

Tree Fruit Leafrollers

March, 2016

Several species of leafroller attack pome and soft fruit throughout the Southern Interior and South Coastal regions of B.C. The main leafroller pests include single-generation species (fruittree leafroller (FTLR) and European leafroller (ELR) and two-generation species (obliquebanded leafroller (OBLR) and threelined leafroller (TLLR). The distribution and abundance of these leafrollers varies from region to region and within regions, so it is important to know which species are present in your area.



Fruittree leafroller larva



Adult Leafroller moth

Prevention

To reduce immigration of leafroller moths and larvae into your orchard, spray or remove all nearby host fruit trees. An area-wide control program is the most effective way to reduce movement of leafroller moths and larvae between orchards. Cherry trees left unsprayed after harvest and adjacent to pome fruit blocks are a source of summer-generation larvae, especially TLLR. Wild non-fruit host plants are not as great a threat as unmanaged fruit tree hosts. Thinning fruit to singles where practical will greatly reduce the risk of fruit damage.

Fruittree and European Leafrollers (*Archips argyrospilus*, *Archips rosanus*)

Hosts

Fruit trees, berry crops, native and ornamental trees and shrubs including hawthorn, poplar, willow, rose, locust, English walnut and box elder.

Damage

Buds - Small entry holes in buds, chewed petals and flower parts.

Blossoms - Petals webbed together, often remaining attached through petal-fall; inner flower parts eaten.

Leaves - Chewed, rolled and tied together with silk.

Fruit - Deep irregular holes in small fruit resulting in large russeted scars in mature fruit.

Identification

Egg - Masses of up to 150 tan to white eggs on small branches.

Larva - Light to dark green with black head, wriggles backward when disturbed.

Adult - Fruittree leafroller moths are about 12 mm long, bell-shaped, with a pattern of gold, tan and white on the forewings. European leafroller moths are about 12 mm long, brown, bell-shaped, with thin dark brown transverse lines on the forewings.

Life History

These leafrollers are only present in orchards in Creston and from Summerland north in the Okanagan Valley (isolated populations are present in the south Okanagan and Similkameen Valleys). Overwintering egg masses begin to hatch at about the 15-mm green bud stage of McIntosh apple. Egg hatch may extend over several weeks if temperatures are cool. Also, eggs on south-facing side of branches will hatch up to 4-5 days before eggs on north side of branches. Newly hatched larvae release silken threads so they can float on the wind throughout the orchard and into adjacent orchards. Larvae enter buds and feed on flower parts, moving to leaves after bloom. They feed on leaves and nearby fruit. Mature larvae pupate within leaf rolls. Adults emerge from June to August, mate and lay eggs that hatch the following spring. There is one generation per year.



Fruittree leafroller feeding damage on apple fruitlet



Fruittree leafroller eggs



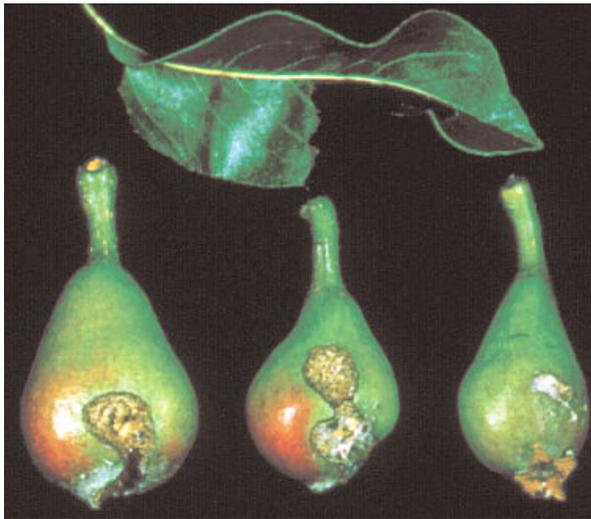
Shallow, russeted areas on mature apple

Monitoring

Inspect branches for egg masses during pruning. Mark at least 10 south-facing and 10 north-facing egg masses per orchard with surveyor tape and monitor egg hatch weekly. A small dark hole will appear in hatched eggs. Select only egg masses that do not have any dark spots. A degree-day model (base 5°C from February 1) is available to determine the proportion of FTLR eggs hatched (e.g. 50% egg hatch at 154 DD; 100% at 250 DD). Alternatively, limb taps and/or examination of fruit bud and blossom clusters on a weekly basis can be done to monitor for the presence of young larvae. A pheromone-baited trap is commercially available to monitor fruittree leafroller adults, however no relationship between moth captures and subsequent larval abundance the following year has been established.

