



NSW DEPARTMENT OF  
PRIMARY INDUSTRIES

## **Readers' Note**

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This document is part of a larger publication. The remaining parts and full version of the publication can be found at:

<http://www.dpi.nsw.gov.au/agriculture/horticulture/stone-fruit/summerfruit-ipdm>

Updated versions of this document can also be found at the above web address.

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Budswell		Blossom	Mid Season	Harvest	After Harvest	Dormancy
Bacteria ooze from active cankers and infect young stems and developing leaves			Fruit develops sunken, greasy spots which may ooze		Bacteria survive the winter months in dormant summer cankers	
	New cankers appear on twigs	Bud death	Leaves develop lesions, slot hole symptoms and become tattered			
<b>MONITOR</b>						

### When to look

Monitor weekly from early budswell to mid-blossom. Bacterial spot is favoured by periods of rain, heavy dews, hail, warm temperatures and high winds during the growing season. Be particularly careful with your control measures during these times, (see chart at top of page).

### What to look for

Examine the twigs and young growth on your marked monitoring trees very carefully. Look for lesions. You will find them only by thorough examination.

Control must be applied early in the season. Therefore, monitoring must target the small cankers that become active on twigs. These are difficult to see, but by the time fruit infection is obvious control measures are futile.



*Cankered twigs*

### Appropriate action

#### Action threshold

If bacterial spot is seen. Once bacterial spot is detectable it is difficult to control. Orchardists should

- use strategies to reduce its rate of spread (see 'Prevention')
- take precautions early next season.

In reality, by the time symptoms are seen it is probably too late for complete control. Expect some losses. In this case the action threshold is an indicator that appropriate action will be required very early next season.

#### Protective spray program

No effective protectant bactericides have Australia-wide registration for application after shuckfall. Copper oxychloride is registered in **Queensland only** for this use. In cases where bacterial spot has been a serious problem in previous years it is best to be cautious and apply a protectant copper fungicide schedule for other diseases. For example, protectant copper applications are frequently made during dormancy to control bacterial canker (page 137). These may have an effect on bacterial spot. A Summerfruit Australia Limited project is currently developing control strategies for this disease.

#### More information

*Some of the information provided in these references comes from other countries (marked †). Always remember that the biology of pests and diseases and the tactics used to control them vary subtly from country to country and will change with time. Be particularly cautious with pesticide recommendations. If a pesticide is not recommended in this manual (page 137) you must check that it*

*has current registration in your State and abide by the conditions of that registration, as specified on the pesticide's label. ALWAYS READ THE LABEL.*

Dick J, Wood P (1991) *Bacterial Diseases of Stone Fruit*. Farmnote 98/91. Agriculture Western Australia. Available through the DAWA website, [www.agric.wa.gov.au](http://www.agric.wa.gov.au)

Horlock C (2003) *Bacterial Spot of Stonefruit. Identification Chart for Fruit, Leaves and Stems*. Queensland Department of Primary Industries and Fisheries. Available at the QDPIF website, [www.dpi.qld.gov.au/](http://www.dpi.qld.gov.au/)

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Stephens P (2001) *Clay may get the Better of Stonefruit Disease*. Queensland Department of Primary Industries and Fisheries. Available at the QDPIF website, [www.dpi.qld.gov.au/](http://www.dpi.qld.gov.au/)

## Black and green peach aphids

*Brachycaudus persicae* and *Myzus persicae*

### IPDM quick facts

**Sample unit:** *Trees*

**When to monitor:** *Budswell to mid-summer*

**How often:** *Fortnightly*

#### Action level:

- *young trees (< 3 years old): one colony per tree*
- *older trees: > 2 colonies per tree*

*Take extra care when monitoring during spring, when growing conditions are good. Populations decline during hot, dry winds and conditions that harden tree growth.*

### The pests and their damage

Winged and wingless adults of black peach aphid are shiny black and about 2 mm long. Nymphs are reddish-brown.

Green peach aphid nymphs are pale yellowish-green and have three dark lines on the back of the abdomen. Wingless females and winged individuals are pale green or pinkish and around 2 mm long. This is the most important aphid in virus transmission; this aphid can transmit over 100 plant viruses.

Aphid infestation can cause leaf distortion.

Aphids feed on the leaves, extracting sap and causing leaves to yellow and drop. Honey dew

produced by a heavy infestation during the growing season may result in the development of sooty mould on the tree and fruit.



*Black peach aphid*



*Winged green peach aphid*



*Green peach aphid*



*Leaf distortion caused by black peach aphid*

**A serious regional issue during the last 10 years in:**

- Adelaide Hills
- Goulburn Valley
- Sydney Basin
- Tasmania

**Prevention**

***Encourage biological control agents***

The activity and efficiency of biological control agents will depend partly on the absence of insecticides likely to be toxic to them. Therefore, to maximise natural control within the IPDM program, avoid using these insecticides in spring (for more information see page 112).

***Appropriate use of fertilisers***

Avoid excessive amounts of nitrogen fertilisers, which promote soft plant tissue. New soft plant tissue promotes higher aphid populations.



*Biological control agents can be effective controls of peach aphids*



*Sooty mould at the stem ends of nectarines that have been heavily infested by black peach aphid. Note that many of the remaining aphid bodies have been parasitised by natural predators.*

***Reduce weeds***

Control weeds around orchards. Weed host plants are often reservoirs for migrating aphids. Prune out water shoots.

**Monitoring**

***When to look***

Look at leaves on four lateral branches of each of the marked monitoring trees from budswell to ripening at weekly intervals. Aphid numbers can build up very quickly, so it is advisable to monitor relatively frequently (see chart on next page).



