**Left, billbugs of concern** *include the bluegrass billbug (small) and the Hunting billbug (larger). Below, the Green June Beetle adult.*

# Turf Insect Control

**by Harry D. Niemczyk**, Ph. D., professor of entomology, Ohio State University, Wooster, OH and **Patricia Cobb**, Ph. D., extension entomologist, Auburn University, AL.

Entomologists and turf specialists, by placing attention on turf varieties as well as turf pests, are discovering new control methods.

Dr. Reed Funk of Rutgers University discovered a species of fungus (called an endophyte), growing within certain ryegrasses and tall fescues. The endophyte imparts resistance to feeding by certain insects.

Further research has also identified turfgrass varieties that are highly susceptible to insect injury. Avoiding use of susceptible turf varieties and encouraging use of varieties with some resistance will reduce the need for insecticides applied to turf.

Meanwhile, insecticides remain the primary means of control as research proceeds on alternatives and supplemental methods of controlling insect damage to turf.

## Keys to control

Knowing the seasonal occurrence and damage of all life stages of each pest common to your area is a major step toward effective control. This information, combined with the characteristics of the particular turfgrass cultivar and the known length of the residual of the proposed insecticide, makes insect control scientific rather than speculative.

Still, there will be twists to confuse any control program, such as soil type, heavy thatch, weather, and poor application uniformity.

Differences between the cool- and warm-season zones and among mountains, plains, and coastal areas, also result in variations in pest species and their seasonal occurrence. Knowledge of each pest's life cycle in your area is often as important as the choice of insecticide.

The purpose of this guide is to point out some major pests to watch out for in cool- and warm-season turfs in 1985, when their vulnerable stages occur, and some insecticides that may be used. No endorsement of named products is intended nor is criticism implied for those not mentioned.

## LATE WINTER (March)

**Chinchbugs and Billbugs**—In northern zones chinchbugs and billbugs both overwinter as adults in thatch or sheltered sites near buildings. They can become active during warm days in March. Infestations of the hairy chinchbug and bluegrass billbug occur in zoysia, Kentucky bluegrass and fine fescues.

In southern Florida, the southern chinchbug is active throughout the

year. Most varieties of St. Augustinegrass and some bermudagrasses are damaged by southern chinchbugs. Zoysia and bermudagrass are more likely to be infested by the hunting billbug.

When summer damage from chinchbugs and/or billbugs is expected in cool-season areas, a preventative application of liquid or granular Dursban® (chlorpyrifos-1 lb. AI/acre), diazinon (2.5 to 4 lb. AI/acre), or Oftanol® (isofenphos-2 lb. AI/acre) may be made as soon as these insects begin to move about. Treatment at this time controls adults before eggs are laid. If spring is early, these applications may be needed as early as the second week of March. During a late spring, applications may need to be delayed until the last week of March.

Retreatment for chinchbugs in mid to late summer may be necessary if reinfestation from adjacent untreated areas occurs.

Preventative treatments may not be successful in southern Florida where the southern chinchbug has multiple generations and is resistant to most organophosphate insecticides in some areas. In southern Florida, where resistance is a problem, the insecticides Pydrin®, Pounce®, or Baygon® have been substituted for organophosphates. Replacing susceptible turf varieties with Floratam St. Augustinegrass, a variety highly resistant to the southern chinchbug, will provide excellent natural control.

**Grubs**—The larvae of this group of pests normally overwinter six inches or deeper in the soil. If spring comes early, grub activity can be expected along with skunks and racoons who will tear up the turf searching for the grubs. Moles, who feed on grubs and earthworms, also become active at this time.

Application of Oftanol® (2 lb. AI/acre) during March when frost is gone from the ground, provides control of overwintered grubs as they return to the surface. In cool-season areas, such treatment is sufficiently residual to provide adequate control of fall grub infestation. In addition, treatment at this time also kills overwintering chinchbugs and billbugs and reduces infestations of these insects during the summer.

**Mole crickets**—Mole crickets have extended their range from Florida and eastern Georgia into southern Louisiana and eastern Texas. Timing of treatments is critical and varies from one area to another.

The tawny and southern mole crickets are the primary pest species. Except for southern Florida, both have one generation per year. Mole crickets become active in March from north central Florida throughout their range in the Gulf States after overwintering deep in the ground as adults or nymphs. Tunnelling and some feeding damage takes place at night in moist soil and increases as mole crickets become more active. Both mole cricket species begin spring mating flights in late March. In most areas March treatment is seldom required.

**Entomologists** *Dr. Harry Niemczyk and Dr. Pat Cobb.*

In years when feeding of overwintered mole crickets resumes ealier than normal, Oftanol® (2 lb/ AI/acre) has been used with some success. Generally, such applications are better made later in the year.

**Black Turfgrass Ataenius**—This golf course pest overwinters as an adult in the soil under debris in roughs or other protected areas. A few may be seen flying about on warm afternoons in early March. Usually this activity begins when crocus starts blooming and intensifies as the bloom of red bud appears.

While an applications of Oftanol® in March may be successful in preventing summer infestations of larvae, the probability of success is increased by waiting until April.

**Greenbug**—The only stage of the greenbug known to overwinter in northern states is the egg. Shiny black eggs deposited the previous fall may be found adhering to grass blades, fallen tree leaves, or other debris.

Treatment for the greenbug is not appropriate during the late winter.

**Sod Webworms**—The most common sod webworm species overwinter as larvae in the thatch or upper inch of soil. Feeding does not resume until hibernation (dipause) is broken by early spring warmth.

Treatment for sod webworm is usually not appropriate during late winter.

## SPRING (April-May)

**Chinchbugs and Billbugs**—As warm days of spring approach, movement of chinchbug and billbug adults increases rapidly. Generally, egg laying begins the first week of April on warm-season turf and the first week of May on cool-season turf. Occasionally adult billbugs can be seen wandering about on sidewalks on warm afternoons.

Generally, application of insecticides to prevent infestations of chinchbugs and billbugs should be completed by the first week in May in cool-season and mid-April in the South. Such applications are made before significant numbers of eggs are laid. This time may vary as much as a week or more depending upon the spring weather.

When the preventative approach is not used and southern chinchbugs are detected in May, diazinon (4 lb. AI/acre) provides control. In areas with three to five generations, two retreatments at six week intervals may be needed.

**Grubs**—Overwintered grubs return to the surface and begin feeding on turfgrass roots in April. Increased activity and damage from moles, skunks, and racoons foraging on grubs can also be expected. Feeding by mammals and grubs continues through May.

In cool-season areas, a single application of Oftanol® (2 lb. AI/acre) made during April has been successful in controlling overwintered grubs with one year life cycles and preventing subsequent infestations during late summer. Application made during May may not provide immediate control, however, prevention of the late summer infestations may be expected.