Control

Cultural - Pruning will remove many egg masses. Prune older, low-density trees to open up the canopy and improve spray penetration and coverage, especially into the upper canopy. Thinning fruit to singles where practical will help reduce the risk of fruit damage.



Leafroller damage to pear

Photo courtesy Agriculture & Agri-Food Canada

Biological - Dipel 2X DF, Foray 48BA and Bioprotec CAF contains *Bacillus thuringiensis* (Bt), a bacteria that produces a toxin once consumed by fruittree and European leafrollers and other caterpillars. The toxin makes holes in the gut lining allowing other bacteria to enter the blood system of the caterpillars and slowly kill them. Infested caterpillars will stop feeding and eventually die over the next 2 to 10 days. Caterpillars receiving a dose of Bt that does not kill them will resume feeding in about 10 days. This is the basis for the recommended interval of 10 days between Bt applications. Best results are obtained when Bt is applied during blossom or petal-fall. Research and field reports indicate that mixing Bt products with ATS for application to apple during bloom does not affect the performance of either product. Because caterpillars must eat the Bt to be most effective, thorough coverage, fine spray droplets and correct timing are essential to ensure proper performance of Bt products. **It is important that travel speed allow for sufficient displacement of air from the tree canopy to ensure thorough and uniform spray penetration and coverage.**

Where leafroller and green fruitworm numbers are low to moderate, a single application of Bt in late bloom has given good control. However, where larval numbers are high, apply a bloom spray followed by a second spray 10 days later.

Because Bt is sensitive to sunlight it is recommended that Bt products be applied in the very early morning or after 4:00 PM in the afternoon. Bt products can be applied during the day if partial or full cloud cover is present and there is no threat of rain for at least 24 hours. The optimum solution pH for Bt products is 6. Some breakdown occurs above that point and it is unstable above pH 8. To avoid possible degradation in the spray tank, apply the Bt immediately. Control is also improved if Bt is applied under warm (> 15°C) temperatures. Bt products are not toxic to bees or other beneficial insects and mites and are not phytotoxic. They are compatible with most insecticides and fungicides. Do not combine with highly alkaline materials such as Bordeaux mixture or lime-sulphur. Bt can be mixed with diazinon and applied at petal fall to control campylocoma, but do not delay application of the mixture to avoid degradation of the Bt.

****NOTE:** Liquid formulations of Bt (Foray 48BA and Bioprotec) should be used within 6 months of the date of manufacture (see product or package label)**.

Chemical - Many populations of Fruittree (FTLR) and European (ELR) leafrollers in the Okanagan Valley are resistant to the organophosphate (OP) insecticide, Diazinon. These populations are also resistant to Confirm (NOTE: Intrepid is not registered for control of these leafroller species). Therefore, do not apply Confirm if OP products no longer provide satisfactory control of leafrollers in your orchard. Alternative products for protecting fruit where resistant populations occur are Bt products, Success or Entrust and Exirel. If your orchard has resistant species as well as non-resistant two-generation leafrollers, use a Bt product, Success/Entrust or Exirel rather than Confirm to ensure control of all leafrollers. Success and Entrust can harm earwigs and parasitic wasps exposed to direct sprays; however the threat is reduced once residues dry.

Mating disruption - Apply Isomate CM-LR or Isomate-CM/LR TT in apples, pears and cherries at a rate of 1000 dispensers/ha (400/acre) for Isomate CM-LR, and 750 dispensers/ha (300/acre) for Isomate-CM/LR TT. Double the rate along margins of orchards. Read the general instructions for using mating disruption under Codling Moth. It is important that leafroller population levels are very low within the orchard and there are no nearby outside sources of mated females (e.g. fruit trees, roses, raspberries, cottonwoods, chokecherry, alder, willow, dogwood, big-leaf maple, hawthorn, antelope bush, lupine). This control option also requires effective spring larval control. These product also provide mating disruption of any obliquebanded leafroller, threelined leafroller and codling moth male moths present in the treated orchard.