Budswell	Blossom	Mid Season	Ripening to Harvest	After harvest	Dormancy
Wingless adult aphids emerge on leaves			Winged adults form	Aphids return to orchard. Eggs laid on bark	Eggs overwinter on bark or around the buds
<b>MONITOR</b>					

### What to look for

Inspect the underside of leaves for colonies as growth begins, and continue until midsummer.

### Appropriate action

#### Action threshold

Young trees (< 3 years old): one colony per tree

Older trees: > 3 colonies per tree

(See chart overleaf).

There are now several very effective insecticides for control, but growers practising IPDM can limit or even avoid the need for these.

#### Oil sprays

In cooler inland districts, green peach aphid overwinters as eggs around the buds. As spring approaches, the eggs hatch and the aphid life cycle begins. At about this time the eggs and the young aphid nymphs are vulnerable to suffocation by oil sprays.

Oil at budswell will provide reasonable control of aphids. Those that do survive will become prey for predators and parasites that will arrive later in spring.



*Examine the undersides of leaves for peach aphid infestations*

The oil spray can be combined with copper sprays for leaf curl and shot-hole. A decision on the use of oil at budswell needs to be made in conjunction with the use of oil for San José scale control (page 76). It is important that two applications of dormant oil are not made in the one winter.

If you decide to try to control two pests with the one oil spray, then use only one application of horticultural mineral oil (HMO) at budswell. Use a maximum concentration of 2 L per 100 L, applied thoroughly. A product such as D-C-Tron Plus is registered for use at budswell for scale. Its use then will also help control green peach aphid. Other HMOs that can be used and are registered for both pests are Biopest® and Sunspray® Ultra-Fine™. If used at budswell on summer fruit, limit the concentration to 2 L per 100 L.

#### Selective aphicides and spot spraying

Where monitoring indicates that the action level has been exceeded, selective aphicides should be applied. Younger trees are more susceptible to aphid damage, and the action level for younger trees is lower. Appropriate action should be taken in blocks of trees younger than 3 years when monitoring indicates that the trees most severely infested have one colony. For older trees, take appropriate action when the most severely infested trees have three or more colonies.

A list of recommended aphicides for each type of summerfruit can be found in the spray schedules at the end of this manual (page 137)

Aphid infestations tend to be patchy, particularly if seen early as a result of monitoring. Consider spot-spraying individually infested trees or groups of trees, rather than spraying the entire block. Considerably less chemical can be used in this way, and money saved.

#### More information

*Some of the information provided in these references comes from other countries (marked †).*



*Always remember that the biology of pests and diseases and the tactics used to control them vary subtly from country to country and will change with time. Be particularly cautious with pesticide recommendations. If a pesticide is not recommended in this manual (page 137) you must check that it has current registration in your State and abide by the conditions of that registration, as specified on the pesticide's label. ALWAYS READ THE LABEL.*

Strand LL (1999) Aphids. In *Integrated Pest Management for Stone Fruits* †. Statewide Integrated Pest Management Project. University of California Division of Agriculture and Natural Resources, Oakland, California pp. 93–95 †

# Blossom blight and brown rot

*Monilinia fructicola* and *Monilinia laxa*

## IPDM quick facts

### *Blossom blight*

**Sample unit:** Blossom

**When to monitor:** Budswell to full blossom

**How often:** Weekly

**Action threshold:** If present. Weather should also be used to determine action levels.

Take action if the orchard has previously been infected and:

- bud/blossom is wet from rain or dew for 3 to 5 hours when the temperature is more than 20°C, or
- there has been hail, or
- the temperature has been 20 to 25 °C with showery conditions and cool nights.

### *Brown rot*

**Sample unit:** Fruit

**When to monitor:** Midseason – after harvest

**How often:** Weekly

**Action threshold:** If present.

Weather should also be used to determine action levels.

Take action if:

- the orchard has previously been infected, and
- there have been frequent rain periods and warm conditions near or at harvest.

## Causes and consequences

Two closely related fungi – *Monilinia fructicola* and *Monilinia laxa* – cause blossom blight and brown rot in Australia.

Blossom blight reduces fruit set by infecting and killing blossom. Brown rot attacks fruit either on the tree or after harvest.

Blossom infection can also lead to dieback of new shoots. It also attacks green fruit, leaves and shoots. Some brown rot infection can be expected in humid areas every year, especially for fruit under netting.

## Symptoms

Brown rot causes symptoms on the leaves, shoots, blossom and fruit. Fruit can also be infected close to harvest and remain symptomless but then rot in storage.

Blossoms become infected from spores that have survived through winter on mummified fruit and infected twigs. Infected blossoms turn brown and die and the shoots bearing them are often cankered or blighted. Spores produced on these infected flowers and shoots then spread the disease throughout the orchard.



*Blossom blight*



*Brown rot*

Where shoots are infected there is an area of dead or dying bark, which is usually sunken. These cankers often ooze honey-coloured gum.

Fruit is usually infected as it begins to soften and mature. Green fruit can be infected when injured. Monitoring after hail or insect damage is also important.

The first symptoms of brown rot on maturing fruit are small brown spots that rapidly develop into characteristic brown rot. Small grey to buff-coloured tufts of powdery fungus spores form on the discoloured areas about 36 hours after infection. Within 5 days the fruit can be completely rotted and covered with spores.

Infected fruit either fall or remain attached to, or lodge in the tree, where they become dried out and shrivelled or 'mummified'. These 'mummies' can produce spores over a long period of time and are a major source of infection. Brown rot is spread by wind, rain splash and some insects, especially dried fruit beetles (*Carpophilus* spp.).