Infestations of such grubs can also be controlled during April (South) or May (North) by spot or general treatment with Turcam® (bendiocarb, 2 lb.

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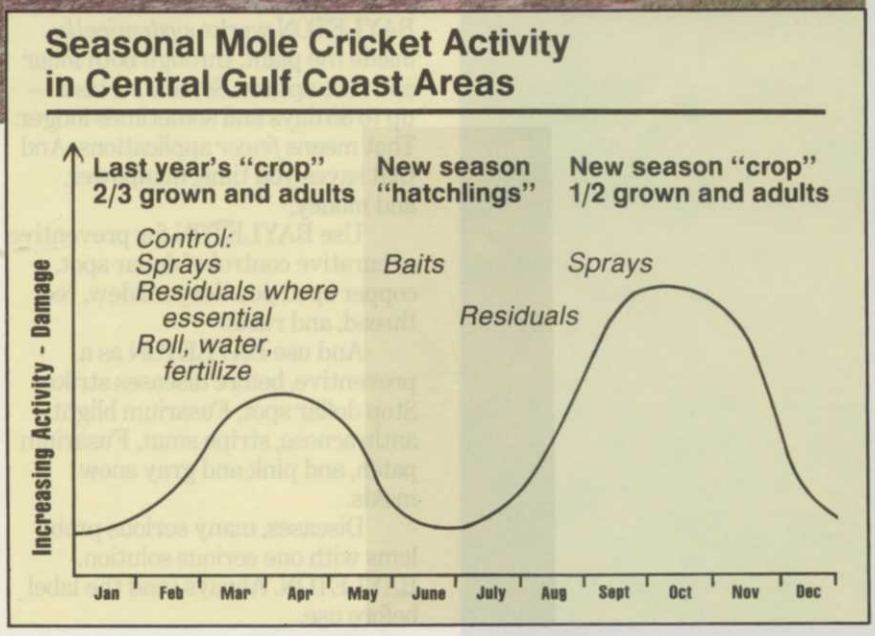
**Shown left**, *mole cricket damage to home lawn.*




AI/acre), Proxol (trichlorfon, 8 lb. AI/acre) or diazinon (5-6 lb. AI/acre). Golf course superintendents may also use ethoprop (Mocap®, Scotts Nematicide/Insecticide, 10 lb. AI/acre). Sevin® (carbaryl, 2-4 lb. AI/acre) has been effective against larvae of the green June beetle.

Treatment should be delayed until grubs are in the top one inch of soil. Irrigation or rainfall should follow such applications to move the insecticides to the target grub as soon as possible.

Although milky spore disease products for control of Japanese beetle grubs may be applied anytime there is no frost in the soil, spring is a good time for such applications. The soil is open and frequent rains move the disease spores into the soil. It should be noted that only the Japanese beetle grub will be affected by milky spore.

Infestations of large grubs (larvae of June bugs) have been occurring on a three-year cycle in some areas of Michigan and Minnesota. Locations of such infestations should be identified because reinfestation is likely every three years.

Controls such as Oftanol®, diazinon, Proxol®, or Turcam® should be applied in August or September during years of when large numbers of adults are seen.

Eggs are laid in May and June, therefore treatment should be made in late summer, early fall of that year or early the next spring while the larvae are small. Later applications against full-grown larvae have given inadequate control.

**Mole crickets**—Damage increases in April from north central Florida throughout the southern areas of the Gulf States. Mating and dispersal flights continue as egg laying and hatching begin.

Spring treatment is often necessary in areas that were severely damaged last fall. Small damaged areas can be rolled or otherwise packed down so the turf roots are reconnected with the soil. To determine cricket presence, pour soapy water (2 oz. liquid dishwashing detergent in one gallon of water) on turf areas where infestation is suspected. Crickets will usually surface in 3 to 15 minutes (longer in cool weather).

Turcam® (2 lb. AI/acre), diazinon (spray or granules, 5-6 lb. AI/acre), Mocap® 10G (ethoprop, 10 lb. AI/acre, commercial turf only), or Oftanol® (granular or liquid, 2 lb. AI/acre) can be used to control spring infestations.

In less critical areas, short residual treatment with Turcam® (2 lb. AI/acre) or diazinon (5-6 lb. AI/acre) applied in late April or May may be adequate.

Critical turf areas may require greater residual control provided by early April insecticide applications. Mocap® 10G (10 lb. AI/acre) provides up to four weeks control and Oftanol® (2 lb. AI/acre) up to eight weeks control. Treatments should be made late in the day if possible and watered in immediately.

**Black turfgrass ataenius**—Adults of the black turfgrass ataenius can be seen flying about in April and are often found in clipping catchers after early mowing of golf course greens. These adults begin laying eggs in early May, or about the time Vanhoutte spirea first comes into bloom. Check with local extension for a more precise time if needed.

Applications of Oftanol® during April or May has successfully prevented larval infestations during the summer. Diazinon (5-6 lb. AI/acre) applied to fairways during egg laying kills adults and also prevents the development of summer larval infestations.

**Sod webworms**—Overwintered larvae of the sod webworm begin feeding as soon as the grass begins to grow. Usually damage is insignificant, but areas that do not green up may be infested. These areas frequently have probe holes from starlings feeding on the larvae.

In warm-season areas webworm larvae pupate during late March and

early April. Moth flights begin in April in southernmost areas and during May in more northern areas.

Young larvae are usually present about two weeks after the spring moth flight peaks, so treatment of young larvae can be done in May in some areas.

When necessary, a wide range of insecticides including diazinon, Proxol®, Aspon®, Sevin®, and others applied at labelled rates may be used to achieve control.

**Cutworms**—Moths of cutworms begin laying eggs on golf course greens and other turf areas in the spring. These eggs hatch producing larvae that feed on grass blades during the night. The black cutworm is the most common species on cool-season turf.

While visible damage is uncommon on home lawns, damage can be significant on golf course greens in late May.

Black, granulate, and variegated cutworm moths become active in March and April in the South. Larvae are present on turf, especially on golf greens and tees. Damage can become evident as early as mid-April. By May, the larvae are large enough to cause severe damage.

Generally the insecticides effective against sod webworm are also effective against cutworms. The principle of controlling these pests is to apply the insecticide late in the afternoon and allow night-feeding cutworms to contact the treated foliage. Irrigation following liquid application is therefore not advisable.

**Greenbug**—Greenbug eggs begin hatching as early as April, but significant infestations do not develop until later in the year. Aphid numbers are too low to detect.

**Winter grain mite**—Damage from this mite is often first noted in April when home lawns are receiving spring fertilizer applications. By late May, the mites will have laid their eggs and died. Mites do not appear again until the eggs hatch in October.

If treatment is necessary, liquid diazinon or Dursban® will provide control.

