Avocado information kit

Reprint – information current in 2001

REPRINT INFORMATION – PLEASE READ!

For updated information please call 13 25 23 or visit the website www.dpi.qld.gov.au

This publication has been reprinted as a digital book without any changes to the content published in 2001. We advise readers to take particular note of the areas most likely to be out-of-date and so requiring further research:

- Chemical recommendations—check with an agronomist or Infopest www.infopest.qld.gov.au
- Financial information—costs and returns listed in this publication are out of date. Please contact an adviser or industry body to assist with identifying more current figures.
- Varieties—new varieties are likely to be available and some older varieties may no longer be recommended. Check with an agronomist, call the Business Information Centre on 13 25 23, visit our website www.dpi.qld.gov.au or contact the industry body.
- Contacts—many of the contact details may have changed and there could be several new contacts available. The industry organisation may be able to assist you to find the information or services you require.
- Organisation names—most government agencies referred to in this publication have had name changes. Contact the Business Information Centre on 13 25 23 or the industry organisation to find out the current name and contact details for these agencies.
- Additional information—many other sources of information are now available for each crop. Contact an agronomist, Business Information Centre on 13 25 23 or the industry organisation for other suggested reading.

Even with these limitations we believe this information kit provides important and valuable information for intending and existing growers.

This publication was last revised in 2001. The information is not current and the accuracy of the information cannot be guaranteed by the State of Queensland.

This information has been made available to assist users to identify issues involved in the production of avocadoes. This information is not to be used or relied upon by users for any purpose which may expose the user or any other person to loss or damage. Users should conduct their own inquiries and rely on their own independent professional advice.

While every care has been taken in preparing this publication, the State of Queensland accepts no responsibility for decisions or actions taken as a result of any data, information, statement or advice, expressed or implied, contained in this publication.

Queensland Government

Spots or marks on trunk and branches

Trunk canker disease

Cause: The fungus *Phytophthora cinnamomi*.

Identification: The canker appears as a water-soaked, dark brown area in contrast to the normal grey-brown of the healthy bark. A white secretion of dried sap is normally evident within the affected area. The presence of the white secretion alone does not necessarily indicate trunk canker disease, as any injury to the trunk may produce the same reaction. Left: overall view. Right: close-up of cankered area. The fungus also affects roots, producing root rot (see pages 4, 16, 19, 41, 43 and 44).

Treatment/prevention: Either cut out all diseased bark and wood and paint the excised area with a mixture of copper fungicide and water-based paint, or spray affected trunks with a registered phosphonate product. Also keep mulch away from the base of the trunk, position sprinklers so that water splash against the trunk is minimised and avoid wounding of trunks.

Scale insects

Cause: Latania scale (*Hemiberlesia lataniae)* is the most common and serious pest. Soft brown scale (*Coccus hesperidum*), white wax scale (*Gascardia destructor*) and pink wax scale (*Ceroplastes rubens*) are occasional pests.

Identification: Upper: latania scales are small (1 to 1.3 mm across) and creamy-brown. They also infest leaves and fruit (see pages 2 and 23). Centre: soft brown scale (about 3 mm long). Lower: pink wax scale (about 5 mm across). Soft brown, white wax and pink wax scales favour the development of sooty mould.

Treatment/prevention: First check that the infestation is serious enough to warrant treatment. Scales need to be obvious on leaves and twigs to justify treatment. Where required, spray with an appropriate oil spray from the *Problem Solver Handy Guide*. Avoid spraying during hot weather. Avoid continuous use of insecticide sprays that are disruptive to beneficial insects. Regularly monitor the orchard so that action can be taken before scales build up to the point of fruit infestation.

Mosquito bug (Helopeltis) damage

Cause: The insects *Helopeltis* spp.

Identification: Left: shoot damage. Bug feeding damage first shows as small dark spots on the stem and sometimes along the leaf veins. Cracks may develop at the feeding sites and affected shoots may wilt. Right: close-up of the adult bug on a young fruit (actual size about 7 mm long). Also affects fruit (see page 23). Occurs in North Queensland only.

Treatment/prevention: Treatment for shoot damage is generally necessary only on young trees. Where young shoots are damaged, sprays recommended for fruitspotting bug should provide adequate protection. In future, monitor young trees regularly so that spraying can start when damage is first detected.

Spots or marks on trunk and branches

Sunburn

Cause: Exposure of unprotected branches to full sunlight. Generally results from rapid defoliation caused by root rot disease, failure to protect branches after major pruning, or extremely hot weather.

Identification: Symptoms range from a yellowing of top branch surfaces to dark sunken cracked cankers. Fruit may also be affected (see page 24).

Treatment/prevention: Where pruning exposes major branches to the sun, liberally paint or spray exposed surfaces with white water-based paint. Control root rot disease and carefully manage nutrition and irrigation to ensure trees maintain adequate leaf cover.

Hail damage

Cause: Impact from hailstones.

