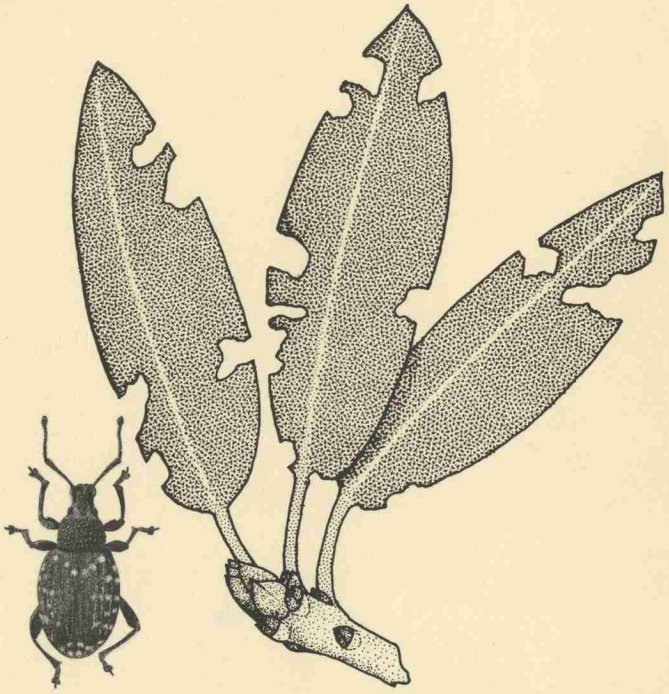
INSECT and related PESTS of SHRUBS



Some important, common, and potential pests in the Southeastern United States.

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Preface

The most important and common insect and mite pests of 14 kinds of shrubs are covered in this volume. In general, if more than 20 insects have been reported from a shrub since the Plant Disease and Insect Clinic at North Carolina State University began keeping records in 1952, that shrub is included here. Conifers, dogwoods, and hollies are included even though some of their forms are definitely trees. Most of the conifers (except pine) and hollies produced by Southern nurserymen and used in our landscapes are shrubs. Even the conifers grown for Christmas trees never really attain tree stature before harvest. Although most dogwoods produced in nurseries are small tree forms, dogwoods are a standard product of the nursery industry and are included on that basis. Insect and related pests described in this manual were selected because of the frequency with which the pest was reported to the Plant Disease and Insect Clinic (at least 5 percent of the complaints for the host shrub) or were included because of the frequency with which the pest was encountered by North Carolina Department of Agriculture Nursery Inspectors.

The nursery industry is one of the most highly regulated segments of agriculture. Because nursery stock is examined annually (or more often) by state department of agriculture inspectors, insect and mite problems are often diagnosed by the inspectors, with treatments soon following by the nurserymen. Consequently, nurserymen have become more dependent on nursery inspectors for recommendations on insect and disease control than have growers in other areas of agriculture. We have included a typical statute and sample regulations establishing authority for the nursery inspection program.

The assistance of Ponglerd Kooaroon, whose many excellent illustrations appear throughout this manual, is especially appreciated (Figs. 10; 12; 13; 16D; 24; 27; 38A; 45A,B; 59A,D to F,I; 61A; 64B; 74C; 80; 83; 86B; 89A; 90A; 91A; 92A to C; 100A,E; 101A,C; 107A to C; 110A; 111A; 114A to C; 117A,B; 122A to D; 123B; 124; 127; 129; 130; 133; 134; 138; 139A; and 140A). Likewise, the illustrations of Susan Van Gieson uphold the standard of excellence for the visuals in this manual (Figs. 1; 11A; 19; 22B; 25; 28B; 29B; 33; 36; 41A to D; 42A to C; 43; 44; 45C; 46; 47; 49A; 51E; 55; 56A to C; 57B; 59M; 74B; 82; 90C,D; 91C; 93B to D; 101B; 106D; 110B,D,E; 111B; 112; 113; 114D; 120D; 125; 126; 128A; 131; and 135). The illustrations of James Wilcox are also very much appreciated (Figs. 4B; 5; 17; 20; 22A; 39A; 40D; 57A; 75C; 90E; 92D; 94; 109; 110C; and 141). Other figure credits include S. H. DeBord (Fig. 14), Mary Carmody (Fig. 30), E. O. Essig (Fig. 136), Deborah Hazel (Fig. 85A), E. A. McGregor (Figs. 23, 26), C. S. Papp (Figs. 15, 18, 21, 28A, 39B to D, 56D to F), R. W. Rings (Fig. 51D), Shu Ling Tung (Fig. 3), G. W. Underhill (Fig. 100B to D,F), and J. R. Baker (Figs. 2A; 4A; 6C; 7; 8; 9B,C; 11B; 29A,C; 31; 35; 37; 38B; 41E; 42D; 48; 51B; 58; 59C,H,J to L,N; 60D,F to H; 61B to D,F; 62A; 63; 64A; 67; 68; 69; 70; 72; 73; 74A; 75A,B; 77; 78; 81; 85B,C; 86A; 87; 88; 89C; 90B; 93A; 95; 96; 98; 99; 102; 104A,B,F,G; 106A to C; 107D; 108; 114E; 115; 116; 118D; 119; 120A to C; 122E; 128B to D; 132; and 139B).

Institutions from which we borrowed illustrations include the California Agricultural Experiment Station (Fig. 32), the Connecticut Agricultural Experiment Station (Fig. 6A,B), the Delaware Agricultural Experiment Station (Fig. 52), the Florida Department of Agriculture Division of Plant Industry (Figs. 89B, 97), the Kentucky Agricultural Experiment Station (Fig. 51A,C), the North Carolina Agricultural Extension Service (Fig. 103), the South Carolina Agricultural Extension Service (Fig. 117C), and the United States Department of Agriculture (Figs. 2B; 9A; 16A to C; 29D; 34; 38C; 49B,C; 50; 54; 59B,G; 60A to C,E; 61E; 62B; 65; 66; 71; 76; 79; 84; 91B; 104E; 105; 118A to C; 121; 123A; 137; and 140B,C). The use of these figures is deeply appreciated. The use of color photographs from the South Carolina Agricultural Extension Service is also very much appreciated (Plate 1D; Plate 3U; and Plate 4CC,FF,GG).

The patience of Lela Conrad, Vicki Grantham, Carmen Sasser, Teresa Snell, and Sara Watson as they prepared the typewritten copy of this manuscript is heartily appreciated. The preparation of prints for the color plates by Connie Anderson is gratefully acknowledged.

Special thanks are extended to Maurice H. Farrier, North Carolina State University; Paul R. Heller, Pennsylvania State University; Richard L. Miller, Ohio State University; and Eric Schwimmer, North Carolina State University, for reviewing the manuscript. The time they spent on this manuscript is well appreciated.

J. R. B.
April, 1980

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INSECT and related PESTS of SHRUBS

The plant boom of recent years has spawned a renewed interest in the home landscape. As the number of certified nurseries in the Southeast increases, an increasingly diverse array of ornamental plants is finding its way into both the home yard and the commercial landscape. Although many contractors and weekend gardeners expect shrubs to be relatively maintenance-free, they often realize too late that each plant in the landscape is the favorite food of some menacing insect or mite pest.

Fortunately, insect and mite pests are not usually fatal to their shrub hosts. In fact, it often takes several years for damage by scale insects, mealybugs, and other sucking insects to become noticeable. Pest populations may go unobserved for years, flair up suddenly, and then recede again. For the homeowner and the commercial landscape maintainer, the complete eradication of a pest species often is not vital to the continued beauty of a landscape. Only in a commercial nursery, where the grower has a responsibility to provide uninfested plants to the public, should an earnest attempt be made to keep nursery stock completely free of noxious plant pests.

Minor insect damage may be easily mistaken for a disease, drought, or fertilizer problem. The symptoms can be strikingly similar: chlorosis, wilting, and die-back; as a result, it is not uncommon for insect pests to inflict extensive damage before their presence is realized. Therefore, the first step toward the alleviation of the problem must be pest identification. It is for this purpose that descriptive keys to insect and mite life stages are provided in this introductory section.

Control of Insect and Related Pests

Information concerning the type of pest, its feeding habits, and its life cycle remains essential in determining the appropriate insecticide to use as well as the rate and method of application that will achieve satisfactory control. Since not all insects and mites are a threat to plants, a suspected pest will occasionally be recognized as a harmless or even beneficial species. Consequently, the information within this volume is geared to pest identification and responsible control decisions.

TYPES OF PESTICIDES

Insect feeding habits determine, to some extent, the type of control chemical used. Pesticides can be classified as stomach poisons, contact-residuals, or fumigants; only the first two groups will be discussed here. Fumigants must be used in enclosed areas and have very little application to landscape maintenance or typical commercial nursery conditions.

Chewing insects, such as caterpillars, beetles, and grasshoppers, are the targets of stomach poisons. A diverse array of botanical, organic, and inorganic chemicals make up this group. Stomach poisons must be ingested to kill pests. Since piercing-sucking pests (aphids, mites, leafhoppers, etc.) feed below the plant surface, they may avoid contact with stomach poison pesticides. However, contact-residual chemicals, such as malathion, kill a wider range of pests. Such chemicals poison insects or mites that crawl on treated surfaces, eat treated leaves, or are sprayed directly.

The length of time a pesticide lasts depends to some extent on the chemical group to which it belongs. Materials like the plant-derived pesticide pyrethrin may last less than 1 hour, although similar synthetic pesticides are now being made that linger considerably longer. In general, an insecticide classified as a chlorinated hydrocarbon is long-lasting. A good example is chlordane, which is applied to the soil for termite control. Such a treatment may be effective for several decades. The majority of pesticides recommended for insect and mite control on shrubs belong to the related organophosphate and carbamate groups. Less persistent than chlorinated hydrocarbons, most organophosphates and carbamates do not remain effective for more than 1 to 4 weeks. Many of the organophosphates and carbamates are systemic and may give 6 or more weeks of residual activity in treated plants.

Information on toxicity to man, formulations, chemical groups, and mode of action for most insecticides labeled for

insect control on shrubs is given in the following table. Pesticides listed in this table can be used for controlling pests of shrubs. This listing is ***not*** to be used as recommendations for control but as an aid to better understand the use and classification of pesticides. For proper chemical recommendations, see the current state extension service recommendations.

Column I—Pesticide trade names are listed in alphabetical order with the common name listed in parentheses.

Column II—The LD_{50} listed refers to the acute oral LD_{50} of a rat. LD_{50} indicates the amount of toxicant necessary to effect a 50-percent kill of the rats being treated. It is expressed in weight of the chemical per unit of body weight (mg/kg). The lower the LD_{50}, the more poisonous the chemical. The LD_{50} is based on the pure active ingredient and not on the various formulations that contain that ingredient.

Column III—This column indicates the formulations available for use. Certain formulations are safer than others or are more convenient to use, and these factors should be considered when selecting one of these products.

Column IV—This classification refers to the basic chemical structure of the active ingredient. If a certain pesticide is not giving effective control, a pesticide in a different class may give better results. Many nurserymen continue using the same class of pesticide until it no longer seems effective and then switch to a different class. Others alternate classes with each application. Either method is acceptable as long as applications are thorough. The method used is usually a matter of the nurseryman's preference.

Column V—The mode of action refers to how a pesticide actually kills a pest. Contact insecticides require contact with the insect to be effective. Direct spray on the pest or on an area frequented by the pest is necessary for the pesticide to be effective. Systemic pesticides are absorbed by the plants through the roots and tissue and then ingested by the pest during feeding. Most systemic insecticides that are applied as sprays are also contact pesticides. Granular formulations such as Temik and Di-Syston are systemics designed to be applied to the soil surface but are not contact insecticides.

Column VI—Pertinent information about the pesticide listed is given in this column. Any additional formulation, use, or precautionary information you have about the pesticide should be added to any information already presented. Consult the pesticides and plant protection division of the state department of agriculture or the department of entomology at the state university if more data on these products, or others you have encountered, is needed.

Remember: All pesticides must be used in accordance with the directions for use on the label or labeling. When treating a specific plant or pest, refer to the label and the current state extension service recommendations.

Some Pesticides Labeled for Use on Insects and Related Pests of Shrubs

Pesticide	LD_{50} of pure active ingredient	Formulations	Classification	Mode of Action	Remarks
Acraben (chlorobenzilate)	960	25% WP 45.5% EC	Chlorinated hydrocarbon	Contact	Mites.
Azodrin (monocrotophos)	8-23	55% EC	Organophosphate	Contact, Systemic	Aphids, bugs, caterpillars, leafminers, mites, leafhoppers, sawflies, thrips.
Cygon, De-Fend, Rebelate (dimethoate)	320-380	23.4% EC	Organophosphate	Systemic	Aphids, lace bugs, thrips. Will cause defoliation or deformation of Chinese hollies (*Ilex cornuta*). May damage 'President Clay' and 'Modesty' azaleas.
(diazinon)	300-400	50% WP 48% EC 14.3% G	Organophosphate	Contact	Aphids, caterpillars, leafminers, thrips, whiteflies. May be effective as a soil drench to control certain pests.
Dibrom (naled)	430	58% EC	Chlorinated hydrocarbon	Contact	Spider mites.
Dimecron (phosphamidon)	20-22.4	75.5% EC	Organophosphate	Contact, Systemic	Eastern tent caterpillars, webworms, mites, scales on deciduous fruit crops.
Dipel, Biotrol (*Bacillus thuringiensis*)	Greater than 4,000	1.5-3.2% WP	Bacterial	Stomach	Caterpillars.
Di-Syston (disulfoton)	2.6-12.5	15% G	Organophosphate	Systemic	Lace bugs, leafhoppers, scales, thrips, whiteflies. Control may persist for 6 to 8 weeks from treatment.
Dithione (sulfotepp)	7-10	Fumigant	Organophosphate	Contact	Aphids, mites, thrips, whiteflies.
Dursban (chlorpyrifos)	97-276	15% G 41.2% EC	Organophosphate	Systemic	Borers, caterpillars, leafhoppers, mealybugs, mites, scales, spittlebugs, thrips, whiteflies.
Dylox, Proxol (trichlorfon)	450-630	41.2% EC 80% WP	Organophosphate	Contact	Bugs, caterpillars, leafminers, webworms.
NIA 1240, Vegfru-Rosmite (ethion)	280	25% WP 5% D 46% EC + 82% EC 5% G	Organophosphate	Contact	Scales, lace bugs, mites.
Guthion (azinphos-methyl)	13-16.4	50% WP 22% EC	Organophosphate	Systemic	Aphids, lace bugs, leafhoppers, scales, thrips.
Isotox (mixture)	88-125	EC (mixture)	Carbamate, Chlorinated hydrocarbon, Organophosphate	Systemic	Isotox is usually a mixture of Kelthane, Sevin, and Metasystox R, although the mixture may vary.
Karathane (dinocap)	980	25% WP 48% EC	Nitro-phenoxy	Contact	Mites. Will also control powdery mildew.

EC=Emulsifiable Concentrate WP=Wettable Powder D=Dust G=Granular

Pesticide	LD_{50} of pure active ingredient	Formulations	Classification	Mode of Action	Remarks
Kelthane (dicofol)	809	35% WP 18.6% EC	Chlorinated hydrocarbon	Contact	Mites.
(lindane)	18-125	20% EC	Chlorinated hydrocarbon	Contact	Bark beetles, borers.
(malathion)	1,375	57% EC	Organophosphate	Contact	Aphids, lace bugs, mealybugs, scales, thrips.
Marlate (methoxychlor)	6,000	24.8% EC	Chlorinated hydrocarbon	Contact	Bark beetles, caterpillars, leafhoppers. Long residual action.
Metasystox R (oxydemeton-methyl)	56-180	25% EC	Organophosphate	Contact, Systemic	Aphids, lace bugs, leafhoppers, mites, thrips.
Morestan (oxythioquinox)	2,500-3,000	25% WP	Miscellaneous quinoxaline	Contact	Mites. Used as a prebloom spray on most deciduous fruits and in both prebloom and postbloom sprays on apples and pears.
Omite (propargite)	2,200	70% EC 30% WP 4% D	Phenoxysulfite	Systemic	Mites. Widely used on fruit trees. Does not affect bees and is less harmful than many other acaricides to predatory mites. Has residual killing action.
Orthene (acephate)	945	15.6% EC 75% WP	Organophosphate	Contact, Systemic	Aphids, caterpillars, lace bugs, leafhoppers, thrips, webworms. May be phytotoxic to young tender growth. Moderate persistence with residual systemic activity of approximately 10 to 15 days.
Pentac (dienochlor)	3,160	50% WP	Chlorinated hydrocarbon	Contact	Mites. Has long residual action, although slow in action initially. Most effective during cold weather.
Plictran (cyhexatin)	540	50% WP	Metallo-organic (tin base)	Systemic	Mites.
Sevin (carbaryl)	500	50% WP	Carbamate	Stomach, Contact	Chewing pests, thrips.
Summer Oil (petroleum oils)	Greater than 4,000	95% EC	Petroleum	Contact	Aphids, lace bugs, scales, mites.
Systox (demeton)	2.5-12.0	25% EC 66% EC	Organophosphate	Systemic	Aphids, lace bugs, mealybugs, mites, whiteflies. Rapidly penetrates plant tissues and is translocated in the plant and detoxicated.
Tedion (tetradifon)	14,700	Fumigant 25% WP	Sulfonate	Contact	Effective in killing larval stages of mites.
Temik (aldicarb)	0.93	10% G	Carbamate	Systemic	Aphids. Do not use with lime or other highly alkaline materials. Temik should not be mixed with other pesticides or fertilizers prior to use.
Thiodan (endosulfan)	30-110	24.2% EC 50% WP	Chlorinated hydrocarbon	Contact	Aphids, borers, mites, weevils, whiteflies.
(toxaphene)	69	20% D	Chlorinated hydrocarbon	Contact	Bagworms, fall armyworms, lace bugs, leafhoppers, earwigs.
Trithion (carbophenothion)	32.2	25% WP 45% EC	Organophosphate	Contact, Systemic	Aphids, mealybugs, mites, bagworms, potato leafhoppers, scales. Long residual action.
Vapona, DDVP (dichlorvos)	56-80	23% EC Smoke generator	Organophosphate	Contact, Stomach, Fumigant	Aphids, mites, whiteflies.
Vendex (fenbutatin-oxide)	2,000	50% WP	Metallo-organic (tin base)	Contact	Mites.
Vydate L (oxamyl)	5.4	24% EC	Carbamate	Systemic	Flea beetles, mites, nematodes.
Zectran (mexacarbate)	19	25% WP	Carbamate	Contact	Aphids, caterpillars, mites, scales. Product discontinued by manufacturer.

WHEN TO TREAT

Frequently the homeowner and commercial landscape maintainer are faced with the difficult question of whether or not to spray. Unfortunately, there are no pat answers. A decision of this type requires the careful consideration of several factors. Some of these include 1) the type of damage the pest causes, 2) the size of the pest population, 3) the pest's stage of development, 4) the location of the pest on the plant, 5) the cost of control, and 6) the consequences if no control effort is made.

Once it is established that an insect or mite is a pest, pertinent information concerning its habits and life history should be explored. For example, find out if it has chewing or sucking mouthparts, at which stages it is destructive, the number of generations it has each year, its favorite food, and the extent to which it is protected by the plant. This information should suggest when, how, and whether or not the pest can be controlled.

Whether or not the pest should be controlled depends largely on the size of the population. Often low numbers of pests on shrubs pose little threat. However, once populations reach a certain level, control measures become necessary. This level, or "aesthetic threshold," varies greatly from pest to pest, and in most cases it depends upon the plant's placement in the landscape and the fastidiousness of the landscaper. For example, 10 to 20 caterpillars per shrub may cause serious defoliation, whereas 10 to 20 aphids would hardly be noticed. Yet the aphids' reproductive capacity is so great that they may number in the thousands a week or so later. Therefore, certain pests should be controlled at the first sign of their presence because they will likely increase in number and cause considerable damage. On the other hand, with some pests and on certain plants, infestations should be watched closely and treated only if the injury gets progressively worse. A camellia heavily infested with tea scale near a walkway might warrant treatment, whereas a similarly infested camellia

that is ordinarily viewed from 30 feet might not need treating.

HOW TO TREAT

A person may take the time and trouble to spray his plants only to be disappointed with the results. Although the chemical is usually blamed, this conclusion is rarely well founded. As a matter of fact, errors in pesticide application, such as improper storage, improper timing, and wrong concentration, most often account for apparent pesticide failure. The best, most expensive insecticide available will produce poor results unless it is applied thoroughly and at the proper time. To be most effective, the pesticide must be applied when pests are present and vulnerable, and at the proper rate in sufficient gallonage to permit thorough coverage of the upper and lower surfaces of the leaves and branches. However, even a well-timed and thorough application is likely to be a failure if the correct pesticide is not used. Since few insecticides control all insects and mites, carefully check the label to make sure the chemical in hand is registered to control the problem pest.

Environmental conditions also affect the efficacy of a pesticide application. At temperatures below 10°C (50°F) or above 35°C (95°F), insecticides may lose some of their activity. Therefore, applications other than dormant oils are usually not recommended in winter. Warm weather applications are best made in early morning or late evening when the wind is still and the temperature cool.

Shrubs may be reinfested by a resurgence of the original pest population or by other flying insects. Even if a large percentage of pests in an infestation is killed, those remaining may rebuild the population to damaging levels. Such an occurrence is not unusual, since most insecticides applied to shrubbery last only 1 to 7 days. Therefore, recommendations often emphasize repeated applications at specific intervals to eliminate the pests.

Last of all, improper pesticide storage is a possible contributor to pesticide inefficacy. Insecticides and miticides tend to degrade over a period of time once they have been opened. This problem may be common for the homeowner who purchases more pesticide than can be used in a single year or season. Moisture, air, light, and temperature extremes all adversely affect stored chemicals. Generally, pesticides should be stored in a dry, dark place where the temperature never falls below freezing or exceeds 38°C (100°F).

Home Yard—Amateur gardeners generally have a fairly large arsenal of pesticides labeled for home use, especially for home yards. They are willing to take the time to do a thorough job and often do as well at ornamental plant pest control as commercial growers and landscapers. However, amateurs are often taken unawares by insects and other pests because they lack expertise in diagnosing and controlling them.

A variety of applicators is available to the amateur gardener. Dusters apply pesticides in a form that requires no mixing. Although not as efficient as sprayers, dusters offer quick, convenient, and visible application. Plants should be dusted when there is little or no wind to prevent excessive drift.

Trombone and hose-end sprayers also work well for the amateur. With the trombone sprayer, pressure is developed by moving a slide that sucks up the premixed pesticide with one motion and forces it out the nozzle with the next motion. The trombone sprayer is portable, but the spray is somewhat intermittent; consequently, getting uniform coverage may not be easy. Hose-end sprayers use water pressure to dilute and deliver pesticides to the target pest. Concentrated pesticide is placed in the hose-end sprayer and partially diluted; then water pressure siphons, dilutes, and propels the pesticide to the desired area.

Obviously, the length of the hose limits the range of the hose-end sprayer. Sprayers that use air pressure to force diluted pesticide from a nozzle are available in various sizes and price ranges. These offer uniform coverage and are portable. Many sprayers are equipped with adjustable nozzles, which allow a very fine to coarse spray pattern. For the big-time gardener, electric and gasoline-powered models are available.

Care of spray equipment is not difficult. As long as a duster is kept dry, no other maintenance is required, except for an occasional drop of oil on the plunger rod or other moving parts. Sprayers with metal tanks should be washed out three times with clear water after each use to prevent corrosion from ruining even stainless steel sprayer tanks. A tablespoon or so of household ammonia, shaken thoroughly, will neutralize corrosive effects of any insecticide residue and prolong the life of metal sprayer tanks. Sprayers fitted with strong plastic parts, which do not corrode, should also be rinsed after each use. The tank should then be allowed to dry completely. The plunger rod should be lightly oiled.

Commercial Landscape—Shrub insect control in the commercial landscape is similar to control efforts in home yards. However, commercial landscapes include parks, gardens, cemeteries, grounds around public buildings, and other large areas that may require more sophisticated equipment. Various sizes and types of hydraulic sprayers, which deliver a high gallonage under high pressure, are more convenient when spraying involves such large areas. Both manual and motor-driven models are available with tank capacities up to 300 gallons.

Intensity of pest control in the commercial landscape not only varies with the pest species and host plant susceptibility but also depends on the frequency of use of the landscaped area and on the range from which landscape plants are viewed. For instance, plants in a rose garden through which many people pass each day would certainly be more intensely maintained than shrubs used as a screen at the outer boundaries of a large landscape.

Eradication of a pest is usually not as important to the commercial landscape maintainer as it is to the homeowner or even more particular nurseryman. Scale insects on evergreen shrubs may be treated every 3 to 4 years if the shrubs are not close to a sidewalk and if the scales are not causing severe stress to the shrubs. The commercial landscape maintainer might treat once to reduce the population greatly rather than the two to four times required to eradicate the pest population. However, if a shrub infested with scales is close to a walkway and subject to scrutiny by the public, eradication might be considered to alleviate alarm over the scale infestation.

If the commercial landscape maintainer is fortunate enough to be able to select the plants for a landscape, he may be able to eliminate many pest problems by avoiding plants that are infested by pests and by avoiding plant varieties that are difficult to maintain free of pests (roses, boxwoods, Helleri holly, firs, spruces, and white pine).

Nursery—Control of pests in the nursery is unique among such endeavors in agriculture. Because the product sold is a living plant (usually with accompanying soil), the chances of spreading parasites with plants are high. Consequently, it behooves the nurseryman to keep his plants free of noxious insects, diseases, and weeds as much as possible. Many pest problems in the landscape encountered by homeowners and professional landscape maintainers are directly related to pests that accompanied nursery stock from a commercial nursery.

Another unique aspect of pest control in the nursery industry is the aid provided by the state department of agriculture in the identification of pests during the annual nursery inspection. Department of agriculture inspectors often diagnose pests and suggest control measures; consequently, the grower is at once informed of the problem and its solution so that remedial control measures can be taken immediately. Should the nurseryman not comply with suitable control measures, the inspector, as a last resort, can stop sales of the infested nursery stock (see Appendix III).

Many nurserymen recognize the gravity of pests infesting nursery stock and often apply insecticides and acaricides on a preventative, or prophylactic, basis. Usually a mixture of insecticide/acaricide is applied on a 2-week or monthly basis during the growing season. Thus the nurseryman is relatively assured of complete insect and mite control.

Other nurserymen depend on their own inspection of their nursery stock. This method saves time and money over the preventative method, but it is more risky if plants are not inspected on a regular basis. Pest problems may escape notice until economic damage has occurred and the stock must be discarded or held until new foliage obscures pest damage.

Nurserymen are constantly searching for ways to cut costs. Many grow varieties that are hardy and relatively pest-free. This may seem like an easy way out, but the benefits for the consumer are more than imaginary. If the nurseryman must constantly struggle to control southern red mites on a variety such as the Helleri holly, think what a headache that plant will be in the home yard or commercial landscape! Unless they are given constant scrutiny for mites, chances are these plants will always have a chlorotic appearance and uneven growth. If the nurseryman grows varieties that he can maintain with ease, the consumer will start with a vigorous plant and will probably encounter fewer problems with maintenance.

When pest problems are encountered, the nurseryman may call the county extension agent or the nursery inspector for control information. He may also consult with state extension service recommendations, which give information on insect, mite, and disease control; plant growth regulations; and weed control. Suggestions for pest control are also found in nursery association publications, which are available to members. Furthermore, nursery trade journals occasionally carry articles on pest control in the commercial nursery. The following section describes the origin and purpose of pest control and typical regulation of pests in the commercial nursery.

Nursery Industry Plant Inspection Program

PLANT CERTIFICATION, AN INTERNATIONAL SYSTEM OF DEFENSE AGAINST PLANT PESTS

Plant pest quarantines and regulations exist in some form in practically every country in the world. Their purpose is to act as the first line of defense to protect agriculture against the invasion or spread of plant pests, such as insects, weeds, or plant diseases. Plants with soil and roots attached present an ideal medium in which to move plant pests, because a plant can essentially serve as a "mini-environment" for pest organisms. The mobility of plants and plant products, and the potential for spread of pests through this medium, have been major factors in the development of inspection requirements for nursery stock and other plant material and for the inclusion of such material as regulated items in many plant pest quarantines.

Plant certification requirements or nursery inspection regulations can at times cause nurserymen and other plant producers inconvenience and additional expense, but such requirements form just one link in a protective chain in a national and international plant protection system. Every state in this country has inspection requirements for plants that must be met before such material is eligible for sale or movement, and this is also the case with foreign countries (Appendix I). Participation in a system that requires one state's nurseries to meet the requirements of other states or countries into which nursery stock is shipped works as a two-way street. All plant material shipped into the state must meet state standards and be inspected by the certification agency in the state or country of origin.

HISTORY OF NURSERY INSPECTION AND PLANT PEST LAWS

The first state law establishing regulations concerning the movement of plants, with the objective of restricting the spread of a plant pest, was enacted in Michigan on May 1, 1875, in regard to the peach yellows disease. The first national legislation concerning plant pests was introduced in 1892 and failed to receive consideration. Other efforts followed, but it was not until the Federal Plant Quarantine Act of 1912 was passed that authority regulating imports of plant material from other countries and authority for domestic plant pest quarantines were established. During the period from the 1880's through the 1920's, many state plant pest laws were established with authority to require some type of nursery inspection. During the early years of

state regulation, the major problem with state requirements was lack of uniformity. This created problems for nurserymen engaged in interstate commerce.

In the period from 1919 to 1925, a system of regional plant boards and a national plant board composed of state plant pest regulatory officials was established. The system provides a forum in which plant pest problems related to the nursery industry can be addressed, and the system has led to the adoption of more uniform inspection requirements between states.*

STATUTORY AUTHORITY FOR A NURSERY INSPECTION PROGRAM

The basic authority to conduct a nursery inspection program is typically contained in the general statutes of the state laws (Appendix II). The statutes also contain the basic authority for most plant protection activities conducted by the state department of agriculture. Regulations that give specific authority to establish nursery inspection programs and govern the conduct of the nursery inspection program in the state as well as the movement of nursery stock into and within the state are adopted pursuant to the plant pest law and are contained in the state administrative codes (Appendix III).

OTHER PLANT PEST QUARANTINES AFFECTING THE MOVEMENT OF NURSERY STOCK

The state plant pest laws not only contain authority to establish nursery inspection requirements but also authority to establish quarantines to protect plants and plant products in the state. These quarantines are usually adopted as regulations pursuant to the state plant pest laws and may impose additional requirements on the movement of nursery stock within the state. The state quarantines listed here are examples of such regulations:

1. Imported Fire Ant Quarantine
2. White Pine Blister Rust Quarantine (only plants in genus *Ribes*)
3. Witchweed Quarantine

These quarantines require that nursery stock grown inside a regulated area be certified free of the pest before movement outside such an area. The entire state may be designated a blister rust control area; and, under terms of the White Pine Blister Rust Quarantine, it is illegal to plant currant and gooseberry plants of the genus *Ribes* in the state, since they serve as the alternate host for this serious white pine disease.

The Plant Protection and Quarantine Program of the Animal and Plant Health Inspection Service of the United States Department of Agriculture (USDA, APHIS, PPQ) is the federal agency charged with administering quarantines on plant pests that have the potential of affecting more than one state. This agency is responsible for certification of nursery stock and other plant material when it is a regulated article under the terms of any federal quarantine. USDA, APHIS, PPQ currently administers two federal quarantines (imported fire ant and witchweed) in the Southeast. The state quarantines on these pests are fundamentally the same as the federal quarantines; this enables the state and federal agencies to work together in enforcement. Furthermore, these cooperative programs authorize the inspectors of both agencies to issue certification under either set of regulations.

The inspection of nursery stock is one means of protecting agriculture from plant pests. The inspection process is primarily geared to prevent the introduction and inhibit the spread of new pests. Inspection also helps to prevent the movement of other pest species into areas where they are not of general occurrence and their presence is not desired. In the total perspective of pest control for insects and related pests of shrubs, exclusion by plant pest regulations is one method. After pests have been introduced, regulations are not usually effective because of pest biology, climatic factors, economic considerations, or other factors.

PESTS REGULATED DURING INSPECTION

The following insects and related pests are subject to regulatory action by most states. This list serves as a reference to alert nurserymen, other plant growers, and interested parties to the requirements for plant material to be shipped from one state to another (see Appendix I). For more information concerning plant pest regulations, consult the state department of agriculture, pesticide and plant protection division.

* White, R. P. 1975. *A century of service.* Amer. Assoc. Nurserymen, Inc., Washington, D.C. 521 pp.

Pests Regulated During Inspection

1. **Aphids, Leaf-Feeding** ..... p. 113, 133, 155, 161, 181
2. **Azalea Caterpillar** ..... p. 55
3. **Bagworm** ..... p. 85
4. **Balsam Woolly Adelgid** ..... p. 89
5. **Black Vine Weevil** ..... p. 165
6. **Boxwood Leafminer** ..... p. 63

7. **Brown Garden Snail—*Helix aspersa* Müller (Fig. 1)**

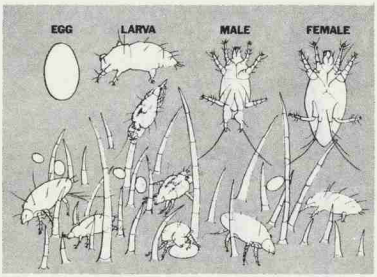
Now found in South Carolina, Louisiana, Arizona, and California, brown garden snails may hitch rides on nursery stock as snails with shells 5 to 30 mm across or as 2.5-mm eggs in soil 25 to 35 mm deep. Each snail may lay 430 eggs per year throughout the growing season. About 10 months is required for complete development. The shell is yellow to brown with chestnut spiral bands. The bands are sometimes interrupted by yellow flecks or streaks, and the surface of the shell is slightly wrinkled.

Fig. 1 Brown garden snail.

8. **Caterpillars** ..... pp. 55, 59, 83, 85, 95, 97, 117, 151, 159, 167

9. **Cyclamen Mite—*Steneotarsonemus pallidus* (Banks) (Fig. 2)**

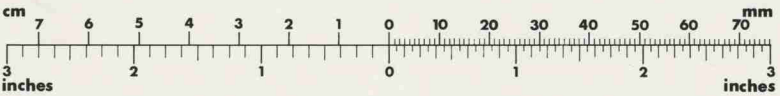
Cyclamen mites are microscopic tarsonemid (thread-legged) mites that feed in the buds and growing tips of many ornamental plants (also damaging to strawberries), causing unusual stunting and twisting of new growth. These mites avoid light and low humidity. Wrinkled nymphs hatch from eggs laid by the female. There is one molt. Cyclamen mites are very sensitive to heat and to miticides.



2A

2B

Fig. 2 Cyclamen mite. A, Stages of the cyclamen mite. B, Delphinium damaged by cyclamen mites.



10. Dogwood Borer ..... p. 117

11. Eastern Spruce Gall Adelgid ..... p. 91

12. European Red Mite—*Panonychus ulmi* (Koch) (Fig. 3)

European red mites infest many fruit and woody ornamental plants. The adult mite is velvety red, and the egg has a central hair (stipe). This mite can be differentiated from the very similar southern red mite by the darker color of the southern red mite and by the small, white bumps at the bases of the long hairs, which are lacking in the southern red mite. The very similar citrus red mite has red bumps and is usually darker. European red mites feed on the leaves, causing chlorotic stippling and premature leaf drop.

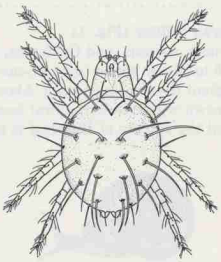


Fig. 3 European red mite.

13. Gall Mites—Eriophyidae (Fig. 4)

Eriophyids are microscopic gall-forming mites whose presence is noticeable because of their feeding injury, which causes the host plant to form galls (some eriophyids do not cause galls). Unusual galls, damaged (blasted) buds, and distorted new growth are often signs of an infestation. Gall mites mate, lay eggs, and develop through two nymphal stages before the adult stage. These mites are the only plant-feeding mites with two pairs of legs.

See also Privet Rust Mite ..... p. 145

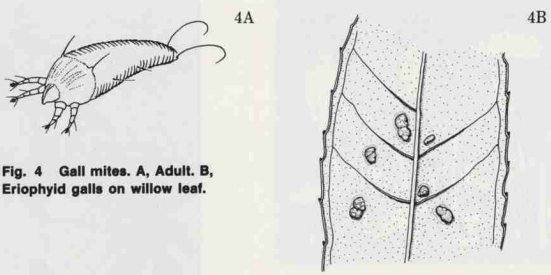


Fig. 4 Gall mites. A, Adult. B, Eriophyid galls on willow leaf.

14. Giant African Snail—*Achatina fulica* Bowdich (Fig. 5)

The giant African snail, as its name implies, is a huge snail (up to 125 mm) found in Africa. It also occurs in Indonesia and Hawaii. An infestation in Florida was eradicated in 1975. The eggs are elliptical (about 4 by 5 mm) and pale yellow. They are laid in batches of about 100 to 400. The eggs hatch in about 1 month, and 6 months later the snails are mature enough to begin laying eggs. (The snails are then about 35 mm

long.) These snails, as well as our endemic snails and slugs, lay their eggs in moist, protected places. They avoid bright, hot, dry conditions and may hide under loose boards, flats, pots, meter boxes, or other places. Giant African snails can be very damaging to ornamental plant foliage, bark, and even painted surfaces. Mature snails are mottled or striped with reddish brown and cream. The shell has a conical spiral shape.

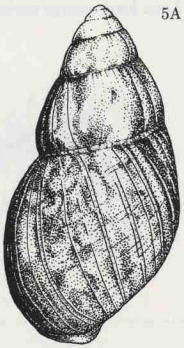


Fig. 5 Giant African snail. A, Adult. B, Egg.

15. Gypsy Moth—*Lymantria dispar* (Linnaeus) (Fig. 6)

The gypsy moth is a great potential threat to hardwood stands in the Southeast. The eggs hatch and the larvae feed from April to June. The larvae then pupate, and 7 weeks later the adults emerge to mate and lay eggs. The summer, fall, winter, and early spring are spent in the egg stage. The female moth is white, sometimes with some black spots. Females usually cannot fly. The male moth is grayish brown and spotted. The pupa is dark grayish brown. The caterpillar has five pairs of blue dots and six pairs of red dots down the middle of the back. The egg mass is tannish and covered with fine, matted hairs. Gypsy moths are transported in the egg mass, which may be laid under a trailer or car, and by ballooning (hanging by a silk thread in the wind) of first-stage larvae.

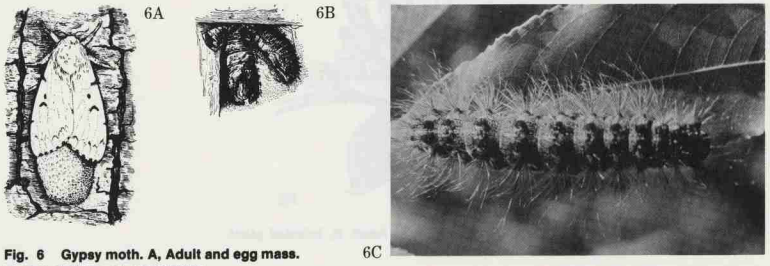
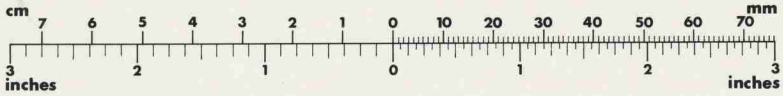


Fig. 6 Gypsy moth. A, Adult and egg mass. B, Pupal skins. C, Caterpillar.



16. Imported Fire Ants—*Solenopsis* spp. (Fig. 7)

Imported fire ant workers are 3 to 6 mm long and reddish to dark brown. A large colony may build a mound 45 cm high and 60 cm across. The fourteen counties now infested by the red imported fire ant in North Carolina represent the northern limit of its range. This ant is annoying because of its vicious sting (and resulting pustule) and because of its unsightly mounds, which may cause problems in harvesting crops. Swarms of winged reproductives (up to 9 mm long) emerge during the spring and summer to form new colonies.

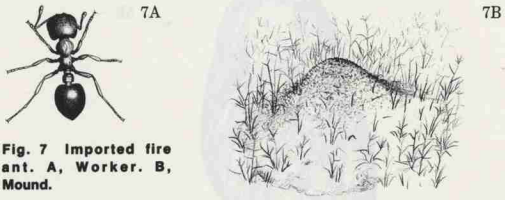


Fig. 7 Imported fire ant. A, Worker. B, Mound.

17. Japanese Beetle ..... p. 179

18. Japanese Weevil ..... p. 141

19. Lace Bugs ..... pp. 57, 157, 169

20. Mealybugs—Pseudococcidae (Fig. 8)

Mealybugs are sucking pests of ornamental plants. Mealybugs are often covered by a powdery bloom of wax, and they feed on all plant parts. Most species lay eggs. Nymphs hatch and begin feeding and developing the white, waxy covering. Male mealybugs are tiny, gnatlike insects. Females are usually oval, always wingless, and frequently have tiny "hairs" of wax around the periphery.

See also Azalea Bark Scale ..... p. 53

Fig. 8 Mealybug. A, Adult. B, Infested plant.

21. Nantucket Pine Tip Moth ..... p. 97

22. Narcissus Bulb Fly—*Merodon equestris* (Fabricius) (Fig. 9)

The narcissus bulb fly is a stout hover fly that resembles a bee. Eggs are laid at the crown of bulb crops in early summer. Maggots hatch and bore into the bulb. The bulb is hollowed out by the feeding of the maggots and usually rots because of secondary fungi and bacteria. There is usually one generation per year. When mature, the whitish or yellowish maggot (about 20 mm long) turns into a puparium. The new adult then emerges to mate and lay eggs.

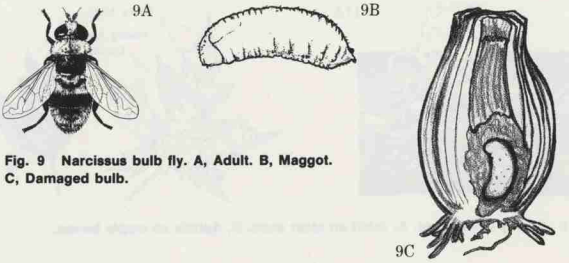


Fig. 9 Narcissus bulb fly. A, Adult. B, Maggot. C, Damaged bulb.

