

Disease Information

Powdery Mildew

Cucurbit powdery mildew is showing up on vine crops, especially where plants are crowded or running together. This foliar disease first appears as small circular lesions located randomly on the leaf surface or on petioles. As the infection continues, leaves turn yellow and become distorted. Fruits are usually not directly affected, but yield and flavor can be reduced. This disease thrives in humid and shady environments under moderate temperatures (up to 80° F). Free water is not necessary and can actually inhibit germination, as can hot temperatures.



Management:

Scout for the disease by looking for the white, powdery lesions on the lowest leaves first. In general, if you find one lesion per 50 older leaves, begin a regular, 7 to 14-day protectant fungicide program. Fungicide applications are most effective when applied before the disease has become established.

When planting next spring, check seed labels for resistance. There are some pumpkin and melon varieties that are at least partially resistant (Merlin, Magic Lantern, Mystic Plus). Also, rotate the location of your cucurbit crops each year. The fungus overwinters on plant debris left in the soil.

Chemical Treatment:

Commercial growers: potassium bicarbonate (Kaligreen, Milstop), horticultural oil (Sporatec), sulfur (Cosavet, Kumulus, Microthiol Disperss), *Bacillus subtilis* (Serenade, Cease, Rhapsody)

Residential growers: horticultural oil (Monterey Garden Spray), sulfur (Bayer Natria, Bonide), myclobutanil (Spectracide Immunox).

Note: Do not use oil and sulfur within two weeks of each other, and do not spray when temperatures are over 90° F.

Botrytis on Basil

Botrytis was found recently in a field of basil plants. It is a fungus that is found world-wide and can cause a wide variety of diseases on a wide variety of plants. It can occur both in the greenhouse and in the field. On basil, and some other vegetables, it is known as gray mold.

The fungus produces lots of spores on dead plant material. The spores are easily moved to other plants by air movement, and contact from diseased plants to healthy plants.

In the greenhouse, you will notice stem lesions at, or just below the soil level. Infections usually occur through tiny wounds or dead leaves, and spread rapidly in cool, humid conditions. Any other tissue touching an infection will also become diseased. Eventually, a gray fuzzy "mold" will form, killing that plant tissue, but not necessarily killing the plant.



Management:

To manage gray mold, improve air circulation in the greenhouse, keep humidity under 85%, provide adequate spacing between plants, use drip irrigation or water in the morning so leaves can dry, and try not to injure plants. There is no cure for infected plants so all diseased tissue needs to be removed immediately. Additionally, all plant debris needs to be removed because the fungus can survive on it.

Chemical Treatment:

No fungicides are registered for Botrytis on herbs.

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Insect Information

Squash Bugs

Squash bugs are laying eggs now and nymphs will be hatching soon. They overwinter as adults, and when they emerge in the spring, they fly to cucurbit plants to feed and mate. Females commonly lay eggs individually in small clusters (about 20) on the undersides



of the leaves, especially between the veins where they form a V. The females usually start appearing in gardens in early June and continue to lay eggs through early September. Eggs hatch into nymphs about 10 to 14 days after being laid.

Feeding/Damage

Nymphs feed by sucking plant juices, causing yellow speckling and browning. Adult squash bugs feed on the vines and stems, puncturing the xylem cells, and preventing water transport up to the leaves.



In areas of heavy feeding, wilting and death of leaves or plants can occur. This is sometimes referred to as "sudden wilt." Wilting can occur on individual leaves, a section of a plant, or an entire plant.

Management

The most critical time to monitor and treat for squash bugs is when your plants are young seedlings and also when they are flowering. Eggs and nymphs are the easiest to treat, and as squash bugs get older (just a few days), they disperse and are more difficult to manage.



Look on the undersides of leaves at V's of leaf veins for the bright orange eggs. To prevent eggs from hatching, they should be crushed or removed by tearing them out or using tape. To manage nymphs, shake them off plants into a bucket of soapy water; this is most effective when nymph numbers are low. Insecticides can also be used to treat squash bug nymphs.

Chemical Treatment:

While plants are in bloom, spray only in early morning or evening to avoid harming pollinators.

Commercial growers: acetamiprid (Assail), esfenvalerate (Asana), permethrin (Ambush, Pounce), bifenthrin (Tundra), Carbaryl (Sevin), lambda-cyhalothrin (Warrior).