**Clover mite**—Incidents of visible damage to home lawns has been seen in April in several Ohio cities and Denver, CO. Usually a nuisance pest in and around homes, the clover mite appeared in large numbers (5,000 per sq. ft.) across entire lawns and on turf next to building foundations. Symptoms of injury were the same as the winter grain mite. Turf next to foundations was often killed.

The clover mite has a slightly pink body and eight pale-colored legs. The first pair of legs are extremely long and protrude well out in front of the mite. The absence of bright red legs distinguishes the clover mite from the winter grain mite.

Treatment with liquid diazinon (2.5 lb. AI/acre) or Dursban® (1 lb. AI/acre) readily provides control.

**Fire ants**—Fire ants are spreading across much of the South causing serious and painful injury to man and animals. They begin establishing new mounds during warm, wet days of spring. During this time, ants are active near the surface of mounds and workers are foraging for food.

Mound treatments include diazinon granules or drenches, various Dursban® formulations, Oftanol®, or MC-96® (trichloroethane). Read the label for specific directions for mound treatment. Do not disturb the mound before or during treatment.

Where mound treatment is impractical, the turf can be treated with Amdro® fire ant bait (no more than 1.5 lb. AI/acre). All the bait should be used within three days of opening. Retreatment during the fall is usually necessary.

## SUMMER (June-August)

**Chinchbugs**—In northern cool-season turf chinchbug eggs continue to hatch into June. Bright red nymphs appear. The number of chinchbugs increases rapidly in June and peaks in July when northern lawns can receive severe damage. This damage is often masked by summer dormancy of turf caused by drought.

During August the nymphs molt into adults that mate, lay eggs, and produce a second generation. Some northern areas have only one generation per year.

Southern chinchbugs are not usually a problem in well-irrigated turf or during summers when rainfall is plentiful. Southern chinchbug damage first appears during the dry periods of June and July. Damage may continue throughout the summer and into the fall because of overlapping generations.

A wide range of insecticides may be used at label rates to control existing infestations. They include Dursban®, diazinon, Aspon®, and Sevin®. Treatments should be made before injury is severe, otherwise, damaged areas may not recover.

Areas of southern Florida have pockets of southern chinchbugs resistant to these insecticides. Pydrin®, Pounce®, or Baygon® may be substituted. Floratam St. Augustine, a chinchbug resistant variety, should

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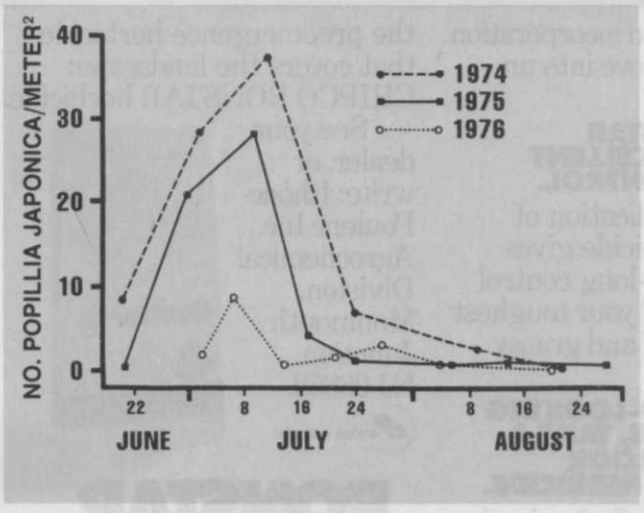
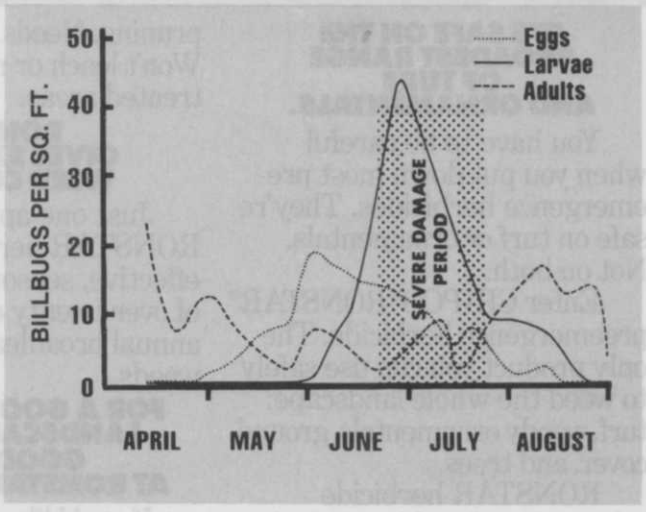



**Emergence of Japanese beetle,** *Popillia Japonica, adults from fescue sod in northern Georgia.*




**Life cycle** *of the bluegrass billbug in Ohio.*

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## Insect and Mite Resistance in Turf

**by Roger H. Ratcliffe**, Agricultural Research Service, Field Crops Lab, Beltsville, MD

Few turfgrass cultivars have been bred specifically for insect resistance. Experimental lines or cultivars, developed for other traits, have been reported to demonstrate varying levels of resistance or tolerance to insect or mite pests.

In many instances, resistance has been observed under field conditions in limited trials. The data obtained may not provide an adequate measure of the level of resistance or tolerance, since the expression of resistance will vary with the severity of natural infestations.

The response of cultivars bred specifically for insect resistance has been studied more thoroughly, and field performance can be predicted more accurately.

Recently, increased emphasis has been placed on developing turfgrass cultivars with insect resistance, in much the same way as selection for disease resistance has been conducted. This research has involved both laboratory and field evaluation of plants for sources of resistance to pests such as the fall armyworm, the southern chinchbug, hairy chinchbug, bluegrass billbug, greenbug, mole cricket, sod webworm, and several mite species. A summary of the results from this research in provided in Table 1, on page 68.

Two approaches are being taken to develop insect resistant turfgrass cultivars. The first is selection for genetic sources of resistance within adapted cultivars or experimental materials (i.e. southern chinch bug resistance in 'Floratam' St. Augustinegrass).

A second approach is developing cultivars with induced resistance by infecting them with endophytic fungi. Resistance to sod webworm in 'Repell' perennial ryegrass is an example.

Repell has a high level of infection by the endophytic fungus *Acremonium coenophialum* Morgan-Jones and Gam. The fungus lives within the host plant, but does not injure it. Substances produced either by the fungus, or the plant in response to invasion by the fungus, cause resistance to some insects.

Endophyte-infected perennial ryegrass or tall fescue has demonstrated resistance to sod webworm, several aphid species (including the greenbug), billbug, and a *Hyperoides* species called the Argentine stem weevil. There are also indications from field studies of chinchbug resistance.

