ORGANIC INSECT AND DISEASE CONTROL FOR LETTUCE

INTRODUCTION

Lettuce belongs to the Composite family, a large group that includes sunflowers, artichokes, endive and chicory, as well as noxious weeds like thistles and ragweed. It is commonly grown for its edible leaves as a salad crop. It may be the most widely grown crop on organic farms because its value as "locally produced" is unsurpassed. There are three commonly grown types of lettuce: leaf, head, and romaine. All three are popular as baby greens and are used in salad mixes. Cultivated lettuce is closely related to wild lettuce and both share the same insect pests and diseases.

INSECT CONTROL

ASTER LEAFHOPPER (*Macrosteles quadrilineatus*)

The aster leafhopper **(Photo 3.1)** is found throughout the Northeast. Since it does not overwinter well in cold climates, its population size varies from year to year depending on migration northward from milder regions. It feeds on over 100 species of plants, although cereal and grasses seem to be its preferred host. It is a major pest of lettuce, not because of direct damage but rather because it transmits the causal agent of aster yellows (see below for details on this disease).

Cultural Control:

Few growers attempt to control the aster leafhopper because a more important factor in the spread of the disease is the proportion of the population that is infective with the causal agent of aster yellows. Consequently, management is centered on reducing the sources of the disease inocula. Lettuce fields should be plowed immediately after harvest to remove that source of infection for later crops. Perennial broadleaf weeds near lettuce plantings should be controlled. The use of reflective mulches can be effective for repelling adult leafhoppers.

Materials Approved for Organic Production:

None are currently available.

SLUG SPECIES (Grey Garden slug: *Derocerus reticulatum*)
Slugs **(Photo 3.2)** cause some cosmetic damage to lettuce leaves and can damage young seedlings when very abundant, but the biggest cause for concern is their presence within harvested lettuce heads. They thrive wherever conditions are moist and living or recently dead plant material is present. Slugs are generally worse in wet years.

Cultural Control:

Mulch and permanent ground cover encourage slugs. Tillage lowers slug populations, so for slug-sensitive crops it may be best to utilize intensive tillage and cultivation.

Materials Approved for Organic Production:

In lab trials, Surround WP™ (Kaolin clay) caused 100% mortality of garden slug in 48 hours (Shelton and Plate 2003). More study is needed, but Surround may play a role in slug control in field grown crops. Use of Surround on near-mature lettuce would cause residue problems on the crop.

TARNISHED PLANT BUG (*Lygus lineolaris*)
The tarnished plant bug (TPB) is a sucking insect **(Photo 3.3)** that feeds on lettuce and dozens of other crops and wild plants including most legumes, buckwheat (when flowering), pigweed, members of the brassica family, and many plants in the Rose family such as strawberries. A plant toxin released during the feeding process in lettuce causes brown lesions along the midrib, which reduces its marketability. TPBs overwinter as adults under debris and in protected areas. They become active in early spring and deposit eggs on stems, midribs and blossoms of host plants. The eggs hatch in about a week and the nymphs feed and cause much of the damage, reaching the adult stage in about 30 days. There are usually at least 3 generations in the Northeast with peak populations in mid June and mid July.

Cultural Control:

1) There are a number of natural enemies of the TPB including the big-eyed bug (*Geocoris punctipes*), and the wasps *Peristenus digoneutis, Leiophron uniformis, Anaphes ovijentatus*, and *Peristenus pallipes. P. digoneutis* is a non-native beneficial that was released in the Northeast in the 1990's. It has become established as a biological control agent, and is spreading in the region. However, vegetable and small fruit growers have not yet reported a significant reduction in damage.

2) Row covers are not very useful for protecting lettuce, since TPB attacks lettuce in the hottest part of the season. Lettuce quality will suffer under row covers during that time.

3) Crop rotation has no effect on the TPB population because it is very mobile and feeds on so many different kinds of plants. On the other hand, managing the whole farm with respect to hosts will have a significant impact. Avoid mowing or harvesting host plants in the area of other host crops that are in a susceptible stage. For example, mow-

ing a field of alfalfa may drive the TPB into a neighboring field of lettuce. On the other hand, maintaining a field of hairy vetch in pre-bloom stage may trap the TPB and hold them away from a nearby lettuce field. It is important to control weeds and keep headlands mowed prior to crop growth to limit overwintering TPB populations.