27. Whitefringed Beetles—*Graphognathus* spp. (Fig. 10)

Whitefringed beetles are short-snouted weevils that feed as grubs on the roots of field, vegetable, and ornamental crops and as adults on the foliage. This pest cannot fly, and there are no males. During the summer, eggs are laid on some object in contact with the soil and grubs hatch to feed. The grubs overwinter and pupate the next spring. The adult is brownish gray (about 11 mm long) with a white band on each side of the wing covers. The yellowish-white larva (grub) is legless and has a brown head. The grub is the most damaging stage.

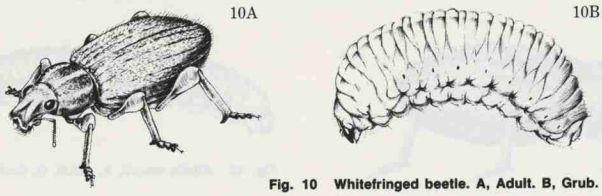
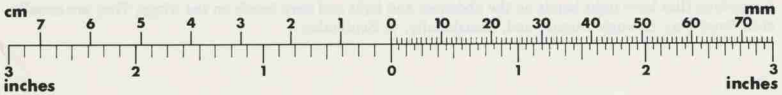


Fig. 10 Whitefringed beetle. A, Adult. B, Grub.



29. Woolly Alder Aphid—*Paraprociphilus tessellatus* (Fitch) (Fig. 11)

The woolly alder aphid migrates from alder stems in late fall to lay eggs on the bark of soft maples. These eggs hatch in the spring, and the new aphids feed on maple leaves. Here they cause leaf distortion and contamination with honeydew and sooty molds. The aphids reproduce on maple leaves until early summer, when they fly back to alder. The aphids are covered with a dense, woolly, white secretion of wax. The migratory forms are winged.

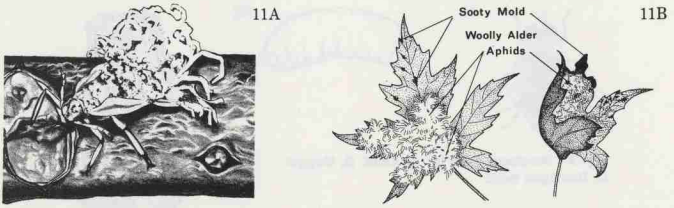


Fig. 11 Woolly alder aphid. A, Adult on alder stem. B, Aphids on maple leaves.

30. Woolly Apple Aphid ..... p. 161

The following pests, with a few exceptions, are regulated by states outside the Southeast. When noted in a commercial nursery or in a plant dealership, these pests should be eliminated or reported to a plant inspector, who will advise proper action.

31. Alfalfa Weevil, *Hypera postica* (Gyllenhal) (Fig. 12)

12 Although not a pest of ornamental plants, the alfalfa weevil and its larva (grub) may be transported inadvertently in container nursery stock, particularly that in which clover covers the soil surface. The 5- to 6-mm-long weevil may be either light brown with a dark stripe down its back or entirely dark in color. The legless, wrinkled, 0.75- to 9.5-mm-long larva is leaf green with a white stripe down its back and along each side. Appearing in early spring and again in summer, adult weevils notch the leaves and stems of alfalfa and clovers. Present for 3 to 4 weeks in late spring, the larvae skeletonize foliage.

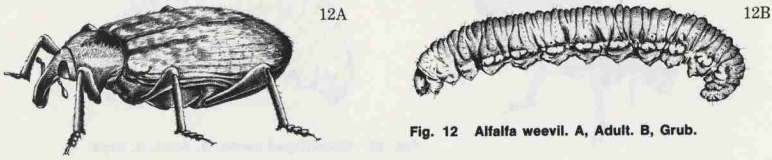


Fig. 12 Alfalfa weevil. A, Adult. B, Grub.

32. Apple-Blueberry Maggots, *Rhagoletis* spp. (Fig. 13)

These two closely related maggots feed within the fruit of apple, blueberry, cherry, crabapple, hawthorn, huckleberry, pear, or plum during the summer. White with pointed heads, they eventually pupate in the soil within hardened, reddish- or yellowish-brown skins (puparia). Adult flies usually emerge from pupae the following spring but may appear late the same fall or in the spring 2 or 3 years later. The dark-brown, 6-mm-long flies have light bands on the abdomen and light and dark bands on the wings. They are usually seen from May through August and, occasionally, in September.

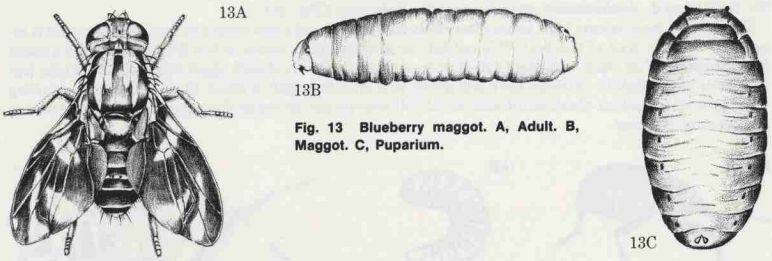


Fig. 13 Blueberry maggot. A, Adult. B, Maggot. C, Puparium.

33. Argentine Ant, *Iriodomyrmex humilis* (Mayr) (Fig. 14)

Primarily a problem in the southern tier of states, especially California, and in the Mississippi Valley, these tiny, brown ants survive only where winters are warm. They are an indirect threat to many plants, particularly citrus, because they protect harmful aphids, scales, and mealybugs from attack by parasites and predators. Argentine ants nest in the soil near infested plants; transport aphids, scales, and mealybugs to suitable host plants; and then feed on the honeydew produced by these pests.

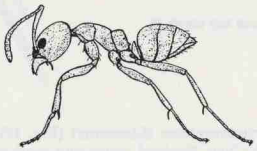


Fig. 14 Argentine ant worker.

34. Black Walnut Curculio, *Conotrachelus retentus* Say (Fig. 15)

Feeding almost exclusively on black walnut, this pest occurs from New Jersey and Pennsylvania south to North Carolina and Mississippi and west to Kansas and Missouri. Emerging in late summer or early fall and again in the spring, this reddish-brown snout beetle (curculio) has a grayish pubescence and measures 6 to 7 mm long. In spring it feeds on new growth and lays eggs on young nuts. The white, legless, up to 11-mm-long larva consumes the contents of young nuts or the husks of older nuts. Infested nuts fall from the tree when the larva is about half grown. Once mature, the larva enters the ground to pupate and emerges 2 to 3 weeks later as an adult beetle, usually in late August. The beetle feeds for a while before hibernating in forest litter.

Fig. 15 Black walnut curculio.

35. Boll Weevil, *Anthonomus grandis grandis* Boheman (Fig. 16)

Though boll weevils have been taken from *Hibiscus syriacus* and a few closely related weeds, cotton is essentially the only host of this pest. This reddish- or grayish-brown weevil is 3 to 8.5 mm long, has a snout half the length of its body, and bears a distinctive spur on the inside of each upper front leg. The white, legless larva has a slightly wrinkled body and grows to a mature length of about 13 mm. Damaging fruiting structures of the cotton plant, adult and larval boll weevils can be found throughout the growing season and most of the year.

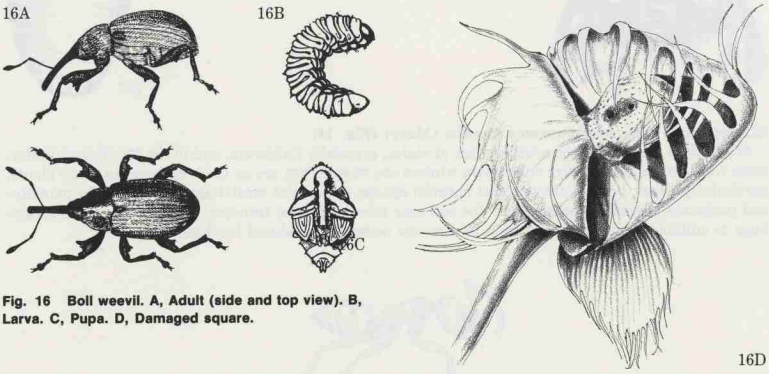


Fig. 16 Boll weevil. A, Adult (side and top view). B, Larva. C, Pupa. D, Damaged square.

36. Browntail Moth, *Euproctis chrysorrhoea* (Linneaus) (Fig. 17)

Most commonly a problem in the New England states and southeastern Canada, the browntail moth caterpillar feeds on the foliage of apple, cherry, hawthorn, pear, plum, rose, white oak, and willow. This worm has a dark-brown or black body up to 38 mm long with long, bristly hairs, a row of white spots along each side, and two red spots near the tip of the abdomen. The long hairs are irritating to human skin. The caterpillars appear from September through May, spending the winter in silken webs attached to leaf clusters. Appearing throughout July, the white moths have brown-tipped abdomens and wingspans of up to 38 mm.

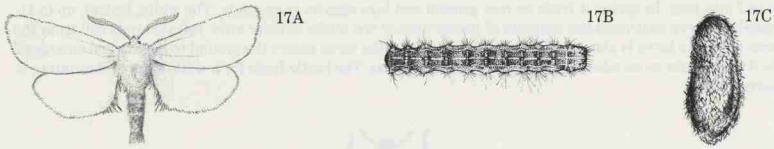


Fig. 17 Browntail moth. A, Adult. B, Caterpillar. C, Cocoon.

37. Butternut Curculio, *Conotrachelus juglandis* LeConte (Fig. 18)

From the Atlantic Coast westward to Texas, Kansas, and Wisconsin, this pest infests butternut, walnut, and hickory. About 5 to 7 mm long, the reddish-brown snout beetle adult has grayish-yellow markings, a broad, white band across the tips of the wing covers, and several discernible humps in the wing covers. It feeds on nuts, tender twigs, and leaf petioles while laying eggs on new twig growth or small nuts. In June and July, tiny, white, legless larvae hatch from the eggs and burrow in nuts, young shoots, leaf petioles, and stems, destroying much new growth. Once fully grown, larvae burrow into the ground to pupate. The new generation of adult beetles forms the overwintering stage.

Fig. 18 Butternut curculio.

38. Cereal Leaf Beetle, *Oulema melanopus* (Linnaeus) (Fig. 19)

Distributed from Maine into the northernmost North Carolina counties and westward into Wisconsin, Iowa, and Missouri, the larva and adult of this imported pest infest most small grain crops as well as many other grasses. The adult beetle has a metallic, blue-black body about 6 mm long, brownish-yellow legs, and a reddish-brown area behind the head. About the same size as the adult, the globular, yellow larva is covered with a coating of black fecal material. Though present most of the year, the beetle is most active in early spring and in June, at which times it leaves many holes in foliage. Found primarily in April in North Carolina, the larva feeds superficially on the upper leaf surface.

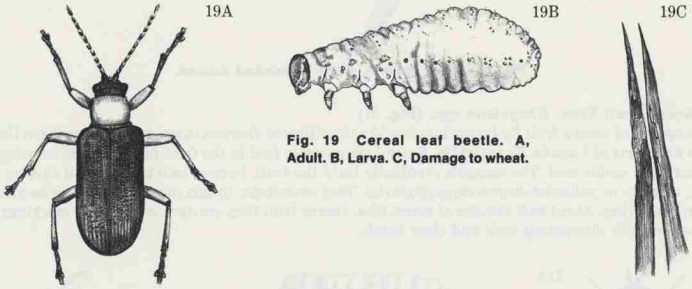
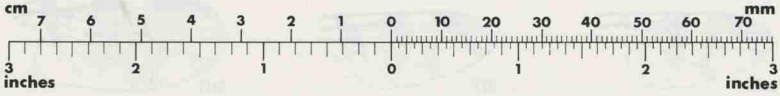


Fig. 19 Cereal leaf beetle. A, Adult. B, Larva. C, Damage to wheat.



39. Chaff Scale, *Parlatoria pergandii* Comstock (Fig. 20)

Occurring primarily in Gulf states, chaff scales feed on many ornamental plants but are particularly pests of citrus, viburnum, and jasmine. Congregating on bark, leaves, and fruit, they suck plant sap, causing the host to lose vigor. They feed throughout the growing season and overwinter on the plant. Less than 2 mm in diameter, the oval to circular female scale is dark purple with a gray-brown, shell-like covering. The white immature male is smaller and narrower than the female.

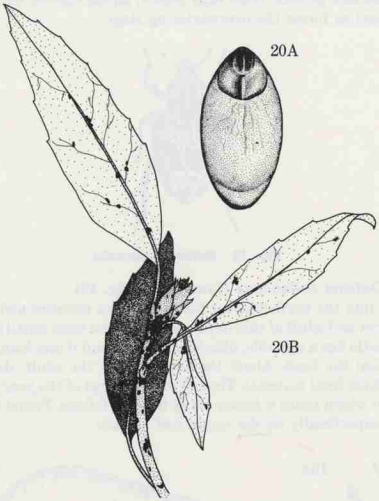


Fig. 20 Chaff scale. A, Adult. B, Infested *Aucuba*.

40. Cherry Fruit Flies, *Rhagoletis* spp. (Fig. 21)

Two species of cherry fruit fly larvae infest wild and cultivated cherries throughout the northern United States and parts of Canada. These white, 6-mm-long maggots feed in the fruit near the seed, causing the cherries to be malformed. The maggots eventually leave the fruit, burrow into the soil, and develop hardened, reddish- or yellowish-brown skins (puparia). They overwinter in this condition, giving rise to adult flies in the spring. About half the size of house flies, cherry fruit flies are dark with yellow markings and have wings with alternating dark and clear bands.

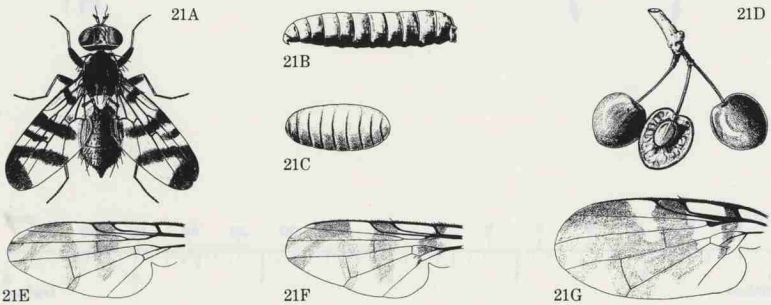


Fig. 21 Cherry fruit flies. A to D, European cherry fruit fly. A, Adult. B, Maggot. C, Puparium. D, Damage. E, Cherry fruit fly wing. F, Western cherry fruit fly wing. G, Black cherry fruit fly wing.

41. Citrus Blackfly, *Aleurocanthus woglumi* Ashby (Fig. 22)

Actually a slate-blue "whitefly" only a few millimeters long, this pest occurs in India, Mexico, southern Asia, Florida, and Texas. Currently, it is a potential threat to North Carolina. The wingless nymph is black, flat, ovate, and shiny with a waxy marginal band and a green spot on the abdomen. Infesting plants such as citrus, mango, persimmon, pear, quince, coffee, myrtle, cherimoya, and sapote, these pests feed on plant sap, causing the foliage to yellow and dry out. Tiny, stalked eggs are deposited in a spiral pattern on the undersides of leaves.

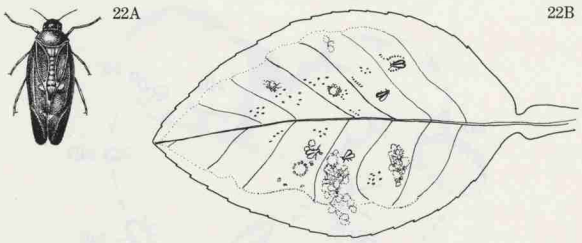


Fig. 22 Citrus blackfly. A, Adult. B, Infested citrus leaf.

42. Citrus Bud Mite, *Eriophyes sheldoni* Ewing (Fig. 23)

Although practically cosmopolitan in distribution, citrus bud mites are most often a problem along the coasts of California, Florida, and Hawaii in this country. Preferring citrus, particularly lemon, these microscopic mites (170 to 180 microns long) are usually concealed under bud scales, within flower buds, under fruit buttons, or at the base of petioles, where feeding causes both floral and vegetative buds to blacken and die. Infested buds, which do not abscise, give rise to misshapen leaves or blossoms. At warm temperatures and high humidities, citrus bud mites may produce a new generation every 10 days.

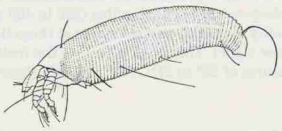
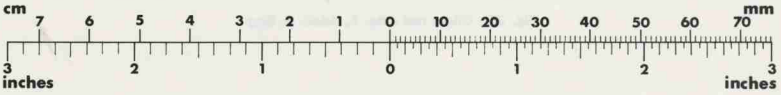


Fig. 23 Citrus bud mite.



43. Citrus Mealybug, *Planococcus citri* (Risso) (Fig. 24)

Though occurring outdoors only in the southern United States and southern Europe, citrus mealybugs may be found in greenhouses farther north. The powdery, white female adults (3 mm long and 1.5 mm wide) and the smaller, pale-yellow crawlers infest 27 plant families, including many ornamental species. Infestations are often not detected early because the mealybugs wedge themselves into plant crevices. Sucking sap and excreting honeydew, they eventually cause distorted growth, premature leaf drop, and the death of plants. Infested plants also become dark with sooty mold. Since only male adults can fly, mealybugs depend largely on other insects or man to transport them from plant to plant.

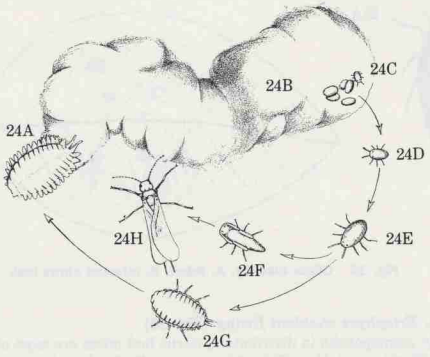


Fig. 24 Citrus mealybug. A, Female. B, Eggs in cottony sac. C to G, Nymphs. H, Male.

44. Citrus Red Mite, *Panonychus citri* (McGregor) (Fig. 25)

This mite is a problem in South Africa, Japan, and India, and in parts of China, South America, and the Soviet Union. In the United States, it is a serious citrus pest in California and Florida but may also infest almond, castorbean, pear, rose, and some broadleaved ornamentals. Usually a problem on new citrus growth in spring and fall, these deep-red to purplish mites (390 to 400 microns long) first cause a silvery stippling of the foliage. Low humidity, drought, or wind stress at these times may trigger more severe mite damage (leaf drop or decreased tree vigor). The direct effect on the fruit is usually minor. At low relative humidities and optimum temperatures of 26° to 27°C (78° to 80°F), these mites develop from eggs to adults in about 3 weeks.

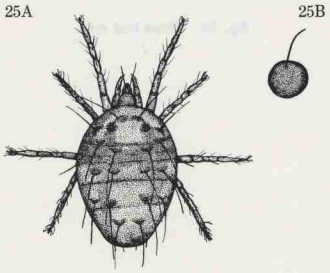


Fig. 25 Citrus red mite. A, Adult. B, Egg.

45. Citrus Rust Mite, *Phyllocoptruta oleivora* (Ashmead) (Fig. 26)

Although they infest a limited number of California orchards when the humidity is sufficiently high, citrus rust mites are most prevalent in Florida, Texas, and other Gulf Coast areas. Favored by a warm, humid climate, these microscopic (150 to 165 microns long), lemon-yellow mites feed primarily on green citrus fruit and the undersides of leaves, occasionally attacking twigs. Heavily infested leaves become bronzed and often drop prematurely, while new twigs are stunted and discolored. However, unlike most other mite pests of citrus, these mites directly damage the fruit, causing reddish, silvery, or black russetting, small size, and rapid deterioration. Citrus rust mites are least common during winter, July, and early August.

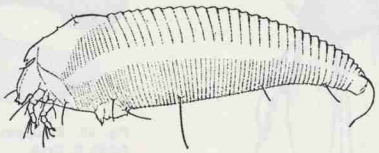


Fig. 26 Citrus rust mite.

46. Citrus Whitefly ..... p. 131

47. Colorado Potato Beetle, *Leptinotarsa decemlineata* (Say) (Fig. 27)

Soft bodied and red to orange with black spots, Colorado potato beetle larvae (about 15 mm long) mature into yellow-brown, black-striped beetles about 9 to 14 mm long. In spring and summer, the beetles and larvae of this species infest the foliage of solanaceous plants, such as eggplant, pepper, potato, tobacco, tomato, and several weeds. On potato, for example, when moderate to severe defoliation occurs, development is reduced and some plants are killed. The beetles also spread several potato diseases. Maturing from eggs to adults in about 1 month, Colorado potato beetles produce one to three generations each year, depending on latitude.

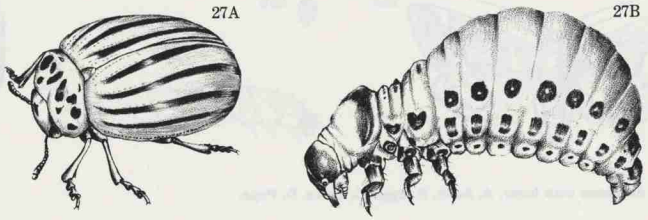
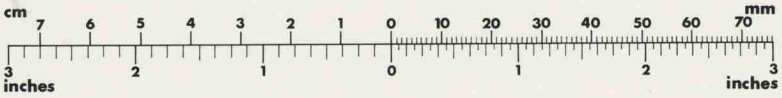


Fig. 27 Colorado potato beetle. A, Adult. B, Larva.



48. European Chafer, *Rhizotrogus majalis* (Razoumowsky) (Fig. 28)

Occurring primarily in New York, European chafers have also been reported in Connecticut, New Jersey, Ohio, and West Virginia. Resembling May beetles, these light-brown, 13-mm-long beetles are most commonly seen in June and July as they swarm around lights at night. White grubs hatch from eggs the beetles lay and begin feeding on the roots of grasses and legumes in July or August. After feeding for about 3½ months, the grubs burrow deep into the soil to overwinter. Only one generation occurs each year.

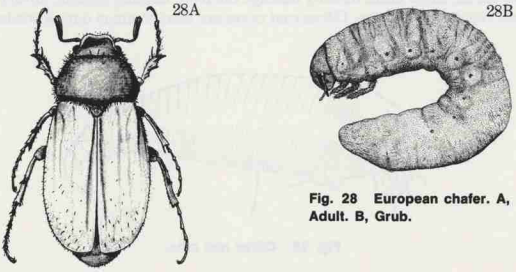


Fig. 28 European chafer. A, Adult. B, Grub.

49. European Corn Borer, *Ostrinia nubilalis* (Hübner) (Fig. 29)

Up to 26 mm long, this pale-yellow, dark-spotted caterpillar can be found throughout the corn-producing states of the Plains, Midwest, and South with the exception of Florida, where it occurs only in the northernmost counties. It feeds on foliage and later bores into the stalks (and other plant parts) of over 200 hosts, including many weeds, field and vegetable crops, and flowers and other ornamentals. The borer eventually pupates and emerges as a yellow or light-brown moth with two dark, zigzag lines across the forewings and a wingspan of about 26 mm. Depending on latitude, one to three generations occur each year, with the larvae overwintering in stubble and the moths appearing in spring.

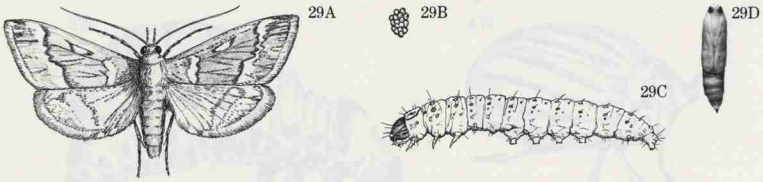


Fig. 29 European corn borer. A, Adult. B, Eggs. C, Larva. D, Pupa.

50. European Pine Shoot Moth, *Rhyacionia buoliana* (Schiffermüller) (Fig. 30)

Though European pine shoot moths occur in Washington and Oregon, they are found primarily in the northeastern states westward to Michigan and Wisconsin. The pine species attacked include red, Scotch, Austrian, mugho, ponderosa, Japanese red, Japanese black, eastern white, jack, pitch, longleaf, and Virginia. This rusty-orange moth with silvery cross lines on its wings and an 18-mm wingspan appears in late spring and deposits eggs on pine buds. Larvae hatch from the eggs and feed until August, spinning resin-covered webs over their entrance holes into the buds. In spring they resume feeding, this time in elongating shoots, causing them to grow crooked or bend over and die. This pest completes only a single generation each year.

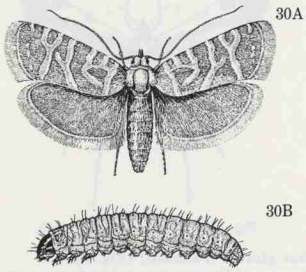


Fig. 30 European pine shoot moth. A, Adult. B, Larva.

51. Florida Red Scale, *Chrysomphalus aonidum* (Linnaeus) (Fig. 31)

Though this scale occurs in greenhouses in California, outdoors it is most common in Florida and other Gulf Coast regions. Sucking sap from leaves, bark, and fruits of citrus, holly, palms, and other fruit trees and ornamentals, Florida red scales can weaken trees severely. The yellow adult females are hidden under circular, dark-red to brown, scalelike shells about 2 mm in diameter. Male adults are tiny, two-winged insects. The immature forms are scales, half the length of the female and lighter in color.

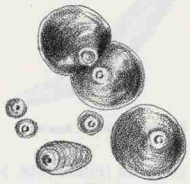


Fig. 31 Florida red scale.

52. Fruit Flies, Tephritidae: See Apple-Blueberry Maggots, Cherry Fruit Flies, and Walnut Husk Fly.

53. Fuller Rose Beetle ..... p. 177

54. Geranium Plume Moth, *Platyptilia pica* Walsingham (Fig. 32)

Primarily a problem in California, the geranium plume moth sometimes becomes a problem in greenhouses in other states. The yellow-green or red larva grows to a length of 10 mm and is covered with setae, which are swollen at the tips. The newly hatched larva mines into leaves but later bores into flower buds or feeds externally on leaves, buds, and flowers. As a result, infested plants may be stunted. After feeding for 3 to 5 weeks, the larva pupates and emerges as a white or brownish moth with bilobed forewings fringed with setae and a wingspan of 15 to 25 mm. In warm climates or in greenhouses, this pest may be present all year.

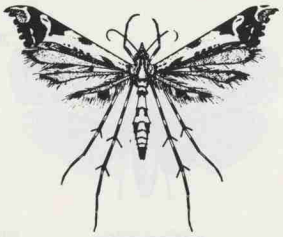


Fig. 32 Geranium plume moth.

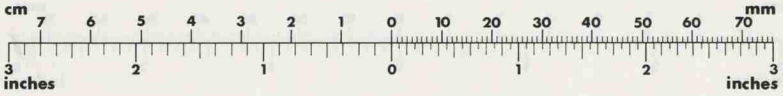
55. Glover Scale, *Lepidosaphes gloveri* (Packard) (Fig. 33)

Primarily a problem in California and Florida, this scale infests a wide range of fruit, landscape, and ornamental plants, including arborvitae, boxwood, cherry laurel, citrus, cypress, euonymous, ivy, magnolia, mulberry, myrtle, orchid, palm, and privet. Narrow and elongated with nearly parallel sides, most of the brownish-yellow to dark-brown scales are about 1.5 to 3.25 mm long. Other forms include immature crawlers and tiny, gnatlike male adults. Though they prefer twigs and smaller branches, the scales suck sap from bark, leaves, and fruit, weakening the plants and leaving honeydew deposits upon which sooty mold will grow. Combined infestations of Glover scales and purple scales often occur.

Fig. 33 Glover scale.

56. Grape Phylloxera, *Daktulosphaira vitifoliae* (Fitch) (Fig. 34)

Winged or wingless and about 1 mm long, the aphidlike phylloxera has red eyes and may be pale green, orange, or yellowish brown. Though native to the United States and found in all but the Rocky Mountain regions, the grape phylloxera is rarely of economic concern in this country. It is primarily a threat only to the rootstocks of European grape varieties, which are more commonly grown in the Pacific Coast states. Most common from June through September, the phylloxera causes gall-like root swellings, which restrict water and nutrient uptake. European varieties grafted onto American rootstocks are not adversely affected. On wild grapes in the eastern United States, foliar galls are more common than root galls.



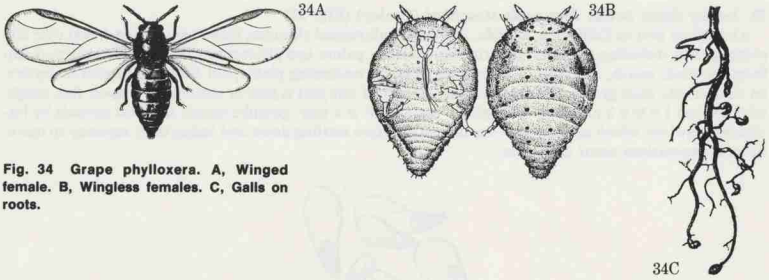


Fig. 34 Grape phylloxera. A, Winged female. B, Wingless females. C, Galls on roots.

57. Greedy Scale, *Hemiberlesia rapax* (Comstock) (Fig. 35)

Light gray and convex, the adult female greedy scale has an off-centered, yellow-brown nipple and a diameter of 1.0 to 1.5 mm. The male preadult is smaller and less convex; the male adult is a two-winged, gnatlike insect. The early immature scale is a motile "crawler." The sedentary forms suck sap from the bark and leaves of citrus and pecan, as well as other deciduous trees, shrubs, and ornamentals. Infested plants become weakened and are soon covered with sooty mold. Most troublesome outdoors in Florida and California, the greedy scale may occasionally become a problem in greenhouses elsewhere in the United States.

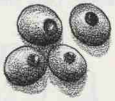


Fig. 35 Greedy scale.

58. Hickory Shuckworm, *Laspeyresia caryana* (Fitch) (Fig. 36)

Found throughout the country wherever pecan or hickory trees occur, the hickory shuckworm caterpillar is white and about 10 mm long with a dark head and five pairs of abdominal legs. It infests pecans primarily from June through August, causing improper kernel development, premature nut drop, and failure of shucks to separate from nuts. After feeding within the nut for 3 to 4 weeks, the larva pupates and transforms into a small, smoky blue-black moth with short, yellow streaks on the front margins of the forewings. Though there are one to four generations each year depending on latitude, shuckworms cause little damage until nuts are present on pecans and hickories.

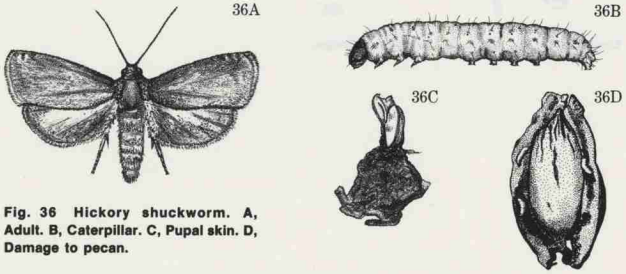


Fig. 36 Hickory shuckworm. A, Adult. B, Caterpillar. C, Pupal skin. D, Damage to pecan.

59. Lesser Snow Scale, *Pinnaspis strachani* (Cooley) (Fig. 37)

An outdoor pest in California, Florida, and other subtropical climates, lesser snow scales infest over 200 plant species, including chinaberry, citrus, fig, hibiscus, palms, and pittosporum. Not only do they suck sap from the bark, leaves, and fruit of their hosts, thereby weakening plants, but they also deposit honeydew on which sooty mold grows. The nonmotile scale stage of this pest is pear or oystershell shaped, flat, tough, whitish, and 1.0 to 2.5 mm long. Though the male adult is a tiny, gnatlike insect, this pest spreads by immature crawlers, which seek out new feeding sites before settling down and losing their capacity to move. Several generations occur each year.

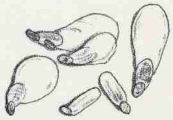


Fig. 37 Lesser snow scale.

60. Locust Borer, *Megacyllene robiniae* (Forster) (Fig. 38)

Black with gold crossbars and a "W" across its wing covers, this 18-mm-long, long-horned beetle occurs throughout most of the eastern United States and Canada. Appearing in fall, especially in September, it feeds on goldenrod pollen in the morning and deposits eggs in the bark of black locust in the evening. Tiny, white larvae hatch from the eggs and bore into the sapwood to spend the winter. Though strong, healthy trees seldom are attacked, young or sickly trees may be damaged considerably by the extensive spring and summer tunneling of mature, 25-mm-long borers. Only one generation occurs each year.

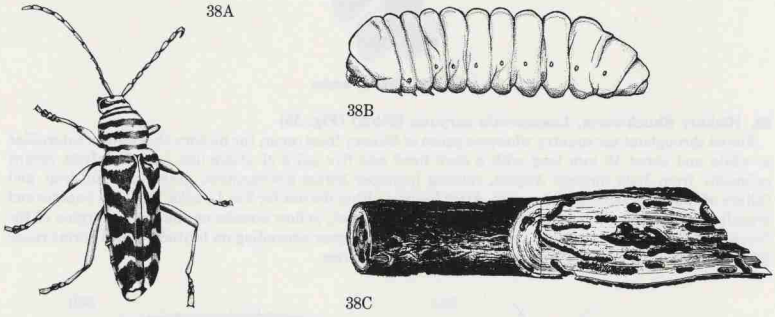


Fig. 38 Locust borer. A, Adult. B, Larva. C, Damage.

61. Mediterranean Fruit Fly, *Ceratitis capitata* (Wiedemann) (Fig. 39)

This pest occurs in most subtropical regions of the world but so far has been eradicated from all parts of North America where it has been introduced. Smaller than houseflies, these yellow and black fruit flies have clear wings with dark bands and give rise to legless, tapering maggots up to 10 mm long. Maggots damage citrus and other fruit crops by tunneling within the fruit for at least a couple of weeks. Several generations are completed each year, a single generation requiring as little as 3 weeks or as long as 3 months for development.

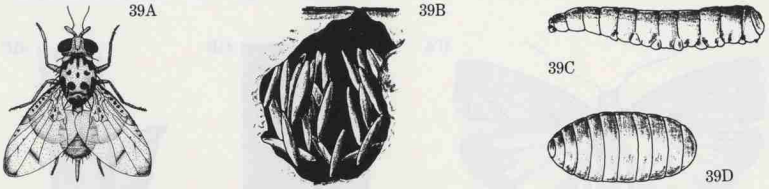


Fig. 39 Mediterranean fruit fly. A, Adult. B, Eggs in egg cavity. C, Maggot. D, Puparium.

62. Mexican Fruit Fly, *Anastrepha ludens* (Loew) (Fig. 40)

Similar in many ways to the preceding pest, this fruit fly is currently under quarantine to prevent its northward spread from Mexico and the Rio Grande Valley of Texas. Slightly larger than a housefly, this yellow-brown fruit fly has transparent wings mottled with brown. It deposits tiny, green eggs below the skin of citrus fruits. White, legless, fruit-tunneling maggots hatch from the eggs and feed for some time in the fruit before pupating in the soil. Four to six generations are completed each year.

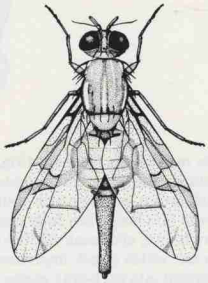
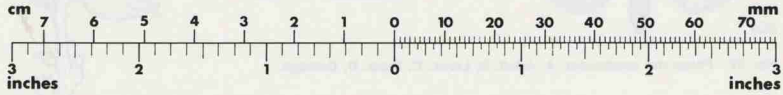


Fig. 40 Mexican fruit fly.



63. Pecan Leaf Casebearer, *Acrobasis juglandis* (LeBaron) (Fig. 41)

Although pecan leaf casebearers occur throughout much of New England, the Midwest, and the South, they are pests primarily in the coastal areas of Georgia, Alabama, Mississippi, Louisiana, Texas, and Florida. Most damaging early in the spring, the casebearer larvae feed on buds and new leaves of hickory, pecan, butternut, or black walnut, thereby weakening trees and keeping them well defoliated. By late spring, the dark-green, heavily wrinkled larvae have sparse long hairs and measure 12 to 18 mm long. In early summer, the larvae are transformed into white or grayish moths with black and reddish-brown markings on their forewings and wingspans of 38 mm. Young larvae hatch from these moths' eggs and construct little, gray, oval cases in which to overwinter around buds. One generation is completed each year.

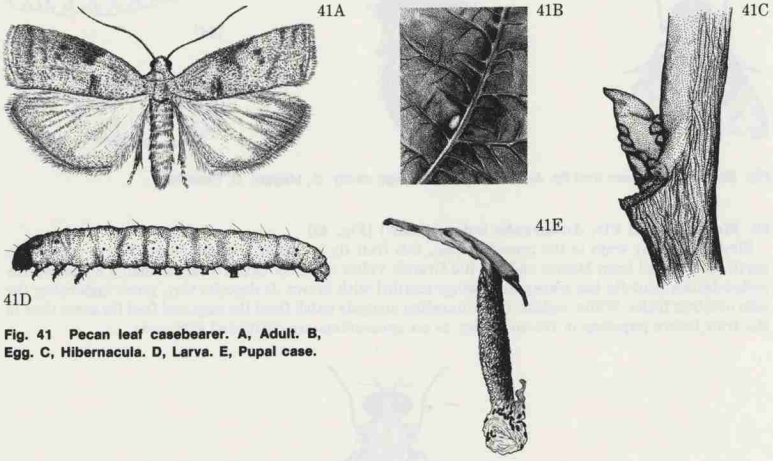


Fig. 41 Pecan leaf casebearer. A, Adult. B, Egg. C, Hibernacula. D, Larva. E, Pupal case.

64. Pecan Nut Casebearer, *Acrobasis nuxvorella* Neunzig (Fig. 42)

Found primarily in the Gulf Coast states, the pecan nut casebearer has also been reported in Illinois, North Carolina, and Oklahoma. Purplish brown, perhaps with a slightly greenish tint, these larvae have sparse whitish hairs and measure 11 to 17 mm long when fully grown. Some first-generation larvae bore into shoot tips, causing them to wilt, turn brown, and break off. The more serious damage, however, is done by the first- and second-generation larvae, which attack immature nuts, leaving them filled with frass, their contents destroyed. The larvae develop into dark-gray moths whose forewings have a ridge of dark scales across them. Three to four generations occur each year, the young, 2- to 3-mm-long larvae overwintering in woven cases near the buds.

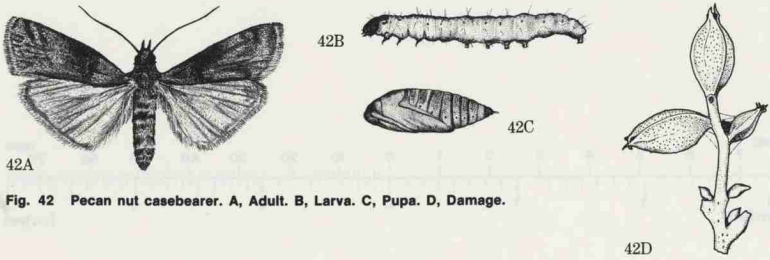


Fig. 42 Pecan nut casebearer. A, Adult. B, Larva. C, Pupa. D, Damage.

65. Pecan Weevil, *Curculio caryae* (Horn) (Fig. 43)

Occurring in the Gulf Coast states and as far north as New York, these weevils primarily infest pecans and hickories, especially early varieties. The 7- to 9-mm-long, dark-brown and gray weevils have long, slender snouts, which may be either slightly longer or just shorter than the length of their bodies. With this beak, they puncture nuts before kernels develop, causing the immature nuts to darken, shrivel, and fall from the tree. The weevils lay eggs on other nuts. Larvae hatch from the eggs and feed within nuts until September or November. Then the fat, legless, yellow larvae (10 to 13 mm long) exit the nuts, leaving holes about 3 mm in diameter. At this time, larvae enter the soil to pupate but may not emerge as adults for another year or two.

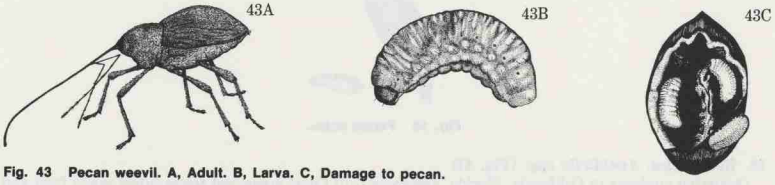


Fig. 43 Pecan weevil. A, Adult. B, Larva. C, Damage to pecan.

66. Persimmon Borer, *Sannina uroceriformis* Walker (Fig. 44)

From Texas and the other Gulf Coast states northward into Kansas and Maryland, the persimmon borer is a threat to persimmon trees in hedgerows, nurseries, and, especially, cut-over areas. White and 30 mm long when fully grown, the larvae bore from solid wood at the base of trees down into the taproot. They may continue to feed within the tree for 2 or more years before transforming into blue-black moths with wingspans of 28 to 32 mm.

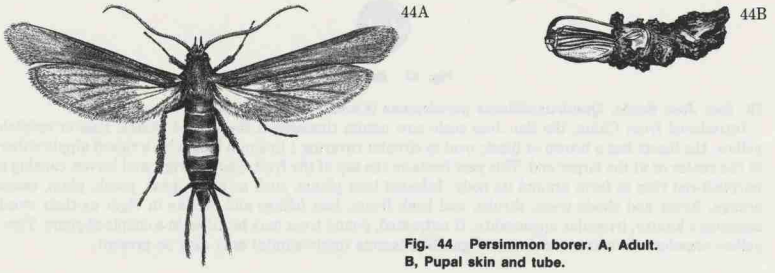


Fig. 44 Persimmon borer. A, Adult. B, Pupal skin and tube.

67. Plum Curculio, *Conotrachelus nenuphar* (Herbst) (Fig. 45)

About 6 mm long, these brown snout beetles with gray markings and four humps on their wing covers occur in most states east of the Rockies. By feeding on developing apple, pear, and quince fruits in the spring, they cause abnormal fruit growth. Eggs, which the curculios insert in the fruit, hatch into larvae, which feed for 2 or 3 weeks, usually causing infested fruit to drop from the tree. Leaving clean holes in the fruit, the white, legless, 10-mm-long larvae emerge and pupate in the soil. The beetles, which emerge in the fall, further damage mature fruit and then either hibernate or lay eggs for a new generation.