With the development of new or improved methods of selecting for insect resistance, greater emphasis will be directed to breeding insect resistant cultivars in the future. Presently, however, insecticides remain the major method for controlling major insect pest species. □

be the primary turf variety grown in more southern coastal areas and Florida where southern chinchbug is a problem.

**Billbugs**—The bluegrass billbug larvae feed in grass stems during June but move to the plant crowns and roots during July. This feeding causes brown spots that frequently resemble the symptoms of some fungus diseases. Symptoms are also often masked when the turf is dormant from drought. During August the larvae burrow deeper into the soil to pupate and transform into adults.

Infestations discovered during this time may be treated at the same rates used for existing grub infestations with diazinon, Turcam®, and Proxol®. Irrigation or rain following application is needed for optimal results. If larvae are feeding in the root zone, control may be difficult to achieve. Oftanol® applied during June should control feeding larvae and provide control of late summer grub infestations.

**Grubs**—By June, in cool-season areas, grubs have stopped feeding and are in the pupal stage three to four inches in the soil. Beginning in mid-June and continuing through mid-July, the adults of various species emerge and burrow into the soil to lay eggs. Hatching and appearance of young larvae occur during July and August.

In warm-season areas, beetle flights continue and often peak in June, although the time flights occur varies from year to year. Japanese beetle flights occur mainly from mid to late May and June. Brown May or June beetle flights often follow heavy rains in late May and June. New generation grubs of most southern species can be found by mid-August.

Oftanol® applied in June provides control of developing grubs during August as well as chinchbug and billbug larvae present in the turf at the time of application. Existing infestations of grubs found in August may be treated with Proxol®, Turcam®, Oftanol®, diazinon, or Mocap® (commercial turf only) at standard label rates. Sevin® (2-4 lb. AI/acre is effective against the green June beetle larvae.

Extreme heat and drought during the summer may cause grubs to move deeper in the soil. Under such conditions, irrigation several hours before treatment and a thorough soaking afterward is advisable.

**Mole crickets**—Egg laying diminishes in late June, and newly hatched nymphs of both species feed voraciously. Tunneling damage suddenly becomes obvious in July as the nymphs grow larger. Because of the potential for sudden damage at this time, turf areas should be inspected several times a week during this period.

Poison baits have been effective in controlling mole cricket nymphs from June through August in the area from central Florida north and west through the Gulf States. Baits work best in eastern Georgia during spring and fall. Bait applications often must be repeated one or more times.

Bait formulations available include: 2% Baygon® (.5 lb./1,000 sq. ft.), 20% Sevin® (5-10 lb. bait/acre), 5% Dursban® (150 lb./acre or two applications of 75 lb./acre three weeks apart), and 2% malathion (100 lb./acre or two applications of 50 lb./acre three weeks apart).

Mole crickets are more active at night in moist soil. Turf should be irrigated several hours before baits are applied. Delay application until later in the day and do not irrigate for 2-3 days thereafter.

Residual control of mole crickets with Oftanol® (2 lb. AI/acre) may vary with location and amount of rainfall. Applications of Oftanol® have given up to 12 weeks control from the Florida panhandle along the Gulf Coast. Residual control was only six weeks in areas where August rainfall exceeded eight inches weekly. Oftanol® works faster on mole cricket nymphs when watered in immediately.

**Black turfgrass ataenius**—Eggs laid by beetles during May hatch in June and the larvae begin feeding on

**TABLE 1**

## Summary of Insect and Mite Resistance in Turfgrasses

| Insect/Mite | Grass |
|---|---|
| **Bluegrass Billbug** | *Kentucky Bluegrass*- No resistant cultivars released. Lower larval counts and/or less injury reported on 'Aquila', 'Arista', 'Arboretum', 'Delta, 'Geary', 'NuDwarf', 'Nebraska Common', 'S-21', 'South Dakota Common', and 'Windsor'. *Perennial ryegrass*- Endophyte-induced resistance in 'Pennant' and 'Repell'.'Repell' is the only cultivar developed specifically with endophyte-induced resistance to billbugs. |
| **Fall Armyworm** | *Bermudagrass*- Cultivars 'Tifton 44' and 'Tifton 292' show moderate and high resistance, respectively. Research is underway to incorporate resistance into good turf types. |
| **Hairy Chinch Bug** | *Kentucky Bluegrass*- No resistant cultivars released. In laboratory tests 'Baron' and 'Newport' demonstrated higher levels of tolerance to adult feeding. *Fine-leaf fescues*- No resistant cultivars released. In field trials 76G1-322, FL-1, MomFrr 25, MomFrr 33, FRT 3, and 'Silvana' were least damaged. *Perennial ryegrass*- In field trials 'Manhattan', 'Pennfine' and 'Score' were least damaged. |
| **Southern Chinch Bug** | *St. Augustinegrass*- 'Floratam' and 'Floralawn' are resistant cultivars. 'Floralawn' is a new cultivar soon to be released by the Florida Agricultural Experiment Station. A third cultivar, 'Floratine' demonstrates a moderte level of tolerance. |
| **Greenbug** | *Kentucky Bluegrass*- No resistant cultivars released. Good progress has been made in selecting for resistance in adapted cultivars. Resistant germplasm is under development. |
| **Sod Webworm** | *Kentucky Bluegrass*- No resistant cultivars released. Kentucky-grown 'Kentucky Common' reported to be less damaged by Crambus species. *Bermudagrass*- No resistant cultivars released. Differences in response of tropical sod webworm (Herpetogramma phaeopteralis Guenee) and grass webworm (H. licarsisalis Walker) reported on strains and some cultivars. 'Common' and 'Tifway' showed the least feeding damage by grass webworm.'Common' and FB-119 showed more tolerance to tropical sod webworm than 'Tifway' and 'Tifgreen'. *St. Augustinegrass*- 'Roselawn' reported as less preferred by tropical sod webworm than 'Bitter Blue', 'Scotts 1081', 'Florida Common' and three Florida accessions. *Perennial ryegrass*- Endophyte-induced resistance to complex of Crambus species in 'Pennant' and 'Repell'. |
| **Mole Crickets** | *Bermudagrass and Bahiagrass*- No resistant cultivars released. Some genotypes have shown little reduction in root and shoot growth after several months of exposure to mole crickets which severely damaged 'Tifway' and 'Tifgreen'. |
| **Banks Grass Mite** | *Zoysiagrass*- No resistant cultivars. A genotype of Zoysia tenuifolia was reported as highly resistant. |
| **Bermudagrass Stunt Mite** | *Bermudagrass*- FB-119 (Franklin), a medium-to-coarse textured bermudagrass cultivar, is highly resistant. |

the turf roots immediately.

From late June to mid-July, symptoms of injury include wilting in spite of irrigation. In July, larvae move deep into the soil, pupate and emerge as adults. These adults lay eggs during August producing a second generation in states such as Ohio. The second generation larvae are capable of damaging turf.

