Pest Fact Sheet
Fruit fly

Identification

There are 2 species of fruit fly that are a concern to cherry production; the Queensland fruit fly (*Bactrocera tryoni*) and the Mediterranean fruit fly (*Ceratitus capitata*). The adult flies look similar and are difficult to tell apart. The QFF can be up to 8mm long, while the MFF only reaches 5mm long. Both have dark yellow/brown bodies but the QFF has transparent wings, while the MFF has orange/brown bands across the wings. Larvae and pupae are also similar, but only QFF overwinters as an adult.

Mediterranean fruit fly (top)
with enlarged view of banded wings (bottom)

Damage

Fruit fly damage results from flies laying eggs in ripe and maturing fruit. This causes physical damage to the surface of the fruit (stings) and further damage when the eggs hatch. Stings can be seen in maturing fruit. The emerging larvae feed on the fruit. Damaged fruit is not only unmarketable due to feeding damage but quickly rots on the tree. Under ideal conditions rot can spread quickly increasing the level of damage.

Life Cycle

In cherry orchards, fruit fly are not often detected until late in the season (late summer) when populations peak. Fruit flies usually enter cherry orchards from other fruit orchards. Adult flies become increasingly active as spring progresses and lay eggs in maturing fruit. Eggs can hatch within a few days – the larvae remain in the fruit. When mature, larvae leave the fruit to drop to the soil to pupate.

Larval and pupal stages progress depending on temperature, but can be as little as 2 weeks. The QFF overwinters as adult flies, but the MFF overwinter as pupae.

Queensland fruit fly – transparent wings

Fruit fly are pests of concern to;

QFF – **China, Japan, Korea, Philippines, Taiwan. Thailand, USA**

MFF – **China, Japan, Korea, Philippines, Taiwan. Thailand, USA**

Monitoring and control

Monitoring for fruit fly involves trapping. To meet export requirements traps should be in place by bud burst and monitored until fruit is harvested. It may also be worthwhile to continue monitoring post-harvest for your own records, and to help build up a picture of when fruit fly are in your region. Fruit fly will continue to breed on unpicked and fallen fruit. Traps for both types of fruit fly are available – talk to you local supplier.

State departments also monitor for fruit fly – talk to your local department about what is happening in your region, and for updates on current distribution and zoning. For areas accepted as pest free, state monitoring is usually accepted under export protocols but check with them prior to the start of the season.

In addition, fruit should be monitored for 'stings' from the middle of the season as they mature. Appropriate action when fruit fly is detected includes bait spraying (bait plus insecticide) and when pressure is high - cover sprays. Refer to the IPM calendar and export manual spray program guide.

References

NSW DPI factsheet – managing QFF in citrus
NSW DPI 1995 IPDM manual – Summerfruit
PaDIL
http://www.padil.gov.au/

Pest Fact Sheet
Codling Moth

Identification

Codling moth eggs are oval-shaped, flat and about 1mm long. When first laid they are white, but develop a reddish ring with time. The larvae start out as a 2mm white grub with a black head, and then progresses through different larval stages to become cream/pink with a brown head. Larvae can reach up to 15mm long when mature.

Larvae remain dormant or pupate in a cocoon before emerging as adult moths. Adult codling moths can be up to 1cm long with a wingspan of up to nearly 2 cm; the females are usually bigger that males. They have mottled grey wings with dark brown tips and are often hard to spot.

Damage

Codling moth damage is not generally seen and there is evidence to support cherry not being a host plant for codling moth (Hansen & Lewis 2003; Hansen & Lewis 2011; Wearing & Hansen 2008; Wearing & McLaren 2001). In apples, codling moth larvae can enter the fruit by chewing the skin and boring. The larvae can feed on seeds and exude a brown 'frass' or secretion that forms on the fruit surface at the point of entry.

Life cycle

Adults emerge in spring, mate and lay eggs on leaves and fruit. Female moths release pheromones to attract male partners. Eggs are laid singly; females can lay up to 70 eggs. As soon as eggs hatch the larvae search for fruit to bore into and mature. Once mature the larvae exit the fruit, drop to the ground and find a suitable pupation site.

Pupation occurs in the soil, in plant debris, or under bark. Temperature effects the rate of development, but up to 3 generations can occur in an apple production season. As the weather cools, pupae can overwinter to emerge as adults the following spring.

Codling moths are pests of concern to; **Japan, Korea, Philippines, Taiwan**

Monitoring and control

Monitoring is required to meet export protocols. This is undertaken in Tasmania by DPIPWE for export to Korea or Japan – talk to DPIPWE if this is your situation. Otherwise, it is recommended to monitor for codling moth by having at least one pheromone trap per registered block (up to 10 ha.) Pheromone traps are recommended more to determine the first flight of moths to develop an action plan, than to use as a control measure only. Maintaining good orchard hygiene (keeping weeds down and removing loose bark and pruning waste) will reduce the number of overwintering sites.

Chemical control should be timed to match hatching of eggs as once larvae enter fruit control is difficult. Using traps to find first flight will then give you a good indication of when eggs will hatch. This can be calculated by degree days; optimum temperatures for codling moth activity are between 10 and 31^{o}C, 111 GDD required for egg hatch. Talk to your local agent for further information, but it is anticipated that control will not be needed. Refer to the export manual spray guide for available chemical options.

In cherries, monitoring for the presence of codling moth should be all that is required, given the support available for cherry not being a host plant. Continued monitoring may establish evidence for non-host status in Australia. Studies have even shown that codling moth (when given only cherry fruit into which to lay eggs) could not complete a full life cycle in cherry fruit (Hansen & Lewis 2003). Trap counts are reported to be low in cherry orchards, even when adjacent to pome fruit (Johnson & Hansen 2008).

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Hansen, J. D., & Lewis, L. R. (2011). Pre-harvest survival of codling moth in artificially infested sweet cherry fruits. Crop Protection, 30(9)

http://www.ipm.ucdavis.edu/

Johnson, J. A., & Hansen, J. D. (2008). Evidence for the non-pest status of codling moth on commercial fresh sweet cherries intended for export. Crop Protection, 27(11)

Wearing, C. H. & McLaren, G. F. 2001. Evidence that sweet cherry, *Prunus avium* L. is not a host of codling moth, *Cydia pomonella*, (Lepidoptera: Tortricidae). Crop Protection, 20

Mature codling moth larvae

Pest Fact Sheet
Light Brown Apple Moth
Lesser Light Brown Apple Moth

Identification

Eggs from the apple moths are laid on upper surfaces of leaves in clumps of up to 80 eggs. They are small (less than 1mm), pale to begin with but progressively become yellow as they age. Just before hatching the dark head of the larvae become apparent. Larvae yellow/pale green and about 1mm long when emerging from eggs. They can reach up to 15mm long when mature. Larvae can have a central strip of darker green. Pupae are about 12 mm long.