Although both species of the fungus cause similar symptoms, it is necessary to start treatment for blossom blight caused by *M. laxa* 2 weeks earlier than for brown rot. Symptoms of blossom blight tend to appear earlier when caused by *M. laxa* – as opposed to *M. fructicola*. In trying to control the disease it is therefore important to know which pathogens are present in your orchard. Send disease samples to a diagnostic laboratory and they will be able to tell you which pathogen is dominant in your orchard. If the dominant species is *M. laxa*, you should begin treatment approximately 2 weeks earlier than if it is *M. fructicola*.

Symptoms similar to those of blossom blight and twig canker can also be caused by *Pseudomonas syringae* pv. *syringae* (the bacterium that causes bacterial canker; page 14). Treatment for blossom blight will not affect the symptoms caused by this bacterium.

If you are unsure about the pathogen causing the symptoms, submit a sample for diagnosis.

**A serious regional issue during the last 10 years in:**

- Adelaide Hills
- Manjimup/Donybrook
- Riverlands
- Sydney Basin
- NSW southwest slopes
- NSW central west
- Granite Belt
- Tasmania
- Alstonville
- Goulburn Valley
- Swan Hill

**Prevention**

**Choosing species and varieties**

If you know that your area has a problem with brown rot, select varieties or species with higher resistance to the disease. For example, apricots are generally more susceptible to blossom blight than are peaches, nectarines and plums. Small flowered peach varieties are less susceptible to blossom blight than are large flowered varieties. Thick-skinned fruit, such as the sugar plum, are often less prone to fruit rot than thin-skinned varieties. However, no summer fruit species or variety is immune to infection.

**Orchard design**

When designing a new orchard or planting, align the rows to allow good spring and summer breezes through the whole planting (north–south rows). Thin out the surrounding bush and the undergrowth in dense windbreaks. Anything that will increase the rate of drying after rain or dew will help to reduce brown rot. Brown rot tends to be more severe under bird, flying fox or hail netting.



*Blossom blight on apricots. Note the gumming at the bases of the flowers.*



*Early symptoms of brown rot on peach*



*Early symptoms of brown rot on plum*

**Pruning and shaping trees**

Prune and shape trees to allow good spray penetration. It is hard to get adequate spray coverage on trees that are very dense or tall. Fruit in dense trees dries more slowly than fruit in open trees. Dew can provide enough moisture to allow infection of ripe fruit, and because fruit remains wet longer in dense trees, the risk of infection is increased.

When pruning and thinning, try to prevent fruit from touching. This will make it easier to achieve proper spray coverage before harvest and will prevent the spread of brown rot by fruit-to-fruit contact.

**Monitoring**

Because blossom blight and brown rot are widespread and have the potential to seriously reduce crop production, it is recommended that a combination of monitoring for the disease and weather be used to determine whether appropriate action should be undertaken. If **any** action threshold is reached, take appropriate action.

**When to look**

Weekly monitoring is recommended during the critical times for infection. Monitor more frequently if possible (see chart below).

Examine all developing flowers on four lateral branches of all marked monitoring trees for symptoms during the period from budswell to late blossom.

Examine all fruit on four lateral branches of the marked monitoring trees from mid-season to harvest.

**What to look for**

**Blossom blight.** Look for dead twigs and blossom. Examine them closely and look for clear to honey-coloured gum.

**Brown rot.** Look for soft brown areas on the surface of the fruit, usually accompanied by fluffy white-grey fungal material.

**Appropriate action**

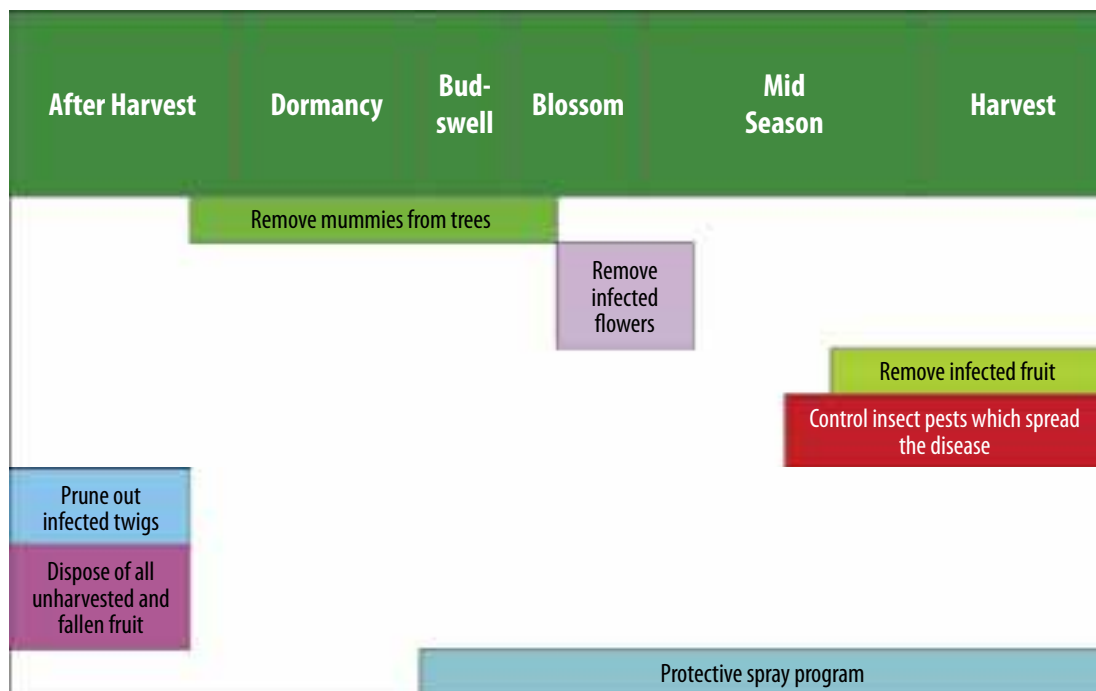
**Action threshold**

If either blossom blight or brown rot is observed (see chart overleaf).

