



Home & Garden Pest Management Guide For British Columbia

2019 Edition

Chapter 11 Pests of Berries



Pests of Berries

This chapter describes insect and disease problems of berries, and provides information on how to manage them. The first section describes pests that affect many different berry crops, followed by sections on pests of specific berry crops. Management information describes preventative and cultural measures that may control the pest. Sometimes the management information also mentions use of pesticides. When more than one pesticide is mentioned, the least toxic pesticide is listed first. Before using a pesticide read and follow label directions, including the precautions, application rates and days-to-harvest after a pesticide application. See the “Pesticide Table” in Appendix I for information on available home garden pesticides. Also read Chapter 8 "Using Pesticides to Manage Pests". It contains important safety information.

Proper identification of plant pests and diseases is an important step before attempting to control the pest. Not all plant problems are caused by pests; some are caused by cultural, nutritional, soil or environmental conditions. See Chapter 2, “Identification of Plant Problems”, for information on how to get help identifying plant problems.

Pests Affecting Many Berry Crops

Insects

Aphids

Aphids feed on most berry crops and can be significant pests. There are many species of aphids, and many feed specifically on a host crop (raspberry aphid, strawberry aphid, blueberry aphid, currant/lettuce aphid), however, some feed on a variety of crops (green peach aphid).

Aphids are small (1.5 - 3 mm), pear-shaped, insects that vary in colour from pink to green and black. They reproduce rapidly and are often found in clusters or colonies on new growth and the undersides of leaves.

These sap-sucking insects can cause leaves to curl and twist or cause stunted and deformed shoot growth. Some aphids transmit viruses that cause plant diseases, such as blueberry aphids which transmit blueberry scorch virus.

Aphids produce a sticky, sugary secretion called honeydew that is attractive to some species of ants. These ants protect aphids from attack by insect predators such as lacewings, ladybugs, hover flies and pirate bugs. Fruit, leaves and shoots can often be coated in black sooty mold that grows on the honeydew.



Green peach aphid

Aphids overwinter as black, shiny eggs either on summer host plants or on nearby woody ornamentals and trees. Eggs hatch in the spring giving rise to only female aphids that give birth to live young that are also female. These in turn can give birth to live young within 7 to 14 days depending on weather conditions. Winged male and female aphids are produced when colonies outgrow their food source or as day length shortens in the late summer. These mate and the females lay overwintering eggs on summer or winter hosts.

Management:

Aphids are best controlled when colonies are small and before leaves start to curl. Aphids can often be removed by hosing plants with water. Do not use an insecticide if large numbers of predators such as ladybugs and lacewings are present as these will help to control the aphids. Purchasing ladybugs for outdoor use has minimal effectiveness as they usually fly away. Over the growing season, aphids will usually be managed by naturally occurring biological control agents. Regular use of broad spectrum insecticides may limit the effectiveness of these agents. Note that some aphids may still be present even if biological control agents are abundant and effective. If an insecticide is necessary, use an insecticidal soap or pyrethrins, and use it earlier in the season rather than later.

Climbing Cutworms

Including Variegated Cutworm (*Peridroma saucia*), Bertha Armyworm (*Mamestra configurata*), *Xestia c-nigrum*, and others.



Cutworm larvae



Spotted cutworm Xestia c-nigrum on raspberry



Cutworm pupae in soil

Cutworm larvae (caterpillars) can feed on several different types of plants. Cutworms are fleshy, striped and variably coloured caterpillars that climb up plants to feed at night, and rest in the soil at the base of plants during the day. Some species will feed during the day as long as there is adequate cover from foliage. Caterpillars may change from green to dark as they grow and age. They measure up to 4 cm long as full size larvae and curl up when handled or disturbed. Look for stems that are cut off at the base, or chewing injury on stems, leaves and buds from early spring through summer and fall.

Management:

Remove cutworms from plants by hand after dark or destroy those found in the soil around the base of the plant during the day. Pouring a pail of water containing a ¼ cup of dish washing liquid on the soil around the plants may bring cutworms to the surface during the day.

Early spring feeding on new buds can be significant, particularly if there are no alternative feeding sites, such as a cover crop or turf. If the population is high enough to warrant a pesticide treatment, apply it to the plants after sunset when the most cutworms will be exposed. One well timed application with an appropriate insecticide may be adequate for control of the population; however, additional applications may be needed. Btk (*Bacillus thuringiensis* var. *kurstaki*) is not effective as a spray on medium to large cutworms but can be effective on small ones. Always check the pesticide label for application directions and appropriate use.

Leafhoppers

Including Bramble Leafhopper (*Ribautiana tenerrima*),
Rose Leafhopper (*Edwardsiana rosae*)



Rose leafhopper skins



Bramble leafhopper. Photo courtesy of Kevin Hall, Bugguide.net

Leafhoppers are a common problem on grapes and blackberries. Leafhoppers are small (up to 5 mm long), slender, sap-sucking insects, usually pale green, white or yellow, and jump or fly when disturbed. They feed on the undersides of leaves causing them to become stippled and pale. Some species overwinter as adults in plant debris on the ground, and some overwinter as eggs on plant surfaces. The first generation occurs in early summer (June, July). Some species have a second generation about August or September. If the species overwinters as adults, there will be many adults present through the fall. Species may be variously spotted or marked on their wings. These markings are used in identification.

Management:

Watch for leafhopper nymphs on foliage starting in in mid-May, depending on location and species. Leafhopper eggs are parasitized by a small parasitic wasp in some areas of B.C. Wait until nymphs (wingless immature stage) appear on the undersides of the leaves before deciding whether there are enough to warrant an insecticide treatment

If necessary, spray with pyrethrins (these are very effective for leafhoppers) or insecticidal soap. Follow directions and days to harvest on the label. Effective control of the first generation will usually protect the plants for the rest of the growing season, however, continue to watch/scout the plants over the season for a second generation of nymphs.

Leafrollers and Spanworms

Including Oblique Banded Leafroller (*Choristoneura rosaceana*), European Leafroller (*Archips* spp.), Bruce Spanworm (*Operophtera bruceata*), and Winter moth (*O. brumata*)



Bruce spanworm larva



Leafroller larva

Various species of small greenish caterpillars that feed on leaves and fruit can be present from bud burst in early spring through summer and into harvest.

Leafroller caterpillars feed on fruit, flowers and leaves from April to August. In June and July, chewed leaves will be found rolled up and tied together with silk. Leafrollers wriggle backwards and drop from the plant on a silken thread when disturbed. One species present in the fall forms leaf shelters that appear as red “flags” on blueberry bushes. Summer feeding does not generally affect the plant significantly, but larvae can be fruit contaminants if the population is high. There are one to two generations per year, depending on the species.

Spanworms and winter moth larvae feed on buds in early spring, and have one generation per year. These caterpillars feed on new growth, flower clusters and fruit, and damage swelling buds. Check plants in late March and early April for damage, as well as silk and frass in and around the buds. Look for the small green caterpillars. It is important to control the larvae in early April before they bore into buds. Spanworms grow to 1.5 cm and pupate by late May, and moths fly in November and December, and lay eggs on plants in the winter.

Management:

Watch for and treat when damage first appears. Suggested action thresholds for berries are as follows: If more than 5% of flower buds have spanworms or leafrollers present, fruit production may be decreased due to bud feeding. During the summer, tolerance of leafrollers is higher. If

more than 20% of plants have leafrollers, there may be some fruit damage. Hand-pick and destroy larvae if practical. Insecticides are available for caterpillar management, including the microbial product Btk (*Bacillus thuringiensis* var. *kurstaki*). Btk will not harm beneficial insects. Check product labels for your crop and the pest.

There are native biological control agents of leafroller caterpillars, which will help manage the insects. Pheromone traps are available for monitoring leafroller moths, which can be used to determine the species present and timing of life stages. This information is useful for timing of control measures such as sprays, or releases of biocontrol agents. *Trichogramma minutum*, an egg parasite, can be purchased and will parasitize and kill a significant number of leafroller eggs if applied weekly when leafroller moths are flying (as determined by pheromone traps).