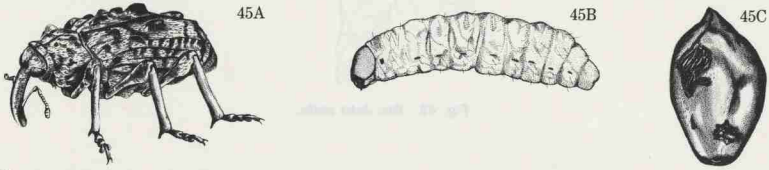


Fig. 45 Plum curculio. A, Adult. B, Larva. C, Damage to peach.

68. Purple Scale, *Lepidosaphes beckii* (Newman) (Fig. 46)

The purple scale is one of the most important pests of citrus. Fifty other fruit and ornamental host plants are also infested by purple scale. Female scales are dark brown to purple, oystershell shaped, and up to 3 mm long. (Male nymphs are similar but smaller.) Purple scales cause yellow spots on leaves and premature leaf drop. Fruit and bark are also infested. Males emerge as tiny, two-winged insects and mate with females. Forty to 80 eggs are laid under the mother's armor. They hatch in 2 weeks to 2 months. Tiny crawlers hatch and emerge from the mother's armor to feed. They molt three times (females) or four times (males) before maturing. There are three generations per year.

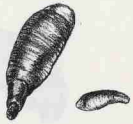


Fig. 46 Purple scale.

69. Red Scales, *Aonidiella* spp. (Fig. 47)

Occurring outdoors in California, Florida, and some Gulf Coast areas, red scales infest many fruit and ornamental plants, including citrus, fig, ligustrum, and podocarpus. The flat, circular, orange-red to red-brown scales may have a diameter of up to 3 mm but usually average only half this size. Tiny immature scales (crawlers) and two-winged, gnatlike insects (adult male scales) may also be present. The sedentary forms attack practically all plant parts but seem to prefer leaves, fruit, and young branches. In addition to sucking sap, causing defoliation, excreting honeydew, and thereby encouraging sooty mold, these scales also inject the host with toxic substances, which weaken the plant further. Red scales complete three to four generations each year.

Fig. 47 Red scale.

70. San Jose Scale, *Quadraspidiotus perniciosus* (Comstock) (Fig. 48)

Introduced from China, the San Jose scale now occurs throughout the United States. Pale or reddish yellow, the insect has a brown or black, oval to circular covering 1 to 2 mm long with a raised nipple either in the center or at the larger end. This pest feeds on the sap of the fruit, young twigs, and leaves, causing a purplish-red ring to form around its body. Infested host plants, such as apple, pear, peach, plum, osage orange, forest and shade trees, shrubs, and bush fruits, lose foliage and decline in vigor as their wood assumes a knotty, irregular appearance. If untreated, young trees may be killed in a couple of years. Tiny, yellow crawlers (immature scales) and gnatlike insects (male adults) may also be present.

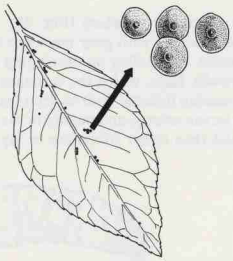


Fig. 48 San Jose scale.

71. Southern Cornstalk Borer, *Diatraea crambidoides* (Grote) (Fig. 49)

This pest infests corn, sorghum, cane, broomcorn, and johnsongrass. Infested plants are often stunted and enlarged near the ground. Leaves may be ragged from holes eaten in the whorl. These worms are creamy yellow with dark heads in winter and dirty white with black, bristled spots in summer (up to 25 mm long). They may bore into the taproot or destroy the growing point, causing suckering. The worms pupate in the stalks, and straw-colored adults (wingspans 15 to 40 mm) emerge twice a year. Eggs are flat and overlap like fish scales in the egg mass. This pest is found from Kansas south and east.

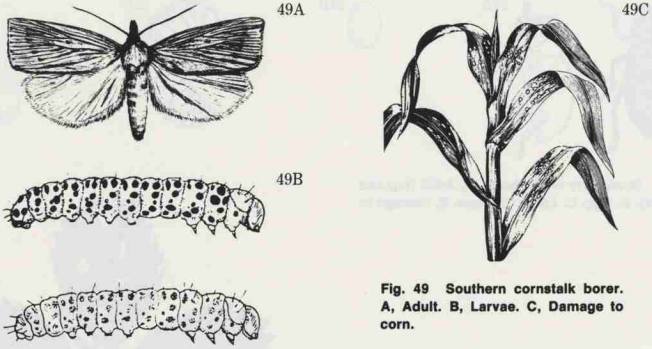


Fig. 49 Southern cornstalk borer. A, Adult. B, Larvae. C, Damage to corn.

72. Southwestern Corn Borer, *Diatraea grandiosella* (Dyar) (Fig. 50)

This pest is similar in biology and appearance to the southern cornstalk borer. Southwestern corn borers occur in the southwestern United States eastward to North Carolina, Tennessee, and Kentucky.

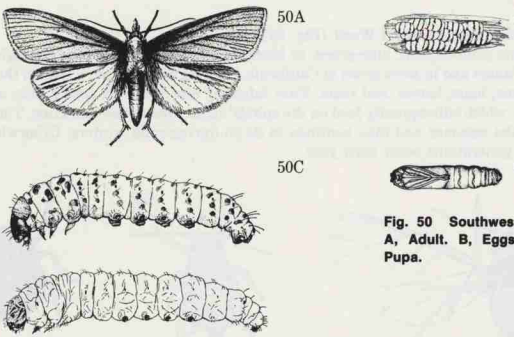
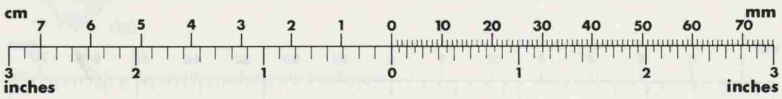


Fig. 50 Southwestern corn borer. A, Adult. B, Eggs. C, Larvae. D, Pupa.



73. Strawberry Crown Borer, *Tyloderma fragariae* (Riley) (Fig. 51)

Native to this country, the strawberry crown borer occurs in all but the Rocky Mountain states. About 4 mm long and dark brown with three darker spots on each wing cover, the beetles emerge from hibernation about the time strawberries begin to bloom. They consume foliage, leaving small holes, and deposit eggs in cavities near the crown of the plant. Once they emerge, the white, legless larvae bore into the crown, weakening or sometimes killing the plant. Here they feed for 4 to 8 weeks before transforming into adult beetles. Only one generation occurs each year.

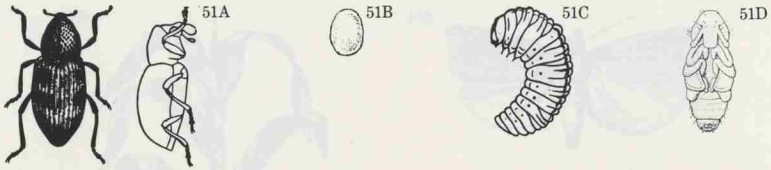


Fig. 51 Strawberry crown borer. A, Adult (top and side view). B, Egg. C, Larva. D, Pupa. E, Damage to leaf.

74. Strawberry Root Aphid, *Aphis forbesi* Weed (Fig. 52)

Less than 2 mm long, this yellow-green, blue-green, or black, egg-shaped aphid occurs throughout the eastern half of the United States and in some areas of California. Feeding on strawberry plants, the aphids suck sap from crowns, stems, buds, leaves, and roots. First infesting new leaves in spring, they are soon carried to the roots by ants, which subsequently feed on the aphids' sugary honeydew excretion. The aphids feed on roots throughout the summer and may continue to do so during mild winters. Otherwise, they overwinter as eggs. Many generations occur each year.

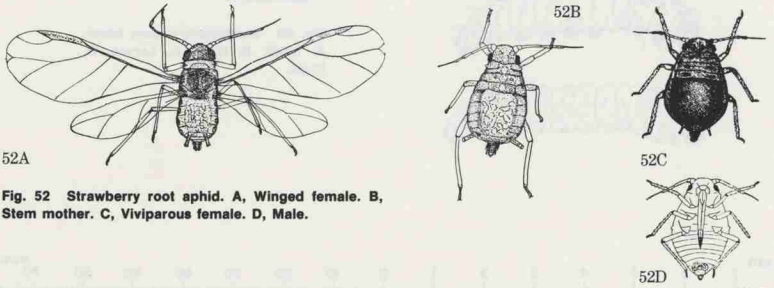


Fig. 52 Strawberry root aphid. A, Winged female. B, Stem mother. C, Viviparous female. D, Male.

75. Strawberry Root Weevils, *Otiorhynchus* spp. (Fig. 53)

Though they occur throughout most of North America, strawberry root weevils are a problem primarily in the Pacific Northwest and sometimes in California. Emerging in May or June, the weevils are black with yellow pubescence and about 5 to 6 mm long. They feed at night on leaves and berries and deposit masses of eggs near crowns of plants. White, legless larvae tinged with pink hatch from the eggs, burrow into the soil, and feed on roots throughout most of the summer. Strawberry, raspberry, blueberry, loganberry, grape, apple, peach, pine, and spruce (in nurseries and plantations) are some of the plants infested by these weevils and their larvae.

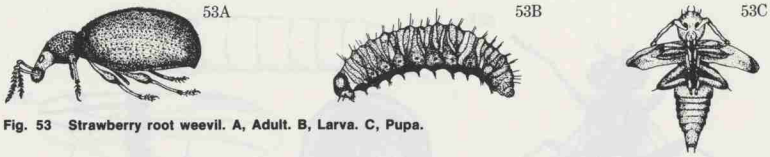


Fig. 53 Strawberry root weevil. A, Adult. B, Larva. C, Pupa.

76. Sugarcane Borer, *Diatraea saccharalis* (Fabricius) (Fig. 54)

Found in the West Indies, Central and South America, and Gulf Coast areas from Florida to Texas, this borer infests sugarcane, corn, rice, sorghum, and other grasses. After hatching, the yellow-white, brown-spotted larva feeds first on leaves, progresses to the whorl, and, as it matures, bores into the stalk. As a result, plants may be severely weakened, lodge, and die. After feeding for 20 to 30 days, the larva pupates and soon emerges as a straw-colored moth. It has a wingspan of about 25 mm and a series of black dots on the forewings that form a "V." Four or five generations are completed each year, the overwintering stage being an unspotted larva.

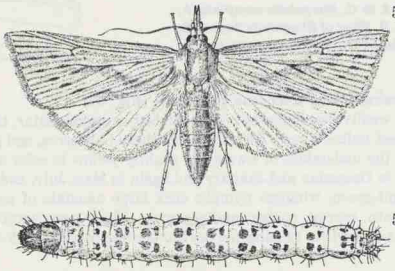


Fig. 54 Sugarcane borer. A, Adult. B, Larva.

77. Sugarcane Rootstalk Borer Weevil, *Diaprepes abbreviatus* Linnaeus (Fig. 55)

Primarily a pest of citrus and sugarcane in the West Indies, this weevil infests many acres of citrus near Apopka, Florida. Most abundant from August to December, the 17- to 18-mm-long, yellowish- to olive-green, black-striped weevils often feed on the foliage of nursery trees or young trees just set out. More severe damage, however, is caused by the white, legless larvae of these weevils. Feeding for 2 to 4 months on the roots of the same crops, the larvae reach a mature length of 20 mm. Overlapping generations occur in Florida so larvae are present in the soil all year. It generally takes about a year to complete the life cycle.

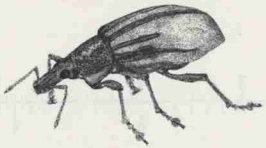


Fig. 55 Sugarcane rootstalk borer weevil.

78. Walnut Husk Fly, *Rhagoletis completa* Cresson (Fig. 56)

The walnut husk fly has been found in West Virginia, throughout the New England states, and from Minnesota to Texas and California. Producing only one generation each year and emerging in July, these brown and yellow, 7-mm-long flies have blue eyes, dark crossbands on the abdomen, and black bands on the wings. Yellow maggots appear soon after the flies and feed on the green fruit husks of walnuts, butternuts, and peaches. Once nuts have fallen to the ground, maggots do the most damage, turning the green husks to black pulp. Black stains left on nutshells are a less severe symptom of this pest. Reaching a length of 10 mm, fully grown maggots enter the soil to spend the winter.

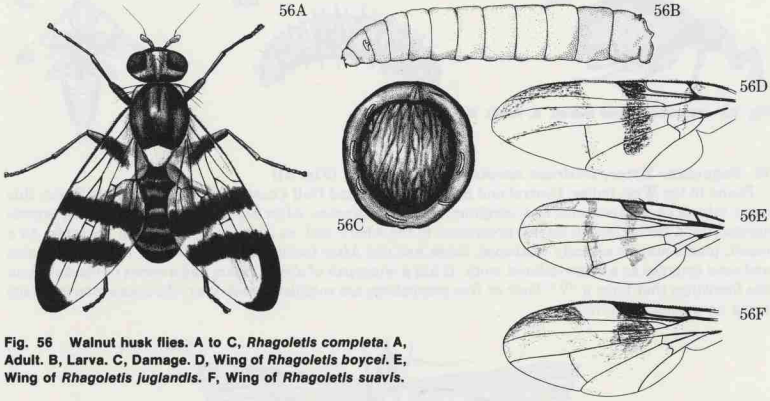
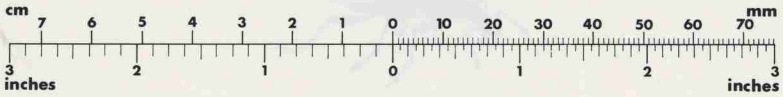


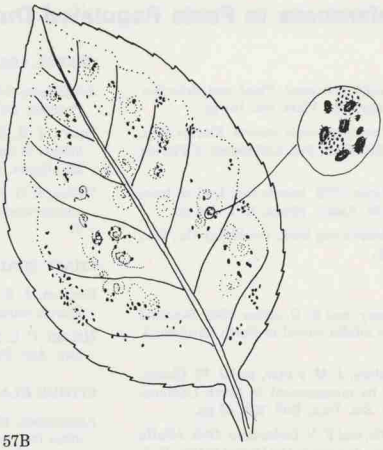
Fig. 56 Walnut husk flies. A to C, *Rhagoletis completa*. A, Adult. B, Larva. C, Damage. D, Wing of *Rhagoletis boycei*. E, Wing of *Rhagoletis juglandis*. F, Wing of *Rhagoletis suavis*.

79. Woolly Whitefly, *Aleurothrixus floccosus* (Maskell) (Fig. 57)

So named for the waxy, woolly filaments that cover the last nymphal instar, the woolly whitefly occurs throughout Mexico, the West Indies, Puerto Rico, Cuba, southern California, and parts of Florida. The tiny, mothlike adults found on the undersides of leaves are slightly yellow in color and unusually sluggish in nature. They are common in December and January and again in May, July, and October. Before developing a woolly coat, the light-green, wingless nymphs suck large amounts of sap from citrus, especially grapefruit and orange, guava, mango, rubber, and sea grape. These pests excrete honeydew to the point that it drips from the foliage, further causing the host to become covered with sooty mold and to attract purple scales.



57A



57B

Fig. 57 Woolly whitefly. A, Adult. B, Infested citrus leaf.

80. Yellow Scale, *Aonidiella citrina* (Coquillett) (Fig. 58)

This flat, yellow- or coppery-white scale is circular or slightly elongated and has a maximum diameter of about 1.75 mm. It sucks sap primarily from the foliage and fruit of citrus, ligustrum, and euonymus, as well as from other fruits, ornamental shrubs, and trees. Motile, immature scales (crawlers) and tiny, gnat-like insects (male adults) may also be present. Occurring in Florida and in the interior areas of California, yellow scales produce three or four generations a year.

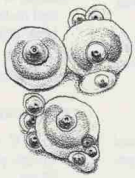


Fig. 58 Yellow scale.

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Michelbacher, A. E. and J. C. Ortega. 1958. A technical study of insects and related pests attacking walnuts. California Agr. Exp. Sta. Bull. 764. 86 pp.

WOOLLY WHITEFLY

Yothers, W. W. 1919. The woolly white fly in Florida citrus groves. U. S. Dep. Agr. Farmers' Bull. 1011. 14 pp.

Keys to Orders and Groups of Insect and Related Pests

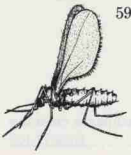
Following are four keys, one for adult pests and three for immature stages. In general, the adult stages are most easily differentiated (especially in winged insects). However, it is not always easy to tell if a pest that is not winged is mature or immature. The following truisms may help to decide which key to use: (1) If a pest has wings, it is an adult (insect). (2) If a pest is mating, laying eggs, or giving birth to young, it is in the adult stage. Otherwise, the pest should key out successfully in immature keys, even if it is an adult.

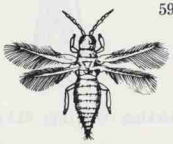
Immature pests (and wingless adults) may not be easy to distinguish; therefore, in the keys to immature pests, the pests have been broken down by the portion of the plant infested (blossom and leaf, stem, root). Once a pest has been identified to order or group, it may be possible by using the host index at the back of this manual and the insect notes to determine exactly which pest is involved.

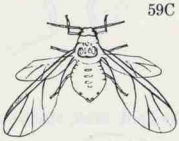
KEY TO ADULTS

1. Wings present (Fig. 59A to F) 2

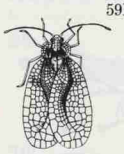
   Wingless (Fig. 59G to N) 10

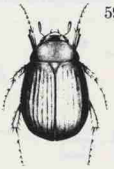

59A

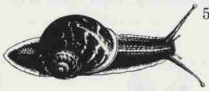

59B


59C


59D


59E


59F

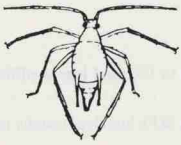

59G

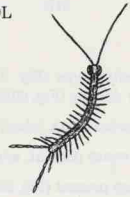

59H


59I


59J


59K

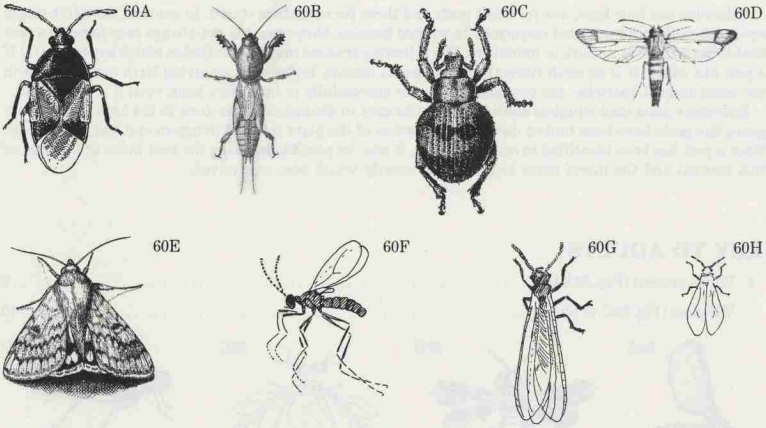

59L


59M


59N

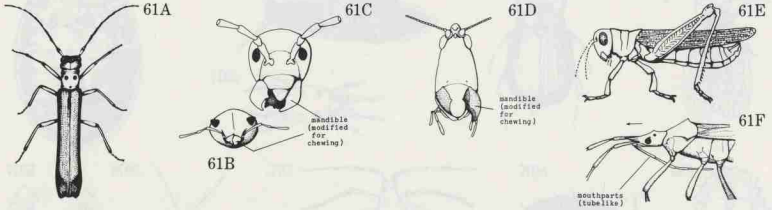
2. Front pair of wings (the wings that lie on top when folded) partially or completely thickened and leathery (Fig. 60A to C) 3

Front pair of wings flexible and papery, sometimes clear (Fig. 60D to H) 5



3. Front pair of wings usually hard, thick, opaque, and lacking veins (Fig. 61A); mouthparts chewing type (Fig. 61B to D) ..... BEETLES

Front pair of wings usually leathery, with veins (Fig. 61E); mouthparts chewing type or extended into a tube (Fig. 61F) 4



4. Mouthparts chewing type (Fig. 61B to D); hind legs modified for jumping (Fig. 61E) or front legs modified for digging (Fig. 60B) ..... GRASSHOPPERS, CRICKETS

Mouthparts extended into a tube (Fig. 61F); hind legs usually not modified for jumping ..... BUGS

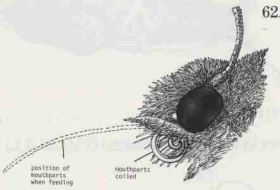
5. Only one pair of wings present, wings usually clear (Fig. 59A) 8

Two pairs of wings present (Fig. 59B,C) 6

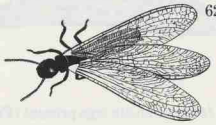
6. Mouthparts chewing type (Fig. 61B to D); wings with network of light, tiny veins evenly covering surface, front wings similar in size to hind wings; fragile insects; antennae filiform (Figs. 60G, 62B) ..... TERMITES

Mouthparts extended into tube or hairlike structure, modified for sponging or missing altogether (Fig. 62A); wings variable; antennae variable 7

62A



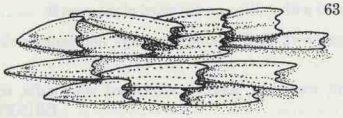
62B



7. Wings covered with tiny scales that resemble dust when smudged on one's finger (Fig. 63); mouthparts long, threadlike ..... BUTTERFLIES, MOTHS

Wings without scales; mouthparts variable or lacking 9

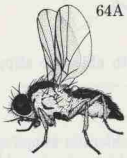
63



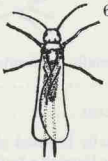
8. Mouthparts adapted for sponging or sucking; second pair of wings represented by small knobs; no tail filaments (Figs. 59A, 64A) ..... MIDGES, FLIES

Mouthparts absent; second pair of wings sometimes represented by small knobs (sometimes absent); usually with terminal waxy filaments (Fig. 64B) ..... MALE MEALYBUGS AND SCALES

64A



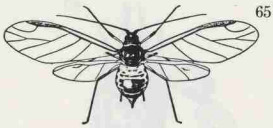
64B



9. Body with "honey tubes" or "exhaust pipes;" slow-moving insects; seem to reproduce rapidly (Fig. 65) ..... APHIDS

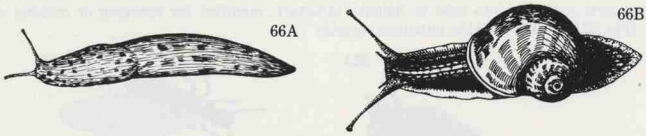
Body without "honey tubes" 20

65



10. No legs; soft, slimy, sometimes with a helical shell (Fig. 66A,B) ..... SLUGS, SNAILS

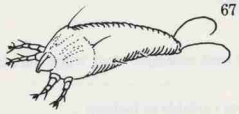
Legs present 11



66A 66B

11. More than or fewer than six legs present (Figs. 59H,M,N; 67) 12

Six legs usually present (legs may be reduced and obscure in many scale insects) (Fig. 59I,J,L) 17



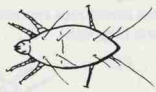
67

12. Microscopic, often associated with galling or distorted plant growth 13

Visible to the unaided eye (with 20-20 vision); damage not usually characterized by galls and distorted growth 14

13. Two pairs of legs present; wormlike, usually associated with galls, erineums or chlorosis of host plant (Fig. 67) ..... ERINEUM, GALL, OR RUST MITES

Four pairs of legs present; oval; females with hind legs threadlike; usually associated with distorted growth (Fig. 68) ..... THREAD-LEGGED MITES



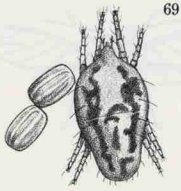
68

14. Four pairs of legs present; usually associated with chlorotic stippling of host plant leaves (Fig. 59H) 15

More than four pairs of legs present 16

15. Tiny silk "spider webs" on heavily infested plant; chlorotic stippling symptoms developing rapidly; legs arranged somewhat like those of a typical spider; color variable (Fig. 59H) ..... SPIDER MITES

No silk webbing on heavily infested plants; chlorotic stippling symptoms developing slowly; legs more or less pointing forward and backward; color red (Fig. 69) ..... FALSE SPIDER MITES



69

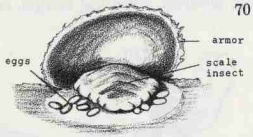
16. Seven pairs of legs present; oval; sometimes capable of rolling up into a ball (Fig. 59K) ..... SOWBUGS, PILLBUGS

Many pairs of legs present; sides straight, long, slender, sometimes coiling into a helix (Fig. 59N) ..... MILLIPEDES

17. Body covered by shell-like secretion, which can often be pried loose without dislodging insect (Fig. 70) ..... ARMORED SCALES

No secretion on body, or if secretion is present, then it cannot be pried loose without dislodging insect 18

70



18. Body usually naked 19

Usually covered with a white, waxy bloom that resembles flour or white, waxy threads (Fig. 59J) ..... MEALYBUGS, WOOLLY APHIDS, ADELGIDS, (and less often) SOFT SCALES

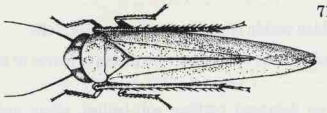
19. Legs and antennae well developed; body with "honey tubes" or "exhaust pipes;" mobile (Fig. 59L) ..... APHIDS

Legs and antennae obscure; no "honey tubes;" often immobile ..... SOFT SCALES

20. Small insects (2 mm or less); run or flutter when disturbed 21

Slightly larger insects (2 to 10 mm); jump when disturbed (Figs. 71, 73) 22

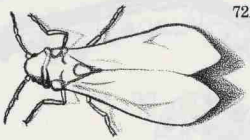
71



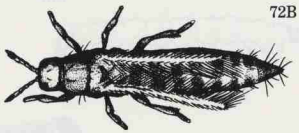
21. White insects (up to 2 mm) that resemble tiny moths; often found on the undersides of host plant leaves, often associated with honeydew and sooty molds; flutter when disturbed (Figs. 60H, 72A) ..... WHITEFLIES

Orange, brown, or black insects (up to 2 mm) that are slender and spindle shaped; often found in buds or flowers, foliage, and even corms; often associated with chlorosis and distorted growth; run or fly when disturbed (Figs. 59B, 72B) ..... THRIPS

72A



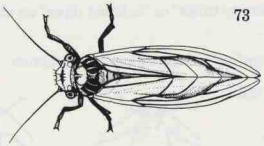
72B

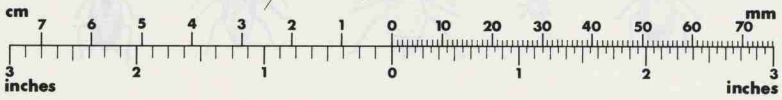


22. Five to 10 segments in antenna; 2 to 5 mm long (Fig. 73) ..... PSYLLIDS

Three segments in bristlelike antenna; 2 to 10 mm long (Fig. 71) ..... LEAFHOPPERS

73





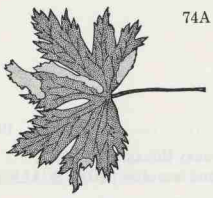
KEY TO IMMATURE STAGES

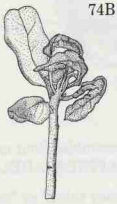
BLOSSOM AND LEAF FEEDERS

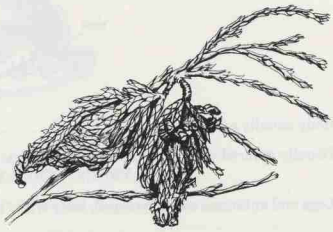
1. Chewing mouthparts (Fig. 61B to D) (leaf removed or consumed by pest) 2

   Mouthparts extended into tube or hairlike structure (Fig. 61F) (leaf may be distorted or discolored, but not consumed by pest) 7

2. Insect within leaf mine, leaf gall, inwardly rolled leaf margin, or case made of plant material (Fig. 74A to C) 3


74A


74B


74C

   Pest exposed on leaf 5

3. Insect mining within leaf, leaving visible tunnels or leaf blisters (Fig. 74A) ..... LEAF-MINING CATERPILLARS OR MAGGOTS

   Not as above 4

4. Tiny, whitish maggot(s) hidden within curled leaf margins (Fig. 74B) ..... MIDGE MAGGOTS

   Pest enclosed in a baglike, silken case enmeshed with pieces of leaves or needles (Fig. 74C) ..... BAGWORMS

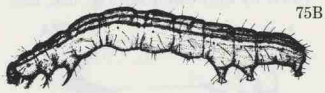
5. Slime trail often noticed on damaged portion; soft-bodied, slimy animal, sometimes with helical shell (Figs. 59G; 66A,B) ..... SLUGS AND SNAILS

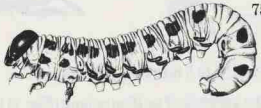
   No slime trail; worm shaped with paired legs 6

6. Caterpillar with five to eight pairs of legs (Fig. 75A to B) ..... MOTH CATERPILLARS

   Caterpillar with more than eight pairs of legs (Fig. 75C) ..... SAWFLY CATERPILLARS


75A


75B

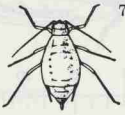

75C

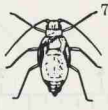
7. Pest mobile, usually with two "honey tubes" or "exhaust pipes" on abdomen (Fig. 76A to E) ..... APHIDS

   Mobility variable; no "honey tubes" or "exhaust pipes" on abdomen 8


76A


76B


76C


76D


76E

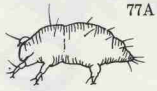
8. Microscopic pest usually associated with distorted plant growth; if not distorted, leaves may be scratched, brown, and/or curled 9

Not microscopic, or if microscopic, not associated with above symptoms 10

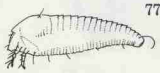
9. Microscopic pest usually associated with distorted plant growth; three pairs of legs (Fig. 77A) ..... THREAD-LEGGED MITES

Microscopic pest that causes leaves to appear scratched, turn brown, and curl; two pairs of legs (Fig. 77B) ..... RUST MITES

77A



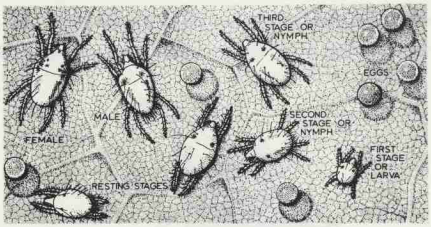
77B



10. Almost microscopic; three or four pairs of legs; usually associated with very fine webbing, spherical eggs, chlorotic stippling of host plant, and adult spider mites (Fig. 78) ..... SPIDER MITES

Not as above 11

78

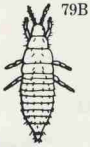


11. Very small, active, orange to yellow, spindle-shaped insect; feeding in buds, flowers, and on leaves (Fig. 79A to D) ..... THRIPS

Not as above 12

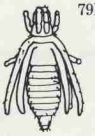
79A

79B



79C

79D



12. Immobile (except newly hatched crawler stage); body adhering to plant surface so that legs are not visible 13

Mobile; legs visible 15

13. Body covered with fluffy or "mealy," white wax secretions; older individuals with waxy strands around periphery (Fig. 80A to E) ..... MEALYBUGS

Body not covered by mealy wax 14

80A

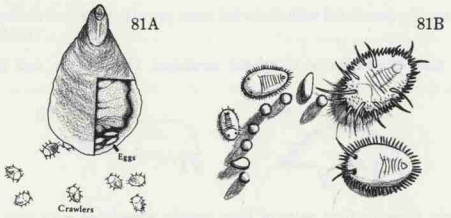
80B

80C

80D

14. Eggs usually laid under body of mother or young born live under mother (Fig. 81A) ..... SCALES

    Eggs inserted into leaf tissue and scattered on lower leaf surface; immatures often associated with whitefly adults (Fig. 81B) ..... WHITEFLIES

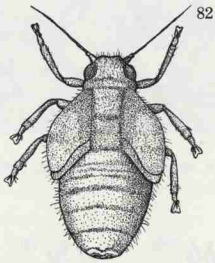


15. Body covered with white, powdery secretions 16

    Body bare of secretions 17

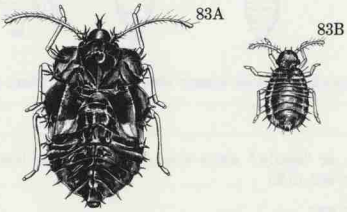
16. Slow moving; body coated with floury or "mealy" secretions (Fig. 80A to E) ..... MEALYBUGS

    Jumping insect covered with white, waxy filaments; associated with small, cicadalike adult (Fig. 82) ..... PSYLLIDS



17. Tiny, black or colorless, spiny nymphs (Fig. 83A,B) ..... LACE BUGS

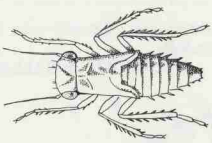
    Nymphs not spiny 18



18. Jumps when disturbed; body elongate (Fig. 84A) ..... LEAFHOPPERS

Runs when disturbed; body oval in top view (Fig. 84B) ..... PLANT BUGS

84A



84B

STEM BORERS AND FEEDERS

1. Pest mobile 2

Pest immobile (except for first-instar nymph crawler stage) or moves very rarely 6

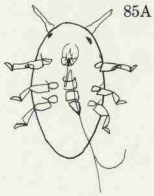
2. Oval, round, or pear-shaped pest that may or may not be covered with waxy strands 3

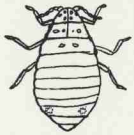
Wormlike larva with variable number of legs 5

3. Covered with woolly strands of wax; feeds only on conifers, usually near tips of branches; causes galling and distortion of branches (Fig. 85A) ..... ADELGIDS

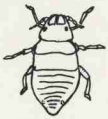
Not as above 4

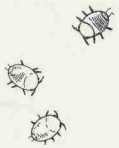
85A





85B





85C

4. Covered with woolly secretion of wax; may feed on both roots and stems, may cause galls especially on roots (Fig. 85B) ..... WOOLLY AND GALL-FORMING APHIDS

Tiny, flattened insect (crawler); not waxy or pear shaped; no cornicles; found in conjunction with immobile scale insects (Fig. 85C) ..... SCALE CRAWLERS

5. Body generally cylindrical, with eight pairs of legs; bores in stems (Fig. 86A) .....
..... MOTH CATERPILLARS

Body flattened somewhat; legless or has three pairs of legs; bores in stems (Fig. 86B) .....
..... BEETLE LARVAE

86A

86B

6. Rarely moves once feeding is initiated; covered with cottony, waxy strands; feeds only on conifers, usually near tips of branches; causes galling and distortion of branches (Fig. 85A) .... ADELGIDS

Body adhering to plant surface so that legs are not visible; eggs usually laid under saclike body of mother or young born live under mother (Fig. 85C) ..... SCALES

ROOT FEEDERS

1. Soft-bodied, grublike larva that strips off bark and chews out notches in roots (Fig. 87) ..... WEEVIL LARVAE

Small insect with heavy, light, or practically nonexistent coat of woolly wax; feeds on stems and roots often causing gall-like swellings on roots (Fig. 85B) ..... WOOLLY or GALL-FORMING APHIDS

87

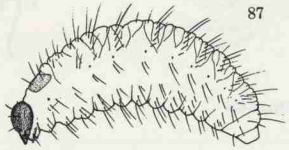


PLATE 1

A. Arborvitae leafminer adults and damage.

B. Azalea bark scales.

C. Azalea caterpillars.

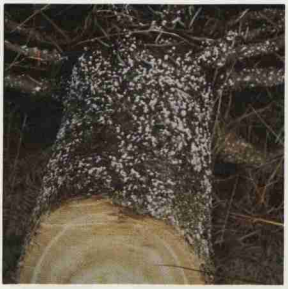
D. Azalea lace bug adults.

E. Azalea lace bug damage.

F. Azalea leafminer damage to azaleas.

G. Bagworms.

H. Balsam twig aphid damage.



I. Balsam woolly adelgids on Fraser fir.

PLATE 2

J. Black vine weevil and damage.

K. Boxwood leafminer adult.

L. Boxwood leafminer maggots in gall.

M. Boxwood leafminer galls.

N. Boxwood psyllid adult.

O. Boxwood psyllid nymphs.

P. Boxwood psyllid damage.

Q. Camellia scales.

R. Citrus mealybugs.

PLATE 3

S. Crapemyrtle aphids.

T. Crapemyrtle aphid damage.

U. Euonymus scale insects.

V. Hawthorn lace bugs.

W. Japanese beetles.

X. Japanese weevils.

Y. Juniper webworms.

Z. Peony scale insects.

AA. Rhododendron lace bug nymphs and damage.

PLATE 4

BB. Southern red mite eggs.

CC. Southern red mite injury (left).

DD. Spruce spider mites.

EE. Spruce spider mite injury.

FF. Tea scale insects.

GG. Tea scale damage.

HH. Twospotted spider mites.

II. Twospotted spider mite damage.

JJ. Woolly apple aphids.

Azalea Pests

The azalea is one of the most popular flowering shrubs in the landscape. Each year more than 78 million azalea plants are grown in the Southeast. However, these shrubs, like most cultivated plants, are subject to attack by insect pests. The principal insects that attack azaleas in the Southeast are azalea bark scales, azalea leafminers, lace bugs, whiteflies, peony scales, thrips, and leaf-eating caterpillars and beetles. To this list of insects can be added several species of mites. Though they are not insects, they may occasionally be troublesome.

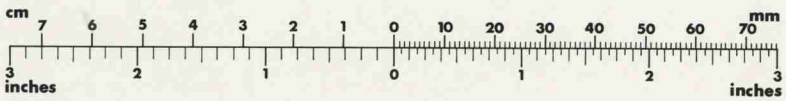
KEY TO COMMON AND IMPORTANT AZALEA PESTS

1. **Azalea bark scale**—Infested azaleas usually appear chlorotic; the bushes are often covered with a black fungus; and white cottony or matted waxy, threadlike masses may be found in crotches and on twigs ..... p. 53

2. **Azalea caterpillar**—The plant is defoliated or has "chewed-up" younger leaves. The length of the caterpillar varies from about 10 mm (reddish to brownish black with white and yellow stripes) to about 51 mm (black with white or yellow stripes and red head) .....p. 55

3. **Azalea lace bug**—The upper surfaces of the leaves are discolored in spots (mottled); the undersurfaces are often dotted with "fly specks" (excrement). Also on the undersurfaces of leaves are adult insects (3 mm long with brown and black markings on lacelike wings) and nymphs (small, dark, and spiny) ..... p. 57

4. **Azalea leafminer (leafroller)**—Brown blisters appear on leaf tips, and margins of leaves are often curled up. The small, yellow caterpillar causing the blisters is not visible because it feeds between the two leaf surfaces .....p. 59



DESCRIPTION

Adult—The adult female azalea bark scale is dark red with short legs and antennae and long, sucking mouthparts. The insect is hidden from view by the egg sac, a covering of felted or matted waxy threads (Color Plate 1B). The sac is about 3 mm long and 1.5 mm thick.

Egg—The egg is laid within the egg sac, occupying the void left by the female's shrinking body.

Nymph—The tiny nymph hatches from the egg and ventures out of the egg sac. It soon penetrates the bark with its long, sucking mouthparts and begins to feed. The nymph is inconspicuous and practically free of any waxy covering.

BIOLOGY

Distribution—The azalea bark scale occurs in the eastern United States; it has also been reported in Belgium, Germany, and Russia.

Host Plants—The azalea bark scale has been found on four azalea species, rhododendron, "flowering cherry," and huckleberry.

Damage—Since its discovery in 1881, the azalea bark scale has become recognized as a prominent pest of azaleas. Infested plants usually appear chlorotic and unthrifty. The bushes are often covered with sooty mold, a black fungus that grows in the honeydew excreted by the azalea bark scales as they feed. Eventually twigs may die back.

Life History—As the female azalea bark scale matures, it secretes white, waxy threads, which become felted or matted into a thick covering over its entire body. This covering is called the egg sac, where eggs are laid after mating. As the female lays eggs, its body shrivels gradually until the egg sac is almost completely filled with eggs. Eggs are laid in late April. They hatch in about 3 weeks. This new generation matures during the summer and produces eggs in September. Mature females tend to feed in crotches and on twigs. Adult males, two-winged and tiny, tend to feed on the leaves. Azalea bark scales overwinter as nymphs feeding on the bark.

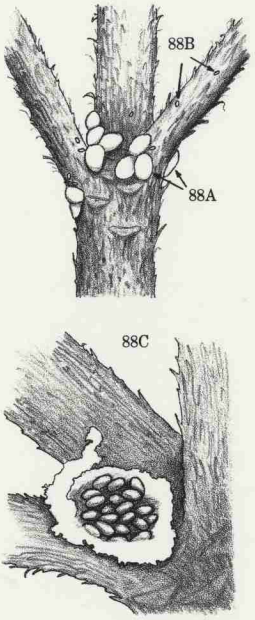
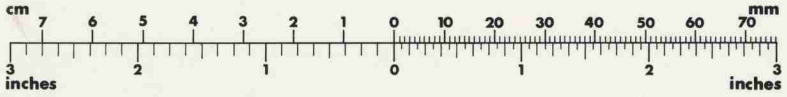


Fig. 88 Azalea bark scale. A, Adults. B, Nymphs. C, Eggs.

CONTROL

Adult females and eggs are protected by the egg sac from virtually any pesticide. The key to control is treatment in late spring and late fall when the nymphs are present. For specific chemical controls, see the current state extension service recommendations.



**Eriococcus azaleae* Comstock, Eriococcidae, HEMIPTERA

DESCRIPTION

Adult—The light-brown moth has a wingspan of 45 mm.

Larva—The partly grown larva (caterpillar) is approximately 10 mm long and reddish to brownish black with white and yellow stripes. The mature caterpillar is about 50 mm long and black with eight near-white, longitudinal, broken stripes; the head and legs are mahogany red (Color Plate 1C).

BIOLOGY

Distribution—Azalea caterpillars are serious pests of azaleas in the Southeast: Virginia, the Carolinas, Florida, Alabama, Mississippi, and Louisiana.

Host Plants—An important pest of azaleas, azalea caterpillars have also been reported on blueberry in Delaware, on red oak in Maryland, and occasionally on Andromeda and apple in Atlantic states.

Damage—Often the caterpillars defoliate much of the plant before they are detected.

