Insects

Insect Guides

For photographs and additional information on cranberry pests, consult the following publication:

Integrated Pest Management for Cranberries in Western Canada 2nd Edition 2015 by Sheila Fitzpatrick, Warren Wong, Miranda Elsby and Heidi Dokkumburg

Insecticides

Before applying any insecticides, check with your handler regarding recommendations for use and follow the pesticide label.

Actara, Entrust, Malathion, Orthene, Imidan and Sevin are very toxic to pollinating bees. Do not apply these insecticides during the blossom period. If it is absolutely necessary to apply one of these chemicals, contact the beekeepers in the area. Applications of insecticides in the evening are less hazardous to bees.

The Cranberry Institute publishes a Canadian Cranberry Pesticide Chart each year that is a useful reference tool.

Chemigation

When pesticides are applied through the irrigation system, there is a real danger of contaminating the water supply in the event of a sudden drop in mainline pressure. To avoid the possibility of contamination of the supply, a reduced pressure backflow preventer must be installed in the supply line well ahead of the point at which pesticides are injected into the system. These devices are available from the major valve companies. Ordinary check valves are NOT satisfactory. If a pesticide is approved for chemigation read the label for equipment requirements and precautions.

For more information refer to the publication Chemigation Guidelines for BC available from BCAGRI.

Blackheaded Fireworm

Life History and Damage

Blackheaded fireworm, Rhopobota naevana (Hlon.), overwinters as flat, yellowish eggs on the underside of cranberry leaves. The larvae are greenish or pale yellow with shiny black heads and are about 8 mm long when fully grown. Larvae of the first generation begin hatching in late April. At first they burrow into undersides of old leaves and mine between leaf surfaces. Within several days of hatching, they move up to the growing tips of uprights and runners, to feed on the new tissue. After feeding for 3 to 5 weeks, larvae go through a pupal stage in the trash layer, emerging as small brown moths in late May through June. The moths make short, jerky flights above the vines and lay eggs on leaf undersides. Some eggs will overwinter, but the majority hatch into a second generation of larvae in early July. Larvae of this generation feed at plant tips, often webbing uprights together. Damaged plant tissue dries out and appears scorched, hence the name “fireworm.” Second-generation moths are present from late July through September. They also lay eggs, most

of which overwinter and some of which give rise to a small number of third-generation larvae. Second and third generation larvae may enter and feed on berries.

Monitoring

Monitoring is best done under the supervision of a trained integrated pest management (IPM) person.
Blackheaded fireworms are present on most farms. Larvae tend to occur in the same places from year to year. Numbers of larvae are often greatest around the edges of cranberry beds. In early spring, begin monitoring by looking at upright and runner tips at warm edges of the bed (such as north edges that receive reflected heat from south-facing dykes) and in areas of previous infestations. Every 10-15 m, examine a small area (0.3 by 0.6 m) of uprights and runners. Count the number of fireworm "tents" (feeding shelters) in these areas, then open the tents to determine if larvae are "tiny" (1-2 mm), "small" (2-3 mm), "medium" (3-5 mm) or "large" (5-8 mm). Monitor young plantings closely, as fireworms are prolific on young, heavily fertilized vines. On a map of the bed, note the sample sites and record the numbers and sizes of larvae at each site. If the insecticides Diazinon, Malathion, Sevin, Orthene or Imidan are to be used, they should be applied when the average number of fireworm larvae per sample is one, and most larvae are medium-sized. Confirm, Delegate, Entrust or Intrepid should be applied earlier to target eggs and tiny larvae. See Chemical Control below.

In mid-May, place wing traps baited with fireworm lures in the beds at the rate of one trap per 1-2.5 ha. Traps should be positioned 10-20 m in from the edge and about 15 cm above the vines. Once a week, count and record the number of moths caught, then scrape them off the trap bottom or replace it. Trap counts will rise to a peak, then diminish. Begin monitoring for second-generation larvae 10-14 days after peak trap count has occurred. If monitoring reveals an average of more than one larva per sample, insecticide treatment is warranted, but do not spray when pollinators are on the beds. Check traps weekly throughout the season and replace lures with new ones every 6 weeks. Expect a second peak trap count in early to mid-August, and check for third-generation larvae 10-14 days after the second peak. There are rarely enough third-generation larvae to warrant an insecticide.

Management

Biological control

Trichogramma sibericum, is a tiny parasitic wasp native to BC found naturally attacking fireworm eggs in beds not treated with insecticides. It is most effective (80% or more) where fireworm density is high, such as in hot spots and along edges. Where fireworm density is low, T. sibericum has more difficulty finding eggs. Trichogramma sibericum is not currently available commercially . Other Trichogramma species are available commercially but do not parasitize fireworm eggs to the extent that T. sibericum does.