Spanworm (winter moth larvae) severe feeding damage to buds of blueberry, April.

Root and Vine Weevils

Including Black Vine Weevil (*Otiorhynchus sulcatus*), Obscure Weevil (*Sciopithes obscurus*), Clay Coloured Weevil (*Otiorhynchus singularis*), Rough Strawberry Root Weevil, (*O. rugosostriatus*), Strawberry Root Weevil (*O. ovatus*), and Green Immigrant Leaf Weevil (*Polydrusus formosus*)



Black vine weevil larva and damage



Weevil larvae



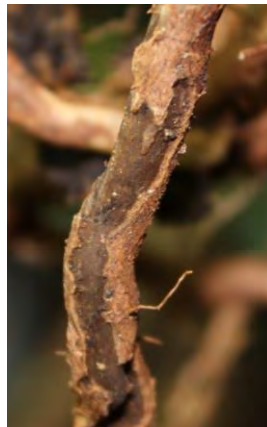
Rough strawberry root weevil



Black vine weevil



Clay coloured weevil
Photo courtesy of
AAFC, Fitzpatrick



Root girdling on blueberry by weevil larvae



Stem girdling by adult weevil



Leaf 'notching' by adult weevils on blueberry leaves

Weevil adults are primarily active at night, and attack many types of woody plants, including berry and ornamental plants.

The snout-nosed adult beetles feed mostly at night on the edges of leaves giving them a notched appearance. There are five or six species ranging in size from 3 to 10 mm, and in colour from tan to black. Adults can be found all year-round, but each species has a specific peak adult and larval activity period. Some species feed on new growth in April, and some emerge and feed from late June onwards. Weevil adults may feed on grape bunches causing grapes to drop off, and clip petioles of raspberry laterals in spring causing the new growth to die.

Weevil larvae or grubs feed on roots, crowns, and underground stems, seriously weakening or killing roots and causing gradual decline and sometimes death of plants. Larvae can be found year-round in the soil or plant crowns, but are easier to see in some crops at certain times of the year. Feeding can look like girdling or ‘tracking’ on woody roots like blueberries, or larvae can bore into fleshy roots such as into strawberry crowns.

Management:

Some limited management of adult weevils is possible by placing short pieces of board or corrugated cardboard among plants. Weevils hide under these and can be collected and destroyed every few days. Beneficial nematodes can be purchased and applied to soil to suppress weevil larvae in late summer and fall. Check with your garden center for product availability. The nematodes attack the weevil larvae in the soil, so should be applied when larvae are small for best results. Nematodes need to be applied in water, as they require water for movement and survival. Adult weevils can be collected and destroyed, either by hand-picking or shaking plants over a ground sheet. Adult weevils can be more easily found at night, feeding on the leaf edges. Spraying with pyrethrins will also help to control adult weevils.

Mites

Spider Mites, Including Two Spotted Spider Mite

(Tetranychus urticae)



Mites and eggs on underside of a raspberry leaf



Mite damage to raspberry leaves

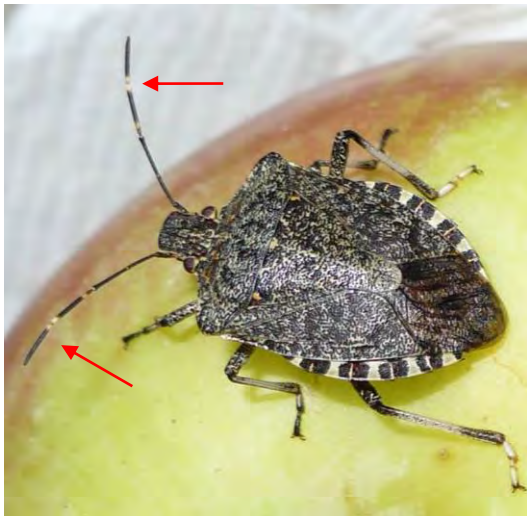
Mite damage occurs most often during hot, dry weather in July and August. When monitoring for mites, look for pale speckling or browning of foliage, sometimes accompanied by extensive webbing. Use a hand lens of at least 10X magnification to examine undersides of leaves for the presence of mites. Look for very small, spider-like creatures that are almost invisible without magnification. Spider mites have a wide host range, and are common on many berry, fruit, vegetables, and ornamental plants.

Management:

Spraying plants with water disrupts colonies and slows down population development of spider mites. Pesticides for mite management are available, including insecticidal soap and dormant or summer oils. Check pesticide labels for use instructions and to ensure the crop and pest are listed, and observe the pre harvest interval. Predator mites naturally occur, and can also be purchased and released onto infested plants. After release, do not apply insecticides that may harm the predators.

Other Mites: Additional species of mites may be found in berry crops, including big bud mites (*Cecidophyopsis ribis*) in currants.

Brown Marmorated Stink Bug



Adult brown marmorated stink bug



Brown marmorated stink bug nymphs

Brown marmorated stink bug was first detected in British Columbia in 2015. It is a serious pest and feeds on more than 100 different plant species including tree fruits, berries, grapes, vegetables, and ornamental plants. Both adults and nymphs feed by inserting their needle-like mouthparts into the flesh of fruit or vegetables, resulting in dead areas and distortions. They can be a nuisance to homeowners when the adults aggregate on and in buildings in the fall to seek warm overwintering sites.

The adult is shield-shaped, about the size of a dime, has a brown marbled back with alternating brown and white markings on the outer edge of the abdomen. It can be distinguished from other stink bugs by the presence of distinctive white bands on the antennae and legs. Immature stages (nymphs) range in colour from bright orange and black, black and white, to mottled brown in later stages. They are pear-shaped with white markings on legs and antennae.

Management:

Low numbers of brown marmorated stink bugs can be removed by hand, sweeping or a shop vacuum. Prevent entry into the home by sealing off any access points. The use of insecticides for controlling brown marmorated stink bugs in the home is not recommended. Traps to catch the adults and nymphs are available for purchase, or can be constructed at home. Traps will not eradicate the bugs from your area, but can be useful to remove some of them from your home and surrounding area.



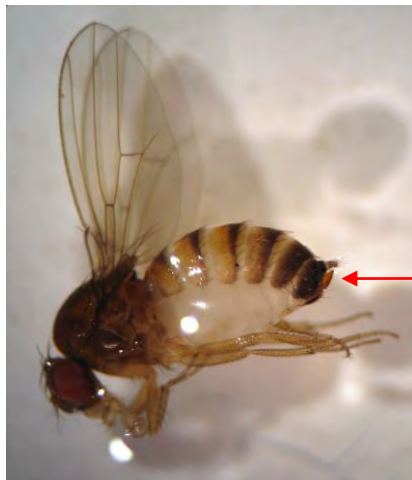
Brown marmorated stink bug sticky trap and lure system

In spring and summer brown marmorated stink bugs are outside feeding on plants. Plants can be protected from bug feeding by using floating row covers, netting or mesh covers, put on before bugs become active, or when new plants are planted. Trap and lure systems continue to improve for brown marmorated stink bugs, and use can help with collecting and removing bugs from gardens. Be sure to remove any stink bugs from harvested fruit containers, to prevent any flavor impacts. Beneficial insects and mites prey upon and parasitize stink bug eggs and nymphs, and can help keep bug numbers in check.

Spotted Wing Drosophila



Spotted wing drosophila adult male with wing spots.



Spotted wing drosophila adult female.



Spotted wing drosophila female ovipositor

Photo Credits: Sheila Fitzpatrick, Agriculture & Agri-Food Canada.

Spotted wing drosophila is a serious fruit fly pest of soft fruit and berries. It is now widespread in Coastal and Interior fruit growing areas of B.C., since its introduction in 2009.