Good orchard sanitation is critical. Unless sanitation measures are thoroughly carried out, spraying with fungicides will be of limited use.

After Harvest	Dormancy	Budswell	Blossom	Mid Season	Harvest
Rotten fruit provides an infection source for next season	Mummified fruit and infected twigs provide overwintering sites		Spores infect blossoms	Spores dormant in developing fruit	Maturing fruit triggers fungal development. Infection spreads on wet fruit surfaces

**MONITOR**



**Remove mummies from trees**

During the growing season, remove any mummies or shrivelled or dead fruit that have been overlooked earlier. Also remove any fruit that has been damaged by hail or insects.

Remove any remaining mummies during winter pruning, as they are easier to see at this stage. Take care to examine the crotch of each tree for lodged mummies (particularly in larger trees). Bury or burn all of this diseased material with the prunings.

**Remove infected flowers**

Towards the end of blossoming, remove and burn any diseased shoots. Check again for diseased shoots when thinning.

**Remove infected fruit**

One month before harvest, start inspecting each variety every few days. Remove from the orchard

any fruit infected with brown rot. Continue removing infected fruit until harvesting is complete. Removing infected fruit restricts the build-up of spores and slows the spread of the disease. It also restricts the opportunity for the fungus to grow from fruit into the peduncles and reduces the number of sites that can produce spores the following season. Remove rotted fruit during periods of high humidity and low wind velocity (usually early in the morning), as spores are not well dispersed in these conditions.

**Control insect pests that spread the disease**

Brown rot spores need a wet surface to germinate and infect tissue, and injury can provide a surface wet with sap or fruit juice. Control insect pests that cause fruit injury, such as the oriental fruit moth (*Grapholita molesta*), the lightbrown apple moth (*Epiphyas postvittana*) and dried fruit beetles (*Carpophilus* spp.). Good insect pest control is essential for successful brown rot control.



**Brown rot mummies**



**Remove rotting fruit from the orchard floor**

**Prune out infected twigs**

If bad weather makes it impossible to maintain a sanitation program and a serious outbreak of brown rot occurs, prune out blighted and badly cankered shoots immediately after harvest. Remove any remaining mummified fruit by pruning out the shoots to which they are attached.

Cut out all remaining cankered or dead shoots during winter pruning. They are easier to see at this stage.

**Dispose of fruit left after harvest**

After each variety is harvested, check the trees again and remove remaining fruit, whether rotten or sound. If possible, collect any fruit remaining on the ground and bury it. In districts where Queensland fruit fly occurs, it is not satisfactory to bury rotten fruit—it must be burned.

**Protective spray program**

If conditions favour the disease, or monitoring indicates heavy disease pressure, or an orchard has a history of brown rot, then a full schedule of protective fungicide applications is recommended. This disease has the potential to seriously reduce yield, and under these conditions a conservative approach is warranted.

Thorough spraying is essential. Aim to get the best possible coverage of fruit and flowers. Calibrate your orchard sprayers regularly to maximise efficiency. Because of variation in maturity times, varieties may need to be sprayed separately. Spray application at budswell and blossom is particularly important.

After considering the level of infection during previous seasons and the results of monitoring, you may find it possible to reduce fungicide applications. Begin a program of spray reduction by applying sprays at a frequency that you are confident will control brown rot. Monitor the level of disease season-by-season. If infection levels are consistently low to moderate, reduce the number of sprays applied to a small number of trees or rows and monitor the disease. If the disease level is low in the test trees or rows, and **dependent on weather**, reduce fungicide applications to a larger area next season. Infection is unlikely during fine and dry weather, particularly between shuckfall and fruit softening; take this opportunity to reduce fungicide applications.

A spray schedule for this disease can be found on page 137.

**Postharvest**

Avoid picking when fruit is wet.

Several fungicides are registered for postharvest dipping of summer fruit. Where control of brown rot prior to harvest has been good, it is often unnecessary to use a postharvest fungicide dip. Consider your target market and the possible length of storage.

**Brown rot resistance to fungicides**

In some areas the fungus *M. fructicola* is resistant to some fungicides. For example, in many summer fruit orchards in NSW it is resistant to the benzimidazole (Group A) fungicides. Check with your local district horticulturist if you suspect control failure due to fungicide resistance.

**More information**

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Strand LL (1999) Brown rot. In *Integrated Pest Management for Stone Fruits. Statewide Integrated Pest management Project*. University of California Division of Agriculture and Natural Resources, Oakland California pp. 115–120 †

Washington WS (1999) *Brown Rot of Stone Fruits*. State of Victoria, Department of Primary Industries. Available through DPIV website, [www.dpi.vic.gov.au/dpi/index.htm](http://www.dpi.vic.gov.au/dpi/index.htm)

Pocock D (2004) *Brown Rot*. Technical Bulletin, Australian Fresh Stone Fruit Growers Association. Department of Agriculture, Western Australia. Available through DAWA website, [www.agric.wa.gov.au](http://www.agric.wa.gov.au)

# Carpophilus beetle

*Carpophilus* spp.

