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VISUAL IDENTIFICATION OF INSECT DAMAGE TO TREES AND SHRUBS[1]

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Abstract. A simplified method of determining insect damage to trees and shrubs is explained. Rather than a scientific determination of the species attacking the plant, the method describes the mode of the attack. Five different ways in which insects injure plants are discussed.

From time immemorial, man has been fearful of those things unknown or not understood. An old Scottish prayer states: "From ghoulies and ghosties and long-leggety beasties and things that go bump in the night, Good Lord deliver us."

Many are understandably fearful due to a lack of knowledge in dealing with insect pests of trees and shrubs. The study of Entomology can be a rather detailed undertaking. Some have tended to ignore insect pests as a whole, hoping that somehow, along with the ghoulies and ghosties and the long-leggety beasties, they, too, would simply disappear. Too many times, this does not occur.

Insects are found in every crack and cranny imaginable and are the most numerous of all animal life in the world. There are over 750,000 known insect species, constituting some 75% of all animal life known to science. It is conceivable that few of us would be able to recognize most insect pests that fly by. However, don't despair, it is not that important in insect control to recognize all insects that infest trees and shrubs. The important part is to narrow this information down to what damage is being done. Most controls are based on the type of damage an insect does, no matter what kind of insect it is.

Sucking insects generally are controlled differently than chewing insects. It narrows down to recognizing one of five methods of injury. Insects damage plants either by sucking, rasping, chewing, leafmining, or boring. Obviously those which are leafminers or borers chew but are usually treated differently so we will consider them as producing distinct types of injury to plants.

Now that we have narrowed the field down from 750,000 to 5, let's study those 5 a little more closely. Sucking insects obviously take sap from the plant and their presence is often accompanied by a sweet sticky fluid called "honeydew." This is not insect excrement but rather an excess of sweetish excretion which the insect was not able to use as food and which is discarded onto the leaves and bark. This honeydew

Mealybugs on leaf, an example of sucking insects. While "woolly" material is wax produced by the mealybugs.

is often covered by a black-appearing sooty mold fungus which grows on the honeydew. Associated with the honeydew-sooty mold complex are many insects including a variety of species of ants. One rather sure conclusion that can be readily reached is that when ants are observed climbing into trees, sucking insects giving off

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honeydew are almost sure to be infesting those trees (unless they're feeding on nectar). Such insects are usually either aphids or soft scales since the armored scales apparently emit little, if any, honeydew.

Damage by sucking sap from a plant by one insect is infinitesimally small. When hundreds to sometimes thousands of sucking pests are present, the plant can, and often does, show the strain from such an attack. Most sucking insects do not crawl much, seemingly content to stay in one spot once they have settled. Control measures are a little more demanding then for those insects which do not move about. Thorough coverage with insecticides is essential for sucking pest control. To skip an area on the plant only leaves a source of reinfestation, once the control measures have worn out. Insecticides of short residual duration are permitted here since the insects do not move much. Except for aphids, leaf- and treehoppers, cicadas and such, adults usually will not be flying in to reinfest. Generally, with waxy insects, such as mealybugs and some adelgids, extra wetting agent should be used in order to wet the wax. Insects with heavy wax on the bodies require more wetting to enable the insecticide to get through the wax to the insect body to be effective.

Rasping insects give the plant a "silvery" appearance since the rasping action seems to collapse some surface cells, giving the leaf a glistening look. Distortion of the leaves usually results from this rasping action. Generally, thrips are those insects involved in the rasping feeders. Thrips can also be carriers of viruses and it is to one's benefit to try to control them.

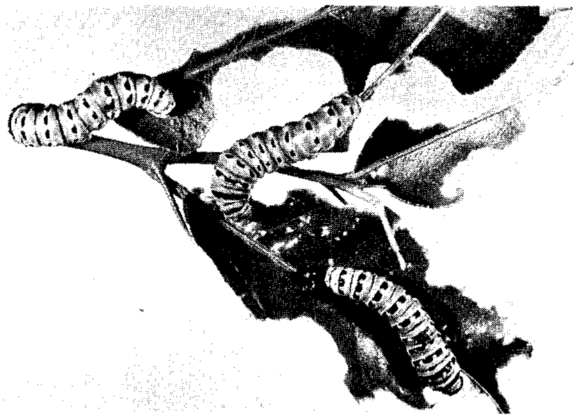
Chewing insects are generally the ones which disturb the tree owner the most since the damage can be readily seen. With injury from leaf chewing insects, it is often hard to tell whether the damage was done recently or several months ago. It is best to do a little detective work here. The Indians called it reading the signs. Is the raw edge of the leaf still moist or has it hardened off? Has it turned brown and, if so, how far back has the necrosis developed? Depending upon local weather conditions, leaves that have been recently fed upon will show the damaged edge to be moist. If the injury is several days old, the edge will have hardened off. If necrosis shows, forget trying to control the pest, the damage may have been done last month, or last year. This simple method of detection will save a lot of time in treating an insect that may no longer be in the area. It isn't necessary to be present at all times in order to tell when the damage has taken place. Learn to read the signs.