Identification: Causes an irregular gouging of the bark on exposed twigs and branches accompanied by extensive defoliation. In severe cases, bark may be completely stripped from exposed branches. Fruit may also be affected (see page 29).

Treatment/prevention: Apply an anthracnose fungicide spray as soon as possible after damage to help prevent fungal infection. Where possible, paint the exposed surfaces of large branches with a white water-based paint to prevent sunburn.

Sunblotch viroid disease

Cause: Avocado sunblotch viroid.

Identification: Twigs and branches develop streaking and spotting of the bark. This is generally yellow, but may be orange, white or almost colourless. Streaking is generally associated with grooving of the bark. Leaves and fruit may also be affected (see pages 5, 21, 31 and 43).

Treatment/prevention: There is no treatment for affected trees. They must be destroyed to avoid transmission to healthy trees. Select budwood and rootstock seed only from viroid-tested trees. Plant trees propagated from viroid-tested material at least 15 m from untested trees to avoid transmission from natural root grafting. Reserve a special set of pruning, injecting and harvesting implements for these viroid-free trees to avoid transmission through sap. Alternatively, disinfect cutting tools thoroughly with a 1.5% solution of sodium hypochlorite before using on viroid-free trees.

Pepper spot disease

Cause: The fungus *Colletotrichum gloeosporioides*.

Identification: Causes a myriad of small dark raised spots on the twigs. Also affects fruit (see page 21).

Treatment/prevention: The field spray program normally applied for anthracnose should adequately control pepper spot.

Spots or marks on trunk and branches

Boron deficiency

Cause: Insufficient boron available to the tree.

Identification: Corky sunken lesions develop on trunks (left) and branches (right). Also affects leaves, twigs, flowers and fruit (see below and pages 7, 13, 15, 20, 30, 40 and 44).

Treatment/prevention: Get leaf and soil analyses done to confirm the diagnosis. Apply borax or Solubor to the ground under the trees at rates determined by either the AVOMAN software or a qualified agronomist. Apply evenly to avoid toxicity. This is best achieved by mixing it in water and spraying it on the ground or applying it by fertigation. Do regular leaf and soil analyses to monitor nutrient levels.

Trunk injection damage

Cause: Tree reaction to the injection of phosphonate fungicide for root rot disease control.

Identification: Left: dark patches develop in the bark around the injection sites accompanied by white secretions of dried sap. The damage is relatively superficial and doesn't appear to be permanent. Right: internal symptoms in a cut section of a major branch.

Treatment/prevention: No treatment is necessary, but foliar sprays of phosphonate could be considered where trees are not visibly affected or only mildly affected by root rot disease.

Dieback of twigs and branches

Phytophthora root rot disease

Cause: The fungus *Phytophthora cinnamomi*.

Identification: Affected tree showing extensive twig and branch dieback. See other symptoms on pages 4, 16, 17, 41, 43 and 44. Do not confuse with Verticillium wilt where leaves die suddenly and remain on the tree (see page 8).

Treatment/prevention: Use an integrated disease management program of both chemical and cultural measures as outlined on page 4.

Boron deficiency

Cause: Insufficient boron available to the tree.

Identification: Shoots become twisted and distorted with corky lesions and dieback. Multiple branching with a weeping habit develops. Also affects leaves, branches, flowers and fruit (see above and pages 7, 13, 15, 20, 30, 40 and 44).

Treatment/prevention: Get leaf and soil analyses done to confirm the diagnosis. Apply borax or Solubor to the ground under the trees at rates determined by either the AVOMAN software or a qualified agronomist. Apply evenly to avoid toxicity. This is best achieved by mixing it in water and spraying it on the ground or applying it by fertigation. Do regular leaf and soil analyses to monitor nutrient levels.

Dieback of flowers

Boron deficiency

Cause: Insufficient boron available to the tree.

Identification: Flower panicles develop, but subsequently dry and wither. Also affects leaves, trunk, branches and fruit (see pages 7, 13, 15, 19, 30, 40 and 44).

Treatment/prevention: Get leaf and soil analyses done to confirm the diagnosis. Apply borax or Solubor to the ground under the trees at rates determined by either the AVOMAN software or a qualified agronomist. Apply evenly to avoid toxicity. This is best achieved by mixing it in water and spraying it on the ground or applying it by fertigation. Do regular leaf and soil analyses to monitor nutrient levels.

Spots or marks on skin surface of fruit (field)

Cercospora spot disease

Cause: The fungus *Pseudocercospora purpurea*.

Identification: Spots are initially small, raised and black, in time becoming slightly sunken and cracked. Occurs in North Queensland only. Also affects leaves (see page 2).

Treatment/prevention: Generally well controlled by the fungicide spray program applied for anthracnose, provided good spray coverage is maintained.

Anthracnose disease

Cause: The fungus *Colletotrichum gloeosporioides*.

