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MONITORING ARTHROPOD PESTS OF CONNECTICUT NURSERIES

The proper identification and monitoring of pests is the foundation of integrated pest management. Monitoring is necessary to detect the presence of pests so that action can be taken before infestations become damaging. Many pests are most susceptible to insecticides and other control techniques when they are in a particular stage of development. Monitoring enables the grower to target these susceptible stages. In addition, regular scouting reveals the presence and activity of natural enemies. This enables the grower to avoid spraying at times that will harm populations of natural enemies, and to choose materials that are compatible with biological control. Some pests of nursery plants, such as psyllids, leafhoppers, and thrips, cause damage to growing tissue that is not evident until after the pests are no longer present. If action is not taken until damage is seen, plants may already be unmarketable. In some instances it is advisable to treat plants with systemic insecticides in anticipation of damage by psyllids, adelgids, leafminers and other pests. Staff trained in basic pest scouting and monitoring can maintain quality control of plants and reduce costly pest infestation surprises.

Several tools are available to monitor pest arthropods. Nursery managers and plant protection staff will benefit from knowing which pests typically attack their crops, and from having a monitoring plan under way that anticipates pest problems. As a minimum, a scouting program consists of weekly, random examination of a limited number of plants in each house or section of the nursery. In addition to visual examination, hard-to-see insects and mites can be detected by striking foliage or flowers toward your hand or onto a plain surface. Blue or yellow sticky cards, and pheromone traps can be used to monitor certain pest groups. This fact sheet will discuss these scouting techniques, as well as the use of degree days and phenological indicators to monitor pests.

Fig. 1. A 10 x magnification hand lens and scouting form are standard scouting tools.

VISUAL INSPECTION

Leaves. Many of the most problematic nursery pests initiate infestations on the underside of leaves. These include mites, whiteflies, plant bugs, lace bugs and leafhoppers. Whitefly adults will fly when disturbed and other insects such as leafhoppers will move rapidly when the leaf they are on is turned over. This tendency to move can help the scout detect pests even at low densities. In some instances the type of movement, such as the sideways movement of the potato leafhopper, helps to identify the insect. To detect other pests, such as mites and whitefly eggs and nymphs, it is often necessary to examine the underside of the leaf with a hand lens (at least 10×). Spider mites produce characteristic webbing and yellowish patches from puncturing plant cells that offer clues to their presence. Spider mites and other types of mites are often suppressed by naturally-occurring predators in Connecticut's nurseries; it is important to monitor the presence of predatory mites, ladybird beetles, minute pirate bugs and other predators when mite infestations are detected.

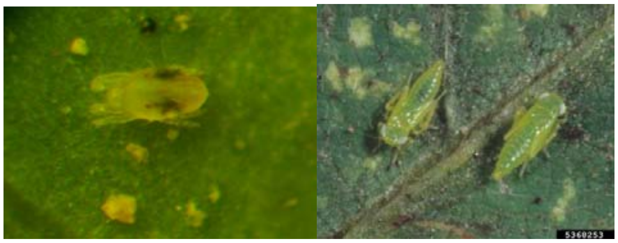

Fig. 2. Small pests such as spider mites (left) and leafhoppers (right) can be difficult to detect. Leafhopper photo: Merle Shepard, Clemson University, Bugwood.org.

Leafminers attack many different trees, shrubs and annuals of importance to Connecticut's nurseries. The shape of the mine, and whether it initiates on the upper or lower leaf surface, is often characteristic of the leafminer species. For example, mines of the serpentine leafminer are usually visible from the top of the leaf, while mines of the boxwood leafminer are most apparent from the underside of the leaf. The azalea leafminer initiates mines on the underside of the leaf, but completes its larval development in mines on the upper side of the leaf. Leafminer larvae are highly susceptible to parasitism. However, broad spectrum insecticides decimate parasitoids and disrupt biological control. Parasitized leafminer larvae appear dark in the mine. In addition to the mining damage caused by larvae, females of many leafminer species can produce a stippling damage on leaves with their ovipositor.

The feeding damage produced by certain beetles and other pests can in some instances be used to help identify the pest. Flea beetles produce small "shot holes" on the leaf; larger beetles such as the Japanese beetle produce large holes and can skeletonize the leaf, leaving only the leaf veins. Adults of the black vine weevil have small mandibles, allowing them to feed only on the leaf edge, which leaves characteristic notches. If damage by chewing insects such as beetles and caterpillars is detected and treated early, the plant may outgrow the damage.