## IPDM quick facts

**Sample unit:** Trap

**When to monitor:** Mid-season to harvest

**How often:** Weekly

**Action level:** Depends on varietal susceptibility, stage of crop development, climate and block history.

**Pay particular attention to monitoring:**

- following summer rainfall
- if your orchard or neighbours' orchards have large amounts of fallen fruit
- if the block is near early-maturing varieties of summerfruit or other fruit that hosts *Carpophilus* beetles.

### The pest and its damage

*Carpophilus* beetles are small (2 to 3 mm long) and brown or black. A distinguishing feature is that their wing covers (elytra) are short and do not cover the last two or three segments of the abdomen. In most other beetles the elytra extend over the whole abdomen.

At least 12 species of *Carpophilus* beetles occur in Australia, although only three (*Carpophilus davidsoni*, *Carpophilus mutilatus* and *Carpophilus hemipterus*) appear to be economically important.

*Carpophilus* beetles are serious pests of ripening summer fruit (mainly peaches, nectarines and apricots) in Australia. They are attracted to and penetrate ripening fruit, causing rapid breakdown, which can result in substantial fruit losses. The beetles also serve as mechanical carriers of brown rot (*Monilinia* spp.; page 27), which frequently develops at the sites of beetle entry.

Beetles enter the fruit by chewing through the skin. This entry is usually around the stem end or in sutures. They can also enter through sites of mechanical damage.

In recent years, growers have indicated that losses caused by *Carpophilus* beetles have

been as high as 30% of their crops. Many Australian orchardists believe that *Carpophilus* beetle problems have increased over the last 10 years owing to a decline in the use of organophosphates and other insecticides to control other pest species. Damage by *Carpophilus* beetle is most severe as the fruit ripens. *Carpophilus* beetles are highly active pests and can quickly move between blocks and from fruit to fruit within a crop.

### A serious regional issue during the last 10 years in:

- Sydney Basin
- Southeast Queensland
- Riverlands
- NSW southwest slopes
- NSW central west
- Granite Belt
- Alstonville
- Goulburn Valley
- Swan Hill

### Prevention

#### Orchard hygiene

Many fruit growers dispose of their rejected or waste fruit on their own properties. Fruit packers



*Fruit damage caused by Carpophilus beetle*

Budswell	Blossom	Mid Season	Ripening to Harvest	After Harvest	Dormancy
					Mature adults overwinter under bark or in mummified fruit
Overwintering adults become active, mate and lay eggs in rotting fruit					
		Larvae leave fruit and pupate in the soil			
		Adults emerge in late spring			
		Adults continue to mate. Several generations per season. Adults fly to distant food sources			
<b>MONITOR</b>					

and processors dispose of waste fruit in sites that are often located near orchards. These fruit dumps may act as important sources of *Carpophilus* beetles if they provide good protection and breeding sites during winter and early spring. *Carpophilus* beetle populations that develop in the fruit dumps may invade summer fruit orchards as fruit ripens. If the fruit stays on the ground after harvesting, problems may also occur. The fermentation odours associated with rotting fruit can be detected by the beetles up to 0.5 km from their source and will attract them. The beetles will breed in rejected fruit, increase their numbers and then infest the later-maturing blocks. *Carpophilus* beetles have also been found in mummified fruit during winter and in rotting fruit residues from other crops such as citrus, apples and pears. The removal and destruction of waste fruit from commercial orchards have provided some success in reducing *Carpophilus* beetle numbers.

#### **Fruitfly control**

Good fruitfly control (page 46) will mean that less fallen fruit is available for use by *Carpophilus* beetles as breeding sites.

#### **Monitoring**

##### **When to look (See chart above)**

*Carpophilus* beetles are good fliers, and adults can travel quite large distances (several kilometres) to find a food source. Populations can build up very

rapidly. It is therefore important to monitor the crop frequently so that appropriate action can be taken before severe damage is done.

Early-season crops are more consistently attacked, because populations are at their peak during late spring to mid-summer. This threat is reduced if there have been dry conditions during the previous autumn and/or unfavourable winter conditions.

Weekly monitoring is recommended in the period between stone hardening and harvest. Casual monitoring should also be done after harvest, as this will give an indication of the likelihood of problems next season.

##### **What to look for**

Growers can use knowledge of their own orchards to work out which blocks they consider at highest risk of *Carpophilus* beetle damage and monitor with a few traps scattered in these crops weekly until harvest. Just before harvest they should check for *Carpophilus* beetle damage to fruit on trees and on the ground.

Monitoring should only take a few minutes for each trap. We can't give you an example of the beetle numbers that will cause damage to your summer fruit crops, as damage will depend on a range of factors such as the varietal susceptibility, stage of crop development, climate and block history. If you monitor 2 years in a row you will be able to see trends in the number of beetles trapped and compare those trends with your

### **Carpophilus beetles and the weather**

When monitoring, orchardists should also consider the weather, which has an effect on beetle development and life cycles.

- The development duration from egg to adult is 47 to 65 days at 20 °C and 14 to 18 days at 32 to 35 °C.
- More beetles survive at 25 to 30 °C.
- Beetles start to develop only at 14.6 to 15.4 °C.
- Flight does not occur at temperatures below 18 °C.

#### **Southern regions**

- The number of beetles peaks in November–December in southern NSW. If there is adequate moisture in December–January, another population peak will occur in February–March.
- If there is average or below-average rainfall in December–January, there will be a lower beetle population in January to March. Beetle problems tend to occur only when the rainfall in December–January is at least double the long-term average.