Life History—The azalea caterpillar is gregarious, feeding in groups; all members raise head and posterior in unison when disturbed. Comparatively little is known about the biology of this insect. Apparently there is only one generation per year. Eggs are deposited by the female moth in masses of 80 to 100 on the underside of the leaf. The first-instar caterpillars feed in a cluster side by side unless disturbed. Most of the damage occurs in August and September.

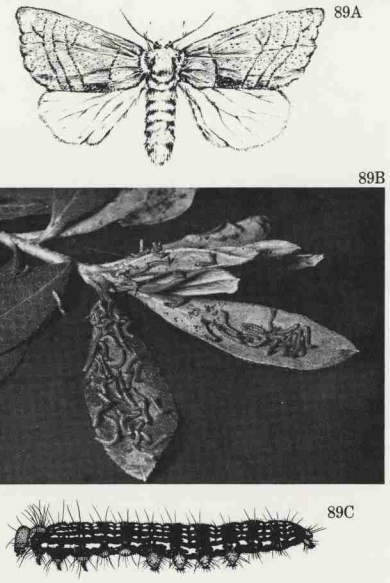
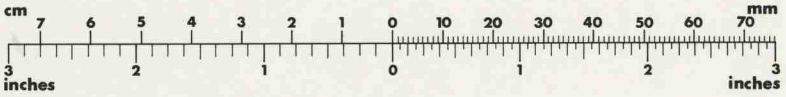


Fig. 89 Azalea caterpillar. A, Adult. B, Young caterpillars. C, Mature caterpillar.

CONTROL

Because the caterpillar is harmless to humans, it can be removed by hand. For specific chemical controls, see the current state extension service recommendations.



**Datana major* Grote and Robinson, Notodontidae, LEPIDOPTERA

DESCRIPTION

Adult—The small adult, 3 mm long and 1.5 mm wide, has lacy wings with brown and black markings, and light-brown legs and antennae (Color Plate 1D).

Egg—The smooth, white egg, which measures approximately 0.4 mm by 0.8 mm, is flask shaped with the neck to one side. It is usually deposited in the tissue of a young leaf along the midrib or a large vein. Each egg is inserted in the tissue with its neck slightly above the leaf surface. Up to 90 eggs have been found in a single leaf. Most of them are placed irregularly along the midrib.

Nymph—Commonly found on the underside of a leaf, the nymph is almost colorless at birth but soon turns black and spiny. It molts six times and ranges in size from 0.4 mm to 1.8 mm before becoming an adult. After the fourth molt, wing pads show distinctly.

BIOLOGY

Distribution—In the United States, the azalea lace bug occurs from New York and Massachusetts southward into Florida and Alabama.

Host Plants—The evergreen azalea varieties are preferred by azalea lace bugs, although the deciduous varieties may be attacked. Mountain laurel is also subject to infestation.

Damage—Injury is caused by the nymphs and adults as they extract sap from the undersurfaces of the leaves. The damage shows as spotted discoloration of the upper surfaces of the leaves (Color Plate 1E). In severe infestations, the leaves become almost white, many of them drying completely and dropping off. The undersides of the leaves are also disfigured by the excrement and cast skins of the insects.

Life History—Since its introduction from Japan in the early 1900's, the azalea lace bug has been recognized as an important pest of azaleas. Female lace bugs lay groups of eggs on the undersides of the leaves, most often along the midribs. This egg-laying takes place over an average period of 2 weeks. These eggs require an average of 2 weeks for hatching. Colorless at first, the spiny nymphs hatch from the eggs, gradually darken, and go through five growth stages before becoming adults. Because of the extended oviposition period, it is quite possible to find all stages together on the undersides of the leaves at the same time. Usually two or more generations are produced in a year.

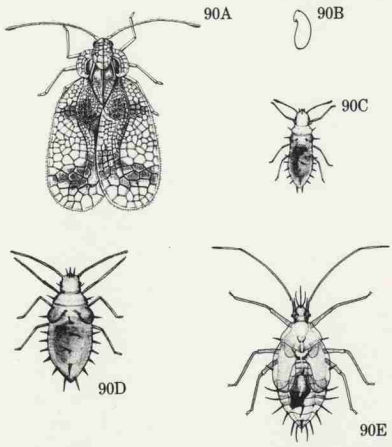
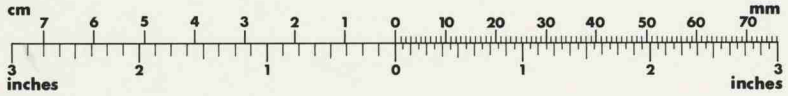


Fig. 90 Azalea lace bug. A, Adult. B, Egg. C to E, Nymphs.

The insect overwinters in the egg stage. In the South these overwintered eggs start hatching in late February, building up to a dense population during March, April, and May. A second brood comes along in July, August, and September. During early August eggs are laid. By the middle and last week in September, many adults of this brood are present, the overwintering eggs being deposited at this time and during the first part of October.

CONTROL

Repeated applications of some insecticides may be needed to control lace bugs effectively. The first application should be made as soon as nymphs appear in the spring and be followed with a second application 7 to 10 days later, if needed. Applications should be repeated as needed at monthly intervals. Thorough coverage is essential when applying sprays if good control is to be expected. The undersides of the leaves must be covered. For specific chemical controls, see the current state extension service recommendations.



**Stephanitis pyrioides* (Scott), Tingidae, HEMIPTERA

DESCRIPTION

Adult—The adult azalea leafminer is a small, yellow moth with purplish markings on the wings. The wingspan is about 10 to 13 mm.

Larva—The leaf-mining larva is yellowish and about 13 mm long. It has three pairs of prolegs found on abdominal segments three, four, and five. The proleg hooks (crochets) are singly arranged in a U-shaped pattern (penellipse) with a series of crochets within the pen.

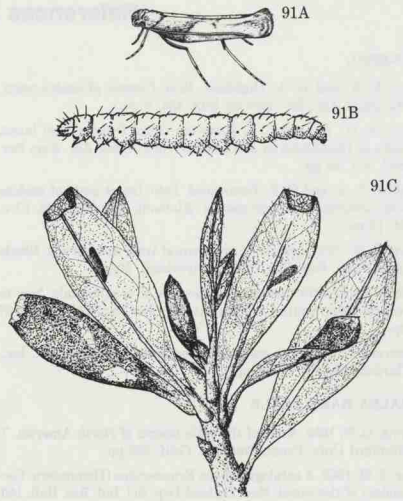


Fig. 91 Azalea leafminer. A, Adult. B, Larva. C, Damaged leaves.

BIOLOGY

Distribution—The azalea leafminer is found in most states where azaleas are grown.

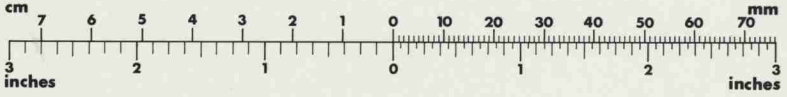
Host Plants—Azaleas are the only known hosts for this insect.

Damage—This leafminer larva has little effect on plants grown outdoors, but it may do considerable damage to cuttings in the greenhouse. Mining within the leaf, the young larva causes the formation of brown blisters on the leaf surfaces (Color Plate 1F). As the larva matures, it emerges and rolls the edge of a leaf around itself for protection while feeding on the leaf surface. Seriously injured leaves usually turn yellow and drop, thereby causing an unslightly plant.

Life History—Eggs are deposited singly on the undersides of leaves along the midribs, usually one to five per leaf. The young (larvae) hatch in about 4 days, mine into the leaves, and feed inside them. At this stage, the leaves appear to have blisters. If a leaf is held up to the light, the larva can be seen inside. When about one-third grown, the larva emerges, moves to the tip of a new leaf, and rolls it up for protection while feeding and growing. When nearly grown, the larva rolls up the margin of a leaf and spins a cocoon inside. The moth emerges from the cocoon, mates, and deposits eggs for another generation. Under greenhouse conditions, the larvae may be found at any time during the year. The insect overwinters outdoors as a larva or pupa. Adults appear and females begin to lay eggs about the time plants bloom in the spring.

CONTROL

Because the larva protects itself by mining into and rolling the leaf, this insect is not easy to control. Several insecticide-spray mixtures have yielded satisfactory control when applied at the first sign either of the adult moth or of foliar injury by the larva. One or two applications, 1 to 2 weeks apart, are usually sufficient. For specific chemical controls, see the current state extension service recommendations.



**Caloptilia azaleella* (Brants), Gracillariidae, LEPIDOPTERA

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Boxwood Pests

Approximately 3,600,000 boxwoods are produced each year by nurserymen in the southeastern United States. Although handsome and stately plants, boxwoods are sometimes difficult to grow. In the wrong situation, boxwoods are susceptible to leafminers, wax scales, and other insects as well as spider mites, nematodes, and various root diseases.

KEY TO COMMON AND IMPORTANT BOXWOOD PESTS

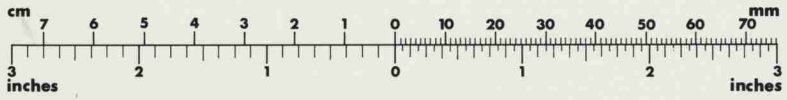
1. **Boxwood leafminer**—The leaf's lower surface appears "puffy" or blistered. Heavily infested plants have distorted and discolored leaves ..... p. 63

2. **Boxwood psyllid**—New growth is distorted and cup shaped. Pale-green insects (up to 3 mm long) feed inside distorted growth and secrete a fluffy, waxy covering; or small, green, leafhopperlike insects jump or fly onto foliage ..... p. 65

3. **Japanese wax scale**—White, waxy blobs up to 6 mm in diameter appear on the limbs and twigs. They are often accompanied by a sooty mold ..... p. 69

4. **Spider mites**—The leaves are speckled with tiny, pale dots. The whole shrub may appear off-color, gray, or bronzed.
   a. **Twospotted spider mite**—Damage appears as aggregates of single dots. The eggs are round and often reddish ..... p. 71

   b. **Boxwood spider mite**—Damage appears as tiny lines or "hen scratches" on the leaf surface. The eggs are flattened and yellowish ..... p. 67



DESCRIPTION

Adult—The mature boxwood leafminer is a yellow to orange-red fly. Mosquitolike but small (2.5 mm), it can often be observed swarming around boxwoods during the time weigelas are in bloom (Color Plate 2K).

Larva—The larva is a small, whitish to lemon-yellow maggot up to 3 mm in length (Color Plate 2L).

Pupa—The elongate, 3-mm-long pupa is whitish to dark yellow. Close examination reveals legs and wings appressed to the body surface.

BIOLOGY

Distribution—The boxwood leafminer is probably the most commonly reported pest of boxwoods. Imported from Europe, this small fly is a greater pest in the Mountains and Piedmont than in the Coastal Plain. However, infestations can occur wherever boxwoods are grown.

Host Plants—All boxwoods may be infested, but more slowly growing English varieties are less susceptible than American varieties.

Damage—Mining in the foliage, this pest causes the formation of small blisters on the undersurfaces of leaves (Color Plate 2M). Infested leaves usually become yellowish and are smaller than uninfested leaves. As a result, heavily infested plants assume an unthrifty appearance.

Life History—Adult flies insert their eggs into the leaves' upper surfaces. Tiny larvae hatch and mine into the leaves as they feed. The leaves first acquire a water-soaked appearance at the feeding site. Soon, blisters develop on the lower leaf surface; one to several larvae may develop on a single leaf. The leafminers spend the winter in the blisters as larvae. In spring, the blisters develop a translucent "window" through which pupae protrude from the lower leaf surface. Adult flies emerge from the pupae over a 2-week period in early spring, shortly after the boxwoods have put out their new growth. The adult flies live only a few days. Only one generation occurs each year.

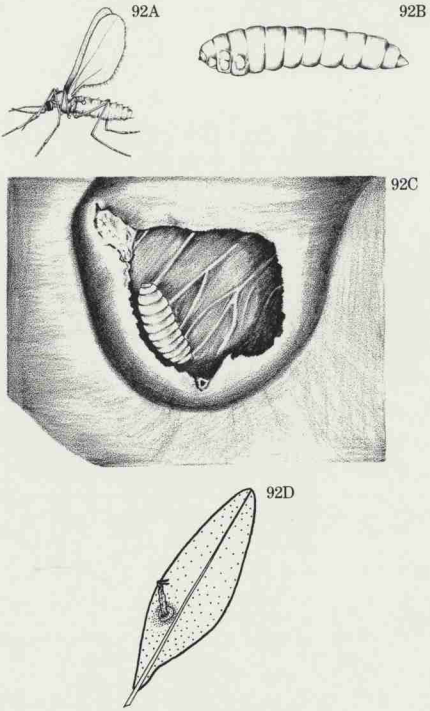
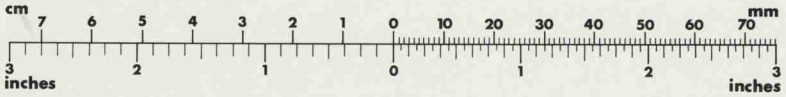


Fig. 92 Boxwood leafminer. A, Adult. B, Larva. C, Larva in mine. D, Pupal skin protruding from leaf.

CONTROL

For specific chemical controls, see the current state extension service recommendations.



**Monarthropalpus buxi* (Laboulbène), Cecidomyiidae, DIPTERA

DESCRIPTION

Adult—This small (3-mm-long), grayish-green sucking insect has transparent wings and resembles a miniature cicada (Color Plate 2N).

Egg—The tiny, orange egg is spindle shaped.

Nymph—The flat, green- and brown-mottled nymph is covered with whitish, waxy filaments. The nymph is wingless and smaller than the adult (Color Plate 2O).

BIOLOGY

Distribution—Boxwood psyllids seem to occur wherever boxwoods are grown. In the United States, however, they are most common in temperate areas.

Host Plants—Boxwood is the only known host of this pest. Although both American and English varieties are attacked, American boxwoods are more likely to be severely infested.

Damage—Psyllid nymphs extract sap from buds and young foliage. As a result, terminal leaves of infested plants become cupped and twig growth may be checked (Color Plate 2P). Since the boxwood psyllid completes its single annual generation early in the growing season, plants tend to outgrow their injury by midsummer.

Life History—Boxwood psyllids overwinter as first-instar nymphs still within their orange egg shells. In spring as buds begin to grow and leaves unfold, the nymphs hatch from the eggs. They immediately begin to suck sap from new leaves. As their feeding causes leaves to curl, the nymphs become concealed and protected. After developing through several instars, psyllid nymphs molt into adults in May or early June. Although adults continue to feed, they are not as damaging as nymphs. In July or August, female adults deposit one to seven eggs under each bud scale. First-instar nymphs develop within the egg before winter but do not emerge until spring. Only one generation occurs each year.

CONTROL

Insecticides are available for control of boxwood psyllids. Infested plants should be treated when new growth appears, and applications should be repeated as necessary. For specific chemical controls, see the current state extension service recommendations.

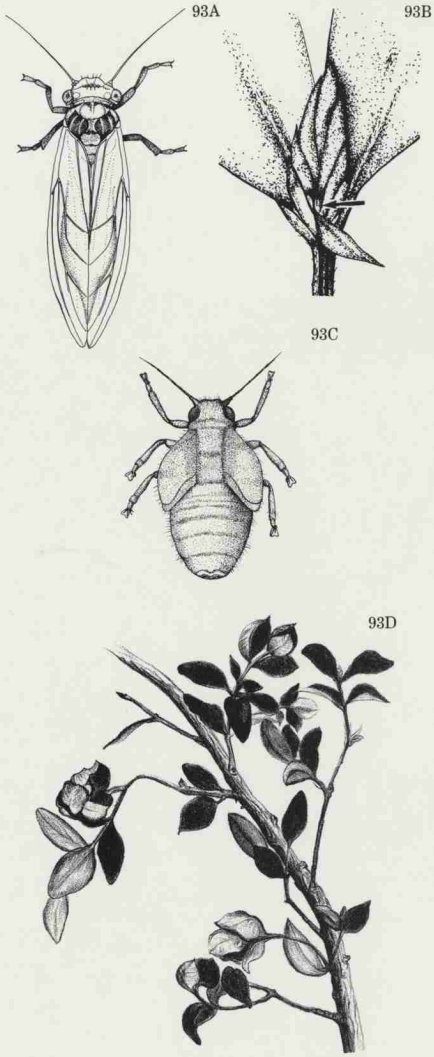


Fig. 93 Boxwood psyllid. A, Adult. B, Overwintering nymph. C, Mature nymph. D, Boxwood leaves cupped by psyllids.

**Psylla buxi* (Linnaeus), Psyllidae, HEMIPTERA

DESCRIPTION

Adult—The adult is green to yellowish brown. The body is ovate in females and tapering in males. It is slightly less than .375 mm long and has eight legs.

Egg—The lemon-yellow egg is flattened on the bottom and slightly flattened on top.

Larva—The larva is green. Except for its small size and six legs, it resembles the adult.

Nymph—The green nymph is similar to the adult except for size.

BIOLOGY

Distribution—This mite has been reported in North Carolina, Virginia, Georgia, Connecticut, Michigan, Oregon, and California.

Host Plants—Boxwoods are the only known host for the boxwood spider mite.

Damage—All stages of mites feed on the upper and lower surfaces of the leaves. As they feed, they apparently inject a toxic saliva, which causes small, yellow, scratchlike spots to form on the upper leaf surfaces. New plant growth seems particularly susceptible to attack. Twospotted spider mites and other spider mites, on the other hand, usually cause tiny chlorotic stipples of discrete dots.

Life History—Overwintering eggs are laid in September and October. In midspring the eggs hatch into six-legged larvae, which crawl about and feed freely for about 3 days. After a resting stage (about 1 day), the larvae molt into eight-legged first nymphs. They feed for about 4 days and then go into a resting stage (about 2 days). After that period, the second nymphs emerge to feed for about 4 days. The final resting stage lasts about 4 days, and then the adults emerge. Mating takes place immediately. Within hours a female may start laying eggs, usually 25 to 30. Because the entire life cycle takes from 18 to 21 days, there are at least eight generations per year.

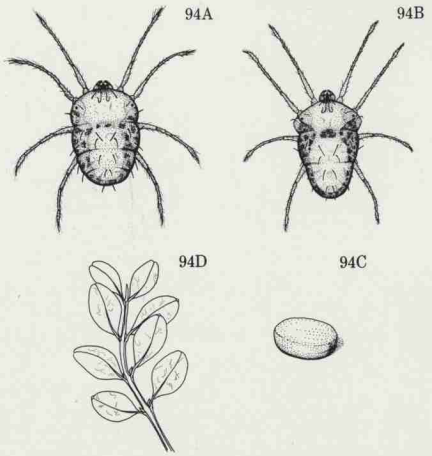
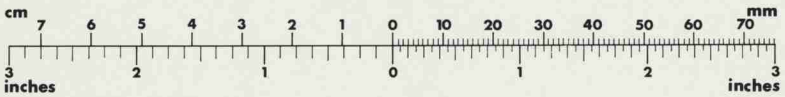


Fig. 94 Boxwood spider mite. A, Female. B, Male. C, Egg (enlarged). D, Damage to boxwood leaves.

CONTROL

For specific chemical controls, see the current state extension service recommendations.



**Eurytetranychus buxi* (Garman), Tetranychidae, PROSTIGMATA

DESCRIPTION

Adult—The brownish-purple female has tiny legs and a thick covering of sticky wax. There are no males.

Egg—Ovoid and pale purple, the egg resembles purple pollen when shaken onto a white surface.

Crawler—Each crawler is flattened and tiny. In a mass, newly hatched crawlers appear rusty red.

Star Stage—After molting, each scale secretes wax in tufts, forming a star.

BIOLOGY

Distribution—The Japanese wax scale is found from Florida to Virginia and Maryland.

Host Plants—Japanese wax scales have been reported on azalea, blueberry, camellia, Chinese elm, citrus, fig, eugenia, gumbo-limbo, Chinese holly, yaupon, jasmine, mulberry, pear, persimmon, plum, quince, sapodilla, turkscap, and other plants.

Damage—A severe infestation of Japanese wax scale detracts from the host plant's appearance because of the many white scales and the copious honeydew that they excrete. A black fungus called sooty mold grows in the honeydew, further disfiguring the host plant.

Life History—Japanese wax scales begin to lay eggs in March, each scale laying from 1,000 to 2,000 eggs. By late May, tiny crawlers hatch and move about, searching for a place to feed. Feeding occurs along the twigs and leaf midribs of numerous woody plants. Once the crawlers insert their sucking mouthparts into the host plant, they are immovable. They then secrete the waxy covering from which they derive their name. The young scales mature throughout the summer, producing more waxy covering and becoming increasingly tolerant to pesticides. They overwinter as adults.

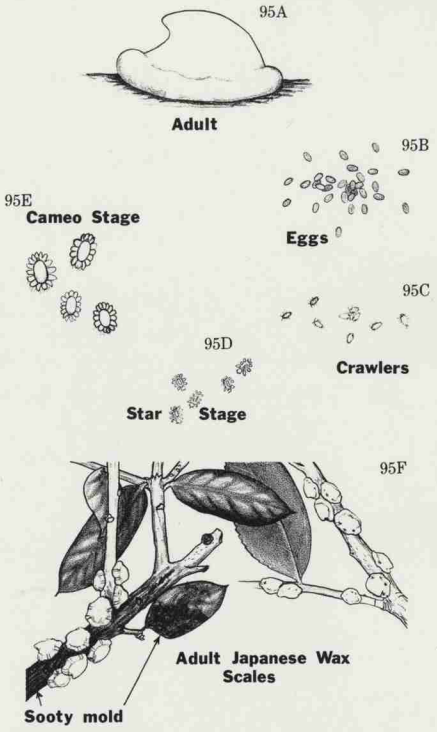
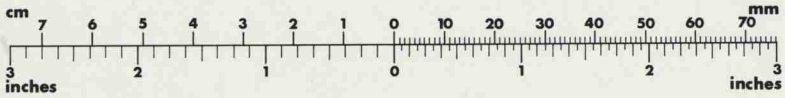


Fig. 95 Japanese wax scale. A, Adult. B, Eggs. C, Crawlers. D, Star stage. E, Cameo stage. F, Damage.

CONTROL

Handpicking scales in winter (if practical) is an effective control measure. Since they may lay their eggs apart from their host plants, the scales should be destroyed after removal. The Japanese wax scale seems to be one of the most difficult ornamental plant pests to control. However, because there is only one generation per year, applying pesticides to the crawler stage in early June will give virtually complete control. Applications of any pesticide must be repeated because the crawlers emerge from the female's protective wax coating for 2 or 3 weeks and because recommended pesticides grow ineffective in the environment. For specific controls, see the current state extension service recommendations.



**Ceroplastes ceriferus* (Fabricius), Coccidae, HEMIPTERA

DESCRIPTION

Adult—The eight-legged adult can be rusty green, greenish amber, or yellow. The overwintering female, however, is orange. Usually having two (sometimes four) black spots on top, the adult is about .375 mm long (Color Plate 4HH).

Egg—The spherical egg ranges in color from transparent and colorless to opaque straw yellow.

Larva—The six-legged larva is colorless to pale green or yellow.

Nymph—Similar to the adult except in size, the pale-green to brownish-green nymph has eight legs. Large spots of black may develop on each side.

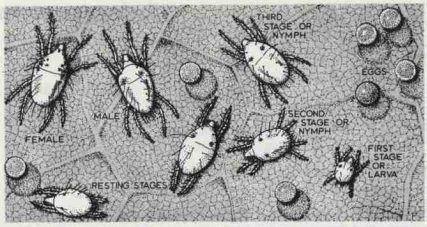


Fig. 96 Stages of the twospotted spider mite.

BIOLOGY

Distribution—Twospotted spider mites are widely distributed in the United States.

Host Plants—Twospotted spider mites have been reported on over 180 host plants, which include over 100 cultivated species. Violets, chickweed, pokeweed, wild mustard, and blackberry are common foci from which infestations develop on nearby crops.

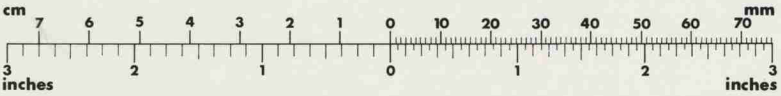
Damage—Twospotted spider mites pierce the epidermis of the host plant leaf with their sharp, slender mouthparts. When they extract the sap, the mesophyll tissue of the leaf collapses in the area of the puncture. Soon a chlorotic spot forms at each feeding site. After a heavy attack, an entire plant may become yellowed, bronzed, or killed completely (Color Plate 4II). The mites may spin so much webbing over the plant that it becomes entirely covered.

Life History—Twospotted spider mites occur as important pests on more crops than any insect pest in the Southeast. Though insects and mites are in a group called the Arthropoda (meaning jointed foot), because jointed legs are common to both, spider mites are not actually insects. Being more closely related to spiders, they derive their name from the thin web that some species spin.

In the Southeast, twospotted spider mites overwinter as adults in the soil or on weed hosts such as violets and hollyhocks. In mild winter weather, twospotted spider mites continue to feed and lay eggs, although development in the winter is much slower than in the summer. Six-legged larvae hatch from the eggs. They develop into eight-legged nymphs, which pass through two nymphal stages. After each larval and nymphal stage, there is a resting stage. The adults mate soon after emerging from the last resting stage, and in warm weather the females soon lay eggs. Each female may lay over 100 eggs in her life and up to 19 eggs per day. Development is most rapid during hot, dry weather. A single generation may require as many as 20 or as few as 5 days to reach adulthood and begin producing offspring.

CONTROL

The resting stages and eggs of the twospotted spider mite are more tolerant to pesticides than the motile forms. Consequently, a second application of pesticide may be necessary at a 4- or 5-day interval in hot weather (a 7- to 10-day interval in cool weather) to kill those mites that may have survived the first application. For specific chemical controls, see the current state extension service recommendations.



**Tetranychus urticae* Koch, Tetranychidae, PROSTIGMATA

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Camellia Pests

Camellias are prominent flowering shrubs in the Piedmont and Coastal Plain. Approximately 2,000,000 camellia plants are grown in Southern greenhouses and nurseries each year. Three species of camellia are in general cultivation: *Camellia japonica, C. sasanqua,* and *C. reticulata.* Varieties of these species flower in red, pink, or white, or combinations of these colors. Though numerous species of insects and mites have been reported on camellias, few actually cause damage; the vast majority are merely casual visitors. Scale insects are the most serious pests of the camellia.

KEY TO COMMON AND IMPORTANT CAMELLIA PESTS

1. **Camellia scale**—Most prevalent on cuttings and young plants grown in greenhouses, the camellia scale infests only leaves. The foliage appears sickly but not discolored; it can drop prematurely. The armor of the female scale resembles a tiny oyster shell ..... p. 75

2. **Peony scale**—Appearing white and circular on bark, the peony scale can kill twigs and branches, if infestation is severe. The convex shell of the scale, being small and brown, is an inconspicuous hump on the bark ..... p. 77

3. **Tea scale**—On the upper surface of infested leaves are yellow splotches caused by the feeding of the underlying insects; cottony masses are evident on the undersides of the leaves. Plant vigor and production of blooms may be impaired ..... p. 79

DESCRIPTION

Adult—The shell of the female camellia scale varies from light to dark brown and resembles an oyster shell. Nearly 2.5 mm in length, it covers the white to purplish saclike insect.

Nymph—The immature male scale lives under a smaller shell narrower than that of the adult female (Color Plate 2Q). Immature females secrete an oval armor about 0.8 mm long.

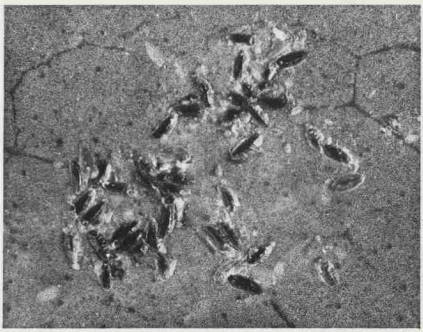


Fig. 97 Camellia scale.

BIOLOGY

Distribution—Wherever camellias are grown, the camellia scale is a pest.

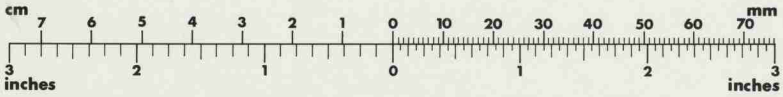
Host Plants—Unlike the tea scale, the camellia scale has little effect on camellias grown under natural conditions. It is found mostly on cuttings and on young plants in greenhouses and nurseries. The camellia scale is found on *Camellia* spp. and holly (*Ilex* spp.).

Damage—The devitalized foliage drops prematurely but is not discolored. The sale value of infested plants is reduced.

Life History—When 40 to 50 days old, females lay 25 to 55 eggs, which hatch in 11 to 24 days. From the shell, the young nymphs (crawlers) migrate either to fresh leaves or to old leaves near the parent. As soon as they settle, they begin to secrete a protective covering. In 12 to 17 days after birth, they molt. The second molt occurs 6 to 10 days later, after which the shell gradually enlarges to accommodate the growing insect. The life cycle is usually completed in 60 to 70 days. Few eggs are laid outdoors during the winter, but hatching may continue in greenhouses and in cold frames. Because of overlapping broods, all stages of the life cycle are present in summer.

CONTROL

The camellia scale is often heavily parasitized by tiny wasps, which make holes in the shells when they emerge. Lady beetles also feed rather extensively on this scale. For specific chemical controls, see the current state extension service recommendations.



**Lepidosaphes camelliae* Hoke, Diaspididae, HEMIPTERA

Notes

DESCRIPTION

Adult—With a small, grayish-brown shell, the adult grows to about 2.5 mm. The female is circular or oval, and moderately to very convex (Color Plate 3Z). The orange-yellow exuviae are subcentral to submarginal. Though similar to the female, the immature male is more slender, with submarginal exuviae.

Nymph—The nymph is tiny, flat, and purple.

BIOLOGY

Distribution—The peony scale has been reported only in the South.

Host Plants—Found mostly on camellias and azaleas, the peony scale is occasionally present on ligustrum and other shrubs.

Damage—Burrowing beneath the bark of twigs and stems, the scale feeds on plant juices. Infested areas swell and later sink; small stems die quickly.

Life History—Little information on the biology and control of the peony scale is available.

The scale has a burrowing habit, at times becoming practically hidden by the bark. Its presence, in such cases, can be detected only by the discovery of small bumps on the bark. Crawlers are present in May, only one generation of young being produced per season.

CONTROL

The scale is sometimes parasitized by a small wasp. For specific chemical controls, see the current state extension service recommendations.

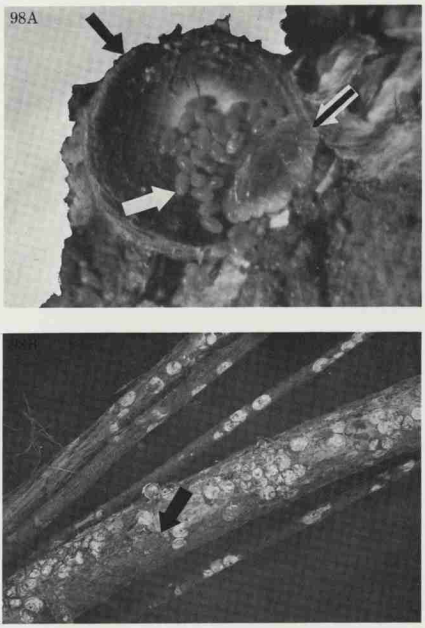
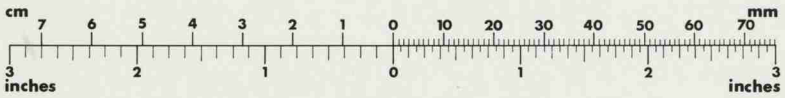


Fig. 98 Peony scale. A, Arrows point to armor (black), female scale insect (striped), and eggs (white). B, Scale scars and scale (arrow).



**Pseudaonidia paeoniae* (Cockerell), Diaspididae, HEMIPTERA

DESCRIPTION

Adult—The female tea scale is at first thin and light yellow, later becoming hard and brown. Elongate oval or boat shaped, it is 1.5 mm long, with the residue from the first molt attached at one end. The male adult is soft, white, and narrow with a ridge down the middle of its back (Color Plate 4FF).

Egg—The egg is yellow and lemon shaped.

Nymph—The nymph is a flat, yellow "crawler."

BIOLOGY

Distribution—The tea scale has been reported on camellias in the South and in California.

Host Plants—In the Southeast, the tea scale is a serious pest of camellias as well as Chinese and Japanese hollies. It has also been reported on bottlebrush, dogwood, euonymus, ferns, mango, Satsuma orange, orchids, tea plant, and yaupon.

Damage—The infestation occurs primarily on the undersides of leaves. The most conspicuous characteristic of an infested plant is yellow splotching on the upper leaf surfaces, an effect of feeding insects underneath (Color Plate 4GG). The whole plant may appear generally unhealthy, with leaves dropping prematurely. The number of blooms decreases, and cuttings may die before roots develop.

Life History—Each female deposits from 10 to 15 eggs under the scale shell. They hatch in 7 to 21 days, depending on the weather. The flat, yellow crawlers migrate to the newer growth on the plant and, in 2 or 3 days, attach themselves. At first they secrete thin, white coverings, but shortly afterward they produce great quantities of white threads. When the population of nymphs is dense, the undersides of the leaves may be covered with this cottony secretion. The nymphs molt 18 to 36 days after hatching, and a second molting occurs about a week later. From 41 to 65 days after hatching, female scales begin to lay eggs. The life cycle is usually completed in 60 to 70 days. The hatching of tea scale nymphs occurs throughout the year, although it is less frequent in cold than in warm weather. Because there are many overlapping broods, crawlers can hatch continuously from March to November.

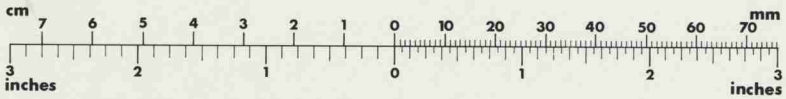
99A

99B

Fig. 99 Tea scale. A, Arrows point to female (white), male (black), and crawler (striped). B, Damage to camellia.

CONTROL

Several spray mixtures are recommended for the control of tea scale. These sprays should be heavily applied to the undersides of leaves. The best time to spray is in the spring, after the plants have finished blooming and the danger of cold weather has passed. Two applications, 10 days apart, should be sufficient. For specific chemical controls, see the current state extension service recommendations.



**Fiorinia theae* Green, Diaspididae, HEMIPTERA

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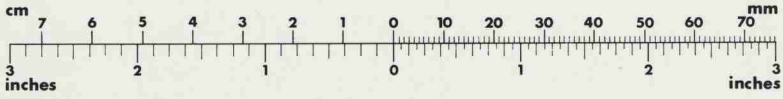
Conifer Pests

Included in this section are pests that infest arborvitae, cedar, deodar cedar, fir, hemlock, juniper, pine, and spruce in nurseries and in the landscape. Conifers form a major portion of the shrubs grown by commercial nurserymen. With their amazing variety of forms and shades of green and yellow, conifers are among the most important landscape plants. Although conifers generally require little care, they are occasionally damaged or killed by insects and spider mites in the landscape.

KEY TO COMMON AND IMPORTANT CONIFER PESTS

1. **Arborvitae leafminer**—Arborvitae leaves are tunneled and brown; heavily infested shrubs are unthrifty and defoliate prematurely; tiny (1- to 3-mm), greenish or brownish caterpillars are found in tunnels ..... p. 83
2. **Bagworm**—Spindle-shaped silk bags covered with pieces of plant foliage hang from twigs; when bagworms are numerous, much of the plant may be defoliated and may die ..... p. 85
3. **Balsam twig aphid**—Needles of Fraser fir twisted and curled; bark may have a roughened appearance; aphids are bluish gray but are present only very early in the growing season ..... p. 87
4. **Balsam woolly adelgid**—Gouty and twisted new growth of fir; needles defoliating prematurely; small, cottony fluffs on the bark of trunk and branches with small, bluish-black insects underneath; heavily infested trees declining or dead ..... p. 89
5. **Eastern spruce gall adelgid**—Pineapple-shaped galls at the base of new twigs; growth distorted at older galls; small, greenish-white aphids in new galls ..... p. 91
6. **Introduced pine sawfly**—Colonies of grayish caterpillars with rows of black and yellow spots on sides feed on white and Virginia pines. Heavily infested trees may be defoliated ..... p. 93
7. **Juniper webworm**—Foliage of junipers webbed together by silk strands; heavily infested shrubs with much dead foliage incorporated in the webbing and dead foliage below the shrub; slender, whitish worms with brown stripes in webbing ..... p. 95
8. **Nantucket pine tip moth**—Dead buds and shoots are hollowed out; small worms or pupae are inside. Small (up to 6-mm), gray moths may be noticed around dusk ..... p. 97
9. **Pine bark adelgid**—Small (up to 3-mm), dark insects with conspicuous white, waxy filaments feeding on back. Most noticeable in late winter and spring ..... p. 99
10. **Pine needle scale**—Needles of pine (sometimes balsam fir, *Cedrus*, *Juniperus*) infested with small (1- to 4-mm), white scale insects with light-yellow exuviae on one end ..... p. 101
11. **Redheaded pine sawfly**—Colonies of yellowish caterpillars with brown spots and orange heads feeding on foliage; small shrubs may be completely defoliated ..... p. 103
12. **Spittlebugs**—Masses of frothy liquid on twigs of pine. Twig dieback common ..... p. 105
13. **Spruce spider mite**—Foliage pale yellowish or whitish; foliage may drop prematurely; spider mites may be present in large numbers; foliage may be webbed with fine silk webbing ..... p. 107
14. **White pine aphid**—Large (up to 6-mm), dark, soft-bodied insects sucking sap from twigs and branches of white pine. Honeydew and sooty molds often present ..... p. 109



DESCRIPTION

Adult—The adult is a small (about 5-mm-long), light-gray (with brown and black spots) moth with a wingspread of about 8 mm. The antennae are long and slender. The legs and abdomen are light brown (Color Plate 1A).

Egg—The egg is tiny (0.4 mm by 0.25 mm) and almond shaped with wrinkled sculpturing on one end. It is pinkish but turns darker as the embryo matures.

Larva—The larva is a small (0.75- to 3-mm), green (sometimes with a reddish tinge) or brownish caterpillar with a black head and cervical shield.

Pupa—The 3.5- to 4-mm-long pupa is greenish but turns brownish red as it matures. The tail segment has a group of six to eight short, stout hooks (the cremaster).

BIOLOGY

Distribution—The arborvitae leafminer is known from New England and eastern Canada south to the Middle Atlantic states and west to Missouri.

Host Plants—The arborvitae leafminer apparently confines its feeding to all varieties of arborvitae but seems to prefer American pyramidal, globe, and golden arborvitae (about in that order).

Damage—Mined leaves detract from the appearance of infested arborvitae (Color Plate 1A). Heavily damaged leaves may drop from the plant prematurely, and in extreme cases the plant may be killed.

Life History—Arborvitae leafminers overwinter as larvae in the mined leaves. Pupation occurs and adults appear in late spring and throughout the summer. After 2 or 3 days, females deposit eggs in the axils of branchlets or along leaf margins. A female may oviposit for 4 or 5 weeks. Most of the eggs are laid around the first of June. Newly hatched larvae bore into the leaves and feed for the rest of the season. The larvae mine from the tips of branchlets toward the bases and allow the frass to collect in the tunnels until winter. When mining is resumed the following spring, the frass is expelled from the mine. Larvae will sometimes leave old mines and begin new ones. Pupation occurs in the new portion of the mine after an exit hole has been chewed and takes place from March to May. The pupal stadium is 3 to 5 weeks. Pupae face the exit hole.

CONTROL

Some control may be obtained by pruning out infested tips in the fall. Hymenopterous parasites also help control the population. If a spray is used, it should be applied in early June or late May. For specific chemical controls, see the current state extension service recommendations.

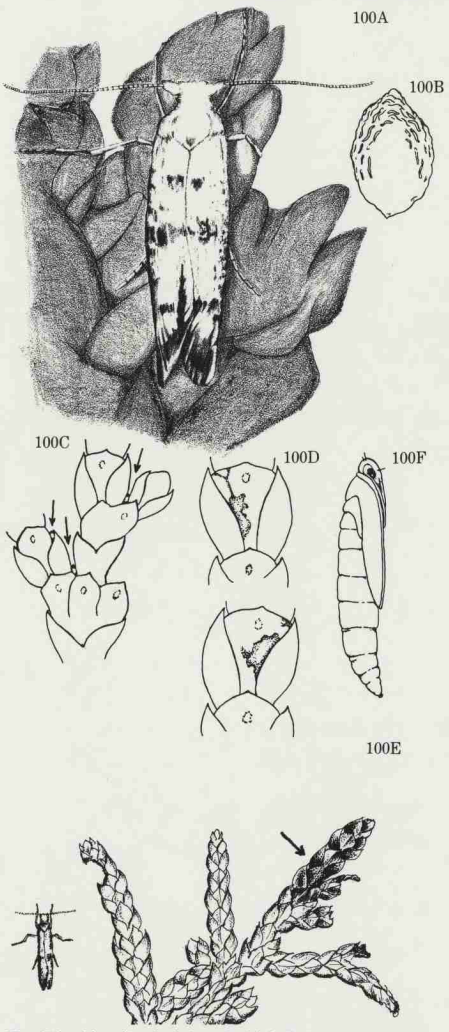
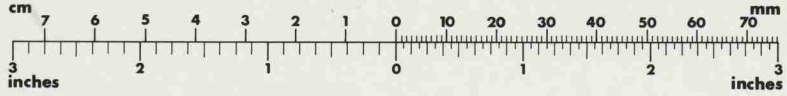


Fig. 100 Arborvitae leafminer. A, Adult. B, Egg. C, Egg placement. D, Early damage. E, Damage (arrow). F, Pupa.



Argyresthia thuiella (Packard), Yponomeutidae, LEPIDOPTERA

DESCRIPTION

Adult—The female is wingless and grublike with tiny, useless legs. The male is a small, brown, hairy moth with clear wings.

Egg—The yellow egg is slightly oblong or spherical, about 0.8 mm by 1.0 mm. It is found in the mother's bag, usually in her pupal exuviae.