Fig. 3. Leaf-knotching caused by adult black vine weevil. Photo: Robert Childs, University of Massachusetts.

Leafhopper feeding can result in the yellowing of leaf margins, called "hopper burn." Other piercing-sucking insects such as lace bugs and plant bugs also cause yellowing and sometimes malformation of the leaf. A variety of insects including the rhododendron gall midge can cause yellowing and distortion of growing tissue. It is important to detect the presence of these pests early, and not wait for the appearance of yellowing or leaf distortion to address the problem. Yellow sticky cards and visual examination can be used to monitor many piercing-sucking insects and flies such as midges.

Another very distinctive form of injury is caused by feeding of thrips or mites inside of buds. When feeding takes place on the meristem, the result can be dwarfing or death of the subsequent growth. One example is juniper tip dwarf mite, an eriophyid mite. Broad-leafed plants fed upon by cyclamen and broad mites (members of the tarsonemid mite family) cause leaves to be dwarfed, thickened, and cupped when they later expand. Mites feeding in such protected locations may only be detected by careful examination under a dissecting microscope, whereas flower thrips can be disclosed by breathing on the affected flower. The carbon dioxide in breath disturbs thrips so that they exit their refuge.

OTHER PLANT PARTS

Depending on the host and the behavior of the scale species, scales can be found in bark crevices, twig crotches, leaf veins or other locations on the plant. Aphid infestations often originate on the growing points of plants. Most thrips feed on pollen, and can be first detected in flowers. Several types of wood boring beetle and moth larvae produce holes in trunks and limbs from which sawdust and frass (excrement) are expelled; wood boring insects can also cause bark to discolor and exude sap.

EVIDENCE OF PESTS

Most pests can either be found directly, while feeding on the plant, or shed skins of immature stages can be used to identify the pest. Some pests, such as cutworms and the Asiatic garden beetle only feed at night and so are not directly detected through routine scouting. As mentioned above, feeding damage and in some cases the frass of pests is characteristic and can be used to diagnose a problem when the pest is not immediately detected. Lacebugs can leave varnish-like specks of frass on the underside of leaves. Thrips feeding damage produces shiny abraded patches on the leaf or petal, and thrips often leave characteristic dark specks of frass in the areas where they feed. Whiteflies, aphids, soft scales and mealybugs all produce honeydew, a sugar-rich excretion which makes leaves sticky and shiny. A fungus called sooty mold often grows in honeydew, turning the leaf surface black.

Fig. 4. Varnish-like frass of lace bugs. Photo: Rose Hiskes, Connecticut Agricultural Experiment Station.

STRIKING THE PLANT TO DISLODGE SMALL INSECTS

Thrips, mites, and recently hatched crawlers of scale insects and mealybugs can easily escape detection. Routine striking of foliage and flowers toward a light colored surface can reveal the presence these and other tiny, cryptic pests, such as leafhopper, plant bug and lace bug nymphs. You can use the palm of your hand, the back of a scouting form or clipboard as a surface on which to dislodge insects. Insects and mites can then more easily be examined against a plain light surface using a hand lens. It can be useful to have both a dark surface and a white surface available for this sampling method. Most pests will contrast with and are best seen against a dark surface. Holding a clipboard so that the light shines obliquely across the surface can make mites or other small pests more visible as they cast a very long shadow on the collection surface. It is recommended that scouts carry flagging tape to mark damaged or infested plants. This makes it easier to return to the infested plant.

Yellow sticky cards can be placed in and around greenhouses and nurseries, and in trees, to monitor a range of pests and facilitate their early detection. Whiteflies, thrips, winged aphids, leafhoppers, leafminer adults, and fungus gnats adults can all be monitored in nurseries using yellow sticky cards. Thrips are especially attracted to blue sticky cards. Adults of the birch leafminer and leafminers attacking holly can also be monitored using yellow sticky cards. In nurseries, yellow cards should be placed toward the top of the plant canopy and be changed every week. If monitoring for fungus gnat adults, the cards should be placed horizontally and close to the media surface It is important to remember that yellow sticky cards are also attractive to beneficial insects such as parasitic wasps and syrphid flies, and will kill them when they become stuck.

Fig. 5. Yellow sticky traps can be used to detect the winged stages of certain pests such as thrips and fungus gnats.