Chemical control

If threshold numbers (1 larva per sample) of blackheaded fireworm larvae are detected, use one of the following sprays:

Group 1A

Sevin XLR Plus (466 g/L carbaryl) at 6.4 to 7.6 L/ha in 3000 L/ha of water (2.6 to 3.1 L/acre in 1200 L/acre of water). Do not apply within 2 days of harvest; or

Sevin 50W (50% cabaryl) at 6.25 to 6.75 kg/500 L. Use 3,400 L/ha (1,360 L/acre) of water. Do not apply within 1 day of harvest; or

Group 1B

Imidan 50 WP (50% phosmet) at 2.2 kg/ha (0.9 kg/acre) or Imidan 70 WP (70% phosmet) at 1.57 kg/ha (0.63 kg/acre) by ground application or chemigation. Apply after egg hatch. A second application can be made 5 to 7 days later if necessary. Do not apply more than 4 times per year. Do not enter treated fields for 3 days after application. Do not apply within 30 days of harvest; or

Orthene 75 SP (75% acephate) at 562 g/ha in 225 to 1650 L of water (300 g/acre in 90 to 670 L water) by ground application. A total of 2 applications are permitted, one pre-bloom and one post-bloom. Do not apply from start of bloom until all berries are set. Do not apply within 75 days of harvest; or

Malathion 500 E (500 g/L malathion) at 1.25 to 2.25 L/1000 L water or Malathion 85EC (85% malathion) at 610 to 1100 mL/ 1000 L water. Spray for thorough coverage. Repeat as necessary. Note: Apply to new growth only. May cause injury to blossoms and stunting of berries if applied near end of bloom. Apply when temperatures are above 20°C. Do not apply within 3 days of harvest; or

Group 5

Delegate WG (25% spinetoram) at 420 g/ha (168 g/acre) in at least 500 L of water/ha (200 L water/acre) at egg hatch or to small larvae. Application may be done by chemigation – follow recommendations on the product label. Repeat application if necessary. Do not apply more than 3 times per year. Allow a re-treatment interval of at least 7 days. Do not apply within 21 days of harvest; or

Success 480SC (480 g/L spinosad) at 182 mL/ha (73 mL/acre). If cranberry fruitworm is present at the same time as blackheaded fireworm or Sparganothis fruitworm, a higher rate of 365 mL/ha (146 mL/acre) may be used. Apply a maximum of 3 times per year. Do not apply within 21 days of harvest; or

Entrust 80W (80% spinosad) at 109 g/ha (44 g/acre) or **Entrust SC** (240 g/L spinosad) at 364 mL/ha (146 mL/acre). If cranberry fruitworm is present at the same time as blackheaded fireworm or Sparganothis fruitworm, the higher rate of 218 g/ha (87 g/acre) of **Entrust 80W** or 727 mL/ha (290 mL/acre) of **Entrust SC** may be used. Apply 1 to 3 times per year at 7 to 10 day intervals. Entrust is OMRI approved for organic production. Do not apply within 21 days of harvest; or

Group 15

Rimon 10EC (10% novaluron) at 677-835 mL/ha (270-334 mL/acre) . If chemigating, use a spray volume of 1500-3000 L/ha. Apply at egg hatch to early instar stage of larvae.

Group 18

Confirm 240F (240 g/L tebufenozide) at 1.2 L/ha (480 mL/acre) in 190 L/ha (76 L/acre) of water. Apply when first generation larval activity begins and make a second application 10 days later. For second generation control, apply at about 10 % egg hatch followed by a repeat application 10 days later. Do not apply more than 4 times per year. Do not apply within 30 days of harvest; or

Intrepid 240F (240 g/L methoxyfenozide) at 0.75 to 1.16 L/ha (300 to 464 mL/acre) in a minimum of 200 L of water/ha (80 L water/acre). Use 3200 to 3500 L of water/ha when applying by chemigation, Do not apply more than 2 times per year. Do not apply within 14 days of harvest; or

Group 28

Altacor (35% chlorantraniliprole) by ground application at 145 to 285 g/ha (58 to 114 g/acre) in a minimum of 200 L of water/ha (80 L water/acre). Use the high rate when pest pressure is heavy. For ground application, do not apply more than 3 times per season. For chemigation, apply at 285 g/ha in a minimum of 3000 L of water/ha (1200 L water/acre). For chemigation,do not apply more than 2 times per season. Do not apply more than once every 7 days. Do not apply within 1 day of harvest; or

Exirel (cyantraniliprole 100 g/L) at 750 to 1500 mL/ha (300 to 600 mL/acre) in a minimum finished spray volume of 200 L/ha by ground or up to 3000 L/ha by overhead chemigation. Use the high rate under heavy insect pressure. Do not apply more than once every 7 days. Maximum of 4 applications per season. Do not apply within 14 days of harvest.

