Forest Insect & Disease Leaflet 182
April 2013
U.S. Department of Agriculture • Forest Service

Fall Cankerworm

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Fall cankerworm, *Alsophila pometaria* (Harris), is an insect that feeds on the foliage of many species of broadleaf trees. It is native to North America and populations periodically build to outbreak levels that cause extensive defoliation. This insect is a member of a large family of moths known as the Geometridae. The larvae are commonly referred to as "loopers, spanworms, inchworms or measuring worms." These names derive from their unique way of locomotion. Geometrid larvae have only two functional pairs of prolegs. They clasp their front legs on a leaf or branch and draw up with the prolegs on the hind end. This causes the thoracic and abdominal segments to form an arch (Figure 1). They then reach out again with their thoracic legs. This gives the impression that they are measuring as they move about.

Distribution and Hosts

Fall cankerworm is found from the Maritime Provinces of Canada west to Alberta, throughout the eastern United States from Maine to Georgia and west to California, Colorado, Missouri, Montana, New Mexico and Utah.

Larvae feed on a wide range of broadleaf trees and smaller woody plants including apple, *Malus pumila*, ash, *Fraxinus* spp., basswood, *Tilia* spp., beech, *Fagus grandifolia*, cherry, *Prunus* spp., elm, *Ulmus* spp., hickory, *Carya* spp., maple, *Acer* spp. and many species of oaks, *Quercus* spp. Oaks

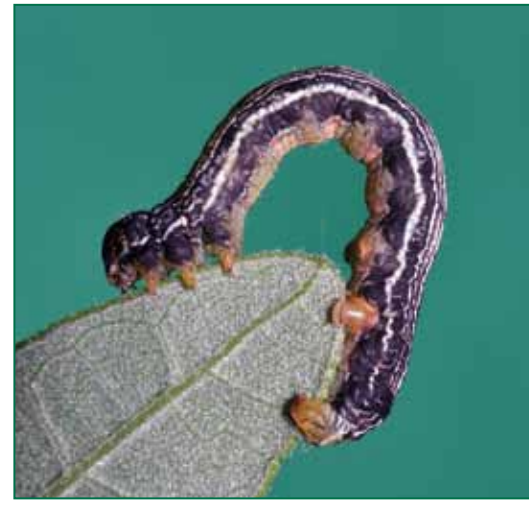

Figure 1. Mature fall cankerworm larva in a classic "looper" position. Note reduced proleg on fifth abdominal segment.

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Figure 2. Aerial view of fall cankerworm defoliation adjacent to a subdivision in Chesterfield County near Richmond, VA.

tend to be among the favorite hosts and extensive outbreaks have occurred in oak dominated forests.

Outbreak Characteristics

Outbreaks can occur in natural forests and woodlands, urban forests, shelterbelts and windbreak plantings throughout the insect's range (Figure 2) and have been recorded since 1661. In 1793, the Massachusetts Society for Promoting Agriculture offered "a premium of 100 dollars to the person who shall ... discover an effectual and the cheapest method of destroying the canker worm ...."

Many outbreaks have been relatively localized and/or of short duration. Others, however, have been prolonged and extensive. Beginning in 1987, for example, an outbreak developed in parks and street trees within the city of Charlotte, North Carolina, which has persisted for over 20 years. In 2012, some 73,000 acres, representing 56% of the City, suffered varying degrees of damage. One possible reason for the prolonged outbreak may be the City's large numbers of willow oaks, *Quercus phellos*. These oaks were planted during the 1930s and have become quite large. They line the city's streets and create an almost cathedral-like atmosphere. Given their age and the characteristics of an urban landscape, such as paved streets and compacted soils, they are under a variety of stresses. In addition cankerworm populations have since spread into areas with no willow oaks.

Several outbreaks of fall cankerworm have occurred in Pennsylvania. One occurred in the southeastern part of the state in 1953. A statewide outbreak took place in 1959. Another took place from 1964 to 1967 in north central Pennsylvania and in the same area from 1975 to 1977. In New York, outbreaks tend to occur most frequently in the southern tier of counties that adjoin Pennsylvania. From 1978 to 1980 extensive areas of defoliation by fall cankerworm occurred in higher elevation mixed broadleaf forests in the mountains of western North Carolina and northwestern Georgia.