The adult moths are pale yellow to pale brown. The adult apple moths can be up to 10mm long with a wingspan of up to nearly 2.5 cm; the females are usually bigger than males. The lesser light brown apple moth is so named as it is slightly smaller than the light brown apple moth, but otherwise it is extremely difficult to distinguish between the two. Talk to your local diagnostic agency regarding identification if you are concerned.

Damage

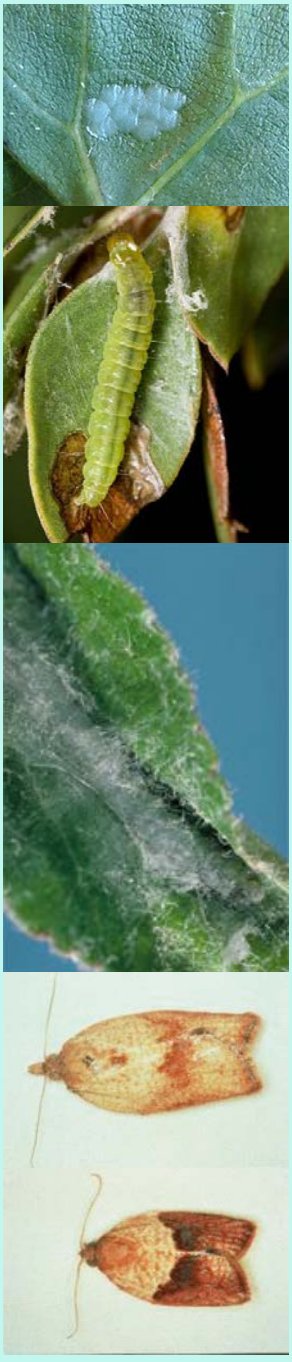
Apple moth damage is a result of the larvae feeding on buds, fruit, flowers, and leaves. Damage to fruit usually occurs as surface feeding, causing irregular brown areas forming on the surface of the fruit. The larvae will enter the fruit occasionally to feed.

In addition to this direct damage, apple moths are also linked with the spread of fungal infections such as botrytis. The webbing produced by the larvae in fruit bunches early during fruit development can lead to poor development, and the debris left within bunches increases the risk of fungal infection in bunches. The larvae will seek protection by spinning a webbed covering on the underside of leaves, or rolling a leaf closed altogether with webbing. This leaf rolling nature of the insect may also reduce leaf function.

Life cycle

Adults emerge through spring and into summer in consecutive generations. In Australia three generations have been noted under ideal conditions. The adult moths lay eggs on the upper sides of leaves, from which the larvae emerge after 1-3 weeks. Larvae search for protected areas to mature and pupate. Initially the undersides of leaves close to midribs are preferred sites and the larvae create a silken cocoon. As larvae mature the silken webbing may envelop whole leaves, or they may enter fruit bunches. This larval period lasts from 3-6 weeks, and then pupation occurs in the larval 'nests'. The moth overwinters as larvae (usually those from eggs late in the growing season or in Autumn) in plant debris or host plants such as weeds. Warmer weather then accelerates development, pupation occurs and the adult moths emerge and mate soon afterwards.

Light Brown Apple Moths are pests of concern to;
LBAM – **China, Korea, Thailand, USA**
LLBAM – **China, Korea**



Monitoring and control

Light brown apple moths have been noted in many regions of Australia, but prefer the cooler climates. Hot, dry climates can suppress moth numbers. Monitoring is required to meet export protocols. Monitoring for apple moths is undertaken using pheromone traps. Pheromone traps are used to determine the first flight of moths and to develop an action plan. Chemical control should be timed to match hatching of eggs. Flight dates and climate information can give you a good indication of when eggs will hatch. This can be calculated by degree days (130 GDD); optimum temperature for activity is between 7 and 30^{o}C. Talk to your local agency for further information, and refer to the IPM calendar. Refer to the export manual spray guide for available chemical options.

Maintaining good orchard hygiene (keeping weeds down and removing loose bark and pruning waste) will reduce the number of overwintering sites. There are a number of parasitic insects of apple moths, so exercise caution when applying broad spectrum insecticides.

References

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Burgi, L. P. & Mills, N. J. 2010. Cold tolerance of the overwintering larval instars of light brown apple moth Epiphyas postvittana. Journal of Insect Physiology, 56
Gutierrez, A. P., Mills, N. J. & Ponti, L. 2010. Limits to the potential distribution of light brown apple moth in Arizona-California based on climate suitability and host plant availability
GWRDC LBAM fact sheet 2012
Zalom, F. LBAM Biology. California Ornamental Research Federation

From top to bottom: LBAM eggs, larvae, webbing and leaf-rolling, and female and male adult moths

Pest Fact Sheet
Oriental Fruit Moth

Identification

Oriental fruit moth eggs are laid on the upper surface of leaves; new shoots are preferred. The eggs are small (6mm) and circular or oval-shaped. They are a translucent white progressing to a yellow/orange over a period of 1-2 weeks, depending on temperature. Larvae are creamy pink with a black head, and range from 1.5mm to 12mm long. They are similar to codling moth larvae, but oriental fruit moth have a distinctive anal comb (look on the underside of the last body segment). When the larvae mature they leave the terminal leaves or fruit on which they have been feeding to find a suitable place to pupate.

Pupation occurs in cocoons on lower parts of the trunk or in surrounding plant debris. The emerging adult moths are mottled grey (without the brown on wing tips found in codling moth). Wingspan can reach 13mm.

Oriental Fruit Moth damage on young shoots

Damage

Larvae prefer new shoots and young leaves, so this is where damage is first seen. The larvae enter the shoot tips and burrow down which causes shoot wilting and dieback, and can impact on tree development (especially when trees are young). As fruit develop larvae can sometimes enter and feed on green fruit, but it is more likely that ripening fruit will be infested. This occurs more easily when the weather is damp, and consequently fruit damage associated with oriental fruit moth can lead to fungal infections.