Warning: Do not apply Imidan, Malathion, Orthene, Sevin XLR,Delegate or Entrust during blossom or within 7 days of the introduction of bees for pollination.

Cranberry Fruitworm

Life History and Damage

Cranberry fruitworm, Acrobasis vaccinii (Riley), has been found in Washington and is present on some farms in B.C. It is a potentially serious pest, because it feeds only on the berries. Generally the larvae are found in green fruit well ahead of harvest. However, in cool, late seasons, larvae may still be found in the berries at harvest time. Cranberry fruitworm is of biggest concern for fresh market fruit.

The fruitworm spends the winter in the larval stage wrapped in old leaves, soil, sand and other material in the trash layer. Pupation occurs in spring and the moths begin to appear in June. In other cranberry-growing areas, peak flight occurs about the same time as cranberries are in full bloom and may continue through much of July. The moths are dark brown with very noticeable white bands on the forewings and have a wingspan of about 15 mm. Moths are strong fliers, moving readily between cranberry beds and from alternate hosts such as highbush blueberries.

The eggs are usually laid on the calyx end of the berry. As soon as the larva hatches, it moves to the stem end, enters the berry then seals the entrance with a white silken web. Only very close inspection will reveal that the berry has been attacked.

The larva is pale green with a yellowish head. When fully grown it is 13 cm long. It rarely leaves a berry until it has eaten all the pulp and seeds, and filled the berry with frass (excrement). Usually it leaves the berry by boring through the side into an adjoining berry. It may eat several berries before going into diapause (a hibernation-like state) in the trash layer for the winter. Infested green fruits redden prematurely, then shrivel up like raisins.

Monitoring and Management

Male moths may be attracted to traps baited with cranberry fruitworm pheromone. The correlation between trap catch and egg-laying has not been established, but it is known that eggs are laid after peak catch. In Massachusetts, egg laying begins when berries have just begun to grow, and may continue to late August. Females prefer to lay eggs on berries just larger than pinhead stage. Work in Massachusetts showed that most eggs are found at the calyx end of berries from the edges of beds and ditches, in weedy areas, and on berries that stick up above the vine canopy. Berries from these areas (25-50 berries per acre if possible) should be examined under a magnifying glass or microscope to look for eggs.

In Massachusetts, “late water” (a spring reflood one year out of three) is recommended for fruitworm control but, in the Pacific Northwest, the holding of late water is not practised.

Chemical Control

Group 1A

Sevin XLR Plus (466 g/L carbaryl) at 6.4 to 7.6 L/ha in 3000 L/ha of water (2.6 to 3.1 L/acre in 1200 L/acre of water). Do not apply within 2 days of harvest; or

Sevin 50W (50% carbaryl) at 6.25 to 6.75 kg/500 L. Use 3400 L/ha (1,360 L/acre) of water. Do not apply within 1 day of harvest.

Group 1B

Malathion 500 E (500 g/L malathion) at 1.25 to 2.25 L/1000 L water or Malathion 85EC (85% malathion) at 610 to 1100 mL/ 1000 L water. Spray for thorough coverage. Repeat as necessary. Note: Apply to new growth only. May cause injury to blossoms and stunting of berries if applied near end of bloom. Apply when temperatures are above 20°C. Do not apply within 3 days of harvest; or

Group 5

Success 480SC (480 g/L spinosad) at 365 mL/ha (146 mL/acre). Will provide suppression only. Apply a maximum of 3 times per year. Do not apply within 21 days of harvest; or

Entrust 80W (80% spinosad) at 218 g/ha (87 g/acre) or **Entrust SC** (240 g/L spinosad) at 727 mL/ha (290 mL/acre). Apply 1 to 3 times per year at 7 to 10 day intervals. Entrust is OMRI approved for organic production. Do not apply within 21 days of harvest; or

Group 15

Rimon 10EC (10% novaluron) at 677-835 mL/ha (270-334 mL/acre) . If chemigating, use a spray volume of 1500-3000 L/ha. Apply at egg hatch to early instar stage of larvae.

