BLACK-HEADED FIREWORM

(*Rhopobota naevana* Hübner)
Lepidoptera: Tortricidae

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On cranberry in North America, there are several different species in the family of leafroller moths (Tortricidae) that are called 'fireworms,' three of which are economically important. Spotted fireworm, *Choristoneura parallela* (Robinson), occurs as a severe problem in New Jersey. Yellowheaded fireworm, *Acleris minuta* Robinson, appears sporadically in Massachusetts. Blackheaded fireworm, *Rhopobota naevana* (Hübner) is a key problem throughout North America. The larvae of these three 'fireworms' damage the vines by skeletonizing the leaves, often so severely that areas of the cranberry bed turn brown and appear burned. The larvae wriggle vigorously when disturbed and use silk to construct protected feeding sites by webbing together cranberry uprights.

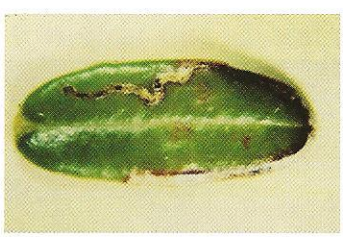
Blackheaded fireworm (BHFW) is a major pest throughout North American cranberry growing regions. Historically, this species was chief among the damaging insects in Massachusetts. In the second half of the 20th century, BHFW lost its key pest status in Massachusetts and was found only in high numbers in wild and unmanaged beds. It occurred very sporadically on commercial beds. Lately however, we have seen a remarkable resurgence of BHFW in Massachusetts, and it has again become a serious problem for many growers.

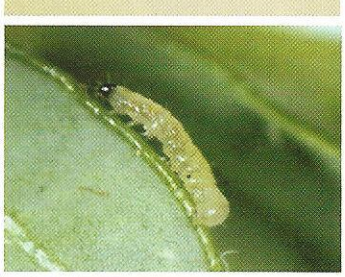
Seasonal history

The egg stage overwinters. Spring egg hatch normally begins close to the time that the cranberry plant breaks dormancy, about the middle of May, but it may be earlier depending on bog conditions. The hatching period of the overwintered eggs in the spring may last for up to 6 weeks on heavily vined bogs or in cool weather.

In the spring, newly hatched larvae burrow into a cranberry leaf or mine into the unopened terminal buds as they swell. They strongly prefer the growing, new leaves over last year's growth. Larval development within old leaves is very slow when compared to new leaves. On new growth, the larva silks together two or more leaves in the tip area of the upright and feeds within. As the season progresses, older caterpillars web a few uprights together, creating a tent. According to Maurice et al. (2000), one larva may construct up to 5-6 tents during the course of its development. Development from egg hatch to the end of the pupal period may be completed in 4-5 weeks for this first generation.

The first generation of moths emerges, mates, and lays eggs in June and July. In British Columbia and Wisconsin, eggs laid by the first generation females began hatching within 2-7 days and the majority of eggs hatched





Clockwise from left: Damage from tiny larva acting as a leafminer, tiny larva, small larva, and the adult moth.

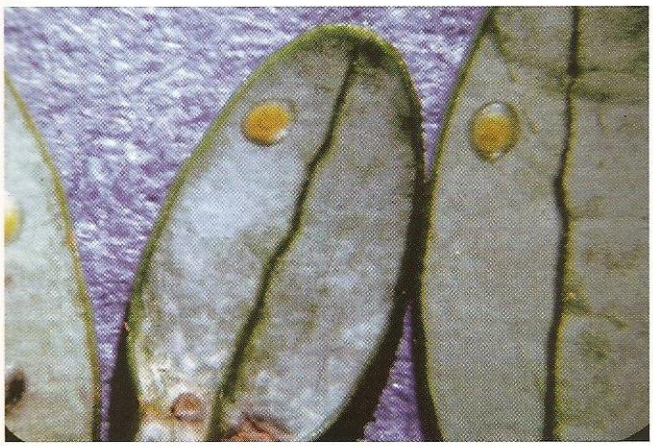
by 6-15 days after they were laid (Cockfield et al. 1994). However, a portion (5-10%) enter diapause and hatch is delayed until the following spring (Fitzpatrick and Troubridge 1993). Development from egg hatch to the end of the pupal period may be completed in around 3-4 weeks for the second generation (Averill and Sylvia 1998). In controlled studies at constant 20° C, Fitzpatrick and Troubridge (1993) found that the durations of first generation pupal and adult stages were ca. 10 and 7 days, respectively; the durations of second generation pupal and adult stages were longer, ca. 13 and 10 days, respectively.