#### **Inland regions**

- Summer populations are usually low, especially when there has been below-average rain.
- Summer rainfall in inland regions is often related to localised thunderstorms, so beetle populations can vary across a region.

#### **Northern coastal regions**

- Populations remain at moderate levels around Nambour during summer; this is perhaps associated with high summer rainfall.

levels of fruit damage. This will allow you to determine the risk of *Carpophilus* beetle damage to your blocks.

Funnel traps can be used to monitor *Carpophilus* beetle. Hang the traps approximately 1.5 m high on a branch of peach tree.

To monitor beetles we use an attractant. To make enough attractant for two monitoring traps you need:

- 1 g bakers' yeast (dry)
- 200 mL apple juice (100% pure juice)
- 10 g water storage crystals  
(Waterwise, Arthur Yates Co.,  
available from hardware stores)

Dissolve the yeast in apple juice uniformly before adding the crystals. Wait approximately 1 hour for the water crystals to absorb the apple juice. Once the crystals have absorbed the juice, store them at 5 °C if you are not going to use them the same day.

Half fill a plastic container with the bait (approx. 250 mL) and secure a piece of fine mesh mosquito net over the top with a rubber band (to prevent the beetles getting into the crystal). Put

the plastic container inside the trap and close the trap properly.

Check traps every week and place trapped beetles into a plastic container. Label the container with the date of collection and the trap number. Count the trapped beetles and record the number and location in a field notebook. If the beetle number is high, count a subsample and calculate the approximate number. To do this, use a clear plastic tube such as a blood sample tube (ask your doctor or local hospital for a clean, empty tube). Count 200 beetles and put them in the tube.



**Funnel trap for monitoring *Carpophilus* beetle**



Mark the side of the tube to indicate the level of the beetles. Add another 200 beetles and mark the tube. Keep doing this until you have reached 600 beetles. You can now use this calibrated tube to calculate the number of beetles in your traps.

### Appropriate action

#### Action threshold

Because varieties vary in their susceptibility to *Carpophilus* beetles, we suggest that orchardists develop their own thresholds for this pest by considering:

- the number of beetles observed in previous seasons and the subsequent damage
- the loss caused by this level of damage
- the cost of control
- the possible impact on predators and the likely impact that this will have on other pests and diseases.

(See chart at top of page).

#### Spray insecticides

At present, growers facing infestations beyond their action thresholds have only one control option: spraying insecticides. A spray schedule for this purpose can be found on page 137. Bifenthrin is registered for the control of *Carpophilus* beetles, but remember that this insecticide will also kill non-target, beneficial insects (see page 112). Spray only when it is necessary. The use of bifenthrin can often lead to high populations of two-spotted mite later in the season.

#### Aggregation pheromone and its use for future management

Male *Carpophilus* beetles produce a special type of secretion called 'aggregation pheromone' when they locate a suitable food source. This attracts other *Carpophilus* beetles to the vicinity. Our team has developed a control strategy based on the use of synthetic aggregation pheromone and a synthetic version of the smell of ripening fruit to attract *Carpophilus* beetles outside the orchards and kill them. The synthetic food attractant was 12 times more effective than fermented apple juice (FAJ). FAJ was used in the comparison

because it had been thoroughly evaluated in previous field experiments. The number of *Carpophilus* beetles captured in funnel traps baited with synthetic pheromone and synthetic food attractant was highest compared with the numbers in other traps tested by DPIV scientists. Funnel traps will be used for limited commercial testing of the attract-and-kill system in the 2004–05 season in Goulburn Valley summer fruit orchards.

This system relies on the attract-and-kill system to drastically reduce *Carpophilus* beetle populations in the orchard before the crop ripens and becomes ready to serve as a host to *Carpophilus* beetles. Furthermore, it could be used to reduce the impact of any migrating *Carpophilus* beetles.

#### More information

*Some of the information provided in these references comes from other countries (marked †). Always remember that the biology of pests and diseases and the tactics used to control them vary subtly from country to country and will change with time. Be particularly cautious with pesticide recommendations. If a pesticide is not recommended in this manual (page 137) you must check that it has current registration in your State and abide by the conditions of that registration, as specified on the pesticide's label. ALWAYS READ THE LABEL.*

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- SF99023—*Chemical Control of Carpophilus Beetle by Bifenthrin & Fipronil*
- SF97003—*Integrated Management of Carpophilus Beetles in Stone Fruit Orchards*
- FR99031—*Developing an Integrated Pest Management Strategy using Pheromones for Controlling Oriental Fruit Moth and Carpophilus Beetles in Orchards*

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# European earwig

*Forficula auricularia*

## IPDM quick facts

**Sample unit:** *Trap*

**When to monitor:** *Budswell to harvest*

**How often:** *Fortnightly*

**Action level:** *When any trap contains five or more earwigs*



*European earwigs and their damage on peach*



*Male (upper) and female (lower) European earwigs*

## The pest and its damage

Earwigs are brown, elongated insects with distinctive pincers at the ends of their abdomens. Males have broadly bowed pincers; those of females are slender and relatively straight. Adult earwigs are approximately 12 to 13 mm long. They are usually reddish brown. Young earwigs look similar to adults but are olive green.

Earwigs are nocturnal and nest during the day in cool shady places (e.g. beneath stones or debris)

Earwigs have chewing mouthparts and bite holes in young and ripening fruit and eat the flowers. All summerfruit can be attacked by earwigs, but these pests are particularly troublesome on white-fleshed nectarine varieties.

Earwigs cause shallow, irregular depressions in fruit where feeding has occurred. These wounds can become infected by brown rot.