Adults are light yellow or brown flies with red eyes, about 2 - 3 mm long. They look like regular vinegar flies but male flies have a single black spot on the end of each wing. Females have no

spots, and have a distinctive saw-like ovipositor (egg laying organ) which enables them to cut into thin-skinned fruit and deposit eggs inside. Adult flies overwinter in B.C. They begin laying eggs in ripe fruit in late May, and there are at least 3 generations. Populations increase over the season and mid season (late July-August) fruit is at highest risk of infestation.

Unlike most vinegar flies which normally infest overripe, fallen, decaying fruit, spotted wing drosophila females lay their eggs inside intact ripening fruit. Larvae hatch and begin to feed within the fruit, causing softening in the area of feeding. Known hosts in B.C. are both wild and cultivated fruit, including cherry, peach, plum, nectarine, apricot, strawberry, blueberry, blackberry, raspberry, mulberry, salmonberry, thimbleberry, fig, table grape, Oregon grape, currant, elderberry, goji berry, and honeysuckle.

Management:

Good sanitation practices are critical to controlling spotted wing drosophila. Remove or crush leftover and fallen fruit. Collected culls can be sealed in plastic bags or frozen for 2 days or more before disposal. Backyard composting of infested fruit will not kill flies.

Harvest on time, pick clean and often, as overripe unharvested fruit serve as sources of infestation. Pick every day if possible. Refrigerate fruit as soon as possible after picking. Insecticides containing pyrethrins registered for control of fruit pests in the home garden will provide control of spotted wing drosophila flies. No insecticides will kill larvae inside fruit or pupae on the ground. Two sprays for adults flies will likely be needed over the fruit ripening period (eg. A full canopy spray every 7-10 days) particularly in mid season varieties –those harvested from mid July through August. Read and follow label directions and do not apply when bees are present. Commercial pesticide applicators can be hired if desired.

Pests of Specific Berry Crops

Blueberries

High Soil pH

Blueberries planted in high pH soil are typically stunted and fail to thrive. Yellowing of leaves between the veins, especially in new growth, is common. This symptom is commonly mistaken for a pest problem or a nutrition issue.

Management:

Test soil at least 6 months prior to planting to determine pH. A pH of 4.5 to 5.2 is optimum for blueberries. Sulphur-containing products can be added to the soil to lower the pH. Do not lime the soil around the plants unless the soil pH is confirmed to be too low for blueberries. Also see “Lime and Soil pH, page 7-5.

Insects

Blueberry Aphids

(*Ericaphis fimbriata* and other species)

Aphids are carriers (vectors) of a plant-killing disease called blueberry scorch virus. If aphids are abundant, there are no natural biological control agents present, and there are infected blueberry plants nearby, consider spraying the aphids early in the season, before bloom. This is the most critical time (before winged aphids disperse to new plants), but aphids can transmit the virus throughout the growing season. See Aphids, under “Pests Affecting Many Berry Crops” for more information on aphids and management on page 11-1.

Leafrollers and Spanworms

See Leafrollers and Spanworms, under “Pests Affecting Many Berry Crops” on page 11-4.

Weevils

Weevil adults can damage foliage and larvae can damage roots, causing plant decline and death, even in well-established plants. See page 11-6 for more information on weevils.

Diseases of Blueberries

Bacterial Blight

(Pseudomonas syringae)

Bacterial blight is more severe in cool, wet springs or after a late spring frost. The bacterium overwinters on the plant and in dead twigs then spread by wind-blown rain in the spring and fall. The bacterium enters the plant through natural openings such as leaf scars and through wounded tissue. Leaf and flower buds and twig tips blacken and canes die back in early spring. The presence of the bacterium also increases frost damage. Canes with orange leaves may wilt and die. Fruit production is reduced and young plants may be killed by bacterial blight. Small lesions on young canes are irregularly shaped and brownish-black from a few millimeters in length spreading



along the entire length of one-year old canes. Infection stops once the weather warms up.

Management:

The varieties 'Elliot', 'June', 'Rancocas' and 'Weymouth' appear more resistant while 'Bluecrop', 'Bluetta', 'Brigitta', 'Jersey' and 'Patriot' are susceptible. Prune out and destroy all diseased wood as soon as possible before the fall rains. Do not over-fertilize with nitrogen as overly vigorous growth is more susceptible to bacterial blight. Cover bushes with clear plastic tents from late January until blossoms open in April to help reduce damage. The covers should be staked down but left open at the bottom to allow air to circulate.

Copper can be applied before and at bud break in the spring and in the fall to reduce bacterial blight. Follow mixing directions on the label carefully since copper can burn young shoots. Avoid copper application in cool and cloudy or wet weather. Repeated copper applications can lead to development of copper tolerant bacterial strains resulting in ineffective disease control.

Godronia Canker

(*Fusicoccum putrefaciens*)

Godronia canker, one of the most serious fungal diseases of blueberry in B.C., destroys branches and reduces fruit production. This disease spreads from diseased to healthy branches during wet weather in the spring and fall. It infects through leaf scars and openings in the bark. Small, oval, reddish-brown lesions form on one-year-old branches. The centre of the lesion turns grey with reddish to dark brown margin. Lesions turn into larger cankers over several years and eventually girdle and kill the branch. Dead branches look like “reddish brown flags” above the cankers as leaves dry out.



Godronia canker of blueberry

Management:

‘Rancocas’ and ‘Rubel’ varieties are resistant to godronia canker while ‘Bluecrop’, ‘Earliblue’, ‘Jersey’, and ‘Pemberton’ are considered highly susceptible to the disease. Prune off all diseased branches at the base and promptly dispose of the prunings to stop the fungus from spreading. Ensure good air circulation in the garden by selective pruning. Water the plants at the base so that plants dry off as quickly as possible.

Mummy Berry

(*Monilinia vaccinii-corymbosi*)



Mummy berry symptoms on fruit



Mummy berry symptoms on blueberry leaves

Fruit loss due to mummy berry can be severe in wet spring weather and all blueberry varieties are susceptible to the disease. Soon after buds open in spring, the developing flowers, leaves and shoots can become infected by the mummy berry fungus. Damaged new plant growth looks blackened as if damaged by frost. Symptoms of mummy berry show up on new leaves and shoots that suddenly wilt and become covered in a distinct tan to grey fungal growth. At this stage, the fungus produces spores that spread by air and infect the flowers. No further symptoms are

noticed until infected berries start to mature and turn a tan to salmon colour instead of the waxy green colour of healthy fruit. Infected berries drop off before healthy fruit is harvested. When infected berries are cut open, a spongy white fungal growth can be seen inside. Fallen infected berries underneath the blueberry bushes overwinter as tiny, grey to black, shriveled, hard mummies that are pumpkin-shaped. These mummified berries germinate the following spring, in late February to March, forming tiny mushroom-like cups that release spores into the air and infect opening blueberry buds.

Management:

Gather and destroy infected, off-coloured berries during harvest. Keep the ground under bushes clean and rake up and destroy any fallen berries prior to bud-break the next spring to prevent new infections. Ensure good air circulation around bushes by keeping proper plant spacing, weeding and selective pruning. Application of Regalia Liquid Fungicide (a biofungicide containing *Reynoutria sachalinensis*) will provide some suppression of mummy berry.

Fruit Rot



Anthracnose fruit rot of blueberry



Botrytis blight of blueberry

Several fungi cause fruit to rot. Rot may be seen while berries are still on the bushes or after harvest. Many fruit rot infections occur during flowering in the spring but no symptoms can be seen until the fruit starts to ripen. Grey mold caused by the fungus *Botrytis* and anthracnose caused by *Colletotrichum* are the most common fruit rot. Rainfall, presence of moisture, high humidity or cool temperatures (15 - 20 °C) favour botrytis fruit rot, and the infected fruit have a distinctive grey, fuzzy fungal growth. Anthracnose forms salmon to orange coloured masses of spores on the berry surface. Temperatures between 12 - 27 °C are required for anthracnose infection.