If preventative applications of insecticde were not made, existing infestations may be spot or generally treated with Proxol, Turcam, diazinon, or Mocap at label rates.

**Sod webworms**—Damage from sod webworm larvae occurs occasionally in most of the cool-season turf region. Injury is more common in midwestern states and is usually seen in July and August. Older sod fields and heavily thatched turfs are good candidates for infestation. There are generally one or two generations per year, depending upon the species.

In warm season areas most sod webworms complete at least three generations a year, with overlapping generations toward the end of the season.

Damage is most severe from late June through August. In southern Florida where the tropical sod webworm is active throughout the year, damage is most severe in late summer and fall.

Hybrid bermudagrasses are favored by sod webworms, but damage occurs on other warm season grasses. Webworm damage to bermudagrass often superficially resembles symptoms of some diseases. Flushes of soapy water can be used to determine the presence of sod webworm larvae.

Insecticide applications should be made when larvae are present and/or one to two weeks after peak moth flight.

Formulations of Dursban, diazinon, Sevin, Proxol, or Aspon applied at labelled rates provide control. Retreatment may be necessary depending upon the location and number of generations.

**Cutworms**—Cutworm larvae continue to cause visible damage to golf course greens through June. These larvae pupate in the soil or thatch and emerge as moths that lay eggs for additional generations.

Cutworm larvae can be controlled with a wide range of insecticides at label rates; including Dursban, Proxol, Aspon, Sevin, and others. Irrigation following liquid applications is generally not advisable.

Fall armyworm—The fall armyworm is seldom a problem of cool-season turf.

But in the South, summer always means the arrival of the moths of this migratory pest. Although in mild winters fall armyworms may overwinter along the Gulf Coast, it is generally believed that the moths are blown in on winds from Central and South America. Several generations occur each season, one about every five weeks. Generations overlap in the fall.

Lush, green bermudagrasses are preferred. By late June, fall armyworm damage to turf has usually been reported along the Gulf Coast. Damage is seldom permanent, unless drought and/or heat stress follow.

Fall armyworms may feed anytime

during the day but are most active in the early morning and late evening.

Treatment is most effective at these times. During hot, mid-day hours, larvae may retreat into the thatch.

Insecticides such as diazinon, Sevin, Dursban, and Proxol can be used at labelled rates to control fall armyworm.

**Greenbug**—Damaging populations of greenbug can occur from June through August. Populations and incidents of damage freqently varies from area to area, even within a city.

Symptoms of injury include turf under the dripline of trees and in open areas having a burnt orange color. When symptoms are seen, numerous aphids (40 or more) may be seen on a single grass blade. Close examination of damaged turf is necessary because the aphids are small. If left untreated, a heavy infestation can kill the turf. Little damage from this pest was seen in 1983.

Greenbug infestation may be controlled with liquid treatments of Dursban (1 lb. AI/acre) or diazinon (2.5 lb. AI/acre). If reinfestation occurs following treatment with these insecticides, Orthene (acephate) at labelled rates has been effective.

**Fire ants**—Fire ants are more difficult to control during hot, summer days because they are deeper in the soil. However, during rainy periods, they may become active and establish new mounds. Treatments during these months should be applied early in the morning before the heat of day.

**Scale insects**—Although Rhodesgrass scale is present in Gulf Coast areas throughout the year, damage becomes most pronounced during the hot, dry days of summer. Bermudagrass and St. Augustinegrass are preferred hosts, but other grasses are also infested. Several treatments with diazinon and a wetting agent are required for control to be effective.

Ground pearls are scale insects that live in the soil throughout the year, sometimes 8-10 inches deep. In the spring eggs hatch producing nymphs. The nymphs feed throughout the summer by piercing turf roots and extracting plant fluids.

Chemical control has not been effective for ground pearls at any time of year. Damage is most severe during summer months when the turf is stressed from heat and drought.

Centipedegrass is especially susceptible to damage, particularly when weakened by overfertilization or drought. Proper fertilization, disease control, and adequate irrigation to maintain healthy turf is the best defense.

## FALL (Sept.-Oct.)

**Chinchbugs**—In the northern U.S. the second generation of chinchbug is at peak numbers in September. Nymphs complete their development to adults in late October. Most chinchbugs overwinter in the turf, but some move to protected areas before winter.

Generally, infestation levels at this time are not high enough to warrant the use of insecticides. Early fall rains and infection by a parasitic fungus (*Beauveria* spp.) usually provides sufficient control.

**Second generation chinchbugs reach peak numbers in late September in the North, but infestation levels are generally not high enough to use insecticides.**

Damage by southern chinchbug may continue in untreated areas. Late summer applications of insecticide usually make fall treatment unnecessary.

**Billbugs**—During September billbug adults that developed from summer larvae are often seen wandering about on sidewalks, driveways, or other paved surfaces. Before winter, these adults seek shelter in thatch, along sidewalk edges, or near foundations and overwinter there. Many, if not most, overwinter in the turf.

**Grubs**—Most species of grubs are in the third of their three stages of development and are feeding actively. When soil temperatures decrease in late October the larvae burrow deeper into the soil to overwinter. Severely cold winters have little effect on survival.

Treatments of existing grub infestations can be accomplished as late as early to mid-September, using standard grub insecticides and sufficient (½-inch or more) irrigation. Treatment after this time may or may not kill the grubs before they move deeper into the soil to overwinter.

If the soil is dry irrigation before treatment is advisable. Whenever treatment is applied, the grubs should be in the top one to two inches of soil.

**Black turfgrass ataenius**—By September, adults of the current generation begin to fly into protected areas, such as golf course roughs, to overwinter. Larvae that have not completed development to adults before frost are killed.

**Mole crickets**—Mole crickets fly again in the fall, but no egg laying is know to occur at this time. The crickets are large and difficult to control at this time. Damage becomes obvious as turf growth slows.

Sprays of diazinon (5-6 lb. AI/acre) or Turcam (2 lb. AI/acre) may have to be repeated several times. Oftanol (2 lb. AI/acre) may work too slowly for adequate control of large crickets in October. Mocap 10G (10 lb. AI/acre, commercial turf only) is usually effective at this time providing up to four weeks residual control.

**Sod webworm**—Northern sod webworm larvae are small and cause little if any damage in the fall. Late in the fall the larvae construct a cocoon-like shelter in which they overwinter.

Except for the most southern areas where development is continuous, sod webworm larvae present in September will overwinter. Areas treated earlier in the season may be reinfested by this time. Treatment in September reduces the population for next season.

**Fall armyworm**—Fall attacks on newly established turf from mid-September through October may result in damage that will not recover with fall fertilization. This forces the turf to enter winter in a stressed condition. Such damage can contribute to winter turf mortality.