Materials Approved for Organic Production:

Pesticides have only limited effect on TPB because of the rapid re-infestation that occurs from non-treated areas.

1) Pyrethrum gives limited control (40-60% control in the older literature; one poor result in recent studies).

2) Neem has shown some promise but more studies are needed (two fair results against Lygus bugs in recent studies).

DISEASE CONTROL

DISEASES CAUSED BY BACTERIA AND BACTERIAL-LIKE ORGANISMS

ASTER YELLOWS

Aster Yellows is caused by a unicellular organism belonging to a group of organisms called phytoplasmas. They differ from bacteria in that they lack a cell wall and are smaller. The organism that causes Aster Yellows infects the phloem sieve cells in lettuce (the food conducting cells). Symptoms include blanching and chlorosis of the young center leaves of lettuce plants **(Photo 3.4)**. These leaves appear as short, thick stubs in the middle of the head. Outer leaves also become yellow. The disease also causes sterile or aborted flowers in seed crops. The organism overwinters in the body of adult aster leafhoppers and in perennial or biennial host plants, e.g., Russian thistle, wild lettuce, dandelion, plantain and many others. The disease is transmitted to lettuce during leafhopper feeding. Aster Yellows is not a seed borne disease.

Cultural Control:

Control is based upon removal of reservoirs of the overwintering organism near lettuce fields, i.e., weed control in the headlands and fields nearby. Lettuce fields should be plowed down soon after harvest.

Materials Approved for Organic Production:

None currently known to be effective.

DISEASES CAUSED BY FUNGI AND FUNGAL-LIKE ORGANISMS

BOTTOM ROT AND WIRESTEM (*Rhizoctonia solani)*

The same fungus causes two different diseases in lettuce. Wirestem, which is a late damping off disease, occurs in seedling production. Symptoms include a shrinking of the stem just above the soil line causing the stem to collapse and the plant to fall over. Bottom rot occurs late in field plantings, usually when the lettuce is approaching maturity and the bottom leaves are in direct

contact with the soil. Rust-colored lesions appear on the midrib of these leaves and may expand and eventually cause the leaf to collapse. There is no fluffy white mycelium as there is with lettuce drop, and there is no gray mass of spores as there is with gray mold. The fungus can overwinter as either mycelia or sclerotia in the soil and on plant residues. Plants are most commonly infected by direct contact with mycelium.

Cultural Control

1) Rotation with grass family green manures helps by reducing the population of the pathogen in the soil.

2) Plow before planting, instead of disking, to bury the sclerotia. Plant lettuce in well-drained soil and control weeds to allow good air flow.

3) In fields with a history of bottom rot, growing on raised beds helps.

4) Romaine and other upright lettuce varieties are likely to escape infection because the leaves do not touch the soil.

Materials Approved for Organic Production:

None are currently available.

DOWNY MILDEW (*Bremia lactucae*)

Downy mildew is caused by a fungal-like water mold. It is particularly common where temperatures are low and leaves are wet for long periods. This is a common environment in cool season hoophouse and greenhouse production. Downy mildew lesions first appear light green and then the leaf develops a yellow, chlorotic appearance. Older lesions turn tan and papery **(Photo 3.5)**. Under optimal conditions for pathogen growth, sporangiophores (structures bearing sporangia) and sporangia (structures containing spores) emerge from the leaf stomata **(Photo 3.6)**. These appear as discrete white projections usually on the underside of the leaf. Diseased leaves often become infected by soft rot bacteria and fungi. The organism survives between crops as mycelia and oospores in residue of infected plants. Wild lettuce can carry the disease.

Cultural Control:

1) Crop rotation is the first line of defense. Plow deep to bury diseased crop residue.

2) Reduce the duration of leaf wetness by avoiding overhead irrigation, orienting the rows parallel with prevailing wind, using wide spacing within the row, controlling weeds, and minimizing crop debris in the field at time of planting.

3) Do not use poorly drained fields for early or late plantings.

4) Manage greenhouses to avoid long periods of leaf wetness.

Materials Approved for Organic Production:

None currently known to be effective.