Life Cycle

Oriental fruit moths can have several generations each year, depending on the weather. Adults emerge in spring prior to bloom and begin to lay eggs within 7-10 days. Each female can lay up to 200 eggs. In warm conditions eggs can hatch quickly, larvae maturation and pupation can be completed in a few weeks so the life cycle can repeat several times in a season. Any larvae present as the weather cools in autumn can overwinter in cocoons.

Oriental Fruit Moth is a pest of concern to;

Philippines

Monitoring and control

Monitoring for oriental fruit moth is recommended, even though it is not a well-known pest of cherries and is rarely a pest when an insecticide program is in place. Most insecticides targeted at leaf rollers will suppress other moth pests such as oriental fruit moth. Refer to the export manual spray guide. Pheromone disruption is a potential option.

Oriental Fruit moth larva (above) and adult moth (below)

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Hogmire, H. & Beavers, S. 1998 Fruit Insect focus – OFM. West Virginia University

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Pest Fact Sheet
Aphids

Identification

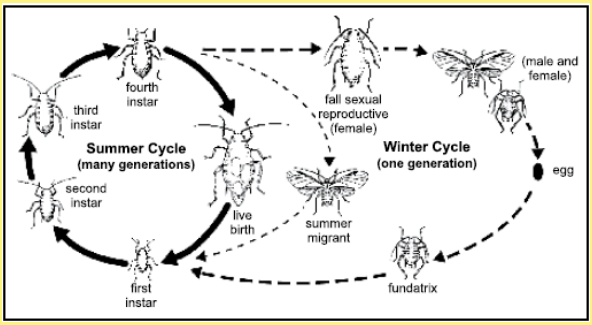
The two black aphids (black cherry and black peach) are difficult to tell apart however the black peach aphid is not likely to infest cherry trees but may infest stone fruit trees (the black cherry aphid is the only dark-coloured aphid known to attack cherry trees). The adult aphids are both dark and about 2mm in size. The nymphs are slightly different; the black cherry aphid nymphs have been described as dark brown to black, with the black peach aphid described as reddish brown to brown. Both aphids have shiny black oval eggs usually found on the underside of leaves, on buds and bark.

Life Cycle

Black cherry aphid eggs hatch just before bud burst in spring. During spring and early summer there can be several generations feeding on new leaves. Generally aphids (black cherry and black peach) will not be seen after mid-summer, when winged adults migrate to summer host plants (plants from the mustard family). Black cherry aphid eggs can remain (overwinter) on bark or buds ready to hatch in the next spring. The black peach aphid overwinters on roots of host trees (peach and related trees).

Damage

Both the black cherry aphid and the black peach aphid cause similar damage symptoms on fruit trees. Aphids often inhabit terminal leaf shoots, particularly when leaves are young and just emerging. Damage at this time includes leaves that curl inwards, and the presence of a sweet 'honeydew' secretion within the curled leaves and extending into lower leaves. The honeydew secretion can additionally cause fungal problems. Also if aphid infestation is severe leaves may brown and drop. Under these conditions fruit may decay, develop with abnormalities or with a reduction in size.



General life-cycle of aphids (above) and black cherry aphid adults and nymphs (right)

Aphids are pests of concern
Black Cherry Aphid - **China**
Black Peach Aphid – **China, Korea**

Monitoring and control

It is essential to examine trees (especially terminal leaf tips) regularly during and shortly after bud break for the presence of aphids. During this short period monitoring at least twice weekly is recommended. Once leaf-curl damage has occurred it will become more difficult to control numbers. To meet some export protocols it may be required to continue monitoring each fortnight until harvest (see export manual).

A good winter program (oil sprays before bud burst) will help prevent infestation, and aphids have a number of natural enemies – such as ladybirds. Should infestation occur, there are chemical options available in Australia for use in sweet cherry orchards. Refer to the export manual spray program guide and bear in mind that some chemicals may harm natural enemy populations. Also – it may not be necessary to spray entire blocks; look out for hot spots and treat them.

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http://www.agf.gov.bc.ca/cropprot/tfipm/aphids.htm

Pest Fact Sheet
Weevils

Identification

Two types of weevils are important to cherry production; the Fuller's rose weevil, and the garden weevil (Vine calandra). Adults of both are about 7-8 mm long and grey to dark brown in colour. The way to distinguish between the two is to look for a v-shaped marking on the back of the weevil – if present you are looking at the garden weevil.

Weevils lay eggs in clumps and colour varies anywhere from white to black depending on age. The Fullers rose weevil eggs are often in clumps of 20-30 and look papery. Larvae of the Fullers rose weevil and the garden weevil are pale yellow, pupating after 4-11 instars. Pupae have short bristles.

Garden weevil (left) and Fuller's rose weevil (right)

Damage

Weevils do not generally damage fruit, but will sometimes feed on them, however they can lay eggs on fruit making them unmarketable. Weevils damage leaves (of both the cherry tree and weeds within the orchard) chewing leaf margins and creating a ragged edge. In some cases leaves may also have 'shot hole' symptoms.

Life Cycle

Adult weevils can be found all year, but peak levels are during summer. Adults lay eggs in plant debris, mulch or the soil and can lay up to 70 eggs over a 7 day period depending on temperature. Eggs hatch in about 2 weeks. The larvae remain in, or burrow into, the top 10cm of soil to overwinter.

After progressing through a number of instars, pupation occurs in the soil in late winter, early spring, and adult emergence occurs from spring through summer. Adults can begin laying eggs 3 weeks after emergence and continue to lay eggs over the summer period.

Weevils are pests of concern to;
Fuller's Rose Weevil – **China, Korea**
Garden Weevil – **China, Korea**

Monitoring and control

Monitoring for weevils needs to target the pupation period; shortly before and during bud burst - it may be required to continue monitoring each fortnight until harvest (see export manual).

Check soil for pupae when soil disturbance may be effective in reducing numbers. Regularly examine new leaf growth close to the ground, and weed leaves for adult leaf damage. Banded cardboard traps may be useful for monitoring and beating tree limbs will help find adult weevils moving within the tree.

Refer to the export manual for chemical control options. Dusk or night applications are recommended as weevils are active during the night. Post-harvest treatments may also be an option to prevent the use of insecticides close to harvest.

Leaf damage caused by weevils in citrus

References

Bredenhand, E., Van Hoorn, A., May, F., Ferreira, T. & Johnson, S. 2010. Evaluation of techniques for monitoring banded fruit weevil, Phlyctinus callosus (Schoenherr) (Coleoptera: Curculionidae), infestation in blueberry orchards. African Entomology, 18, 205-209.