Obliquebanded and Threelined Leafrollers **(*Choristoneura rosaceana*, *Pandemis limitata*)**

Hosts

Fruit trees, alder, roses, cottonwood, willow, dogwood, hawthorn, antelope bush, chokecherry, and lupine and other woody wild and landscape ornamentals.

Damage

Buds - Small entry holes in buds, chewed petals and flower parts.

Leaves - Chewed, rolled and tied together with silk.

Fruit - Spring feeding by overwintered larvae causes deep irregular holes in small fruit resulting in large russeted scars in mature fruit. First summer generation larval feeding causes shallow irregular grooves in the fruit skin, often under a leaf tied to fruit or where two fruit are touching. The second summer generation cause small pin holes which can become infected with rot pathogens leading to storage losses. This latter damage is difficult to distinguish from that of eyespotted bud moth larvae.



Obliquebanded leafroller - late season feeding injury on apple



Obliquebanded leafroller

Identification

Egg - Greenish masses of up to 150 eggs on leaves.

Larva - Yellowish-green to light green body. Threelined larva has pale green to light tan head; obliquebanded has brown to black head.

Adult - Obliquebanded moth is about 15 mm long, bell-shaped, brown with alternating light and dark brown transverse bands on the forewings; the threelined moth is about 13 mm long, bell-shaped, pale gray to chocolate brown with alternating white and dark brown transverse bands on the forewings.



Summer generation leafroller feeding on apple



Second generation threelined (Pandemis) leafroller on cherry

Life History

These leafrollers are present throughout the Southern interior and coastal regions. Young larvae overwinter in silken cocoons in bark crevices or under bark scales. Most of the larvae emerge about the 15-mm green bud stage and bore into fruit buds. Some larvae do not emerge until petal-fall. They feed on flower parts, leaves and young fruit. Mature larvae pupate within rolled leaves. Moths of the summer generation emerge from early June to late July. Females lay egg masses on leaves and other objects, and young larvae first feed on terminal growth and may later tie a leaf to a fruit and feed beneath the leaf or between two fruits. Moths of the second generation are active from late August to October and lay eggs on leaves. Larvae hatching from these eggs feed briefly before seeking protected sites on trees in which to overwinter.

Monitoring

Examine fruit bud and blossom clusters for larvae in the spring. In the summer examine terminals and look under leaves attached to fruit for young larvae and feeding damage. Use beating trays to detect the presence of larvae. Pheromone-baited traps are available to monitor adults to establish biofix for the purpose of timing application of sprays such as Confirm and Intrepid against eggs and larvae. There is no relationship between moth captures and subsequent larval abundance or damage.

Control

It is essential to control the spring generation of obliquebanded and threelined leafrollers in order to reduce the need to control the summer generations that are much more difficult to control (increased canopy density, spread out generation time). If no insecticides are applied in the spring or for second generation codling moth, one or more sprays may be needed in July or August against the first summer generation, and possibly in late September to protect the late-maturing fruit from the second summer (overwintering) generation of larvae. An effective spring control program is also necessary if planning to use mating disruption for control of summer generations.



Leafroller damage to cherry - fruit deformed with deep creases

It is also essential that you calibrate and operate your sprayer properly to ensure optimal performance of pest control products. It is important that travel speed allow for sufficient displacement of air from the tree canopy to ensure thorough and uniform spray penetration and coverage.

Cultural - It is also important to prune trees to allow thorough penetration and coverage of sprays. Because larvae like to feed where two fruit are in contact, thin fruit to singles where practical. Elimination or spraying of unmanaged host trees next to commercial host crops can help reduce leafroller pressure.

Biological - See the discussion under fruittree and European leafrollers for use of *Bacillus thuringiensis* (Bt) products Dipel, Foray and Bioprotec for early-season (spring) control of OBLR and TLLR. Some success has been achieved against summer generations using Bt products, especially in cherry blocks within a few days of harvest. Repeat treatments at 10-day intervals may be necessary due to the extended length of time larvae are present.