Group 18

Intrepid 240F (240 g/L methoxyfenozide) at 1.16 L/ha (464 mL/acre) in a minimum of 200 L of water/ha (80 L water/acre). Use 3200 to 3500 L of water/ha when applying by chemigation, Do not apply more than 2 times per year. Do not apply within 14 days of harvest; or

Group 28

Altacor (35% chlorantraniliprole) by ground application at 145 to 285 g/ha (58 to 114 g/acre) in a minimum of 200 L of water/ha (80 L water/acre). Do not apply more than 3 times per season. Do not apply more than once every 7 days. Do not apply within 1 day of harvest; or

Exirel (cyantraniliprole 100 g/L) at 750 to 1500 mL/ha (300 to 600 mL/acre) in a minimum finished spray volume of 200 L/ha by ground or up to 3000 L/ha by overhead chemigation. Use the high rate under heavy insect pressure. Do not apply more than once every 7 days. Maximum of 4 applications per season. Do not apply within 14 days of harvest.

Cranberry Girdler

Life History and Damage

The cranberry girdler, Chrysateuchia topiaria Zeller overwinters within a cocoon of soil particles in the trash layer. The overwintering stage is reported to be the prepupa. The moth, which has a long snout and whitish wings marked with gold and silver lines and three dark dots at the outer edge, emerges from overwintering cocoons in June and July. Eggs are deposited on the trash layer, and hatching larvae feed first on soft tissues such as the crowns and roots of grasses. Mature larvae feed on the bark of cranberry roots and crowns, girdling or severing vines in the process. The leaves of girdled vines turn orange in August and September, sharply defining the injured areas. Patches of vines become so loosened that they can easily be rolled back to reveal the dirty white larvae and their orange frass (excrement).

Cranberry girdler larvae are primarily pests of grasses in lawns, hayfields, pasture and turf; they also feed on young fir trees. In cranberries, there is one main flight per year in June and July, but the moths may be found in small numbers through the summer. In very hot years, a second flight of moths may occur in August.

Monitoring

Monitoring is best done under the supervision of a trained integrated pest management (IPM) person.

Currently there is no easy way to detect overwintering cocoons or young larvae. Therefore, pheromone traps and visual observations are used to detect and monitor moths. In mid-May, place wing traps baited with cranberry girdler lures in the beds at the rate of one trap per 1-2.5 ha. Traps should be positioned 10-20 m in from the edge and about 15 cm above the vines. Once a week, count and record the number of moths caught, then scrape them off the trap bottom or replace it. Trap counts will rise to a peak, then diminish. There is no definite relationship between the number of moths caught and later damage. It is also helpful to walk through the beds on a warm day and count the numbers of girdler moths that fly up. This will help to identify spots where most egg-laying will occur. Follow distributor's directions for lure replacement.

Management

Biological Control

Entomopathogenic (insect-attacking) nematodes can be applied at the recommended rate through the sprinkler system, with a boom sprayer, or by a helicopter flying just above an operating sprinkler irrigation system. If dykes are covered with grass (an alternate host for girdlers), they should also be treated with nematodes. The nematodes should be kept cool in their shipping containers until application. Nematodes should be applied in

the evening or on a cloudy day to well-irrigated beds, then watered in with as much irrigation as the bed can take (at least 2-4 hours). The objective is to rinse the nematodes from the foliage and through most of the trash layer, to the trash/soil interface where most girdler feeding occurs.

Insect-feeding birds such as swallows have been seen taking girdler moths. Providing suitable habitat for these birds will likely help reduce girdler populations.

Cultural Control

Flooding for 24-48 hours in mid-August will drown girdler larvae (and may drown nematodes as well, so it may be advisable to use either nematodes or flooding). Flood water should be deep enough to cover the tallest weeds, because larvae crawl up them to escape. Flooding will increase the risk of fruit rot on producing beds, but is a good preventive measure for young or non-producing beds. The probability of fruit rot may be lessened by flooding on cloudy days, and getting the water on and off quickly. Flood harvesting in early September may kill larvae that have not yet spun cocoons and pupated.

Regularly sanded beds tend to have fewer girdler problems, probably because the sand covers fungi, moss and small plants on which young larvae feed. Sand should be applied to large areas (possibly whole beds) before eggs are laid in June and July. Remove grassy weeds from sanded areas.