Management:

Prune out dead twigs that appear grey and dried up during winter or early spring to remove overwintering sites of the fungi. Improve air circulation by adequately spacing and pruning plants. Remove and dispose of infected fruit to reduce disease spread. Avoid high amounts of nitrogen fertilizer which encourages excessive plant growth and disease. Water in the morning

from the base of the plant and avoid overhead watering. In a wet summer when fruit rot is prevalent, quickly refrigerate fruit and process your berries promptly after harvest as they may not store well. Application of Regalia Liquid Fungicide (a biofungicide containing *Reynoutria sachalinensis*) will provide some suppression of fruit rots.

Blueberry Viruses

Blueberries in B.C. are commonly affected by two virus diseases, *Blueberry scorch*, caused by *Blueberry scorch virus* (BIScV), and *Blueberry shock*, caused by *Blueberry shock virus* (BIShV).

Amongst the two, BIScV is a serious concern because infected bushes do not recover, fail to produce fruit, slowly decline and die after several years. BIScV is spread by aphids (the common blueberry aphid and other aphid species) from infected bushes to healthy ones. Symptoms appear 1 to 2 years after a bush is infected.

Blossoms become blighted, turn brown and cling to the plant.

Young shoots and twigs become blighted and die back. A common symptom is leaves with yellow edges. Other symptoms include red line patterns (oak leaf patterns) on leaves in the fall, leaf mottling, overall pale foliage, blighting of and fewer blossoms and a ‘twiggy’ appearance to bushes. All parts of the plant become infected, even

the roots. BIShV causes blossoms and new shoots to blight at early bloom. At this stage, scorch virus and shock virus symptoms may look the same although shock symptoms usually appear earlier in the season. Although there will be less fruit produced, infected plants recover from the symptoms in 2 to 4 years, but remain infected with the virus. Pollen produced from the infected plants can spread the virus to nearby healthy bushes during pollination.



Blossom blight caused by Blueberry scorch virus

BIScV and BIShV symptoms are easily mistaken for other diseases, such as spanworm damage, bacterial blight, phomopsis blight or frost. Laboratory testing is necessary for correct identification of virus diseases.

Management:

Most commonly grown blueberry varieties are susceptible to blueberry scorch. ‘Jersey’ has some virus tolerance but can carry the virus and is still a source of infection. All varieties appear to be susceptible to BIShV.

Prevent disease spread by:

- entirely removing infected plants including all the roots as soon as possible;
- controlling aphids starting early in the year (before bloom) and again after bloom if aphid numbers increase; and
- using certified, virus-free plants. Do not take or use cuttings from infected plants as these will also be infected with the virus.

Currants and Gooseberries

Insects

Currant Aphid

(*Cryptomyzus ribis*)

Currant aphids feed on the undersides of leaves and young shoots by sucking juices from the plant tissues. Feeding causes leaves to become curled, crinkled, distorted and often yellow or brown coloured. Many generations occur during the growing season. Later in the season, winged females will be produced to migrate to other currant plants. At the end of the season, both females and males are produced and mating and egg laying occur. Aphids overwinter as shiny-black eggs in protected areas on buds and stems.

Management:

There are many natural predators and parasitoids of currant aphids, including ladybugs, green and brown lacewings, hover flies and wasps. These natural enemies generally control the aphids in mid to late summer, and leaf curling soon stops. There is usually no need to apply a pesticide, but it can take a while for the natural enemies to manage the aphids. A strong water spray, or insecticidal soap can help to control aphids; applications need to reach the underside of leaves to be effective, which can be difficult in curled leaves.

Currant Clearwing Borer

(*Synanthedon tipuliformis*)

Larvae feed within canes from summer until the next spring, causing weak canes with yellowish foliage which die during fruit development. Larvae are white with a brown head. They pupate within the cane, and new adults emerge and fly in early summer (May-June). Exit holes and pupal cases can be found on dead canes after emergence. Moths have clear wings, and look like slim wasps. They can be seen resting on leaves and flying above the canopy for the approximately 4 week long flight period. They mate and lay eggs on the currant canes in summer. There is one generation per year.



Currant clearwing borer adult resting on currant leaf



Dying canes caused by currant clearwing larval feeding within

Management:

Cut out dead canes, ideally as soon as they start to die in the early summer. Burn infested canes (where permitted) to kill the larvae within. It is important to cut the canes as low as possible, as the larvae could be down very low in the cane. Completely mowing down currant/gooseberry plantings can be done once every few years to decrease the borer population. New canes will grow in the following year. Note that there will be no fruit in the first year after mowing.

There is no effective chemical control for larvae due to the fact that the larvae are concealed inside the canes. Spraying for moths in home gardens may have limited results and is not recommended. There are pheromones available for this insect that can be used to determine when moth flight begins and ends. Pheromone-baited traps catch males only.

Currant Fruit Fly

(Euphranta canadensis, and Rhagoletis ribicola)

Small yellow and black flies with dark bands across their wings, half as large as house flies, are present at and just after bloom (April-May). The flies lay eggs under the skin of green fruit, which hatch into white, legless larvae which feed within the berries. Some infested berries will drop prematurely; others will remain until harvest, contaminating the crop. These pests may also be found in gooseberries. *Rhagoletis ribicola* also infests Oregon Grape (*Mahonia aquafolium*), a common wild host. There is one generation per year.



Euphranta canadensis, Currant fruit fly, caught on sticky trap

Management:

Bushes can be covered with mesh or netting after blossom is completed to prevent flies from accessing the fruit. Be sure to secure the bottom of the mesh around the stem, as the flies emerge from the ground. “Tree bags” can be made or purchased, and reused year after year. Tarps or weed mats placed under the bushes prior to any fruit dropping off will prevent larvae from getting into the soil to overwinter. Collect and dispose of dropped fruit, larvae, and pupae found on the mats under the plants. Do not compost, as larvae will complete development if not adequately heated. Sticky yellow traps baited with ammonium carbonate can be used to detect the first fly activity which is expected from late April through May. If fruit was infested the previous year, a foliar spray directed at adult flies when they are present can be very effective. Choose an insecticide registered for use on currants for fruit flies and available for home garden use, such as a pyrethrins-based product. One well timed spray for adult flies can significantly decrease pest pressure and improve fruit quality. Insecticides will not affect the larvae as they are inside the fruit. The first spray should be applied within 7 days of the first fly catch, or just after blossom is complete and flowers have dropped.. A second spray can be applied if desired in 7-10 days. Spray in late evening to avoid killing bees that may be active in the area.



Yellow sticky trap for catching emerging currant fruit flies in spring (April, May)

Currant and Gooseberry Sawfly

(Nematus ribesii)



Sawfly larvae - Photo courtesy of Whitney Cranshaw, Colorado State University, Bugwood.org



Entire leaves eaten by sawfly larvae on gooseberry plants

Foliage is eaten by green larvae, up to 12 mm long, with small black spots along their backs and black heads. Larvae feed in groups and entire bushes may be defoliated. Sawfly larvae usually appear during the last half of April on the inner parts of the bush, and gradually feed from inside the canopy and outwards as foliage is depleted. A second generation occurs in mid-summer and can also be damaging.

Management:

Remove larvae by hand-picking or with a water spray. If defoliation is a concern, spray bushes with an insecticide registered for insect control on currants and gooseberries. Repeat later in the season if more larvae appear. Observe pre-harvest intervals on the label. *Bacillus thuringiensis kurstaki* (Btk) is NOT effective against sawfly larvae.

Diseases of Currants and Gooseberries

Powdery Mildew

(*Podosphaera mors-uvae*)

A white, talc-like fungal growth with spores covers the leaf surface, green shoots and particularly the fruit. Later the mildew becomes a dark brown coating with tiny small black specks, intended for overwintering and producing spores. Mature berries also develop a dark brown coating and may crack open and rot. Berries become unmarketable and plants become stunted. The black fruiting bodies of the fungus overwinter on canes and twigs or in fallen leaves and fruit. Spores are released and infect plants the following spring around bloom time. Currants, gooseberries and ornamental *Heuchera* are infected by the common powdery mildew pathogen that occurs in the Pacific Northwest.