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NSW DPI Pest and Disease info

Padil

http://www.padil.gov.au/

UC ipm online

Pest Fact Sheet
Mealybugs

Identification

There are several types of mealybugs in Australia. The two of concern to cherry production and export are the long-tailed mealybug and the citrophilus mealybug. In general, the adults are all soft-bodied, segmented, covered in varying levels of powdery wax (usually white) and can be up to 5mm long. The long-tailed mealybug is so named because of its distinctive long tail filaments. It has a pale body. The citrophilus mealybug in contrast has dark red body contents under the white coating, and short tail filaments. Adults live in colonies alongside eggs and nymphs (crawlers). Mealybug crawlers can be very difficult to see – a hand lens is recommended.

Damage

Mealybug damage is similar to aphid damage – they are both sap-sucking insects. Mealybugs will also secerte 'honeydew' which encourages fungal growth. Severe infestations of mealybugs can also cause leaf drop and reduced fruit growth and maturation.

Another concern with mealybugs is that they are known vectors of viruses. The grape and apple mealybug (which are not likely to be seen in Australia) are vectors for the little cherry viruses, but it is unknown whether the citropilius and long-tailed mealybugs are vectors. However, until it is shown to be otherwise mealybugs should be managed carefully.

Life Cycle

Mealybug lifecycles are generally short, varying with species from 1 to 4 months, so several generations per year are likely. Mealybug eggs are laid on the undersides of leaves in a protected spot such as in dense canopy or bunches. Egg numbers can be high. The adult female long-tailed mealybug can lay up to 200 eggs, which hatch almost immediately. The citropilius mealybug lays eggs into sacs and the eggs hatch after several days.

Nymphs (or crawlers) are usually present in spring but stay with the adult for a few days before venturing out to new leaves to feed. Once feeding the mealybug is unlikely to move. Adult mealybugs are very resilient and can overwinter in bark, plant debris, cracks and crevices in trellis or netting posts.

Mealybugs are more abundant in mild and warm conditions (optimum of 25^{o}C) and high humidity.

Mealybugs are pests of concern to;
Citrophilus Mealybug - **Korea**
Long-tailed Mealybug - **China**

Monitoring and control

Given the number of generations that can occur each year, different stages can be present at any one time and mealybug numbers can increase rapidly when conditions are ideal. It is essential to examine trees (especially the undersides of leaves, stem bowls and other natural crevices) regularly during spring for the presence of crawlers. Crawlers are more vulnerable and easier to control with chemical treatments; adults can have a protective waxy coating. To meet some export protocols it may be required to continue monitoring each fortnight until harvest (see export manual).

A good winter program (oil sprays before bud burst) will help prevent infestation, and mealybugs have natural enemies – such as ladybirds. Should infestation occur and it is recognised quickly, there may be chemical options available in Australia for use in sweet cherry orchards. Ask your local agronomist and refer to the export manual spray program guide and bear in mind that some chemicals may harm natural enemy populations.

The citrophilus mealy bug (left) and the long-tailed mealybug (right)

References

AWRI viti notes 2011
GWRDC fact sheet – Mealybug management 2012
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Kansas state University Extension sheet mealy bug
United States National Collection of Scale Insects Photographs Archive, USDA Agricultural Research Service, Bugwood.org - See more at: http://www.forestryimages.org/browse/detail.cfm?imgnum=5119056#sthash.OUDIfzCG.dpuf

Pest Fact Sheet
Scale

Identification

Scale insects can vary in size and appearance. There are 2 general forms of scale; hard-bodies and soft-bodies. Scales are usually circular, or oval- shaped, and secrete a waxy coating. Adults look like scales or shells, and are usually immobile. Females are often slightly larger than males. The immature insects (crawlers) have legs and are mobile while searching for an appropriate feeding site. They are usually pale (white to yellow/orange in colour.)
The four scale insects of concern are summarized below (adults).

Life Cycle

Scale can have several lifecycles within a season; up to 3 generations for San Jose scale. Brown scale usually only has one cycle per season. Female scales can lay over 1000 eggs, depending on type, and as such populations can grow rapidly. Crawlers usually appear in spring and start feeding within a day. Crawlers are mobile within a tree, but can also be transported between trees by wind. Once feeding starts, the crawlers become less mobile, and begin to secrete a protective waxy coating. The near-mature crawlers can then overwinter and emerge as adults the following spring, once sap flow in the tree resumes.

Adult scale descriptions

	Colour	*Shape*	*Size*
European Brown	*Brown, reddish-brown*	*Circular - oval*	*3mm*
Oleander	*White, yellow*	*circular-oval*	*2.5mm*
Oystershell	*Dark brown, chestnut*	*oval*	*2mm*
San Jose	*Gray, brown, black*	*oval*	*1.5mm*

Damage

Scale damage can be extensive. Scales can feed on leaves and twigs, and occasionally on fruit. When severe infestation occurs leaves can wilt, yellow and drop, and tree growth can become stunted. Like aphids, scale infestation can lead to the presence of a sweet 'honeydew' secretion. This secretion can additionally cause fungal problems.

Heavily infested twig

Scale are pests of concern to;
European Brown Scale - **Thailand**
Oleander Scale - **Korea**
Oystershell scale - **Thailand**
San Jose Scale - **Philippines**

Monitoring and control

Monitoring for the presence of crawlers is essential. The waxy coating excreted by scale insects makes control difficult, so control options must be targeted to the early crawler stages. Depending on scale type this may only last a few days to a week. A good winter program will help reduce numbers, and physical removal is possible but may not be practical. Chemical options are available – refer to the export manual spray guide.

Clockwise from top-left; European Brown scale, Oleander scale, Oystershell scale, San Jose scale

References

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Inra taxonomy fact sheets
PaDIL
http://www.padil.gov.au/
ucdavisipm, ipm.ucdavis.edu
UC IPM online

Pest Fact Sheet
Thrips

Identification

Two thrips are listed on export protocols; Plague thrips and Western flower thrips. Both adult stages are yellow/light brown. The abdomen of the female western flower thrips has a black tip. Adult western flower thrips range from 0.9 to 1.8mm and adult plague thrips range from 0.8 to 1.3 mm long. In both the female is bigger than the male. Adult thrips have 2 pairs of wings.