If needed, apply controls early in the morning or late in the day when fall armyworms are most active. Use diazinon, Sevin, Dursban, or Proxol.

**Fire ants**—Hot, dry periods in September and October may make fire ant control difficult. Once rain begins, fire ants become active and may be effectively controlled with mound treatments of diazinon, Dursban, Orthene, Amdro® bait or MC-96. Larger infested areas where mound treatment is impractical can be treated with Amedro fire ant bait (1.5 lb./acre).

**Greenbug**—Severe infestations of greenbug have been known to occur as late as the first week of December. Areas having a history of infestation should be reexamined when mild temperatures extend late into the fall. Heavily infested turf will not survive through winter.

Late fall infestations may be controlled with the same insecticides used to control the pest during the summer.

**Shown above, southern red mite eggs** *overwintering on Japanese holly. Above right, are boxwood leafminer adults. These emerge in April, a good time to spray. Immediately right is an Eastern Spruce Gall Adelgid with eggs.*

# Woody Ornamental Insect Control

**by Dr. D. G. Nielsen**, professor of entomology, Ohio State University, Wooster, OH and **Dr. J. R. Baker**, extension entomologist, North Carolina State University, Raleigh, NC

Landscape trees and shrubs constitute a major investment and add significantly to the beauty and value of residential and commercial properties. Landscape managers need to be familiar with woody plants, their requirements for survival and vitality, and their pest problems to implement effective insect control programs.

Most native trees and shrubs on undisturbed sites suffer only rarely from ravages of insect pests. However, trees growing in landscapes are commonly stressed by lack of water (or too much water if there is poor drainage), high temperatures, compacted soils, and other factors that reduce the tree's ability to either repel or withstand insect attack without suffering decline.

Most major pests of trees and shrubs are probably opportunists that exploit hosts that have been altered by their physical environment.

Landscape managers can take advantage of the information in this article to develop strategies for controlling insect pests of woody plants. The information is organized according to seasonal insect activity. The time or times an insect is vulnerable to a direct control tactic and up-to-date insect control recommendations are provided.

## Control strategies

In the past, cover sprays were often used to control any insect pests that may be present on the property, because the detrimental side effects of some pesticides were not yet known and landscape managers were not familiar enough with local pests to develop target spray programs. Many times, all trees on a property were sprayed when only a few of them harbored pest species.

Today, conscientious tree care specialists use insecticidal sprays only after determining which pest(s) is present, whether or not it has reached a potentially damaging population level, and spot-spraying only infested plants. This approach is cost effective in terms of landscape beauty and longevity and environmental quality.

## Dormant period (November-March)

Some insect and mite pests are vulnerable to control tactics after trees and shrubs have become acclimated to winter temperatures.

In the South, woody ornamentals may not become dormant until late December. Landscape managers can capitalize on this vulnerability by conducting pest control activities when other maintenance activities are not competing for their time.

Horticultural spray oils can be used safely on many woody plants to control overwintering eggs of spider mites and aphids and immature forms of adelgids and soft scales.

New information from Cornell University indicates that currently available horticultural oils can be used throughout the year when the temperature is above freezing. However, four cautions should be considered before using these products:

**1** read the label to make sure the product is not phytotoxic to plants on which you intend to use it;

**2** do not use oils at the dormant season rate in the fall before plants have become winter-hardy;

**3** oil sprays should not be used on plants under moisture stress or when temperatures are high with high humidity;

**4** do not apply oil sprays to tender new growth in spring.

**Spruce gall and pine bark adelgids**—Adelgids are small, soft bodied insects that commonly cause pineapple-like galls to form on their spruce host(s).

Eastern spruce gall adelgid and Cooley spruce gall adelgid overwinter as young nymphs on the underside of branches on spruce or on the lower leaf surface of Douglas fir, the alternate host of the Cooley gall adelgid. Pine bark adelgid overwinters as eggs, nymphs and adults in bark cracks and crevices on white pine.

Adelgids can be controlled on all hosts any time after spruce galls open in late summer until just prior to bud break the following spring. Horticultural oil may reduce the overwintering population. Sevin (carbaryl) or lindane can also be used in a thorough-coverage, hydraulic spray, making sure to cover the underside of spruce branches and Douglas fir needles. A wetting agent may be useful to help penetrate the fluffy wax covering on the insect, especially for the pine bark adelgid.

**Spider Mites**—Spider mites, including spruce spider mite on coniferous evergreens and southern red mites on broadleaf evergreens, suck plant juices and deposit silk and waste material on their hosts, causing foliage to become dull and bronze colored.

These mites tend to feed in spring and fall but usually die out in very hot or very cold weather. They overwinter in the egg stage which is susceptible to control with horticultural oil.

**Aphids**—Aphids are small, soft-bodied insects that insert their mouthparts into the phloem of leaves and stems to suck out sap. Aphids excrete honeydew, a sweet liquid which coats infested plants when they feed in groups of large numbers.

Some species (melon aphid, apple aphid) feed on the most succulent part of the plant. Other species (giant willow aphid, giant bark aphid, *Cinara* aphids) feed on stems.

High aphid populations can cause leaves to yellow and fall prematurely.

Honeydew they excrete serves as a substrate for a black sooty mold fungus that reduces the aesthetic appeal of the plant and reduces its ability to manufacture food.

Many aphids overwinter as exposed eggs on conifer needles or on stems and buds of other woody plants. If a damaging aphid population was detected the previous summer or fall, an application of horticultural oil before bud break will reduce the spring aphid population, thereby giving the tree a chance to recover before aphids build-up again during the spring and summer.

**Soft Scales**—Soft scales are another kind of sucking insect that hurts a tree's vitality by removing energy and reducing the tree's ability to manufacture food. They also suck sap from the phloem and produce honeydew; some of them seriously weaken or kill their hosts. Heavily infested trees and shrubs often become blackened with sooty molds.

Some overwinter as immature forms (cottony maple, cottony maple leaf, magnolia, pine tortoise, and Fletcher scales) that are vulnerable to horticultural oils used at the dormant application rate.

## Spring (April-late June)

Most insects become active in the spring, responding to warmer weather and resumption of plant growth and development. Monitoring trees and shrubs during spring is one of the most important tactics in a modern, rational insect control program. Newly expanding or expanded leaves should be checked for the presence of sucking insects, leafminers, and defoliators.

Tree limbs and trunks should be inspected to determine presence of active borer galleries. Early detection will permit time for learning the identity of the pest and determining if a spray program is justified.

**Defoliators**—Eastern tent caterpillar, fall cankerworm, whitemarked tussock moth, and pine sawflies are among the first defoliators to begin feeding in spring.

Eastern tent caterpillar is obvious and readily detectable because it forms a silken tent in tree crotches, especially flowering fruit and nut trees. During years of high caterpillar numbers, entire trees may be defoliated.

