio, Spinach, Swiss Chard* | 2.0-2.8 oz. per acre. Do not exceed 8.4 oz. per acre per season. REI: 12-hour. PHI: 0-day. IRAC 29.

**Brigade 2EC (bifenthrin)** *Cilantro, Coriander, Head Lettuce* | Use 2EC formulations at 2.1-6.4 fl. oz. per acre and do not exceed 32 fl. oz. per acre per season. Use 10DF, 10WP, or 10WSB formulations at 5.3-16 oz. per acre and do not exceed 80 oz. per acre. Allow 7 days between applications. REI: 12-hour. PHI: 3-day. IRAC 03A. *RUP.*

**Capture LFR (1.5) (bifenthrin)** *Head Lettuce* | 3.4-6.8 fl. oz. per acre. *Lettuce root aphid only.* See label for application methods. Do not exceed 0.1 lb. per acre per season as an at-plant application. Do not exceed 0.5 lb. per acre per season including at-plant plus foliar applications of other bifenthrin products (such as Brigade 2EC). REI: 12-hour. PHI: see label. IRAC 03A. *RUP.*

**Dimethoate 4EC (dimethoate)** *Endive, Leaf Lettuce, Swiss Chard* | Use 2.67EC formulations at 0.75 pt. per acre and do not exceed 2.2 pts. per acre per season. Use 4EC, LV-4, and 400 formulations at 0.5 pt. per acre and do not exceed 1 pt. per acre per season. REI: 48-hour. PHI: 14-day. IRAC 01B.

**Fulfill (50WDG) (pymetrozine)** *Arugula, Chicory, Endive, Escarole, Florence Fennel, Head Lettuce, Leaf Lettuce, Parsley, Radicchio, Spinach, Swiss Chard* | 2.75 oz. per acre. Do not exceed 5.5 oz. per acre per season. REI: 12-hour. PHI: 7-day. IRAC 09B.

**M-Pede (3.8) (potassium salts of fatty acids)** *Arugula, Basil, Chicory, Chive, Cilantro, Coriander, Cress, Dill, Endive, Escarole, Fennel, Florence Fennel, Head Lettuce, Lavender, Leaf Lettuce, Marjoram, Oregano, Parsley, Radicchio, Rosemary, Sage, Savory, Spinach, Swiss Chard, Tarragon, Thyme* | 1-2% by volume. Must contact aphids to be effective. Avoid spraying under hot conditions to minimize potential for plant injury. REI: 12-hour. PHI: 0-day. IRAC UN, FRAC NC. *OMRI-listed.*

**Malathion 5EC (malathion)** *Endive, Head Lettuce, Leaf Lettuce, Parsley, Spinach* | Use 5EC formulations at 1.0-2.0 pts. per acre on parsley, 1.6 pts. per acre for spinach, 2.0 pts. per acre on lettuce, or 1.5-2.0 pts. per acre on endive. Use 57EC formulations at 1.5-2.4 pts. per acre on parsley, 1.6 pts. per acre for parsley, 2.0-3.0 pts. per acre on lettuce, or 1.5-2.0 pts. per acre on endive. Do not exceed 2 applications per season. Allow 5-7 days between applications depending on crop. REI: 12-hour. PHI: 7-day for endive, parsley, and spinach; 14-day for head and leaf lettuce. IRAC 01B.

**Movento (2SC) (spirotetramat)** *Arugula, Chicory, Cress, Endive, Escarole, Florence Fennel, Head Lettuce, Leaf Lettuce, Parsley, Radicchio, Spinach, Swiss Chard* | 4-5 fl. oz. per acre. Do not exceed 10 fl. oz. per acre per season. REI: 24-hour. PHI: 3-day. IRAC 23.

**Orthene 97 (S) (acephate)** *Head Lettuce* | 8-16 oz. per acre. Do not exceed 2-1/8 lb. per acre per season. REI: 24-hour. PHI: 21-day. IRAC 01B.

**Platinum 2SC (thiamethoxam)** *Arugula, Chicory, Cress, Endive, Escarole, Florence Fennel, Head Lettuce, Leaf Lettuce, Parsley, Radicchio, Spinach, Swiss Chard* | Use 2SC formulations as a soil treatment at 5-11 fl. oz. per acre and do not exceed 11 fl. oz. per acre per season. Use 75SG formulations as a soil treatment at 1.66-3.67 oz. per acre and do not exceed 3.67 oz. per acre per season. REI: 12-hour. PHI: 30-day. IRAC 04A.

**PQZ (1.87SC) (pyrifluquinazon)** *Arugula, Chicory, Cilantro, Cress, Dill, Endive, Escarole, Head Lettuce, Leaf Lettuce, Parsley, Radicchio, Spinach, Swiss Chard* | 2.4-3.2 fl. oz. per acre. Do not exceed 4.8 fl. oz. per acre per crop cycle. REI: 12-hour. PHI: 1-day. IRAC 09B.

**Pyganic EC 5.0 II (0.41) (pyrethrins)** *Arugula, Cress, Endive, Escarole, Fennel, Florence Fennel, Head Lettuce, Leaf Lettuce, Parsley, Radicchio, Spinach, Swiss Chard* | *Soil drench* (in greenhouse): add 0.375 fl. oz. to 5 gal. of water and apply as a soil drench to 1,000 sq. ft. of soil or non-soil media. Do not exceed the maximum rate of 0.375 fl. oz. per 1,000 sq. ft. *Foliar applications*: 4.5-15.61 fl. oz. per acre in a minimum of 2 gallons of water per acre for field crops. Do not exceed the maximum application rate of 0.05 lbs. ai. per acre. REI: 12-hour. IRAC 03A. *OMRI-listed.*

**Sivanto 200 (1.67SL) (flupyradifurone)** *Arugula, Chicory, Cress, Endive, Escarole, Florence Fennel, Head Lettuce, Leaf Lettuce, Parsley, Radicchio, Spinach, Swiss Chard* | 10.5-12 fl. oz. per acre. Do not exceed 28 fl. oz. per acre per season. REI: 4-hour. PHI: 1-day. IRAC 04D.

**Torac (1.29SC) (tolfenpyrad)** *Arugula, Chicory, Cilantro, Cress, Endive, Escarole, Florence Fennel, Head Lettuce, Leaf Lettuce, Parsley, Radicchio, Spinach, Swiss Chard* | 17-21 fl. oz. per acre. Do not exceed 42 fl. oz. per acre per crop, or 2 applications per season. REI: 12-hour. PHI: 1-day. IRAC 21A, FRAC 39.

**Versys Inscalis (0.83DC) (afidopyropen)** *Arugula, Chicory, Cress, Dill, Endive, Escarole, Head Lettuce, Leaf Lettuce, Parsley, Spinach, Swiss Chard* | 1.5 fl. oz. per acre. Do not exceed 14 fl. oz. per acre per season. REI: 12-hour. PHI: 0-day. IRAC 09D.

# Caterpillars

There are many caterpillar pests of leafy vegetables and herbs, including cutworms, loopers, and armyworms. Always check the label for the specific list of caterpillars that the product can be used on.

Treat when 5% of plants are infested.

## Pesticide

**Avaunt (30WDG) (indoxacarb)** *Arugula, Chicory, Cress, Endive, Escarole, Florence Fennel, Head Lettuce, Leaf Lettuce, Parsley, Radicchio, Spinach, Swiss Chard* | 2.5-6.0 oz. per acre. For armyworms, and loopers. Do not exceed 24 oz. per acre per season for leaf greens and herbs. Do not exceed 14 oz. per acre for spinach. REI: 12-hour. PHI: 3-day. IRAC 22.