Leaf on right shows adult thrips. Note shiny areas of leaf or "silvering" effect from feeding. Leaf on left shows mostly fecal spots from thrips.

Leaf or needle consuming insects may be open feeders, feeding on rolled leaves from either the inside or the outside, or feeding from a hole in the leaf working their way to the outer edge. Either way, the general appearance of the plant is damaged.

In treating leaf chewers, pay special attention to covering undersides of the leaves for larvae and under the bark plates for any adults hiding there. For leaf consuming insects, an insecticide with longer lasting ability would be best since adults may fly in at a later time to lay eggs.

Leaf- or needleminers present a special problem. Even though they can't usually be seen, at least the damage is very apparent. The larva doing the mining is quite protected from insecticide application to the leaf. Most leafminers are either lepidopterous (moths) or hymenopterous (sawflies) for the most part. The egg is laid either on the surface of the leaf or needle, or inserted into the leaf or needle tissue. The newly hatched larva will usually eat right into the leaf, never exposing itself to the outside environment.



Typical example of damage caused by leaf chewing insects.

Sometimes the first instar (newly hatched larva) will walk about over the surface, thereby exposing itself to insecticide attack. The young larvae usually are so small that one is not aware of their presence until the mine has been started, thereby protecting themselves from being sprayed.

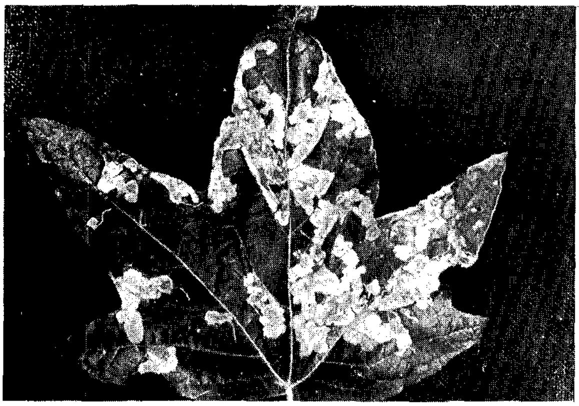
Mines come in a variety of shapes and sizes. They may be serpentine and remain serpentine or broaden into a blotch, depending upon the species mining. They may be very small or very large or somewhere in between. All mines are very visible since they are of a different coloration than the leaf. Leafminers and all other insects' mandibles (jaws) operate sideways, like scissors, rather than up and down like most other animals. In this manner, miners are able to cut away all but the very thin upper and bottom leaf layers and eat the rich chlorophyl-bearing material sandwiched in between. Most leafminers' life cycles last from a new weeks to a few months. Miners of needles sometimes go a year or so before emerging as adults.

One sure method of telling whether a leafmine is still occupied by the miner is to check the stiffness of the mine surface. If it (either top or bottom) is soft and pliable, the miner is still in the mine. If the mine is brittle and dry, be assured that the occupant has moved on, either by pupating or emerging as an adult. Minute inspection with a very sharp knife blade will help decide if anyone is at home in the needle. Needleminers are different. Some stay with the needle to pupate, some leave and pupate elsewhere. Moths almost always pupate inside the mine whereas sawflies drop to the ground and pupate in the duff or in the soil.

Leafminers in the leaves have been difficult to control, as indicated, since they are protected by the thin leaf covering of the mine. Once the adult is out, contact is simple with an adequate insecticide. Rather precise timing is required to determine the adult emergence. Although many leafminers are controlled by systemics, they have not proven to be the complete answer as yet. Systemics are not overly effective in leaf consumers either, probably because of the amount of bulk the larvae ingest. Systemics should not be ruled out, however, because they are constantly being upgraded and new ones tried.

Borers are a group unto themselves. Some are coleopterous (the beetles), some lepidopterous (the moths), some hymenopterous (the bees and wasps). The term "borer" usually indicates an insect whose immature stage is spent boring into wood. They have well-developed mandibles for tearing at the wood. They usually have a longer life cycle, taking a few months to over 10 years to emerge as adults, although an average is probably one or two years. Borers come in all sizes, from very tiny to very large.

Borers start out as eggs like all other insect life. Most eggs are usually deposited on the bark, in crevices, or in tunnels, just beneath the bark surface as in the bark borers. Borers do considerable damage to the plant. They either



Light areas on the leaf are mines from leaf miners.

structurally weaken or actually cut off the flow of food and water by their feeding pattern at the cambium junction, as in some of the bark beetles. Dutch Elm Disease can result from certain borer attacks. Although the bark beetles do not continuously carry D.E.D. fungus spores, they carry them enough to be a serious menace. Some borers can be detected in the same manner as the leafminers. If the tunnel is moist, the larva is still working, if the tunnel is dry, the larva has already emerged as an adult.

