K-STATE Kansas State University

Home and Horticultural PESTS

Bagworms

Shade trees and woody ornamentals are subject to attack by numerous species of insects. The larvae of various moths and butterflies constitute some of the most destructive foliar feeding pests. While caterpillars of most species are wormlike and may not appear much different from one another, the species *Thyridopteryx ephemeraeformis*, commonly known as bagworms, is instantly and universally recognized. (Figure 1). As the name implies, bagworm larvae, caterpillars, and worms live in bags.

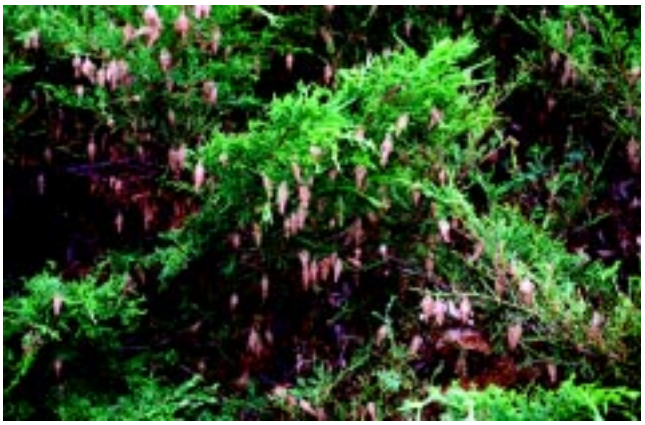

Figure 1.

Seasonal Life History

Bagworms overwinter as eggs deposited in female pupal cases, which are individually housed within spindle-shaped female bags. Generally, from about mid-May through the end of June, larvae hatch from eggs and exit from the posterior opening of old bags. Individual larvae often drop down from the bag on a fine silk. Swinging in the breeze, they come into contact with limbs or foliage and immediately construct miniature silk-lined bags. Only after the bags have been completed do the larvae begin feeding. They decorate their bags with bits and pieces of whatever foliage they are consuming. As larvae grow, bags increase in size to accommodate them. (Figure 2)

Larvae remain in their bags as they feed and move about. Only their heads and thoracic (legged) segments protrude from the bag's anterior opening when they molt. At this time larvae temporarily close off the anterior opening. After molting, larvae reopen their bags and continue to forage. The posterior of the bags is always open, providing an exit through which fecal materials and shed skins can be eliminated.

Figure 2. Bagworm Life Stages

By mid- to late-August feeding is complete. Larvae firmly anchor their bags to the twigs and branches on which they were feeding, sealing the anterior ends of their bags. Within the bags, the larvae turn with heads facing downwards near the posterior opening of their bags and enter the pupal stage.

Pupation is completed in two to three weeks. Just before moths emerge, male pupae work their way through the posterior opening until they partially protrude, after which males emerge. **Male moths** are black with clear wings (Figure 3). After pupation, **female moths** remain in their pupal cases within the female bags. Lacking wings, legs, antennae, mouthparts and functional eyes, female moths are nothing more than soft, white slug-like, egg-filled sacks (Figure 4).

Figure 3. Male Bagworm Moth

Figure 4. Female Bagworm Moth

Male bagworm moths find female bags by using their feathery antennae to home in on the source of a female sex pheromone. Once at the female's bag, male moths extend their abdomens and copulatory organs and thrust them through the posterior opening of the female bag and through a slit in the pupal case that houses the female moth. After copulation, females deposit their eggs (up to 1,000 eggs per female) into their pupal cases. After all eggs have been deposited, female moths use their body hairs to plug the entrance into the pupal case, helping to isolate and protect the eggs from parasites and cold winter temperatures and moisture. Greatly diminished in size, spent females attempt to exit their bags. Those that are successful drop to the ground where they die. Those that are unsuccessful in exiting their bags die, and their bodies form an additional plug to protect the eggs. This completed, the seasonal life cycle is repeated with the overwintering eggs.

Hosts

While widely recognized as a notable pest of eastern red cedar and junipers, bagworms will attack arborvitae, spruce and pine. An array of broadleaf trees, shrubs and ornamentals serve as hosts to bagworms: willow, maple, oak, box elder, sycamore, poplar, locust, rose, barberry, pyracanthia, clematis, sumac elm, cherry, quince pear, peach and blackberry. In the absence of these hosts, bagworms reportedly feed freely on clover, ragweed, parsley and nightshade.

Bagworms are not restricted to the host species on which they began feeding. After defoliating a host plant, larvae are capable of migrating in search of the next available host, which may be the same species or a completely different one. In one instance, larvae moved out of defoliated junipers and up the trunks of neighboring flowering crabapples, which they proceeded to defoliate.

Damage

The damage caused by bagworm feeding is much the same as for any lepidopteran species. Small larvae are not especially destructive because they are only capable of taking small bites and do not require great amounts of plant material to sustain themselves. But as larvae enter later developmental stages, they require more food. In a short time — seemingly overnight — heavy populations of large larvae may completely defoliate their tree hosts.

While broadleaf/deciduous trees have greater abilities to absorb foliar feeding damage (auxiliary buds can replenish foliage within three to four weeks depending on the time of the season), coniferous species are more easily damaged due to their slower growth patterns. Several successive years of heavy foliar feeding by uncontrolled bagworm populations may kill large established conifers such as those making up the bulk of plantings in windbreaks.

Control

Naturally occurring factors (i.e. climatic and biotic) are known to suppress populations of certain insect species. Similarly, under optimal moisture and temperature conditions, coupled with a disruption (lessening or elimination) of the numbers of predators and parasites, a species population may rapidly build, especially if that species possesses a high reproductive capability. Thus, bagworm population outbreaks occur from time to time and may persist for several consecutive years until populations are naturally reduced to nondamaging levels.