**Baythroid XL (1EC) (beta-cyfluthrin)** *Arugula, Chicory, Cress, Endive, Escarole, Florence Fennel, Head Lettuce, Leaf Lettuce, Parsley, Radicchio, Swiss Chard* | 0.8-3.2 fl. oz. per acre. For armyworms, cutworms, and loopers. Do not exceed 12.8 fl. oz. per acre per season. Allow 7 days between applications. REI: 12-hour. PHI: 0-day. IRAC 03A. *RUP.*

**Brigade 2EC (bifenthrin)** *Cilantro, Coriander, Head Lettuce, Spinach* | For armyworms, cutworms, and loopers. Use 2EC formulations at 2.1-6.4 fl. oz. per acre and do not exceed 32 fl. oz. per acre per season for cilantro, coriander, or head lettuce or 25 fl. oz. per acre per season on spinach. Use 10DF, 10WP, or 10WSB formulations at 5.3-16 oz. per acre and do not exceed 80 oz. per acre on cilantro, coriander, or head lettuce or 64 oz. per acre per season on spinach. Allow 7 days between applications. REI: 12-hour. PHI: 3-day for cilantro and coriander; 7-day for head lettuce, 40-day for spinach. IRAC 03A. *RUP.*

**Bt (Bacillus thuringiensis) products for caterpillars (Bacillus thuringiensis aizawai strain ABTS-1857, Bacillus thuringiensis aizawai strain GC-91, Bacillus thuringiensis kurstaki strain ABTS-351, Bacillus thuringiensis kurstaki strain EVB-113-19, Bacillus thuringiensis kurstaki strain SA-11)** *Arugula, Basil, Chicory, Chive, Cilantro, Coriander, Cress, Dill, Endive, Escarole, Fennel, Florence Fennel, Head Lettuce, Lavender, Leaf Lettuce, Marjoram, Parsley, Radicchio, Rosemary, Sage, Savory, Spinach, Swiss Chard, Tarragon, Thyme* | For armyworms, cutworms, and loopers. Various Bt products are available for control of young caterpillars (Agree, Biobit, Dipel, Javelin, etc.) Different Bt subspecies have different control properties. Check labels for pest insects controlled before use. Follow label directions for rates, timing of application and required safety equipment. REI: 4-hour. PHI: 0-day. IRAC 11A.

**Confirm 2F (tebufenozide)** *Arugula, Chicory, Cress, Endive, Escarole, Florence Fennel, Head Lettuce, Leaf Lettuce, Parsley, Radicchio, Spinach, Swiss Chard* | 6-8 fl. oz. per acre. For armyworms, cutworms, and loopers. Do not exceed 40 fl. oz. per acre per season. REI: 4-hour. PHI: 7-day. IRAC 18.

**Coragen (1.67SC) (chlorantraniliprole)** *Arugula, Basil, Chicory, Chive, Cilantro, Coriander, Cress, Dill, Endive, Escarole, Fennel, Florence Fennel, Head Lettuce, Lavender, Leaf Lettuce, Marjoram, Parsley, Radicchio, Rosemary, Sage, Savory, Spinach, Swiss Chard, Tarragon, Thyme* | For armyworms, cutworms, and loopers. Use 3.5-7.5 fl. oz. per acre on leafy greens as a foliar spray or soil treatment. Use 3.5-5.0 fl. oz. per acre on herbs as a foliar application only. Allow 3 days between foliar applications and 10 days between soil applications. Do not exceed 15.4 fl. oz. per acre per crop or 61.7 fl. oz. per acre per season. REI: 4-hour. PHI: 1-day. IRAC 28.

**Entrust SC (2) (spinosad)** *Arugula, Basil, Chicory, Chive, Cilantro, Coriander, Cress, Dill, Endive, Escarole, Fennel, Florence Fennel, Head Lettuce, Lavender, Leaf Lettuce, Marjoram, Parsley, Radicchio, Rosemary, Sage, Savory, Spinach, Swiss Chard, Tarragon, Thyme* | For armyworms, and loopers. Use 2SC formulations at 3.0-8.0 fl. oz. per acre for leafy greens or 4.0-6.0 fl. oz. per acre for herbs and do not exceed 29 fl. oz. per acre per season for leafy greens or 30 fl. oz. per acre per season for herbs. Use 80WP formulations at 1.0-2.5 oz. per acre for leafy greens or 1.25-2.0 oz. per acre for herbs and do not exceed 9 oz. per acre per season for leafy greens or 11 oz. per acre per season for herbs. Observe resistance management restrictions. REI: 4-hour. PHI: 1-day. IRAC 05. *OMRI-listed.*

**Exirel (0.83SE) (cyantraniliprole)** *Arugula, Chicory, Endive, Escarole, Florence Fennel, Head Lettuce, Leaf Lettuce, Parsley, Radicchio, Spinach, Swiss Chard* | 10-17 fl. oz. per acre. For armyworms, and loopers. Do not use adjuvants in tank mix in spinach. Do not exceed 61.7 fl. oz. per acre per season REI: 12-hour. PHI: 1-day. IRAC 28.

**Intrepid 2F (methoxyfenozide)** *Arugula, Basil, Chicory, Chive, Cilantro, Coriander, Cress, Dill, Endive, Escarole, Fennel, Florence Fennel, Head Lettuce, Lavender, Leaf Lettuce, Marjoram, Oregano, Parsley, Radicchio, Rosemary, Sage, Savory, Spinach, Swiss Chard, Tarragon, Thyme* | For armyworms, cutworms, and loopers. *Early season applications:* 4-8 fl. oz. per acre. *Mid-to late-season applications:* 8-10 fl. oz. per acre. Do not exceed 64 fl. oz. per acre per season. REI: 4-hour. PHI: 1-day. IRAC 18.

**Lannate LV (2.4L) (methomyl)** *Head Lettuce, Leaf Lettuce, Parsley, Spinach, Swiss Chard* | For armyworms, cutworms, and loopers. 1.5-3.0 pts. per acre for parsley, spinach, and swiss chard. 0.75-3.0 pts. per acre for head and leaf lettuce. Do not exceed 12 pts. per acre for leaf lettuce, parsley, spinach, or swiss chard. Do not exceed 21 pts. per acre per season for head lettuce. REI: 48-hour. PHI: 7-day for spinach and lettuce under 1.5 pts. per acre, 10-day for parsley and

swiss chard, 10-day for lettuce over 1.5 pts. per acre. IRAC 01A. *RUP.*

**Mustang Maxx (0.8) (zeta-cypermethrin)** *Arugula, Chicory, Cilantro, Cress, Endive, Escarole, Florence Fennel, Head Lettuce, Leaf Lettuce, Parsley, Radicchio, Spinach, Swiss Chard* | 2.24-4.0 fl. oz. per acre. For armyworms, cutworms, and loopers. Do not exceed 24 fl. oz. per acre per season. REI: 12-hour. PHI: 1-day. IRAC 03A. *RUP.*

**Orthene 97 (S) (acephate)** *Head Lettuce* | 1 lb. per acre. For armyworms, and loopers. Do not exceed 2.2 lb. per acre per season. REI: 24-hour. PHI: 21-day. IRAC 01B.

**Perm-Up 25DF (permethrin)** *Arugula, Chicory, Cress, Endive, Escarole, Florence Fennel, Head Lettuce, Leaf Lettuce, Parsley, Radicchio, Spinach, Swiss Chard* | 6.4-12.8 oz. per acre. For armyworms, and loopers. Use 25W, 25WP or 25DF formulations at 6.4-12.8 oz. per acre and do not exceed 64 oz. per acre per season for leafy greens and herbs or 38.4 oz. per acre per season for spinach. Use 3.2EC formulations at 2-8 fl. oz. per acre and do not exceed 80 fl. oz. per acre per season for leafy greens and herbs or 24 fl. oz. per acre per season for spinach. Allow 7 days between applications. REI: 12-hour. PHI: 1-day. IRAC 03A. *RUP.*

**Pyganic EC 5.0 II (0.41) (pyrethrins)** *Arugula, Cress, Endive, Escarole, Fennel, Florence Fennel, Head Lettuce, Leaf Lettuce, Parsley, Radicchio, Spinach, Swiss Chard* | For armyworms, fruitworms, hornworms, loopers and pinworms. *Soil drench* (in greenhouse): add 0.375 fl. oz. to 5 gal. of water and apply as a soil drench to 1,000 sq. ft. of soil or non-soil media. Do not exceed the maximum rate of 0.375 fl. oz. per 1,000 sq. ft. *Foliar applications*: 4.5-15.61 fl. oz. per acre in a minimum of 2 gallons of water per acre for field crops. Do not exceed the maximum application rate of 0.05 lbs. ai. per acre. REI: 12-hour. IRAC 03A. *OMRI-listed.*

**Radiant 1SC (spinetoram)** *Arugula, Basil, Chicory, Chive, Cilantro, Coriander, Cress, Dill, Endive, Escarole, Fennel, Florence Fennel, Head Lettuce, Lavender, Leaf Lettuce, Marjoram, Parsley, Radicchio, Rosemary, Sage, Savory, Spinach, Swiss Chard, Tarragon, Thyme* | 5-10 fl. oz. per acre. For armyworms, cutworms, and loopers. Do not exceed 34 fl. oz. per acre per season for leafy greens. Do not exceed 39 fl. oz. per acre per season for herbs. REI: 4-hour. PHI: 1-day. IRAC 05.