Residential growers: neem oil (Concern, Ferti-Lome), permethrin, (Ace Dust, Bayer Advanced Dust, Bonide Eight), kaolin clay (Surround), carbaryl (carbaryl can cause plant damage [phytotoxicity] when applied in hot weather).

Onion Thrips

Onion thrips damage was observed in most onion growing areas in the state. They are tiny insects (about 0.04 inch) with fringed wings. They overwinter as adults and begin feeding in the spring when temperatures warm. Thrips reproduce rapidly especially in hot, dry conditions. Thrips eggs are deposited inside the leaf tissue and cannot be seen



with the naked eye. Thrips can complete one generation (egg to adult) in 3 to 4 weeks during the summer months. Adults and nymphs can be found on the underside of leaves or in tight spaces such as the neck of onions.

Feeding/Damage

Onion thrips have a broad host range, but severe damage from feeding usually occurs exclusively on onions, garlic, cauliflower, cabbage, snap beans, cucumbers, melons, and tomatoes in



the home garden. Thrips feeding damage may vary depending on the host plant, but generally causes white to silvery streaks on the foliage and may lead to the plant withering and reduced bulb size (onion and garlic) due to loss of plant vigor. Onion thrips can also vector viruses such as the iris yellow spot virus (IYSV), tomato spotted wilt virus (TSWV), and impatiens necrotic spot virus (INSV).

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Management

Thrips populations usually increase rapidly in July, so it's important to monitor and prevent thrips numbers from escalating. Spray thrips off plants with water from a hose, or use overhead sprinklers.

This method is especially effective on immature thrips which don't have wings and can't fly back on the plant to feed more.



Use mulches, such as straw, to provide a barrier and enhance natural thrips predators.

Chemical Treatment:

Thrips can develop resistance to insecticides rapidly so it's important to use various management practices in addition to chemical treatments.

Commercial growers: azadirachtin (Azatin, Aza-direct), spinosad (Success, Entrust), spinetoram (Radiant), spirotetramat (Movento), insecticidal soap (Safer's, M-pede), kaolin clay (Surround), permethrin (Ambush, Pounce).

Residential growers: Spinosad (Green Light, Monterey Garden Spray), insecticidal soap (Safer's, Bayer Nutria), kaolin clay (Surround), pyrethrin (Monterey Take Down, Garden Tech Worry Free).

Flea Beetles

There are two common species of flea beetles that are actively feeding now on a variety of crops, including the tobacco flea beetle and the western flea beetle.

Flea beetles are small, shiny, and have large rear legs that allow them to jump like a flea when disturbed. They spend the winter as adults in plant debris or under soil clods and



Tobacco flea beetle adult

become active early in the spring. Females lay clusters of eggs in small holes in the roots, soil, and leaves of many different plants. Small white larvae hatch from the eggs and begin feeding on the roots of newly planted

seedlings. Larvae will then pupate in the ground. There are about one to two generations each year. Flea beetles are common in home gardens on plants such as broccoli, cabbage, radishes, eggplant, melons, peppers, potatoes,

spinach, tomatoes, and turnips.

Feeding/Damage

Adult beetles, which produce most plant injuries, chew many small holes or pits in the leaves which produces a characteristic injury known as "shotholing."



Western flea beetle adult

Young plants and seedlings are particularly susceptible to this type of injury; growth may be seriously retarded and plants may even die. Leaf feeding also damages plant appearance which is important among certain ornamentals and leafy vegetable crops. Plants commonly attacked by flea beetles include

tomato, eggplant, potato, peppers, turnips, radish, rutabagas, parsnip, collards, kale, swiss chard, broccoli, brussels sprouts, cauliflower, and beets.



Management

On established plants, there needs to be at least 10 to 20 percent of the leaf area destroyed before there is any effect on yields. The plants most likely to benefit from treatment are the more sensitive seedlings, and plants grown for edible greens or for ornamental purposes. Make sure the seedbed is prepared well, this will accelerate seedling growth. Floating row covers or other screening can exclude the beetles during seedling establishment. In isolated plantings, thick mulches may also help reduce the number of flea beetles by interfering with activity of the root and soil stages.

