Defoliators > Identifying and Managing the Life Stages of Winter Moth (*Operophtera brumata*)

Figure 1
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Figure 2
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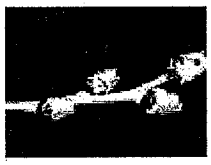
Eggs:(see Fig_13 & 18.jpg): Male and female winter moths emerge over a period of several weeks beginning in late November and continue through December. During this time period, the moths mate and the females lay eggs. Female winter moths lay their eggs primarily on the trunks and branches of their host plants. The tiny oval eggs first appear in late November and continue to appear through December as new female moths appear. Initially, these eggs are tiny and green in color. They will be scattered loosely along the bark, in bark furrows, under lichen, and out on the larger branches. After a short time period, the eggs turn a pinkish-orange color and thus are more visible **(see Fig_1).** Within days prior to hatching in the early spring, winter moth eggs will turn very dark in color.



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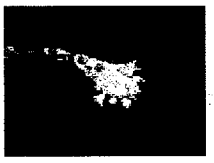

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Treatment for the Eggs: Given that many winter moth eggs are exposed on the bark, the potential to manage them with a horticultural oil spray exists. Typically, dormant oil sprays are applied in the very late winter or very early spring depending on temperatures and host plant phenology. Oil sprays can be applied in the fall but it is of no use for winter moth given that the eggs do not appear until very late fall and into the early winter. When applying oil sprays, it is prudent to have temperatures above 45° F and to avoid applying oil when temperatures may dip below freezing for 24-48 hours after application. Temperatures below this threshold greatly increase the risk of creating injury to the plant (phytotoxicity). Any weather conditions, such as cool and cloudy, can also delay drying time and enhance the potential for injury. Oils work by suffocation and can be affective on the eggs. Oils must cover the target organism at the time of application or no Insecticidal effects will result. Eggs that are protectively hidden within crevices and under lichen will not be covered by the spray nor killed. Given the phenomenal numbers of winter moth eggs in Massachusetts this year, oil sprays will most likely only achieve limited results; eggs are virtually everywhere on trees and shrubs and new caterpillars will quickly migrate from untreated areas to the oil-treated plants. Commercial spray applicators sometimes add a chemical companion, such as a specific organophosphate **or** carbamate,

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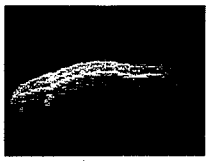

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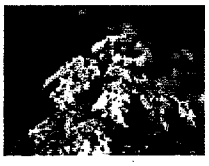

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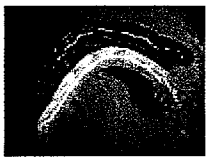

or pyrethroid, in with the oil spray, according to label instructions. However, it is extremely important to know what can and cannot be mixed with oils and then applied to specific plants. This method is best left to the professional licensed applicator and not the homeowner. Mixing compounds that should not be together can cause serious injury to plants, the environment and the applicator. The theory of mixing a specific insecticide with the oil spray is to kill any newly hatching caterpillars that were not affected by the oil alone while still in the egg stage.

Newly Hatched Caterpillars (see Fig_5): Winter moth is a generalist feeder and has the potential for a rather wide host plant range. In general, however, winter moth caterpillars commonly feed upon all maples, oak, apple, crabapple, ash, fringetree and blueberry, This pest has been known to drop from trees and feed on perennials such as roses and others. It has **not** been commonly seen feeding on magnolia and flowering or kousa dogwoods. There is evidence, although not yet well documented, that winter moth caterpillars time their hatching from the egg closely to the time of bud-swell of the specific host plant that the eggs are on. This suspected phenomenon only occurs in larger stands that consist primarily of one type of tree (e.g. oaks or maple). It has not been observed in landscapes with mixed tree species. It is estimated that winter moth eggs hatch between 20-50 Growing Degree Days (base 50) in Massachusetts. Typically, this can occur anytime late March (during atypically warm springs) into the second or third week in April (cool springs). The tiny (less than 1 mm) caterpillars then spin a small silk strand and become air-buoyant and are carried upwards on air currents into the tree canopy where they then try to "weasel" between the bud scales, bracts, etc. to get into the buds. They do not chew their way in via an entrance hole. If buds are not yet swollen enough for them to gain access, these small larvae will then spin down from the tree on a silken thread and be carried away by the wind, which is a dispersal process known as ballooning.