**Sevin XLR Plus (4SC) (carbaryl)** *Endive, Escarole, Florence Fennel, Head Lettuce, Leaf Lettuce, Parsley, Spinach, Swiss Chard* | 1-2 qts. per acre. For armyworms, cutworms, and loopers. Do not exceed 6 qt. per acre per season. REI: 12-hour. PHI: 14-day. IRAC 01A.

# Flea Beetles

*Seedlings:* >50% plants infested and defoliation is >30%.

## Pesticide

**Actara (25WDG) (thiamethoxam)** *Arugula, Chicory, Cress, Endive, Escarole, Florence Fennel, Head Lettuce, Leaf Lettuce, Parsley, Radicchio, Spinach, Swiss Chard* | 1.5-3.0 oz. per acre. Apply as a foliar spray. Do not exceed 11 oz. per acre per season. Allow 7 days between applications. REI: 12-hour. PHI: 7-day. IRAC 04A.

**Admire Pro (4.6SC) (imidacloprid)** *Arugula, Basil, Chicory, Chive, Cilantro, Coriander, Cress, Dill, Endive, Escarole, Fennel, Florence Fennel, Head Lettuce, Lavender, Leaf Lettuce, Marjoram, Oregano, Parsley, Radicchio, Rosemary, Sage, Savory, Spinach, Swiss Chard, Tarragon, Thyme* | 4.4-10.5 fl. oz. per acre soil application, or 1.3 fl oz. per acre foliar application on leafy greens. 4.4-10.5 fl. oz. per acre soil application for fennel and swiss chard. 7.0-10.5 fl. oz. per acre soil application, or 1.2 fl oz. per acre foliar application on herbs. Do not exceed 10.5 fl. oz. per acre per season from soil applications. Do not exceed 3.6 fl. oz. per acre per season from foliar applications. REI: 12-hour. PHI: 45-day for soil application on fennel and swiss chard, 14-day for soil application on herbs, 21-day for soil application on leafy greens, 7-day for foliar applications on leafy greens and herbs IRAC 04A.

**Baythroid XL (1EC) (beta-cyfluthrin)** *Arugula, Chicory, Cress, Endive, Escarole, Florence Fennel, Head Lettuce, Leaf Lettuce, Parsley, Radicchio, Spinach, Swiss Chard* | 2.4-3.2 fl. oz. per acre. Do not exceed 12.8 fl. oz. per acre per season. Allow 7 days between applications. REI: 12-hour. PHI: 0-day. IRAC 03A. *RUP.*

**Belay (2.13SC) (clothianidin)** *Arugula, Chicory, Cress, Endive, Escarole, Florence Fennel, Head Lettuce, Leaf Lettuce, Parsley, Radicchio, Spinach, Swiss Chard* | *Soil applications*: 9-12 fl. oz. per acre. *Foliar applications*: 3-4 fl. oz. per acre. Do not exceed 12 fl. oz. per acre per season. REI: 12-hour. PHI: 21-day for soil application, or 7-day for foliar application. IRAC 04A.

**Brigade 2EC (bifenthrin)** *Cilantro, Coriander, Head Lettuce* | Use 2EC formulations at 2.1-6.4 fl. oz. per acre and do not exceed 32 fl. oz. per acre per season. Use 10DF, 10WP, or 10WSB formulations at 5.3-16 oz. per acre and do not exceed 80 oz. per acre. Allow 7 days between applications. REI: 12-hour. PHI: 3-day. IRAC 03A. *RUP.*

**Capture LFR (1.5) (bifenthrin)** *Cilantro, Coriander* | 3.4-6.8 fl. oz. per acre. *Soil application:* See label for application methods. Do not exceed 0.1 lb. a.i. per acre per season as an at-plant application. Do not exceed 0.5 lb. a.i. per acre per season including at-plant plus foliar applications of other

bifenthrin products (such as Brigade 2EC). REI: 12-hour. PHI: see label. IRAC 03A. *RUP.*

**Mustang Maxx (0.8) (zeta-cypermethrin)** *Arugula, Basil, Chicory, Chive, Cilantro, Coriander, Cress, Dill, Endive, Escarole, Fennel, Florence Fennel, Head Lettuce, Lavender, Leaf Lettuce, Marjoram, Oregano, Parsley, Radicchio, Rosemary, Sage, Savory, Spinach, Swiss Chard, Tarragon, Thyme, Watermelon* | 2.24-4.0 fl. oz. per acre. Do not exceed 24 fl. oz. per acre per season. REI: 12-hour. PHI: 5-day. IRAC 03A. *RUP.*

**Platinum 2SC (thiamethoxam)** *Arugula, Chicory, Cress, Endive, Escarole, Florence Fennel, Head Lettuce, Leaf Lettuce, Parsley, Radicchio, Spinach, Swiss Chard* | Use 2SC formulations as a soil treatment at 5-11 fl. oz. per acre and do not exceed 11 fl. oz. per acre per season. Use 75SG formulations as a soil treatment at 1.66-3.67 oz. per acre and do not exceed 3.67 oz. per acre per season. REI: 12-hour. PHI: 30-day. IRAC 04A.

**Pyganic EC 5.0 II (0.41) (pyrethrins)** *Arugula, Cress, Endive, Escarole, Fennel, Florence Fennel, Head Lettuce, Leaf Lettuce, Parsley, Radicchio, Spinach, Swiss Chard* | *Soil drench* (in greenhouse): add 0.375 fl. oz. to 5 gal. of water and apply as a soil drench to 1,000 sq. ft. of soil or non-soil media. Do not exceed the maximum rate of 0.375 fl. oz. per 1,000 sq. ft. *Foliar applications*: 4.5-15.61 fl. oz. per acre in a minimum of 2 gallons of water per acre for field crops. Do not exceed the maximum application rate of 0.05 lbs. ai. per acre. REI: 12-hour. IRAC 03A. *OMRI-listed.*

**Sevin XLR Plus (4SC) (carbaryl)** *Endive, Escarole, Florence Fennel, Head Lettuce, Leaf Lettuce, Parsley, Spinach, Swiss Chard* | 0.5-2 qts. per acre. Do not exceed 6 qt. per acre per season. REI: 12-hour. PHI: 14-day. IRAC 01A.

**Torac (1.29SC) (tolfenpyrad)** *Arugula, Chicory, Cilantro, Cress, Endive, Escarole, Florence Fennel, Head Lettuce, Leaf Lettuce, Parsley, Radicchio, Spinach, Swiss Chard* | 14-21 fl. oz. per acre. Do not exceed 42 fl. oz. per acre per crop, or 2 applications per season. REI: 12-hour. PHI: 1-day. IRAC 21A, FRAC 39.