Sawflies are much more difficult to see since they blend in with their pine needle hosts. They often reach maturity before defoliation is noticed.

The tent caterpillars and their relatives, including mimosa webworm, fall webworm, bagworm, and gypsy moth, are readily controlled with a number of conventional insecticides or with the bacterium, *Bacillus thurengiensis*, commonly known as B.t.

Sawflies are related to bees and wasps and are highly susceptible to Sevin. Orthene (acephate) is also labeled for this use.

Elm leaf beetle larvae and adults consume foliage. There are two generations each summer. Sevin, Orthene, or Turcam/Dycarb (bendiocarb) can be used when trees leaf out in spring. A second generation may require a second application in July.

**Spider mites are most common and damaging on plants under water stress and during droughts. They complete many generations throughout the summer.**

**Armored Scales**—Armored scales are soft-bodied sucking insects that suck juices from leaves and stems but do not produce honeydew. They are called armored scales because after the first stage molts, later stages are covered by cast skins and tough wax. Consequently, armored scales are vulnerable to contact insecticides only during the crawler and settled first nymph stages.

Armored scales overwinter as eggs (pine needle scale, oystershell scale), as mated females (euonymus and white peach scales), or in more than one stage (hemlock and tea scales). As indicated, all of them are most easily controlled with crawler sprays.

Species that overwinter as eggs can usually be controlled with a single application of an insecticide, if thorough coverage is achieved. If timing of the application is not precise, a systemic insecticide like Metasystox-R (oxydemetonmethyl) or Orthene should be used.

Species like euonymus scale require more than one crawler spray, since the first hatching crawlers molt before the last spring generation eggs are laid. Three thorough-coverage, hydraulic sprays at 10 to 14 day intervals are needed to provide an adequate level of control.

All armored scales having more than one generation per year (pine needle, euonymus and white peach scales) should always be controlled during the spring crawler hatch. This is because the hatching period is shorter at that time, so fewer sprays are required to provide control.

Horticultural oils are effective for armored scale control, but use the summer rate only after new plant growth has emerged and hardened off a little.

**Aphids**—Aphid populations can explode in a short time, since a new generation can be produced every 10 to 15 days in the North and even faster in the South.

In the North, aphids are often at high population density during summer droughts, or just after a drought period, and should be controlled before they cause premature leaf drop.

In the South, aphid populations are often high in early spring before lady beetles and other predators become active. However, crape myrtle aphid populations often become damaging later the growing season.

Mistblower application is excellent against free-living aphids.

**Adelgids**—Remember, overwintering forms can be controlled by using a hydraulic application of lindane or Sevin, stressing coverage to the underside of branches and leaves, before bud break. After bud break, adelgids on spruce are protected as their galls form. They become vulnerable again in fall after their galls open.

**Leafminers**—Birch, boxwood, and holly leafminers are highly specialized insects that in the larval stages damage trees and shrubs by destroying tissue within the leaf.

Birch leafminer is a sawfly (closely related to bees and wasps) that emerges as adults in May. Foliage can be protected by spraying when the adult sawflies are actively mating and feeding on birch trees. Sevin, malathion, and lindane are effective before eggs are laid within leaf tissue.

After egg laying has begun or mines have begun to form, a systemic insecticide should be used. Metasystox-R, Orthene, and Cygon (dimethoate) are labeled for this use.

There are several generations per year, but the first two generations seem to be most destructive.

Holly leafminer is a true fly that has only one generation per year. Spring application of Metasystox-R or Orthene after the new plant growth has hardened off is necessary

to achieve control.

Boxwood leafminer is a gall midge which also has one generation per year. A mid to late spring application of Cygon will adequately control boxwood leafminer.

**Spider Mites**—Spider mites are also most common and damaging on plants under water stress and during droughts. They complete many generations throughout the summer.

Kelthane (dicofol), Mavrik (fluvalinate), or another miticide should be used before mites cause foliage to turn bronze. A hydraulic sprayer must be used to maximize coverage, especially on plants with dense foliage, including foundation plantings, conifers, and other evergreens.

Two sprays must be used at a 7 to 10 day interval, since most miticides do not kill eggs. A single application will usually not be effective against spider mites.

**Root Weevils**—Root weevils (black vine, strawberry root), can be destructive in both adult and larval stages. Adults chew notches in leaf margins. Larvae consume small roots and girdle larger roots, sometimes causing death of foundation plants, including rhododendron, azaleas, and yews (taxus).

Spray foliage with Orthene or Turcam/Dycarb in mid-June, followed by repeat applications at three to four week intervals until August. Level of control is directly related to the degree of coverage, so use a hydraulic sprayer to control root weevils. Drenching soil beneath host plants may help reduce larval populations.

**Borers**—Clearwing moth borers are common in lilac, ash, dogwood, rhododendron, oak, and flowering cherries. Flatheaded borers (adults are called metallic wood borers) are common in white-barked birches, oaks, and other stressed hardwoods.

Larvae do the damage by feeding beneath bark, disrupting movement of food and water, destroying the cambium (the growth layer of cells), and causing structural weakness. Clearwing presence and flight periods can be monitored with pheromone traps.

A single, thorough-coverage bark spray of Dursban (chlorpyrifos) or lindane, 10 to 14 days after first male moth capture, will provide season-long control of most clearwing moths. Three applications of bark/foliage sprays with Turcam/Dycarb, Dursban, or Lindane are required to control flatheaded borers.

## Summer (July-September)

**Defoliators**—Mimosa webworm, bagworm, fall webworm, Japanese beetle adults, and second generation elm leaf beetles sometimes become common in early summer.

All of these pests should be controlled when larvae are small to minimize damage and maximize effectiveness of the insecticide. Caterpillars can be controlled with one of the B.t. formulations. Sevin, Orthene, Turcam/Dycarb, and several other common insecticides will also control these pests. Mistblower application may be most cost-effective but may result in unacceptable drift of insecticidal sprays, especially in windy weather.

**Monitoring trees and shrubs during spring is one of the most important tactics in a modern rational insect control program. Check new leaves for sucking insects, leafminers, and defoliators.**

Japanese beetle adults defoliate many kinds of woody plants and roses. They are most easily controlled with weekly sprays of Sevin or Turcam/Dycarb. Japanese beetle traps can be used to capture large numbers of beetles, but they do not reduce defoliation or control the beetle population. Grub control is much more effective for reducing numbers of Japanese beetle adults.

Second generation elm leaf beetles can cause significant defoliation if heavily infested trees are not sprayed.

Birch leafminer can be controlled, if trees are sprayed when second or third generation adults are mating and ovipositing.