Cranberry Tipworm

Life History and Damage

The cranberry tipworm, Dasineura oxycoccana (Johnson) was found on cranberries in B.C. for the first time in 1998, and has since become a pest of moderate concern. The adult is a tiny midge, about one-tenth the size of a mosquito. After spending the winter in the pupal stage in the trash layer or soil, adults emerge, mate, and lay single eggs in upright tips. First-instar larvae are clear maggots about 0.5 mm long. Second instars are slightly larger and cloudy to greenish white. Third instars are 1.5-2 mm long, pink to orange, and can be seen without magnification. All three instars feed by piercing leaf tissue at the growing tips. Injured plant tissue dies and turns dark brown. Leaves surrounding the damaged tip become cupped and slightly puckered. When third-instar larvae finish feeding, they pupate a white cocoon. During the growing season, pupae are often found in upright tips. Cranberry tipworm has at least two overlapping generations per growing season in B.C.

Monitoring and Management

Calendar dates cannot be used to predict egg-laying, larval development or adult emergence. To detect eggs and larvae, the tips of cranberry uprights should be examined under magnification. When uprights begin to elongate in spring, 25 uprights per field (15 from edges and 10 from the middle) should be examined every week, and the number of eggs and larvae recorded. If 30% or more of examined uprights contain cranberry tipworm, monitoring should be intensified to 50 uprights per field (60% from edges and 40% from the middle) at least once per week. Accurate records of sampling data and insecticide applications for other pests should be kept. It is helpful to work with a trained pest manager when monitoring for and managing cranberry tipworm.

Cranberry tipworm damage is often most pronounced in plantings with excessive succulent overgrowth.

Biological Control

In other growing regions where cranberry tipworm is a pest, tiny parasitic wasps are known to attack and kill tipworm larvae. In B.C., two species of parasitic wasps are natural enemies of cranberry tipworm larvae.

Chemical Control

A trained pest manager should assist with timing chemical control for cranberry tipworm. If 30% or more of the sampled uprights contain tipworm eggs or larvae, insecticide application is warranted. Repeated applications of the same insecticide can select for resistant strains of cranberry tipworm.

Apply:

Delegate WG (25% spinetoram) at 420 g/ha (168 g/acre) in 500 L of water/ha (200 L water/acre) at egg hatch or to small larvae. Repeat application if necessary, which can be done through chemigation. Delegate is toxic to bees. Do not apply during bloom when bees are actively foraging. Do not apply more than 3 times per year. Allow a re-treatment interval of at least 7 days. Do not apply within 21 days of harvest; or

Note: Local research has shown shown better efficacy of Delegate when applied as a ground spray rather than by chemigation.

Movento 240 SC (240 g/L spirotetramat) at 365 to 435 mL/ha (146 to 174 mL/acre). Apply post bloom after bees have been removed from the field when hatching tipworm eggs are detected. For chemigation, use the higher rate and a maximum water volume of 3000 L/ha. Allow at least 7 days between applications. Do not apply more than a total of 1.8 L/ha (0.72 L/acre) per crop per season. Do not apply within 7 days of harvest.

Rimon 10EC (10% novaluron) at 677-835 mL/ha (270-334 mL/acre) . If chemigating, use a spray volume of 1500-3000 L/ha. Apply when the majority of tipworms are at an early instar stage.

Dearness Scale

Life History and Damage

Scales are soft-bodied insects covered above by a thick protective shell or scale, and below by a partial membranous scale. The thick shell of dearness scale resembles a small beige clam shell and is often covered with a white secretion. Female scales are round and globular whereas male scales are longer and flatter. The white waxy coating gets rubbed off during flood harvest but usually remains after dry harvest. On female scales, the skins cast by the two immature stages may be seen as a yellow area on the uppermost point of the shell.

Dearness scale, Rhizaspidiotus dearnessi (Cockerell), caused economic damage to cranberry vines in B.C. in 2003. Damage first appeared in July as small patches of vines with reddened leaves. Infested vines became pale green, dropping lower leaves from the current years' growth. By the end of summer, patches of scale infestation had been found in fields planted with Stevens, Bergman or McFarlin.

Dearness scale has been reported on cranberry in Massachusetts and in Wisconsin. Its host range includes many perennial plants. Dearness scale is native to North America, and has been found in 24 states, as well as Canada, Cuba and Mexico.

In Massachusetts and Wisconsin, dearness scale has one generation per year. The armored females overwinter, and the eggs within them are usually formed in spring. Crawlers (first stage immatures) are reported to begin hatching from eggs in early June in Wisconsin and mid-June in Massachusetts. Crawlers are bright yellow-orange and tiny: about 0.25 - 0.33 mm long. Crawlers wander or are dispersed by wind, and settle to begin feeding on plant stems within one to three days of hatch. In B.C., we suspect that crawlers emerge earlier than in Wisconsin.

Monitoring and Management

Scale insects are found during monitoring for blackheaded fireworm. Although action thresholds have not been developed, a trained pest manager can guide management decisions for this pest.