**Up-Cyde 2.5EC (cypermethrin)** *Head Lettuce* | 2.5-5.0 fl. oz. per acre. Do not exceed 30 fl. oz. per acre per season. REI: 12-hour. PHI: 5-day. IRAC 03A. *RUP.*

**Warrior II (2.08CS) (lambda-cyhalothrin)** *Head Lettuce, Leaf Lettuce* | 0.96-1.92 fl. oz. per acre. Do not exceed 19.2 fl. oz. per acre per season. REI: 24-hour. PHI: 1-day. IRAC 03A. *RUP.*

# Leafhoppers

## Pesticide

**Actara (25WDG) (thiamethoxam)** *Arugula, Chicory, Cress, Endive, Escarole, Florence Fennel, Head Lettuce, Leaf Lettuce, Parsley, Radicchio, Spinach, Swiss Chard* | 1.5-3.0 oz. per acre. Apply as a foliar spray. Do not exceed 11 oz. per acre per season. Allow 7 days between applications. REI: 12-hour. PHI: 7-day. IRAC 04A.

**Admire Pro (4.6SC) (imidacloprid)** *Arugula, Basil, Chicory, Chive, Cilantro, Coriander, Cress, Dill, Endive, Escarole, Fennel, Florence Fennel, Head Lettuce, Lavender, Leaf Lettuce, Marjoram, Oregano, Parsley, Radicchio, Rosemary, Sage, Savory, Spinach, Swiss Chard, Tarragon, Thyme* | 4.4-10.5 fl. oz. per acre soil application, or 1.3 fl oz. per acre foliar application on leafy greens. 4.4-10.5 fl. oz. per acre soil application for fennel and swiss chard. 7.0-10.5 fl. oz. per acre soil application, or 1.2 fl oz. per acre foliar application on herbs. Do not exceed 10.5 fl. oz. per acre per season from soil applications. Do not exceed 3.6 fl. oz. per acre per season from foliar applications. REI: 12-hour. PHI: 45-day for soil application on fennel and swiss chard, 14-day for soil application on herbs, 21-day for soil application on leafy greens, 7-day for foliar applications on leafy greens and herbs IRAC 04A.

**Baythroid XL (1EC) (beta-cyfluthrin)** *Arugula, Chicory, Cress, Endive, Escarole, Florence Fennel, Head Lettuce, Leaf Lettuce, Parsley, Radicchio, Spinach, Swiss Chard* | 2.4-3.2 fl. oz. per acre. Do not exceed 12.8 fl. oz. per acre per season. Allow 7 days between applications. REI: 12-hour. PHI: 0-day. IRAC 03A. *RUP.*

**Belay (2.13SC) (clothianidin)** *Arugula, Chicory, Cress, Endive, Escarole, Florence Fennel, Head Lettuce, Leaf Lettuce, Parsley, Radicchio, Spinach, Swiss Chard* | *Soil applications*: 9-12 fl. oz. per acre. *Foliar applications*: 3-4 fl. oz. per acre. Do not exceed 12 fl. oz. per acre per season. REI: 12-hour. PHI: 21-day for soil application, or 7-day for foliar application. IRAC 04A.

**Dimethoate 4EC (dimethoate)** *Endive, Leaf Lettuce, Swiss Chard* | Use 2.67EC formulations at 0.75 pt. per acre and do not exceed 2.2 pts. per acre per season. Use 4EC, LV-4, and 400 formulations at 0.5 pt. per acre and do not exceed 1 pt. per acre per season. REI: 48-hour. PHI: 14-day. IRAC 01B.

**Mustang Maxx (0.8) (zeta-cypermethrin)** *Arugula, Basil, Chicory, Chive, Cilantro, Coriander, Cress, Dill, Endive, Escarole, Fennel, Florence Fennel, Head Lettuce, Lavender, Leaf Lettuce, Marjoram, Oregano, Parsley, Radicchio, Rosemary, Sage, Savory, Spinach, Swiss Chard, Tarragon, Thyme, Watermelon* | 2.24-4.0 fl. oz. per acre. Do not exceed 24 fl. oz. per acre per season. REI: 12-hour. PHI: 5-day. IRAC 03A. *RUP.*

**Neemix (0.39) (azadirachtin)** *Arugula, Basil, Chicory, Chive, Cilantro, Coriander, Cress, Dill, Endive, Escarole, Fennel, Florence Fennel, Head Lettuce, Lavender, Leaf Lettuce, Marjoram, Parsley, Radicchio, Rosemary, Sage, Savory, Spinach, Swiss Chard, Tarragon, Thyme* | 7-16 fl. oz. per acre. Nymphs only. REI: 4-hour. PHI: 0-day. IRAC UN. *OMRI-listed.*

**Orthene 97 (S) (acephate)** *Head Lettuce* | 8-16 oz. per acre. Do not exceed 2-1/8 lb. per acre per season. REI: 24-hour. PHI: 21-day. IRAC 01B.

**Perm-Up 25DF (permethrin)** *Arugula, Chicory, Cress, Endive, Escarole, Florence Fennel, Head Lettuce, Leaf Lettuce, Parsley, Radicchio, Spinach, Swiss Chard* | Use 25W, 25WP or 25DF formulations at 6.4-12.8 oz. per acre and do not exceed 64 oz. per acre per season for leafy greens and herbs or 38.4 oz. per acre per season for spinach. Use 3.2EC formulations at 2-8 fl. oz. per acre and do not exceed 80 fl. oz. per acre per season for leafy greens and herbs or 24 fl. oz. per acre per season for spinach. Allow 7 days between applications. REI: 12-hour. PHI: 1-day. IRAC 03A. *RUP.*

**Platinum 2SC (thiamethoxam)** *Arugula, Chicory, Cress, Endive, Escarole, Florence Fennel, Head Lettuce, Leaf Lettuce, Parsley, Radicchio, Spinach, Swiss Chard* | Use 2SC formulations as a soil treatment at 5-11 fl. oz. per acre and do not exceed 11 fl. oz. per acre per season. Use 75SG formulations as a soil treatment at 1.66-3.67 oz. per acre and do not exceed 3.67 oz. per acre per season. REI: 12-hour. PHI: 30-day. IRAC 04A.

**Pyganic EC 5.0 II (0.41) (pyrethrins)** *Arugula, Cress, Endive, Escarole, Fennel, Florence Fennel, Head Lettuce, Leaf Lettuce, Parsley, Radicchio, Spinach, Swiss Chard* | *Soil drench* (in greenhouse): add 0.375 fl. oz. to 5 gal. of water and apply as a soil drench to 1,000 sq. ft. of soil or non-soil media. Do not exceed the maximum rate of 0.375 fl. oz. per 1,000 sq. ft. *Foliar applications*: 4.5-15.61 fl. oz. per acre in a minimum of 2 gallons of water per acre for field crops. Do not exceed the maximum application rate of 0.05 lbs. ai. per acre. REI: 12-hour. IRAC 03A. *OMRI-listed.*

**Scorpion 35SL (3.24) (dinotefuran)** *Arugula, Chicory, Cress, Endive, Escarole, Florence Fennel, Head Lettuce, Leaf Lettuce, Parsley, Radicchio, Spinach, Swiss Chard* | *Soil treatment*: Use Scorpion 35SL at 9.0-10.5 oz. per acre, or Venom 70SG at 5.0-5.5 oz. per acre. *Foliar treatment*: Use Scorpion 25SL at 2.0-5.25 oz. per acre,or Venom 70SG at 1-3 oz. per acre. Allow 7 days between applications. REI: 12-hour. PHI: 7-day. IRAC 04A.

**Sevin XLR Plus (4SC) (carbaryl)** *Endive, Escarole, Florence Fennel, Head Lettuce, Leaf Lettuce, Parsley, Spinach, Swiss Chard* | 0.5-2 qts. per acre. Do not exceed 6 qt. per acre per season. REI: 12-hour. PHI: 14-day. IRAC 01A.

**Sivanto 200 (1.67SL) (flupyradifurone)** *Arugula, Chicory, Cress, Endive, Escarole, Florence Fennel, Head Lettuce, Leaf Lettuce, Parsley, Radicchio, Spinach, Swiss Chard* | 7-10.5 fl. oz. per acre. Do not exceed 28 fl. oz. per acre per season. REI: 4-hour. PHI: 1-day. IRAC 04D.