Females of both first and second generations lay about 70-80 eggs (Fitzpatrick and Troubridge 1993). First-generation moths lay eggs toward the tip of the upright while second-generation females tend to lay eggs lower in the vine canopy, but still utilizing the current season's growth. Females are able to begin laying eggs within a day after emergence. Fitzpatrick and Troubridge (1993) determined that for Pacific coast populations, first generation females laid 75-80% of eggs on the day after mating. Second generation females laid approximately 50% of their eggs on the day following mating and then gradually laid the remainder in the 3-4 following days.

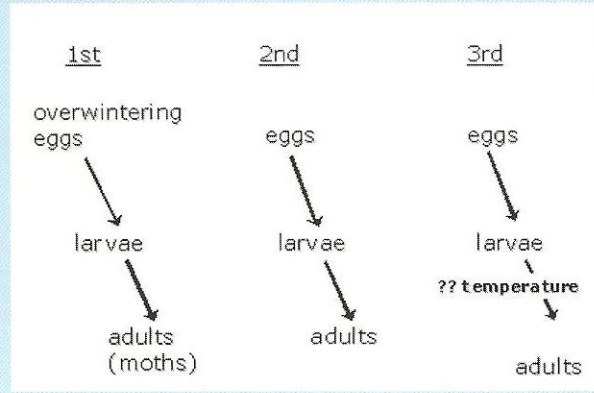
Insect description

Egg: Eggs are laid singly on the back of leaves. They are flat, yellow disks (0.8 mm, 1/32") and become very dark just prior to hatching. The larva's black head can be seen inside the egg in the day or two before it hatches. Several eggs may be found on one leaf.

Eggs are laid singly on the underside of leaves.



SEASONAL HISTORY



Blackheaded fireworm completes two generations annually. In some rare years, there may be a partial or complete third generation, depending on the earliness of spring, warmth of the season, and extended favorable conditions into the fall. Larvae hatch from overwintering eggs in spring and the resulting moths fly in June and July. The larvae of second generation hatch during bloom and the resulting moths fly in late July and August.

Larva: The larva has a distinct shiny black head and the body is a greenish, greenish-yellowish, or grayish color. Mature larvae are only 7-9 mm (1/3-1/2") long and complete larval development in 2.5 - 5 weeks.

Other than newly-hatched *Sparganothis* fruitworm larvae (which lose the black head at the first molt), no other pest larva has a jet-black head capsule; thus, the black head can serve as a diagnostic trait to differentiate BHFW from the many other types of larvae on the Massachusetts bog.

A full size ready-to-pupate larva is still considerably smaller than a cranberry leaf.

Pupa: Pupae are light brown or yellowish brown and are 6-7 mm (1/4") long and are found silked in the tent of uprights or within the trash layer below the vines.

Adult: The moth is small, ca. 9-10 mm (3/8") across the expanded wings. The forewings are marked with gray-brown and silver-gray bands. They fly in the daytime through dusk. According to Maurice et al. (2000), most mating occurs in late afternoon and evening.

Scouting

Scouting is difficult, particularly for small larvae. However, it is absolutely critical to management since these young larvae are most susceptible to chemical treatments.

Sweep net sampling has been recommended for many years by the Massachusetts IPM program. Treatment is now advised if an average of 2 caterpillars is found in 25 sweeps of a sweep net. Based on observations in Wisconsin, when larvae are small, this sampling approach can be risky because of the very poor relationship between the actual infestation level of young caterpillars on a bed and the number picked up in a sweep net. Further, the infestation most often is patchy: "hot spots" of fireworm are common, particularly along edges. Sometimes hot spots occur where vines are overgrown, where leaf trash has accumulated, or where winter flooding was truncated. As a result, spot treatment is desirable here.

Visual sampling: Because there is a poor relationship between the number of small larvae picked up while sweeping and the actual infestation, in British Columbia and Wisconsin, where BHFW has caused serious damage for years, visual sampling is recommended. This is a more effective means to detect an infestation of small larvae. Monitoring in Massachusetts should begin as soon as larvae begin to hatch, which in the earliest years will be the first week of May, and typically is near mid-May. The earliest activity should be sought out in the warmer bog edges and known "hot spots" by inspecting buds and leaves for mining, webbing, and brown pellets of excrement (frass). According to Maurice et al. (2000), 1-2 weeks after the earliest larvae are first seen, more extensive monitoring can be done by 'visual sweeps.' This involves crouching down to closely examine areas of about 2 ft^2. Repetition of ten 'visual sweeps' is recommended per acre.

Pupae often form a silk case within leaves; this one has been opened to show pupa for the photo.

When the caterpillars are half-grown or larger, they are more readily picked up in a sweep net and the numbers reflect the actual infestation level—but at this point, larval size may be beyond the point where the most effective management can be realized.