Eggs are small, and often hard to spot as they can be laid in crevices, within plant tissue and within closed flower buds. Eggs hatch quickly giving rise to the larvae (nymphs). There are generally 2 active and feeding nymph stages, followed by 2 non-feeding resting or pupating stages before the adult stage. Nymphs are small, pale (white or yellow) and wingless.

Damage

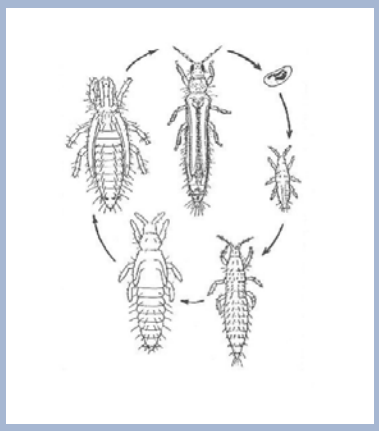
Damage from thrips occurs on buds, leaves and flowers. New growth is especially vulnerable. Thrips feed on plant tissue by inserting mouth parts (stylets), damaging tissue and accessing cellular fluids. As such, symptoms of thrips damage include distorted growth, leaf scarring, silvery tissue and malformed flowers. In addition, thrips can excrete directly onto leaf surfaces. Thrips are potential vectors for viruses.

Life Cycle

The thrips life cycle is very short – the entire cycle from egg to adult can be completed in 2 weeks.

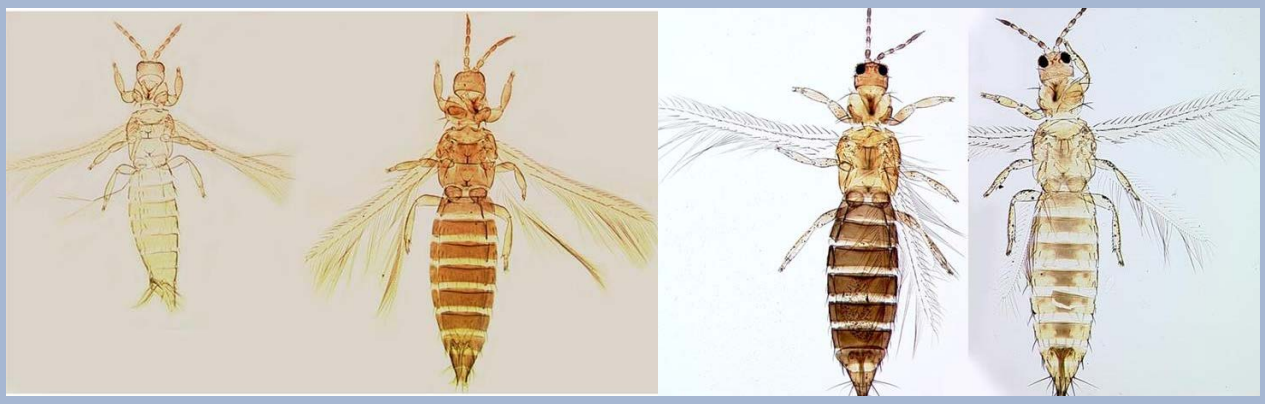
Thrips have a life cycle that involves five stages (see diagram).
Adult - eggs - nymphs - prepupa - pupa

Female adults lay eggs from which the larval nymphs emerge after a short time – less than a week. Nymphs have two stages; nymphs are active, feeding and transmit viruses. After this nymphs either leave the tree to pupate in the soil, or remain (non-feeding) in the tree. Pupation time is also short – less than a week. Adults can overwinter in leaf or flower buds. Thrips are most active in spring while the weather is not too hot.



Thrips life cycle

Thrips are pests of concern to;
Plague Thrips – **China, Korea**
Western Flower Thrips - **Taiwan**



Adult plague thrips (left) and western flower thrips (right)

Monitoring and control

Regular monitoring is required. For export fortnightly monitoring may be required, but to ensure thrips infestations are quickly discovered twice weekly monitoring from bud swell to petal fall is recommended. In particular check growing tips for young nymphs. Peak populations will occur in early spring. Chemical options are available – refer to the export manual and IPM calendar.

If thrips have been a problem in the past, ensure the orchard floor is clear from broad-leaved weeds. Thrips can live, feed on and overwinter on broad-leaved weeds. If weed control has not been achieved by bud swell, do not mow at this stage as thrips can move from weeds into the new tree growth.

References

Cloyd, R. Developing an Effective Western Flower Thrips Management Program Dept. Entomology Kansas State University
DoA WA Farmnote 30/93
DPI NSW 1995 Summerfruit IPDM manual
Kansas State University – fact sheets – WFT
PaDIL
http://www.padil.gov.au/pests-and-diseases

Leaf damage from thrips

Pest Fact Sheet
Native Bud Worm

Identification

The native budworm eggs are small (0.5mm) and white progressing to yellow/brown as they mature. The larvae (worms) range in size depending on age from 1.5mm up to 40mm long and vary in colour. The worms can be yellow, green, red, brown or black making identification difficult. All have a darker stripe down the back, dark heads and dark hairs coming from 'bumpy' skin.

Pupae can be up to 20-25mm long and also range in colour from yellow to brown. The adult moth has a pale brown body with a wingspan of up to 45mm; females have more vibrant forewings than males (reddish brown compared to light brown). Hind wings are pale with a dark band at the tip.

Native Budworm larvae

Damage

As the name suggests, this pest causes most damage as a worm (during the larval stage). Damage occurs to the leaves and buds when worms are feeding. New tender growth is particularly vulnerable. The adult moth feeds on nectar, but flowers are not damaged.

Life Cycle

Adult moths lay eggs in spring; each female can lay thousands of eggs over a few days. Eggs hatch within 21 days. The larvae immediately look for food, generally staying on plant surfaces. They also create silken threads with which to travel, blown by a breeze, to other trees. After a number of developmental stages occurring in as little as 3 weeks (6 weeks when cooler) larvae leave the tree to pupate.

Pupation occurs in the top 20cm of soil. If pupation commences in spring they this stage can last only 2 weeks, giving the moth time to re-emerge as an adult for a second time – 2 generations. When pupation commences later, pupae remain underground to overwinter and moths emerge again the following spring.

Native Bud Worm is a pest of concern to; **Thailand**

Monitoring and control

Monitoring for bud worm needs to target the larval period; this may be anytime throughout the season – but regular monitoring will identify the emergence and early stage. Larvae that are small and still feeding in the open are most easily controlled. Continue to monitor after any treatment to check numbers and reassess. Over time, you may be able to develop a threshold for action – vegetative damage by budworm does not often cause economic or yield losses, but control may be required for export.