Chemical Treatment:

Most flea beetle treatments are applied as foliar sprays. Since plants produce continuous new growth and the highly mobile beetles can rapidly reinvade plantings, insecticides usually have to be reapplied after a week.

Commercial growers: spinosad (Success, Entrust), azadirachtin (Azatrol, Ecozin, Molt), bifenthrin (Hero, Tundra), permethrin (Ambush, Pounce), pyrethrin (Pyganic), neem oil, and diatomaceous earth.

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Residential growers: carbaryl (Sevin), spinosad (Green Light, Monterey Garden Spray), bifenthrin (Garden Insect Killer), permethrin (Bayer Advanced Complete Insect Killer, Bonide Eight), pyrethrin (Fertilome Triple Action Plus, Worry Free Home Pest Control, Ortho Garden Insect Killer), neem oil and diatomaceous earth.

Leafminers

Leafminers are active now, laying eggs on spinach, beet and chard leaves. There is both a beet (*Pegomya betae*) and spinach (*Pegomya hyoscyami*) leafminer, and both species feed on similar crops.



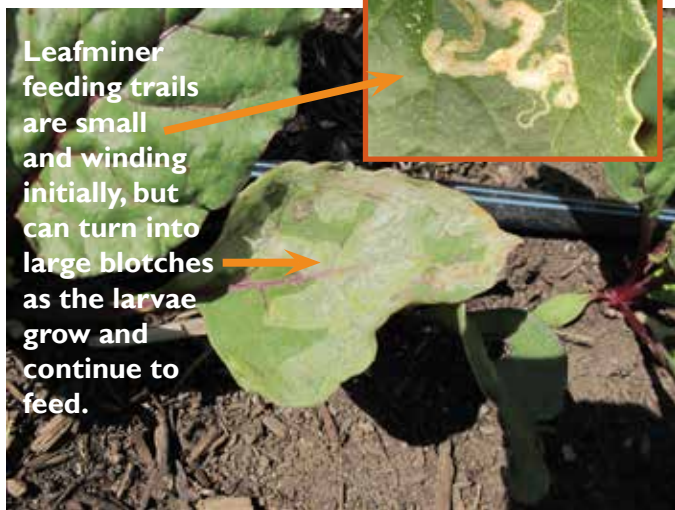
The adult fly lays oblong white eggs in neat rows that are easily visible on the undersides of leaves. Maggots (immature leafminers) feed for a few weeks before pupating in the soil. There are 3 to 4 generations per season. Late May is the first peak period of activity.

Feeding/Damage

The maggots burrow inside the leaves, eating cell contents between the upper and lower epidermis. The visible symptom is a winding trail that may enlarge to gray blotches on the leaves. A single maggot can cause significant damage, feeding on multiple leaves during its development.



Leafminer feeding trails are small and winding initially, but can turn into large blotches as the larvae grow and continue to feed.



Management

Both species of leafminers also feed on lambsquarters, chickweed, nightshade, and Amaranthus species, so weed control is the first line of defense. Crop rotation and removing infested leaves can also help to reduce the population and damage. Row covers applied just before and during egg-laying (June, August) will exclude flies and protect plants.

Chemical Treatment:

Chemical control is not recommended unless leaves are to be used for consumption. (Homeowners, however, can cut away mined portions.) If used, chemicals are only effective when timed with egg deposition or hatching. Look for eggs or the start of new mines to determine when to start treatment. Repeat treatment in 7-10 days.

Commercial growers: abamectin (Agri-mek), chlorantraniliprole (Coragen), flonicamid (Beleaf), imidacloprid (Provado).

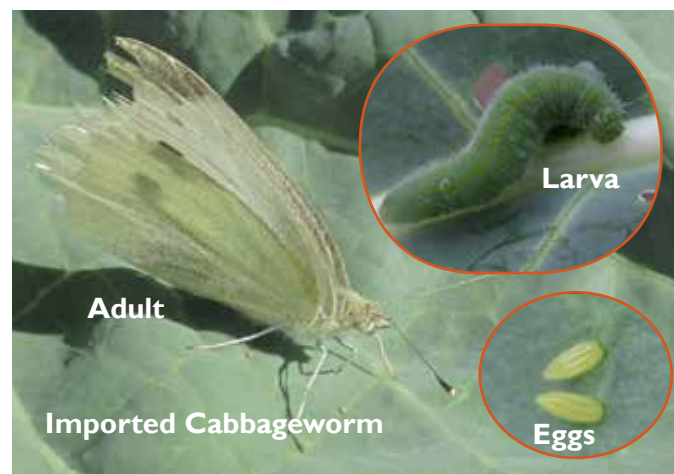
Residential growers: malathion (Bonide, Ortho Max), insecticidal soap (Safer's, Bayer Natria), pyrethrin (Monterrey Take Down, Garden Tech Worry Free), spinosad (Bonide, Fertilome, Monterey Garden Spray).