GRAY MOLD (*Botrytis cinerea*)
The fungus that causes gray mold is, in addition to being a plant pathogen, a widespread saprophyte that feeds on dead and dying plant material. Consequently, spores are blowing around at all times and management depends on growing practices that minimize favorable conditions for spore germination and fungus growth rather than trying to reduce the number of spores. Under cool humid conditions, the fungus invades wounds and soft dying tissue on many plant species. On field-grown lettuce, gray mold is a common problem in the spring and fall when weather conditions are often favorable. In the greenhouse, poor management of humidity and plant surface moisture is the usual cause of an outbreak. Gray mold can spread from a harvested infected plant to other plants and is a common disease of lettuce, chicory and endive in the marketplace. Initial infection causes the infected area to look water soaked. As the infection progresses the lesion changes color from brown to gray **(Photo 3.7)**. The disease can spread from the leaves to the stem. Affected areas rapidly turn soft and rot. A characteristic gray fuzzy mycelium that is usually seen on gray mold infected plants may not always be present on lettuce.

Cultural Control:

1) Avoid wounding the plant during cultivation.

2) Reduce the duration of leaf wetness by avoiding overhead irrigation, orienting the rows parallel with prevailing wind, using wide spacing within the row, controlling weeds, and minimizing crop debris in the field at time of planting.

3) Use raised beds.

4) Crop rotation may be effective but often is not because the spores are ubiquitous.

Materials Approved for Organic Production:

None currently known to be effective.

LETTUCE DROP (*Sclerotinia minor* or *S. sclerotiorum*)
Drop is also referred to as white mold or watery soft rot. The causal organism has many different hosts including weeds and vegetables such as carrots, cabbage, beans, tomatoes and celery. It is also a major disease of chicory and endive. On lettuce, the name describes the symptoms where the plant appears wilted and the outer leaves drop to the ground while remaining attached to the plant **(Photos 3.8 and 3.9)**. The fungus attacks the petioles and spreads to the center of the plant. If you pull up the plant, you will see the characteristic pure white cottony mycelia that may include black sclerotia (tiny hard black oblong capsules, which are formed of compact masses of mycelia) in various stages of development. Sclerotia drop to the soil when the host tissue disintegrates. If the conditions are favorable, the sclerotia will produce new mycelia that spread through the soil and can infect new plants. The hard sclerotia can also survive for at least 5 years

and when favorable conditions develop will form spore producing fruiting bodies called apothecia. Ascospores are released from the apothecia and germinate on host plant tissue.

Cultural Control:

1) Growers who experience only occasional outbreaks during seasons of prolonged wet weather can get satisfactory control with practices that promote quick leaf drying. Control of weeds is important. Crop rows should be oriented parallel to the prevailing wind and the plants spaced widely in the row. Drip irrigation is recommended. Avoid overhead irrigation.

2) If the disease has been severe, a minimum 5-year long rotation with non-host crops such as corn, cereal or forage grass is recommended. Shorter rotations with onions and potato can be used where the disease is less severe.

3) Flooding of the field between crops can promote spore release when no host is present and helps reduce inocula.

4) There are no resistant varieties.

Materials Approved for Organic Production:

Contans® (a biological control material) is a formulation of a beneficial fungus, *Coniothyrium minitans*, that parasitizes and kills sclerotia in the soil. It may be most beneficial applied after a year of heavy disease pressure to reduce the survival of sclerotia.

REFERENCE

Shelton, A. M. and J. D. Plate. 2003. Report on Insecticide Evaluations on Selected Pests of Vegetable Crops in New York. Cornell University/NYSAES (internal document).

CHAPTER 3 - LETTUCE

Photo 3.1 Aster leafhopper (courtesy W. Cranshaw, Colorado State University, www.insectimages.org).

Photo 3.2 Grey garden slug.

Photo 3.3 Tarnished plant bug adult.

Photo 3.4 Aster yellows symptoms (courtesy S. Vanek and NEON).

Photo 3.5 Older downy mildew lesion.

Photo 3.6 Young downy mildew infection.

Photo 3.7 Botrytis grey mold symptoms (courtesy G.S. Abawi).

Photo 3.8 Lettuce drop symptoms (courtesy G.S. Abawi).

Photo 3.9 Lettuce drop epidemic in a field (courtesy G.S. Abawi).