Check soil for pupae when soil disturbance may be effective in reducing numbers. Some natural enemies exist that will parasitise the native budworm eggs, so keep this in mind if using broad spectrum insecticides. Refer to the export manual for chemical control options.

Native Budworm Adult moth (left) and native budworms eggs (right – healthy and parasitised)

References

DAFF Qld. Helicoverpa species sheet
DEPI Vic. 1995 Native Budworm fact sheet
Gutierrez, A. P. & Ponti, L. 2013. Eradication of Invasive Species: Why the Biology Matters. Environmental Entomology, 42, 395-411

Pest Fact Sheet
Beetles

Identification

There are two beetles to take notice of in cherry orchards; the plague soldier beetle (which does not usually cause damage but is a pest of concern to China) and the Carpophilus beetle (which does cause damage and requires management).

The plague soldier beetle is soft-bodied beetle up to 15mm long; it is black with a yellow/orange abdomen and yellow/orange stripe. The carpophilus beetle is smaller, up to 5mm long and is a dull brown/black colour with club-ended antennae. The carpophilus beetle eggs are small and white and larvae are white progressing to pale yellow as they mature, with a brown head.

Damage

The plague soldier beetle is generally recognized as a 'beneficial' insect. It will not cause damage to fruit unless found in extremely high numbers. In this situation sometimes just the weight of the population may weigh down branches.

The carpophilus beetle can accumulate in large enough numbers to weigh down branches too. However, they may also damage fruit; Adults they will eat, and lay eggs in ripening fruit. Adult movement will spread rot from fruit to fruit. Early populations can damage flowers in their search for nectar.

Life Cycle

The full life cycle of the carpophilus beetle is completed in about a month. Eggs are laid in late spring in ripening fruit; larvae feed on the fruit, pupate and then emerge as adults about three weeks later. Adults can overwinter underground, under bark or in decaying or mummified fruit, emerging again in spring. They tend to be more abundant in hot, humid conditions following a wet winter.

Plague Soldier Beetle is a pest of concern to; **China**

Monitoring and control

Given that carpophilus beetles do not appear until fruit is ripe, and that the plague soldier beetle does not usually cause damage, insecticide use on the crop is discouraged. Chemical control should only occur if the beetle or larvae are found; area wide treatment is recommend.

Beetle populations can be monitored using funnel traps, or by checking rotting and fallen fruit. Orchard hygiene is important as a preventative strategy as the carpophilus beetle is particularly attracted to rotting fruit.

Refer to the export manual and IPM calendar. If plague soldier beetle is observed in the orchard, ensure that pickers and the pack house are alerted to prevent any beetles entering the packing shed.

References
CSIRO Science Image http://scienceimage.csiro.au/
http://www.extension.umn.edu/

Pest Fact Sheet
Cherry Slug

Identification

Cherry slugs are the larvae of the sawfly. They are covered in a layer of dark green/black slime and look like small slugs. They can be up to 1 cm long. They do have legs (3 pairs) underneath the body but these are difficult to see.

The cherry slug (and slug damage) on cherry leaves

Damage

It is the larval stage (the slug) that damages leaves of fruit trees. Fruit are not affected. Damage from feeding initially creates small brown dots or patches but as the slugs feed on softer leaf tissue, only the leaf 'veins' remain. Usually the lower leaves are damaged first. If infestation is severe terminal growth can also be damaged. High levels of damage across the tree can reduce tree resources and impact fruit growth in the following season.

Life Cycle

The adult sawfly lays eggs on leaves throughout spring and early summer. The eggs are laid into the leaf tissue. Eggs hatch and the larvae, which look like a black slug, emerge onto the upper side of leaves in early summer. There are several stages of larval development, and the slugs can continue to feed on leaves for up to 3 weeks.
After this feeding stage and slugs are mature, the slugs drop to the ground to pupate. It is possible for 2 life cycles to be completed within one growing season. The cherry slug overwinters in the top 5-10 cm of soil as pupae in cocoons.

Cherry slug is not a pest of concern for export

Monitoring and control

Start looking for cherry slug on leaves as soon as leaves emerge. Because slugs can complete 2 lifecycles in a season it is important to catch the first generation and act as soon as possible. The physical force of a water jet will remove some slugs. Keeping other host plants to minimum (such as weeds) will also help.

There are chemical options for the control of cherry slug. Refer to the IPM calendar and export manual spray guide. Pyrethrins are effective, but keep in mind that this is a non-selective option and can reduce the number of beneficial insects. Most insecticides targeted at other pests will also suppress or control cherry slug.

Cherry slug (sawfly) pupae in cocoons (top)
Adult sawfly (middle)
And sawfly eggs (bottom)

References

NSW DPI 1995 IPDM Manual - Summerfruit
http://archive.agric.wa.gov.au/objtwr/imported_assets/content/hort/fn/pw/orchard%20alert%20issue%209%2024%20november%202010.pdf
Oregon State University fact sheet – pests of horticulture – sawfly

Pest Fact Sheet
Earwigs

Identification

Earwigs are very well known. Adults have distinctive claw-like forceps or pincers located at the end of the abdomen. Generally; male pincers are bowed while female pincers are straight. They have brown/black bodies and grow to 25mm long. Earwigs have chewing mouth parts and may or may not have wings (but rarely fly).

Earwig nymphs are grey, slightly smaller than adults and are wingless. They emerge from eggs up to 1mm long. Eggs begin as white and circular/oval but progress through to brown and can become kidney shaped.

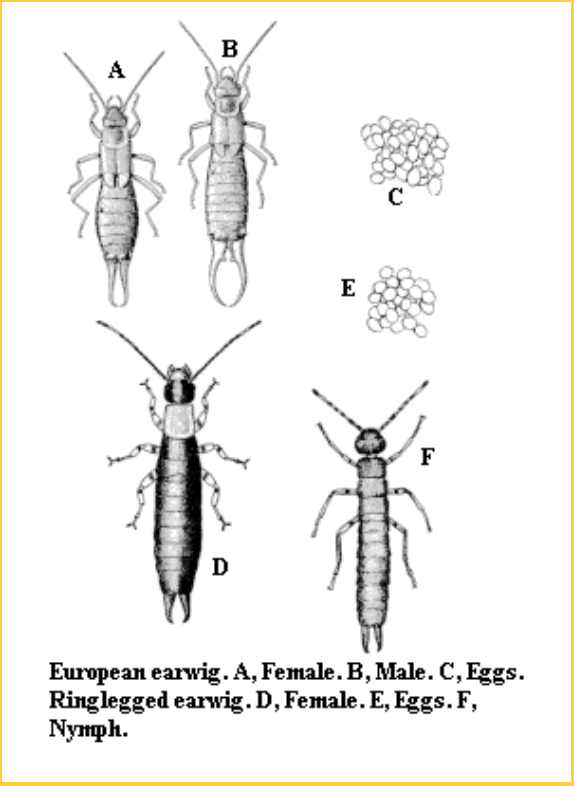
Life Cycle

Earwigs can have 2 generations per year, with numbers peaking in early spring and mid-summer.