Identification: Two types of symptoms occur in the field. Upper: large circular brown spots (arrowed) may form around puncture marks to the skin. In this case, fruitspotting bug has caused the initial damage. The spots darken with age, centres become sunken, and in moist conditions pinkish spore masses may form on the spots. Lower: the other field symptom is small spots, less than 5 mm in diameter, which develop around the breathing pores (lenticels). The fungus also causes a major post-harvest problem in ripe fruit (see symptoms on pages 36 and 38).

Treatment/prevention: Spray with an appropriate chemical from the *Problem Solver Handy Guide*. Follow label directions. Spray regularly from fruit set to harvest. Control fruit damaging pests such as fruitspotting bug and fruit fly. Pay attention to orchard hygiene by pruning out dead wood before flowering and regularly removing infected fruit and dead leaves entangled in the canopy. Keeping the canopy open by judicious pruning and tree shaping helps to reduce the severity of infection. Use regular leaf and soil analyses to keep nutrient levels, particularly calcium and nitrogen, at adequate levels as this increases the resistance of the fruit to infection. Avoid planting new trees grafted to Duke 6 rootstock.

Spots or marks on skin surface of fruit (field)

Sooty blotch

Cause: A disease complex caused by *Stomiopeltis* spp. and *Akaropeltopsis* spp.

Identification: Causes an uneven black superficial blemish on the skin surface.

Treatment/prevention: The field spray program normally applied for anthracnose should adequately control sooty blotch, provided good spray coverage is maintained.

Pepper spot disease

Cause: The fungus *Colletotrichum gloeosporioides*.

Identification: Causes a myriad of small dark raised spots on the fruit surface. Also affects twigs (see page 18).

Treatment/prevention: The field spray program normally applied for anthracnose should adequately control pepper spot, provided good spray coverage is maintained.

Sunblotch viroid disease

Cause: Avocado sunblotch viroid.

Identification: Affected fruit develop yellow or reddish depressed streaks, generally extending from the stem end. Fruit may also be small and distorted. Also affects leaves and branches (see pages 5, 18, 31 and 43).

Treatment/prevention: There is no treatment for affected trees. They must be destroyed to avoid transmission to healthy trees. Select budwood and rootstock seed only from viroid-tested trees. Plant trees propagated from viroid-tested material at least 15 m from untested trees to avoid transmission from natural root grafting. Reserve a special set of pruning, injecting and harvesting implements for these viroid-free trees to avoid transmission through sap. Alternatively, disinfect cutting tools thoroughly with a 1.5% solution of sodium hypochlorite before using on viroid-free trees.

Monolepta beetle damage

Cause: The insect *Monolepta australis*.

Identification: Upper: the beetles feed on and remove the surface layers of the fruit. As the underlying tissue dries out, the surface of the fruit takes on a dark brown 'crazed' appearance. Lower: adult beetles (actual size about 4 mm long). Leaves may also be damaged (see pages 9 and 10).

Treatment/prevention: Where insect activity is significant, spray with an appropriate chemical from the *Problem Solver Handy Guide*. Follow label directions. Regularly monitor the orchard, particularly after rain in spring, so that treatments can be applied before major damage occurs.

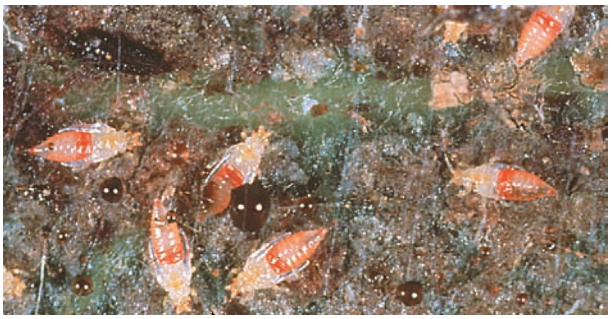
Spots or marks on skin surface of fruit (field)

Thrips damage

Cause: The insects *Selenothrips rubrocinctus* (redbanded thrips) *and Heliothrips haemorrhoidalis* (greenhouse thrips).

Identification: Upper: fruit affected by redbanded thrips showing the silvery-bronze discolouration of the skin surface (unaffected fruit at left for comparison). Lower: fruit severely affected by greenhouse thrips showing the muddy brown discolouration of the skin surface. The discolouration is generally confined to sites where neighbouring fruit touch. Greenhouse thrips are mainly a problem in Western Australia on the Hass variety. Below: close-up of redbanded thrips showing a black adult and several cream-coloured nymphs (actual size about 1 to 1.5 mm long). The small dark spherical objects are thrips excreta. Greenhouse thrips are similar in size and appearance to redbanded thrips, but nymphs are green. Also affects leaves (see page 11).

Treatment/prevention: Generally not serious enough to warrant special treatment as they are usually well controlled by beneficial insects and, where applicable, the spray program for fruitspotting bug. Avoid continuos use of insecticide sprays that are disruptive to beneficial insects. In Western Australia, monitor the orchard from November to February so that action can be taken if necessary before damage is significant.



Garden weevil damage

Cause: The insect *Phlyctinus callosus*.