Larva—The male is 2 to 43 mm long; the female, 2 to 52 mm. The head and forward parts are dark and sclerotized; the remainder is pale amber. Larval bags grow to about 5 cm long and 12 mm wide (Color Plate 1G).

Pupa—The pupa is dark brown. Males are slender posteriorly, and females are cylindrical. The pupal stage is spent inside the bag.

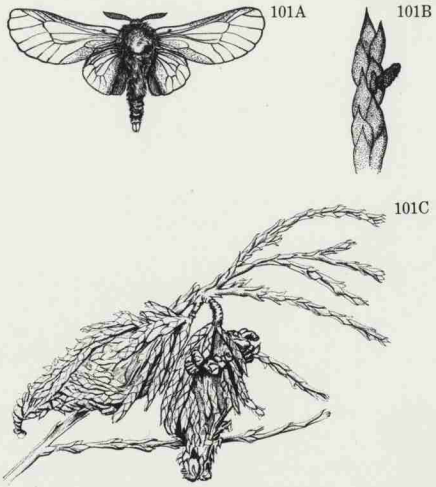


Fig. 101 Bagworm. A, Male. B, Small caterpillar. C, Mature bagworms.

BIOLOGY

Distribution—Bagworms occur throughout the eastern United States.

Host Plants—Bagworms feed on many trees including maple, boxelder, sycamore, willow, black locust, elm, linden, poplar, oak, apple, wild cherry, sassafras, and persimmon; but the preferred hosts are conifers. Arborvitae is highly susceptible.

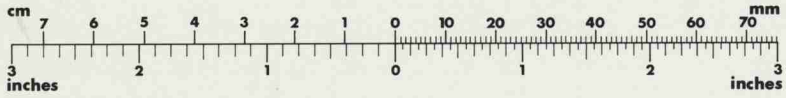
Damage—A single bagworm does relatively little damage. Yet because females do not fly, populations are often very dense; and excessive defoliation may actually kill conifers within one or two seasons. Damage is most noticeable on ornamental plantings rather than in forests and woodlands.

Life History—The bagworm is sometimes called the evergreen bagworm. Populations vary, but occasionally bagworms become extremely abundant, alarming homeowners. The winter is spent as eggs (500 to 1,000) in the mother's bag. They hatch in May and June, and the young worms drop from the bag on a slender silk thread. Such small worms may be "ballooned" for short distances on this long thread. In August, the worms mature and change into the pupal stage. During August and September, male moths emerge from their bags to mate, living 1 or 2 days. Female bagworms, living 4 to 9 days, do not leave the bag until the eggs are laid.

Before the young worm feeds, it secretes silk and forms a bag. Bits of plant tissue become enmeshed in this bag when the worm feeds. As the worm grows, the bag enlarges, reaching about 5 cm when complete. It is fastened to the plant by silk manufactured whenever the worm rests or molts.

CONTROL

Where practical, bagworms can be removed with scissors or a sharp knife. Bagworms are parasitized by several ichneumonid and chalcid wasps. Low winter temperatures and bird predation on small larvae are also limiting factors. Chemical control is effective, particularly in June and early July when the bags are small. For specific chemical controls, see the current state extension service recommendations.



**Thyridopteryx ephemeraeformis* (Haworth), Psychidae, LEPIDOPTERA

DESCRIPTION

Adult—Stem mothers (fundatrices) are wingless, bluish-gray aphids. Sexuparae and egg-laying adults (sexuales) have wings, five dark spots on the thorax, and four sclerites on the top of the abdomen. The honey tubes are indistinct.

Egg—The brown eggs are covered with small, white rods of wax. They are laid in crevices in the bark.

Nymph—The nymphs are small, pale yellowish-green, wingless aphids. Nymphs that develop into egg-laying adults are slender.

BIOLOGY

Distribution—Balsam twig aphids have been found from Maine to Washington and in both the Rocky Mountain and Appalachian Mountain regions. They apparently occur wherever balsam fir, white fir, and spruce are grown.

Host Plants—This aphid feeds on a wide variety of hosts, including balsam, Siberian, alpine, and Fraser firs; white spruce; and juniper.

Damage—Balsam twig aphids cause curled needles and roughened bark of infested Fraser firs (Color Plate 1H). Although trees may tolerate large populations, eventually they will decline in vigor. Most serious damage occurs in Christmas tree plantations, where appearance and market value of infested trees are degraded and reduced.

Life History—Balsam twig aphids are unique pests because of their confusing life cycle and short feeding time. Each generation is different from its parent generation, and only one generation each year lays eggs. Most of the year is spent in the egg stage in crevices of the bark. The eggs are laid in early summer, and they remain on the tree throughout the fall and winter. In early spring the eggs hatch and the first generation of nymphs develops into wingless aphids called stem mothers (fundatrices). The stem mothers give birth to live nymphs, which may develop into wingless forms called fundagenae or winged forms called sexuparae. The egg-laying adults (sexuales) are winged and are the offspring of either the fundagenae or sexuparae. All of this happens in the spring and early summer. By the end of June, the eggs have been laid and the adult aphids have disappeared.

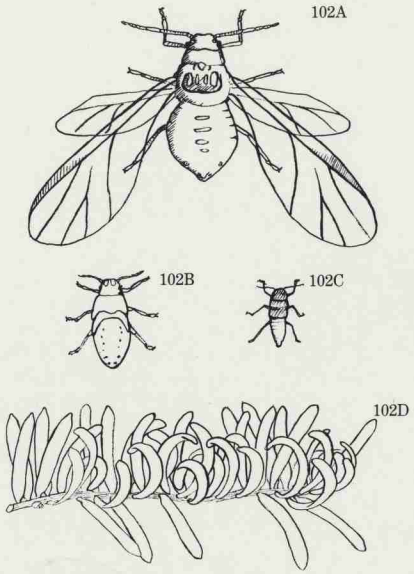
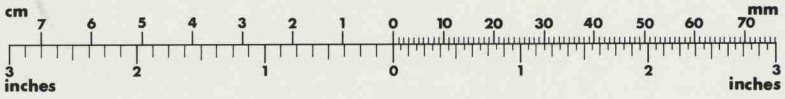


Fig. 102 Balsam twig aphid. A, Adult. B and C, Nymphs. D, Damage on Fraser fir.

CONTROL

Control of balsam twig aphids is difficult because the damage occurs in early spring when weather is unpredictable. For specific chemical controls, see the current state extension service recommendations.



**Mindarus abietinus* Koch, Aphididae, HEMIPTERA

DESCRIPTION

Adult—The balsam woolly adelgid is a small (about 1-mm), round, bluish-black or purple sucking insect covered by woolly strands of wax (Color Plate 1I). The mouthparts are long (1.5 mm) and slender. (They may break off when the insect is removed from the host.)

Egg—The ovoid, amber egg is usually found in a mass of waxy strands and eggs.

Nymph—The newly hatched nymph is called a crawler. It is a small (0.35-mm), amber, flattened insect with red eyes. As it matures, the older nymph generally resembles the adult except for size. The overwintering form (neosistens) of the crawler flattens itself to the bark and secretes a waxy fringe at the body margin.

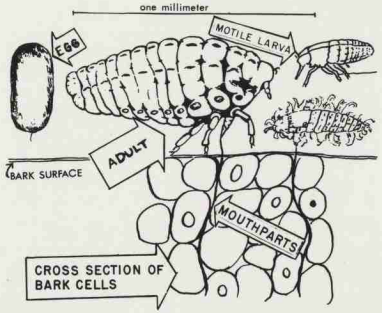


Fig. 103 Stages of the balsam woolly adelgid.

BIOLOGY

Distribution—Apparently limited in its northern distribution by cold weather, balsam woolly adelgids infest firs in southern Canada, the Pacific Northwest, and the northeastern United States. They also occur in the Appalachian Mountains as far south as North Carolina. They are distributed by wind in the crawler stage. Birds and other animals can also spread this pest. However, adelgids probably reached North Carolina on infested nursery stock.

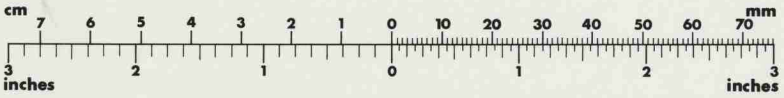
Host Plants—Balsam and Fraser firs are the host plants for balsam woolly adelgids in the eastern United States. Apparently all species of firs (*Abies* spp.) are infested by this pest. However, while some species are very tolerant (Noble fir), other species are devastated by the pest (balsam, Fraser, and sub-alpine firs).

Damage—Balsam woolly adelgids, introduced from Europe or Asia, were first noticed in Maine in 1908. Billions of feet of fir timber have been killed by balsam woolly adelgids in North America. Balsam woolly adelgids secrete an irritating salivary substance, which is injected into the host as they feed. This substance causes unusual growth (swelling or "gouting"), which distorts the normal growth pattern. Branchlets thicken, twist, and bend down at the ends. The main stem tapers rapidly at the top, and the tip bends or becomes flattened. A heavy stem attack may kill an otherwise healthy tree in 3 or 4 years. The wood of heavily infested trees becomes brittle and darkened.

Life History—Balsam woolly adelgids overwinter as first-stage nymphs. In spring, development resumes and the insects mature about the time the buds begin to break (mid-April). Eggs are deposited in spring and summer. Each egg is attached to the bark behind its mother by a waxy thread. In warm weather the eggs hatch in a few days. Up to 248 eggs are produced by each female. By fall all stages may be present. Three generations occur each year in North Carolina. Balsam woolly adelgids feed anywhere on the tree from which they can reach the parenchyma of the cortex (living portion of the bark) with their mouthparts.

CONTROL

Low winter temperatures and a small, brown beetle, *Laricobius erichsonii*, are important natural agents of control. Silvicultural methods (clean cutting, prompt salvage in winter, short rotation, etc.) will lessen the effect of the pest. For specific chemical controls, see the current state extension service recommendations.



**Adelges piceae* (Ratzeburg), Phylloxeridae, HEMIPTERA

DESCRIPTION

Adult—A close relative of aphids, the adult eastern spruce gall adelgid is a small, bluish-green sucking insect, covered by cottony, waxy strands. The summer generation develops wings.

Egg—The black, oval egg is laid in a cottony mass of waxy strands.

Nymph—The yellowish- to bluish-green nymph grows to a length of about 1 mm. An exposed nymph is usually covered by cottony, waxy strands, which may obscure the nymph.

BIOLOGY

Distribution—The eastern spruce gall adelgid was introduced apparently from Europe before 1900. Since then it has spread throughout the northeastern United States and southern Canada, south at least to North Carolina.

Host Plants—Norway and white spruce are the favored hosts of the eastern spruce gall adelgid, but it has been found on red, black, Engelmann, and Colorado blue spruce as well.

Damage—The eastern spruce gall adelgid causes minor physiological damage to its host plants unless the host is severely infested. Severely infested trees may decline in vigor. The primary damage is that of reduced aesthetic value of host plants in nurseries, Christmas tree plantings, or landscapes. The galls are 1.5 to 2 cm long and pineapple shaped. In summer the galls dry out and turn brown. The stem is often distorted at the gall.

Life History—Eastern spruce gall adelgids overwinter as partially grown females (stem mothers) near or at the dormant buds. In early spring the stem mothers mature and lay 100 to 200 eggs surrounded by cottony or woolly wax. The eggs are laid about the time the buds break. About 10 to 14 days later, the nymphs hatch and begin to feed at the bases of the needles. Their feeding causes a pineapple-shaped gall to form in the new twig. The nymphs mature in cells inside the gall until the gall dries out and splits open in summer. Although winged, the females usually stay on the host and soon lay up to 60 eggs in a cottony or woolly wax, usually at the tips of needles. The nymphs from this summer generation of eggs are the overwintering forms. There is one generation per year, and there are no males.

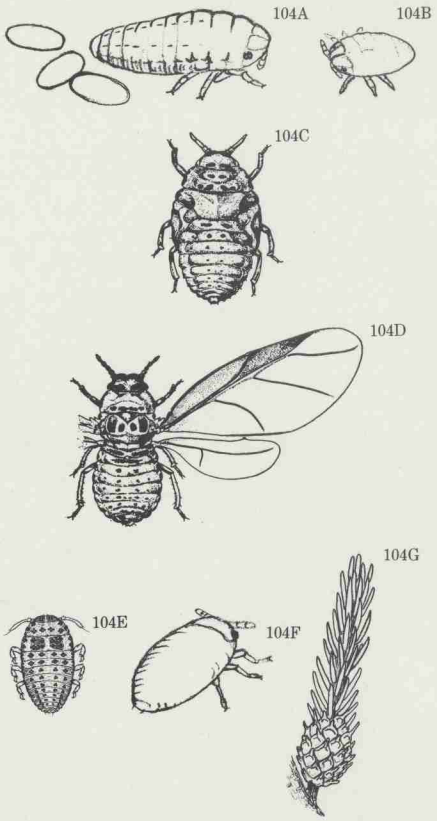
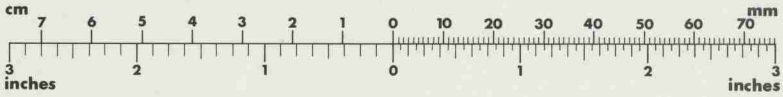


Fig. 104 Eastern spruce gall adelgid. A, Wingless female with eggs. B and C, Nymphs of spring generation. D, Winged female. E and F, Nymphs of fall generation. G, Gall on spruce.

CONTROL

The overwintering nymphs should be controlled in early spring before new growth begins. For specific chemical controls, see the current state extension service recommendations.



Adelges abietis (Linnaeus), Phylloxeridae, HEMIPTERA

DESCRIPTION

Adult—Like a fly in appearance, the introduced pine sawfly differs from a fly in that it has two pairs of wings. The female sawfly is black and yellow with threadlike antennae and averages 8 mm long. The male sawfly is brown and black with broad, feathery antennae and averages 7 mm long.

Egg—When first laid, the egg is pale bluish white and about 1.5 mm long. It has straight sides and blunt, rounded ends. Before hatching, the egg becomes slightly enlarged and turns dark green.

Larva—Less than 3 mm long when newly hatched, the young larva is dull gray with black legs. The larva undergoes subtle color changes as it matures and eventually becomes dark gray or black with white and yellow spots, a shiny black head, and a dark, double stripe down its back. A fully grown larva may be as long as 25 mm.

Cocoon—The pupa is enclosed within a dark-brown cocoon 7 to 9 mm long and 3.5 to 4 mm wide. The cocoon of a female sawfly is slightly larger than that of a male sawfly.

BIOLOGY

Distribution—The introduced pine sawfly occurs from Maine, Ontario, and Quebec into the North Carolina mountains and westward through the Central and Great Lakes states into Minnesota. Only recently a problem in North Carolina, this pest has been reported from the Mountains eastward to the Piedmont.

Host Plants—Five-needled pines and soft, two-needled pines are the preferred hosts of this pest. White pine is particularly subject to infestation; Scotch, red, jack, and Austrian pines are also commonly injured.

Damage—Sawfly larvae damage conifers by defoliation. Ragged, shredded edges on the outer tips of needles are the first sign of infestation. Young larvae are responsible for this type of injury. Older larvae consume entire needles and nibble at the bark. If heavy defoliation occurs late in the season after bud formation, branches or entire trees may be killed. Those trees or shrubs that survive infestation often lose much of their top growth.

Life History—Studies of the biology of the introduced pine sawfly in the southern Appalachians are just beginning. Therefore, little is known concerning its life history in North Carolina. The following information is based on life history studies in the more established areas of its range.

Introduced pine sawflies overwinter as prepupae inside cocoons usually hidden among ground litter. First-generation adults appear from April to June, the first eggs being laid around mid-May. Depositing an average of 70 eggs, females insert about 10 eggs in a row into single pine needles. Ten to 14 days later, larvae hatch from the eggs and feed on conifers. In late July, larvae begin spinning cocoons among needles, in bark crevices, or at the base of small branches.

Second-generation sawflies first appear in early August. Seven or 8 days after eggs are laid, larvae hatch and feed until September. Cocoons are then spun on trees or among soil litter. Some of these cocoons overwinter, but adult sawflies emerge from others and produce a partial third generation in late fall. However, most of these late larvae, as well as prepupae in cocoons on trees, are killed by low winter temperatures. Cocoons among soil litter have the best chance of surviving the winter.

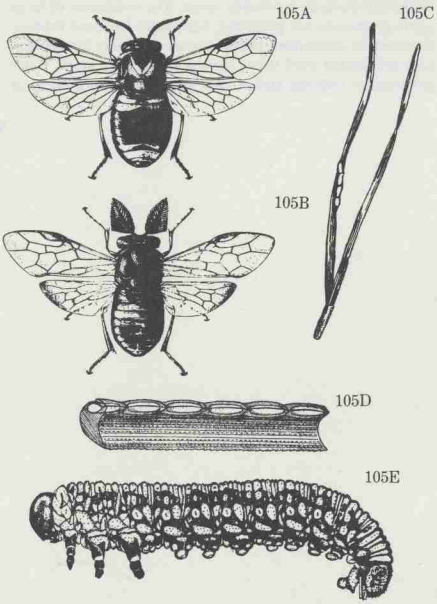


Fig. 105 Introduced pine sawfly. A, Female. B, Male. C, Eggs on needle. D, Close-up of eggs. E, Larva.

CONTROL

Parasites, predators, and low winter temperatures kill well over half of the overwintering sawfly population; yet

**Diprion similis* (Hartig), Diprionidae, HYMENOPTERA

heavy infestations inevitably recur. The treatment of large areas of trees is not practical, but small, localized infestations can be controlled. Pesticides are available for application to infested yard trees, shrubs, or nursery stock. Since generations overlap and all life stages may be present at once, repeated pesticide applications may be necessary to control new sawfly larvae as they emerge. For specific chemical controls, see the current state extension service recommendations.

Notes

DESCRIPTION

Adult—The juniper webworm is a small, brown moth (6 to 7 mm) with white wing margins. It is rarely noticed when flying unless it is disturbed.

Egg—The whitish, pinkish, or dark reddish-orange egg is 0.5 mm by 0.3 mm. It is subcylindrical with rounded ends. The surface has many longitudinal, waxy lines.

Larva—The larva is a small, whitish to light-brown worm (0.5 to 15 mm) with reddish-brown stripes (Color Plate 3Y).

Pupa—The light or dark reddish-brown pupa is almost as long as the adult (5.5 mm).

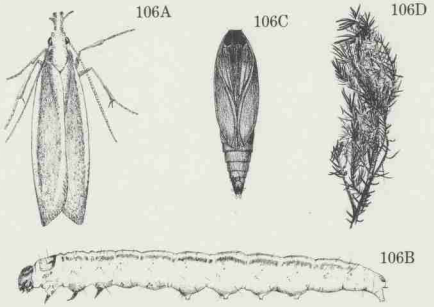


Fig. 106 Juniper webworm. A, Adult. B, Larva. C, Pupa. D, Damage to shore juniper.

BIOLOGY

Distribution—The juniper webworm was first reported on juniper in Europe in 1775. It also occurs in northern Asia except Siberia, the eastern and midwestern United States, California, Oregon, and Idaho. Southern areas of Canada adjacent to infested areas in the United States are infested as well.

Host Plants—Irish juniper is the preferred host, although Chinese juniper, red cedar, and *Juniperus communis* varieties *aurea, horizontalis, depressa, hibernica, suecia,* and *squamata meyeri* are also infested. *Juniperus procumbens* and *J. squamata* are infested only occasionally.

Damage—The leaf-mining by newly hatched larvae is inconsequential. The feeding of larger worms in the fall and following spring may seriously damage ornamental junipers. Large masses of dead needles appear, and the shrubs look unthrifty. Small shrubs may be completely webbed (Color Plate 3Y).

Life History—Juniper webworms overwinter as partially to nearly grown worms inside webbed masses of foliage. Adult emergence occurs from May to July, peaking in June. Males live about 12 days; females, about 14. After mating, females lay from 50 to 200 eggs singly at the base of new needles in the axil. About 10 days later, tiny larvae hatch, puncture the leaf surface, and feed as leafminers, causing the leaves to turn brown. The mined leaf is used as a protective retreat from which the tiny worm emerges to feed on fresh foliage. A tiny, white web is soon formed around the infested leaf. As the worm grows, the web expands to encompass dead leaves. Silken tubes are then constructed in which the worms retreat when not feeding. The worms mature throughout the summer, fall, and winter. By the following spring, they feed gregariously and form a community web. Considerable amounts of foliage may be spun together, and small trees may be completely webbed. The worms pupate inside whitish silken cases, and new adults appear in about 14 days to continue the infestation. There is one generation per year. Braconid and ichneumonid wasps parasitize the larval and pupal stages of juniper webworms.

CONTROL

Where practical, the webbed masses should be pruned and burned. For specific chemical controls, see the current state extension service recommendations.

**Dichomeris marginella* (Fabricius), Gelechiidae, LEPIDOPTERA

DESCRIPTION

Adult—The adult is about 6 mm long, with a wingspan of 13 mm. Basically copper colored, it has silvery markings on its wings.

Egg—The egg is slightly convex and approximately 0.75 mm in diameter. It is opaque white to yellow or medium orange.

Larva—The tiny larva is cream colored with a black head. The mature larva is light brown to orange and approximately 10 mm long.

Pupa—The pupa is light to dark brown and approximately 6 mm long.

BIOLOGY

Distribution—Nantucket pine tip moths extend from Massachusetts south to Florida and west to Texas. They also occur in Canada.

Host Plants—Within its range, the Nantucket pine tip moth feeds on nearly all species of pine except longleaf and eastern white pines. Slash pine is also somewhat resistant, but it is occasionally attacked. In the Southeast, loblolly and shortleaf pines are preferred hosts.

Damage—This pest causes the retardation of height growth, crooking or forking of main stems, reduction of cone crops, and occasionally the death of the tree. Attacks are generally restricted to trees under 4.6 m (15 feet) tall and to young plantations, though severe attacks on commercial-sized trees have been reported.

Life History—The Nantucket pine tip moth is an important pest of pines grown in plantations in the eastern United States. Because the establishment of large pine plantations is becoming increasingly popular, the importance of this insect is also increasing.

In the Southeast, Nantucket pine tip moths overwinter as pupae within the injured tips of pines. On warm days as early as February, adults emerge and mate. They lay eggs on needles, in the axils of needles and stems, and on developing tips or buds. The egg stage lasts about 30 days in cool spring weather and 5 to 10 days in summer.

Newly hatched larvae either feed on the surface of new growth, causing shallow injuries, or bore into the needle bundles. Later they migrate to the shoot tips, construct a protective web at the base of the buds, and begin to bore into the bud or stem. Feeding continues inside these tissues until larvae are fully grown (3 to 4 weeks). Pupation then occurs within the cavities formed by the larvae. In the Southeast, there are three generations per year.

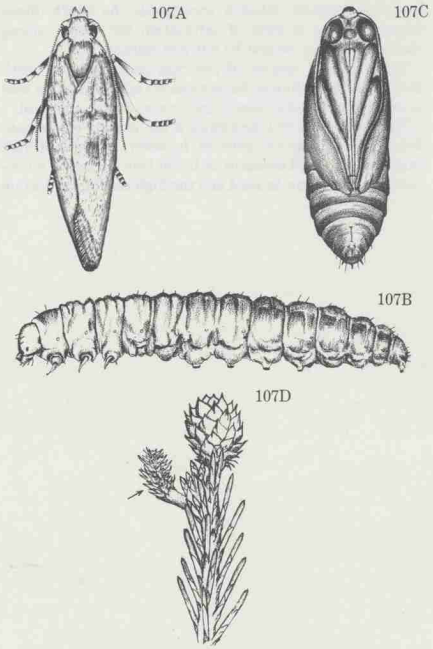
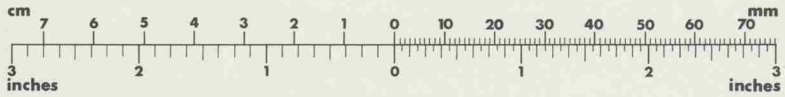


Fig. 107 Nantucket pine tip moth. A, Adult. B, Larva. C, Pupa. D, Damage to small cone (arrow).

CONTROL

Cultural practices are the most effective means of control. Before outplanting, seedlings should be inspected and injured buds and twigs should be destroyed. Infested trees should be pruned well below the dead part because larvae normally feed in the green tissue there. In areas with a history of heavy infestation, planting of loblolly and shortleaf pines should be avoided except on sites most suitable for quick growth. Anything that encourages rapid development, such as vigorous tree strains or ideal sites, helps reduce damage. Seedlings on barren soils along roadside



**Rhyacionia frustrana* (Comstock), Olethreutidae, LEPIDOPTERA

fences are heavily infested throughout the South. Since these trees are sources of infestation for nearby young plantations, they should be cut and burned.

Some natural control of the Nantucket pine tip moth does exist. More than 30 known species of parasites, as well as several predatory insects and birds, attack this pest.

Large-scale use of insecticides is not usually recommended. Such use may be justified, however, in areas of high value, such as seed orchards or forest tree nurseries, where power sprayers can be used and the high cost of application is not prohibitive.

To obtain control throughout the season, spraying may be necessary for each generation of the moth. The spray should be directed at the young larvae, which feed on the exterior of the shoot for a period of several days. Larvae begin to hatch 5 to 10 days after peak adult emergence. When cool weather follows this peak in early spring, spraying should be deferred for about 14 days. For specific chemical controls, see the current state extension service recommendations.

Notes

DESCRIPTION

Adult—The adult is a small, dark (purplish to yellow) adelgid covered with a white, flocculent wax.

Egg—About 2.5 mm long and 1 mm wide, the egg is a milky to light yellow-brown color. As the embryo matures, the egg darkens.

Nymph—The nymph resembles the larger adult. At first naked and yellow, it soon darkens and begins to secrete white, waxy threads.

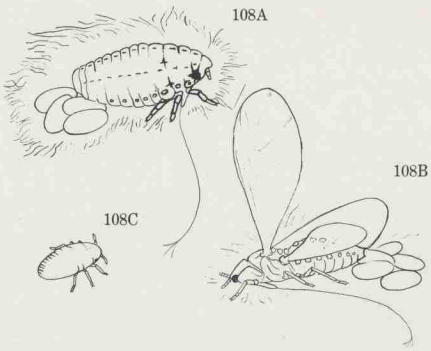


Fig. 108 Pine bark adelgid. A, Wingless female with eggs. B, Winged female with eggs. C, Nymph.

BIOLOGY

Distribution—The pine bark adelgid occurs over most of the United States wherever white, Scotch, and Austrian pines grow.

Host Plants—Found principally on white pine, the pine bark adelgid occasionally attacks Scotch, Austrian, and other pines.

Damage—This adelgid is more unsightly than injurious on older trees, but it may seriously damage newly planted trees in parks and recreational areas as well as small nursery stock. The needles turn yellow, and small trees may be stunted or killed.

Life History—Adelgids are among the most commonly reported insect pests of pines. Not true aphids, they are often confused with woolly aphids because of the woolly strands of wax they secrete as they feed. The most commonly encountered phylloxerid on conifers is the pine bark adelgid, which feeds primarily on eastern white pine. Pine bark adelgids overwinter in all stages, though usually as immature females. In late winter, development resumes and each female lays up to 24 eggs in a woolly mass. From these eggs develop both winged and wingless forms. On pines there are several different forms of immature adelgids (a characteristic of phylloxerids), but only the crawler stage and winged forms are capable of migrating. The stationary wingless forms continue to reproduce parthenogenetically all season. There are five or more generations per year.

CONTROL

For specific chemical controls, see the current state extension service recommendations.

**Pineus strobi* (Hartig), Phylloxeridae, HEMIPTERA

DESCRIPTION

Adult—The female pine needle scale is 3 to 4 mm long and glossy white with light-yellow exuviae at one end. The male, about 1 mm long, is white and has light-yellow exuviae on one end. The male also has three ridges down the white part of the scale.

Egg—The mature egg is pinkish to reddish brown and oval.

Nymph—Newly hatched crawlers are reddish brown with black eyespots.

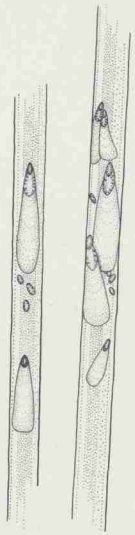


Fig. 109 Pine needle scale.

BIOLOGY

Distribution—The pine needle scale is evidently found on pines throughout the United States.

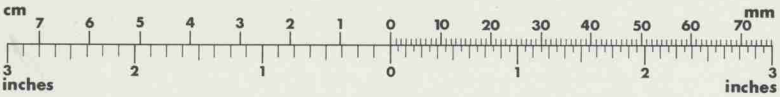
Host Plants—Most pines as well as firs, spruces, deodar cedar, yew (*Taxus*), and *Torreya* are infested by the pine needle scale.

Damage—Pine needle scales are most damaging to ornamental pine plantings. Austrian and mugho pines may be so heavily infested that these shrubs become chlorotic and suffer premature needle drop.

Life History—Pine needle scales overwinter as eggs under the mother's armor. These eggs hatch in late spring. Tiny crawlers emerge from under the mother's armor and begin feeding on the needles. As they mature, the characteristic white, waxy armor is secreted in midsummer. Males emerge and mate with females. Another brood is produced in late July. There are two generations per year.

CONTROL

Pine needle scale is usually not considered an economic pest, although on specimen plants or nursery stock chemical control may be desired. The best time to treat is in May or late July when the crawlers are present. For specific chemical controls, see the current state extension service recommendations.



**Chionaspis pinifoliae* (Fitch), Diaspididae, HEMIPTERA

DESCRIPTION

Adult—The adult sawfly has four wings and varies from 5 to 10 mm in length. The female is robust. Her head and thorax are reddish brown, and her abdomen is black. The smaller male is more slender and entirely black with broad, feathery antennae.

Egg—The newly laid egg is whitish, smooth, shiny, and translucent. It is about 0.2 mm long and 0.6 mm wide.

Larva—The newly hatched larva is about 0.6 mm long with a whitish body and a brownish, transparent head. When fully grown, the larva is nearly 26 mm long and has a bright-red head. The body varies from pale whitish yellow to deep yellow and is marked by two to four rows of black spots on each side of the abdomen. The last abdominal segment has a large, black patch on each side.

Cocoon—The pupa is in a reddish-brown, papery, tough cocoon that is cylindrical with rounded ends. The male's cocoon is about 8.5 mm long; the female's, about 10 mm long.

BIOLOGY

Distribution—The redheaded pine sawfly occurs throughout the eastern United States and in southeastern Canada.

Host Plants—Although the redheaded pine sawfly was first described in 1858, serious outbreaks and the killing of host trees were not common until the establishment of pine plantations. Preferred hosts are jack, red, shortleaf, loblolly, slash, longleaf, pitch, and Swiss mountain pines. White pine, larch, deodar cedar, and Norway spruce may also be defoliated, especially when they are growing close to trees of preferred species. Redheaded pine sawflies lay eggs only on hard pines. This insect preferentially feeds on young trees (0.3 to 5 m tall). In the South it also seems to prefer trees in shaded areas.

Damage—Complete defoliation kills small trees, whereas less extensive feeding results in poor diameter growth and stunted height growth. Defoliated branches often die.

Life History—Winter is spent as a prepupa in a cocoon spun in the litter or in topsoil beneath the host. Pupation occurs in early spring, and the adults appear in a few weeks. Some prepupae may remain in a resting state (diapause) over several seasons before emerging. Eggs are deposited in the tissues of the current or previous year's needles. A single female lays about 120 eggs, which are generally clustered on needles of a single twig. Egg-laying may occur before mating, the unfertilized eggs producing only male progeny. The eggs hatch in 3 to 5 weeks. The larvae feed in clusters of up to 100 for 25 to 30 days, sometimes completely defoliating a tree from the top downward before they reach maturity. They may abandon the tree and migrate for several yards in search of new foliage. Fully grown larvae drop to the ground, enter the soil, and spin their rough, reddish-brown cocoons, where they spend the winter. In the South there may be five generations per year.

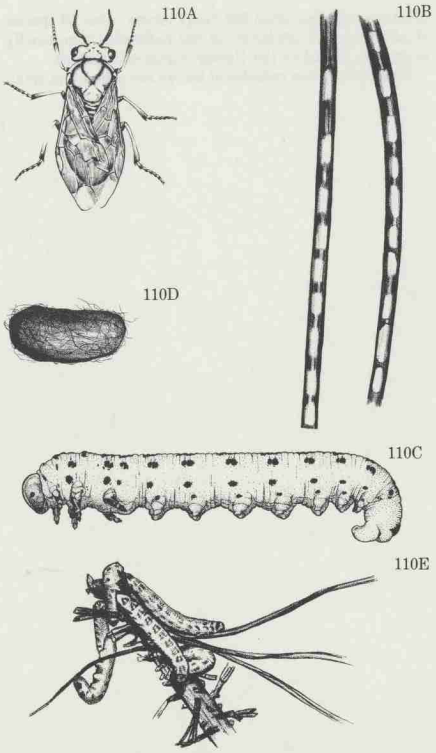
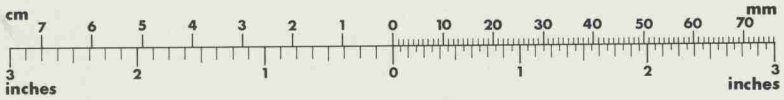


Fig. 110 Redheaded pine sawfly. A, Female. B, Eggs. C, Larva. D, Cocoon. E, Damage.

CONTROL

In forests some natural control is achieved by rodents, which destroy large numbers of cocoons. Diseases and tem-



**Neodiprion lecontei* (Fitch), Diprionidae, HYMENOPTERA

perature extremes often kill many larvae. Also, 58 species of parasites and predators of the redheaded pine sawfly have been reared in the United States and Canada.

When only a few colonies of larvae are present on small roadside, ornamental, or plantation trees, they can be picked or shaken from the trees and trampled underfoot. For specific chemical controls, see the current state extension service recommendations.

Notes

DESCRIPTION

Adult—Adult spittlebugs are tan to dark reddish brown and approximately 8 to 11 mm in length. The Saratoga spittlebug is characterized by a white "arrow" across its head and thorax.

Egg—The teardrop-shaped eggs can be found under bud scales, in needle sheaths, or under the bark of dead twigs.

Nymph—Young pine spittlebug nymphs are red and black, whereas mature nymphs are chestnut brown. Saratoga spittlebug nymphs are orange and black when young and light brown to black when mature.

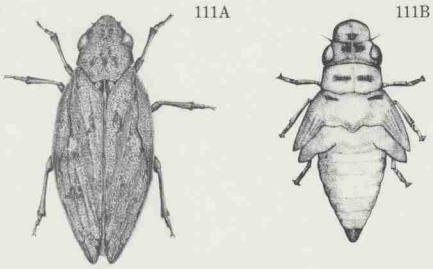


Fig. 111 Spittlebug. A, Adult. B, Nymph.

BIOLOGY

Distribution—Both species of spittlebugs are found from southern Canada to Florida and rarely farther west than Arkansas and Minnesota.

Host Plants—The Saratoga spittlebug prefers red and jack pine but will attack Scotch pine. Broadleaf ground cover plants, such as sweetfern, are alternate hosts.

The pine spittlebug prefers eastern white, Scotch, and jack pine, although other pines in addition to spruces, larch, hemlock, and fir are suitable hosts.

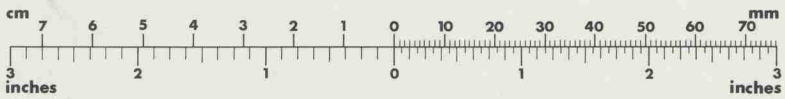
Damage—In heavy infestations, trees die from the top down in 2 or 3 years. Symptoms include flagging branches, dead terminal growth, and stunted and distorted stems and branches. Adult feeding causes characteristic red flecks and pitchy scars in the wood just below the bark. Although several spittlebugs are associated with pine, only the Saratoga and pine spittlebugs are serious pests in the eastern United States.

Life History—Spittlebugs complete only one generation per year. Eggs, which are laid in July or August, hatch the following spring, usually in May. Eggs of the pine spittlebug are laid near the terminal buds of the host tree, whereas those of the Saratoga spittlebug are laid under the bud scales or needle sheaths or under the bark of dead twigs. The nymphs of Saratoga spittlebugs crawl to the ground, where they feed at the bases of alternate hosts. Nymphs feed in groups and soon become covered with a white, frothy spittle mass. When mature, they emerge from the spittle mass, molt, and become winged adults. At this stage the Saratoga spittlebug migrates back to its primary host (pine) and begins feeding like the pine spittlebug on sap from the twigs. Adults are active from late June to late September.

CONTROL

The Saratoga spittlebug can be controlled by destroying or avoiding its preferred alternate hosts. Dense plantings of susceptible pines will shade out the ground cover host plants.

The pine spittlebug and, to a lesser extent, the Saratoga spittlebug can be managed by pruning out the dead and dying branches in which these pests like to deposit eggs. For specific chemical controls, see the current state extension service recommendations.



*Saratoga spittlebug, *Aphrophora saratogensis* (Fitch);
Pine spittlebug, *A. parallela* (Say), Cercopidae, HEMIPTERA

DESCRIPTION

Adult—Almost black with a pale midstripe, the female resembles a small spider (0.38 to 0.42 mm long). Its cephalothorax and legs are pale brownish pink. The two red eyespots are conspicuous. The male is similar but smaller (0.29 to 0.35 mm) (Color Plate 4DD).

Egg—Brown, round, and depressed, the egg (0.15 mm wide) is faintly striated around a central seta.

Larva—The larva has six legs and is pale brownish pink.

Nymph—Except for its smaller size, the nymph resembles the adult.

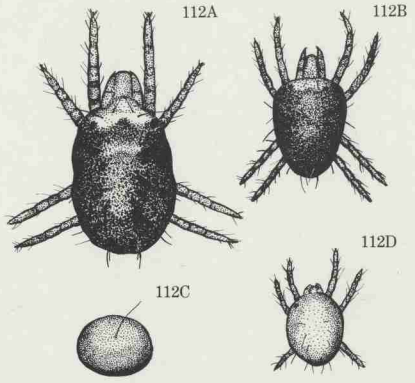


Fig. 112 Spruce spider mite. A, Female. B, Male. C, Egg. D, Larva.

BIOLOGY

Distribution—Spruce spider mites are apparently found throughout North America.

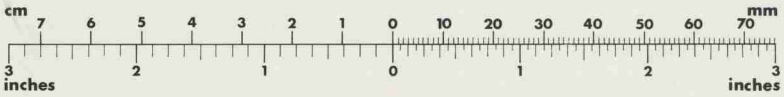
Host Plants—Spruce spider mites feed on spruce, hemlock, arborvitae, pine, Douglas fir, Fraser fir, and various conifers in nurseries and foundation plantings.

Damage—The spruce spider mite is regarded as the most destructive spider mite feeding on conifers in the United States. This pest causes needles to yellow or brown and drop off prematurely (Color Plate 4EE). With a serious infestation, the plant may be webbed. After several years of the mites' heavy feeding, the plant may die.

Life History—Spruce spider mites overwinter as eggs usually laid at the base of needles. In April and May the eggs hatch, and larval mites begin to feed. The mites develop through a series of nymphal stages, reaching the adult stage in 4 to 5 weeks. As the season advances, so much overlapping of generations occurs that all stages are present at once. Spruce spider mites seem to be "cool weather mites," maximum feeding and reproduction taking place in spring and fall. Virtually inactive in hot weather, they are subject to attack by predaceous insects and mites, which usually decimate the population during the summer.

CONTROL

Because the spruce spider mite is most active in cool weather, infestations should be treated at the end of summer or winter for maximum effectiveness. Multiple foliar applications of proper miticides at 2-week intervals may be needed to obtain desired control. For specific chemical controls, see the current state extension service recommendations.



**Oligonychus ununguis* (Jacobi), Tetranychidae, PROSTIGMATA

DESCRIPTION

Adult—The adult may be winged or wingless. The winged form is about 6 mm long; the wingless form is somewhat smaller. The shiny body is dark brown to black with long, stiff hairs.

Egg—The blackish egg is usually laid in an end-to-end row of eight or more eggs on the long-needled pines.

Nymph—The nymph is similar to the adult in body appearance, but it is smaller and wingless.

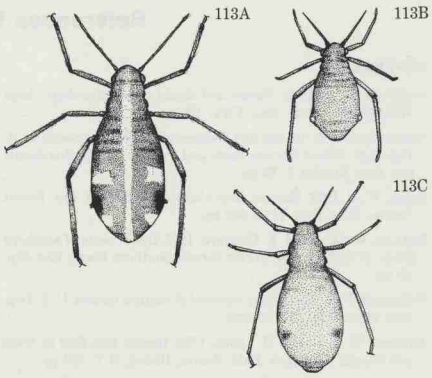


Fig. 113 White pine aphid. A, Wingless female. B and C, Nymphs.

BIOLOGY

Distribution—The white pine aphid occurs wherever eastern white pines are grown.

Host Plants—White pine is the only known host of the white pine aphid.

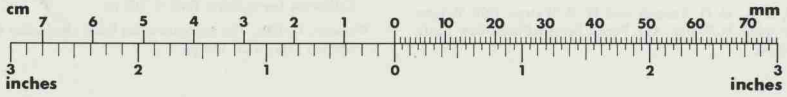
Damage—This pest feeds on twigs and branches. Young trees or individual branches of large trees may be killed by heavy infestations, or their growth may be seriously reduced.

Life History—Aphids in the genus *Cinara* are the largest of the pine-feeding aphids. One outstanding feature of a heavy infestation is sooty mold, a dark fungus that grows in the honeydew excreted by the aphids as they feed.

The white pine aphid usually overwinters in the egg stage; but if the weather is mild, the last generation may persist into the winter. Six generations in 1 year are not unusual; the new generations often move to fresh sites on the tree as the season progresses. The life cycle is complex. For example, adults of the intermediate summer generations consist of females only, some winged and others wingless, which give birth to living young. Males occur only in the late fall generation, which produces the overwintering eggs.

CONTROL

Control is usually unnecessary in forest areas. When control on ornamentals is required, a contact insecticide should be satisfactory. Often two applications, 7 or 10 days apart, are needed to avoid reinfestation from plants in untreated areas and from those that missed the first application. Treatment should be repeated if aphids reappear. For specific chemical controls, see the current state extension service recommendations.