**Torac (1.29SC) (tolfenpyrad)** *Arugula, Chicory, Cilantro, Cress, Endive, Escarole, Florence Fennel, Head Lettuce, Leaf Lettuce, Parsley, Radicchio, Spinach, Swiss Chard* | 14-21 fl. oz. per acre. Do not exceed 42 fl. oz. per acre per crop, or 2 applications per season. REI: 12-hour. PHI: 1-day. IRAC 21A, FRAC 39.

**Up-Cyde 2.5EC (cypermethrin)** *Head Lettuce* | 2.5-5.0 fl. oz. per acre. Do not exceed 30 fl. oz. per acre per season. REI: 12-hour. PHI: 5-day. IRAC 03A. *RUP.*

**Warrior II (2.08CS) (lambda-cyhalothrin)** *Head Lettuce, Leaf Lettuce* | 0.96-1.92 fl. oz. per acre. Do not exceed 19.2 fl. oz. per acre per season. REI: 24-hour. PHI: 1-day. IRAC 03A. *RUP.*

# Leafminers

*Seedlings:* 50% of plant infested.

*Near Harvest:* 5% of leaves infested.

## Pesticide

**Agri-Mek SC (0.7) (abamectin)** *Arugula, Basil, Chicory, Chive, Cilantro, Coriander, Cress, Dill, Endive, Escarole, Fennel, Florence Fennel, Head Lettuce, Lavender, Leaf Lettuce, Marjoram, Parsley, Radicchio, Rosemary, Sage, Savory, Spinach, Swiss Chard, Tarragon, Thyme* | Use 0.7SC formulations at 1.75-3.5 fl. oz. per acre and do not exceed 10.5 fl. oz. per acre. Use 0.15EC formulations at 8-16 fl. oz. per acre and do not exceed 48 fl. oz. per acre per season. Use with NIS adjuvant. Do not use binder or sticker-type surfactants. REI: 12-hour. PHI: 7-day for leafy greens, 14-day for herbs. IRAC 06. *RUP.*

**Belay (2.13SC) (clothianidin)** *Arugula, Chicory, Cress, Endive, Escarole, Florence Fennel, Head Lettuce, Leaf Lettuce, Parsley, Radicchio, Spinach, Swiss Chard* | *Soil applications*: 9-12 fl. oz. per acre. *Foliar applications*: 3-4 fl. oz. per acre. Do not exceed 12 fl. oz. per acre per season. REI: 12-hour. PHI: 21-day for soil application, or 7-day for foliar application. IRAC 04A.

**Brigade 2EC (bifenthrin)** *Cilantro, Coriander, Head Lettuce* | Use 2EC formulations at 2.1-6.4 fl. oz. per acre and do not exceed 32 fl. oz. per acre per season. Use 10DF, 10WP, or 10WSB formulations at 5.3-16 oz. per acre and do not exceed 80 oz. per acre. Allow 7 days between applications. REI: 12-hour. PHI: 3-day. IRAC 03A. *RUP.*

**Dimethoate 4EC (dimethoate)** *Endive, Leaf Lettuce, Swiss Chard* | Use 2.67EC formulations at 0.75 pt. per acre and do not exceed 2.2 pts. per acre per season. Use 4EC, LV-4, and 400 formulations at 0.5 pt. per acre and do not exceed 1 pt. per acre per season. REI: 48-hour. PHI: 14-day. IRAC 01B.

**Entrust SC (2) (spinosad)** *Arugula, Chicory, Cress, Endive, Escarole, Florence Fennel, Head Lettuce, Leaf Lettuce, Parsley, Radicchio, Spinach, Swiss Chard* | For armyworms, and loopers. Use 2SC formulations at 6.0-10.0 fl. oz. per acre and do not exceed 29 fl. oz. per acre per season. Use 80WP formulations at 2.0-3.0 oz. per acre and do not exceed 9 oz. per acre per season. Observe resistance management restrictions. REI: 4-hour. PHI: 1-day. IRAC 05. *OMRI-listed.*

**Movento (2SC) (spirotetramat)** *Arugula, Chicory, Cress, Endive, Escarole, Florence Fennel, Head Lettuce, Leaf Lettuce, Parsley, Radicchio, Spinach, Swiss Chard* | 4-5 fl. oz. per acre. Do not exceed 10 fl. oz. per acre per season. REI: 24-hour. PHI: 3-day. IRAC 23.

**Neemix (0.39) (azadirachtin)** *Arugula, Basil, Chicory, Chive, Cilantro, Coriander, Cress, Dill, Endive, Escarole, Fennel, Florence Fennel, Head Lettuce, Lavender, Leaf Lettuce, Marjoram, Parsley, Radicchio, Rosemary, Sage, Savory, Spinach, Swiss Chard, Tarragon, Thyme* | 4-7 fl. oz. per acre. Mix with oil-based adjuvant for best results. REI: 4-hour. PHI: 0-day. IRAC UN. *OMRI-listed.*

**Perm-Up 25DF (permethrin)** *Arugula, Chicory, Cress, Endive, Escarole, Florence Fennel, Head Lettuce, Leaf Lettuce, Parsley, Radicchio, Spinach, Swiss Chard* | Use 25W, 25WP or 25DF formulations at 6.4-12.8 oz. per acre and do not exceed 64 oz. per acre per season for leafy greens and herbs or 38.4 oz. per acre per season for spinach. Use 3.2EC formulations at 2-8 fl. oz. per acre and do not exceed 80 fl. oz. per acre per season for leafy greens and herbs or 24 fl. oz. per acre per season for spinach. Allow 7 days between applications. REI: 12-hour. PHI: 1-day. IRAC 03A. *RUP.*

**Platinum 2SC (thiamethoxam)** *Arugula, Chicory, Cress, Endive, Escarole, Florence Fennel, Head Lettuce, Leaf Lettuce, Parsley, Radicchio, Spinach, Swiss Chard* | Use 2SC formulations as a soil treatment at 5-11 fl. oz. per acre and do not exceed 11 fl. oz. per acre per season. Use 75SG formulations as a soil treatment at 1.66-3.67 oz. per acre and do not exceed 3.67 oz. per acre per season. REI: 12-hour. PHI: 30-day. IRAC 04A.

**Pyganic EC 5.0 II (0.41) (pyrethrins)** *Arugula, Cress, Endive, Escarole, Fennel, Florence Fennel, Head Lettuce, Leaf Lettuce, Parsley, Radicchio, Spinach, Swiss Chard* | *Soil drench* (in greenhouse): add 0.375 fl. oz. to 5 gal. of water and apply as a soil drench to 1,000 sq. ft. of soil or non-soil media. Do not exceed the maximum rate of 0.375 fl. oz. per 1,000 sq. ft. *Foliar applications*: 4.5-15.61 fl. oz. per acre in a minimum of 2 gallons of water per acre for field crops. Do not exceed the maximum application rate of 0.05 lbs. ai. per acre. REI: 12-hour. IRAC 03A. *OMRI-listed.*

**Radiant 1SC (spinetoram)** *Arugula, Chicory, Cress, Endive, Escarole, Florence Fennel, Head Lettuce, Leaf Lettuce, Parsley, Radicchio, Spinach, Swiss Chard* | 5-10 fl. oz. per acre. Do not exceed 34 fl. oz. per acre per season. REI: 4-hour. PHI: 1-day. IRAC 05.

**Scorpion 35SL (3.24) (dinotefuran)** *Arugula, Chicory, Cress, Endive, Escarole, Florence Fennel, Head Lettuce, Leaf Lettuce, Parsley, Radicchio, Spinach, Swiss Chard* | *Soil treatment*: Use Scorpion 35SL at 9.0-10.5 oz. per acre, or Venom 70SG at 5.0-5.5 oz. per acre. *Foliar treatment*: Use Scorpion 25SL at 2.0-5.25 oz. per acre,or Venom 70SG at 1-3 oz. per acre. Allow 7 days between applications. REI: 12-hour. PHI: 7-day. IRAC 04A.