Biological Control

There is evidence of natural biological control – parasitism and predation – on dearness scale in B.C. Holes made by emerging parasitoids have been found. Some scales show marks typical of parasitoid egg-laying punctures and others have grooves that might be made by ladybird beetles.

Chemical Control

With the loss of Diazinon, there are no insecticide registered for control of dearness scale crawlers.

Leatherjackets

Life History and Damage

Leatherjackets are larvae of craneflies, which are large flies (14-25 mm long) known for their wobbling, unsteady flight. Two species, the European crane fly, Tipula paludosa Meigen, and the marsh crane fly, T. oleraceae, are present in B.C. European crane flies emerge, mate and lay eggs in late August through September; marsh crane flies emerge in April.

The larvae of both species are grayish, cylindrical and tapered at both ends, with no apparent head. If present in cranberry beds, larvae are usually found in the roots of grasses and sedges. In spring (June), larvae of the European crane fly measure about 13-20 mm, while marsh crane fly larvae are smaller (5-10 mm). In addition to grasses, European crane fly larvae are known to feed on strawberries, flowers and vegetable crops; marsh crane fly larvae may feed on conifer seedlings. Therefore, larvae of the marsh crane fly (and perhaps the European crane fly) are potential cranberry pests, but seem to prefer grass roots.

Monitoring and Management

If larvae are present in young, weedy plantings, larvae may move to cranberries if grassy weeds are removed, so it may be advisable to kill larvae by flooding before controlling grassy weeds.

Miscellaneous Caterpillars (Cutworms, Spanworms, Hairy Caterpillars and Leafrollers)

Life History and Damage

Caterpillars including cutworms, spanworms (Operophtera spp.), hairy caterpillars or leafrollers are occasional pests in cranberries. Depending on the species, they may spend the winter as partially grown larvae, pupae or adults. Larvae begin feeding in spring or early summer. Cutworms usually feed at night, and may defoliate uprights and runners, girdle stems, prune tips and destroy berries. Spanworms, hairy caterpillars and leafrollers can be found feeding on leaves, buds and flowers during the day. If present in large numbers, larvae of all four groups can do much damage.

Cutworms that have been found in cranberries include the black cutworm, Agrostis ipsilon Hufnagel; the alfalfa looper, Autographa californica Speyer; the zebra caterpillar Melanchra picta Harris; the false armyworm, Xylena nupera Litner; and Ochropleura implecta Lafontaine, that has no common name. Zebra caterpillars feed extensively on weeds and rarely damage cranberries enough to warrant treatment. Spanworms are the Bruce's spanworm Operophtera bruceata Hulst and the winter moth O. brumata L. Hairy caterpillars of the rusty tussock moth Orgyia antigua L. have been found on cranberries next to coniferous forests. The leafroller, Clepsis spectrana Treitschke, which attacks other fruit crops such as raspberry, strawberry and currant, is found occasionally.

Monitoring and Management

Larvae of these species may be found during monitoring for blackheaded fireworm larvae or during night sweeps for black vine weevil. Cutworm moths can be attracted to light traps; moths of the Bruce spanworm and winter moth can be attracted to pheromone traps in winter and are not seen in spring. Ochropleura implecta is attracted to pheromone traps for blackheaded fireworm. In 1997, light trapping showed two flights of O. implecta: the first in June and the second in August. Larvae were first found in night sweeps two weeks after peak catch in light traps.

Chemical Control

Chemical control is usually not necessary, but if high populations are found, insecticides recommended for fireworm will also provide control of caterpillars.

Root Weevils

Life History and Damage

Weevils are killed by flooding and, in B.C., usually are only a problem on beds that are not flooded at harvest. Weevils initially enter cranberry beds by walking in from salal and similar weeds on dikes and headlands.

The most common weevil pest on dry-pick farms is the black vine weevil, Otiorynchus sulcatus F., although the strawberry root weevil, O. ovatus L., and the clay-coloured weevil, O. singularis L., can also cause damage to vines. The adult black vine weevil is a black beetle 8-9 mm long. Its long snout distinguishes it from the beneficial ground beetle. Adult black vine weevils emerge from pupal cells in the soil in late May or early June; some adults may live through the winter. Adults feed on foliage for 4-6 weeks before egg-laying begins. Black vine weevils are all females, so there is no mating before egg-laying. Eggs are laid during late spring and early summer at the soil surface beneath the vines and hatch within 2-3 weeks. The newly emerged larvae feed on

cranberry rootlets and, later on the larger roots and root bark. The larvae are white, legless, have brown heads, and often curl their bodies into the shape of the letter C. They feed from the time they emerge from the egg until pupation the next spring. They may be inactive during very cold spells in winter.