**Cinara strobi* (Fitch), Aphididae, HEMIPTERA

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Crape Myrtle Pests

The crape myrtle was first brought to the Southeast by early settlers. Originally from Asia, this shrub or small tree had lavender or purple flowers; red and white varieties are now available as well. All varieties have showy flowers and are susceptible to relatively few insect pests. In view of the many attributes of this ornamental plant, it is surprising that fewer than 250,000 are produced and sold by Southern nurserymen each year.

KEY TO COMMON AND IMPORTANT CRAPE MYRTLE PESTS

1. **Crapemyrtle aphid**—The foliage is covered with sooty mold and honeydew excreted by aphids; the small, green aphids are visible on the lower surfaces of leaves ..... p. 113

DESCRIPTION

Adult—Pale yellowish green with black spots on the abdomen, the winged adult is just over 1.5 mm long. It has dark-tipped antennae and two double-pronged humps on the abdomen. The wingless adult is also yellowish green with bumps on the body, dark antennae, and dark hairs (Color Plate 3S).

Nymph—Except for its smaller size and lighter pigmentation, the nymph resembles the wingless adult.

BIOLOGY

Distribution—Crapemyrtle aphids were first discovered in Hawaii, though they are now known to be in China, Formosa, Japan, and North America. In the Southeast they are found wherever crape myrtles are grown.

Host Plants—Crape myrtle is the only known host of this aphid.

Damage—The crapemyrtle aphid is the only significant insect pest of crape myrtles in the Southeast. Because it feeds on the lower surface of crape myrtle foliage, it is inconspicuous except for the copious amounts of honeydew that it excretes. A sooty mold, *Capnodium* sp., grows in the honeydew and thus alerts the grower to his aphid problem (Color Plate 3T). In addition to being unsightly, this black mold blocks light from the leaves. Because the foliage may drop prematurely, a plant can be in deplorable condition by midsummer. During some years, the aphid population may be kept in check by lacewings and ladybird beetles.

Life History—Very little information is available on the biology of the crapemyrtle aphid. In the Southeast, this pest is found on the foliage of crape myrtles from late April through September. Winged and wingless forms are present during these months. Reproduction, the birth of living young, occurs especially during the summer season.

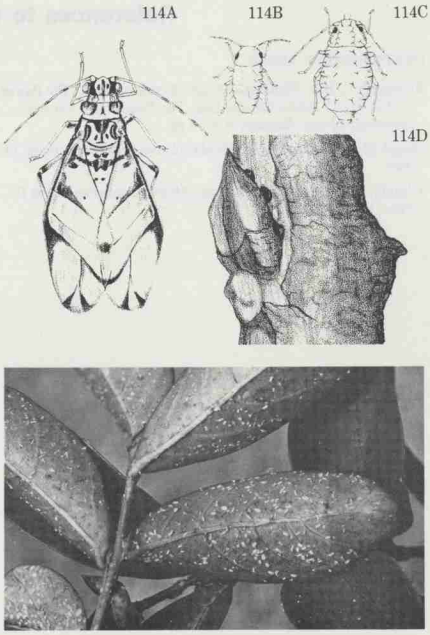
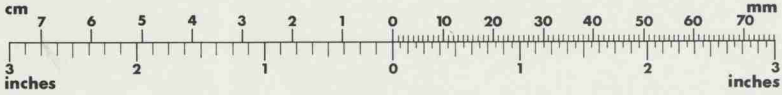


Fig. 114 **Crapemyrtle aphid. A, Adult. B and C, Nymphs. D, Overwintering eggs. E, Damage to crape myrtle leaves.**

CONTROL

The sooner this aphid is discovered and treated in the growing season, the better. Pesticides should be directed against the bottom of the foliage. For specific chemical controls, see the current state extension service recommendations.



**Tinocallis kahawaluokalani* (Kirkaldy), Aphididae, HEMIPTERA

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Dogwood Pests

The dogwood is one of the most desirable ornamental trees because of its showy inflorescence, attractive foliage, and controlled growth habits. Approximately 4,200,000 dogwood trees are grown in Southern nurseries each year. When planted in full sun or on an unfavorable site, dogwoods may be susceptible to a variety of insect pests, most of which cause damage to the trunk and branches of the tree.

KEY TO COMMON AND IMPORTANT DOGWOOD PESTS

1. **Dogwood borer**—The bark is injured, with fine boring dust on the trunk and branches in late summer ..... p. 117
2. **Dogwood clubgall midge**—Club- or spindle-shaped galls appear near the growing tips of dogwood twigs. Some of the twigs may be dead above the gall, and the tree may be deformed ..... p. 119
3. **Dogwood twig borer**—Leaves wilt on individual twigs; girdled tips drop ..... p. 121
4. **Seedcorn maggot**—Dead or dying flies are attached to the twigs ..... p. 123

DESCRIPTION

Adult—The basic color of the moth is dark blue, appearing almost black, with occasional yellow markings on the body. The dark thorax is marked with yellow lines and a yellow patch below. The abdomen is dark with yellow on the second and fourth segments. The wings are clear toward the base and have a span of about 15 mm.

Egg—Basically elliptical, the egg is blunt on both ends and very small. When first laid it is pale yellow, turning only slightly darker before the larva hatches.

Larva—Off-white to cream colored, the larva has a reddish-brown head. The prothoracic shield characteristically has two reddish-brown dorsal spots. The larvae range in length from about 1.5 mm when newly hatched to 15 mm or more when mature. There are six stages.

Pupa—The pupa is light brown and about 10 mm long.

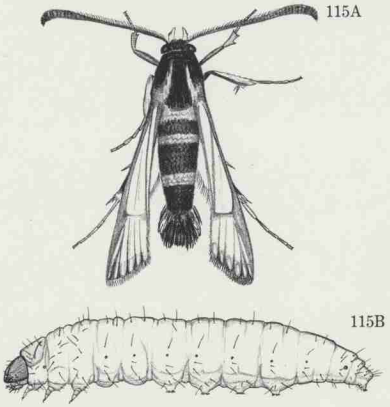


Fig. 115 Dogwood borer. A, Adult. B, Larva.

BIOLOGY

Distribution—The dogwood borer is found in southeastern Canada and throughout the eastern half of the United States wherever flowering dogwoods are grown.

Host Plants—Flowering dogwood is the preferred host, but the dogwood borer has also been collected from oak, chestnut, hickory, elm, willow, and pecan. However, it may be confused with at least two other species, *Synanthedon corrusca* Edwards and *Aegeria pyri* Harris.

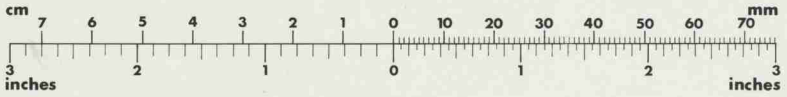
Damage—On dogwood, attack is apparently confined to the trunk and limbs. In a single year one borer can completely girdle and kill a tree 10 cm in diameter, but death is more often brought about by the combined activity of several larvae and by successive infestations. Cultivated trees are usually more heavily infested than those growing in wooded areas.

Life History—The dogwood borer is the larval stage of a clearwing moth. A native pest, it is known by several other common names: pecan sesia, nine-bark borer, woody gall borer, oak gall borer, and others.

In the South, adult emergence occurs from late April to late October, peaking in mid-May. Eggs are laid singly on bark. A female may lay up to 116 eggs. Incubation usually requires 8 to 9 days. Newly hatched larvae become established only if they encounter a broken bark wound, a cracked callous area, such as a canker, or some site affording immediate protection. Feeding, confined to the cambium and bark, continues until winter. The dogwood borer then hibernates in the larval stage within its tunnel. Pupation takes place the following spring. Although there is only one generation per year, borers may be found in various stages of development throughout most of the year because eggs are laid over a period of several months.

CONTROL

Sprays should be applied in early June and repeated in 10 to 14 days. For specific chemical controls, see the current state extension service recommendations.



**Synanthedon scitula* (Harris), Sesiidae, LEPIDOPTERA

DESCRIPTION

Adult—The delicate adult is a small fly about 1.5 mm long. The abdomen is bright orange; the thorax is yellow orange or duller. The wings are mottled with varying patches of black and yellow hairs, which in some specimens resemble irregular, black and yellow bands. The male's antennae are about the same length as the body, the joints appearing beadlike. The female's antennae are shorter and less conspicuously adorned.

Larva—The larva is an orange-colored maggot.

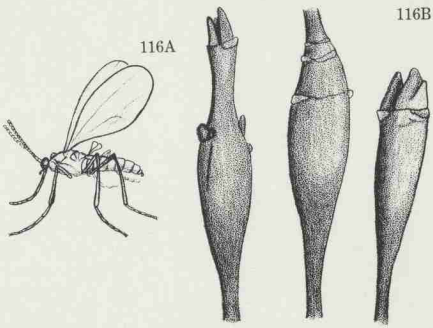


Fig. 116 Dogwood club gall midge. A, Adult. B, Galls.

BIOLOGY

Distribution—Galls of the dogwood clubgall midge are more common on dogwoods grown as ornamentals than on those growing naturally in the woods.

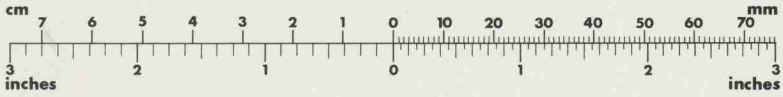
Host Plants—Flowering dogwood is the only known host for this pest.

Damage—The dogwood clubgall midge causes club- or spindle-shaped tubular swellings (galls) from 13 to 25.5 mm long, which form at the tips or along the stems of dogwood twigs. From 30 to 120 galls per tree have been reported. Some of the twigs may die above the swollen part, and the tree may be deformed if the infestation is heavy.

Life History—The dogwood clubgall was first recorded as a common deformity on flowering dogwood in 1939. In the fall, maggots emerge from the galls by chewing small, round holes through the sides. They drop to the soil under the dogwood trees, where they overwinter. Pupation occurs the following spring. In late spring, adults emerge and lay their eggs among the minute terminal leaves. Usually the eggs are laid on the most vigorous twigs where the nodes are close together in the developing bud. Upon hatching, the maggots work their way into the interior of the leaf base or into petioles at the junction of the apical pair or two pairs of minute terminal leaves. Occasionally, entrance to the midrib may be through adjacent leaf tissue. Feeding causes the formation of an elongate gall, where the maggots live in a central cavity. From 1 to 39 maggots may be found per gall.

CONTROL

Swollen twigs should be cut off and burned while the larvae are present.



**Resseliella clavula* (Beutenmüller), Cecidomyiidae, DIPTERA

DESCRIPTION

Adult—The adult is a slender beetle measuring 10 to 15 mm long and 3 mm wide. The head is dark to almost black. A triangle of three black spots is visible on the top of the thorax. The wing covers are yellow tan, with a narrow, black line on the inner edge and a broader, darker line on the lateral margin.

Larva—When fully grown, the larva is yellowish, legless, and about 19 mm long.

BIOLOGY

Distribution—Wherever flowering dogwoods are grown, the dogwood twig borer is a threat.

Host Plants—Elm, viburnum, azalea, and many fruit trees may be attacked by the dogwood twig borer, though its principal host is the flowering dogwood.

Damage—Wilting leaves on individual twigs or drooping girdled tips usually indicate infestation by this borer.

Life History—The dogwood twig borer is the larval stage of a small, long-horned beetle. It is also known as the elm twig girdler. Seldom appearing in large numbers, adults emerge in early summer. After girdling the tip of a twig, the female deposits her eggs singly in its bark crevices. When an egg hatches, the larva tunnels along the center of the twig, making a series of closely placed holes to remove the boring dust. Portions of the hollowed branch may be internally separated from the plant as the larva moves into the green wood. The winter is usually passed in the pupal stage inside the tunnel.

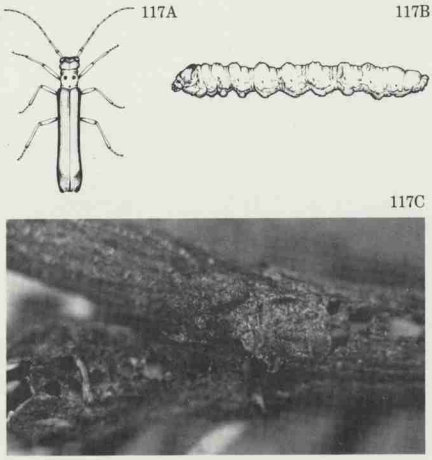
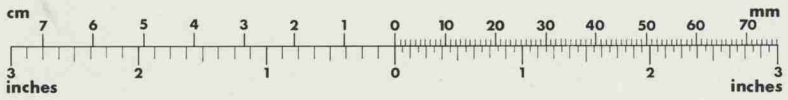


Fig. 117 Dogwood twig borer. A, Adult. B, Larva. C, Damage.

CONTROL

After wilting occurs in the spring, the twig should be clipped off several inches below the girdled or infested portion and destroyed.



**Oberea tripunctata* (Swederus), Cerambycidae, COLEOPTERA

DESCRIPTION

Adult—The fly is grayish brown and about 5 mm long.

Larva—When fully grown, the larva is yellowish white. About 6 mm long, it is sharply pointed at the front, legless, and tough skinned.

Pupa—The capsulelike puparium is dark brown and about 5 mm long.

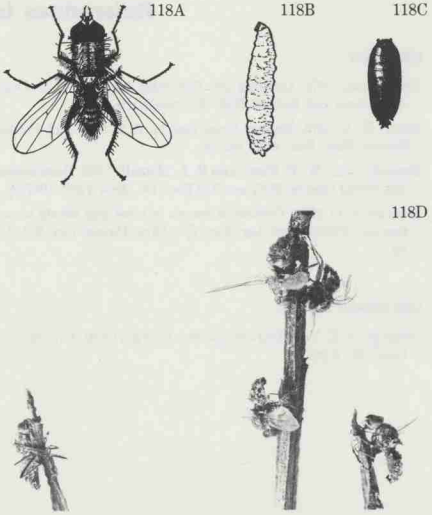


Fig. 118 Seedcorn maggot. A, Adult. B, Larva. C, Puparium. D, Flies infected with *Entomophthora*.

BIOLOGY

Distribution—The species is widely distributed in Europe. First found in this country in 1856 in New York, it has now spread over the entire United States and southern Canada.

Host Plants—Corn, beans, peas, cabbage, turnips, beets, radishes, seed potatoes, and several other plants are damaged by the seedcorn maggot.

Damage—The seed attacked by the seedcorn maggot usually fails to germinate. If it does sprout, the plant is weak and sickly. Injury is usually most severe during wet, cold seasons and on land rich in organic matter.

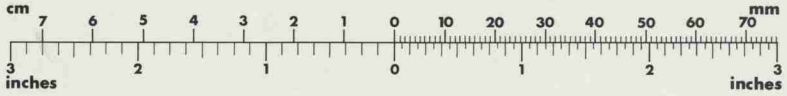
Life History—The seedcorn maggot does no harm to dogwood trees, but it is a frequently reported guest of dogwood and other ornamental plants. Only the adult is found on dogwood. It is infected by a fungus (*Entomophthora*), which apparently causes the fly to light on and cling to protruding twigs. It usually dies in the afternoon as its abdomen swells with internal fungal strands. Early the next morning when humidity is high, the fungal spores are released into the air to infect other flies. The dead flies shrivel and eventually fall from the twigs.

Most of the life cycle is spent in the maggot stage in the soil of various field crops. Flies emerge in May to deposit their eggs on seed, on plantlets, or on soil with an abundance of decaying vegetable matter. Upon hatching, the maggots burrow into the seed, often destroying the germ. They develop into pupae inside brown puparia in the soil and emerge as adults 12 to 15 days later. As many as three to five generations occur each year.

CONTROL

On dogwoods and other ornamental shrubs, no control of the adults is necessary since infected adult flies indicate a natural mortality factor at work.

For control of the maggots in field crops, shallow planting in a well-prepared seedbed, sufficiently late for quick germination of the seed, is probably the best means of preventing injury. Land where manure is heavy or where a cover crop is turned under should be plowed early in the fall, if possible, to make it less attractive to the egg-laying flies the following spring. Prompt resetting or replanting of the damaged crops will usually give a good stand.



**Hylemya platura* (Meigan), Anthomyiidae, DIPTERA

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Euonymus Pests

Plants in the genus *Euonymus* are fairly common in Southern landscapes, although only about 220,000 are produced by nurserymen each year. Because of its varied leaf size, color, and form and its varied growth pattern, euonymus can be used in many situations.

Several scales, the Japanese weevil, and spider mites have been reported on euonymus in the Southeast. The most important pest of euonymus is the euonymus scale.

KEY TO COMMON AND IMPORTANT EUONYMUS PESTS

1. **Euonymus scale**—Chlorotic spots appear on the leaves; tiny, brown and white scales mark leaves and stems ..... p. 127

DESCRIPTION

Adult—Elongate (.75 mm) and white, the mature male is a tiny, two-winged insect. The female is 1.5 mm long, dark, and shaped like an oyster shell (Color Plate 3U).

Egg—The tiny egg is yellow and oval.

Crawler—The crawler is also tiny and yellow.

BIOLOGY

Distribution—Euonymus scale is the most commonly reported pest of *Euonymus, Pachysandra,* and *Celastrus* throughout the Southeast. Although this scale is small, infestations are often dense and plainly visible.

Host Plants—*Euonymus, Pachysandra, Celastrus,* ivy growing near euonymus, *Camellia,* twinberry, eugenia, and hollies are the known hosts of the euonymus scale.

Damage—The first visible damage is yellow spotting on the leaves. The stems may become so encrusted with the scales that whole branches or the entire plant dies.

Life History—This scale usually has two or three generations per year. The males emerge as tiny, two-winged flies and mate with the females, which shrivel as they lay eggs under their protective shells. The tiny crawlers hatch and emerge from the mother's shell in April, May, and June; female adult euonymus scales do not leave the protective covering. The crawlers move along the leaves and stems before inserting their sucking mouthparts to feed. They then secrete their protective covering. Another brood hatches in late summer, and a partial third brood may appear even later. As a result, all stages of development are present most of the year. Males are usually more numerous than females; in dense infestations, clusters of the snow-white males on the leaves and twigs are clearly noticeable.

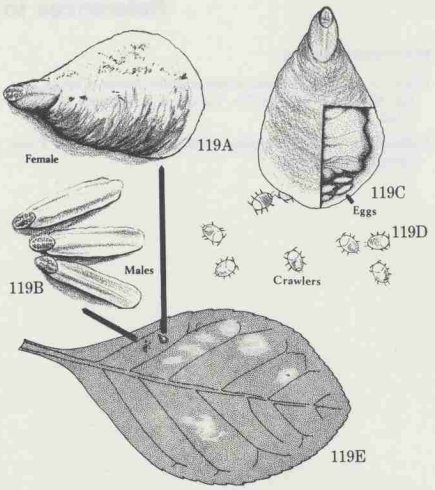
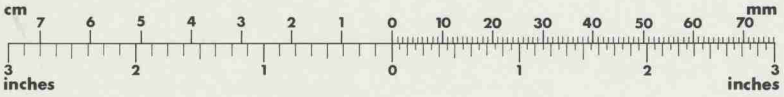


Fig. 119 Euonymus scale. A, Female. B, Males. C, Eggs. D, Crawlers. E, Damage to euonymus leaf.

CONTROL

Euonymus scale is difficult to control, but the removal of heavily infested branches will help. For specific chemical controls, see the current state extension service recommendations.



**Unaspis euonymi* (Comstock), Diaspididae, HEMIPTERA

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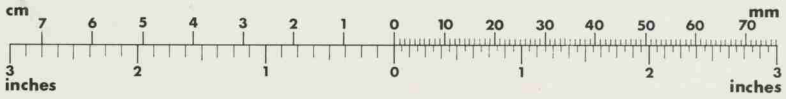
Gardenia Pests

Gardenia or cape jasmine, with its showy, fragrant white flowers and glossy, deep-green leaves, is one of the most delightful shrubs in the landscape. Although gardenias are not winter hardy for the upper Piedmont and Mountain areas, about 155,000 are produced each year by Southern nurserymen.

Various scale insects and spider mites feed on gardenias, though the most commonly reported insects are whiteflies, Japanese wax scales, and aphids.

KEY TO COMMON AND IMPORTANT GARDENIA PESTS

1. **Citrus whitefly**—The leaves are coated with honeydew and sooty mold. Flat, pale-green scales (about 1.5 mm long) and occasionally whiteflies are found on the leaf bottoms ..... p. 131
2. **Japanese wax scale**—White, waxy blobs (up to 6 mm in diameter), often accompanied by sooty mold, appear on limbs and twigs ..... p. 69
3. **Melon aphid**—New growth is curled and stunted by small, green or brown aphids feeding on leaves and new shoots ..... p. 133
4. **Twospotted spider mite**—Tiny chlorotic dots or stipples appear on the upper leaf surface; tiny mites or eggs appear on the lower surface ..... p. 71



DESCRIPTION

Adult—The adult is a small, mothlike insect, orange but covered by a snow-white, waxy bloom.

Egg—Almost microscopic, the egg is pale yellow-green.

Crawler—Tiny and pale green, the crawler has six legs, two antennae, and two red eyespots.

Nymph—The flattened nymph is pale green and scalelike.

BIOLOGY

Distribution—The citrus whitefly was introduced from Asia. Until the advent of synthetic organic pesticides, this pest caused an estimated loss of 45 to 50 percent of the citrus crops in Florida and the Gulf states. Several infestations in California have been eradicated. Among many other host plants, gardenias seem to be exceptionally susceptible. In fact, one of the infestations eradicated in California (at considerable expense) originated from a gardenia that had been smuggled into the state.

Host Plants—The citrus whitefly has been reported on 38 genera of evergreen and deciduous plants. Preferred host plants include chinaberry, all varieties of citrus, gardenia, privet, prickly ash, and Japanese persimmon.

Damage—Adult citrus whiteflies damage their host plants directly by ovipositing and feeding. Immature citrus whiteflies suck much sap from the leaves, although no quantitative work has determined exactly how much damage this causes.

The honeydew excreted by the feeding whiteflies provides an excellent medium for the sooty mold fungus *Capnodium citri.* It coats the leaves and stems of infested plants, shading them from sunlight. The number, size, and quality of citrus fruit are reduced; heavily infested gardenias, black with sooty mold, eventually drop their leaves prematurely.

Life History—Each female citrus whitefly may lay up to 125 eggs, which are partially inserted into the lower leaf surface. In heavy infestations, eggs may be so numerous that leaves are malformed and growth is impaired. The eggs hatch in 6 to 21 days, and tiny, pale-green crawlers move about the plant seeking a place to feed. When they insert their long, threadlike mouthparts into the lower leaf surface, they become immobile. After the first molt, legs and antennae are lost. After two additional molts, the pupae form. The adults finally emerge from T-shaped splits in the pupal skins. There are three broods each year in Alabama and Florida. Summer broods require about 2 months for development; the last brood overwinters in the immature stage.

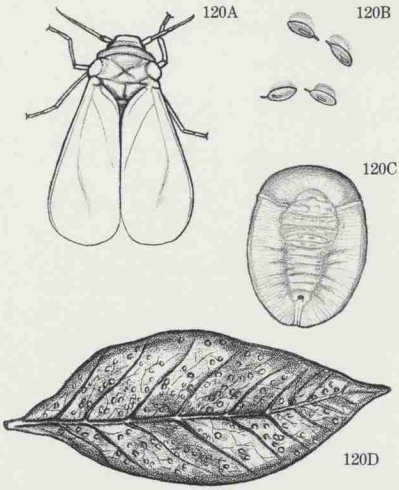
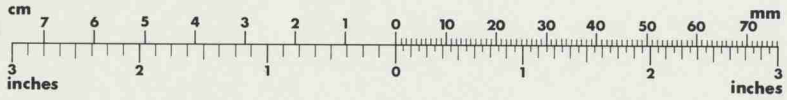


Fig. 120 Citrus whitefly. A, Adult. B, Eggs. C, Nymph. D, Damage to gardenia leaf.

CONTROL

At least three species of lady beetles are known to feed on citrus whitefly crawlers and nymphs, but they are seldom numerous enough to effect real control. A tiny wasp has recently been introduced into Florida to help control citrus whiteflies.

Insecticides should be applied in late spring before the emergence of first-generation adult whiteflies. The spray should be directed to the undersides of the leaves. For specific chemical controls, see the current state extension service recommendations.



**Dialeurodes citri* (Ashmead), Aleyrodidae, HEMIPTERA

DESCRIPTION

Adult—The wingless adults are soft bodied and yellow to dark green. They range from 1.0 to 1.5 mm long. The adults that are lighter in color tend to be smaller and have fewer antennal segments than the darker adults. The winged adult is also soft bodied and yellow to dark green. It has a black head and thorax with the wings held rooflike over the abdomen. The antennae and cornicles are longer than those of the wingless adult. The winged form is about 1.25 mm long.

Nymph—The nymph is smaller than but similar in shape and color to wingless female adults.

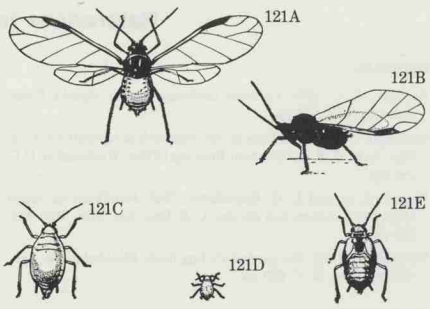


Fig. 121 Melon aphid. A and B, Winged adults. C, Wingless adult. D and E, Nymphs.

BIOLOGY

Distribution—The melon aphid is apparently distributed throughout the tropic, subtropic, and temperate zones of the world. Due in part to its wide host range, this aphid is practically omnipresent.

Host Plants—Melons and other cucurbits, cotton, okra, hops, strawberries, beans, spinach, tomatoes, clover, asparagus, citrus, catalpa, violet, hydrangea, begonia, ground ivy, gardenia, and weeds are some of the hosts of melon aphids. They have been discovered feeding on plants in 25 plant families.

Damage—The melon aphid is an important pest of both agricultural and ornamental plants. On woody ornamentals, such as gardenias, feeding is confined to new growth in the spring.

The melon aphid feeds by piercing the plant surface with the threadlike mouthparts to suck out plant juices. This feeding causes distorted growth, decreased yield, reduced quality of yield, and prematurely ripened fruit. The fruit may be covered by the feeding aphids' honeydew and by cast skins.

The melon aphid transmits several important plant viruses, including cucumber mosaic, onion yellow dwarf, citrus quick decline, lily symptomless diseases, and lily rosette.

Life History—In the Southeast, melon aphids may spend part of the winter as wingless adults in soil or field debris. During warm periods, they travel to weedy hosts and continue feeding until cold weather forces them back into hibernation. In spring, winged females fly to suitable host plants and give birth to living young. Each female produces an average of 84 nymphs. Under favorable conditions, a nymph will mature in about 5 days and begin producing its own progeny. Most nymphs develop into wingless adults. However, when crowding occurs or food becomes scarce, winged adults develop and fly to new host plants. Reproduction continues through the winter as in the summer but at a much slower rate. Many overlapping generations are produced each year.

Syrphid maggots and ladybird beetles and their larvae feed upon melon aphids. Braconid wasps parasitize the aphids, and ants feed upon the honeydew excreted by feeding aphids.

CONTROL

Shrubs should be sprayed thoroughly when aphids are noticed on new growth in the spring. For specific chemical controls, see the current state extension service recommendations.

**Aphis gossypii* Glover, Aphididae, HEMIPTERA

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Holly Pests

Hollies, with their tremendous variation in growth habits, leaf size, shape, and color, and sometimes showy berries, are highly desirable landscape plants. Over 11 million hollies of 42 varieties are produced in Southern nurseries each year. Although numerous insects and mites have been collected from hollies, plants often withstand prolonged infestations without visible deleterious effects. Other than in a commercial nursery, the presence of a few insects or mites on a holly is no reason for great alarm. The native holly leafminer, Japanese wax scale, and southern red mites are the most frequently reported pests of hollies in the southeastern United States.

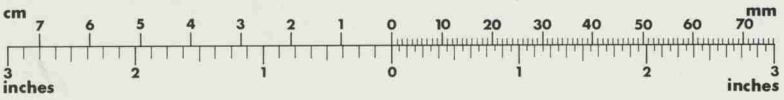
KEY TO COMMON AND IMPORTANT HOLLY PESTS

1. **Japanese wax scale**—White, waxy blobs up to 6 mm in diameter appear on limbs and twigs. They are often accompanied by sooty mold ..... p. 69

2. **Native holly leafminer**—Irregular, elongate, yellow or brown splotches on upper leaf surface (tunnels); small, chunky maggots in tunnel. (Adults rarely found.) ..... p. 137

3. **Southern red mite**—Small chlorotic spots on leaf surface, heavily infested leaves becoming bronze in color; tiny, spiderlike animals (spider mites) on lower leaf surface usually in spring or fall ..... p. 185

4. **Tea scale**—Cottony masses are evident on the lower leaf surface. Sooty mold may be present, and plant vigor may be impaired ..... p. 79



DESCRIPTION

Adult—The adult is a small (2.5-mm), black and gray fly. The first two segments of the antennae are gray, and the third segment is black. The native holly leafminer female is generally more active than the male. There is only one generation per year.

Egg—The white egg is oval and 0.25 mm long.

Larva—The pale-yellow, legless larva is tapered from front to back, with its head retracted into the body. The larva is 1.5 mm long.

Pupa—The oval pupa is reddish brown, 2 mm long, and uniformly tapered to blunt points at both ends.

BIOLOGY

Distribution—As the name implies, the native holly leafminer is indigenous to the United States. It is found along the East Coast and westward into Ohio and Alabama.

Host Plants—The native holly leafminer has infested American, Japanese, Chinese, English, and yaupon hollies. Other hosts include winterberry (or black alder) and inkberry (or bitter gallberry) and their varieties. The fly is particularly damaging to the American hollies.

Damage—It is the most injurious insect pest of holly in the eastern United States. The larval leaf-mining can cause partial defoliation, especially during a dry season; and the mines make the trees unattractive. Moreover, the females insert their ovipositors into the leaf tissue, causing wounds from which sap flows. Both females and males then feed on the sap. This wounding deforms the leaves. The leafminers prefer new growth.

Life History—There are three larval stages in the life cycle of this fly, the last of which overwinters. In March and April the larvae pupate, and adult flies begin to emerge in May. They have a brief lifespan; females live 3 days, males only 2. Eggs are inserted into the undersides of newly formed leaves, causing tiny, green blisters to appear on the leaf bottoms. Most eggs are laid near the tips of the leaves, close to the midveins.

Eggs hatch in about 4 days. The larvae mine into the leaves, remaining there for 9 to 10 months. The mines are yellowish brown and usually contain only one larva apiece. Each serpentine mine eventually broadens into a blotch, which contains the pupa. Just before each larva pupates, it prepares a circular exit hole covered by a thin layer of leaf cells.

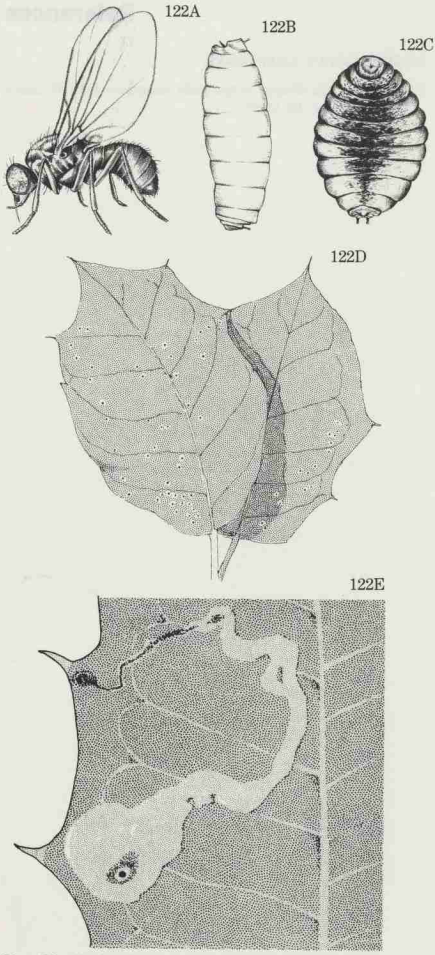


Fig. 122 Native holly leafminer. A, Adult. B, Larva. C, Puparium. D, Ovipositor punctures. E, Mine in holly leaf.

CONTROL

If only a few plants are damaged, picking the mined leaves and burning them gives some control. For specific chemical controls, see the current state extension service recommendations.

**Phytomyza ilicicola* Loew, Agromyzidae, DIPTERA

References to Holly Pests

NATIVE HOLLY LEAFMINER

Hartzell, A. 1943. Biology of the holly leafminer. Contrib. Boyce Thompson Inst. 13: 17-27.

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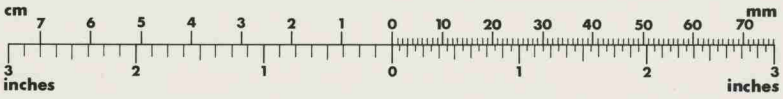
Ligustrum Pests

Ligustrums are hardy plants ideally adapted to conditions in the Southeast. Generally fast growing, ligustrums, or privets, are available in a variety of leaf forms, shades of green, and growth habits. Southern nurserymen produce 660,000 ligustrums each year. As a rule, ligustrums require little care, although at least two weevils, white peach scale, and rust mites occasionally cause problems.

KEY TO COMMON AND IMPORTANT LIGUSTRUM PESTS

1. **Japanese weevil**—Little, chunky, dark beetles with pale bands across the back chewing notches from leaf margins during the day; occasionally present in large numbers ..... p. 141
2. **Ligustrum weevil**—Little, shiny brownish-yellow beetles that feed by chewing oblong holes in leaves late at night ..... p. 143
3. **Privet rust mite**—Foliage dull, russeted, and cupped; microscopic mites are present in large numbers in the growing season ..... p. 145
4. **White peach scale**—Round, dingy-white scales with yellow exuviae in the center (2 mm across) and slender, pure-white scales 2 mm long on bark, twigs, and sometimes leaves ..... p. 147



DESCRIPTION

Adult—The Japanese weevil varies in size from 4.5 to 7 mm. It is light or dark brown with a short, blunt snout. The wing covers (elytra) are striped with indistinct white lines in the grooves, white spots on the apical half, and a dark-brown or black transverse band (Color Plate 3X).

Egg—The eggs are small and cream colored.

Pupa, Larva—The pupal and larval stages have not been described.

BIOLOGY

Distribution—This introduced pest was first found in the United States in 1914 near Philadelphia. The Japanese weevil is now firmly established in the eastern United States, where it feeds on a number of ornamental plants. It occurs in New England, the Middle Atlantic states, Kentucky, and Indiana.

Host Plants—Some of the plants attacked by the Japanese weevil are ash, azalea, barberry, burr marigold, camellia, dogwood, elm, fern, hemlock, holly, lilac, mountain laurel, privet, rhododendron, rose, spirea, strawberry, and weigela.

Damage—Japanese weevil larvae feed on plant roots, but the adults do more serious and apparent damage. The weevils feed extensively on new leaves, shoots, and inner foliage. As a result, infested plants are tattered and unhealthy in appearance.

Life History—It is assumed that the Japanese weevil is parthenogenetic because no males have been recorded. Eggs are deposited in folds along the margins of leaf fragments or dead leaves, and the free edge is sealed to form a pod. When the eggs hatch, the larvae burrow into the ground and feed on the roots. These weevils have fused elytra and thus are unable to fly. They feed during the day and, if disturbed, drop to the ground and remain motionless. There is only one generation each year.

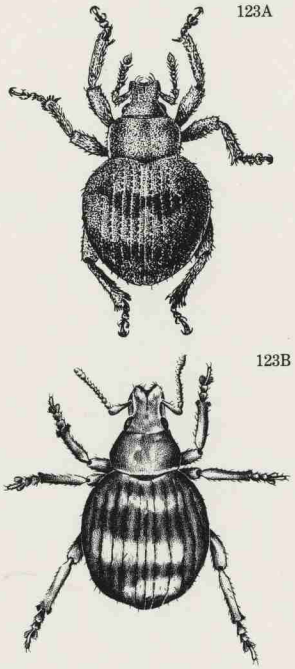
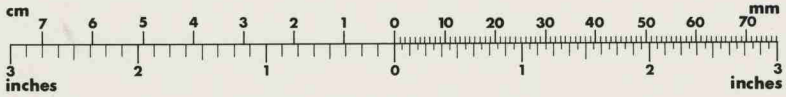


Fig. 123 Japanese weevil. A and B, Adults.

CONTROL

For specific chemical controls, see the current state extension service recommendations.



**Pseudocneorhinus bifasciatus* Roelofs, Curculionidae, COLEOPTERA

DESCRIPTION

Only the adult stage of the ligustrum weevil has been described.

Adult—An adult ligustrum weevil is shiny brown with golden-yellow setae. It has a definite median stripe and an obscure lateral stripe. The prothorax is wider than it is long and strongly rounded on the sides. The insect is about 3.9 mm long, and the rostrum or "bill" is about 1.0 mm long (but varies considerably).

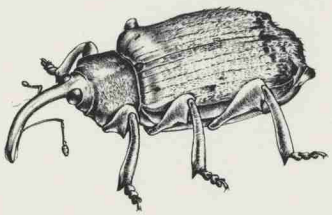


Fig. 124 Ligustrum weevil.

BIOLOGY

Distribution—The ligustrum weevil was described in 1959 from specimens collected in Wake County, North Carolina. Because the genus of the ligustrum weevil, *Ochyromera*, is generally found in eastern Asia, this weevil is probably an introduced species. It has now been found in North Carolina and South Carolina.

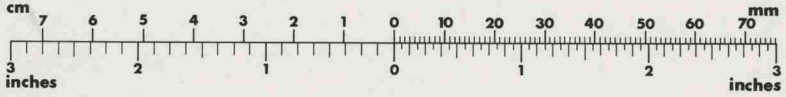
Host Plants—Ligustrum weevils favor Japanese privet but also feed on common privet, glossy privet, and lilac.

Damage—With their chewing mouthparts, the ligustrum weevil adults form jagged holes in the leaves while they feed. They often destroy the buds, causing bunchy growth and a tattered appearance.

Life History—Adults emerge from ligustrum seeds beginning in late May and feed on the leaves and pollen. The adult ligustrum weevils are most common in May, June, and early July. Adults feed at night and prefer wilted foliage. About the first of July, eggs are laid in the seed capsules of fruit of privets. A small, slightly curved incision can be seen on the seed where the egg has been deposited. In a few weeks the eggs hatch, and the larvae feed in the fruit or seed capsules throughout the fall and winter. By late April, the larvae are fully developed and they pupate. There is only one generation each year.

CONTROL

Ligustrum weevils may be controlled by shearing off flowers and fruits of ligustrum. For specific chemical controls, see the current state extension service recommendations.



**Ochyromera ligustri* Warner, Curculionidae, COLEOPTERA

DESCRIPTION

Adult—Rust mites are generally broader than other eriophyid gall mites and are more sclerotized. Microscopic examination is usually required to see these minute mites. Unlike other mites, eriophyid adults have only four legs in the adult stage. Adult privet rust mites are slightly curved, spindle shaped with numerous microtubercles encircling the body, brown, and slightly less than 0.2 mm long.

Egg—The egg has not been described.

Nymph—The nymphal stages look similar to the adult.

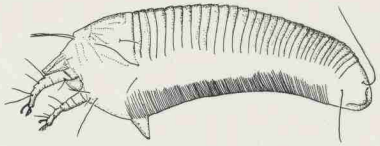


Fig. 125 Privet rust mite.

BIOLOGY

Distribution—The privet rust mite has been reported from California and Georgia. These records suggest that it occurs throughout the Southeast.

Host Plants—Since eriophyid mites are usually very host specific, the privet rust mite is probably restricted to privet.

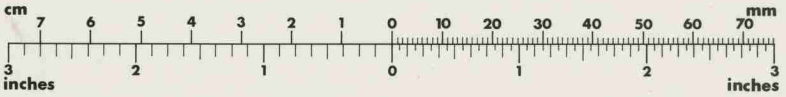
Damage—Infestations of the privet rust mite will cause the leaf surface to appear scratched, the leaves to turn brown, and the young leaves to curl.

Life History—Privet rust mites become active shortly after the leaves begin to develop in the spring. In the spring and early summer, the mites multiply rapidly on the leaves and green stems; but by the end of June, no living mites can be found on the leaves. Hot weather decreases the mite population, and it is not until the cooler fall weather that the mites revive and begin to multiply vigorously again. During the warm summer period, the mites survive as aestivating females under old bud scales at the base of the current season's growth.

The typical life cycle of eriophyid mites includes an egg, two nymphal instars, and an adult stage. Mites can develop from eggs to adults in only 1 week under favorable conditions. The mites can be distributed to other plants by wind, insects, and birds.

CONTROL

For specific chemical controls, see the current state extension service recommendations.



**Aculus ligustri* (Keifer), Eriophyidae, PROSTIGMATA

DESCRIPTION

Adult—The female scale is 1 to 2.25 mm in diameter, circular, convex, and thickened. It is white, yellowish white, or grayish white with a yellow or reddish spot (the cast skin of the nymph). The male adult scale is a small, two-winged insect that looks like a gnat but has two tail filaments.

Egg—The female egg is coral colored, and the male egg is pinkish white. The tiny eggs are found beneath the female scale.

Nymph—The female nymphal scale looks like the adult but is smaller and lacks the spot on the scale. The male nymph is elongate oval, white or dirty white, and about 1 mm long. Crowding and particular host plants can affect the shape and color of the scale considerably.

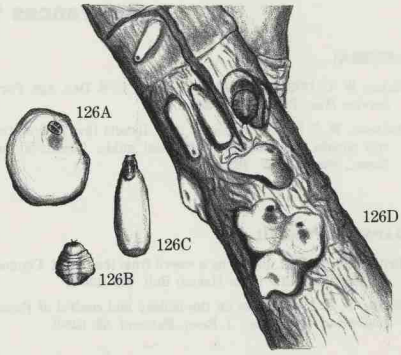


Fig. 126 White peach scale. A, Female armor. B, Female. C, Male armor. D, Damage.

BIOLOGY

Distribution—The white peach scale is found throughout the southern part of the United States and as far north as Connecticut.