Identification: Upper left: typical fruit damage. Damage tends to consist of small discrete patches chewed into the skin. Upper right: chew marks on fruit stalks. In severe cases, the fruit stalks may be ringbarked, leading to reduced fruit size. Lower: adult weevil (actual length about 7 mm long). Also affects leaves (see symptoms on page 15). Occurs in Western Australia only.

Treatment/prevention: Spray with an appropriate chemical from the *Problem Solver Handy Guide*. Before spraying, check that the damage is serious enough to warrant treatment. This minimises any disruption to beneficial insects from the prolonged use of the broad-spectrum insecticides necessary to control the weevil. Regularly monitor the orchard during spring and summer for signs of damage.

Spots or marks on skin surface of fruit (field)

Scale insects

Cause: The scale insects *Hemiberlesia lataniae* (latania scale) and *Fiorinia fioriniae* (fiorinia scale).

Identification: Upper: latania scale. Scales are 1 to 1.3 mm across and creamy-brown. Latania scale is also common on leaves and twigs (see pages 2 and 17). Lower: fiorinia scale. Scales are 1 to 1.3 mm across, brown to orange-brown and shield-shaped.

Treatment/prevention: First check that the infestation is serious enough to warrant treatment. There needs to be 4 (rough-skinned varieties) to 20 (smooth-skinned varieties) scales per fruit to justify treatment. Smooth-skinned varieties have a higher action level as it is much easier to brush scales off in the packing shed. Where required, spray with an appropriate oil spray from the *Problem Solver Handy Guide*. Avoid spraying during hot weather. Avoid continuous use of insecticide sprays that are disruptive to beneficial insects. Regularly monitor the orchard so that action can be taken before significant build-up of scales.

Mosquito bug (Helopeltis) damage

Cause: The insects *Helopeltis* spp.

Identification: Left: bug feeding damage shows as numerous small black spots which can coalesce to cover large parts of the fruit surface. An adult bug is just visible on the upper right of the fruit. Right: close-up of the adult bug on a young fruit (actual size about 7 mm long). Note that very young fruit are attacked. Also attacks shoots (see page 17). Occurs in North Queensland only.

Treatment/prevention: Where damage to young fruit is detected, sprays applied for fruitspotting bug should provide adequate protection. In future, start monitoring young fruit immediately after fruit set so that spraying can start when damage is first detected.

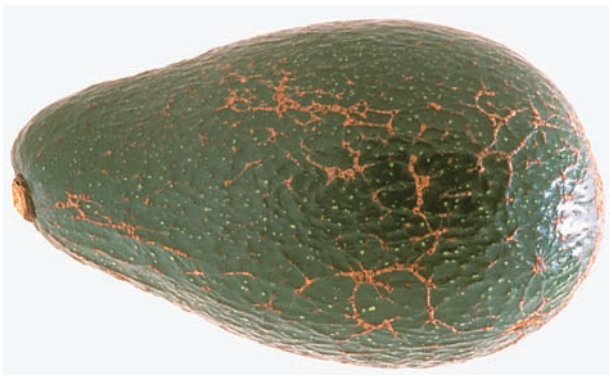
Calyx damage in Shepard fruit

Cause: Wet weather during early fruit set.

Identification: Causes the calyx to stick to the surface of the fruit. Skin around the stem entry point is subsequently damaged.

Treatment/prevention: There is no practical treatment or preventative measures.

Spots or marks on skin surface of fruit (field)



Wind rub damage

Cause: Leaves or twigs rubbing against the surface of the fruit during wind. This ruptures the skin cells.

Identification: Upper: typical severe wind damage. Centre and lower: close-up of the two main types of damage—abrasion caused by a branch or twig (centre), and the netting or sandpaper effect caused by leaf abrasion (lower).

Treatment/prevention: Establish effective windbreaks.

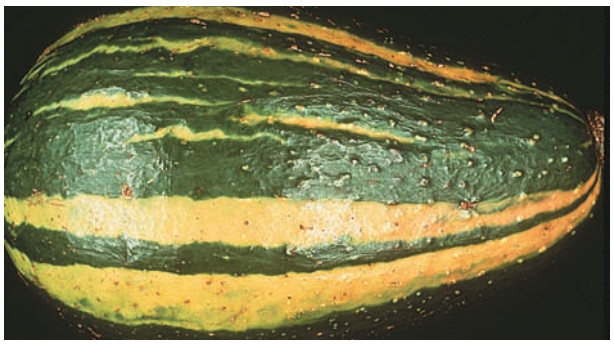
Sunburn damage

Cause: Exposure of fruit to the sun during hot weather. Generally only a problem in trees that have lost their leaf cover or where pruning has been poorly managed. More likely on the exposed western side of the tree after very hot weather. More common on Hass.

Identification: Upper: typical range of symptoms. Lower: close-up of affected fruit. Sunburn areas range from yellow to dark brown with distinct margins and can be slightly sunken. Branches may also be affected (see page 18).