Management:

Plant resistant varieties such as the red currant variety ‘Rovada’, the white currant varieties ‘Blanka’, ‘Mason’s’ and ‘Primus’, the black currant varieties ‘Titania’, ‘Tisel’ and ‘Ben Alder’ and the gooseberry varieties ‘Hinnomaki Red’ and ‘Invicta’.

Prune bushes to remove dead and diseased canes and twigs and improve air circulation and light penetration. Rake up and remove infected leaves in the fall or cultivate under the plants in the fall to bury leaves.

Apply lime sulphur at label rates as a delayed dormant spray (just before blossoms are ready to open). Repeat at reduced rates at full bloom and two weeks later. Do not use on sulphur-sensitive varieties. Lime sulphur may cause yellowing and defoliation on some varieties. Do not apply when foliage is wet or when the temperature is above 27 °C.

White Pine Blister Rust

(*Cronartium ribicola*)

The rust fungus *Cronartium ribicola* forms yellow/orange pustules with masses of orange spores on the underside of leaves of currants and gooseberries. Distinct large yellow leaf spots are visible on both the top and bottom of the leaf. Brown hair-like growths develop on the leaf spots on the bottom of the leaf from early spring to late fall. On very susceptible varieties, heavily infected leaves turn yellow and drop off, but the effect on currants is usually minor. However, the alternate host plant, white (5-needled) pine, can be killed by this fungus. (See “Pine”, page 16-60).



White pine blister rust. Photo courtesy of Petr Kapitola, Central Institute for Supervising and Testing in Agriculture, Bugwood.org

Management:

Grow ‘Titania’ black currant which is resistant to rust. Do not plant any currants within 300 meters (1000 feet) and preferably not within 1 km of white pines in landscapes or forests of Eastern Vancouver Island or the Southern Interior valleys. Fungicides are not usually needed or recommended for rust control on currants and gooseberries.

Viruses

Two viruses are known to cause yellow leaf mottling to overall yellowing of currants and gooseberries in British Columbia. They are of minor importance.

Currant big bud mite (*Cecidophyopsis ribis*) and the “reversion” virus it transmits is a very serious problem in Europe. While the mite is sometimes detected in North America, the virus disease is not known to be present here. **Do not obtain *Ribes* (currant or gooseberry) plants from sources outside North America.** Importation of all plants, cuttings and tissue-cultured material is against the law.

Raspberries, Loganberries and Blackberries

Insects

Raspberry Crown Borer

(*Pennisetia marginata*)



Raspberry crown borer larva

New canes wilt, become spindly and can develop swellings or galls at the base or upper root. Canes may break off when tied up in the spring. Plant damage is caused by a 2.5 cm long, white caterpillar with a brown head. This insect spends two years in the larval stage, feeding on the central pith of raspberry canes and in the plant crowns. Pupation occurs in summer within the cane about 2 cm above the soil line, and adult emergence holes can be seen. Adults look similar to yellowjacket wasps, and can be seen resting on raspberry leaves in late summer. Eggs are laid on leaves and the new larvae crawl down to the soil line, where they spend the winter under a small blister-like covering. In the spring larvae tunnel into the cane, and move down into the plant crown to spend their second winter.

Management:

Remove wild *Rubus* species, particularly blackberries, near cultivated plants, as these harbour crown borers. Reduce borer numbers by pruning out weak canes or those with galls at the base; prune as close to the crown as possible without leaving stubs. Look for tunnels in the pruning stubs and canes and kill any exposed larvae. There are no effective insecticides for this pest. Commercial attractant lures are available for purchase to use for monitoring moth flight, but they are not useful for decreasing the pest population.

Raspberry Sawfly

(*Monophadnoides geniculatus*)

Adult sawflies are small thick-waisted black wasps with four clear wings, and yellow legs. They are about 6 mm long, black with yellowish and reddish markings. Adults lay eggs on raspberry plants during flowering. Larvae hatch and feed on the undersides and margins of the leaves during early summer. The larvae grow 13-18 mm in length and are pale green with short, white

spines (tubercles) along their body. Sawfly larvae have many legs (prolegs), which distinguishes them from caterpillars. They may feed in groups if numbers are high enough. After feeding for a few weeks, they drop to the ground, pupate, and spend the winter. There is one generation per year.

Management:

Healthy, vigorous raspberry plants are not seriously damaged by sawfly larvae unless they are present in very large numbers. If larvae are abundant, spray with a strong water stream, insecticidal soap, or other insecticide labeled for use on raspberries. *Bacillus thuringiensis kurstaki* (Btk) is NOT effective on sawfly larvae.

Western Raspberry Fruitworm, or Raspberry Beetle

(Byturus unicolor)



Fruitworm beetles and larvae



Early season feeding damage to raspberry leaves

Adults are 3 mm long, yellowish-brown beetles that feed on new leaves and flower buds and lay eggs at the base of the fruit receptacle. Larvae are pale to tan, slim, up to 5 mm long, and feed inside the berry on the fruit receptacle. There isn't likely to be much direct damage from this insect, but the larvae can become fruit contaminants as they can remain inside the berry at harvest.

Management:

If this pest was present the previous year, and beetles are present or feeding damage on the new growth can be seen, spray plants when blossom clusters separate (late April, early May) to kill the adult beetles. Do not spray after blossoms start to open. Once the larvae are in the berries, there is no way to control them as they are protected inside the fruit. Raspberry fruitworms also inhabit wild *Rubus* such as thimbleberry and blackberry. If possible, locate your raspberry plants away from these wild hosts.

Leafhoppers

Including Bramble Leafhopper (*Ribautiana tenerrima*),
Rose Leafhopper (*Edwardsiana rosae*)

Blackberries are the only caneberries that can be significantly affected by leafhoppers. Both nymphs and adults feed on blackberry leaves, resulting in white stippling, which can become extensive. There are two generations per year.

Management:

If leafhopper numbers are high enough to cause significant stippling, consider applying a spray to manage them. Spray when leafhoppers are still nymphs (not winged) for best results. Adults fly and are easily disturbed; therefore attempting to spray adults is less effective. See page 11-3 for more information on leafhoppers.

Eriophyid Mites

Dry Berry Mites (*Phyllocoptes gracilis*)

Red Berry Mites (*Acalitus essigi*)

These tiny eriophyid mites are best seen with a microscope as they are nearly invisible to the un-aided eye. If populations are high, it is possible to see them on the surface of fruit or at the base of fruit - they look like tiny grains of salt. Red berry mites live and feed on the surface of developing fruit of blackberries. Their feeding prevents full ripening of the berries. Fruit remains red and firm, and doesn't fully mature. Sometimes fruit can become partially but not fully ripe. Dry berry mites also prevent normal fruit ripening, but fruit turns brown and dry rather than remaining red. Late maturing varieties are most susceptible to both these mites.



Fruit damaged by Red Berry Mite feeding

Management:

For both mites, start with an application of sprayable lime sulphur or sulphur alone in early spring before bud break. A second application of sulphur can be made after about 3 weeks, depending on the cultivar. Additionally, at least one application of horticultural (summer) oil that is safe to apply on foliage can be applied during fruit ripening. Ensure oil application does not follow closer than 3 weeks after a Sulphur application.

Diseases of Raspberries and Blackberries

Cane Diseases

(*Botrytis cinerea*, *Elsinoe veneta*, *Leptosphaeria coniothyrium*, *Didymella applanata*)

Botrytis cane wilt, cane anthracnose, cane blight and spur blight are caused by different fungi that infect canes during wet weather. Grey, purple, or brown spots or small cankers appear on canes causing young shoots to wilt and die in spring. Canes turn brown to grey coloured over the winter with sunken, flattened or cracked areas. Check for the presence of fruiting bodies of the fungi that appear like tiny blisters or pimples on cankered canes. Eventually canes become girdled and killed. Bacterial blight (*Pseudomonas*) will also cause shoot dieback in spring.