In 2011 an outbreak developed in eastern and central Virginia including portions of the City of Richmond. By 2012, some 2.5 million acres of broadleaf forests suffered varying degrees of defoliation. Fall cankerworm outbreaks have also occurred frequently along parts of the Blue Ridge and

Figure 3. Defoliation of a Gambel oak woodland by fall cankerworm near Castle Rock, CO.

Appalachian Mountains in the western part of the State. In addition, cankerworms have been a recurring problem in several heavily populated northern Virginia counties and municipalities outside of Washington DC such as Arlington, Alexandria, Fairfax and Manassas.

In the central Rocky Mountains, woodlands of Gambel oak, *Quercus gambeli*, have been subject to periodic episodes of defoliation by fall cankerworm (Figure 3).

During outbreaks, other species of broadleaf defoliating caterpillars may also be present in sufficient numbers to be noticeable. For example, throughout the 2012 fall cankerworm outbreak in eastern Virginia, a complex of other native defoliators also contributed to the defoliation. These included spring cankerworm, *Paleacrita vernata* (Peck), buck moth, *Hemileuca maia* (Drury), and forest tent caterpillar, *Malacosoma disstria* Hübner.

Moderate to heavy defoliation, typically concentrated on ridgetops, is visible from long distances and gives forests a winter-like appearance (Figure 4). In late April, May and early June, large numbers of larvae are present in trees. When disturbed, they spin out of infested trees on silk webbing. When larvae finish feeding and seek places to pupate, they can accumulate on fence posts and sides of buildings in large numbers (Figure 5). Moths, winged males and wingless females, appear in late fall and may persist during the winter months.

Figure 4. . Heavy defoliation of oaks and other broadleaf trees by fall cankerworm in Powhatan County, VA.

Successive defoliation can weaken trees and result in reduced growth, branch dieback and some tree mortality, especially if trees suffer from additional stresses such as drought, overstocked stands or poor site conditions. Defoliation is unsightly and presence of large numbers of larvae and associated droppings (frass) can be a nuisance, especially in picnic areas, campgrounds, parks and urban areas.

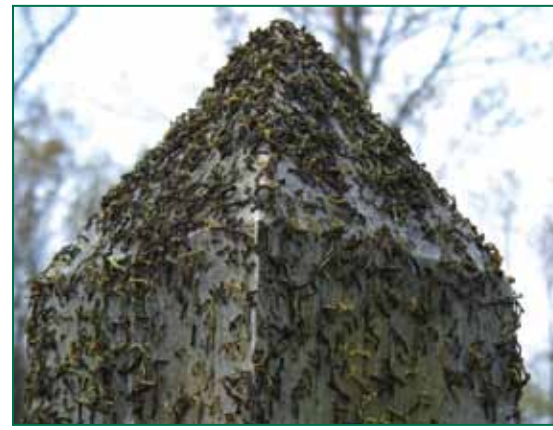

Figure 5. Aggregation of fall cankerworm larvae on a concrete fencepost prior to pupation.

Life Stages

Female adults lack wings and are about 0.5 inch (12 mm) long. They are densely covered with gray-brown scales. Abdominal segments have alternating bands of light and dark scales (Figure 6A). Male moths are winged and have a wingspan of 1-1.4 inches (25-35 mm). Forewings are somewhat glossy and mottled with dark brown and light gray scales. Some individuals have faint light colored bands across the forewings. There is a faint white marking on the leading edge of the forewing near the end of the vein known as the subcosta. Hind wings are gray-brown (Figure 6B). The coloring of the adults allows them to easily blend with the stems of host trees (Figure 6C).

Eggs are deposited in flat, neat rows that encircle twigs or small stems. Individual eggs are barrel-shaped, gray with a light-brown ring around a dark spot on the upper surface and less than 0.04 inches (1 mm) long (Figure 6D). Fall cankerworm larvae are unique among the North American geometrids in that they have three pairs of prolegs (Figure 1). All other species native to North America have two pairs of prolegs. The third pair of prolegs, on the fifth abdominal segment, is reduced in size and non-functional. Larval coloring is highly variable and ranges from light green to dark brown. The head and anal segment vary from pale green to almost black and are sometimes mottled. A median longitudinal dark stripe runs down the back of the darker larvae (Figure 7A). Light green larvae have longitudinal white lines (Figure 7B). Color forms are associated with population density, with darker colored larvae predominating during outbreaks. Mature larvae are about 1 inch (25 mm) long.