PHEROMONE TRAPS

Insects attract mates by releasing chemicals called sex pheromones. Synthetic versions of pheromone attractants are available for many pest insects and are used in traps for monitoring. The pests of woody ornamental plants for which pheromone-based traps are available include the peachtree borer, the lilac/ash borer, obliquebanded and redbanded leafrollers, the Nantucket pine tip moth and the European pine shoot moth. Clearwing borer pheromones, such as for the peachtree and lilac borer, often attract more than one species, and so the scout needs to be able to identify the trapped male moths [use "A Guide to the Clearwing Borers (Sessiidae) of the North Central United States, North Central Regional Publication No. 394 (1991)" for identification]. In addition, pheromone traps are available for Japanese beetle, oriental beetle, elm bark beetle, and San Jose scale. Many more traps are available from commercial distributors. Pheromone traps have an effective field life of about two weeks to two months, depending on the lure. Pheromone traps only indicate that a pest species is present in the area. They usually cannot be used for estimating densities of pests, damage to plants, or the need to spray.

Fig. 6. Different types of pheromone and bait traps are available.

INDICATOR PLANTS

Most pests have strong preferences to feed on certain species or varieties of plants. This host preference can be used to facilitate detection of pests in nurseries. For example, black vine weevil adults readily feed on the northern willow herb weed (*Epilobium angustifolium*) and will feed on this plant long before feeding on rhododendron foliage. The presence of notched leaves on this weed is a good indication that black vine weevil adults are active. Other hosts that could be used as indicator plants for black vine weevil are *Heuchera*, *Bergenia* and *Epimedium*.

Nursery growers can also use certain varieties of petunia or fava beans as indicator plants to monitor for symptoms of impatiens necrotic spot virus, a serious disease of many herbaceous plants that is vectored by western flower thrips.

DEGREE DAYS

The term degree day refers to the average amount of heat that builds up above a baseline temperature over a twenty-four hour period. This information can be used to monitor pests because the developmental rate of arthropods is determined directly by temperature. The number of degree days needed for developmental events such as egg hatch and adult emergence has been determined for many insects. In temperate regions, 50° F (10° C) is generally accepted as a useful baseline threshold from which to begin calculating the accumulation of degree days for most insects and mites. For this reason, information on degree day accumulation can be used to calculate when action such as insecticide applications or monitoring should be initiated for a given insect. Degree day information is available to predict egg hatch of certain scales, mites, adelgids, caterpillars, sawflies and other important pests of Connecticut nurseries. Degree day information is also available to predict the emergence of adults of certain leafminers and borers. There is more than one method for calculating degree days. Consult the references listed below for further information on degree days.

Pests harbored with plants protected from cold winter temperatures, such as in hoop houses, can be expected to have earlier seasonal development than those overwintering without protection, and so degree day calculations will not match pest developmental stages, unless the calculations are made from measurements taken from within the protected environment.

PHENOLOGICAL INDICATORS

Phenology is the study of the relationship between climate and recurring biological phenomena. Flower production, like insect egg hatch, is a phenological event that is directly determined by degree day accumulation. A phenological indicator is a conspicuous event in nature such as flower production that enables an observer to track the accumulation of degree days without engaging in time-consuming calculations. The number of degree days needed to achieve first bloom or full bloom of many plant species has been determined. When information on flower production for a specific plant species corresponds with degree day requirements for egg hatch or adult development of specific pests, the flowering event can be used to help determine when monitoring or insecticide applications should be initiated for those pest species. For example, flower bloom of Japanese quince, saucer magnolia and Japanese flowering cherry in May coincide with egg-laying and first egg hatch of the birch leafminer. Bloom by these plants serves as a phenological indicator for the appropriate time to spray for birch leafminer adults and young larvae. It is important to emphasize that while degree day information and phenological indicators can help fine-tune a monitoring program, there is no substitute for weekly inspection of plants.

ADDITIONAL RESOURCES

For pest-specific information on monitoring pests, including the use of degree-days and phenological indicators, consult the following references:

The Connecticut Agricultural Experiment Station Arthropod Database. http://www.ipm.caes.ct.gov/

Herms, D.A. 2004. Using degree-days and plant phenology to predict pest activity. In: V. Krischik and J. Davidson, eds. *IPM (Integrated Pest Management) of Midwest Landscapes*, pp. 49-59. Minnesota Agricultural Experiment Station Publication SB-07645, 316 pp.

New England Greenhouse Floriculture Guide. A Management Guide for Insects, Diseases, Weeds and Growth Regulators. 2009-2010. New England Floriculture, Inc., and the New England State Universities.

University of Massachusetts. 2008. Professional Management Guide for Insects, Diseases, and Weeds of Trees and Shrubs in New England. UMass Extension. Landscape, Nursery, and Urban Forestry Program, Amherst, MA.