Pheromone traps can be used to monitor the June/July flight of male moths. A substrate, such as a rubber septum, is treated with synthetic female sex pheromone and placed inside a trap. Attracted males are caught on sticky surfaces inside the trap. Different sticky traps (see photos below) may be used. The same type should be used throught the entire moth flight. Under conditions of heavy infestation, the larger trap type (wing trap) should be used since the surface area of the smaller trap (Pherocon II) may become saturated with moth bodies, throwing off accurate counts.

Pheromone traps can be used to monitor moth flight; use either the 1C wing trap (left) or the Pherocon II trap (right).

Based on work in Wisconsin, some rules of thumb were found for estimating egglaying following the point in time when the the first few moths were caught in a pheromone trap (= 'biofix'). They found that oviposition began 7-12 days after biofix, peak flight of males occurred 14-22 days after biofix, and that flight was completed 35-42 days after biofix (Cockfield et al, 1994a). Counts of moths may allow accurate timing of treatments for 2nd generation, and among-year catches can give an indication of population levels. The traps should be put out ca. June 1 and cleaned and checked regularly. In the past, it was advised to check the traps weekly; however, if one aims to pinpoint biofix, the traps should be checked every 1-2 days until the biofix is established. Pheromone traps are key in timing both chemical sprays and mating disruption (see page 5).

Uprights and fruit webbed by larvae through the season.

Injury: The foliage turns brown over time as a result of larval feeding. Infestations may occur at the same bog site in successive years. The second generation of females lays egg from June through bloom. This timing makes management of the larvae difficult, since some pollinators are usually present. Fruit damage is usually limited to surface feeding and thus, is different from cranberry fruitworm (*Acrobasis vaccinii*) where the larvae feed entirely within the fruit. This generation may reduce the crop for the next year because the feeding on the tips of the upright results in a failure to form normal fruit buds.

Monitoring: Timing and Methods

STAGE	TIMING	LOCATION	HOW TO SAMPLE
Eggs, overwintering	September - May	Underside of leaf	In early spring, at each of 5 locations on each bed, collect 20 uprights and examine leaf underside for eggs
Eggs, summer	July	Underside of leaf	
Larvae, spring	May	Small larvae may burrow within leaf or developing buds; larger larvae are sandwiched between leaves or within tent of uprights	Small larvae: Use visual sampling where you search for larvae in a 2 ft^2 area. Complete 10 squares/A.
Larvae, summer	end June - August	Small larvae silk together leaves; larger larvae silk together uprights and score fruit	Mid-size to large larvae: Complete 1 sweep set (drag the net across the vines, in 180ϒ arc, 25 times) per acre.
Adults, 1st flight	June-July	Flying among vines, particularly at dusk	Pheromone traps
Adults, 2nd flight	August - September		
Pupae, spring	June	Inside silk case between leaves or in trash layer of bog	
Pupae, summer	August		

Management

Ecological management:

Sanding: Regular and uniform sanding regimes and complete trash flows discourage outbreaks. It is particularly hard to manage populations in heavy, rank vines. Here, hatch may be very asynchronous, resulting in an extended period of moth flight and egglaying. Further, in rank vines, one is even less likely to pick up larvae during sweeping. Care should be taken when replanting and one is importing vine from possibly infested beds.

Flooding: A short spring re-flood is possible and must be carried out by monitoring egg hatch. If egg hatch has not occurred, the flood treatment is negated. Following egg hatch, floods will reduce the number of larvae, but likely not eliminate all larvae.

In Massachusetts, the traditional BHFW flood was advised for 24-48 hours in mid-May when harm to the cranberry vine (plants have not substantially broken dormancy) is minimized. The success of such an approach was evaluated by Cockfield and Mahr (1992), who reported field trials in Wisconsin. At three sites, 24-50 hour floods while the vines were still dormant in the second week of May, showed significant reductions in BHFW larvae.

Flooding was also studied in the lab by Cockfield and Mahr (1992). They found that larval mortality was very high after 2 days under low dissolved oxygen levels. However, under conditions of high dissolved oxygen, the larvae could survive for days; their silken shelters likely trapped air when the vines were submerged.

It is clear that several factors must be considered for an effective flood: known egg hatch, plant development, water temperature, and water dissolved oxygen (Cockfield and Mahr 1992).

Biological control:

In a review, Mahr (1999) noted that in several studies of BHFW, a very low level of larval parasitism was found. On the other hand, he asserted that very tiny wasps, *Trichogramma* sp., that parasitize blackheaded fireworm eggs may play an important role. Henderson et al. (2002) found high levels of *Trichogramma* parasitism in British Columbia. Two species of *Trichogramma*, both native to British Columbia, were reared from blackheaded fireworm eggs. Mass production has been successful and protocols for release have been addressed (Henderson et al. 2002). One species is commercially available for management of the summer generation. Check with the Cranberry Station for contact information and availability.

