

ENTOMOLOGISTS estimate that there are as many insects in every square mile of earth's surface as there are human beings on the whole planet.

This fact would not be hard to convey to a suburban homeowner whose lawn is infested with insects. When these hexapods get too plentiful in turf, beautiful grassy areas may be severely blighted. Enter the contract applicator. The market is wide open for services of competent CAs who diagnose and treat ailing turf areas such as golf courses, school and hospital lawns, cemeteries, parks, and roadsides, not to mention the huge home lawn demand.

To help CAs better understand



Infamous Japanese beetle, shown here in a remarkable close-up of an adult, is a prime ornamental pest; larva destroys lawns, and is probably the best known lawn insect among the general public. Shiny metallic coloration of the Japanese beetle makes this eastern pest easy to spot.

How to Identify and Control Insect Pests in Turf

the pests with which they are dealing and how to control them best, *Weeds and Turf* surveyed extension services of state universities from 8 different geographical regions to find variations in pest prominence and control recommendations.

How Insects Damage

Understanding insect habits helps explain why techniques may vary from one pest to another. Most damage results from feeding activities. Beetle grubs eat grass roots, but moth and butterfly larvae feed on above-ground leaves. Other pests, such as chinch bug nymphs, feed by piercing stems with their mouthparts to suck plant juices. There are some pests, such as ants and the cicada killer wasp, which do not destroy grasses directly, but deface lawns by burrowing in turf. It is easy to see that controls, though chemicals may be the same, will differ from pest to pest.

In general, to control pests in soil, insecticide is applied so that it penetrates the ground to the zone where insects feed. Apply insecticides with sufficient water in a spray to soak the chemical into the soil. If dusts or granules are used for smaller jobs, thoroughly water turf after application.

For leaf-feeding species, if granules or dusts are used, water lightly to wash insecticide down around the crown of the plant where in-

sects feed. Completely irrigate and flush off insecticide a few days later. Spray treatments are similar to soil pest control treatments, except that the object is not to wash insecticide into the soil but rather to have it remain on the soil and leaves. Don't water again until necessary. Usually spray treatments for leaf feeders last for only 1½ to 2 months.

Turf insecticides are usually formulated from chemicals which have proved their worth against other insects. Today, however, there are lawn insecticides which were originally intended for nematodes and crabgrass (V-C 13 and Zytron respectively. Zytron has not yet been labeled for control of lawn insects).

While turf insecticides may be obtained in dust or granular form for small jobs, most economical for the CA are the spray applications, provided equipment is avail-

able. Sprays can be prepared from either wettable powder or emulsifiable concentrate. Both require occasional agitation because the insecticide is not completely soluble in water.

All of the popular lawn preparations are products of organic synthesis. Either the chlorinated hydrocarbons such as DDT, heptachlor, and chlordane, or organic phosphates such as parathion, Diazinon, Ethion, and Trithion, will give good control when used properly against the right target pests. These chemicals are toxic to insects and humans alike and must be handled with respect, knowledge, and care.

Beetle Grub Control

Several hundred species of beetles (family Scarabaeidae) infest soils in the larval or white grub stage. Some of these are: May Beetle, June Beetle, Japanese Beetle, Asiatic Garden Beetle,

Lawn sprayers will soon find their busy season upon them, so *Weeds and Turf* begins this month a two-part article which defines the basic elements of turf insect control. This in-depth research paper will be concluded next month with a discussion of chinch bugs, lawn moths, and miscellaneous invaders.



Japanese beetle is spreading relentlessly westward despite strict quarantines. Adult stage, shown here in comparison with a millimeter rule, ruins flowers and foliage by its feeding.

Oriental Beetle, Masked Chafer, Rose Chafer, White-fringed Beetle, Green June Beetle, and the Rhinoceros Beetle. Turf grubs are a major problem in New England, Midwest, and Central Plains states. They range from the East Coast as far west as Kansas, and south into Florida, although their relative pest classification is lower in importance in the southern states.

Typically, eggs are laid about 5 inches deep in the soil at about 25 eggs per female. Eggs hatch in 2 to 3 weeks. Larvae feed on roots and underground plant parts, pruning them severely at infestation levels. Greatest damage is noticed when weather becomes hot and dry; grass withers from lack of water uptake. By autumn, larvae are about 1 inch long. One can readily recognize them by their characteristic "C" shaped body posture. Grubs have a dark head and three pairs of legs on the forepart of their body. Most of the species remain in the soil for 3 years; some spend only one year; while a few take 4 years to develop.