Botrytis cane wilt of raspberry

Management:

Anthracnose resistant red raspberry varieties include ‘Heritage’, ‘Meeker’, ‘Nootka’ and ‘Willamette’. *Botrytis* cane wilt resistant varieties include ‘Chilcotin’, ‘Meeker’, ‘Nootka’ and ‘Willamette’.

Avoid wounding canes. Improve air circulation by pruning and controlling weeds. Prune out and destroy severely infected canes as soon as possible and remove old fruiting canes promptly after harvest. Avoid using excessive nitrogen. Lime sulphur applied at the delayed dormant stage for rust will also help to control cane diseases (see “Yellow Rust”, below).

Fruit Rot

(*Botrytis cinerea*)

Fruit rot is severe during rainy weather or under sprinkler irrigation when flowers, green fruit and ripening fruit become infected with fungi, especially *Botrytis*. *Botrytis* survives the winter on old, dead leaves, petioles and mummified fruit. In spring, *Botrytis* spores infect young blossoms causing them to turn brown and shrivel up. Often there are no symptoms of fruit rot until berries start to ripen. Fruit become soft, rotted, and may have tufts of fuzzy, grey mold causing them to rapidly rot before or just after harvest. Sometimes other fungi are involved and the mold may be white or green.

Management:

‘Chilcotin’, ‘Meeker’ and ‘Willamette’ have some resistance to *Botrytis* which may help reduce the degree of fruit rot.

Space plants adequately to allow for good air circulation and rapid drying of fruit and foliage after rain. Practice good sanitation by controlling weeds, removing fallen leaves and pruning out diseased canes. Avoid excessive leaf growth by limiting the application of nitrogen fertilizer. Water in the morning from the base of the plants and avoid wetting blossoms and fruit, or use trickle irrigation. Avoid watering close to or during harvest. Pick fruit as soon as it ripens and cover rotten berries in the compost to prevent spreading diseases. Pick and refrigerate fruit as soon as they ripen. Process your harvested berries promptly.

There are no effective fungicides available for use in home gardens. Application of Regalia Liquid Fungicide (a biofungicide containing *Reynoutria sachalinensis*) may provide some suppression of botrytis.

Root Rot and Wilt

Root rot is a major disease complex caused by fungi and/or fungus-like microorganisms such as *Phytophthora* that occurs in heavy, wet soil. *Phytophthora* root rot occurs when soil is cold and wet for a long time in spring and fall. Roots become blackened, rotted and lack fine, fibrous roots. Leaves are small and yellow, becoming bronzed or scorched ‘flags’ that wither during hot weather and stand out distinctly in the summer. Berries often shrivel before ripening. Plants may appear to recover with the production of new roots above the rotted ones. The following autumn, these roots also will become infected and plants become stunted and may die. Pathogenic nematodes and *Verticillium*, a soil-inhabiting fungus, may also attack plants even in well-drained soil, causing a progressive dying of the plants.

Management:

There is no red raspberry variety that is entirely resistance to root rot although ‘Meeker’ and ‘Nootka’ have some tolerance to root rot. ‘Malahat’ and ‘Tulameen’ are especially susceptible to root rot. Use healthy, disease-free plants grown in fertile, well-drained soil to avoid root rot.

Avoid pathogenic nematodes by establishing plants in a fertile, well-drained site that has not been planted with berries or where sod has not been grown. Reduce the risk of verticillium wilt, especially in the Interior, by avoiding areas where alfalfa, eggplant, peppers, potatoes or tomatoes have been grown.

Raspberries will not tolerate waterlogged heavy soils (“wet feet”). In heavy soils, install deep plastic tile drains or build raised beds prior to planting. Do not replant in areas where raspberries have died out unless the soil and drainage are improved. Setting plants in raised beds may be of some benefit, but will require more watering in summer. Do not apply high nitrogen levels to plants infected with root rot. Improving calcium levels in the soil by adding gypsum may have some benefit.

Yellow Rust

(Phragmidium rubi-idaei)

Yellow rust is a problem when wet weather continues late in the spring. The rust fungus overwinters in leaf debris and old cane stubs and can infect all succulent parts of the plant. Yellow pustules appear on the upper and lower surface of the leaves throughout the spring and summer during wet conditions. The rust fungus rapidly builds up causing distinct yellow spots and lower leaves turn yellow and drop off prematurely. By autumn, rust pustules on the lower surface of infected leaves turn black with overwintering spores. Cankers occasionally form on canes making them brittle so that they break off easily when old fruiting canes are being removed. Plants lose vigour and become unproductive, and fruit die on the canes before ripening.



Yellow rust of raspberry

Management:

Rust has not been a problem on ‘Willamette’ or ‘Meeker’ but new races of the rust fungus are being reported in the Pacific Northwest.

Good sanitation is critical in reducing yellow rust. Rake up and burn fallen leaves and remove cane stubs as this is where the fungus overwinters. Be sure to prune out old canes flush with the ground level. Remove and dispose of old fruiting canes and any infected canes soon after harvest. Cultivate under the plants in late fall or early spring to cover any plant debris which could be a source of rust infection. If further control is necessary, spray at the green tip (delayed dormant) stage with lime sulphur. Spraying should be done when conditions are dry to avoid plant injury.

Raspberry Bushy Dwarf Virus (RBDV)

Raspberry bushy dwarf virus infects ‘Meeker’ and many other red raspberry varieties where it causes crumbly fruit and reduced growth. The virus is spread by pollen which is carried by bees to healthy plants. Once a plant is infected it cannot be cured. Plants infected with RBDV have no leaf symptoms; however, fruit quality is seriously affected because the fruit is crumbly. Infected plants are neither bushy nor dwarfed, although canes may be a bit shorter than normal in some varieties. Another possible symptom of RBDV is leaf yellowing in the spring.

RBDV can only be confirmed by testing leaf tissue in a plant diagnostic laboratory. Other factors, such as poor pollination, poor nutrition, root and crown injury, drought or flooding, can cause crumbly berries. A few varieties have the genetic tendency to produce crumbly berries, but these are not generally grown in British Columbia.

Management:

Use only healthy, disease-free planting material that has resistance to RBDV. The red raspberry varieties ‘Chilcotin’, ‘Haida’, ‘Nootka’ and ‘Willamette’ have resistance to RBDV. The newly released ‘Cowichan’ variety is thought to be resistant to RBDV. Most of the other red raspberry varieties, such as ‘Meeker’, are susceptible.

Remove fruiting laterals before bloom in the first year to help delay infection if RBDV occurs in the area. Remove and dispose of infected plants.

Strawberries

Insects

Aphids

Including Shallot Aphid (*Myzus ascalonicus*) and Strawberry Aphid (*Chaetosiphon fragaefolli*)

These small green, yellow, or pink insects feed on many plants. Generally, aphids do not cause direct damage to plants from their feeding. However, shallot aphids can cause direct damage to new growth, resulting in stunting, twisting, and misshapen blossoms and fruit. As well, aphids spread viruses to strawberries, limiting the number of seasons that plants can effectively produce fruit. Aphids have numerous generations per year, and can be found on plants in early spring.

Management:

Control weeds, as they harbour aphids both in summer and winter. A number of naturally occurring beneficial insects help control aphids. However, if viruses are a concern, an insecticide treatment may be warranted when aphid populations start to build, and before winged aphids are formed and disperse to new plants.

Caterpillars

Leafrollers, including Strawberry Fruitworm or Omnivorous Leaf Tier (*Cnephasia longana*), and *Clepsis* spp.

Leafroller larvae are various shades of green with a brown or black head, but can be brown or paler, and up to 20 mm long. The larvae are present in early spring and feed on berries as well as leaves. New leaves are rolled or webbed together. Often, the first few berries to ripen will be damaged just under the calyx. One caterpillar may damage several fruits. Later fruits will not be affected. Moths are tan and bell-shaped or slender, reasonable fliers, but are not commonly seen,

as they fly after strawberry (June bearing) harvest. Day neutral (ever-bearing) varieties which product flowers and fruit all summer and fall may experience other species of leafrollers over the season. Strawberry fruitworm and *Clepsis* spp. (which is usually blackish in colour) have one generation per year. Other leafroller species have two generations per year, but are less common in strawberries.