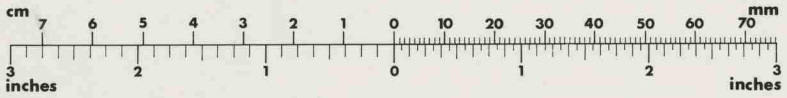
Host Plants—As its name implies, the white peach scale is a pest of peach. However, this insect feeds on many other plants of economic and ornamental value. Some of the most frequently infested ornamentals are chinaberry, flowering peach, French mulberry, and persimmon; but other hosts include catalpa, lilac, privet, and walnut.

Damage—The white peach scale feeds on the bark, fruit, or leaves of the host plant. Its feeding can cause stunting, leaf drop, and death of entire branches.

Life History—Overwintering as adult females, white peach scales become active in the spring and begin depositing eggs about April 1 in the Southeast. The insects continue laying eggs for approximately 30 days. Female eggs are produced before male eggs during the sequence of egg-laying. In 3 or 4 days, the eggs hatch into young nymphs or crawlers. Female crawlers are more active than their male counterparts. The crawlers settle and begin feeding within 2 days. The first nymphal stadium lasts 7 or 8 days. The second female nymphal stadium lasts about 12 days. The adult emerges after the second molt. Second-instar male nymphs molt about 5 days after their first molt and then emerge from their scales in 7 or 8 days as adults. The emergence of the male scale and the final molt of the female scale coincide. After molting, male scales die within 24 hours. Fourteen to 16 days after mating, the females begin to lay eggs. At 25°C, a generation is completed in 35 to 40 days. There are three generations per year in the Southeast. Because mortality of the first and second generations is high, the movement of the scale to other plants occurs mostly during the third generation in September and October.

CONTROL

Because the insect may be found on the undersurfaces of branches, it is important to treat all infested areas on the plant. For specific chemical controls, see the current state extension service recommendations.



**Pseudaulacaspis pentagona* (Targioni-Tozzetti), Diaspididae, HEMIPTERA

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Lilac Pests

Southern nurserymen produce about 15,000 lilacs for sale each year. These shrubs have long been prized as landscape ornamentals. The name "lilac" is derived from the Sanskrit and Arabic words for indigo, *nilak* and *lilak*, respectively. Lilacs were once extensively forced into bloom in European greenhouses to provide fragrance and beauty for nobility during winter.

Common lilacs grow well in the Piedmont and Mountains; Persian lilacs grow better in the Coastal Plain.

KEY TO COMMON AND IMPORTANT LILAC PESTS

1. **Lilac borer**—Trunks and large limbs are marked by cracked bark and holes with protruding material resembling sawdust. Sometimes the leaves wilt on infested branches, or the branches break off easily . . . . . p. 151

DESCRIPTION

Adult—The adult lilac borer is a wasplike clearwing moth with brown forewings and transparent hind wings. The head, thorax, and a portion of the abdomen are chestnut red with narrow, black margins. Males have featherlike (bipectinate) antennae; females have unmodified (filiform) antennae. The female's wingspread ranges from 32 to 38 mm; the male's, from 26 to 32 mm.

Larva—The larva is a brown-headed, white caterpillar that can grow up to 25 mm long.

BIOLOGY

Distribution—Lilac borers are found throughout the eastern United States and Canada and as far west as west Texas and Colorado.

Host Plants—The lilac borer was first reported in 1839 on lilac. Ash, mountain ash, privet, and other trees in the olive family (*Osmanthus*, old man's beard) are also victims of the lilac borer.

Damage—Lilac borers tunnel into the main stems, causing the plant to wilt during hot weather. Infested shrubs appear unhealthy, the stems breaking off rather easily. Infested areas appear swollen and cracked because the sapwood is also destroyed. Numerous holes are visible in heavily infested stock, and frass is usually abundant. Moreover, the wounds caused by the lilac borer allow a wood-destroying fungus, *Polyporus vericolor*, to enter, producing additional damage.

Life History—The adult lilac borer is a clearwing moth closely resembling a paper wasp in form and behavior. Adults emerge in August and September to mate, and the females lay their eggs on the rough bark or wounds of lilac and privet. As soon as they hatch, the tiny worms bore into the bark. Contact is maintained with the outside, and frass is expelled through the opening. Lilac borers overwinter as larvae in the wood, usually near the ground. The following spring and summer, the borers tunnel under the bark and into the wood. The larvae pupate close to the surface. There is one generation per year.

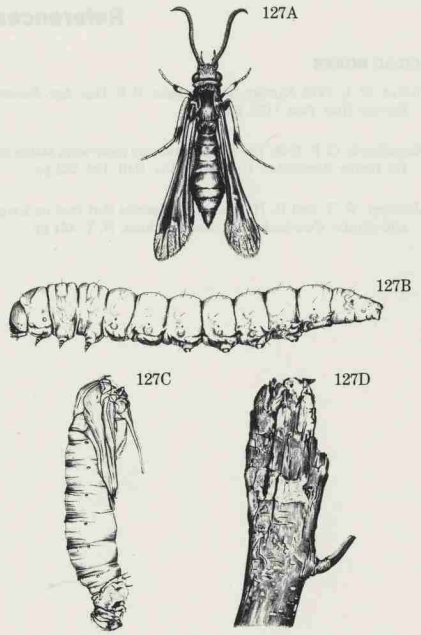
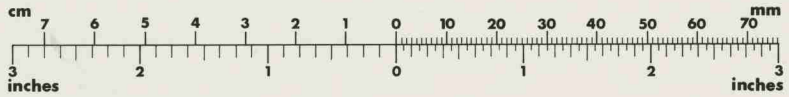


Fig. 127 Lilac borer. A, Adult. B, Larva. C, Pupal skin. D, Damage to lilac stem.

CONTROL

Heavily infested stems should be pruned out. Infestation-prone shrubs can be sprayed with a residual pesticide in August to prevent further infestation. In lightly infested stems, the borers may be destroyed by probing with a flexible wire. For specific chemical controls, see the current state extension service recommendations.



**Podosesia syringae* (Harris), Sesiidae, LEPIDOPTERA

References to Lilac Pests

LILAC BORER

Baker, W. L. 1972. Eastern forest insects. U. S. Dep. Agr. Forest Service Misc. Pub. 1175. 642 pp.

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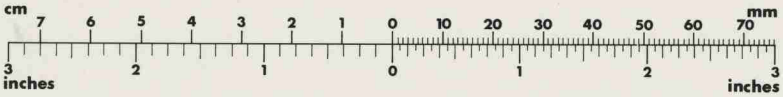
Pyracantha Pests

Pyracanthas have dark-green foliage, white clusters of springtime flowers, and fruit that matures into clusters of shiny yellow, orange, or red berries. They also have exceedingly sharp, strong thorns from which they get their name (pyr = fire, acantha = thorn). Southern nurserymen grow 200,000 pyracanthas each year. Although they are not fraught with pests, it is not unusual to find some of the insects below on most pyracanthas.

KEY TO COMMON AND IMPORTANT PYRACANTHA PESTS

1. **Aphids**—Small, soft-bodied insects sucking sap from twigs of pyracanthas, especially in the spring.
   A. **Apple aphid**—Green to yellow-green or yellow with dark cornicles and legs ..... p. 155
   B. **Woolly apple aphid**—White, waxy filaments covering small, dark aphids ..... p. 161
2. **Hawthorn lace bug**—Chlorotic spots on upper leaf surface, numerous dark spots of insect excrement on lower leaf surface; small, dark, spiny insects and slightly larger (3-mm), lacy insects with dark spots on wings ..... p. 157
3. **Leaf crumpler**—Groups of leaves webbed together into a small, roughly globular shape; small, purplish caterpillar inside webbing ..... p. 159



DESCRIPTION

Adult—The apple aphid varies in size from 1.8 to 2.6 mm and in color from yellow to light green or dark green. The head, tips of the antennae, legs, and cornicles are dark. The stem mother is somewhat darker than other forms and is sometimes covered with a waxy bloom. The male is elongate, and the female is round. This aphid may be wingless or winged, or possess small wing remnants. Wings, if present, are transparent with brown veins and a smoky stigma.

Egg—The egg is oval, flattened on the side next to the bark. It is 0.6 mm long and 0.3 mm wide. Initially yellow (rarely green), the egg turns black.

Nymph—The first instar is dark green with dusky appendages. The nymph's color lightens as the nymph matures.

BIOLOGY

Distribution—The apple aphid is found throughout the United States and Europe.

Host Plants—Crabapple, hawthorn, mountain ash, and pyracantha are hosts for the apple aphid. The ornamental plants attacked by this insect are secondary hosts.

Damage—As they feed, apple aphids cause the foliage of terminal growth to curl. They also excrete honeydew (a nuisance) in which sooty molds sometimes grow. Heavily infested plants are often sticky with honeydew, dark with sooty molds, and disfigured by distorted new growth and cast aphid skins.

Life History—Overwintering as eggs on suckers and the terminals of trees, the aphids hatch in early spring and appear on the buds as the first leaves are unfolding. Throughout most of the year only females, which give birth to live young, are produced. The females that hatch from the overwintering eggs are called stem mothers. More than half of the offspring of the stem mothers are winged, and the first major dispersal occurs. This migration takes place in late May or early June. Winged individuals are produced throughout much of the summer but are most numerous in early summer.

Each female produces about 50 nymphs in a period of about 30 days. Stem mothers produce more offspring than succeeding generations. A female produces young aphids about 1 day after its final molt. The four nymphal instars develop within 2 weeks. As many as 16 generations can be produced in 1 year.

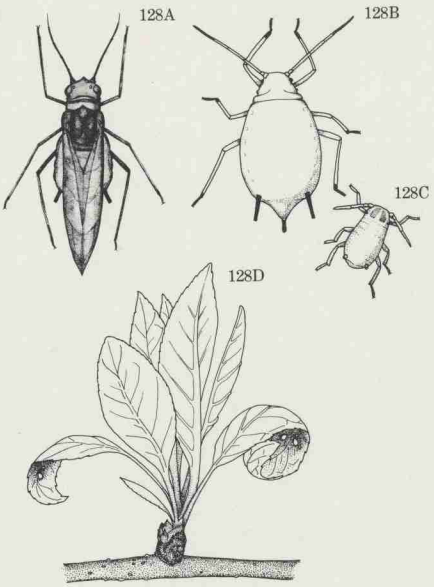


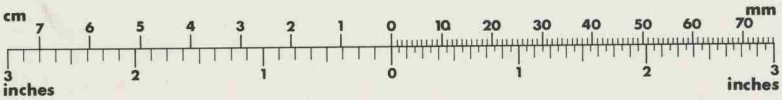
Fig. 128 Apple aphid. A, Winged adult. B, Wingless adult. C, Nymph. D, Damage to crabapple.

The apple aphid is most abundant from mid-June to the beginning of August. In early September, male and female aphids appear and mate. Mated females deposit one to six eggs, which develop partially before the first frost.

Populations of the apple aphid undergo fairly regular fluctuations in density throughout the summer. Because the aphid feeds only on new growth, the density of the populations is regulated somewhat by the growth of new shoots.

CONTROL

For specific chemical controls, see the current state extension service recommendations.



**Aphis pomi* DeGeer, Aphididae, HEMIPTERA

DESCRIPTION

Adult—About 3.4 mm long and 1.8 mm wide, the small adult has lacy wings with large, brown areas. The antennae and legs are yellowish (Color Plate 3V).

Egg—The egg is sharply truncate, having the appearance of a small cone. It is smooth, whitish, and semitransparent with a white cap; however, the female often secretes a brownish substance that hardens over the eggs, obscuring their characteristics.

Nymph—There are five nymphal stages distinguished by the varying spines that occur over their bodies. The nymphs are dirty brown, and the later stages become broadly oval and flat.

BIOLOGY

Distribution—Native to the United States, the hawthorn lace bug was first recognized as a serious pest in the middle 1800's. The hawthorn lace bug occurs throughout the United States and in parts of Canada and Mexico.

Host Plants—The hawthorn lace bug feeds on a number of plants in the rose family. It has been reported on apple, button bush, cotoneaster, hawthorn, juneberry (or serviceberry), loquat, oak, pear, pyracantha, and quince.

Damage—Both the nymphs and adults suck fluids out of the leaves from the undersurfaces, speckling the tops of the leaves with yellowish spots. The lower surfaces of the leaves also become discolored with cast skins and excrement (Color Plate 3V). Extensive feeding can cause wilting of the leaves.

Life History—This lace bug is known to overwinter in the adult stage. However, it may overwinter in the egg stage when developing on evergreen hosts. A New England study indicates that development from egg to adult takes about 7 weeks, though the length of time seems to depend upon the temperature. About 40 eggs are laid per leaf in groups of 10 to 30 along the sides or prominent veins on the undersurface. There are five nymphal stages, with only one full generation per year occurring in the New England area. Adults are first noticeable in early May and are found in New England as late as November. They overwinter under leaves, stones, bark, and other natural cover.

CONTROL

Treatment should begin as soon as the lace bugs or their damage is seen. Properly labeled chemicals should be used, and safety precautions listed on the labels should be followed. For specific chemical controls, see the current state extension service recommendations.

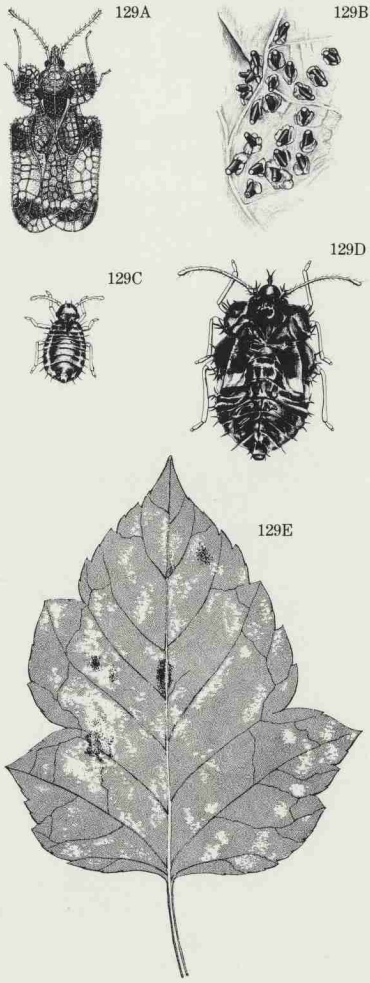
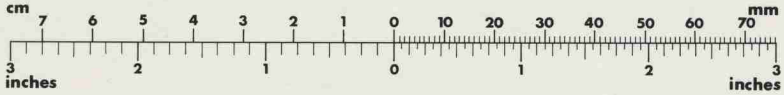


Fig. 129 Hawthorn lace bug. A, Adult. B, Eggs. C and D, Nymphs. E, Damage to hawthorn leaf.



**Corythucha cydoniae* (Fitch), Tingidae, HEMIPTERA

DESCRIPTION

Adult—The leaf crumpler moth has a wingspan of 15 to 20 mm. The forewings are light brown with a white patch on each wing and several black lines. The hind wings are lighter in color than the forewings.

Egg—The egg of this insect has not been described.

Larva—The larva of the leaf crumpler varies in size (14.5 to 17.5 mm long). Its head is pale reddish brown; the top of the body is grayish green with some purplish markings, particularly where the segments overlap; the underside is pale grayish green.

Pupa—Measuring about 7 to 9 mm long, the pupa is yellowish brown to reddish brown and slightly darker dorsally.

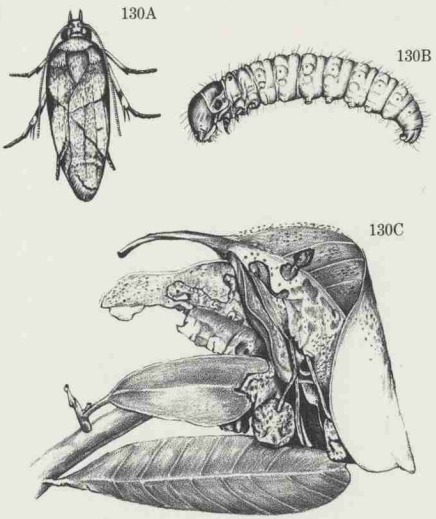


Fig. 130 Leaf crumpler. A, Adult. B, Larva. C, Damage to pyracantha.

BIOLOGY

Distribution—Although it is generally found east of the Rockies, the leaf crumpler also occurs in California.

Host Plants—Apple, cherry, cotoneaster, crabapple, hawthorn, peach, pear, plum, prune, pyracantha, and quince have been recorded as hosts of the leaf crumpler.

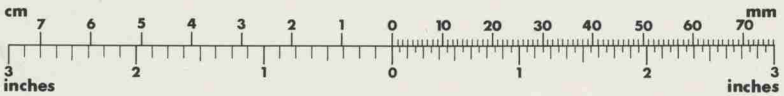
Damage—Damage is caused by the feeding of the larvae and the tubes and clusters of leaves they form. Girdling of the twigs and feeding on the buds and fruit (probably caused by crowding) have also been reported.

Life History—In the southeastern United States there are two generations of leaf crumplers each year. Eggs are deposited on the foliage, and they hatch in 2 to 3 weeks. The larvae construct tubes that are attached to twigs of host plants. As the larvae mature, they expand their tubes with silk and leaf fragments. The sinuous tubes can be 5 to 6 mm wide and 30 to 40 mm long when the larvae are fully grown. In late July and mid-August, larvae seal over the ends of the tubes and pupate. Pupation lasts about 2 weeks. Leaf crumplers overwinter as partially grown larvae in the tubes on the host. In the spring in eastern North Carolina, the larvae become active and resume their feeding. These larvae pupate about the middle of May.

During the winter, the first 5 to 10 mm of the reddish-brown tube may become detached from the host. The larvae seal up the open end so that the end of the tube is flat. Larvae first feed on developing leaves near their tubes; but when the adjacent food supply is depleted, they leave their shelters in search of more plant material. These wanderings are usually at night. Leaves brought back to the tube frequently dry and become unpalatable. The accumulation of dry leaves offers additional protection and may result when two or more larvae feed in proximity to one another.

CONTROL

For specific chemical controls, see the current state extension service recommendations.



**Acrobasis indigenella* (Zeller), Pyralidae, LEPIDOPTERA

DESCRIPTION

Adult—Several different forms of the adult woolly apple aphid exist. The globose, 2-mm-long stem mothers are yellowish or reddish with dark dorsal markings and are covered with bluish-white, waxy material that is longer caudally (Color Plate 4JJ). Other wingless females are rusty or reddish brown, occasionally slightly purple. These females are smaller and more elongate than the stem mothers. Winged females are reddish brown and do not possess as much wax as the wingless forms. The sexual forms, which are the smallest, are covered by a fine, powdery wax and lack mouthparts. The legs and heads of all the adult forms are darker than their bodies.

Egg—The dark, glistening egg is oval and about 0.3 mm long.

Nymph—The nymph is similar to the wingless adult but is smaller and does not have as much waxy material.

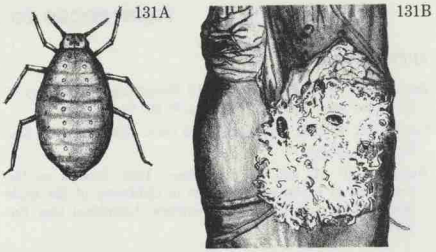


Fig. 131 Woolly apple aphid. A, Adult. B, Infestation on bark wound of crabapple.

BIOLOGY

Distribution—The woolly apple aphid is found throughout the United States.

Host Plants—Elm is the primary host; but apple, hawthorn, mountain ash, pear, and quince are secondary hosts.

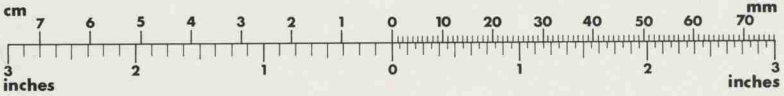
Damage—Stem mothers feed at the base of leaf buds, causing the leaves to curl and thicken once the leaves begin to develop. This damage forms a rosette of deformed leaves. Woolly apple aphids are particularly drawn to open wounds or pruning scars. If the insects are feeding on branches or twigs, galls or knotty swellings are produced at the feeding sites. These galls may be 13 to 75 mm long depending on the severity of the infestation. Eventually, the bark splits as the tree attempts to cover the galls with new growth. Similar swellings are formed on the roots after the insects feed there.

Life History—Elm is the primary host of the woolly apple aphid. Apple is a secondary host, although the aphids are capable of living for several years on the roots of apple trees without migrating back to elm. Overwintering occurs on both hosts. On elm, the overwintering stage is the egg, which is deposited in crevices in the bark. On apple, the young nymph attached to the roots is the overwintering form.

In the spring, the eggs on elm hatch into wingless females called stem mothers. These aphids and succeeding generations give birth to live young without mating. The stem mothers' offspring are winged, and they migrate to apple. A single stem mother was recorded as producing 299 nymphs; however, the average number of offspring is much lower and varies according to the form of aphid. Wingless forms average about 30 young per female; winged forms, about 6; and those feeding on apple roots, about 85. The four nymphal instars develop in 8 to 20 days. Adults live about 25 days. As many as 18 generations can be produced in 1 year. Sometimes the next to the last generation on apple is winged and migrates to elm, where male and female aphids are produced. These aphids mate, and the female deposits one egg.

CONTROL

For specific chemical controls, see the current state extension service recommendations.



**Eriosoma lanigerum* (Hausmann), Aphididae, HEMIPTERA

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Rhododendron Pests

Close to 4,056,000 rhododendrons are grown or collected by Southern nurserymen each year. Although sometimes difficult to maintain in the Piedmont and Coastal Plain, rhododendrons are highly desirable landscape plants because of their attractive flowers, variable growth habits, and leaf texture and color. Rhododendrons are not highly susceptible to insect pests, but they are occasionally beset by rhododendron borers, rhododendron lace bugs, and two kinds of weevils.

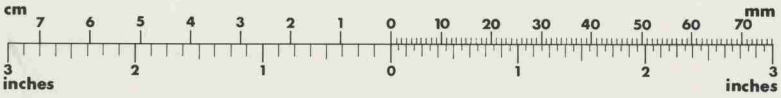
KEY TO COMMON AND IMPORTANT RHODODENDRON PESTS

1. **Rhododendron borer**—Heavily infested branches weak, breaking easily; leaves wilt and turn brown; holes in infested branches with fine sawdust; white caterpillars in tunnels ..... p. 167

2. **Rhododendron lace bug**—Chlorotic spots on upper leaf surface, numerous dark spots of insect excrement on lower leaf surface; small, dark, spiny insects and slightly larger (3-mm), lacy insects on lower leaf surface ..... p. 169

3. **Rhododendron tip midge**—New growth distorted, leaf margin curled under tightly; small (1.3-mm) maggots inside cavity formed by curled margin ..... p. 171

4. **Weevils**—Leaves notched on margin, sometimes wilting during hot weather; eventually heavily infested plants may die.
   A. **Black vine weevil**—Damage to leaves done late at night; white grubs feeding on roots during growing season; adult weevil is black ..... p. 165
   B. **Japanese weevil**—Damage to leaves occurs during daylight; larvae are white grubs, which probably feed on the roots during the growing season ..... p. 141



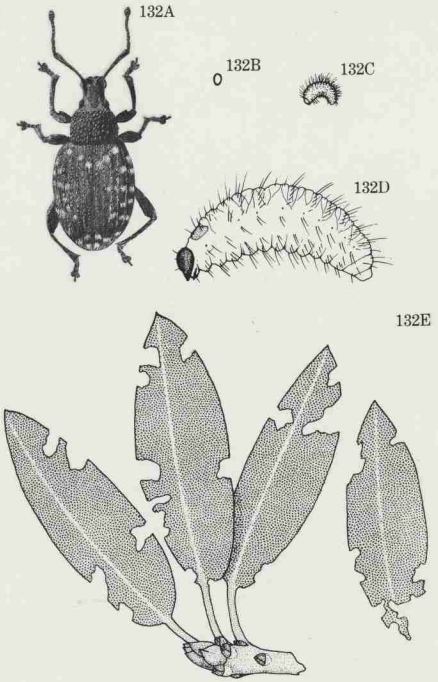
DESCRIPTION

Adult—The oblong black vine weevil is 10 to 11 mm long and has a short snout. The elytra possess many rounded tubercles, each with a short seta. The body is blackish brown; the antennae are black and slightly pubescent; and the head is smoother than the thorax (Color Plate 2J).

Egg—The egg is approximately 0.7 mm in diameter, with a smooth, shiny surface. It is white when first deposited but becomes brown as it ages.

Larva—As the legless larva matures, thickening thoracic segments cause its body to become curved. The fully grown larva is dirty white with a brown head.

Pupa—The pupa is white with prominent dusky spines on the head, abdomen, and legs.



BIOLOGY

Distribution—The black vine weevil has the name "vine" in its common name because it was first recognized as a pest of grapes in Germany in 1934. About 1910 the beetle was found in Connecticut and has since become a serious ornamental pest in southern Canada and the northern United States.

Host Plants—Many herbaceous and woody plants have been listed as hosts for the black vine weevil. Some of the preferred woody hosts include hemlock, rhododendron, and yew.

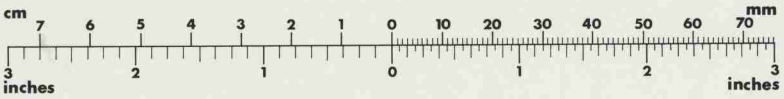
Damage—Black vine weevil larvae can stunt the growth of a plant by feeding on the roots. Larger roots are stripped of their bark or girdled, or they have notches chewed out of them. The adult weevils chew the edges of the leaves, cut off the tips of needles, or devour entire needles (Color Plate 2J). The interior, older foliage is preferred to the terminal growth.

Life History—Black vine weevils overwinter as mature larvae or as pupae. However, a few adults also survive the winter to feed and deposit eggs during a second season. This weevil is parthenogenetic. Although one female was recorded as laying 863 eggs, the average number of eggs deposited by each female is probably about 200. During the preoviposition period, which lasts about 45 days, the adults feed most extensively. The longevity of the adult usually ranges from 90 to 100 days. Eggs, deposited in the soil and leaf litter, hatch in 2 to 3 weeks. Initially the young larvae feed on rootlets; but after the third molt, the larvae move to the larger roots. During their development, the larvae molt five or six times within earthen cells in the soil constructed by the larvae prior to molting. After a quiescent prepupal stage that lasts from 3 weeks to 8½ months, the larvae pupate. Three weeks later, adults emerge. Adults feed at night and drop from the plant, feigning death when disturbed. These weevils cannot fly; so they must be carried or must crawl to uninfested areas.

Fig. 132 Black vine weevil. A, Adult. B, Egg. C and D, Larva. E, Damage to rhododendron leaves by adult weevils.

CONTROL

For specific chemical controls, see the current state extension service recommendations.



**Otiorhynchus sulcatus* (Fabricius), Curculionidae, COLEOPTERA

DESCRIPTION

Adult—The rhododendron borer moth has a black head with green and white markings. The thorax is black and blue with a broad patch of pale yellow or shiny white on each side. The abdomen is also black and blue with segments two, four, and five trimmed with yellow dorsally; segments three through six are yellowish on the underside. The legs are yellow and white apically and dark basally with some light-colored markings. The wings are transparent with a rusty-black fringe and some yellow scales. There is a tuft of black and yellow scales at the tip of the abdomen. The female has broader bands on segments two, four, and five than the male does. The female's anal tuft is short and rounded, whereas the male's is fan shaped. One of the smallest members of the family of clearwing moths, this moth has a wingspan of 10 to 15 mm.

Larva—The yellow-white larvae are caterpillars about 13 mm long.

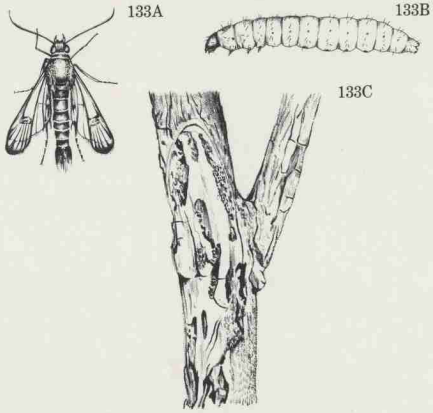


Fig. 133 Rhododendron borer. A, Adult. B, Larva. C, Damage to rhododendron stem.

BIOLOGY

Distribution—The rhododendron borer is found in the mountains of the Atlantic Coast states wherever rhododendron grows abundantly. This moth is indigenous to the United States.

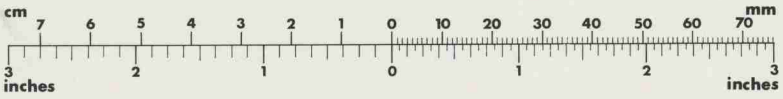
Host Plants—Rhododendron is the principal host for the rhododendron borer. Mountain laurel and azalea are also attacked.

Damage—Twigs and small branches are preferred by the rhododendron borer. Infested branches become weakened and may break off. Leaves on infested branches often turn brown. Occasionally older parts of the shrubs are attacked. The main trunk may have numerous holes with fine sawdust protruding from them. Past infestations on older plant parts will appear as shallow, longitudinal grooves in the bark.

Life History—Adults emerge from their pupation sites during May and June and deposit eggs on twigs. Newly hatched larvae bore into stems and dig long tunnels in the soft pith. The tunnels become filled with small, reddish fecal pellets and serve as sites for overwintering and spring pupation.

CONTROL

Pruning infested branches helps to control the rhododendron borer. For specific chemical controls, see the current state extension service recommendations.



**Synanthedon rhododendri* Beutenmüller, Sesiidae, LEPIDOPTERA

DESCRIPTION

Adult—The small adult, about 3.5 mm long and 2.4 mm wide, has lacy wings that are unusually broad. It is pale yellow, with yellowish legs and antennae.

Egg—The yellowish-white egg is 0.4 mm long and 0.2 mm wide. Basically cylindrical, it is tapered at both ends, with the neck bent to one side. The eggs are deposited in irregular rows, usually along the larger veins. Their caps are level with the leaf surface. The females deposit a brown substance over the eggs, which hardens to form a varnishlike covering.

Nymph—Unlike most lace bugs, the rhododendron lace bug has only four nymphal stages. The nymphs feed in groups in the younger stages. They range from 0.9 to 2.1 mm in length and are black and spiny (Color Plate 3AA).

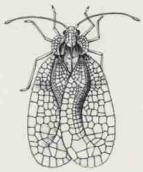


Fig. 134 Rhododendron lace bug.

BIOLOGY

Distribution—The rhododendron lace bug was originally described in the United States from specimens taken in Holland in the early 1900's; however, the earliest report of the insect was from Pennsylvania, and the pest is now considered indigenous to the United States.

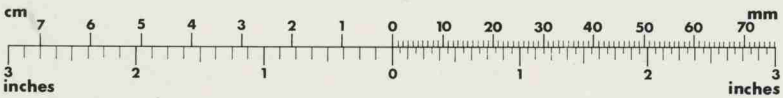
Host Plants—The rhododendron lace bug attacks over 120 types of rhododendrons, as well as mountain laurel and fetter-bush.

Damage—Both the nymphs and adults prefer young leaves, which they damage by extracting the sap. The upper surfaces become mottled with white spots, and many times the leaves will dry and shrivel. The undersurfaces are also discolored with the excrement and cast skins of the insects (Color Plate 3AA).

Life History—These lace bugs overwinter as eggs, which hatch in April in the area of Washington, D.C. There are only four nymphal stages, which require about 30 days for development. The eggs are usually laid in new leaves along the midvein or a short distance from it. As many as 170 eggs can be found on a single leaf. Nonoverwintering eggs hatch in about 3 weeks. The insect seems to favor relatively well-lighted sites, but bushes in the shade can also be badly infested. The pests are commonly transported in the egg stage on nursery stock.

CONTROL

Rhododendron should be treated when the lace bugs are first noticed. Properly labeled chemicals should be used, and safety precautions listed on the label should be followed. For specific chemical controls, see the current state extension service recommendations.



**Stephanitis rhododendri* Horvath, Tingidae, HEMIPTERA

DESCRIPTION

Adult—The rhododendron tip midge is a light-brown, 1.25-mm-long fly. The hairy male has antennae 1.5 times the length of its body. The female, on the other hand, has a short ovipositor and antennae about as long as its body.

Egg—The egg has not been described.

Larva—The flattened maggot is whitish and about 1.27 mm long.

Pupa—The pupa has not been described.

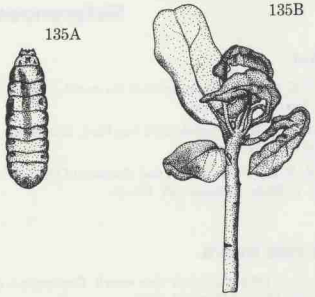


Fig. 135 Rhododendron tip midge. A, Maggot. B, Damage to new growth of rhododendron.

BIOLOGY

Distribution—First described in 1939, this midge does not have a well-defined distribution. It has been reported in New York, New Jersey, Pennsylvania, and North Carolina; therefore, it may occur over much of the eastern seaboard.

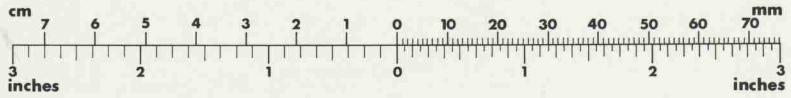
Host Plants—Rhododendron is the only known host of this pest.

Damage—Rhododendron tip midge maggots feed exclusively on tender new growth. Young infested leaves, usually less than 5 cm long, develop inwardly rolled margins with swollen, greenish-yellow tissue. The margins may fold over the midrib. Lightly infested leaves have pale-green bulges over most of the surface and become stunted and distorted. On severely infested plants, new growth may be so distorted after emergence that additional foliage fails to develop.

Life History—These pests overwinter as pupae in the soil. The adult flies emerge and lay eggs in the spring as new plant growth develops. The newly hatched larvae protect themselves by feeding from within the curled leaf margins. When mature, the maggots drop to the soil to pupate. Damage first appears in late May or early June and often reappears in August on the second flush of growth. Therefore, it seems that at least two generations occur each year.

CONTROL

Heavy infestations of this pest are unusual and sporadic. An effective cultural control method for both homeowners and nurserymen is the removal and destruction of newly infested foliage. This practice may eliminate an infestation within a single year or two. No chemicals are currently registered for control of this pest.



**Clinodiplosis rhododendri* (Felt), Cecidomyiidae, DIPTERA

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Rose Pests

With their showy and fragrant flowers, roses are often used in North Carolina landscapes. Roses as cut flowers are appropriate for any occasion. Fraught with insect, mite, and fungal pests, the challenge of growing a nice-looking rosebush has been euphemistically described as "interesting." About 350,000 roses are handled by Southern nurserymen each year.

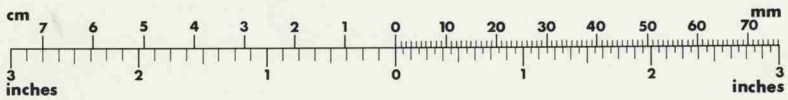
KEY TO COMMON AND IMPORTANT ROSE PESTS

1. **Beetles**—Rose petals or leaves consumed by beetles.
   A. **Fuller rose beetle**—Light-brown to ash-gray beetle with a short snout and a faint white band on each side feeds on leaf margins at night ..... p. 177
   B. **Japanese beetle**—Beetle metallic green with brown wing covers and white spots on side, chunky ... . p. 179
   C. **Rose chafer**—Beetle buff, fairly slender ..... p. 183

2. **Flower thrips**—Petals distorted and spotted, buds not opening properly; very small, slender, yellowish insects crawling in buds and petals ..... p. 175

3. **Rose aphid**—Small (0.5- to 3-mm), soft, pink or green insects often found in clusters on twigs and buds, where they suck sap from the plant ..... p. 181

4. **Spider mites**—Small chlorotic spots on leaf surface; heavily infested leaves dropping prematurely; tiny, spiderlike animals (spider mites) on lower leaf surface.
   A. **Southern red mite**—Mites prevalent in spring or fall, usually dark red with pale legs ..... p. 185
   B. **Twospotted spider mite**—Mites prevalent in hot weather, usually pale yellow but sometimes green, brown, or red ..... p. 71



DESCRIPTION

Adult—The small (1.25-mm), winged flower thrips is yellowish brown to amber with an orange thorax. The male is slightly smaller and lighter in color than the female.

Egg—The flower thrips' delicate egg is cylindrical and slightly kidney shaped with a smooth, pale or yellow surface.

Larva—The tiny young thrips is lemon yellow, resembling the adult except for its lack of wings.

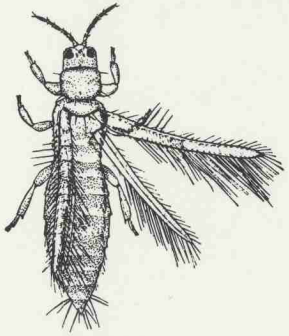


Fig. 136 Flower thrips.

BIOLOGY

Distribution—Flower thrips were first described in New York in 1855. Evidently because of their small size, they are carried by frontal wind systems over large areas. They have been trapped at altitudes of 3,100 m (10,000 ft). In the summer they are found throughout the eastern United States, the maximum rate of migration taking place in the first week of June.

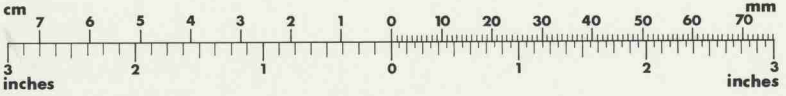
Host Plants—Flower thrips have been collected from 29 plant orders, including various berries, cotton, day lilies, field crops, forage crops, grass flowers, legumes, peonies, privet hedges, roses, trees, truck crops, vines, and weeds. They seem to prefer grasses and yellow or light-colored blossoms. Roses are most susceptible in June.

Damage—Flower thrips are one of the most numerous insect pests of ornamental crops. In warm periods, this species often flies in late afternoon in swarms of tiny, orange insects. "When they light, they bite," as the old saying goes; and thrips do bite people, causing a noticeable stinging sensation. Their large numbers account for considerable and rapid damage to flowers, especially those with light-colored petals. Yet thrips contribute to pollination, an unexpected benefit!

Life History—Flower thrips are generally found at the base of the flower's petals. They reproduce throughout the year in North Carolina, with the majority of their 12 to 15 generations occurring during the warmer months. Newly emerged females begin to lay eggs within 1 to 4 days in summer and within 10 to 35 days in winter, reproduction being much faster in warmer weather. In summer the adult stage is reached in about 11 days. Flower thrips pass through egg, two larval, prepupal, pupal, and adult stages. The eggs are inserted into flower or leaf tissue, and the prepupal and pupal stages are spent in the soil. In summer flower thrips may live 26 days, though overwintering thrips may live all winter. Flower thrips can overwinter as far north as North Dakota in grass clumps and other sheltered refuges.

CONTROL

Flower thrips are consumed by green lacewings, lady beetles, insidious plant bugs, and salamanders; yet control of thrips is difficult because of their constant migration from weeds, grass, flowers, and trees. The destruction of old rose blossoms and the application of pesticides at close intervals can help reduce damage. For specific chemical controls, see the current state extension service recommendations.



**Frankliniella tritici* (Fitch), Thripidae, THYSANOPTERA

DESCRIPTION

Adult—This light-brown to ash-gray beetle has elbowed antennae, which arise from its snout, and a white band on the side of each wing cover. About 7 to 9 mm long, this beetle is unusual not only because males of this species have never been found but also because the adults cannot fly.

Egg—An egg mass is composed of 10 to 60 smooth, pale-yellow eggs. Each egg is about 1 mm long and oval to elliptical.

Larva—The legless, slightly curved larva has a white body with a pale, almost white, head. When fully grown, it is approximately 9.5 mm long.

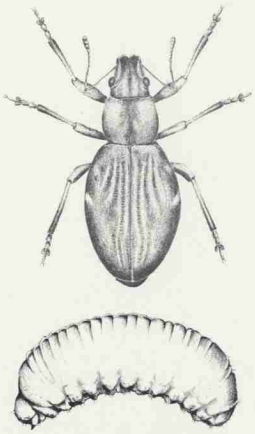


Fig. 137 Fuller rose beetle. A, Adult. B, Larva.

BIOLOGY

Distribution—The Fuller rose beetle has been reported from most areas of North and South America, the Mediterranean countries, Australia, and many Pacific islands. In the United States, it is a common outdoor pest primarily in California and the South Atlantic states. As a greenhouse pest, however, this beetle is more nationally distributed.

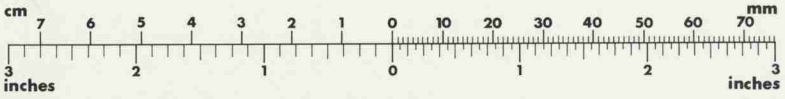
Host Plants—In addition to feeding upon many fruit trees and vegetable crops, the adult and larva of this beetle attack an array of ornamental trees and flowering plants. Some economically important hosts of the adult include apple, apricot, azalea, begonia, blackberry, gardenia, hibiscus, hydrangea, lily, oak, peach, pear, persimmon, plum, prune, raspberry, rose, and strawberry. The larva feeds primarily on the roots of blackberry, loganberry, raspberry, rose, and strawberry.

Damage—Fuller rose beetles feed on the leaves of host plants, leaving ragged or scalloped edges. They do little serious damage except to the plants' appearance. The larvae, though serious root pests of some plants, do not infest most shrubs.

Life History—For the most part, Fuller rose beetles overwinter as larvae in the soil, though a few adults have been known to survive the winter. Pupation occurs in spring within 10 cm of the soil surface. Adults first appear in July and continue to emerge through November. The adults, which are all females, produce eggs parthenogenetically and deposit them in small masses around the base of the plant or under the calyx of the fruit. Protected with a white, spongy material, the eggs hatch approximately 3 weeks later. The newly hatched larvae work their way down into the soil to feed on the roots. Throughout the growing season, the larvae may be found 8 to 61 cm underground. Only one generation occurs each year.

CONTROL

Fuller rose beetles seldom cause real damage to the shrubs, though the aesthetic value of infested plants may be reduced. In the event of excessive foliar damage, effective pesticides are available. For specific chemical controls, see the current state extension service recommendations.



**Pantomorus crevinus* (Boheman), Curculionidae, COLEOPTERA

DESCRIPTION

Adult—The 12-mm-long beetle is shiny metallic green with coppery-brown wings (Color Plate 3W). Six small patches of white hairs appear along the sides toward the rear of the insect. The male and female look alike, but the male is generally smaller and has sharper spines on its forelegs.

Egg—The whitish egg is ellipitcal, becoming more spherical as the embryo develops. It has a diameter of about 2 mm.