This is the stage where high levels of injury to the host plant can occur. The longer that the buds stay swollen but unopened, there is a greater potential for feeding injury. Winter moths will enter both leaf and flower buds. For blueberry growers, this is the most critical stage of winter moth activity. If flower buds sustain heavy feeding, there will be no flowers and thus no fruit. There are no known controls for winter moth in this life stage.

Free-Feeding Caterpillars (see Fig_6 through 9): Once the buds open, the larvae are known as "free-feeders" given that

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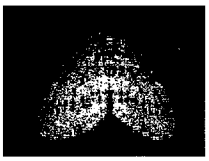

Figure 13
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Figure 14
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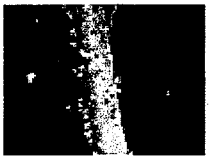

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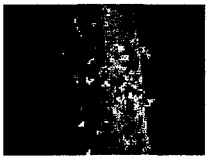

Figure 17
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Figure 18
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they are now on the foliage and free to move readily from one area to another. Winter moth will be in this stage until late May or early June whereupon they drop to the soil and almost immediately spin a cocoon and pupate. While still on the host plant, however, they are exposed and very treatable with a variety of products.

1. *Bacillus thuringiensis* (kurstaki), also commonly known as B.t.k. This product is a bacterium that is specific to lepidopteran larvae (butterfly and moth). It must be ingested to be effective. Once inside the gut, this bacterium becomes activated and multiplies. By going through a somewhat complicated biological process, this product will eventually form toxins that become lethal to the caterpillar. A few notes about its use:

A. B.t.k. works best on the younger instar stages of caterpillars; older ones are much less affected.

B. This product fits well into any IPM program in that it does not pollute the environment, harm the applicator nor does it affect beneficial organisms such as predators and parasitoids, when used as directed.

C. If applied while the buds are still expanding, any new foliage that emerges days after application of this product will not be protected.

D. Caterpillars that ingest B.t.k. will stop feeding almost immediately however they may not die for 1-3 days. It is often disconcerting to still see live caterpillars days after treatment but even though moving, they are not feeding.

E. Although some may be concerned about B.t.k's effect on native lepidopteran species, it usually poses a limited negative

Figure 19
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effect given the relatively small areas being treated (e.g. individual trees and not entire forests).

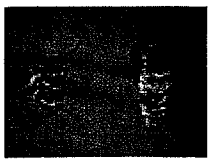

Figure 20
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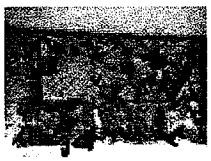
2. Spinosad Products: The first version of this product in the USA was only available to commercial licensed pesticide applicators and was trademarked as Conserve SC™ (Dow AgroScience); other trade named products are now available for specific uses. Since 2004, homeowner spinosad products have become available and two common ones are known as Monterey Garden Insect Spray™ and Bull's-Eye Bioinsecticide™. These products are derived from a bacterium that is subjected to a specific fermentation process to derive the active ingredient(s) for the insecticide commonly known as spinosad. It works on the insect nervous system in a novel manner and can be effective as a contact spray as well as by ingestion.



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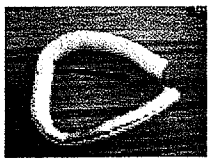

Figure 22
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A. Spinosad products work well on caterpillars of all ages, even caterpillars known as sawfly caterpillars, which are the larval stage of certain wasps in the order, Hymenoptera.

Figure 23
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B. Although fairly safe by not harming parasites and predators, the label does warn that it can be highly toxic to bees at the actual time of application. Once the spray has dried, however, the toxicity to foraging bees is much reduced.

3. Tebufenozide (e.g. Confirm T&O™, Dow Agro Sciences): This product is only available to licensed commercial applicators and not homeowners. Its mode of action (how it kills) is that of an IGR (insect growth regulator). Tebufenozide mimics the hormone ecdysone, which is commonly referred to as "the molting hormone" and ingestion of this product prevents the caterpillar from molting (shedding its exoskeleton and forming another in order to grow) and it dies. It is only effective against

lepidopteran caterpillars and will not work on sawfly caterpillars. Tebufenozide is considered to be a very effective tool for the IPM approach to managing winter moth caterpillar.