Cabbage Worms

There are two common caterpillars that attack cabbage and its relatives (e.g., broccoli, cauliflower, kale, etc.) in Utah – the **imported cabbageworm** and the **cabbage looper**.

The imported cabbageworm adult is a pretty white butterfly that can be seen flitting through the garden as it searches for host plants to lay eggs. The immature stage, or caterpillar, is lime green with short fuzzy hairs on its body.

The cabbage looper adult is a brown moth and the caterpillar is light green with white stripes down its body. Its "looping" crawl causes its back to arch as it pulls its hind end forward like an inchworm.



Feeding/Damage

The caterpillars chew ragged holes in the leaves and contaminate the harvested product with their frass (excrement) and bodies.

Management

To protect plants from egg-laying, cover them with floating row cover, or remove caterpillars, with a stiff spray of water from the hose or overhead sprinklers.

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Chemical Treatment:

Insecticides effective against young caterpillars:

Commercial growers: azadirachtin (Aza-direct, Azatin, Molt), Bacillus thuringiensis (Biobit, Crymax, Dipel), spinosad (Success, Entrust).

Residential growers: carbaryl (Garden Tech Sevin), Bacillus thuringiensis (Bonide Thuricide, Green Light), spinosad (Bonide Captain Jack's, Monterey Take Down).

Grasshoppers

Young grasshoppers have been seen in high numbers in gardens and rangeland areas. They overwinter as eggs which are laid in undisturbed soil in September and October. The eggs are laid in groups held together in a pod formed from a sticky secretion to which loose soil becomes bound. Eggs hatch in the spring depending on temperature. Immature grasshoppers, called nymphs, go through five instars before becoming adults. The nymphs are flightless, but will gradually develop small wing pads. Most adults are capable of flying great distances.

Feeding/Damage

Grasshoppers have voracious appetites and feed on just about everything, from grasses to ornamental plants to vegetables and fruits. Grasshoppers have chewing mouthparts that tear away plant tissue, and the primary injury caused by grasshoppers is defoliation. Adults and nymphs consume and clip foliage as they feed, but with high infestations grasshoppers may feed on all parts of the plant. Widespread, severe infestations are often associated with hot, dry years.

Management

One of the best management options is to use a bait product with a grasshopper pathogen soon after egg hatch (late May to late June). NoLo or Semaspore bait is available at most garden center/farm stores, and contains Nosema

locustae in a bran shell. Another bran bait may be available that contains carbaryl (EcoBran, Lily Miller Bait, and others). Baits should be used when grasshoppers are small, and spread evenly throughout the infested site. Grasshoppers will consume the bait as they forage. Re-apply following rainfall or irrigation.

Grasshoppers are highly mobile, so if it looks like you may have a grasshopper problem in your yard or garden talk to your neighbors about treating their property also because community-wide management is often needed.

Chemical Treatment:

The high mobility of grasshoppers makes insecticides not as effective as baits. Treatments applied after grasshoppers have reached maturity are also not effective.

Commercial growers: azadirachtin (Azatrol, Azera), carbaryl (Sevin), Spinosad (Blackhawk, Success, Entrust).

Residential growers: insecticidal soap (Bayer Natria), imidacloprid (Bayer Complete), pyrethrins (Worry Free).



Leafhoppers

At least two species of leafhoppers that affect vegetables are out right now, the potato leafhopper and the beet leafhopper.

Both the beet leafhopper and the potato leafhopper overwinter as a mated female in weed hosts in southern Utah, and migrate or are blown to other parts of the state in early summer.

Feeding/Damage

Potato leafhoppers feed on a variety of crops including beans, eggplant, and potato. Beans and



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eggplant can tolerate feeding but on potatoes, leaves are susceptible to scorch, also called 'hopper burn'.