**Scales**—Crawlers of several soft scales (Fletcher, cottony maple, cottony maple leaf, pine tortoise, wax and tulip tree) hatch in late June or early July (earlier in the South). crawlers and settled nymphs are susceptible to scalicides (Sevin, Orthene, Diazinon, Dursban, and Turcam/Dycarb) in early July. A single, thorough-coverage, hydraulic spray should provide control.

Settled nymphs and other nymphal stages are vulnerable to contact insecticides, because they are not protected by cast skins. Sprays to control soft scales should always be applied after all eggs have hatched to minimize the impact of pesticides on lady beetles and other predaceous insects, to minimize insecticide usage, and to maximize control.

Second generation pine needle scale, euonymus scale, and white peach scale crawlers hatch during July and early August. Two sprays at a 10-day interval may be required to control pine needle scale and white peach scale because crawlers hatch over a three week period. Summer generation euonymus scale crawlers hatch over a longer period, so three applications at 10-day intervals are required.

**Aphids**—Aphid populations should be controlled before they secrete copious amounts of honeydew or do irreversible damage to leaves. If aphids are allowed to build-up in high numbers, plant growth may be distorted and leaves may fall prematurely. Once sooty molds are established they may persist long after aphids have been controlled by pesticides or natural enemies. Aphids are vulnerable to contact sprays whenever they are active.

**Spider Mites**—Spider mites can be controlled whenever they are active by spraying twice with a 5-day (South) or 10-day (North) interval. If trees are receiving repeated applications of Sevin to control other insects, be especially watchful for build-up of spider mites. Sevin selectively kills natural enemies of mites, thereby contributing to increases in spider mite populations.

**Root Weevils**—The second and third applications of black vine weevil adulticides should be applied in July and August. In the South, Japanese weevils and Fuller rose beetles can be controlled with Orthene as a spray and drench during July. A single spring application will not control black vine weevils or other weevils mentioned earlier.

**Borers**—White-barked birches determined to be infested by bronze birch borer during the summer can be injected with Inject-A-Cide B (Bidrin) using microinjection procedures developed by the J. J. Mauget Company. Injection must be done by a skilled technician in early July or early August.

Infested trees should be watered weekly during summer and fall drought and fertilized in the fall after the first hard frost. The following year, bark/foliage sprays should be

## Insecticide Directory

| Common Name | Brand Name | Company | Circle No. |
|---|---|---|---|
| acephate | Orthene | Ortho/Chevron | 250 |
| aspon | Aspon | Stauffer | 251 |
| Bt | Thuricide<br>Dipel<br>SOK Bt | Sandoz<br>Abbot Labs<br>Tuco/Upjohn | 252<br>253<br>254 |
| bendiocarb | Turcam | Nor-Am | 255 |
| carbaryl | Sevin | Union Carbide | 256 |
| chlorpyrifos | Dursban | Dow | 257 |
| diazinon | Diazinon<br>Sarolex | Ciba Geigy | 258 |
| dicofol | Kelthane | Rohm and Haas | 259 |
| dicrotophos | Bidrin | Shell | 260 |
| dimethoate | Cygon | American Cyanamid | 261 |
| dinocap | Karathane | Rohm and Haas | 262 |
| dioxathion | Deltic | Nor-Am | 263 |
| dymet | Dymet | Mallinckrodt | 264 |
| ethoprop | Mocap Nematicide/ Insecticide | Rhone Poulenc<br>O.M. Scott | 265<br>266 |
| fenamiphos | Nemacur | Mobay | 267 |
| femobutatin-oxide | Vendex | Shell | 268 |
| fenvalarate | Pydrin | Shell | 269 |
| isofenphos | Oftanol | Mobay | 270 |
| malathion | Malathion | American Cyanamid | 271 |
| methiocarb | Mesurol | Mobay | 272 |
| methomyl | Nudrin<br>Lannate | Shell<br>Du Pont | 273<br>274 |
| methoxychlor | Marlate | Kincaid | 275 |
| naled | Dibrom | Chevron | 276 |
| oxydemeton-methyl | Metasystox | Mobay | 277 |
| phosmet | Imidan | Stauffer | 279 |
| oxythioquinox | Imidan | Stauffer | 279 |
| propoxur | Baygon | Mobay | 280 |
| trichlorfon | Dylox<br>Proxol | Mobay<br>TUCO/Upjohn | 281<br>282 |

mented as indicated earlier. Injection should not be used as an annual, preventive tactic.

Peachtree borer can be controlled with a single application of Dursban or Lindane in early July (in the North, late August in the South). The second application for control of lesser peach tree borer should also be applied at this time to infested flowering cherries.

### Fall (September-October)

**Defoliators**—Mimosa and fall webworms reach their highest population density and cause most defoliation during late summer and early fall. They should be controlled as soon as first generation larval webs are detected in early summer.

However, both pests are susceptible to larvicides in late August and early September. If B.t. is to be used, it must be applied when larvae are small to achieve an acceptable level of control.

**Scales**—Magnolia scale crawlers hatch and tulip tree scales are born in late August and early September. Infested magnolias should be sprayed when goldenrod is in full bloom (early September). A single, thorough coverage, hydraulic spray with Orthene or Sevin will provide excellent control. Magnolias and tulip trees may be killed by heavy infestations of these scales.

**Gall Adelgids**—Galls on spruce caused by eastern and Cooley spruce gall adelgids turn brown and open in August and September. After galls open, adelgids are vulnerable to contact insecticides. Remember, adelgids on spruce, Douglas fir, and pine remain vulnerable to insecticidal sprays until the following spring when new buds open.

**Root Weevils**—Attempts to control root weevil larvae should be made in early September and early October. Two drenches with Turcam/Dycarb have been effective against larvae established in soil surrounding roots of field plants. A single drench with Turcam/Dycarb, Orthene, or Furadan (carbofuran) controls larvae infesting containerized plants. Recent evidence indicates that overwintered larvae may also be susceptible to drenches in early spring.

### Closing thought

Throughout this article we have stressed the importance of proper timing and thorough coverage for achieving a high level of insect control. Coverage and timing are often more important than the insecticide or miticide used. So, make sure of proper pest identification, determine when it is most vulnerable to control, and apply a pesticidal spray thoroughly to only infested trees following label directions.

All conventional insecticides are poisons, but they can be used safely and effectively by well-informed practitioners. **WT&T**

FOOTNOTE

1—Insecticides labeled for use against pests mentioned in this article are listed in two Extension Service Publications. The first is "Insect and Mite Control on Woody ornamentals and Selected Perennials," Ohio Cooperative Extension Service Bulletin #504. This manual is available for $3.50 from Extension Publications Office, The Ohio State University, 2120 Fyffe Road, Columbus, OH 43210-1099. The second publication is the "1985 North Carolina Agricultural Chemicals Manual" which is available for $7.50 from Agricultural Communications, Box 7603, Raleigh, North Carolina 27695-7603.