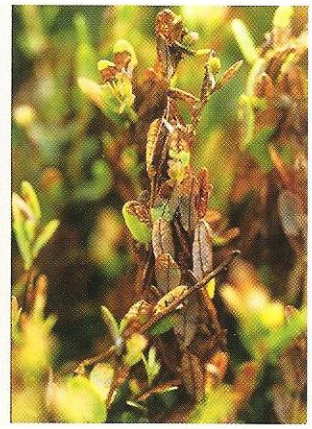
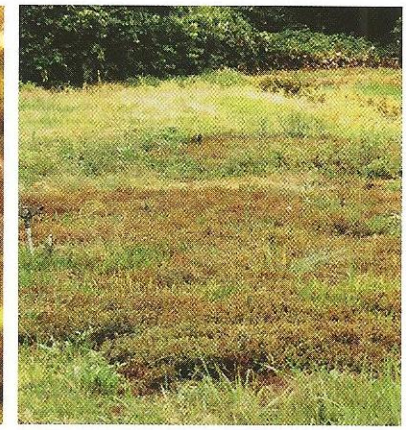
Mating disruption:

The use of synthetic sex attractants (synthetic sex pheromone) to disrupt mating has been investigated in British Columbia and Wisconsin. This activity blocks the ability of males to find females for mating, and, as a result, there is a reduction in the number of fertile eggs laid. Different delivery systems for the sex pheromone have been evaluated, but commercial availability of the different systems is in flux. Check with the Cranberry Station for the most current contact information and availability.

Chemical control:

For best results with the insect growth regulators (Confirm, Intrepid), keep in mind that, based on trap catch data, applications of these newer chemicals follow a different schedule in comparison to conventional insecticides (e.g., Diazinon). It is recommended that Confirm or Intrepid be applied around the third week after the ***onset*** of moth flight while Diazinon be applied 10 days after ***peak*** flight. Consult the current Cranberry Chart Book for more extensive information on chemical management.

Adult moth (on left) and many adult moths caught within a Pherocon II pheromone trap.

In spring sweeps, take care to inspect contents of net as the larvae can be very difficult to see owing to body damage, small size and drab look: Typical dingy appearance of fireworm larvae (left) and their damage close-up (middle) and from a distance (right).

Literature

Averill, A.L. and M.M. Sylvia. 1998. Cranberry Insects of the Northeast. UMass Extension Publication.

Cockfield, S.D. and D.L. Mahr. 1992. Flooding cranberry beds to control blackheaded fireworm (Lepidoptera: Tortricidae). J. Econ. Entomol. 85: 2383-2388.

Cockfield, S.D., S.M. Fitzpatrick, K.V. Giles, and D.L. Mahr. 1994a. Hatch of blackheaded fireworm (Lepidoptera: Tortricidae) eggs and prediction with temperature-driven models. Environ. Entomol. 23: 101-107.

Cockfield, S.D., S.M. Fitzpatrick, K. Patten, D. Henderson, T. Dittl, A. Poole, C. Shanks, and D.L. Mahr. 1994b. Modeling of blackheaded fireworm (Lepidoptera: Tortricidae) oviposition and pheromone-trap catches. J. Econ. Entomol. 87: 787-792.

Fitzpatrick, S.M. and J.T. Troubridge. 1993. Fecundity, number of diapause eggs, and egg size of successive generations of the blackheaded fireworm (Lepidoptera: Tortricidae) on cranberries. Environ. Entomol. 22: 818-823.

Henderson, D.E., S.Y. Li and R. Prasad. 2002. *Rhopobota naevana* (Hubner) Blackheaded Fireworm (Lepidoptera: Tortricidae) pp. 242-246 *in* Biological Control Programmes in Canada, 1981-2000. CABI Publishing, NY, NY

Mahr, D.L. 1999. Biological control in a high-value native crop: Status, opportunities, and constraints in cranberry. pp. 64-90 *In*: Biological control of native or indigenous pests: challenges, constraints, and potential. Ent. Soc. Amer.

Maurice, C., C. Bedard, S.M. Fitzpatrick, J. Troubridge, and D. Henderson. 2000. Integrated Pest Management for Cranberries in Western Canada- A Guide for Identification, Monitoring and Control for Key Pests and Diseases in Cultivated Cranberry Fields in Western Canada. Technical Report 163 Pacific Agri-Food Research Centre-Agassiz.

Shanks, C.H., L.J. Dapsis and L.M. McDonough. 1990. Monitoring blackheaded fireworm (Lepidoptera: Tortricidae) populations in cranberry bogs with sex pheromone traps. *In:*Monitoring and Integrated Management of Arthropod Pests of Small Fruit Crops. N.J. Bostanian, L.T. Wilson, and T.J. Dennehy, Eds. pp. 131-139.

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UMASS EXTENSION

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