Earwigs overwinter in plant debris or other protected places, emerging to mate and lay eggs in spring. Eggs can hatch in 2 weeks after which nymphs can feed and develop over several weeks depending on weather. Mating can occur again with more eggs laid. It is possible for eggs laid in autumn to overwinter.

Damage

Earwigs are generally beneficial insects in most crops, preying on other insects (aphids), and eggs (LBAM eggs) but they will also eat a variety of plant tissue. Feeding (and activity) is most often at night. In cherries they can be considered a pest because they can damage fruit when in high numbers.



European earwig. A, Female. B, Male. C, Eggs. Ringlegged earwig. D, Female. E, Eggs. F, Nymph.

Different stages of earwig

Earwigs are not pests of concern for export

Monitoring and control

The best way to monitor earwig populations is with cardboard traps on tree trunks. Earwigs are active at night and nest during the day in cool shady places at the base of trees. Check traps regularly from bud swell. A suggested threshold for action is 5 earwigs per trap. Use ground baits. Trees and fruit can be monitored later in the season as fruit grow bigger and provide protected nesting sites within bunches. To reduce nesting sites at the base of trees (and earwig numbers) remove mulch, weeds and pruning material from under trees when adults are likely to be present (from bud burst).

Placement of cardboard trap on tree trunk

References

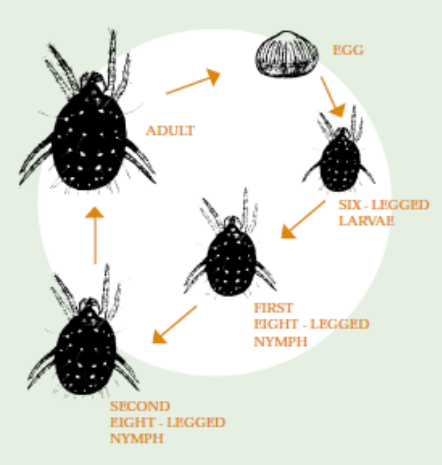
NC State University , IPM fact sheet, Earwig
http://ipm.ncsu.edu/AG268/html/earwigs.htm
NSW DPI, Integrated Pest and Disease Management for Australian Summerfruit 2005
PennState , Extension fact sheet, European earwig
Quarrell, S. 2013 Earwig fact sheet, TIA

Pest Fact Sheet
Mites

Identification

There are several types of problem mites to be aware of in cherry orchards; the twospotted spider mite, the red spider mite and the rust mite.

Mites are small (0.3-0.6mm) and difficult to spot. The spider mites are so called because they often spin protective silken webs. The twospotted spider mites are distinctive with two dark spots on each side of the body. They range from pale greenish white through to yellow/green as they mature, and can sometimes progress to a reddish colour as the season cools down. The red spider mites are red and rust mites progress from white to rust colour. Mite eggs are very small, circular and usually clear or pale yellow. Given that mites are small, a hand lens is required, or look for mite damage.



Damage

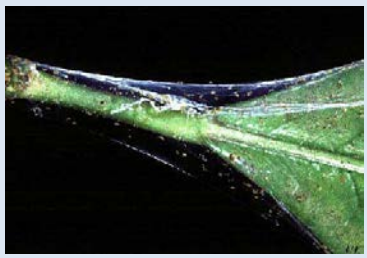
Mites have piercing mouth parts and damage plant tissue by puncturing leaves to feed. This usually occurs on the undersides of leaves and the first noticeable symptoms are pale yellow or silvery flecks on the leaf where feeding has occurred. If left, necrotic patches can develop as chlorophyll is removed. Leaf drop can occur in severe cases, and flower and leaf buds may be affected. Petal browning damage can look similar to spray burn.

Life Cycle

The full life cycle mites follows the general progression from eggs, larvae, nymph stages to adults. This cycle can occur completely within weeks during summer.

Mites are able to overwinter in protected areas, re-emerging in spring. Adult females live for up to 4 weeks and can lay many hundred eggs in that time. Eggs are often attached to webbing on the underside of leaves and can hatch within days.

Generalised mite lifecycle (left) and mite webbing on a leaf (right)



Mites are not a pest of concern

Monitoring and control

Monitoring for mites is difficult given the size of mites. They are more active in hot dry weather, and rapid increases in population can occur under such conditions. As mites do not fly, trees must be monitored. For detection a magnifying glass may be required, or tapping leaves to dislodge mites onto white paper may help to observe and identify them.

Control is best achieved if mites are identified before webbing appears and populations are large. Chemical options are available, but be aware that they may not be effective on eggs, and there are also a number of predatory mites. Predatory mites have longer legs than problem mites. There are also natural enemies of mites. Refer to the IPDM calendar and spray guide in the export manual.

Twospotted spider mites

References
Caon, G and Burfield, T. 2006 SARDI entomology fact sheet – TSM
Fasulo, T and Denmark, H. 2009 University of Florida Entomology Circular 89
Frost, B and Bailey, P. SARDI> Identifying mites on inland Australian citrus
NSW DPI 1995 IPDM manual – Summerfruit

