Integrated pest management of Magnolia Scale

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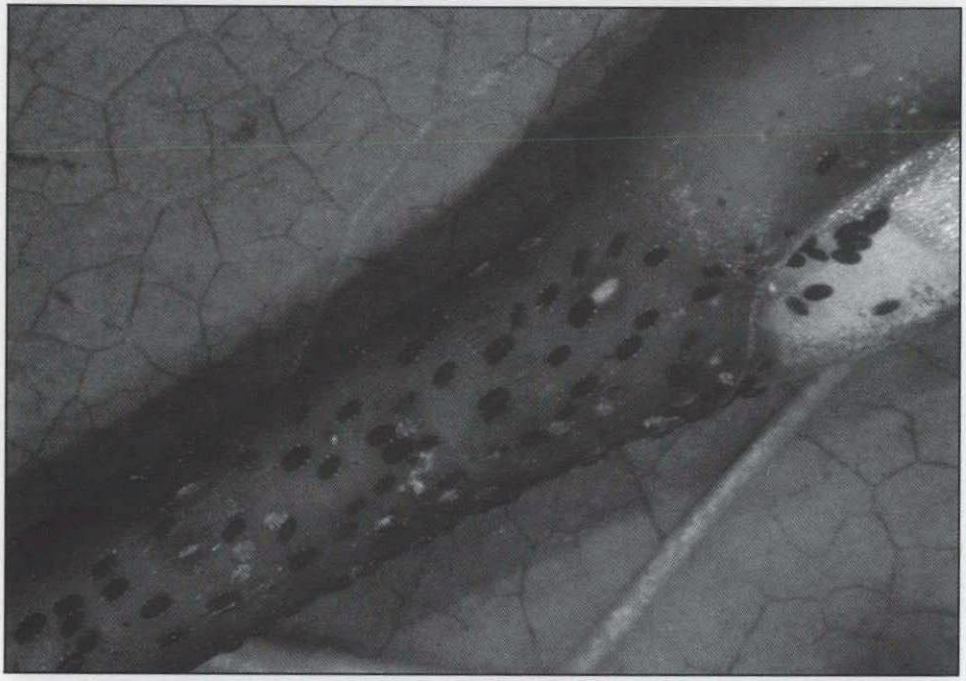
Scale insects belong to the Order Homoptera which also includes such pests as planthoppers, leafhoppers, spittlebugs, cicadas, aphids, adelgids, psyllids, and whiteflies.

Adult female scales lack wings, may have legs, and are sacklike with no definite head, thorax, and abdomen. Adult males are more insectlike in appearance, usually with one pair of wings, long legs, and a definite head, thorax, and abdomen. Adult males are small, fragile, and weak flyers, and normally live only a day or two, during which time they mate [1]. Not all scales have males; some females are capable of reproducing parthenogenetically without fertilization [8]. Most scale insects produce a waxy secretion that covers the body either as a shieldlike structure separated from the body or as a coating on the body surface. The wax varies from a thin, translucent sheet to a thick, wet mass or to a powdery bloom-like secretion. Scale insects, once they settle, remain attached to the host for the rest or their lives. They have muscles to insert their mouthparts deep into host tissue, but most species do not have the capacity to remove them [5]. They depend upon a feeding tube—stylet—which is normally 6-8 times the length of the scale's body [8]. Scale insects, like all insects, have an external skeleton that must be shed in order for them to grow. Shedding of the skeleton is called a molt; the period between molts is called an instar. Typically, for scale insects, there are three molts for the female and four for the male during each generation.

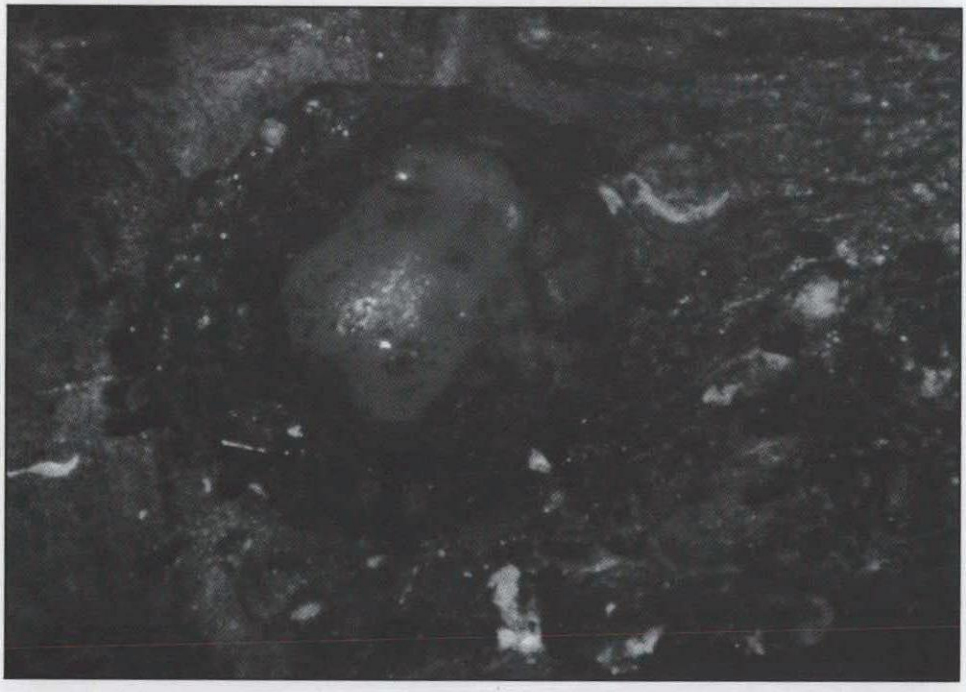
There are about 1,000 described species of scale insects in the United States and Canada [5] grouped into 16 families; two of which attack magnolias most often: armored scales (Family Diaspididae) and soft scales (Family Coccidae).