**Trigard (75WP) (cyromazine)** *Arugula, Chicory, Cress, Endive, Escarole, Florence Fennel, Head Lettuce, Leaf Lettuce, Parsley, Radicchio, Spinach, Swiss Chard* | 2.66 oz. per acre. Do not exceed 6 applications per season. REI: 12-hour. PHI: 7-day. IRAC 17.

# Mites

## Pesticide

**Agri-Mek SC (0.7) (abamectin)** *Arugula, Basil, Chicory, Chive, Cilantro, Coriander, Cress, Dill, Endive, Escarole, Fennel, Florence Fennel, Head Lettuce, Lavender, Leaf Lettuce, Marjoram, Parsley, Radicchio, Rosemary, Sage, Savory, Spinach, Swiss Chard, Tarragon, Thyme* | Use 0.7SC formulations at 1.75-3.5 fl. oz. per acre and do not exceed 10.5 fl. oz. per acre. Use 0.15EC formulations at 8-16 fl. oz. per acre and do not exceed 48 fl. oz. per acre per season. Use with NIS adjuvant. Do not use binder or sticker-type surfactants. REI: 12-hour. PHI: 7-day for leafy greens, 14-day for herbs. IRAC 06. *RUP.*

**Brigade 2EC (bifenthrin)** *Head Lettuce, Spinach* | Use 2EC formulations at 5.12-6.4 fl. oz. per acre and do not exceed 32 fl. oz. per acre per season on head lettuce or 25 fl. oz. per acre per season on spinach. Use 10DF, 10WP, or 10WSB formulations at 12.8-16 oz. per acre and do not exceed 80 oz. per acre on head lettuce or 64 oz. per acre per season on spinach. Allow 7 days between applications. REI: 12-hour. PHI: 7-day. IRAC 03A. *RUP.*

**Capture LFR (1.5) (bifenthrin)** *Head Lettuce* | 3.4-6.8 fl. oz. per acre. *Bulb mites only.* See label for application methods. Do not exceed 0.1 lb. per acre per season as an at-plant application. Do not exceed 0.5 lb. per acre per season including at-plant plus foliar applications of other bifenthrin products (such as Brigade 2EC). REI: 12-hour. PHI: see label. IRAC 03A. *RUP.*

**Pyganic EC 5.0 II (0.41) (pyrethrins)** *Arugula, Cress, Endive, Escarole, Fennel, Florence Fennel, Head Lettuce, Leaf Lettuce, Parsley, Radicchio, Spinach, Swiss Chard* | *Soil drench* (in greenhouse): add 0.375 fl. oz. to 5 gal. of water and apply as a soil drench to 1,000 sq. ft. of soil or non-soil media. Do not exceed the maximum rate of 0.375 fl. oz. per 1,000 sq. ft. *Foliar applications*: 4.5-15.61 fl. oz. per acre in a minimum of 2 gallons of water per acre for field crops. Do not exceed the maximum application rate of 0.05 lbs. ai. per acre. REI: 12-hour. IRAC 03A. *OMRI-listed.*

## Slugs

Occasionally, slugs and snails seriously damage seedlings; tender, low-growing leafy vegetables; or ripening fruit that are on the ground. Slug and snail feeding damage (hollowed-out areas) can be found anywhere on fruit, but is usually concentrated near the stem. Slugs leave behind telltale slime trails (silvery trails) on the surfaces of fruit or leaves. Slugs and snails are active at night or cloudy days.

Slugs and snails favor continuously moist soil and organic mulch. They lay eggs in groups in moist soil, and overwinter in organic mulch. Slugs can complete their entire life cycle in a field.

Prevent infestation by scattering bait products to the soil surface around the perimeter of the planting. Make a rescue treatment by scattering the bait products on the soil as a band between rows. Apply in evening after a rain or irrigation. Avoid contact with edible product.

### Non-Pesticide

*Arugula, Basil, Chicory, Chive, Cilantro, Coriander, Cress, Dill, Endive, Escarole, Fennel, Florence Fennel, Head Lettuce, Lavender, Leaf Lettuce, Marjoram, Oregano, Parsley, Radicchio, Rosemary, Sage, Savory, Spinach, Swiss Chard, Tarragon, Thyme* | Slug hiding places should be eliminated - such as, boards, stones, weedy areas, or heavy mulch - so the soil can become warm and dry. Raised beds that can dry out more readily than flat beds reduce slug problems. Using black plastic mulch discourages slug build-up because it causes the soil to heat up and dry out.

### Pesticide

**Deadline M-Ps (4P) (metaldehyde)** *Florence Fennel, Spinach, Swiss Chard* | 25 lbs. per acre. Scatter bait around the perimeter of plantings or between rows. Apply in evening after a rain or irrigation. Avoid contact with edible product. Do not exceed 3 applications per crop cycle for spinach. Do not exceed 4 applications per crop cycle for Florence fennel and swiss chard. REI: 12-hour. PHI: 0-day for spinach, 1-day for Florence fennel and swiss chard. IRAC UN.

**Sluggo 1B (iron phosphate)** *Head Lettuce, Leaf Lettuce, Spinach, Swiss Chard* | 20-44 lb. per acre, or 0.5-1 lb. per 1,000 sq. ft. Prevent infestation by scattering bait products to the soil surface around the perimeter of the planting. Make a rescue treatment by scattering the bait products on the soil as a band between rows. Apply in evening after a rain or irrigation. REI: 0-hour. PHI: 0-day. IRAC UN. *OMRI-listed.*

## Tarnished Plant Bug

Tarnished plant bug (TPB) damage to lettuce and spinach can reduce the marketability of these crops and can make them more susceptible to bacterial diseases. TPB adults and nymphs also feed on the youngest growth in the heart of the plant, which may lead to symptoms similar to blackheart.

No formal economic thresholds have been developed for this insect pest in leafy vegetables. However, in Canada, the thresholds used in celery have proven to be a suitable guideline for management decisions. Insecticide treatment is recommended whenever a threshold of 0.2 TPB per plant is reached from transplanting until three weeks before harvest. Note that in many cases, TPB damage is observed before large numbers of TPB nymphs and/or adults are detected.

### Pesticide

**Baythroid XL (1EC) (beta-cyfluthrin)** *Arugula, Chicory, Cress, Endive, Escarole, Florence Fennel, Head Lettuce, Leaf Lettuce, Parsley, Radicchio, Spinach, Swiss Chard* | 2.4-3.2 fl. oz. per acre. Do not exceed 12.8 fl. oz. per acre per season. Allow 7 days between applications. REI: 12-hour. PHI: 0-day. IRAC 03A. *RUP.*

**Beleaf (50SG) (flonicamid)** *Arugula, Chicory, Cress, Endive, Escarole, Florence Fennel, Head Lettuce, Leaf Lettuce, Parsley, Radicchio, Spinach, Swiss Chard* | 2.0-2.8 oz. per acre. Do not exceed 8.4 oz. per acre per season. REI: 12-hour. PHI: 0-day. IRAC 29.

**Brigade 2EC (bifenthrin)** *Head Lettuce, Spinach* | Use 2EC formulations at 5.12-6.4 fl. oz. per acre and do not exceed 32 fl. oz. per acre per season on head lettuce or 25 fl. oz. per acre per season on spinach. Use 10DF, 10WP, or 10WSB formulations at 12.8-16 oz. per acre and do not exceed 80 oz. per acre on head lettuce or 64 oz. per acre per season on spinach. Allow 7 days between applications. REI: 12-hour. PHI: 7-day. IRAC 03A. *RUP.*

**Mustang Maxx (0.8) (zeta-cypermethrin)** *Arugula, Basil, Chicory, Chive, Cilantro, Coriander, Cress, Dill, Endive, Escarole, Fennel, Florence Fennel, Head Lettuce, Lavender, Leaf Lettuce, Marjoram, Oregano, Parsley, Radicchio, Rosemary, Sage, Savory, Spinach, Swiss Chard, Tarragon, Thyme, Watermelon* | 2.24-4.0 fl. oz. per acre. Do not exceed 24 fl. oz. per acre per season. REI: 12-hour. PHI: 5-day. IRAC 03A. *RUP.*

**Pyganic EC 5.0 II (0.41) (pyrethrins)** *Arugula, Cress, Endive, Escarole, Fennel, Florence Fennel, Head Lettuce, Leaf Lettuce, Parsley, Radicchio, Spinach, Swiss Chard* | *Soil drench* (in greenhouse): add 0.375 fl. oz. to 5 gal. of water and apply as a soil drench to 1,000 sq. ft. of soil or non-soil media. Do not exceed the maximum rate of 0.375 fl. oz. per 1,000 sq. ft. *Foliar applications*: 4.5-15.61 fl. oz. per acre in a minimum of 2 gallons of water per acre for field crops. Do not exceed the maximum application rate of 0.05 lbs. ai. per acre. REI: 12-hour. IRAC 03A. *OMRI-listed.*

**Sevin XLR Plus (4SC) (carbaryl)** *Endive, Escarole, Florence Fennel, Head Lettuce, Leaf Lettuce, Parsley, Spinach, Swiss Chard* | 0.5-2 qts. per acre. Do not exceed 6 qt. per acre per season. REI: 12-hour. PHI: 14-day. IRAC 01A.