## A serious regional issue during the last 10 years in:

- Adelaide Hills
- Swan Hill
- NSW central west
- Tasmania
- Riverlands

## Prevention

### *Remove alternative shelter*

Remove prunings and other debris from around the bases of trees that could provide alternative nesting sites for earwigs. Remove any drooping branches that come in contact with the ground, providing access to earwigs.

As male earwigs emerge (around the middle of budswell), remove mulch from under trees, as this provides shelter and encourages large numbers to build up. Tall weeds that provide shelter for earwigs and keep the orchard floor shaded and moist should be controlled throughout the season, particularly from bud-burst to the end of harvest.

Tree guards can also become nesting sites for earwigs (and snails); if they are not necessary, remove them.

### *Thinning*

Thinning of fruit reduces the shelter available to earwigs and lowers the numbers in the canopy.

### *Avoid planting near sultana grapes*

Earwigs can be a problem in summer fruit orchards that are grown close to vineyards, particularly those producing sultana grapes.

## Monitoring

During the day earwigs seek out cool moist refuges (see chart overleaf).



*Fruit damaged by European earwigs*



*Earwig traps made of rolled cardboard are used for monitoring.*

You can monitor using corrugated cardboard ‘earwig houses’. Secure them in the forks of trees, and monitor fortnightly.

There are several important points to remember when monitoring for earwigs in this way:

- Earwigs move into trees in two distinct waves.
- The first wave is made up of males. These males move into trees after being ejected from the brood chamber by the females, as they pose a threat to the developing young earwigs on the orchard floor.
- The second wave has more females and young earwigs.
- You need to consider these waves when monitoring. Management action after the first wave will not control later earwigs. Maintain monitoring from budswell to ripening, and take appropriate action whenever numbers reach the action threshold of five earwigs per trap.
- Cardboard traps may need to be changed periodically, particularly after rain, but change them as little as possible. When they have found a suitable shelter, earwigs secrete

an aggregation pheromone to attract others. For this reason, older traps are more likely to attract earwigs and be more effective in monitoring.

- A more durable (though probably less effective) alternative to rolled corrugated cardboard is an upturned piece of treated pine-grooved decking wood.
- Don’t secure cardboard traps in trees with drawing pins or any other fasteners containing copper, as this will kill the tree.

**Appropriate action**

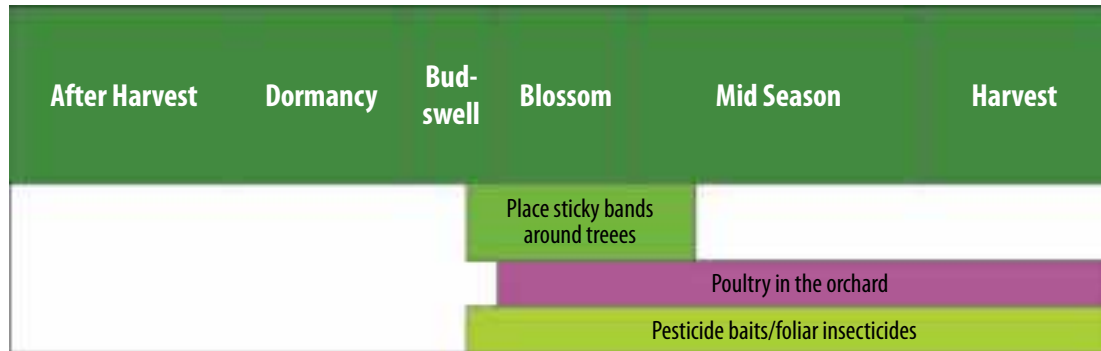
**Action threshold**

When any trap in the orchard contains five or more earwigs (see chart at top of next page).

**Place sticky bands around trees**

Sticky bands can be placed around the butts of trees. This must be done early (budburst). If this is left until later in the season there is a risk that earwigs that have moved into the canopy of the tree will be trapped there and cause severe damage.

After Harvest	Dormancy	Bud-swell	Blossom	Mid Season		Harvest
Adults move underground	Adults underground with eggs	Males emerge	Eggs hatch	Juveniles emerge	Earwigs move up trees and damage fruit	
				2nd and 3rd cycle eggs laid and juveniles emerge	Developing juveniles	
<b>MONITOR</b>						



### ***Poultry in the orchard***

Keeping poultry in the orchard from the end of bud-burst through until the end of harvest can help with earwig problems and may also be useful where European snails are a problem. However, be aware that this is not an option if chemical baits are used.

### ***Pesticide baits / foliar insecticides***

If earwigs have been a persistent problem in previous seasons, consider supplementing other control measures with insecticides. **Be aware that registration of the insecticides used against earwigs varies between States. Orchardists may use only products that are registered for use within their own States. Always check the product label.**

Chemical baits can be applied where monitoring indicates that earwigs are present in large numbers in the orchard.

Chlorpyrifos product labels include instructions for mixing baits to control earwigs. Spread them at dusk: apply around the tree butts in every second row.

Where baits have failed in previous seasons, foliar or butt applications of insecticides can be used as a last option. Chlorpyrifos is preferred to carbaryl, as carbaryl is likely to disrupt the activity of natural predators of pest mites. Some orchardists consider this option ineffective, as earwigs tend to move into shelters and these applications may not make contact with them.