Armored scales are the smallest of the scale insects. They produce shells called tests, that are separate from their bodies and are made from two molt skins and a quantity of hard wax. Armored scales cannot be positively identified from surface characteristics of the shell. The armored scales feeding on magnolias most commonly are camellia, dentate, oleander (ivy), redbay, purple, glover, and greedy.

Soft scales are much larger than armored scales. They are covered during part of their development with white, waxy powder. Like armored scales, they remain immobile for most of their lives. Unlike armored scales, soft scales do not have tests over their bodies. Instead, what appears to be a shell is an external skeleton. Many of



Above: Magnolia scale crawlers. Below: Adult female magnolia scale.



them reproduce parthenogenetically. Unlike armored scales, they excrete large quantities of honeydew. Scales producing honeydew feed in the phloem sieve tubes, like aphids [5]. In addition to magnolia scale, soft scales affecting magnolias include tuliptree, cottony-cushion, and Florida wax scale.

Scale insects are among the most destructive insect pests. Injury apparently results from the ingestion of large amounts of plant sap. Plant deformation and toxin injury are produced by a few scale insects [1]. Plants suffer reduced photosynthetic activity and are weakened, and gradually individual branches may die. Heavily infested trees are not only weakened but are rendered unsightly by sooty mold fungus developing in the copious quantities of honeydew produced. Additionally, the feeding tubes may provide entry for pathogenic fungi.

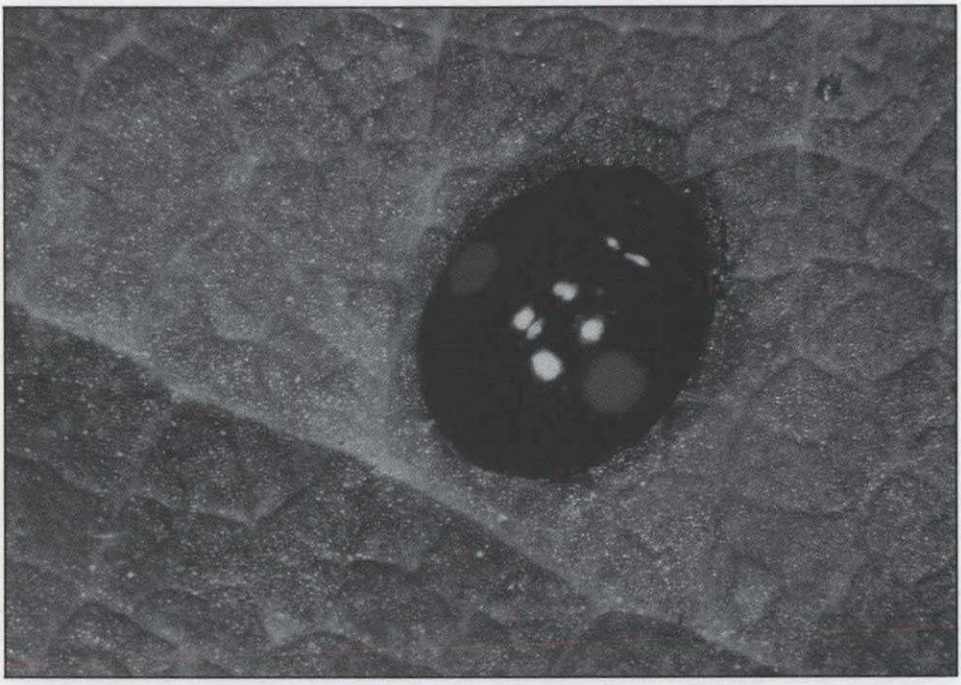
Natural dispersal is primarily by mobile crawlers or first instars. The crawler stage may be dispersed by wind, rain, or carried on bodies of birds and insects. Crawler dispersal usually is limited to short distances. Man's activities contribute significantly to long distance dissemination by moving infested plant material [8].

Armored scales spend winter most commonly as eggs beneath the scale covering of mated mature females. In May and June eggs hatch beneath the female scale covering, and the first instars migrate to new growth and immediately settle and insert their mouthparts. Soft scales overwinter as first or second instars, resume feeding in the spring, and mature during early or midsummer. After females have laid eggs beneath their bodies, crawlers emerge in 2-3 weeks, settle, and start to feed. In some cases females do not lay eggs but give birth to live young (ovoviviparousness).