When intervention becomes necessary, there are cultural and chemical controls.

Cultural: People who are opposed to using insecticidal sprays to control bagworms may try to eliminate bagworm infestations by handpicking individual bags. The best time to remove bags is during the winter when bags stand out in stark contrast to the darker foliage of evergreens, or against a lighter background if leaves have dropped off of deciduous plants or trees. Handpicking should be completed by late April or early May before larvae hatch from their eggs to begin their current season feeding cycles.

While male bags with evident extruded pupal cases need not be removed, **all other bags** should be picked and destroyed or disposed of. Remember that many bags may be hidden deeper within tree foliage and require a thorough search and removal procedure. Again, a single missed female bag could result in a thousand new bagworm larvae.

Handpicking becomes impractical when an individual planting is literally covered with bags or is too tall to make handpicking possible. Also, if there are many infested plantings, handpicking is not an option. Short of the removal and disposal of an entire tree or bush, there are few cultural practices to control bagworms.

Insecticidal Sprays: Once bagworm outbreaks have reached epidemic levels, the application of an insecticide is required to eliminate bagworm larvae. There are several points to consider when implementing bagworm control.

Insecticidal control is most effective when larvae are in their early developmental stages—smaller larvae are more susceptible to insecticides. It is imperative that bagworm-infested trees be **monitored** for the presence of newly emerged larvae. Initiation of bagworm activities varies from year to year, depending on springtime temperatures. **Typically, bagworm larvae will begin emerging from the overwintering bag by mid- to late May.**

Given their small size (1 millimeter), newly emerged bagworm larvae are practically undetectable. However, a week after they emerge from the bag in which they overwintered, their newly constructed bags will be 3 to 4 millimeters long (Figure 2, top row, right). Bags will be brownish and will stand out in contrast to the surrounding foliage. It requires some concentration to discern small bags, but once detected, they

become readily apparent. The bags will be in continual motion as the small worms feed and move about.

Initiation of spray treatments depends upon the condition of the infested tree(s). If the previous year's damage was slight, a single spray treatment should be applied at the end of June or the first week in July. The delay between the appearance of new larvae and the spray application will ensure that all of the larvae will have emerged from the parent bag. At this point, bagworms will not have caused much additional feeding damage because of their small size, and slightly damaged plants can withstand this.

If the previous year's feeding damage was severe, any additional feeding damage even by small larvae could cause further setback to trees. In these instances, immediate treatment is recommended to preserve new and important growth essential to restoring tree vitality. It is imperative to apply a treatment when feeding begins, and a follow-up treatment two to three weeks later to kill worms that emerge later that were not killed by the initial treatment.

Thorough spray coverage is essential to reduce bagworm populations. Merely waving a sprayer nozzle and misting infested trees only kills bagworms feeding on tree peripheries. Insecticides must be applied with sufficient sprayer pressure, and in adequate amounts of water carrier to ensure penetration of dense foliage.

Treatment of windbreaks presents a challenge. Windbreaks generally consist of several long rows of eastern red cedars. It is difficult to deliver insecticides to upper portions of mature trees and inner portions of the windbreak. It is, therefore, recommended that a high-pressure ground sprayer capable of delivering high volumes of an insecticide mixture be used to achieve total coverage. While this will be laborious and time consuming, it will be effective.

Although aerial applications have appeal in terms of ease of insecticide applications to large tree areas, achievable gallon per acre delivery rates will likely be insufficient to penetrate and provide thorough coverage against massive bagworm infestations.

While there are various insecticidal products registered for use against bagworms, it is impractical to list specific product trade names. Many products contain the same active ingredients. Retail outlets vary in the number of product lines they choose to market. The following active ingredients, which are always listed on product labels, will enable people to select products for bagworm control.

Several "natural" products may be favored by people who choose to not use synthetic insecticides. Two natural active ingredients are microbials, which are by-products of biological entities. *Bacillus thuringiensis*, commonly referred to as Bt, is actually a crystalline protein which, when ingested by Lepidopteran caterpillars, causes a physical breakdown of the gut wall. An actinomycete by-product called spinosad, which is a combination of Spinosyn A and Spinosyn D, causes nerve paralysis and death. A third "natural" ingredient is derived from the oil of seeds of the neem tree. Azadirachtin, or neem oil, works as an antifeedant, repellent or insect growth regulator, depending on the components of the azadirachtin active ingredient in the product.

Synthetic active ingredients include some older organophosphates (acephate, diazinon, dimethoate, malathion and trichlorfon) and carbamates (carbaryl and bendiocarb). More recent pyrethroid active ingredients include bifenthrin, cyfluthrin and permethrin.

THE END USER IS RESPONSIBLE FOR READING THE PRODUCT LABEL TO ENSURE ITS SAFE AND LEGAL USE ON THE INTENDED PEST AT THE PROPER SITE AND ON THE INTENDED HOST.

If evergreens have not been damaged beyond the point of no return, expect recovery to occur. The rate of recovery will depend on the severity of damage. Once bagworm populations have been eliminated or reduced to nondamaging levels, fairly good recovery will occur within as little as three to four months (Figure 5 versus Figure 6 on page 4); to as long as two years (Figure 7 versus Figure 8, page 4).

Bagworm Damage and Recovery

Figure 5. Bagworm damage, June 1995.

Figure 6. Four months later, October 1995

Figure 7. Bagworm damage, August 1996.

Figure 8. Two years later, August 1998.

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