During warm months, grubs can be found 2 to 3 inches deep in soil; in winter they migrate below the frost line where they hibernate in a cell. Some species pupate in early summer and adults develop in late summer, but they do not emerge until the following spring when temperatures rise into the 70's again. This phenomenon of adults remaining in the soil is unexplained.

Test for Grubs

If grubs are suspected in a lawn, a test may be made to confirm this before treatment. With a knife, cut an area in the sod about 1 foot square and 2 to 3 inches deep, leaving one side attached

in hinge fashion. Roll back the sod and probe the dirt beneath and dirt clinging to the mat. Sifting may also help. Grubs may then be seen and counted. Repeat this test several times in other sections of the lawn. Average the number of grubs seen in all tests; if it figures 6 or more per square foot, an insecticide should be applied.

Standard chemicals for control of turf grubs include chlordane, aldrin, heptachlor, dieldrin, and in some areas Diazinon. Chlordane usually is applied at 1¼ pounds *active ingredient* per 5000 square feet, though the rate may vary in the South to 2 pounds *active* per 5000 square feet. Aldrin, dieldrin, and heptachlor generally range around ⅓ pound *active* per 5000 square feet.

In areas such as the South where some chlorinated hydrocarbons may not be effective, use of 1% parathion has given successful control of grubs. Care with this organic phosphate is stressed because of its hazard both to user and to children and pets who may use a lawn for a play area.

Insecticide labels should always be checked for proper application rate. Sufficient water should be used to insure washing insecticide into the soil. Fifteen gallons for 1000 square feet is generally recommended; somewhat more may be needed on heavy clay soils. Strive for even distribution of pesticide over turf. Beetle grub control may take 6 months to become completely effective. "Guarantees" of time periods for continued control vary from state to state. Some from Ohio claim 10 years effective control; Connecticut offers a conservative 3 to 5 years; and Indiana says grubs should be

controlled 4 years with one good application. Florida reports that control is not as long as northern states, but white grubs are not considered a major turf pest there.

On the eastern seaboard where the Japanese Beetle is a prominent pest, biological control has been used against the grub stage. Spores of the bacteria, *Bacillus popilliae*, or milky disease, are distributed over an area of turf. This disease is specific for the Japanese Beetle and will kill a large portion of grubs. Some will live to reproduce the disease and infect more grubs as the population grows from year to year. Milky disease does not kill all beetle grubs, but keeps their numbers at a tolerable level for turf. It is reported most effective along the central coastal states.

Miscellaneous Beetles

Wireworms (Elateridae) are larvae of what are called click beetles. Many species are distributed throughout North America. A common economic pest of agricultural crops, these beetles also thrive in cultivated turf where they attack grass roots and basal portions of stems. Damage results when they bore into plants causing them to wither.

Adults are those beetles which click and jump when turned on their backs. Clicking throws them into the air; the desired effect is for them to land on their feet.

Controls use the same chemicals as applied for white grubs with one exception: chlordane needs only



White grub is the name for larvae of scarab beetle. These widespread pests have voracious appetites and can ruin a lawn so that turf can be rolled up like a rug. Note strong mouthparts, curled position, legless hindparts.

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By HOUSTON B. COUCH,
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May 1962. 6 x 9. 304 pages. \$10.00

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½ the dosage for effective wire-
worm control.

Another family of beetles which is very damaging in some years, especially in the South, billbugs (Cucurilionidae), are sometimes called snout beetles or weevils. Billbugs, as their name implies, have a long bill or snout in the adult stage. At the end of this snout are their powerful chewing mouthparts, which they use to chew into grass stems near the base. Adult billbug feeding causes stunting and deformities in plants.

Larvae damage root systems of turfgrasses, mostly bluegrass and redtop in general, Bermudagrass in the Southwest, and zoysia in the Southeast. Their burrowing into stems and roots causes lawns to bleach and wither.

Billbugs in their many species are distributed throughout the United States. They vary in color from clay yellow to reddish brown to jet black, and are generally about ¼ inch long. Control for most of the U.S. consists of using chlordane at twice other beetle grub dosage or, in other words, 40 fluid ounces of chlordane 75% (8 pounds per gallon) emulsifiable concentrate per 5000 square feet. Florida, although not much billbug damage was reported there last year, recommends 4 pounds active (maximum) of V-C 13 per 5000 square feet, or Trithion at 12 ounces active ingredient per 5000 square feet.