# Leafy Vegetables and Herbs (Non-Brassica) – Weeds

Reviewed by Stephen Meyers, Ben Phillips – Sept 2021

## *Recommended Controls*

### All Weeds

Most herbs are weak competitors with weeds, and while a few herbicides are registered on many herbs, they generally are for site preparation or for preemergence control or postemergence control of emerged grasses. Herbicides are not widely labeled across the many leafy greens and herbs. Instead, herbicides are labeled based on the plant families the crops come from. For example, cilantro, dill and parsley have several herbicides that would damage any other crop. Similarly, spinach and Swiss chard have unique herbicides. Lettuces and the related crops like Chicory, Endive, Escarole, Radicchio have few labels for preemergence or over-the-top use because many weeds come from this plant family and are targeted by broadleaf herbicides.

For directed-seed crops, prepare a stale seedbed several weeks in advance of planting, allow weeds to emerge, and kill weeds without bringing new weed seeds to the surface with a burndown herbicide, flame weeder, or very shallow cultivation. In fields with lower weed pressure, it may be possible to plant plant seeds into some emerged weeds, and then use an approved burndown herbicide prior to crop emergence to control emerged weeds. For crops like cilantro and dill that take a long time to emerge, a burndown application made just prior to crop emergence is especially useful, but it can also pay off for faster-emerging species like lettuce or spinach.

For specific weeds controlled by each herbicide, check the Relative Effectiveness of Herbicides for Vegetable Crops table.

Rates provided in the recommendations below are given for overall coverage. For a banded treatment, reduce amounts according to the portion of acre treated.

### Non-Pesticide

*Arugula, Basil, Chicory, Chive, Cilantro, Coriander, Cress, Dill, Endive, Escarole, Fennel, Florence Fennel, Head Lettuce, Lavender, Leaf Lettuce, Marjoram, Oregano, Parsley, Radicchio, Rosemary, Sage, Savory, Spinach, Swiss Chard, Tarragon, Thyme* | Weed control in leafy vegetables and herbs often relies heavily on cultivation and hand-weeding for full season weed control. These operations are most efficient when planting arrangement is designed with weed control in mind and is designed to work with available weed control equipment. Specialized weeding equipment for leafy vegetables includes basket weeders, narrow-bladed hoes, finger weeders, and others. A stale seedbed can be prepared prior to transplanting with flame weeding or very shallow cultivation to control emerged weeds, instead of herbicides. Using transplants is helpful for weed control because the size difference between weeds and crop early in the season make mechanical control easier. Plastic and paper mulches have been used with success for transplanted crops.

### Pesticide

**Aim EC (2) (carfentrazone)** POST *Arugula, Basil, Chicory, Chive, Cilantro, Coriander, Cress, Dill, Endive, Escarole, Fennel, Florence Fennel, Head Lettuce, Lavender, Leaf Lettuce, Marjoram, Parsley, Radicchio, Rosemary, Savory, Spinach, Swiss Chard, Tarragon, Thyme* | 1-2 fl. oz. per acre. **For leafy vegetables (not including herbs):** Apply as burndown treatment at least 1 day before transplanting or at least 7 days before seeding. Tank-mix with another labeled burndown product for best control. **For leafy vegetables and herbs:** Apply to row middles with a hooded sprayer to control weeds up to 4 inches tall. Add COC, NIS, or MSO. AMS will improve weed control. Do not exceed 6.1 fl. oz. per acre per year or 2 applications per crop per year. REI: 12-hour. HRAC 14.

**Balan DF (60) (benefin)** PRE *Head Lettuce, Leaf Lettuce* | 2-2.5 lbs. per acre. Apply and incorporate before seeding or transplanting. REI: 12-hour. HRAC 03.

**Caparol 4L (prometryn)** POST PRE *Cilantro, Dill, Florence Fennel, Parsley* | For **cilantro:** apply 2.0-3.2 pts. per acre after seeding but before crop emergence. For **dill**

*in Michigan only (MI 24c exp. 12/31/24)*: apply 3.2 pts. per acre once after seeding and before crop emergence or apply after crop emerges. Do not exceed one application or 3.2 pts. per acre per season. For **Florence fennel:** apply 2.4-4.0 pts. per acre after seeding but before crop emergence or apply 1.6-2.0 pts. per acre after seeded crop has 2-5 true leaves and before weeds are 2 inches tall, or apply 2.4-4.0 pts. per acre after transplanting. Do not exceed one application to seeded fennel, or two applications in transplanted fennel. For **parsley:** apply 1 pt. per acre up to 14 days after planting. A second application can be made up to 30 days before harvest. A third application can be made up to 30 days before second harvest. Maximum 3 applications per year and 3 pts. per acre per year. To avoid crop injury, do not use on sand or loamy sand, or use lower rate. REI: 12-hour. PHI: 30-day for cilantro, dill, and parsley; 40-day for Florence fennel. HRAC 05.

**clethodim products (clethodim)** POST *Arugula, Basil, Chicory, Chive, Cilantro, Coriander, Cress, Dill, Endive, Escarole, Fennel, Florence Fennel, Head Lettuce, Lavender, Leaf Lettuce, Marjoram, Parsley, Radicchio, Rosemary, Savory, Spinach, Swiss Chard, Tarragon, Thyme* | Use 2EC formulations at 6-8 fl. oz. per acre with 1 qt. of COC per 25 gals. of spray solution (1% v/v). Do not exceed 32 fl. oz. of 2EC formulations per acre per season. Use Select Max at 9-16 fl. oz. per acre with 8 fl. oz. of NIS per 25 gals. of spray solution (0.25% v/v). Do not exceed 64 fl. oz. of Select Max per acre per season. Use low rates for annual grasses, the high rates for perennial grasses. Spray on actively growing grass. Wait at least 14 days between applications. Try on small area before spraying whole field. REI: 24-hour. PHI: 14-day. HRAC 01.

**Devrinol DF-XT (50) (napropamide)** PRE *Basil, Marjoram, Rosemary, Savory* | 2-4 lbs. per acre. Apply before or after seeding and incorporate into soil, or water-in with 0.2-0.4 inch of water. REI: 24-hour. HRAC NC.

**Dual Magnum (7.62EC) (s-metolachlor)** PRE *Chive, Cilantro, Head Lettuce, Leaf Lettuce, Spinach, Swiss Chard | Illinois, Indiana, Michigan, Minnesota, and Ohio only. IL 24c exp. 03/25/24. MI 24c exp. 12/31/21. MN 24c exp. 12/31/2025. OH 24c exp. 12/31/22.* For **chive** in all states listed above *except IL:* apply 0.67-1.33 pts. per acre postemergence starting when the crop has 2 true leaves. For **cilantro** in all states listed above *except IL:* apply 0.67-1 pt. per acre to soil surface after seeding before crop emerges. For **head and leaf lettuce** in all states listed above *except IL:* apply 0.67-1 pt. per acre preplant, preemergence, or after emergence or transplanting. For **spinach** in all states listed above: apply 0.33-1 pt. per acre to soil surface after seeding before crop emerges. For **Swiss chard** in all states listed above: apply 0.5-1.0 pt. per acre to soil surface after seeding before crop emerges. In all cases, use lower rate on sandy soil. Do not incorporate. Do not application per crop per season. REI: 24-hour. PHI: 20-day for head lettuce; 21-day for chives, 25 day for leaf lettuce; 30-day for cilantro; 50-day for spinach, 62-day for swiss chard. HRAC 15.