Magnolia Scale, *Neolecanium cornuparvum* (Thro), is the most important soft scale on magnolias. This species is probably native to North America and occurs from New York to Florida and west to Wisconsin [1]. This scale is restricted to species of magnolia and is found in natural habitats and ornamental plantings. Magnolia scale attacks most often *MM. stellata, acuminata, liliiflora*, and x *soulangiana* [6]. Mature females are up to 12 mm in length, elliptical, convex, smooth, dark shiny brown. Newly mature females are covered with a white bloom that is rapidly lost with age; older ones are brown or yellow. Winter is passed as a bluish-black first instar nymphs on 1- or 2-year-old growth. These begin developing in early spring. The first molt occurs in late April or May and the second in early June, by which time insects have turned a deep purple. The nymphs secrete a white powdery layer of wax over their bodies. They become adult females in early August. The ovoviviparous females give birth to crawlers, that wander about for a short time before settling, mostly through September. One generation develops each year. Heavy infestations of magnolia scale can kill branches or entire trees.

Scale insects are difficult to control. Because of the wax covering the insect's body, many insecticides are ineffective [4]. The life stage

Above: Lady beetle larva. Below: Adult lady beetle on a magnolia.



most susceptible to chemical control is the first instar, apparently because during part of this stage there is little or no protective wax covering on the insects [1]. For effective chemical control, information of the life cycle must be available so that insecticidal spray applications coincide with crawler emergence. Since insects respond directly to weather, egg hatch may occur at different times in different areas, and hot or cold periods can accelerate or retard crawler emergence. Climatic conditions can significantly alter the seasonal development of scale insects, and even the number of generations. Microclimatic conditions can produce differences in the development of scales on the same plant. Time of crawler emergence may be as much as one month earlier from twigs on southern exposures as from other locations on the same tree [8].

There are two periods in the scale life cycle at which controls are normally directed; the overwintering stage and crawler stage. The timing differs between scale species. Dormant sprays with horticultural oils are commonly used and appear to be efficient in controlling overwintering magnolia scales. Most chemical controls applied during the growing season must coincide with crawler emergence or must attach crawlers that have recently settled. The way to ensure proper timing of controls is to inspect scales with a hand lens and apply chemical sprays to control crawlers when approximately 60 to 70% of the eggs have hatched [8]. In the case of magnolia scale, late August through mid-September is the time to apply a crawler spray using one of the following materials: malathion, acephate, diazinon, and carbaryl, as well as horticultural oil. Use of highly toxic matasystox and oxamyl is restricted for commercial applicators. Satisfactory results will usually require application of treatments over a 2-3 year period. Since scale insects feed upon plant sap, it seems that systemic insecticides would give excellent control any time the scale is feeding. So far this has not been proven to be true, and internal poisoning of the sap stream with systemic insecticides has often been disappointing [5].

Assessment of the need for, or the result of, control attempts is not a simple process. The number of covers observed is not always an accurate indicator, since even when dead they remain attached to a plant for several years. Five mature females of soft scales per 3 feet of branch length should be present in order to warrant some type of intervention [7]. Host recovery following control efforts is seldom dramatic. In some cases, even though the scale is controlled, the injury to the host is irreversible.

Another problem with the use of insecticides is public concern for personal health and environmental quality. Biological control of scale insects has produced some spectacular results. Of all complete biological control successes, 2/3 have been against scale insects [8]. Unfortunately, scales of shade trees and ornamentals have received little attention so far. A population outbreak of scale insects may occur as a consequence of the plant being

weakened because of its water and nutritional status, climatic conditions, or absence of natural enemies. Sap feeder populations, including scales, generally are enhanced by nitrogen fertilization [5]. Because many pests of ornamental plants are exotics, natural enemies that should be present are not. Localized and sporadic outbreaks of scale populations sometimes result from local environmental conditions which are adverse to existing natural enemies.

Both larvae and adults of certain ladybird beetles feed on adults and crawlers of magnolia scale, exercising some degree of natural control. The spots that mark the elytra of many ladybird beetles vary considerably within the species, and color patterns alone are insufficient for the identification of all specimens of a species [2]. Honeydew produced by scales serves as a food source for adult stages of many natural enemies, and it is therefore desirable in small amounts. However, honeydew also attracts ants which are known to guard and protect scales insects from attack by natural enemies [4]. Pesticide applications will interfere with this natural event to some extent. Insecticides may be differentially more injurious to enemies than they are to scale insects, since the latter are usually protected by the scale-like covering. Ladybird beetles overwinter as adults, frequently in groups, sometimes in tremendous numbers, usually in well protected places [3]. Therefore, dormant oil sprays of magnolias do not reduce their populations as summer sprays do.

A recommended integrated pest management of magnolia scale should start with preventive measures such as not moving infested plant material and proper cultural practices, including well balanced fertilization. It should comprise horticultural oil sprays during the dormant season. If a population of ladybird beetles feeding on scales is present, summer applications of pesticides should be avoided. If such population is absent and its introduction is not practicable, insecticidal sprays should coincide with crawler emergence. ❧

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