Strawberry root weevils are about half the size of the black vine weevil, and have a similar life cycle. Clay-coloured weevils are intermediate in size between strawberry and black vine weevils and have a mottled, clay-coloured exterior that may look black when wet. Clay-coloured weevil adults emerge very early in spring, when the other two species are still larvae or pupae; egg-laying by clay-coloured weevils also precedes the other two species.

The weevil Sciaphilus asperatus, which is intermediate in size between black vine weevil and strawberry root weevil, was collected on a dry-pick cranberry farm in 2004. Sciaphilus asperatus has a life history similar to black vine weevil, and feeds on many different plants. It has not caused economic damage to cranberry in B.C.

Weevils can completely girdle roots up to the crown of the plants. Damaged vines look similar to girdler-damaged vines, but lack the frass left by girdler larvae at feeding sites. Symptoms of damage (wilting, weakening, browning, death) begin to appear in May or June and intensify through the season.

Monitoring and Management

Monitoring is best done under the supervision of a trained integrated pest management (IPM) person.

In early spring (March and April), check the bed for areas of dead or dying vines. Pull these vines away from the soil surface and look for white, C-shaped larvae, which are likely to be near the surface on a warm, sunny afternoon. (Clay-coloured weevil adults may also be found.) Sometimes larvae are not present, but fresh chewing of the vines can be seen. If dark brown, sawdust-like material is found near chewed vines, the problem is likely to be cranberry girdler, not any of the root weevils. Record the location of weevil-damaged vines on a map of the bed.

When soil temperatures are 13oC or higher, entomopathogenic (insect-attacking) nematodes can be applied through the sprinkler system or with a boom sprayer at the recommended rate. The nematodes should be kept cool in their shipping containers until application. Nematodes should be applied in the evening or on a cloudy day to well-irrigated beds, then watered in with as much irrigation as the bed can take (at least 2-4 hours). The objective is to rinse the nematodes from the foliage and through the trash layer, to the upper 5 cm of soil where most weevil feeding occurs.

In early July, adult weevils can be found feeding on leaves at night. The best way to monitor for them is to sample the bed systematically using a sweep net (one sample = 15 sweeps). Sweep samples must be taken after dusk. The locations of adults can indicate where new infestations are likely to occur. Adult weevils take small notches out of leaf edges where they feed; the location of notched leaves is also a good indicator of weevil presence. Insecticides registered for control of weevils are most effective when applied to the adult stage prior to egg-laying on a calm, warm evening when adults are feeding on the foliage. To determine the presence and maturity of eggs within an adult weevil, pinch the abdomens of about 10 weevils and look for spherical white eggs. When ready to lay eggs, the weevil's entire abdomen will contain eggs and little else.

In early fall, repeat the monitoring process used in spring. Weevil larvae will be younger and smaller than in spring, and harder to find. Watch the soil temperature and do not apply nematodes if the soil temperature is below 13^{o}C.

Chemical Control

Actara 25WG (25% thiamethoxam) at 210 to 280 g/ha (84 to 112 g/acre) in sufficient water to obtain coverage of foliage. Apply when adult weevils or weevil damage is detected. Repeat application if insect populations rebuild. Use the higher rate for heavy infestations. Do not apply more than twice per season. Do not apply within 3 days of harvest; or

Note: Actara is highly toxic to bees exposed to direct treatment or to residues on blooming crops and weeds. Do not apply Actara or allow it to drift onto blooming crops or weeds if bees are foraging in/or adjacent to the treatment area. After an Actara application, wait at least 5 days before placing the beehives in the treated field.

Insecticides used to target blackheaded fireworm, particularly Orthene, will also help to control adult root weevils.

Sparganothis Fruitworm

Life History And Damage

Sparganothis fruitworm, Sparganothis sulfureana (Clemens), was detected for the first time on cranberry in B.C. in 2007, and is considered a minor pest. The yellow-headed, greenish yellow caterpillars (larvae) feed on and within cranberry fruit.

Sparganothis fruitworm overwinters as a tiny larva webbed into uprights or into plant debris in the trash layer beneath cranberry vines. As the plants break dormancy, overwintered larvae begin feeding on leaves and buds. Very young larvae have dark head capsules and can be confused with blackheaded fireworm. From bud break through bloom, first-generation sparganothis larvae make loose feeding shelters by silking two leaves or several vine tips together, and feed on developing blossoms and foliage. Leaves can be skeletonized.