The beet leafhopper is an important pest only due to the fact that it vectors curly top virus; feeding alone usually does not cause severe damage.

The virus is spread when leafhoppers probe plants while searching for suitable hosts. If the leafhopper is infected with the virus it can transmit the virus to a healthy host plant within a matter of seconds while it "tastes" the plant.



Management

Watch hosts now for potato leafhopper infestations. Look on the undersides of leaves for small, pale green, wedge-shaped insects that fly away quickly when disturbed. The young, bright-green nymphs do not fly. Treat when you see 1 adult per 5 feet of row on tomatoes, and more than 2 adults per foot of row on beans. Once beans begin to bloom, they can tolerate feeding.

Management decisions for the beet leafhopper should be focused on preventing leafhoppers from spreading the virus. Plant at a higher than normal density to lower the probability that every plant will be infected, allowing some plants to survive without decimating the entire field. Use remay (a white mesh fabric) over plants to prevent beet leafhopper feeding. Growers in areas that face continual virus infections should plant varieties labeled as resistant.



For more information on beet leafhoppers and curly top disease see the new Utah Vegetable Production and Pest Management Guide (pgs 36 & 41) at <http://utahpests.usu.edu/ipm/htm/vegetables>.

Chemical Treatment:

Insecticide use on the beet leafhopper is not recommended because the wide movement of the insect makes it difficult to determine when the leafhoppers are present.

Insecticides effective against the potato leafhopper:

Commercial growers: azadirachtin (Aza-Direct, Azatin, Ecozin), clothianidin (Belay), carbaryl (Sevin), oils (Saf-T-Side, Ecotec, Purespray), methomyl (Lannate), oxamyl (Vydate) esfenvalerate (Zyrate).

Residential growers: carbaryl (Garden Tech Sevin) esfenvalerate (Monterey), permethrin (Bayer Vegetable & Garden, Bonide Eight), spinosad (Bonide, Monterey Take Down), Bacillus thuringiensis (Bonide Thuricide, Green Light).

Cabbage Aphid

Colonies of cabbage aphid are easy to identify as these aphids have a white waxy coating. These aphids commonly occur in dense colonies, often covered with waxy droplets. The cabbage aphid has a simple life cycle with adult females giving birth to live offspring. Both winged and wingless adults occur; the winged adults have a black thorax and lack the waxy coating.

Feeding/Damage

Aphid feeding causes a localized yellowing of the foliage, leaf cupping, and stunting of smaller plants. They generally do not cause reductions in yield, but they tend to move deep into head-forming crucifers, thus making the harvested portion of the crop unmarketable.



Management

Check for cabbage aphid in the youngest, highest, and innermost leaves of young plants. After heading, check the flowering parts of broccoli and cauliflower and pull back

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wrapper leaves of cabbage. Broccoli and cauliflower crops can tolerate up to 100 aphids per plant up to heading. Once heads begin to form, cabbage aphids must be controlled even if only a few are present. Because of the overlapping growth of their leaves, cabbage crops require more careful management and have less tolerance for aphids even during the early vegetative stages; treat as soon as 1 to 2% of plants are infested with one or more aphids.

After treating, recheck fields frequently and treat if populations reappear. Remove and destroy crop debris after harvest, and remove alternate hosts (weeds in the mustard family) from nearby borders. Also, when transplanting Brussels sprouts, make sure plants are clean since infestations can start in seedling trays.

Chemical Treatment:

When using insecticides to treat aphids, avoid multiple sprays; this will help to conserve natural enemies that help to control crucifer caterpillars. If a treatment is necessary, wait until preheading and apply a single application.

Commercial growers: acetamiprid (Assail), imidacloprid (Admire), Beauveria bassiana GHA (Botanigard 22 WP).

Residential growers: insecticidal soap (Bayer nutria) (can be phytotoxic on Brussels sprouts and cabbage), permethrin (Ace Multi-Purpose Dust, Bayer Advanced Complete Dust, Bonide Eight).

Natural Enemies Spotlight

Minute Pirate Bug

Minute pirate bugs are generalist predators and are often the first and most common predaceous insects to appear in the spring. They are common insect predators in many crops.