Management:

Monitor the crop during spring by visually searching for small caterpillars in new growth and flower buds. If low levels of caterpillars are found, hand picking may be all that is needed to control the damage. If significant numbers of these caterpillars are present, apply *Bacillus thuringiensis kurstaki* (Btk) or other suitable insecticide when larvae are present.

Lygus Bugs (Tarnished Plant Bug)

(*Lygus* spp.)



Lygus bug adult and nymphs



Lygus bug nymph

Nymphs and adult lygus bugs suck sap from blossoms, fruit and buds, causing distorted berries. Fruit may be “catfaced” or irregularly shaped. This type of injury may also be caused by frost damage and, occasionally, by boron deficiency. Lygus bugs reside away from the strawberry plants most of the time and venture onto strawberry plants once flowers are present.

Management:

Many weeds and other flowering crops can be hosts for lygus bugs. Good weed management will help decrease lygus bug presence. Sticky traps can be used around strawberry plants to catch adults, which indicate when the lygus bugs are becoming active in the spring. Once adults are found on the sticky traps, look for nymphs in the new growth and emerging flower buds. If significant numbers of lygus bug nymphs (more than 1 per plant) are present on plants before or during bloom and fruit development, apply an appropriate insecticide such as pyrethrins to decrease the numbers of nymphs. Day neutrals may need a second application some time later in the season as flowering continues and lygus can be present throughout the summer.

Spittle Bugs

(Superfamily Cercopoidea)

A frothy spittle with a small, green insect within is found on deformed leaves or buds in early summer.

Management:

Once spittle masses have been formed, a high pressure water spray will dislodge the insects and cause them to dry out and be exposed to predators by removing their covering of bubbles. If serious infestations are present, and washing is not effective, apply insecticidal soap.



Spittlebug nymph in spittle mass

Root Weevils

Black Vine Weevil (*Otiorhynchus sulcatus*) and other species



Weevil larva in strawberry crown



Notching of leaves by adult weevil feeding

Weevil larvae can cause significant damage to strawberry roots and crowns. Larvae can burrow into the fleshy plant crown. If weevils are a risk or are present, an aggressive approach to preventing and managing weevils should be taken to protect strawberry plants. Weevil adults move to adjacent plants and gradually more plants become infested. Adults feed on leaves in a characteristic ‘notching’ pattern. This damage isn’t usually very damaging, but is an indicator that there will be larvae feeding on the roots and crowns of the plants. Weevils can move into strawberry planting from other host plants such as woody ornamentals or other perennials. Protect your strawberries by planting away from woody plants and other herbaceous perennials that weevils may be established in. Hand pick and destroy weevil adults when found. See page 11-6 for more information.

Note: Predatory ground beetles (Family: Carabidae) look similar to weevils in size and shape, however, ground beetles are much faster runners and are present on the ground. Weevils are usually seen on the plant foliage and walk far slower. Predatory ground beetles are important garden pest predators, and feed on caterpillars and other larvae, as well as slugs and aphids, so should not be harmed.



Three species of predatory Carabid (ground) beetles commonly found in B.C. gardens

Mites

Cyclamen Mite / Strawberry Mite

(*Phytonemus pallidus*)

This tiny mite is not easily visible to the naked eye but its presence can be detected by symptoms on the plants. It attacks all varieties of strawberry and damage is most noticeable during the spring and early summer. It feeds mainly on young unfolding leaves causing them to be “crinkled” or “puckered” in appearance. If the leaf stems and runners are attacked they become rough or bumpy to the touch. Severely infested plants are stunted. Some other factors can cause similar symptoms (see “Misshapen Berries”, page 11-35). Look for mites which look like tiny grains of salt in the growing points, sometimes deep in the crown. Use of a hand lens can be helpful, as these mites are very small. Presence can be confirmed by a plant diagnostic lab.

Management:

Destroy infested plants; obtain new, mite-free plants and plant them in a different part of the garden. No chemical control is available for home garden use. Washing with insecticidal soap will not usually kill cyclamen mites on strawberry, in part due to the mites being in hard-to-reach

places in the plant. Predatory mites can help decrease strawberry mites and their damage, particularly on new plants. These predators occur naturally but can be purchased for release in strawberries.

Two-Spotted Spider Mite

(*Tetranychus urticae*)

These mites feed on the lower surface of older leaves causing white flecking visible on the upper leaf surface. Large populations can build up quickly and cause leaves to dry up and turn brown, particularly during the mid-summer. Yields can be reduced, especially if mites are present early in the season. Two-spotted spider mites are tiny (~0.5 mm long). High populations of these mites will create fine silk webbing and they use the threads for traveling to new plants for further colonization. From April to September they are pale yellow with two large black spots on each side of the body. Adult females have the largest and darkest spots. From mid-September onwards, mites turn orange as they prepare to overwinter in the soil. In early spring, females become active, feed, and lay round clear eggs on the underside of leaves. Numerous generations occur per year. There are many host plants for two spotted spider mites, so mites can easily be introduced into home gardens from the surrounding environment.



Two-spotted spider mites at various stages: eggs, young, and adults. Photo courtesy of Agriculture and Agri-Food Canada.

Management:

Several natural enemies of mites are present in B.C. and can usually keep mite numbers low enough. These include predatory beetles (*Stethorus* spp.), predatory mites (*Neoseiulus* = *Amblyseius fallacis*), and pirate bugs (*Orius* spp.). Keeping plants watered adequately and keeping dust down will limit mites. If mite numbers per leaf are high and there is webbing present, an insecticide registered for mite control in strawberries and the home garden can be used to lower mite numbers. Full coverage of the plants is important because the mites are on the underside of older the leaves.

Diseases of Strawberries

Fruit Rot

(*Botrytis cinerea*)

During cool, rainy weather or under sprinkler irrigation, flowers, green fruit or ripening fruit become soft, rotted and covered with a fuzzy, grey mold called *Botrytis*. This fungus survives the winter on old dead leaves, petioles and mummified fruit. In spring, *Botrytis* spores infect young blossoms which are especially susceptible during anthesis. Symptoms are delayed until fruit start to ripen then infected fruit rapidly rot. In warmer weather, another fungus called *Rhizopus* may cause ripe berries to collapse in a watery decay. This mold is white instead of grey.



Botrytis fruit rot of strawberry

Management:

There are no cultivars entirely resistant to fruit rot. The varieties ‘Shuksan’ and ‘Totem’ are less susceptible to fruit rot. Day-neutral varieties such as ‘Tristar’ and ‘Tribute’ also have less fruit rot in Coastal areas. ‘Rainier’ and ‘Northwest’ are very susceptible to *Botrytis*.

Space plants adequately to allow good air circulation and rapid drying of fruit and foliage after rain. Practice good sanitation by controlling weeds, clipping plants and raking and removing old, dead leaves after harvest. Keep rows narrow and cut runners to prevent matted growth between rows. Avoid excessive leaf growth by limiting nitrogen fertilizer. Prevent fruit contact with soil by using sawdust, straw, or plastic as a mulch. Water in the morning and avoid wetting blossoms and fruit by watering at the base of the plants or use trickle irrigation. Avoid watering close to or during harvest. Pick fruit as soon as they ripen. Refrigerate and process berries quickly as they will go moldy in the fridge. Cover over any rotten berries in the compost to prevent spreading the disease.

There are no effective fungicides available for use in home gardens. Application of Regalia Liquid Fungicide or Bayer Advanced Natria may provide some suppression of grey mold.