Larva—The larva, about 25 mm long when fully grown, is a C-shaped, white grub with a yellowish-brown head. It is usually found in a cell underground. There are three larval stages.

Pupa—The pupa is about 13 mm long and 6 mm wide. It may be pale cream, tan, or green depending upon its age.

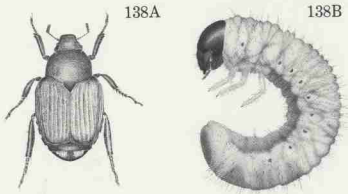


Fig. 138 Japanese beetle. A, Adult. B, Larva.

BIOLOGY

Distribution—Introduced from Japan in 1916, the Japanese beetle has spread from New Jersey throughout the eastern United States. It is a serious pest of many economically valuable plants.

Host Plants—Over 300 plants are known food sources for the Japanese beetle. The adults are particularly fond of roses, and they prefer white and yellow flowers to the darker colors.

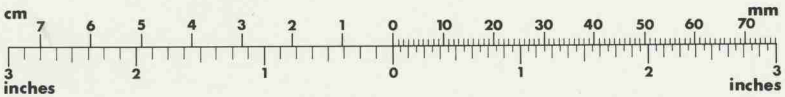
Damage—Both the larvae and adults have chewing mouthparts. The grubs consume roots of turf grasses, whereas the adults feed on leaves, buds, flowers, and fruits. Since the adults do not eat the leaf veins, infested leaves become skeletonized. Flowers and buds have ragged edges after beetles have been feeding.

Life History—Japanese beetles overwinter as larvae, pupate in late spring, and emerge as adult beetles about 2 weeks later. Adults usually appear in mid-May. They are gregarious, often feeding together in masses on flowers, foliage, and fruits of plants in bright sunlight. They fly in broad daylight. Populations diminish during August.

The female selects poorly drained soil in which to deposit her eggs. She burrows 7 to 8 cm into the ground and lays several eggs at a time, continuing for a period of days until she has laid 40 to 60 eggs. They hatch approximately 2 weeks later. Though a dry summer usually reduces the number of live larvae, a severe decrease in rainfall in the fall or spring hardly affects the population because older larvae are resistant to dry conditions. After entering a quiescent prepupal stage, the larvae pupate. The beetles tend to become well established in areas of grazing, general agriculture, truck crops, and fruit-growing. They are usually not found in heavily forested land. Though it takes 2 years for a generation to develop in the beetles' northern limit, 1 year is required in most areas.

CONTROL

Insecticides will not completely protect roses, which unfold rapidly and are especially attractive to beetles. When beetles are first noticed on roses, buds should be nipped and the bushes sprayed to protect the leaves; then when the beetles become scarce, the bushes can be allowed to bloom. To protect a limited number of rose blooms, nets or perforated bags can be tied around the blossoms. For specific chemical controls, see the current state extension service recommendations.



**Popillia japonica* Newman, Scarabaeidae, COLEOPTERA

DESCRIPTION

Adult—This large (2.5-mm) aphid has long, dark legs and honey tubes. Its body is pink, purplish, or green. Adults may have wings.

Egg—The egg has not been described.

Nymph—Nymphs resemble wingless adults (except they are smaller than adults). Both green and pink forms occur in the nymphal stages.

BIOLOGY

Distribution—Originally described from Europe, the rose aphid is now found throughout the United States except in the arid Southwest.

Host Plants—Rose aphids feed on rose and sometimes on pyracantha.

Damage—Rose aphids feed on tender shoots and buds. High populations reduce quality and quantity of flowers.

Life History—The entire life cycle may be spent on one host plant. Reproduction is by birth of live young throughout the growing season. In late fall, a generation of males and females is produced. These mate, and females then lay eggs on the rose canes. The eggs are the overwintering form. In spring as new growth resumes, the eggs hatch and the tiny nymphs begin to feed.

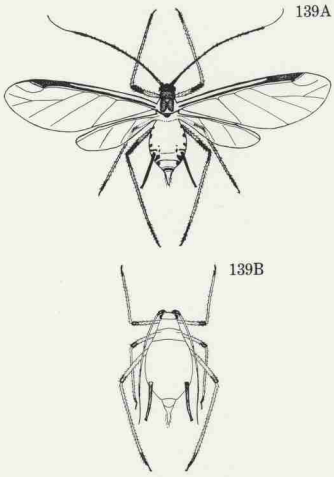
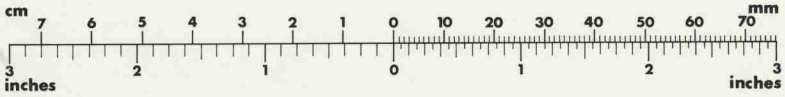


Fig. 139 Rose aphid. A, Winged adult. B, Wingless adult.

CONTROL

Parasitic wasps, lady beetles, and green lacewing adults and larvae prey upon the rose aphid. Except in cool weather, these biological control agents may keep the rose aphid population in check. For specific chemical controls, see the current state extension service recommendations.



**Macrosiphum rosae* (Linnaeus), Aphididae, HEMIPTERA

DESCRIPTION

Adult—The adult rose chafer is a tan, slender beetle with a reddish head and long, spiny, reddish legs (8 to 13 mm in length). The female is somewhat more robust than the male. The wings do not quite cover the abdomen.

Egg—The oval, shiny, white egg is 1 to 2 mm long.

Larva—The larva resembles a white grub (May beetle larva) but is smaller (up to 18 mm in length) and more slender.

Pupa—The light yellow-brown pupa is 16 mm long and has the last larval skin clinging to the posterior.

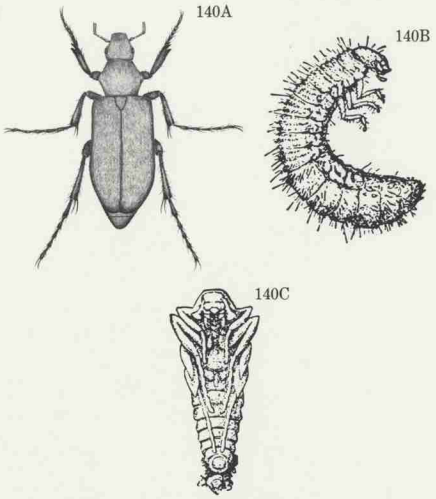


Fig. 140 Rose chafer. A, Adult. B, Larva. C, Pupa.

BIOLOGY

Distribution—Rose chafers are found primarily in the northeastern United States, but they also occur south at least to North Carolina and west to Colorado.

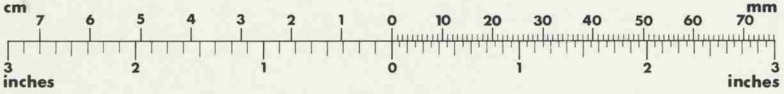
Host Plants—Rose chafers seem to prefer the flowers of roses and peonies, new grapes, and leaves of grapes. They will feed on apple, cherry, dahlia, elder, elm, foxglove, geranium, hollyhock, hydrangea, pear, poppy, Virginia creeper, and wisteria. The grubs feed on the roots of turf, weeds, and nursery stock.

Damage—Rose chafers are remarkable for the variety of hosts upon which they feed and because they are poisonous to chickens and birds when eaten. Rose chafers consume petals of roses and other flowers. The foliage of various broadleaved plants is skeletonized. Rose chafer grubs feed on the roots of grasses, weeds, and nursery stock.

Life History—Rose chafers appear in late May or early June and feed on roses, peonies, and sometimes iris and other flowers. They also feed on grapes and at times may damage elms, birches, and other trees severely. The adults live for about 4 to 6 weeks. Eggs are laid about 15 cm deep in sandy or grassland soil, and they hatch in 1 to 3 weeks. The eggs are laid in groups of 6 to 40, but each egg is deposited in a separate cavity. The larvae feed on the roots of turf and ornamental plants. They apparently move down into the soil for moisture. The larvae spend the winter deep in the soil. In early spring the grubs migrate upward and pupate in early May in earthen cells. There is one generation per year.

CONTROL

Prize rosebushes may be protected by a cheesecloth frame while the beetles are in flight (most of June). Handpicking the beetles may help. Rose chafers should not be fed to poultry or family pets; these insects are poisonous (apparently because they contain cantharidin, a blistering agent). For specific chemical controls, see the current state extension service recommendations.



**Macrodactylus subspinosus* (Fabricius), Scarabaeidae, COLEOPTERA

DESCRIPTION

Adult—The female adult is about 0.38 mm long and resembles a small spider. The abdomen is dark reddish or brown; the cephalothorax is pinkish or red. There is also a pale midstripe. The male resembles the female but is smaller (0.3 mm) and usually dark, lacking the pink or red color.

Egg—The brownish to reddish egg is depressed with a central stipe or hair (seta) (Color Plate 4BB).

Larva—The larva is nearly white with a few reddish dots.

Nymph—The nymph is similar to the adult male in color.

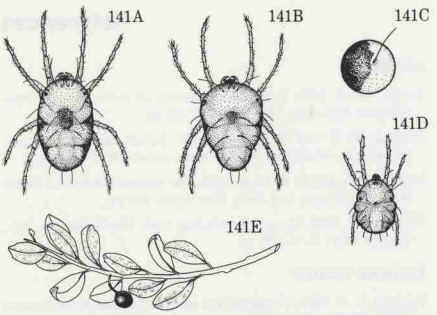


Fig. 141 Southern red mite. A, Female. B, Male. C, Egg. D, Larva. E, Damage to Japanese holly.

BIOLOGY

Distribution—The southern red mite was first reported on hollies at Batesburg, South Carolina, in 1917. This spider mite, at times exceptionally destructive, is a common and serious pest throughout the eastern United States and in California.

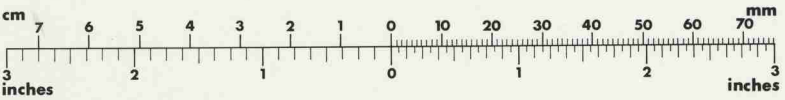
Host Plants—Southern red mites seem to prefer azaleas, camellias, and hollies. These mites have also been recorded on clethra (sweet pepperbush), cleyera, elaeagnus, eucalyptus, eugenia, grevillea, hibiscus, juniper, kalmia, oxalis, photinia, pyracantha, rhododendron, rose, and viburnum. Plants in the Ericaceae and Aquifoliaceae seem to be especially susceptible.

Damage—Southern red mites feed on the lower leaf surface, causing mesophyll collapse. Infested leaves turn gray or brown and may fall from the shrub prematurely (Color Plate 4CC). If uncontrolled, southern red mites may hasten the death of a heavily infested plant.

Life History—Southern red mites pass through a larval stage and a series of nymphal stages before they mature into adults. They usually feed on the lower surfaces of woody ornamental plants. When populations are high, however, these mites will feed on the upper surfaces as well. Being "cool weather mites," they reproduce rapidly in spring and fall and become almost inactive in winter and summer. As a result, when the populations of predaceous insects and mites are active in summer, populations of southern red mites are rather insignificant. Southern red mites evidently overwinter as eggs.

CONTROL

Because southern red mites are most active in cool weather, infestations should be treated at the end of summer or winter for maximum effectiveness. Multiple foliar applications of proper miticides at 2-week intervals may be needed to obtain desired control. For specific chemical controls, see the current state extension service recommendations.



**Oligonychus ilicis* (McGregor), Tetranychidae, PROSTIGMATA

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Appendix I.
Insect and Related Pests Quarantined by State

This appendix is a quick reference to insect and related pests quarantined by each state, the District of Columbia, and Puerto Rico. This information was complete at the time of preparation, but changes may have occurred since publication. Further information can be obtained from any state department of agriculture. The numbers in this appendix correspond to the pests listed under Pests Regulated During Inspection (p. 7). The absence of numbers indicates that no quarantine is in effect at this time.

STATE	PEST
Alabama	
Alaska	
Arizona	27, 40, 43, 44, 46, 47, 48, 51, 52, 54, 63, 64, 70, 81
Arkansas	
California	33, 35, 37, 39, 43, 48, 49, 51, 52, 54, 65, 68, 69, 73, 74, 78, 80
Colorado	
Connecticut	
Delaware	
District of Columbia	
Florida	5, 15, 17, 24, 28, 51, 54, 64, 72, 79
Georgia	
Hawaii	52
Idaho	51, 52, 58, 62
Illinois	
Indiana	
Iowa	
Kansas	
Kentucky	
Louisiana	
Maine	
Maryland	
Massachusetts	
Michigan	32, 56
Minnesota	
Mississippi	34, 71, 72
Missouri	
Montana	42, 52
Nebraska	
Nevada	37, 49
New Hampshire	
New Jersey	
New Mexico	35, 39, 51, 60, 61, 65, 66
New York	
North Carolina	
North Dakota	
Ohio	50, 56, 75, 76, 77
Oklahoma	
Oregon	51, 52, 58
Pennsylvania	
Puerto Rico	
Rhode Island	
South Carolina	
South Dakota	
Tennessee	8
Texas	51, 54, 65, 67
Utah	42, 51, 52
Vermont	
Virginia	28
Washington	51, 58, 77
West Virginia	
Wisconsin	
Wyoming	

Appendix II.
A Sample Regulation

NORTH CAROLINA PLANT PEST LAW
CHAPTER 106, ARTICLE 36

GENERAL STATUTES OF NORTH CAROLINA
AS AMENDED 1971

Article 36. Plant Pests

§106-419. Plant pest defined.—A plant pest is hereby defined to mean any insect, mite, nematode, other invertebrate animal, disease, noxious weed, plant or animal parasite in any stage of development which is injurious to plants and plant products. (1957, c. 985.)

§106-419.1. Any plant, plant product, object or article which has been, or which the Commissioner of Agriculture or his agents have reasonable grounds to believe has been exposed to a plant pest, may be treated as a plant pest for the purposes of this Article. (1957, c. 985, s. 1; 1971, c. 526, s. 1.)

§106-420. Authority of Board of Agriculture to adopt regulations.—The Board of Agriculture is hereby authorized to adopt reasonable regulations to implement and carry out the purposes of this article so as to eradicate, repress and prevent the spread of plant pests (1) within the State, (2) from within the State to points outside the State and (3) from outside the State to points within the State. The Board of Agriculture shall adopt regulations for eradicating such plant pests as it may deem capable of being economically eradicated, for repressing such as cannot be economically eradicated, and for preventing their spread within the State. Regulations may provide for quarantine of areas. It may also adopt reasonable regulations for preventing the introduction of dangerous plant pests from without the State, and for governing common carriers in transporting plants, articles or things liable to harbor such pests into, from and within the State. The board is authorized, in order to control plant pests, to adopt regulations governing the inspection, certification and movement of nursery stock, (1) into the State from outside the State, (2) within the State, and (3) from within the State to points outside the State. The board is further authorized to prescribe and collect a schedule of fees to be collected for its nursery inspection, nursery dealer certification, and narcissus bulb inspection activities. (1957, c. 985.)

§106-420.1. The North Carolina Board of Agriculture is authorized to enter into agreements with any agency of the United States or any agency of another state for the eradication, suppression, control and prevention of spread of plant pests. The Commissioner of Agriculture is authorized to enter into agreements with any unit of local government in this State or any organization incorporated or unincorporated who has an interest in the control of plant pests for the eradication, suppression, control and prevention of spread of plant pests. (1897, c. 264, s. 2; Rev. s. 3980; 1909, c. 90, s. 1; C. S., s. 4897; 1955, c. 189, s. 2; 1957, c. 985, s. 1; 1971, C. 526, s. 1.)

§106-421. Permitting uncontrolled existence of plant pests; nuisance; method abatement.—No person shall knowingly and willfully keep upon his premises any plant or plant product infested or infected by any dangerous plant pest, or permit dangerous plants or plant parasites to mature seed or otherwise multiply upon his land, except under such regulations as the Board of Agriculture may prescribe. All such infested or infected plants and premises are hereby declared public nuisances. The owner of such plants or premises shall, when notified to do so by the Commissioner of Agriculture, take such measures as may be prescribed to eradicate such

pests. The notice shall be in writing and shall be mailed to the usual or last known address, or left at the ordinary place of business, of the owner or his agent. If such person fails to comply with such notice within such reasonable time as the notice prescribes, the Commissioner of Agriculture, through his duly authorized agents, shall proceed to take such measures as shall be necessary to eradicate such pests, and shall compute the actual costs of labor and materials used in eradicating such pests, and the owner of the premises in question shall pay to the Commissioner of Agriculture such assessed costs. No damage shall be awarded the owner of such premises for entering thereon and destroying or otherwise treating any infected or infested plants or soil when done by the order of the Commissioner of Agriculture. (1897, c. 264, s. 2; Rev. s. 3980; 1909, c. 90, s. 1; C. S., s. 4897; 1957, c. 985, s. 1.)

§106-422. Agents of the Board; Inspection.—The Commissioner of Agriculture, shall be the agent of the board in enforcing these regulations and shall have authority to designate such employees of the Department as may seem expedient to carry out the duties and exercise the powers provided by this article. Persons collaborating with the Division of Entomology may also be designated by the Commissioner of Agriculture as agents for the purpose of this Article. The Commissioner of Agriculture, and any duly authorized agent of the Commissioner, shall have the authority to inspect vehicles or other means of transportation and its cargo suspected of carrying plant pests and to enter upon and inspect any premises between the hours of sunrise and sunset during every working day of the year to determine the presence or a absence of injurious plant pests. Any duly authorized agent of the Commissioner shall have authority to stop or cause to be stopped on any highway or other public place, by any law enforcement officer at the request of said authorized agent of the Commissioner, any vehicle or other means of transportation that is being used, or that the representative of the Commissioner has reasonable grounds to believe is being used, to transport or move any plant, plant product or seed in violation of the provisions of this article. (1897, c. 264, s. 4; Rev., s. 3982; 1909, c. 90, s. 1; C. S., s. 4899; 1957, c. 985, s. 1; 1967, c. 976, s. 1.)

§106-423. Nursery inspection; Nursery dealers certificate; narcissus inspection.—The Board of Agriculture shall have the authority to define nursery stock. The Commissioner of Agriculture shall have the right to cause all plant nurseries, and narcissus bulb fields where narcissus bulbs are commercially raised, within the State to be inspected at least once each year for serious plant pests. Every person, firm or corporation buying and reselling nursery stock shall register and secure a dealer's certificate for each location from which plants are sold. (1957, c. 985, s. 1.)

§106-423.1. Criminal penalties; violation of law or regulations.—If anyone shall attempt to prevent inspection of his premises as provided in the preceding sections, or shall otherwise interfere with the Commissioner of Agriculture, or any of his agents, while engaged in the performance of his duties under this article, or shall violate any provisions of this article or any regulation of the Board of Agriculture adopted pursuant to this article, he shall be guilty of a misdemeanor and shall be fined not less than five nor more than fifty dollars, or imprisoned for not less than ten nor more than thirty days, for each offense. Each day's violation shall constitute a separate offense. (Rev. s. 3713; 1907, c. 876; C.S., s. 4900; 1957, c. 985, s. 1.)

Appendix III.
A Sample Nursery Certification Statute

AGRICULTURE - PESTICIDE AND PLANT PROTECTION

SECTION .0300 - NURSERY CERTIFICATION

.0301 DEFINITIONS

For the purpose of this Section the following words and terms shall be construed respectively to mean:

(1) Agent. Any person who solicits, takes orders or sells nursery stock or collected plants for a nurseryman or dealer off the premises or place of business of said nurseryman or dealer;

(2) Certificate of Plant Inspection. A document issued by the North Carolina Department of Agriculture or the appropriate plant pest regulatory agency of any other state which declares that the plants grown by the person named on the certificate has been inspected and found apparently free of injurious plant pests;

(3) Collected Plant. Any nursery stock, other than currently certified nursery stock, which is dug or gathered from any location;

(4) Collected Plant Certificate. A document issued by the North Carolina Department of Agriculture which declares that the person named on the certificate has given satisfactory evidence that all nursery stock collected by him will be in accordance with the plant pest regulations of the North Carolina Department of Agriculture;

(5) Collected Plant Regulated Area. Any counties or parts of counties the State of North Carolina listed or provided for in these regulations; When it is determined that there are large numbers of plants collected in any area of the state, or that movement of nursery stock presents a hazard because of plant collections in that area, such area shall be designated a collected plant regulated area;

(6) Infestation. The presence of any plant pest which is regarded as injurious;

(7) Inspector. An employee of the North Carolina Department of Agriculture designated by the commissioner to enforce these regulations;

(8) Nursery. Any place where any of the plants defined as nursery stock are grown for sale, barter, exchange or gift;

(9) Nursery Certificate or Certificate of Plant Inspection. A document issued by the North Carolina Department of Agriculture or the appropriate plant pest regulatory agency of any other state which declares that the nursery named on the certificate has been inspected and found apparently free of injurious plant pests;

(10) Nursery Dealer. Any person not a grower of nursery stock who obtains certified nursery stock and/or collected plants for the purpose of reselling, exchanging or giving away independently of the control of a nursery;

(11) Nursery Dealer Certificate. A document issued by the North Carolina Department of Agriculture which declares that the person named on the certificate has given satifactory evidence that all nursery stock sold or otherwise disposed of by him will be such as was secured from regularly certified nurseries of certified plant collectors;

(12) Nurseryman. Any person who owns, leases, manages or is in charge of a nursery;

(13) Nursery Stock. All articles defined as plant material excluding greenhouse potted plants intended for indoor use;

(14) Person. Individual, corporation, partnership, firm or association;

(15) Shipping Tag. A tag issued by an authorized inspector of the North Carolina Department of Agriculture which accompanies individual shipments of plants which states the number and identity of all the plants in the shipment and declares the apparent freedom from injurious pests;

(16) Plant Material. All wild, cultivated, or greenhouse grown plants, trees, shrubs, vines, bulbous plants and roots, grafts, scions, and buds grown or kept for or capable of propagation, distribution, or sale. Excluded are annual plants, cut flowers, tree, field, vegetable and flower seed. Also excluded are decorative plants without roots not intended for propagation.

History Note: Statutory Authority G.S. 106-419 to 106-423.1;
Eff. February 1, 1976;
Amended Eff. May 25, 1979

.0302 NURSERIES TO APPLY FOR INSPECTION

Persons within the State of North Carolina who do not possess a valid copy of a nursery certificate shall make application to the North Carolina Department of Agriculture for inspection before June 1 of the year prior to offering plants for sale, barter, exchange or a gift.

History Note: Statutory Authority G.S. 106-419 to 106-423.1;
Eff. February 1, 1976.

.0303 OTHER PLANT INSPECTIONS

Persons desiring inspection of plants for which certification is required as a prerequisite for movement may secure this service by making application to the North Carolina Department of Agriculture for such inspection. When inspections are requested by such establishments as greenhouses, cut flower growers, bedding plant growers, etc., a special certificate may be issued. A fee may be charged based on the schedule for commercial nurseries.

History Note: Statutory Authority G.S. 106-419 to 106-423.1;
Eff. February 1, 1976.

.0304 CLASSIFICATION OF NURSERIES

All nurseries in North Carolina shall be classified as commercial "(a)," "(b)," or "(c)," non-commercial, institutional or special based on the type of operation in which they are engaged and the definitions herein. All nurserymen have the right to request the category to which they are assigned. Final assignment may be based on agreement between the inspector and the nurseryman:

(1) Commercial. Any nursery for which the primary purpose is to obtain livelihood based on the following types of operation:

(a) Retail Nursery. Any nursery where 80 percent or more of the nursery stock sold is to the final consumer for his use;

(b) Wholesale Nursery. Any nursery where 80 percent or more of the nursery stock sold is to other nurseries, dealers or other persons for resale;

(c) Retail and Wholesale Nursery. Any nursery where sales consist of nursery stock which is sold as follows:

(i) directly to the final consumer, and also

(ii) to other nurseries and/or dealers for resale with the percentage of total sales for each category being less than 80 percent.

(2) Non-commercial. Any nursery one acre or less in size for which livelihood is not the primary purpose;

(3) Institutional. Any nursery owned or operated by any governmental agency;

(4) Special. Any person requesting inspection of plants for which certification is not required, but may be needed as a prerequisite for movement.

History Note: Statutory Authority G.S. 106-419 to 106-423.1;
Eff. February 1, 1976;
Amended Eff. May 25, 1979.

.0305 FEES

Schedule of fees for nursery inspection and other plant inspection based on acres of salable nursery stock are as follows:

(1) Commercial and Special nurseries:
First acre or fraction thereof $5.00
Each additional acre 1.00
(2) Non-commercial nursery 3.00
(3) Institutional . . . . . None

A certificate shall not be granted until all fees owed are paid. A charge not to exceed the original inspection fee may be made for each additional inspection necessary to certify all or part of a nursery when such nursery has been found uncertifiable because of plant pests.

History Note: Statutory Authority G.S. 106-419 to 106-423.1;
Eff. February 1, 1976;
Amended Eff. May 25, 1979.

.0306 CERTIFICATE REQUIRED

No person shall sell, offer for sale, barter, exchange or give away nursery stock or collected plants unless in possesion of a valid nursery certificate, a nursery dealer certificate or a collected plant certificate as required in these regulations.

History Note: Statutory Authority G.S. 106-419 to 106-423.1;
Eff. February 1, 1976.

.0307 NURSERY CERTIFICATE

(a) Persons who maintain a nursery shall be required to possess a nursery certificate. Such certificate shall be issued only after such nursery and nursery stock has been inspected by an inspector of the North Carolina Department of Agriculture, found apparently free of injurious plant pests, and the proper fee paid. An inspection shall be made at least once annually. The inspection will be made before September 30 of each year and the certificate shall be valid until September 30 of the following year, but may be revoked sooner for cause.

(b) All nurserymen who purchase or otherwise obtain uncertified nursery stock and/or collected plants for resale or other uses within their nursery must have such stock inspected and certified prior to such resale, shipment from the nursery or other use.

(c) All nurserymen may be required to keep accurate records of plant acquisitions and sales when such records are deemed necessary by the State Entomologist in order to trace the spread of plant pests. These records shall be presented upon request to any inspector.

History Note: Statutory Authority G.S. 106-419 to 106-423.1;
Eff. February 1, 1976;
Amended Eff. January 1, 1978.

.0308 NURSERY DEALER CERTIFICATE

(a) Persons who maintain no regular nursery but who deal in nursery stock grown in regularly certified nurseries and/or collected plants shall be required to possess a nursery dealer certificate. To obtain such a certificate the nursery dealer must submit an application listing all sources of nursery stock and collected plants to be sold, bartered, exchanged or given away. It shall be a violation of this Section for a nursery dealer to sell, barter, exchange or give away nursery stock or collected plants which have not been inspected and certified by an inspector in North Carolina or a duly authorized plant pest regulatory official of another state or country.

(b) The annual fee for a nursery dealer certificate shall be ten dollars ($10.00) for each location from which nursery stock is sold, barterd, exchanged or given away. This certificated expires December 31 of each year.

(c) All nursery stock and/or collected plants in the custody of any dealer shall be subject to inspection at any time and shall be maintained in certifiable condition. Dealer certificates can be revoked at any time for cause. Records shall be kept of all plant acquisitions and shall be made available to any inspector of the North Carolina Department of Agriculture upon request.

History Note: Statutory Authority G.S. 106-419 to 106-423.1;
Eff. February 1, 1976;
Amended Eff. January 1, 1978.

.0309 COLLECTED PLANT CERTIFICATE

Persons who dig or gather collected plants shall be required to possess a collected plant certificate. To obtain such a certificate the collector must submit to the pesticide and plant protection division an application which states where collected plants are to be obtained. Upon approval of this application and payment of an annual fee of one dollar ($1.00), a collected plant certificate will be issued. This certificate expires September 30 of each year, but may be revoked sooner for cause. A record of plant collections and sales shall be maintained and shall be made available to any inspector of the North Carolina Department of Agriculture upon request. Nurserymen who also collect plants shall be required to have a collected plant certificate in addition to a nursery certificate.

History Note: Statutory Authority G.S. 106-419 to 106-423.1;
Eff. February 1, 1976;
Amended Eff. May 25, 1979.

.0310 INFESTED STOCK IN NURSERY

When nursery stock in the nursery is found by the inspector to be infested with any plant pest, the certificate may not be issued until the infested stock has been treated or destroyed to the extent that the salable stock to be covered by the certificate shall be apparently free of plant pests. The authorized inspector making the inspection may prescribe such treatment as may be necessary and shall require full compliance before issuing a certificate. Should it be necessary for the inspector to make additional visits to the nursery to check compliance with recommended procedure, charges may be assessed for each subsequent visit on the same basis as for the initial inspection.

History Note: Statutory Authority G.S. 106-419 to 106-423.1;
Eff. February 1, 1976.

.0311 NORTH CAROLINA NURSERIES

(a) Every carload, box, package or other shipping container of nursery stock or collected plants which is sold, exchanged, bartered, given away or transported by any person whose place of business is in North Carolina shall be accompanied by a copy of a valid North Carolina nursery certificate or North Carolina nursery dealer certificate, plainly and se urely attached unless the shipment bears a shipping tag.

(b) Any shipment of nursery stock which is not accompanied by a valid copy of a nursery certificate, nursery dealer certificate or shipping tag as required is hereby declared to be a public nuisance and may be returned to shipper, destroyed or otherwise disposed of by the inspector without compensation to the consignor, and the consignor will be notified as to the disposition of such shipments.

(c) Out-of-date certificates cannot be revised and used after expiration nor can the date and number of expired copies of certificates be changed and such copies used after expiration of the original certificate. The wording and form of this copy shall be the same as that of the original certificate furnished by the Department of Agriculture and all copies must be complete, printed in full, with issuance and expiration date and number included.

(d) At the discretion of the enforcing agency any holder of a nursery certificate or nursery dealer certificate may be required to submit a sample of the printed copy for approval.

(e) When satisfactory agreements can be reached, permission may be granted for the printing of permanent nursery certificate or other acceptable facsimiles of the certificate. These permanent certificates will be subject to revocation at any time for cause.

History Note: Statutory Authority G.S. 106-419 to 106-423.1;
Eff. February 1, 1976;
Amended Eff. May 25, 1979; January 1, 1978.

.0312 OUT-OF-STATE NURSERIES

Every carload, box, package or other container of plant material originating outside North Carolina and being moved into North Carolina for customer delivery or for resale must have attached to it a tag or certificate stating in effect that the plant material being moved has been inspected and certified as apparently free from injurious plant pests by an authorized official of the state of origin. The shipment must bear the name and address of the shipper. Any shipment of plant material entering North Carolina not meeting these requirements is hereby declared to be a public nuisance and may be returned to shipper, treated, destroyed or otherwise disposed of by the inspector, without compensation to the shipper. This shall in no way be meant to void the requirements of any federal or state plant pest quarantine.

History Note: Statutory Authority G.S. 106-419 to 106-423.1;
Eff. February 1, 1976;
Amended Eff. May 25, 1979; July 30, 1976.

.0313 INFESTED PLANTS FROM OUT OF STATE

Any plants moving from outside North Carolina for delivery in North Carolina, whether or not included under the definition of plant material and whether or not accompanied by a tag or certificate of inspection or dealer certificate, found infested with injurious plant pests, is hereby declared a public nuisance and may be returned to the shipper, treated, destroyed or otherwise disposed of by the inspector without compensation to the consignor.

History Note: Statutory Authority G.S. 106-41 to 106-423.1;
Eff. February 1, 1976;
Amended Eff. May 25, 1979.

.0314 RECIPROCITY AGREEMENT

All out-of-state nurseries and dealers located in states which require a registration fee of North Carolina nurseries and dealers will be charged the same fee for shipping nursery stock into North Carolina as that required of North Carolina nurseries and dealers for shipping into such states. Those states which require no registration fee of North Carolina nurseries and dealers shall not be required to pay a fee for registration and movement of nursery stock into North Carolina. As of this time, no other states require fees of North Carolina nurserymen.

History Note: Statutory Authority G.S. 106-419 to 106-423.1;
Eff. February 1, 1976.

.0315 FOREIGN COUNTRIES

(a) Any person receiving directly or indirectly any plant material or other living plants or plant parts, including seed, from foreign countries shall notify the pesticide and plant protection division of the arrival of such shipment, of the contents thereof, and the name and address of the grower and consignor, and shall hold such shipment in the original container for inspection for a ten-day period unless otherwise directed by an inspector of the pesticide and plant protection division.

(b) At the discretion of the State Entomologist any plant material or other living plants or plant parts, including seeds, may be required to be grown under a state postentry quarantine. When such a situation arises, the State Entomologist may prescribe the exact conditions of this quarantine.

History Note: Statutory Authority G.S. 106-419 to 106-423.1;
Eff. February 1, 1976;
Amended Eff. May 25, 1979.

.0316 TRANSPORTATION COMPANIES

(a) No transportation company or common carrier or agent thereof shall receive for transportation and delivery within North Carolina any carload, box, bale, package or other container of plant material from a point outside North Carolina unless such container shall have plainly and securely attached thereto a copy of a certificate of inspection or dealer certificate or shipping tag where applicable, valid at the time shipment is received, made in favor of the consignor and issued by the authorized official of state of origin.

(b) No transportation company or common carrier or agent thereof shall receive for transportation and delivery from any point in North Carolina to another point within North Carolina any carload, box, bale, package or other container of nursery stock unless such container shall have plainly and securely attached thereto a copy of a certificate of inspection or dealer certificate or shipping tag where applicable, valid at the time the shipment is received, made in favor of the consignor and issued by an inspector.

(c) If any transportation company or common carrier receives any carload, box, package, or other container of plant material from a point outside of North Carolina for delivery in North Carolina or nursery stock from a point within North Carolina for delivery to another point within North Carolina which is not accompanied by an inspection certificate or dealer certificate or shipping tag where applicable, they shall immediately notify the North Carolina Department of Agriculture, and shall hold from delivery such container of nursery stock until released by an inspector.

History Note: Statutory Authority G.S. 106-419 to 106-423.1;
Eff. February 1, 1976;
Amended Eff. May 25, 1979.

.0317 AGENTS AND SALES YARDS TO BE REGISTERED

All nurseries shall list with the pesticide and plant protection division agents and/or sales yards at the time of inspection or by September 30 of each year. All nursery dealers shall list with the pesticide and plant protection division their agents by December 31 of each year. No person shall represent themselves as an agent of a nursery or nursery dealer without being registered with the pesticide and plant protection division.

History Note: Statutory Authority G.S. 106-419 to 106-423.1;
Eff. February 1, 1976;
Amended Eff. May 25, 1979.

.0318 STOP SALE NOTICE

(a) Any inspector of the North Carolina Department of Agriculture shall have the authority to issue a "Stop Sale Notice" when nursery stock and/or collected plants are found to be or suspected to be in violation of any provisions of these regulations or any other regulations as adopted under the North Carolina Plant Pest Law. A Notice of Stop Sale Action shall be filled out by the inspector each time a Stop Sale notice is issued.

(b) It shall be unlawful for any person, after receipt of such "Stop Sale Notice," to obstruct from view or remove such notice from plants or from any location to which attached; or to sell, give away, move or exchange such plants until so authorized by an inspector.

History Note: Statutory Authority G.S. 106-419 to 106-423.1;
Eff. February 1, 1976;
Amended Eff. May 25, 1979.

.0319 NORTH CAROLINA NURSERY STOCK INVENTORY

At the discretion of the North Carolina Department of Agriculture an inventory of nursery stock will be published with the "Certified Nurseries of North Carolina." At such time every wholesale and wholesale and retail nursery shall have the opportunity to list their inventory of nursery stock which will be produced during the current season. Forms will be provided to each wholesale and wholesale and retail nursery for inclusion of such inventories in the publication. Other nurseries may list their inventories of nursery stock by making special arrangements with the pesticide and plant protection division.

History Note: Statutory Authority G.S. 106-419 to 106-423.1;
Eff. February 1, 1976;
Amended Eff. May 25, 1979.

.0320 EXEMPTIONS

The Commissioner of Agriculture is hereby authorized to exempt charitable

organizations from all fee requirements of these regulations when conditions indicate that such action is warranted.

History Note: Statutory Authority G.S. 106-419 to 106-423.1;
Eff. February 1, 1976;
Amended Eff. May 25, 1979.

.0321 CONDITIONS GOVERNING THE MOVEMENT OF NURSERY STOCK

Each shipment of nursery stock and/or collected plants moved from a collected plant regulated area shall be accompanied by a shipping tag which may be issued by an inspector after the plants have been inspected and found apparently free of injurious plant pests. Plants not passing inspection shall be handled or disposed of as directed by the inspector.

History Note: Statutory Authority G.S. 106-419 to 106-423.1;
Eff. February 1, 1976.

.0322 COLLECTED PLANT REGULATED AREAS

The following areas are designated "collected plant regulated areas" and are regulated under the provisions of this Section:

(1) Ashe--the entire county;
(2) Avery--the entire county;
(3) Burke--that portion of Burke County lying north and west of a line beginning at a point where State Secondary Road 1405 intersects the Caldwell County line, thence south and west along said road to its junction with State Highway 181, thence south along said highway to its junction with State Secondary Road 1258, thence south and west along said road to its junction with State Secondary Road 1240, thence north and west along said road to its junction with State Highway 126, thence south and west along said highway to its junction with State Secondary Road 1238, thence north and west along said road to its intersection with the McDowell County line;
(4) Mitchell--the entire county;
(5) Watauga-the entire county.

History Note: Statutory Authority G.S. 106-419 to 106-423.1;
Eff. February 1, 1976;
Amended Eff. August 6, 1978; July 30, 1976.

Glossary

Adelgid, aphidlike insect of the family Phylloxeridae that feeds on the bark and needles of conifers.

Aestivate, to become dormant or inactive during the summer.

Anal, at or near the anus.

Arthropod, an animal having a segmented body, an exoskeleton, and jointed legs.

Caterpillar, the wormlike larva of a moth, butterfly, skipper, or sawfly that usually has three pairs of jointed thoracic legs and two or more pairs of abdominal legs.

Caudal, at or near the tail.

Centimeter, a metric unit of length; 0.394 inches.

Cephalothorax, in mites, a body region including both the head and the thorax.

Chafer, certain phytophagous beetles of the family Scarabaeidae.

Chlorosis, yellowing of normally green plant tissues; a common symptom of insect damage, disease, or nutrient deficiency.

Cocoon, a silken or fibrous case spun by a larva to afford protection during its pupal period.

Cornicle, one of a pair of "honey tubes" that extend from the abdomen of an aphid.

Crawler, the motile first-instar nymph of a scale insect.

Dorsal, top or uppermost; pertaining to the back or upper side.

Elytra, thickened, leathery forewings that cover the hind wings; common to beetles and earwigs.

Eradicate, to eliminate a particular pest species from a designated area.

Eriophyid, a microscopic mite of the family Eriophyidae that is usually associated with galling, distortion, or other abnormal plant growth.

Exuviae, cast skin of an arthropod, e.g. mite, spider, insect.

Fly speck, a tiny spot of excrement left by a fly.

Frass, insect droppings, usually a combination of leaf fragments or wood borings and excrement.

Gall, a tumorlike swelling of plant tissues induced by the development of another plant or an animal (including an insect).

Generation, a group of offspring of the same species that develop at approximately the same time.

Grub, typically a sluggish, C-shaped beetle larva of the family Scarabaeidae having three pairs of forelegs and a fat, whitish body; also, used loosely to refer to many soil-inhabiting larvae of Coleoptera and Hymenoptera (sometimes legless).

Hectare, a metric unit of area; 2.471 acres.

Honeydew, a sugary liquid excreted by certain insects of the order Hemiptera, including aphids and whiteflies.

Infestation, the presence of large numbers of an animal pest species where they are likely to cause damage or annoyance to man.

Insect, a six-legged arthropod that as an adult has three distinct body regions and often has one or two pairs of wings.

Instar, the life stage of an arthropod between successive molts.

Larva (plural *larvae*), in reference to insects with complete metamorphosis, the immature form occurring between the egg and pupal stages; in reference to mites and ticks, the six-legged first instar.

Life cycle, the development of an insect or mite from the egg to the reproductive stage.

Longitudinal, lengthwise.

Maggot, the larva of a fly, usually applied to those larvae lacking a distinct head.

Mesophyll, the photosynthetic tissue of a leaf located between the two outer leaf tissues.

Metamorphosis, change in form and function during the development of an insect or mite.

Meter, a metric unit of length; 1.094 yards.

Microtubercles, microscopic, knoblike projections.

Millimeter, a metric unit of length; 0.034 inches.

Mite, usually a minute arthropod, eight-legged as an adult and closely related to ticks.

Molt, the process of replacing the skin with a new skin; shedding.

Nymph, in reference to insects with simple or no metamorphosis, the immature form between egg and adult; in reference to mites and ticks, the eight-legged immature form.

Oviposition, the process of laying eggs.

Ovipositor, an elongate structure extending from the abdomen of some female insects through which eggs are deposited.

Parasite, any plant or animal that lives in or on another organism to the detriment of the host.

Parenchyma, a plant tissue composed of thin-walled, unspecialized cells separated by air spaces.

Parthenogenetic, capable of reproduction without mating (i.e. without male fertilization of the eggs).

Phytophagous, plant eating.

Pith, soft, spongy tissue located in the center of the stems of some plants.

Prepupa, in reference to caterpillars and grubs, the fully mature, sluggish, nonfeeding last larval instar prior to pupation; in reference to thrips and male scale insects, the next to the last nymphal instar that has wing pads and short, thickened legs (sometimes referred to as "propupa").

Proleg, a fleshy abdominal leg of some insect larvae, particularly caterpillars.

Prothorax, the thoracic segment located closest to the head.

Pubescent, hairy, fuzzy.

Pupa (plural *pupae*), in insects with complete metamorphosis, the life stage between larva and adult; the next to the last developmental stage in thrips, male scales, and whiteflies.

Sclerotization, process by which the insect cuticle becomes hardened and darkened.

Seta (plural *setae*), a hairlike structure.

Sooty mold, a dark fungal growth that develops on foliage covered with honeydew excretions from insects.

Stadium, the period of time between the molts of a developing arthropod.

Stem mother, in aphids, the form that hatches from the winter egg and matures to produce offspring without mating.

Stigma (plural *stigmata*), a thickened area of the wing membrane located just behind the front margin of the forewing.

Thoracic, of or pretaining to the thorax.

Thorax, the second, major body region of adult insects from which the legs and wings arise.

Tubercle, a small, knoblike projection.