**Fusilade DX (2EC) (fluazifop-P)** POST *Head Lettuce, Leaf Lettuce* | 10-24 fl. oz. per acre. Use 1-2 pts. of COC or 0.5-1 pt. of NIS per 25 gals. of spray solution. Apply to actively growing grasses. Effective against perennial grasses. Do not exceed 48 fl. oz. per acre per year. REI: 12-hour. PHI: 14-day. HRAC 01.

**glyphosate products (glyphosate)** POST *Arugula, Basil, Chicory, Chive, Cilantro, Coriander, Cress, Dill, Endive, Escarole, Fennel, Florence Fennel, Head Lettuce, Lavender, Leaf Lettuce, Marjoram, Parsley, Radicchio, Rosemary, Sage, Savory, Spinach, Swiss Chard, Tarragon, Thyme* | See product label for rates, application volume, and adjuvants. Use 4L formulations at 1-3 qts. per acre. Apply to emerged annual and perennial weeds before planting. Transplants that contact freshly sprayed weeds can be seriously injured. Or apply between rows with a hooded or shielded sprayer. Crop will be injured if any spray contacts it. Use low rate for annuals and higher rates for perennials. REI: 4-hour to 12-hour. PHI: 14-day. HRAC 9.

**Kerb SC (3.3) (pronamide)** PRE *Endive, Escarole, Head Lettuce, Leaf Lettuce, Radicchio* | 1.25-5 pts. per acre. Apply before or after seeding. Must be incorporated or irrigated into soil. Can be applied after crop emerges, but weed control will be marginal on muck soils. For **head lettuce** *on muck soils in Michigan only (MI 24c expires 04/06/22.):* use 9.6-14.4 pts. per acre. REI: 24-hour. PHI: 55-day for head lettuce. HRAC 03. *RUP.*

**Lorox DF (50) (linuron)** POST PRE *Cilantro, Coriander, Dill, Parsley* | 1-3 lbs. per acre. For **cilantro and coriander:** apply 1-2 lbs. per acre after seeding and before crop emergence, or make up to 2 postemergence applications after crop has 3 true leaves. Do not exceed 4 lbs. per acre per year. For **dill:** apply 1-2 lbs. per acre after seeding and before crop emergence, or make one postemergence application after crop has 3 true leaves. Do not exceed 4 lbs. per acre per year. For **parsley:** apply 1-3 lbs. per acre after seeding and before crop emergence. Use lower rate on sandy soil, or make one postemergence application at 1 lb. per acre after crop has 3 true leaves (*postemergence application allowed on muck soils only)*. Do not exceed 3 lbs. per acre per year. Use lower rate on sandy soil. Do not apply to soil with less than 1% organic matter. Do not spray when temperatures exceed 85F. REI: 24-hour to 8-day. PHI: 21-day for cilantro, coriander, and dill; 30-day for parsley. HRAC 05.

**paraquat products (paraquat)** POST *Endive, Escarole, Head Lettuce, Leaf Lettuce* | Applications of 1-4 pts. per acre can be made as a banded or broadcast treatment before, during or after planting but prior to emergence. For **head and leaf lettuce** *in Michigan only (MI 24c exp. 06/08/26): m*ake one shielded application of 1.5 pts. per acre to row middles 2-3 weeks after seeding. Include 0.25% NIS v/v. Use a minimum of 40 gals. water per acre. REI: 12 to 24-hour. HRAC 22. *RUP.*

**pendimethalin products (pendimethalin)** *Chive* | Use 3.8 formulations at 2 pts. per acre after seeding but before crop emerges, or when crop has 2-3 true leaves. The 3.3 formulations are not labeled for chive. If both pre and post applications are used, wait 30 days after pre application before making a post application. Only apply pre to muck soils (organic matter greater than 20%) or mineral soils with greater than 3% organic matter. Do not exceed 4 pts. per acre per year. *Michigan only. MI 24c exp. 04/16/24.* For mineral soils with more than 5% organic matter, use 3.8 formulations up to 4 pts. per acre or 3.3. formulations up to 4.8 pts. per acre. Use low rates on course soils. Heavy rain or excessive irrigation soon after application may cause crop injury. Will not control emerged weeds. REI: 24-hour. PHI: 30-day. HRAC 03.

**Poast (1.5EC) (sethoxydim)** POST *Arugula, Cilantro, Cress, Dill, Endive, Escarole, Florence Fennel, Head Lettuce, Leaf Lettuce, Parsley, Radicchio, Spinach, Swiss Chard* | 1.5 pts. per acre. Apply to actively growing grasses. Include 1 qt. COC per acre. Do not exceed 5 pts. per acre per season for dill or 3 pts. for other listed crops. REI: 12-hour. PHI: 30-day for Florence Fennel, Head Lettuce, Radicchio, and Swiss Chard; 15-day for other crops. HRAC 01.

**Prefar 4E (bensulide)** PRE *Arugula, Chicory, Cress, Endive, Escarole, Florence Fennel, Head Lettuce, Leaf Lettuce, Parsley, Radicchio* | 5-6 qts. per acre. *Mineral soils only.* Apply and incorporate before planting or apply after seeding (before crop emerges) and incorporate with irrigation. REI: 12-hour. HRAC NC.

**Ro-Neet (6) (cycloate)** PRE *Spinach* | 2 qts. per acre. *Illinois and Ohio only*. Apply before planting and incorporate 2-3 inches immediately. Use on sandy mineral soils only. REI: 48-hour. PHI: 45-day. HRAC 15.

**Scythe (4.5EC) (pelargonic acid)** POST *Arugula, Basil, Chive, Cress, Dill, Endive, Escarole, Fennel, Head Lettuce, Leaf Lettuce, Oregano, Parsley, Rosemary, Sage, Savory, Spinach, Swiss Chard, Tarragon, Thyme* | 5-10 gals. per acre. **For leafy greens (including herbs)**: Apply as a burndown, or as a directed or hooded spray between rows in 75-200 gals. of water per acre. Use higher rate for large and mature weeds. **For herbs (not including leafy greens)**: Apply prior to emergence of plants from seed or perennial rootstock, ensuring applications are made before crop emerges from the soil. REI: 12-hour. HRAC NC.

**Spin-Aid (1.3) (phenmedipham)** POST *Spinach* | 3-4 pts. per acre. **For spinach grown for processing or seed only**: Apply to spinach with 4-6 leaves when temperature is below 75F. Do not spray when dew is present. Apply in 11-22 gals per acre. May cause crop stunting. REI: 12-hour. PHI: 21-day. HRAC 05. *RUP.*

**Stinger (3) (clopyralid)** POST *Spinach, Swiss Chard* | For **spinach:** apply 2.7-5.3 fl. oz. per acre when spinach is in the 2-5 leaf stage. Do not exceed 2 applications and 8 fl. oz. per acre per year. For **Swiss chard** *in Michigan only (MI 24c exp. 12/31/25):* apply 4-8 fl. oz. per acre in one broadcast application per season. Kills composite weeds, legumes, nightshade and smartweeds. REI: 12-hour. PHI: 21-day for spinach; 30-day for Swiss chard. HRAC 04.

**trifluralin products (trifluralin)** PRE *Chicory, Endive, Escarole, Radicchio* | 0.5-1 lb. a.i. per acre. Use 4EC formulations at 1-2 pts. per acre. Use 10G formulations at 5-10 lbs. per acre. Broadcast and incorporate 1-2 inches before seeding or transplanting.Use low rate on coarse soils with less than 2% organic matter. Not effective on muck or high organic matter soils. REI: 12-hour. HRAC 03.