Treatment/prevention: Control root rot disease and carefully manage nutrition and irrigation to ensure trees maintain adequate leaf cover.

Spots or marks on skin surface of fruit (field)



Fruit touching soil or mulch

Cause: Lack of chlorophyll development and skin discolouration as a result of the fruit touching the soil or mulch cover, away from sunlight.

Identification: Causes a pale yellow to whitish skin, which varies over the fruit according to the amount of light received. Variably shaped dark brown marks or blotches may develop at the point where the fruit contacts the mulch. Also see symptom on page 34.

Treatment/prevention: As only a small number of fruit are affected, no particular action is generally necessary. Skirting of trees to remove the risk of low-hanging fruit may be beneficial.

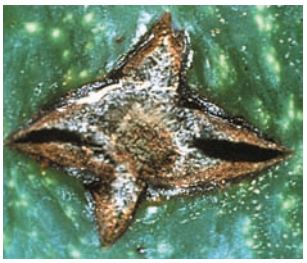
Chimera

Cause: A mutation (genetic alteration).

Identification: Affected fruit may be abnormally coloured, shaped and textured. A whole fruit or just a part of the fruit may be affected. Note: Do not confuse this problem with sunblotch viroid symptoms (see page 21).

Treatment/prevention: There is no treatment for affected trees. Prune out affected branches. If the problem persists, remove the tree and replant. In future, use only budwood and seed for rootstocks from trees of proven genetic performance.

Holes, cracks and gouges in skin of fruit



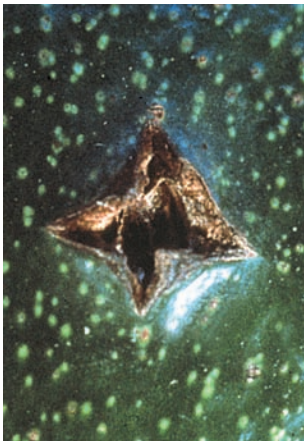
Fruitspotting bug damage

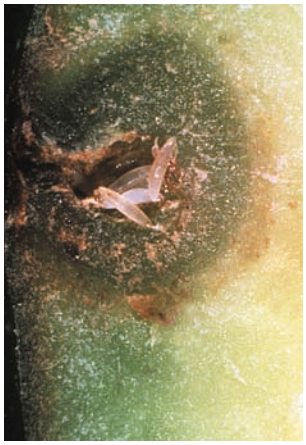
Cause: The insects *Amblypelta nitida* (fruitspotting bug) and *Amblypelta lutescens lutescens* (banana-spotting bug).

Identification: Upper left: typical damage to developing fruit showing the cracks and craters produced by bug feeding. Upper right: the cracks often have a distinct star shape. Centre: damage to very young fruit may show as a dark sunken spot without noticeable cracking. A nymph of banana-spotting bug is shown on the fruit. Lower left: adult (top) and nymph of fruitspotting bug. Lower right: adult (top) and nymphs of banana-spotting bug. Actual size of adult bugs about 15 mm long. A secretion of sap which dries to a white powder often accompanies damage (see page 33). Bug damage is worst in orchards adjacent to rainforest or scrub. Thin-skinned varieties such as Fuerte and Sharwil appear to be more susceptible, but all varieties can be severely attacked. See other symptoms of damage on pages 30, 33 and 41. Occurs in eastern Australia only.

Treatment/prevention: Spray with an appropriate chemical from the *Problem Solver Handy Guide*. Follow label directions. In areas adjacent to rainforest and scrub, spraying may need to start at fruit set and continue at fortnightly intervals until harvest. Monitor the orchard in spring to determine when spraying should start. Particular trees or areas in an orchard seem to be attacked each year, so monitoring should concentrate on these hot spots. In other less susceptible areas, regularly monitor the orchard, so that spraying can start when damage is first detected.

Holes, cracks and gouges in skin of fruit





Queensland fruit fly damage

Cause: The insect *Bactrocera tryoni.*

Identification: Upper left: typical skin damage from a fruit fly sting. The resultant crack is generally star shaped or T-shaped. Superficially, it may be difficult to distinguish from damage caused by fruitspotting bugs. Diagnosis can generally be made by slicing through the centre of the crack and checking for the presence of small, white, banana-shaped eggs of fruit fly embedded in the tissue under the sting (upper right). The depth of damage is also much less than for fruitspotting bug. Lower: an adult fruit fly (actual length about 6 mm). Thin-skinned varieties such as Fuerte and Sharwil are more susceptible. Occurs in Queensland and northern NSW only.

Treatment/prevention: First check that the damage is serious enough to warrant treatment. Where fruitspotting bug sprays are being applied regularly, they will generally suppress fruit fly populations sufficiently. The need for sprays can be assessed by monitoring fruit for damage and by using male lure traps. Where required, apply an appropriate bait spray from the *Problem Solver Handy Guide*. Follow label directions. Bait spraying should only be necessary in some locations and on the more susceptible thin-skinned varieties.