Chemical

Spring Control - Apply Confirm (maximum 3 applications to apples and pears) or Intrepid (maximum 2 applications, apples only) from late bloom to petal fall to control the spring larval generation. These products will also control other leafroller and bud moth larvae present at the time of application. **Because organophosphate-resistant OBLR are also resistant to Confirm and Intrepid, do not apply Confirm or Intrepid if the OBLR population is resistant to organophosphate insecticides (Diazinon, Imidan).** Thorough coverage is essential for effective control because the larvae must eat Confirm and Intrepid. These products are specific for caterpillars and will not harm beneficial insects and

mites. Alternative products to rotate with or replace Confirm and Intrepid are Success/Entrust, Delegate, Altacor, Exirel, TwinGuard and Bt products.

Apply Success or Entrust (maximum 3 applications per season) or Delegate (maximum 3 applications per season) or Altacor (maximum 3 applications per season, or 2 applications per season for rates above 215g/ha) or Exirel (maximum 3 applications per season), TwinGuard (maximum 2 applications per season) for control of spring OBLR and TLLR on pome and stone fruit. Again thorough and uniform coverage is essential because larvae must eat the product to provide maximum control. These products will also control other leafroller and bud moth larvae present as well as the sap feeder stage of tentiform leafminer. Success and Entrust will also provide control of thrips. Success and Entrust can harm earwigs and parasitic wasps exposed to direct sprays; however the threat is reduced once the residues dry.

Summer Control - Be aware that foliage density and area will be greater than in the spring so make adjustments to sprayer operation to ensure thorough coverage. For suppression of summer generations of leafrollers, apply Confirm (maximum 3 applications, apples and pears only) or Intrepid (maximum 2 applications, apples only) about 10-14 days after biofix and repeat not less than 10-14 days later if necessary. Or, using a degree-day model (base 10°C beginning February 1), once biofix is established, apply Confirm or Intrepid between 120 and 140 DD (corresponds to start of egg hatch) and again between 210 and 240 DD if necessary (corresponds to about 50% egg hatch). Field reports indicate that an application at the second timing is essential for satisfactory reduction of feeding damage, regardless of the timing of the first application. To prevent or delay the development of resistance to Confirm and Intrepid in non-organophosphate resistant leafroller populations, do not apply it against successive generations of leafroller larvae. These products will also aid in control of any exposed codling moth larvae.

Apply Success or Entrust (maximum 3 applications per season) or Delegate (maximum 3 applications per season) or Altacor (maximum 3 applications per season, or 2 applications per season for rates above 215g/ha) or Exirel (maximum 3 applications per season) or TwinGuard (maximum 2 applications per season) to all pome and stone fruits or Rimon (maximum 3 applications per season to stone fruits only for control of summer generations of obliquebanded and threelined leafrollers. Again thorough and uniform coverage is essential because the larvae must eat product to provide maximum control. These products will also control any bud moth or other species of leafroller larvae present. Rotate the use of Success or Entrust or Delegate with other control products to prevent or delay the development of resistance. Success Entrust and Delegate can harm earwigs and parasitic wasps exposed to direct sprays; however the threat is reduced once the residues dry. Rimon may be harmful to predatory mites.

Mating disruption – Apply Isomate CM-LR or Isomate-CM/LR TT in apples, pears and cherries at a rate of 1000 dispensers/ha (400/acre) for Isomate CM-LR or 750 dispensers/ha (300/acre) for Isomate-CM/LR TT. Double the rate along margins of orchards. Read the general instructions for using mating disruption under Codling Moth. It is important that leafroller population levels are very low within the orchard and there are no nearby outside sources of mated females (e.g. fruit trees, roses, raspberries, cottonwoods, chokecherry, alder, willow, dogwood, big-leaf maple, hawthorn, antelope bush, lupine). This control option also requires effective spring larval control. These products also provide mating disruption of any fruittree leafroller, European leafroller and codling moth male moths present in the treated orchard.