### **More information**

*Some of the information provided in these references comes from other countries (marked †). Always remember that the biology of pests and diseases and the tactics used to control them vary subtly from country to country and will change with time. Be particularly cautious with pesticide recommendations. If a pesticide is not recommended in this manual (page 137) you must check that it has current registration in your State and abide by the conditions of that registration, as specified on the pesticide's label. ALWAYS READ THE LABEL.*

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# Freckle

*Cladosporium carpophilum*

## IPDM quick facts

**Sample unit:** Fruit

**When to monitor:** Mid season to after harvest

**How often:** Fortnightly

**Action threshold:** If the block has been infected during the last 4 years and it has been raining and temperatures during the 4 week period following shuckfall have been between 18 and 24 °C.

Take care when monitoring and managing young orchards.

## Causes and consequences

Freckle or scab is caused by the fungal pathogen *Cladosporium carpophilum*. The main symptoms of the disease occur on the fruit, but lesions also occur on leaves, twigs and young branches. The fungus survives through winter on these twig lesions. In spring, spores are produced and splashed onto developing fruitlets and young twigs by wind-blown rain.

## Symptoms

### Fruit

Symptoms first appear on fruit when they are half formed, approximately 6 or 7 weeks after petal fall. The first symptoms are greenish brown to black spots that appear primarily around the stem end of the fruit.

When the infection is severe these lesions can coalesce to form a greenish, velvety, blotched area.

Although the lesions are superficial and do not extend into the flesh of the fruit, they affect normal growth and the fruit becomes misshapen and cracks.

### Twigs

Raised lesions occur on the current year's growth. They are initially light brown but become darker later in the season. Although they are superficial and do little harm to trees, they play a crucial role in the disease cycle by providing a site for spore survival through winter.

### Leaves

Leaf lesions first appear late in summer as pale green areas. These develop into dark brown,



*Freckle on nectarines*



*Freckle symptoms around the stem end of the fruit*

narrow lesions. In extreme cases these lesions can cause premature defoliation.

**A serious regional issue during the last 10 years in:**

- NSW southwest slopes
- Swan Hill
- NSW central west
- Sydney Basin
- Riverlands

**Prevention**

**Orchard design**

When planting a new block, align the rows to allow good spring and summer breezes through the whole planting. Thin out surrounding bush and the undergrowth in dense windbreaks. Anything that will increase the rate of drying after rain or dew will help to reduce the incidence of freckle.

Avoid planting in low-lying areas.

**Pruning**

Prune trees to allow good air circulation; this promotes rapid drying of fruits, twigs and leaves.

**Monitoring**

**To prevent the occurrence of the disease in the current season it is far more effective to monitor the weather than the disease,**

particularly where blocks have a history of freckle infection. Twig lesions are difficult to see, and because the disease becomes visible on fruit only 40 to 70 days after infection a substantial disease outbreak can occur before monitoring detects the problem. (See chart on next page).

Freckle on fruit is usually most severe in the first year that trees bear. Be extra vigilant in monitoring young blocks. When monitoring fruit, pay particular attention to the stem end, as this is where lesions first appear.

**When to look**

Monitor the weather from late blossom to after harvest.

Monitor all fruit on four lateral branches of marked monitoring trees during this time. If disease is observed it is likely that substantial damage will have occurred, but immediate appropriate action will limit this. Twig and fruit infection indicates that appropriate action should be taken early next season.

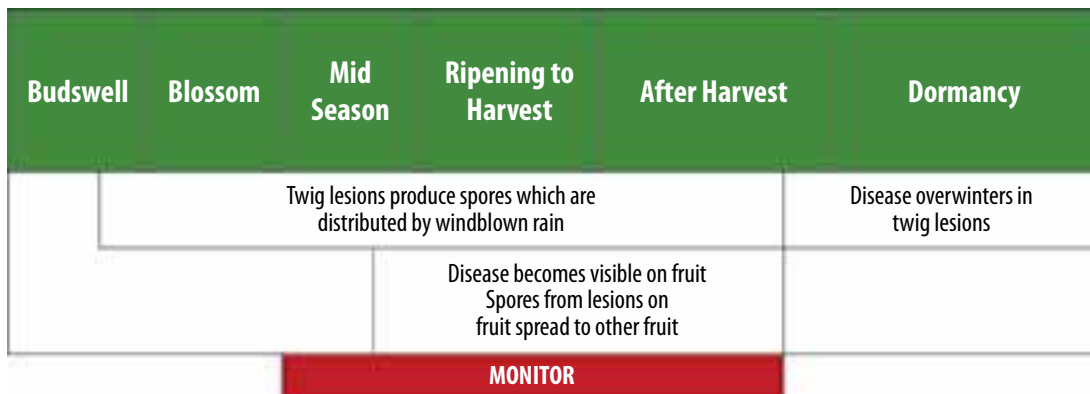
**What to look for**

Weather favouring infection is the most reliable early indicator of this disease.

Twig infection is difficult to see and is unlikely to be observed. Fruit infection indicates that appropriate action should be applied early next season.



*Freckle lesions on twigs*



**Appropriate action**

**Action threshold**

Take appropriate action (see chart at bottom of page) if the block:

- has been previously infected, and
- it has been raining and temperatures during the 4-week period following shuckfall have been between 18 and 24 °C.

Monitoring allows early detection of freckle in the block. You should then take appropriate action to minimise spread. Take action **before** symptoms appear the following season.

**Prune out twig lesions**

Twig lesions are responsible for the first infections of the season. Although they are difficult to see, prune them out where possible and destroy the prunings.

**Destroy infected fruit**

Infected fruit perpetuate the disease in your orchard by providing infections to nearby healthy fruit. Remove and destroy infected fruit (particularly young fruit).

**Protective spray program**

In most cases sprays applied for other diseases such as rust and shot-hole will control freckle and no specific sprays need be applied. A spray schedule for these diseases is included in this manual (page 137).

**More information**

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