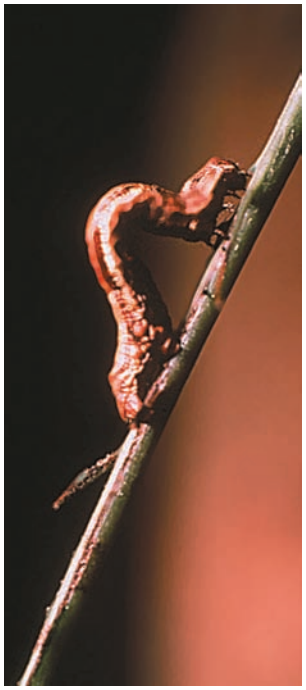
Leafroller damage

Cause: The insects *Homona spargotis* (avocado leafroller) and *Cryptoptila immersana* (ivy leafroller).

Identification: Upper: typical damage from avocado leafroller. The two fruit have been separated to reveal the webbed shelter formed where the fruit were in contact with each other. Note the larva of the pest on the fruit at right. Lower: damage from ivy leafroller showing a larva of the insect (actual length of larvae up to 25 mm). Leaves may also be damaged (see page 14). Avocado leafroller occurs in north Queensland only and ivy leafroller occurs in south Queensland and northern NSW only.

Treatment/prevention: Spray with an appropriate chemical from the *Problem Solver Handy Guide*. In future, regularly monitor the orchard for early signs of leaf and fruit damage and spray before the damage gets too severe.

Holes, cracks and gouges in skin of fruit



Looper caterpillar damage

Cause: The insects *Cleora inflexaria* (grey looper), *Lophodes sinistraria* (brown looper) and *Ectropis sabulosa* (ectropis looper).

Identification: Left: damage from ectropis looper showing the scarring damage to the skin. Right: close-up of a larva of the ectropis looper showing the typical looping action used to move (actual length about 20 mm). Grey looper and brown looper may cause similar symptoms (see photos of larvae of these pests on page 14). When disturbed, the larva stretches out and stiffens to look like a twig. Leaves may also be damaged (see pages 14 and 43).

Treatment/prevention: As these pests are normally kept under reasonable control by beneficial insects, treatment is generally only necessary where damage is severe and the beneficial insects are absent. Where required, spray with an appropriate chemical from the *Problem Solver Handy Guide*. Regularly monitor the orchard so that action can be taken before damage gets too severe. Avoid continuous use of insecticides that are disruptive to beneficial insects.

Orange fruitborer damage

Cause: The insect *Isotenes miserana*.

Identification: Left: typical skin damage. Note how the damage is confined to the surface layers of the skin. Right: a larva of the insect (actual size about 10 mm long). Occurs in eastern Australia only. Note: In Western Australia, western fruit moth may cause similar damage.

Treatment/prevention: The spray program applied for leafrollers will generally control orange fruitborer. Where special treatment is required, spray with an appropriate chemical from the *Problem Solver Handy Guide*. In future, regularly monitor the orchard for early signs of fruit damage and spray before the problem gets too severe.

Monolepta beetle damage

Cause: The insect *Monolepta australis*.

Identification: Upper: the beetles feed on and remove the surface layers of the fruit. As the underlying tissue dries out, the surface takes on a dark brown 'crazed' appearance. Lower: adult beetles (actual size about 4 mm long). Leaves may also be damaged (see pages 9 and 10).

Treatment/prevention: Where insect activity is significant, spray with an appropriate chemical from the *Problem Solver Handy Guide*. Follow label directions. Regularly monitor the orchard, particularly after rain in spring, so that treatments can be applied before major damage occurs.

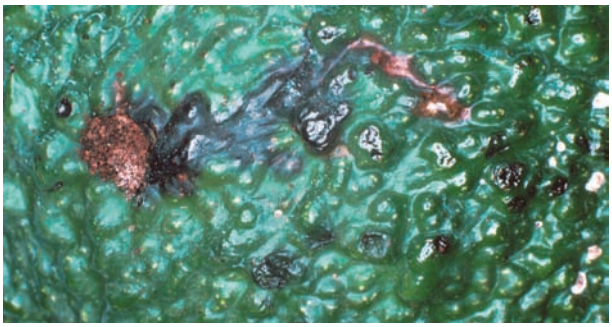
Holes, cracks and gouges in skin of fruit

Tussock moth damage

Cause: The insect *Acyphas leucomelas*.

Identification: Feeding by the larvae of this pest causes deep scarification of the fruit skin. The 20-mm-long larvae are distinctive, with long hairs protruding from the body.

Treatment/prevention: Generally not serious enough to warrant special treatment. The spray program applied for fruitspotting bug and other pests will generally control tussock moth. In future, regularly monitor the orchard for early signs of the pest so that appropriate action can be taken before fruit are damaged.



Fruitborer damage

Cause: Larvae of an undescribed moth similar to macadamia nut borer.