Powdery Mildew

(*Sphaerotheca macularis* f. sp. *fragariae*)

Powdery mildew is caused by a fungus which survives the winter in diseased leaves and plant debris. Moderate to high humidity, warm temperatures (15-27 °C) and dry conditions favour powdery mildew. Flowers, leaves and fruit can become infected with powdery mildew. Infected

leaves curl upward along the edge revealing a reddish undersurface coated with a distinctive greyish-white powdery, fungal growth and fungal spores. Leaves later turn a noticeable reddish purple or have small purple spots. Immature fruit may turn hard and fail to ripen, or fruit may develop a dusty, white covering, a “mushroom” smell with a flat or bitter taste. Severely infected fruit may be brown or russeted.

Management:

There are no completely resistant varieties but ‘Benton’, ‘Hood’ or ‘Totem’ have disease tolerance. ‘Shuksan’ and ‘Sumas’ are moderately susceptible varieties. ‘Redcrest,’ ‘Independence’, ‘Firecracker’ and ‘Puget Summer’ are very susceptible to powdery mildew.

Remove and destroy (compost) severely diseased plants and old infected leaves. Clip off and dispose of old leaves after harvest. Sulphur is effective against powdery mildew and may be used on both June-bearing and day neutral varieties. Sulphur has the advantage that it will volatilize during hot weather increasing its effectiveness; however, it can also burn the fruit and foliage in hot weather. Do not apply within one day of harvest. Fungicides containing citric acid + lactic acid or biofungicide containing *Reynoutria sachalinensis* may also provide some suppression of powdery mildew when used preventatively.

Red Stele, Black Root Rot and Verticillium Wilt

A soil-borne, fungus-like microorganism called *Phytophthora fragariae* causes red stele root rot in cool (1-10°C) wet weather during spring, fall and winter. Heavy, wet soil and low areas that are poorly drained favour root rot. When roots are cut lengthwise, the inner core (stele) of infected roots appears red colour while the outer cortex stays white. The distinct ‘red stele’ symptom will disappear when soil temperatures rise in the summer. Lateral roots are destroyed giving the main roots a ‘rat tail’ appearance. Later, roots turn dark brown and plants become undernourished, wilt and decline, producing little new growth with small berries. Older leaves turn brown and die. In raspberries, root rot is caused by *Phytophthora rubi*, different from the red steel pathogen.

Black root rot is caused by various fungi, chiefly *Rhizoctonia fragariae* in heavy, wet soils. In some cases only young feeder roots are rotted, but in other cases the entire root system and crown of the plant is affected. Infected roots turn black and rot.

Verticillium wilt is caused by the fungus *Verticillium albo-atrum* or *Verticillium dahlia*. Symptoms resemble drought stress where outer and older leaves develop reddish brown necrotic areas between veins. New leaves if any, formed become stunted and wilt. Infected plants wilt rapidly under water or heat stress. On the runners and leaf petioles, dark brown streaks or blotches may appear. Decaying crown and plant base show brown discolouration in the vascular system when cut open.

Management:

Use certified disease-free plants and disease-resistant varieties when planting.

June-bearing varieties Allstar, Delite, Earliglow, Guardian, Lester, Redchief, Scott, Sunrise, and Surecrop are reported to be resistant to Red stele and Verticillium wilt. Ever-bearing varieties, Tribute and Tristar, are also reported to be resistant. Since new varieties are constantly being developed, check with your local nursery or supplier to see if any new resistance varieties are available. Resistant varieties may still become infected under specific conditions if certain races of the pathogens are present.

Avoid growing strawberries repeatedly in the same spot or where the disease is known to occur. Choose new planting sites where the soil is well-drained and the disease is not known to occur. Avoid low areas and heavier soils. Set plants in raised beds or make furrows to improve soil drainage. Soils well supplied with organic matter are generally better-aerated and less prone to root rots.

To avoid verticillium wilt, do not plant strawberries in soil where potatoes, eggplant, peppers, or tomatoes have been grown.

Leaf Spots

(Mycosphaerella fragariae)

Leaf spots are caused by the fungus that can survive on plants or in plant debris and then rapidly spreads during wet weather (12 hours of wetness) in spring and fall (7-25 °C). Rain splashing and overhead watering spread the disease. Grey leaf spots surrounded by red or black margins develop on leaves and small brown spots form on leaf and flower stems (petioles). Occasionally small black spots appear on fruit leading to black seed disease where the fruit surface is hard and brown.

Management:

Use certified disease-free transplants. Most varieties show some resistance but may develop the disease during prolonged wet periods. 'Puget Reliance' and 'Shuksan' are very susceptible.

Leaf spot does not usually cause enough damage to warrant control measures. Space plants to permit good air movement. Clip off and dispose of old leaves and plant debris after harvest to help reduce the disease.



Mycosphaerella leaf spot on strawberry

Misshapen Berries

Berry size and shape depends on the number of healthy seeds that form on the berry surface. Misshapen berries occur when seeds do not develop properly. Berries may be catfaced or monkey faced and become pinched-in or they may have multiple tips or a fan-shape (fasciated). The causes of poor seed development and misshapen fruit can be due to the environment (poor pollination due to wet weather, frost or hail injury, high temperatures, drying wind, nutrient imbalance due to boron or calcium deficiency or excess nitrogen or herbicide injury), genetics of the plant or pest related (grey mold, strawberry mites, aphids, spittlebugs, lygus bugs). Leaves that are blunt and curled up at the tips with misshapen berries may indicate a boron deficiency. A calcium deficiency could be the problem when only the leaves are misshapen. Lygus bugs can cause serious damage in both early June fruit and later in the growing season. Seeds damaged by lygus bugs are hollow inside but they are the same size as non-damaged seeds. Weather related injury or poor pollination results in smaller (non-viable) seeds.



Catfacing in strawberry. Photo courtesy of Andrea Buonassisi

Management:

Try to determine the cause of the misshapen berries. Some strawberry varieties have the genetic tendency to form fan-shaped (fasciated) fruit. Consider weather conditions during bloom that could cause poor pollination. Check for the presence of insects and diseases. Monitor plants for lygus bugs and strawberry mites. If these are not found, the cause may be a nutrient deficiency. If both leaves and fruit are affected, add boron by spraying plants with a solution of 1 to 2 mL borax/L of water. Do not apply more than twice per year as excessive boron is toxic to strawberries. Foliar calcium sprays are not usually effective since calcium moves very slowly within the plant. Instead, apply a soil fertilizer containing calcium each spring if the problem persists.

Strawberry Crinkle Virus

The four common aphid-borne viruses that occur in strawberries are *Strawberry mottle virus*, *Strawberry mild yellow edge virus*, *Strawberry vein banding virus* and *Strawberry crinkle virus*. General symptoms of virus infection on susceptible strawberry varieties such as ‘Hood’ include plant stunting, leaf yellowing, mottling, curling and/or crinkling. A new virus complex in the Pacific Northwest involving *Strawberry latent ringspot virus* (SLRSV) causes severe twisting and stunting of plants and distinct reddening of leaf veins. The varieties ‘Totem’ and ‘Rainier’ are particularly susceptible to this new virus complex. A yellow, variegated mint is implicated with the possible spread of SLRSV in the United States. Virus infected plants gradually decline and become unproductive in one to three years. Nutrient deficiencies can often be confused with symptoms due to virus diseases. A laboratory diagnosis may be needed to identify the cause of the problem.



Strawberry crinkle virus

Management:

Grow certified, disease-free plants that are virus tolerant such as ‘Puget Reliance’, ‘Shuswap’, ‘Sumas’ and ‘Totem’. Although the variety ‘Puget Reliance’ is virus tolerant, it may still show mild symptoms including stunting and reduced fruit size and yield. Avoid susceptible varieties such as ‘Hood’. Do not propagate runners from virus infected plants because they will carry the virus. Do not bring in plants from other areas as they can carry new viruses.

Select a new site for strawberries that is not next to old, infected plants. Remove and dispose of virus infected plants as soon as possible before growing new plants. Control weeds as they can harbour viruses and the insect vectors that spread viruses, such as aphids.

Monitor plants and control aphids in spring and fall when winged aphids and peak flights of aphids that spread the viruses from old to new plantings occur.