Fiorinia Externa *Ferris,* *A Scale Insect of Hemlock*

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The scale insect *Fiorinia externa* Ferris is a pest of hemlock (*Tsuga* spp.) in the Eastern United States. This sucking insect belongs to a group called the armored scale insects, which are important pests of agricultural and ornamental plants. First discovered in 1908 at Queens, N.Y., it has spread slowly into surrounding States. Apparently it was accidentally introduced from the Orient. Though all major infestations are of ornamental plantings, it has become established in native hemlock stands in at least two places (Connecticut and Wissahickon Park, Philadelphia). Fortunately these infestations have been localized.

Fiorinia externa injures hemlock by sucking juices from the needles. Heavy populations cause foliage yellowing, needle loss, a thin crown, and eventually death. Control is especially difficult because developing stages overlap. Though the scale is now restricted to definite areas, it seriously threatens native eastern (Canada) hemlock stands throughout this hemlock's range.

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Hosts and Distribution

Besides eastern or Canada hemlock, the principal hosts are Carolina hemlock, and Japanese hemlock (*T. diversifolia* [Maxim.] Mast.). Yew, fir, and spruce may also be attacked but are not preferred hosts.

The distribution of this scale is not continuous but is restricted to the Eastern United States from coastal Connecticut to Virginia and west to Ohio. Occasional infestations reported from inland cities probably result from shipment of infested plant material.

Evidence of Infestation

A heavily infested tree is easily spotted because of the unhealthy color of its foliage. Wax secretions of the scales give the underside of affected foliage a whitewashed appearance, especially in the spring and fall when crawlers are most numerous. When scales (fig. 1) are numerous, their feeding causes needles to turn yellow and drop prematurely, leaving a very thin crown.

Damage

Like all scale insects, this one sucks nutrients necessary for host plant growth. Excessive loss of nutrients reduces growth and vigor

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Figure 1.—Hemlock scales on underside of hemlock needles (about × 9).

and causes the yellowing of foliage, needle loss, and possible death of the tree.

Microscopic studies reveal that the threadlike mouth part penetrates directly to the internal cells through the cuticle or stomatal openings on the needle underside. Even when the insect is immotile, its long flexible mouth part permits it to feed extensively in needle tissue.

Description

The egg-laden female is yellow and lives within the cast skin of the last immature molt (fig. 2). As the female matures, this white covering becomes reddish brown. Under the female scale, many yellow eggs are deposited in two rows with their ends meeting at the median longitudinal axis of the cast larval skin.

Young scales, known as crawlers, hatch from these eggs and escape from under the female covering. The crawlers are small, lemon-colored, active insects with legs and antennae and can be seen only with the aid of a magnifying glass (fig. 3).

Adult males are minute, yellow with red eyes, and winged. After they have emerged, the scales may remain attached to the underside of needles. The scale covering is white and elongate but narrower than than of the female.

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Figure 2.—Adult female showing general body outline (excluding scale cover) and eggs within the body (× 100).

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Figure 3.—Crawler of *Fiorinia externa* (× 100).

Life History

Fiorinia externa has one or more generations each year, the number depending on location. Two generations are reported from Connecticut and Maryland but only one and a partial second from New York.

A generation typically begins with eggs being deposited under a female scale and hatching in about a month. The first-instar nymphs (crawlers) emerge from under her body and migrate to the new growth of the host tree. In hours the crawlers settle on a needle, insert their mouth parts, and begin to feed.

After feeding for a month, the crawlers undergo their first molt and become immotile. The legs and antennae are discarded with the old cuticle. Male and female scales are now distinguishable.

About a month is required for the winged male to develop and emerge from under its waxy covering. Male emergence continues until cold weather inhibits activity.

The immature female remains fixed to the needle and secretes over herself a flattened, elliptical scale about 1.5 mm. in length. A month after the first molt, the female molts for the second and last time. Now mating takes place. Egg laying begins about 2 months after mating.

Once mated, the female lays a variable number of eggs during her lifetime. Though winter weather may curtail egg production, she resumes activity in the spring. This long period of egg laying results in

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Figure 4.—The wasp *Aspidiotiphagus citrinus* (Craw.) parasitizing a female hemlock scale (× 100).

a great overlap in the various developmental stages and complicates control.

Natural Control

Several small Hymenoptera have been reported as parasites of this scale insect. Of six parasites found in New York, the wasp *Aspidiotiphagus citrinus* (Craw.) (fig. 4) was the most common, but was ineffective. In Maryland an unidentified chalcid, *Prospaltella* sp., was most abundant, but was also ineffective in controlling the scale population. The coccinellid *Chilocorus stigma* (Say) can be found in most infestations, but is not very effective in reducing numbers.

Chemical Control

Control of *Fiorinia externa* is difficult because the crawlers hatch throughout the summer. Conventional insecticides have proved inadequate even when applied repeatedly. The systemic insecticide, dimethoate, has effectively controlled both the crawlers and settled females. For control, follow the label directions for mixing and applying the emulsifiable concentrate of dimethoate. A spray applied in May when the crawlers are first active gives adequate control. Use a high-pressure sprayer. A similar application in July is necessary for thorough control or to curb a heavy infestation.

Pesticide Precautions

Pesticides used improperly can be injurious to man, animals, and plants. Follow the directions and heed all precautions on the labels. Dimethoate is poisonous.

Store pesticides in original containers under lock and key—out of the reach of children and animals—and away from food and feed.

Apply pesticides so that they do not endanger humans, livestock, crops, beneficial insects, fish, and wildlife. Do not apply pesticides when there is danger of drift, when honey bees or other pollinating insects are visiting plants, or when they may contaminate water or leave illegal residues.

Avoid prolonged inhalation of pesticide sprays or dusts; wear protective clothing and equipment if specified on the container.

If your hands become contaminated with a pesticide, do not eat or drink until you have washed. In case a pesticide is swallowed or gets in the eyes, follow the first aid treatment given on the label and get prompt medical attention. If a pesticide is spilled on your skin or clothing, remove clothing immediately and wash skin thoroughly.

Do not clean spray equipment or dump excess spray material near ponds, streams, or wells. Because it is difficult to remove all traces of herbicides from equipment, do not use the same equipment for insecti-

cides or fungicides that you use for herbicides.

Dispose of empty pesticide containers promptly. Have them buried at a sanitary land-fill dump, or crush and bury them in a level, isolated place.

WARNING: Recommendations for use of pesticides are reviewed regularly. The registrations on all suggested uses of pesticides in this publication were in effect at press time. Check with your county agricultural agent, State agricultural experiment station, or local forester to determine if these recommendations are still current.

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