Identification: Upper: overall view of fruit damage showing the entry sites of the larvae. White powder and brown larval excreta often surround the entry holes. Lower: close-up of an entry hole. A distinctive black mark can be seen near the hole, showing where the larva has tunnelled under the skin. Occurs in North Queensland only.

Treatment/prevention: Where fruit damage is detected, sprays applied for other fruit-boring insects, such as orange fruitborer, should provide adequate protection. Particular areas of the orchard, such as perimeter trees and trees facing the prevailing wind, are most likely to be attacked first. Monitor these hot spots regularly for early signs of the pest so that appropriate action can be taken before damage is significant.

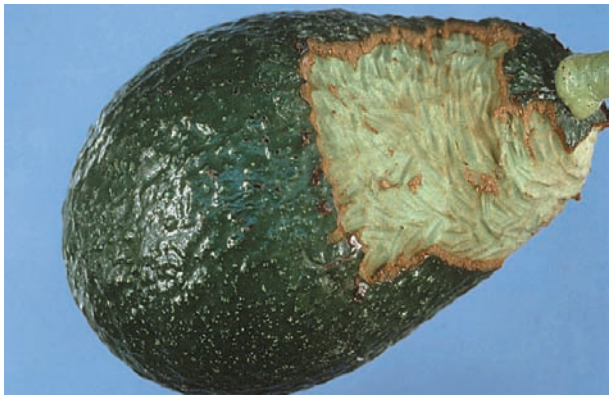
Water stress

Cause: Insufficient water supply to the tree. May be a result of insufficient soil moisture or the lack of an effective root system because of root rot disease.

Identification: Causes cracking of the skin near the stem end. This is generally associated with the related condition known as ringneck, which produces a corky ring of tissue on the fruit stalk (see page 35). This symptom is also obvious here. Also see page 31 for another disorder related to water stress—premature death of the seed coat.

Treatment/prevention: Maintain adequate soil moisture at all times, but particularly during peak demand periods such as flowering and fruit set. Use soil moisture monitoring devices to schedule irrigation accurately. Mulch trees in spring to reduce moisture loss. Ensure root systems are well protected against root rot disease.

Holes, cracks and gouges in skin of fruit



Rat damage

Cause: Damage from feeding by tree-climbing rats.

Identification: Upper: fresh damage. Lower: older damage. Rats chew the skin, often at the stem end of the fruit, leaving a grooved appearance indicative of scraping by their incisor teeth. Damage is worst in orchards surrounded by thick grass or other sheltered habitats infested by the rats. Avocados adjacent to macadamia orchards are generally more affected. Rat damage is often incorrectly ascribed to possums and other tree-dwelling marsupials.

Treatment/prevention: Remove rat habitats from around the orchard. Where the problem is serious, bait stations may help, but first check the regulations on their use.

Bird damage

Cause: Damage from bird feeding.

Identification: The surface of the fruit is eaten away in irregular patches. The indentations in the damaged area correspond to where the bird's beak has been gnawing at the hard immature avocado flesh.

Treatment/prevention: Not generally serious enough to be of concern. Damage tends to be isolated and only where there is a severe food shortage for birds.

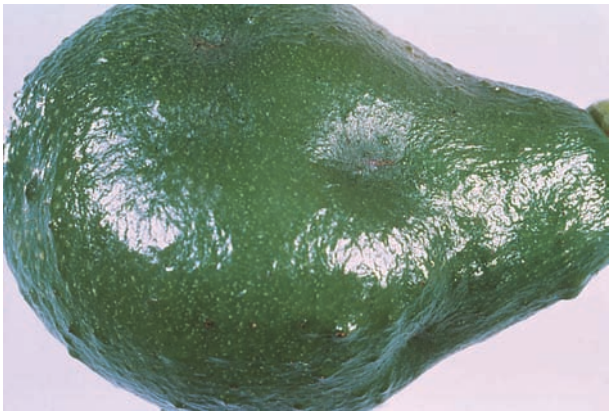
Hail damage

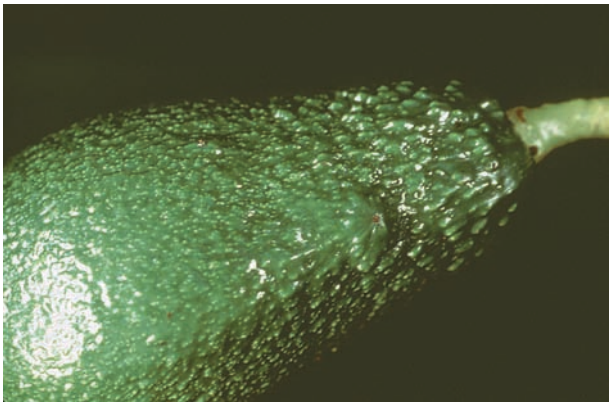
Cause: Impact from hailstones.

Identification: Depending on the intensity and size of the hail, damage varies from a light brown bruising (fruit at left and centre) to an irregular gouging of the fruit surface (fruit at right). Also see symptoms on branches on page 18.