Pupae are yellow to yellow-green in color when first formed and later

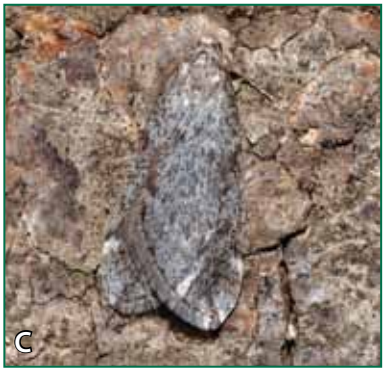

Figure 6. Fall cankerworm life stages: adult female (A), adult male (B), adult male camouflaged against tree bark (C), and egg mass (D).

Figure 7. Fall cankerworm life stages: larva - dark-colored form (A), larva - light-colored form (B), newly formed pupae (C).

become dark red-brown (Figure 7C). Overall length is about 0.5 – 0.6 inches (12-15 mm).

Life History and Habits

Fall cankerworm has one generation per year and passes the winter in the egg stage. Eggs hatch in spring, usually from late March to early May, just as the buds of host trees are bursting. Feeding by early stage larvae causes "shotholes" in the leaves (Figure 8). Later stage larvae feed on all of the leaf tissue except major veins and midribs (Figure 9). Larval feeding lasts for about five to six weeks, during which they pass through five growth stages or instars and then spin to the ground on silken threads to pupate in the soil.

Adults begin to emerge in fall, usually from late October through November and can continue through January with some individuals emerging in spring. Periods of adult emergence often occur immediately following a period of cold weather. In some areas, fall cankerworm adults are among several species of geometrids known as "hunter's moths" because they appear during hunting season.

Wingless females climb trees, mate and deposit about 100 eggs in an egg mass of compact, uniform rows on the trunk, smaller twigs and branches. Reproduction is either sexual or a type

Figure 8. "Shothole" feeding on oak foliage by early stage larvae.

Figure 9. Heavy defoliation by mature fall cankerworm larvae

of parthenogenesis known as gynogenesis. The latter is a process in which the sperm triggers the development of the egg into an embryo but makes no genetic contribution to the embryo.

Related Species

Several other geometrids can damage broadleaf trees either in association with fall cankerworm or on their own. Adults of spring cankerworm, *Paleacrata vernata* (Peck), emerge in spring and deposit eggs in bark crevices of host trees. Larvae tend to be tan in color. Female moths are wingless. Larvae of linden looper, *Erranis tiliara* (Harris), have a yellow body color with a series of dark wavy longitudinal lines on the dorsal surface (Figure 10).

Figure 10. Larval stage of the linden looper, Erranis tiliara*, one of several insects often associated with fall cankerworm outbreaks*

Heads are rusty brown in color. Adults are active in fall and females are also wingless. Larvae of elm spanworm, *Ennomos subsignarius* (Hübner), are variable in color ranging from green to black. Darker color forms are most common during outbreaks. Adults of both sexes are winged, white in color with a faint dark spot on the upper surface of the hind wings. *Phigalea titea* (Cramer), sometimes referred to as "spiny moth," overwinters in the pupal stage beneath the litter. Adults emerge in spring and lay eggs in bark crevices and on dead branches. Larvae are pink with many dark longitudinal lines. Females are wingless.

In 2003 the winter moth, *Operophtera brumata* (Linneaus), a geometrid native to Europe, was confirmed in Massachusetts. Its life cycle is similar to fall cankerworm with adults active in late fall. It is likely that this insect has been in Massachusetts since the 1990's with its defoliation being attributed to fall cankerworm. Bruce spanworm, *O. bruceta* (Hulst), is a closely related species native to Canada and portions of the northeastern and north central U.S.

Natural Controls

Several natural enemies help keep populations of fall cankerworm under control. These include several parasites and predators. One of the more significant natural enemies is a tiny wasp, *Telenomus alsophilae* (Hymenoptera: Scelionidae), which parasitizes the eggs and can bring about the collapse of outbreaks. Ground beetles of the genus *Calasoma* (Coleoptera: Carabidae) feed on the larvae. Late spring frosts can kill newly emerging foliage of host trees at the time early stage larvae are feeding, destroy their food source and bring about the collapse of outbreaks.