Following pupation in late May or early June, the adults emerge, mate and lay second-generation egg masses. Adult sparganothis are distinctive yellow moths about 1 cm long with a cross pattern on their folded wings. Second-generation larvae feed on foliage but seem to prefer to feed on and within cranberries. Pupation and emergence of second-generation adults occurs in late August and September. Egg masses are laid on foliage at that time. The tiny larvae that hatch from these eggs overwinter.

Monitoring And Management

Sparganothis fruitworm has a variety of woody and herbaceous hosts, including highbush blueberry and yellow loosestrife, Lysimachia terrestris. The latter is a common weed on BC cranberry farms.

To detect and monitor sparganothis fruitworm, it is helpful to work with a trained pest manager. Larvae will be detected during visual searches for blackheaded fireworm larvae. Adults can be attracted to sparganothis pheromone lures in sticky traps.

Biological Control

In other growing areas, such as New Jersey and Wisconsin, where sparganothis fruitworm is a pest, entomologists observe that the eggs and larvae have many natural enemies. In these areas, it is believed that sparganothis larvae become a problem when their natural enemies are killed by insecticides. In B.C., it is likely that sparganothis populations are influenced by naturally occurring parasitoids of eggs and larvae.

Chemical Control

Because natural enemies of sparganothis are easily killed by insecticides, chemical control should only be applied if necessary. Diazinon 500 E can be used at the same rate as used for blackheaded fireworm; or

Group 5

Delegate WG (25% spinetoram) at 420 g/ha (168 g/acre) in 500 L of water/ha (200 L water/acre) at egg hatch or to small larvae. Repeat application if necessary, which can be done through chemigation. Do not apply more than 3 times per year. Allow a re-treatment interval of at least 7 days. Do not apply within 21 days of harvest; or

Note: Delegate is toxic to bees. Do not apply during bloom when bees are actively foraging.

Success 480SC (480 g/L spinosad) at 182 mL/ha (73 mL/acre). If cranberry fruitworm is present at the same time as blackheaded fireworm or Sparganothis fruitworm, a higher rate of 365 mL/ha (146 mL/acre) may be used. Apply a maximum of 3 times per year. Do not apply within 21 days of harvest; or

Entrust 80W (80% spinosad) at 109 g/ha (44 g/acre) or **Entrust SC** (240 g/L spinosad) at 364 mL/ha (146 mL/acre). If cranberry fruitworm is present at the same time as blackheaded fireworm or Sparganothis fruitworm, the higher rate of 218 g/ha (87 g/acre) of **Entrust 80W** or 727 mL/ha (290 mL/acre) of **Entrust SC** may be used. Apply 1 to 3 times per year at 7 to 10 day intervals. Entrust is OMRI approved for organic production. Do not apply within 21 days of harvest; or

Group 15

Rimon 10EC (10% novaluron) at 677-835 mL/ha (270-334 mL/acre). If chemigating, use a spray volume of 1500-3000 L/ha. Apply at egg hatch to early instar stage of larvae. Do not apply within 1 day of harvest; or

Group 18

Confirm 240F (240 g/L tebufenozide) at 1.2 L/ha (0.48 L/acre) in 190 L/ha (76 L/acre) of water. Apply when first generation larval activity begins and make a second application 10 days later. For second generation control, apply at about 10 % egg hatch followed by a repeat application 10 days later. Do not apply more than 4 times per year. Do not apply within 30 days of harvest; or

Intrepid 240F (240 g/L methoxyfenozide) at 0.75 to 1.16 L/ha (300 to 464 mL/acre) in a minimum of 200 L of water/ha (80 L water/acre). Use 3200 to 3500 L of water/ha when applying by chemigation, Do not apply more than 2 times per year. Do not apply within 14 days of harvest; or

Group 28

Altacor (35% chlorantraniliprole) by ground application at 145 to 285 g/ha (58 to 114 g/acre) in a minimum of 200 L of water/ha (80 L water/acre). Use the high rate when pest pressure is heavy. For ground application, do not apply more than 3 times per season. For chemigation, apply at 285 g/ha in a minimum of 3000 L of water/ha (1200 L water/acre). For chemigation, do not apply more than 2 times per season. Do not apply more than once every 7 days. Do not apply within 1 day of harvest; or

Exirel (cyantraniliprole 100 g/L) at 750 to 1500 mL/ha (300 to 600 mL/acre) in a minimum finished spray volume of 200 L/ha by ground or up to 3000 L/ha by overhead chemigation. Use the high rate under heavy insect pressure. Do not apply more than once every 7 days. Maximum of 4 applications per season. Do not apply within 14 days of harvest.