Depending upon whether the larval or adult stage is the target, applications should be soaked into the soil somewhat, or left on leaves respectively.

The fungus, *Beauveria bassiana*, originally introduced into United States to control the corn borer, also kills billbugs. This control, however, occurs naturally and is not commercially available.

A number of lepidopterous larvae cause extensive damage when present at infestation levels. They feed directly on stems and leaves of grasses.

Sod Webworm Control

Sod webworms (subfamily Crambidae) are pests which are damaging throughout the United States, as indicated by our survey. "They are most common in housing developments in California," according to Professor Andrew S.



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Deal of the University of California at Riverside. "Lawns are most certain to be damaged by sod webworms unless chemical treatments are applied," he adds.

"Sod webworm larvae are the most damaging species of caterpillar in Florida," reports Professor S. H. Kerr of the University of Florida at Gainesville. They are $\frac{1}{4}$ to $\frac{3}{4}$ inch long, chunky, and usually spotted and coarsely haired. Larvae construct tunnels of pieces of grass and excrement, and line them with silk which they spin. Tunnels are built close to the surface near bases of grass plants. Webworms hide in their tubes in daytime and forage for food at night. They chew off blades of grass and sometimes carry the pieces back to their burrows. Resultant damage resembles dollar spot fungus disease somewhat, being irregular circles of brown or bleached areas.

"We are currently having one of the heaviest sod webworm outbreaks in home lawns that has been reported. They were very destructive during late summer and early fall of 1962," Professor Dave Matthew of Purdue University, Lafayette, Ind., told us.

Sod webworms prefer new lawns, particularly of bluegrass, bentgrass, and fescues. Damage appears in late, hot summer months when home lawns and golf greens are well kept and watered, but other turf is brown and dormant. The moths prefer succulent growth for egg laying and tend to accumulate in well-kept turf.

Adults, $\frac{1}{2}$ to 1 inch long, are pale

Typical resting place of the sod webworm in turf is shown encircled in green. Note ravaged blades of grass around the insect.



Pencil point illustrates size of miller of tropical sod webworm. Larvae chew up expensive areas of turf annually. Adults will emerge from smooth, bulletlike pupae. Note chewed grass leaves and frass or excreta in culture. All three stages may be seen at once in southern United States.

or buff moths commonly called "millers." They are jerky fliers and have a projection on their heads formed from extending mouthparts. From this appearance they are also called snout moths. Millers can often be seen flying over a lawn in early evening during mid-summer. Females at this time drop eggs at random in the grass. There are normally 3 generations a season, but there may be 4 in California and Florida.

Pyrethrum Test

A test for species which hide in soil during daytime, such as the sod webworm, may be made by sprinkling the edge of an area suspect of infestation with 1 gallon of water containing 1 tablespoon of pyrethrum extract. This treatment will irritate the larvae and force older worms to the surface where they can be seen and positively identified.

Control measures are for a leaf-feeding type. Most widely used against sod webworms are DDT and toxaphene. From 6 to 9 ounces active toxaphene per 5000 square feet gives control in Florida. DDT, from 10 to 14 ounces active per 5000 square feet, gives control in the North at the lower rate and in the South at the higher one. Aldrin, dieldrin, and heptachlor also give control at $\frac{1}{3}$ pound active per 5000 square feet. Chlordane at 9 ounces active per 5000 square feet ($\frac{1}{2}$ the wireworm rate) is sometimes used in the North.

In addition to choosing a proper

insecticide for each area, there are other tricks to sod webworm control. Insecticides should be applied in the late afternoon when turf is relatively dry. Lawns should be mowed and watered prior to treatment and given a day or two to dry out. After spraying, turf should not be watered for at least another 24 hours, preferably 48 hours.

If a dry application is made, recommendations are to water lightly to wash insecticide down around the crowns of grasses. Irrigate after 2 or 3 days.

In Kansas, where sod webworms are the "principal problem," Professor D. E. Gates of Kansas State University at Manhattan summed up difficulties and offered controls for his region as follows: "Control problems appear to be in keeping the insecticide in the proper place rather than a failure of the material. The area of feeding of sod webworms at ground surface makes it difficult to hold the materials in the proper area. If left exposed to sunlight, the materials are destroyed rapidly. If they are soaked in, another flight of moths lays eggs for larvae above the treated zone. Apparently our best recommendation is to soak the soil and apply the insecticide to the surface with very little watering in. A treatment in June, July, and August seems to be needed under the heavy moth pressure we are experiencing this year (1962)."

Continued next month