4. Chemical Insecticides: Although many of the organophosphate (e.g. Malathion, Acephate) and carbamate (e.g. Carbaryl,) insecticides are now unavailable or limited in use, a few still exist. Mostly, when considering the chemical insecticide option, the more conservative choices now are the pyrethroids. In general, they would be applied at egg hatch, although timing is difficult. They are mostly used against the free-feeding caterpillars once the buds have opened. In general, pyrethroids have a "knock-down " effect by killing the target organism quickly. They then break down into inert ingredients, often within a matter of days. This, however, varies depending on the specific pyrethroid product used and the conditions that it is subjected to after application (e.g. weather, temperature, added stickers, etc.).

4. Physical Barriers: For years, sticky products have been available for wrapping around tree trunks to (ostensibly, at least) prevent such pests as gypsy moth, fall cankerworm and winter moth caterpillars, as well as the wingless adult females, from climbing up trees. Initially, the product consisted of a band that was wrapped or placed around the trunk of a tree and then coated with a Tanglefoot™-type product, which is remarkably sticky. In small infestations and with limited trees to protect, this may or may not be beneficial overall; the research is still not quite complete. Newer products now consist of a fiber-batting band (about one inch thick) that wraps around the tree trunk. A plastic, doublewide band that is only sticky on one side is placed sticky-side inward around the batting, and being double-wide, half of it hangs down below the batting and held out away from the tree **(see Fig_18)** As wingless female moths race up the trunks and encounter the bands, they attempt to climb over the bands and become stuck on the sticky plastic band. The current infestation in Massachusetts is so large (outbreak proportion) that females and attracted males both become stuck to the band and saturate it within hours. Newly arriving females can then walk over the bodies of the stuck ones and gain

access to the rest of the tree. These bands are also marketed to prevent caterpillars from climbing up trees in the spring. However, caterpillars, due to their ability to balloon, can blow from one treetop into another thus by-passing the trunk bands. These bands are not recommended as a management tool when population numbers are high. **(see Fig_19).**

Winter Moth Pupae in the soil: There are virtually no controls for this pest in this life stage other than natural predation but such factors as ground beetles.

Adult Winter Moths: Male winter moths **(see Fig_13)** have wings and are rather drab-colored moths. The hind edge of their wings is fringed with small hairs and the bottom row of dark banding near the tip of the wing appears as a series of hash marks. This becomes important when trying to separate them from male fall cankerworm moths **(see Fig_15)**, which are active at the same time. The male Fall Cankerworm is similar to winter moth males but has a distinctive light colored patch near the distal end of the front wing on the leading edge.

Adult female winter moths **(see Fig_20))** are said to be wingless but they actually have greatly reduced wings (brachypterous) and are smaller than the totally wingless (apterous) adult female Fall Cankerworm moths **(see Fig_20).**

Males and female moths of both species emerge around Thanksgiving time and may continue to emerge well through December whenever milder temperatures prevail during that time period. The moths of both species are attracted to lights. Females of both species will orient on a vertical silhouette, such as a tree trunk, and race up it while emitting a sex pheromone to attract males of her species. Clouds of male winter moths can be seen flying around tree trunks, resting on the bark and mating with females at this time **(see Fig_16 & 17).** Once mated, the female may continue scurrying up the tree and begins to lay eggs. Both males and females die soon after mating and egg deposition. Each female winter moth lays up to 150 eggs. See the first paragraph for more on winter moth eggs. Fall Cankerworm females lay their eggs around the small stems of host plants. These egg clusters look like tiny individual barrels that are tightly packed together. There are no control options for the adult stages of these moths. They do not feed in this life stage.

the University of Massachusetts cannot assume liability for recommendations. It is the responsibility of the applicator to verify the registration status of any pesticide **BEFORE** applying it. **THE LABEL IS THE LAW: ALWAYS READ AND FOLLOW THE LABEL WHEN APPLYING PESTICIDES.** Use of product names does not imply endorsement.

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April 7, 2005

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