What It Feeds On:

Adults and nymphs feed on insect eggs and small soft-bodied insects such as psyllids, thrips, mites, aphids, whiteflies, and small caterpillars.

Appearance and Life Cycle:

Adult minute pirate bugs are small, (1/12 to 1/5 inch) long, oval, black with white markings, and have a triangular head. They undergo incomplete metamorphosis, and nymphs are



Minute pirate bug adult feeding on a thrips



Minute pirate bug nymph feeding on an aphid

usually pear-shaped and yellowish or reddish brown with red eyes. Developmental time for minute pirate bugs is very short, only 3 weeks from egg to adult.

How To Attract It:

Plant various flowers in and around your garden. Some varieties such as Alyssum and Crimson Clover attract Minute Pirate Bugs and other natural enemies.

Commercially Available:

Commercially available minute pirate bugs are sometimes released in greenhouses to control thrips.

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The First Ever, Comprehensive Vegetable Guide for Utah is Now Available!

The first edition was funded through the Utah State University Extension Grant Program. The guide was authored by a team of USU Extension agents and specialists.

Chapter topics include:

- General vegetable production practices
- Soils, nutrition, and water management
- IPM practices
- Pesticide information
- In-depth crop chapters on eggplant, pepper, tomato, onion, and sweet corn.

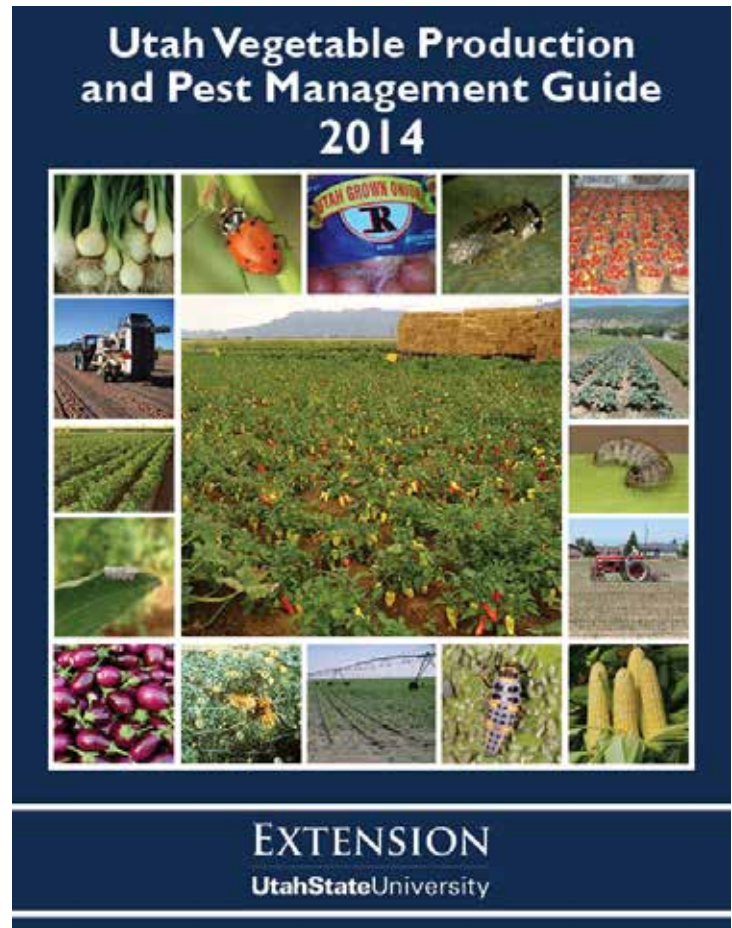
The guide also includes:

- Numerous tables with specific planting and pest management recommendations,
- Color images of pests, monitoring methods, and common natural enemies.

Future editions are already in the planning stage to add chapters on more vegetable crops and production topics.

The guide is now available as a free downloadable pdf on the USU Extension Utah Pests website (<http://utahpests.usu.edu/ipm/htm/vegetables>). We encourage home gardeners to take advantage of the free online copy, as only a limited number of bound copies are available.

Bound copies are available to vegetable growers, industry support sectors (suppliers, processors), and extension and agency crop and pest management staff. Contact guide editor, Bonnie Bunn, USU Extension Vegetable IPM Associate (bonnie.bunn@usu.edu) to order bound copies.



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