Disease Fact Sheet
Brown rot

Identification

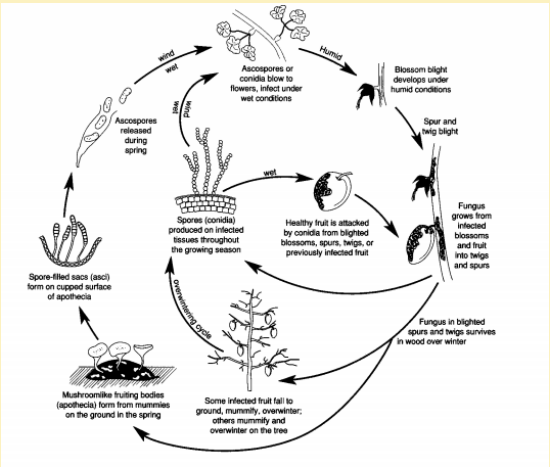
Brown rot is difficult to identify – it is hard to distinguish between brown rot (*Monilinia spp*.) and grey mould (*Botrytis cinerea*). Export markets are concerned with *Monilinia sp*., and to make it even harder two different species of *Monilinia* appear on export lists; *Monilinia fructicola* and *Monilinia fructigena*. Monilinia laxa can also be found in Australia. The rot associated with all *Monilinia* species is similar- a pale grey/brown to brown raised 'mould'. To distinguish *Monilinia sp*. from *Botrytis* requires close microscopic examination – talk to your local service provider. To distinguish between the *Monilinia* species is even more difficult and requires diagnostic services. *Monilinia fructigena* is widespread in Europe (but has never been found in Australia) while *Monilinia fructicola and laxa* are known to be present in Australia and North America.

Damage

Brown rot can affect blossom, spurs, twigs and fruit. The greatest impact is on fruit. Infected blossom (light brown powdery spores) is a potential source of inoculum for developing fruit. Fruit can then develop without symptoms until conditions become ideal; a combination of the presence of fungi, maturing fruit and optimal weather. If weather is unusually wet post bloom green fruit may develop some symptoms such as dark lesions. Disease symptoms often start as dark lesions, expanding and progressing to tissue softening with typical rot appearance.

Life cycle

Brown rot can survive over winter in rotten or 'mummified' fruit, or in cankers on the tree. Spores from these structures (the primary source of inoculum) are released in spring and present a risk during bloom. Infection at this time can result directly in blossom blight, or enter the developing fruit and potentially develop rot symptoms in fruit closer to harvest. The development of rot involves the production of more spores (a secondary source of inoculum) which can spread to other fruit. When inoculum is present, infection occurs under suitably wet conditions. Any infected fruit left on the tree or orchard floor will add to the inoculum levels in the following year.



Typical life cycle of brown rot (Monilinia sp.)

Brown rot is a disease of concern to;
Monilinia fructicola – **China, UK/EU**
Monilinia fructigena – **Thailand**

Monitoring and control

Monitoring brown rot is required from bud burst to harvest for export to China, but it is a good idea to be vigilant for brown rot throughout the year. Orchard hygiene, and the removal of rotten fruit post-harvest, and mummified fruit over winter will reduce the potential for disease the next season. Additional monitoring during bloom is recommended, especially if the weather looks like becoming wet; this will reduce potential for disease affecting fruit later in the season. Regular ongoing monitoring will help spot any early infection on green fruit.

Cultural practices such as pruning should also promote an environment that is unattractive for disease development – aim for good airflow through the orchard. Keeping trees and fruit healthy will also reduce sites for infection to occur or spread; avoid heavy crop loads and bunching, and fruit wounding. Chemical control options are also available and will be most effective if targeted at time of possible infection; target the primary (bloom to fruit drop) and secondary (fruit ripening) inoculum stages. Refer to the IPDM calendar and the export manual.

Brown rot in sweet cherry

References

Barry, K. 2013 Brown rot fact sheet, TIA
USDA, Nomenclature fact sheets - *Monilinia*
Wilcox, W.F. Brown Rot of Stone fruits, IPM Tree Fruit Crops fact sheet, Cornell University

Disease Fact Sheet
Other

Identification

Shot hole (*Stigmina carpophila*) can be identified by the damage it causes – namely holes in leaves. This symptom can result from a number of other factors however. Twig blight (*Phytophthora syringae*) is not known to be a problem in Australia but produces small cankers in twigs. Bacterial canker (*Pseudomonas syringae pv. Morsprunorum*) produces cankers in branches and on trunks and is often identified by the gum exuded. To correctly identify any of these diseases seek advice from your local service provider.

Damage

Shothole, twig blight, and bacterial canker seemed to be named to describe the damage associated with each. Shot hole causes small brown/red spots; the 'spotted' tissue dries and degrades leaving a 'shot hole'. Severe infection may result in leaf drop as well, and brown spots (0.5-1cm) on branches and buds which can start to secrete gum. Occasionally fruit will become infected, and exhibit small circular dark spots. Twig blight causes small cankers on twigs and branches, usually low and close to the trunk union, which appear dark and sunken. Bacterial canker causes larger cankers on branches and trunks of trees. These cankers also appear dark and sunken, with tissue underneath orange/brown. Bacterial canker can also produce a clear, amber gum or resin. Infection can spread to blossom, from which cankers can develop in spurs.

Life cycle

Shot hole and twig blight are fungi. Shot hole fungi can survive the winter in buds and cankers on the tree, while twig blight fungi survive in infected roots and wood. Shot hole spores are produced in spring, twig blight spores are produced when conditions are optimal. The spores of both fungi are dispersed by rain or moisture, and shot hole spores can remain dormant on tissue for months. Under continuously wet conditions (24 hours for shot hole, 18 hours for twig blight) spores are activated and can infect tissue. Infection can occur while trees are dormant.

Bacterial canker survives on the surface of trees, in wood and buds. As such infection can occur at any time there is a wound, but activity is greatest as temperatures cool in autumn. Risk of infection is then high during leaf fall (and associated scarring) and pruning. Gummosis is also a source of infection.

Shot hole symptoms on a peach leaf

The following are of concern to;
Bacterial Canker – **China**
Twig blight – **China**
Shot hole - **Korea**

Twig blight in crab apple (above)
exposing infected and clean tissue,
and bacterial canker in cherry (below)

Monitoring and control

Regular monitoring is required for disease, however many preventative actions are routinely undertaken to ensure minimal disease incidence. Removal of infected tissue should be undertaken during dormancy to reduce the risk of disease in the growing season. Protective chemical options are available early in the growing season, and post-harvest.

Refer to the cherry IPDM calendar and the export manual for further information.

References

Pscheidt, J.W., and Ocamb, C.M. (Senior Eds.). 2014. Pacific Northwest Plant Disease Management Handbook.
SARDI, Pest s and Diseases – Shothole
http://www.sardi.sa.gov.au/pestsdiseases/horticulture/horticultural_crops/apricot_pests_and_diseases/shothole
Spotts. R.A., Olsen, J., Long, L., Pscheidt, J.W. 2010 Bacterial canker of sweet cherry in Oregon.
UTAH State University, Shothole Blight fact sheet