Management

Outbreaks in forests and woodlands often do not require treatment because they tend to be short-lived and cause minimal damage to trees. Outbreaks often succumb to natural enemies within a few years, with peak defoliation occurring during the second year.

However, outbreaks in heavily used recreation sites or urban areas may require direct control, especially when outbreaks persist beyond two to three years.

Several chemicals and the biological insecticide, *Bacillus thuringiensis* var. *kurstaki*, are effective direct control agents. Contact local agriculture extension agents or forest entomologists with the USDA Forest Service or state forestry agencies for the most up-to-date information on currently registered and effective insecticides, dosage rates and method of application.

Banding trees with a sticky agent such as Tanglefoot™ prior to adult emergence, to prevent wingless female moths from climbing trees to lay eggs, is an effective technique for protecting trees in city parks and urban areas (Figure 11). The recommended procedure for tree banding is:

1. Install a strip of batting or insulation around the tree at breast height and below all limbs. This prevents females from crawling under the band on rough barked trees.
2. Position a band of tar paper or roofing felt 6-12 inches wide, around the trunk covering the batting. Short staples may be used for this. Do not use nails. Electrical tape might be used for small smooth-barked trees.
3. Apply Tanglefoot™ or sticky material in a band several inches wide onto the tar paper. Wear disposable gloves for easy clean up. Bands must remain sticky and clear of excessive debris, and may need to be refreshed during the time of adult activity.
4. In order to provide effective protection by tree banding, band only trees whose crowns are not in contact with other tree crowns or band all trees in an area that requires protection.

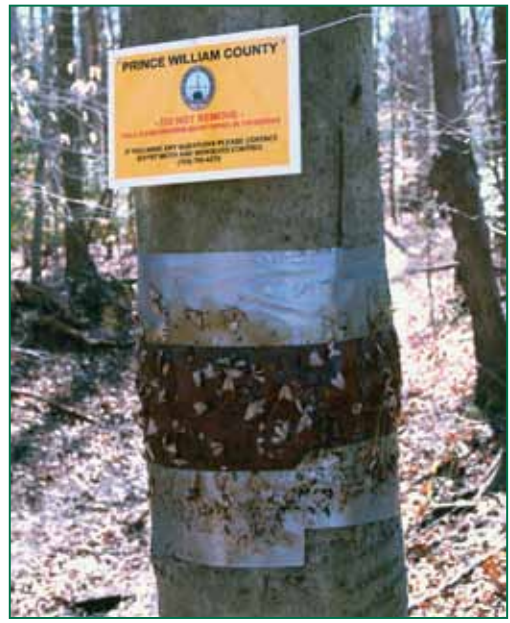

Figure 11. Tree banding prevents female moths from climbing into trees to lay eggs.

For areas where spraying is under consideration, tree banding can be used to monitor population levels to determine if spraying is needed. As a general guideline, moth numbers that average 45 or less per band per season suggest light defoliation levels, while 46-90 moths indicate moderate defoliation. An average of 91 or more moths suggests potentially heavy defoliation and is sometimes used as a trigger to move forward with spray operations. These are only general guidelines, however, and defoliation levels can be influenced by other environmental factors such as weather, host distribution, and abundance of natural enemies.

Additional Information

Forest landowners can obtain more information, such as currently registered and effective insecticides from County Extension Agents, State Forestry Agencies or State Agriculture Departments. Federal resource managers should contact USDA Forest Service, Forest Health Protection (www.fs.fed.us/foresthealth/). This publication and other Forest Insect and Disease Leaflets can be found at www.fs.usda.gov/goto/fhp/fidls.

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Acknowledgements

A draft of this manuscript was reviewed by John Ghent (USDA Forest Service, Southern Region, Asheville, NC), Noel Schneeberger (USDA Forest Service, Northeastern Area, Newton Square, PA) and Marc DiGirolomo (USFS, Northeastern Area, Durham, NH).

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Published by USDA Forest Service, Pacific Northwest Region (R6), Portland, Oregon

FS/R6/RO/FIDL#182-13/002

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