In the case of lepidopterous borers, emergence of adults will be announced by the presence on the outer bark of pupal skins sticking part of the way out of the emergence hole in the bark. Freshly emerged pupal skins are soft and pliable. Old pupal skins are brittle but it doesn't take long in a dry, hot climate for fresh pupal skins to become quite brittle. Once again, read the signs. If there are pupal skins, look to see if there are many. Find out, if you can, how long they have been there. Keep notes stating when the emergence was first noticed, whether it be pupal skins, bark borer emergence holes, or whatever. In that way, next year you will know when to be on the lookout for them.

If the emergence holes are without pupal skins, rather large (1/4 to 1 in.) and roundish-oval, very probably the insect was a member of the Cerambycidae. This is the family of long-horned beetles, named because of their long antennae. If the holes are large and flattened, the insect probably was of the Buprestidae, the family of so-called flatheaded borers or metallic wood boring beetles. Actually, the head itself is not why the larvae bore flattened tunnels, but because the thorax, or shoulder area, is much wider than it is high, requiring the broad flat tunnel to move through. If the emergence holes are very small and round, bark beetles are involved. If large (1/4 in.) and round, wood wasps may have been present.

Bark beetles may go through a life cycle in several weeks to several months whereas if you have cerambycids or buprestids, these usually require at least a year and sometimes much longer to complete a life cycle. A life cycle of any insect is composed of stages from egg to adult

A limb split in half to show effects of a borer. Note the immature borer (larva) in the lower right corner.

(which is capable of laying eggs). Life cycles differ in each insect in that some insects go through in a matter of days (as in the common housefly), and some take years to complete (as in some of the wood borers). If the tree has several cerambycid or buprestid emergence holes in it, it is a good probability that the infestation has been going on for quite a long time for these insects do not usually attack *en masse,* but usually one or a few at one time. Holes in the bark, of course, do not fill in and will accumulate over the years. Once again, it's reading the signs that saves you time (and money).

Controls are difficult for borers of any kind. The systemics don't seem to work in most instances and there seems to be no good way yet of killing the larvae inside of the tunnels in the wood or bark. The only stage remaining for control purposes is the adult stage. Since the rigid governmental controls of the chlorinated hydrocarbons (DDT and its relatives) there are few insecticides with a long enough residual to use with much effect. Lacking a long residual insecticide, the spray operator must somehow gear his operation to be better timed with adult emergence. One cannot afford to go back again and again spraying trees with an insecticide of one week's residual effect (as most of the phosphate insecticides are) when the adult emergence may not occur for several weeks. To successfully control borers at the present time, it is essential to have a borer killing insecticide on the bark at either the time of adult emergence or before egg laying begins. Particular attention should be paid to spraying the upper canopy since many adults roost there. Most larvae emerge from the egg at the point of egg-bark contact and are never exposed to insecticides applied to the bark. Also, most present day insecticides are seemingly not effective against the insect egg itself.

This paper was not prepared to be a substitute for a short course in entomology. Rather, it is only a brief discussion of types of insect injury to trees and shrubs. If you find that you are stimulated and are interested in learning more, so much the better.

The controls have not been specifically discussed, either in material, modes of application or timing. Since controls change so rapidly and since geographical location tends to regulate timing of any application of materials, it is suggested that the local county agent, farm advisor or pest control advisor be contacted to learn more of the specific details involved. Just remember the axiom of good pest control is: The right material at the right place at the right time.

If the ghoulies and ghosties and long-leggety beasties and things that go bump in the night are still keeping you awake, you've got a problem.

All photos are by Leland R. Brown, Department of Entomology, University of California, Riverside, California.

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ABSTRACTS

Heidmann, L.J. 1976. **Frost heaving of tree seedlings.** USDA Forest Service Tech. Rept. RM-21, Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado.

Frost heaving of tree seedlings is more serious among seedlings less than 1 year old than among transplanted stock. It appears to be a surface soil phenomenon, and occurs because of a segregation of soil water which freezes into layers or lenses of ice. Lens formation causes an uplift of the surface soil and the tree seedling. Upon thawing, the tree remains in an extruded position on the soil surface while the soil recedes to approximately its original level. Segregation of the soil water occurs within the total matrix because of supercooling of the water in smaller soil pores and the water adsorbed on soil particles. The difference in freezing points provides the energy necessary to draw water to the ice lens and to lift the surface. Segregation of soil water is related to soil permeability and negative pressure on the water. A silty soil is more likely to heave because the right combination of permeability and tension can be developed. Heaving in a clay soil is determined to a great extent by the type of clay and the nature of the ions adsorbed by the clay particles. Heaving can be controlled by lowering the freezing point of the soil water, by restricting the water flow to the freezing front, or by cementing the soil particles together. Chemicals such as calcium chloride have been successful in reducing frost heaving by lowering the freezing point of the soil water. Dispersing agents, mainly sodium compounds, reduce heaving by plugging the soil pores, thus limiting water movement to the freezing front and subsequent growth of ice lenses. Cementing agents make the soil less frost susceptible by reducing the proportion of finer soil particles (clay and silt).

Lofgren, D.E. 1976. **How to write maintenance specifications for tree and shrub care.** Grounds Maintenance 11(6): 20.

Suggestions are given for maintenance specifications on location, scope of work, general instructions, new plantings, established plantings and times of operation.