Treatment/prevention: Apply an anthracnose fungicide spray as soon as possible after damage to help prevent fungal infection. Where possible, paint or spray the exposed surfaces of large branches with a white water-based paint to prevent sunburn.

Distorted, small or odd-shaped fruit





Fruitspotting bug damage

Cause: The insects *Amblypelta nitida* (fruitspotting bug) and *Amblypelta lutescens lutescens* (banana-spotting bug).

Identification: Upper: 'blind stings', caused when bugs feed on fruit before its rapid growth phase, produce dimpling of the fruit. Lower: as well as dimples, 'blind stings' may produce lumps on fruit. Occurs in eastern Australia only. Bug damage is worst in orchards adjacent to rainforest or scrub. Thin-skinned varieties such as Fuerte and Sharwil appear to be more susceptible, but all varieties can be severely attacked. See pages 25, 33 and 41 for other symptoms of fruitspotting bug damage and photos of the bugs.

Treatment/prevention: Spray with an appropriate chemical from the *Problem Solver Handy Guide*. Follow label directions. In areas adjacent to rainforest and scrub, spraying may need to start at fruit set and continue at fortnightly intervals until harvest. Monitor the orchard in spring to determine when spraying should start. Particular trees or areas in an orchard seem to be attacked each year, so monitoring should concentrate on these hot spots. In other less susceptible areas, regularly monitor the orchard, so that spraying can start when damage is first detected.

Boron deficiency

Cause: Insufficient boron available to the tree.

Identification: Affected fruit show a wide range of shape distortions including bumpiness (upper photo), hooking (fruit at lower left) and sunken corky lesions (fruit at lower right). Sharwil is most susceptible to damage. Also causes leaf, twig, trunk and flower symptoms (see pages 7, 13, 15, 19, 20, 40 and 44).

Treatment/prevention: Get leaf and soil analyses done to confirm the diagnosis. Apply borax or Solubor to the ground under the trees at rates determined by either the AVOMAN software or a qualified agronomist. Apply evenly to avoid toxicity. This is best achieved by mixing it in water and spraying it on the ground or applying it by fertigation. Do regular leaf and soil analyses to monitor nutrient levels.

Distorted, small or odd-shaped fruit

Premature death of the seed coat

Cause: Probably due to over-cropping, but is exacerbated by insufficient water supply to the tree. May be a result of insufficient soil moisture or the lack of an effective root system because of root rot disease.

Identification: The premature death of the seed coat restricts fruit growth and results in small fruit size. Affected fruit at top compared with normal fruit below. The seed has been removed from both fruit to show the remains of the dead seed coat in the affected fruit compared to the living seed coat in the normal fruit. Hass is particularly susceptible to the condition. Water stress also causes other symptoms (see pages 28 and 35).

Treatment/prevention: Maintain adequate soil moisture at all times, but particularly during peak demand periods such as flowering and fruit set. Use soil moisture monitoring devices to schedule irrigation accurately. Mulch trees in spring to reduce moisture loss. Ensure root systems are well protected against root rot disease.

Zinc deficiency

Cause: Insufficient zinc available to the tree**.** Generally exacerbated by high soil pH or high levels of soil phosphorus.

Identification: Affected fruit are smaller and more rounded than is normal for the variety. Left: affected fruit. Right: normal fruit for comparison. Also affects leaves (see pages 6 and 13).

Treatment/prevention: Get a leaf analysis done to confirm the diagnosis. Apply zinc to the ground under the tree in a band around the dripline. In future, do regular leaf and soil analyses to monitor nutrient levels. Apply zinc to the ground under the trees annually according to leaf and soil analysis results.

Sunblotch viroid disease

Cause: Avocado sunblotch viroid.

Identification: Affected fruit develop yellow or reddish depressed streaks, generally extending from the stem end. Fruit may be small and distorted. Also affects leaves and branches (see pages 5, 18, 21 and 43).

Treatment/prevention: There is no treatment for affected trees. They must be destroyed to avoid transmission to healthy trees. Select budwood and rootstock seed only from viroid-tested trees. Plant trees propagated from viroid-tested material at least 15 m from untested trees to avoid transmission from natural root grafting. Reserve a special set of pruning, injecting and harvesting implements for these trees to avoid transmission through sap. Alternatively, disinfect cutting tools thoroughly with a 1.5% solution of sodium hypochlorite before using on viroid-free trees.

Distorted, small or odd-shaped fruit

Herbicide damage

Cause: Uptake of 2,4-D herbicide.

Identification: The systemic action of the herbicide produces severe growth distortion including severely elongated fruit. Also causes leaf distortion (see page 12).

Treatment/prevention: Avoid using 2,4-D type herbicides anywhere in the vicinity of avocado trees. Even when applied at some distance from the orchard, take all measures to minimise herbicide drift and use shielded, low-pressure fan or flood nozzles.

Cocktails (cukes)

Cause: Pollination failure caused by temperatures below about 10°C or above about 30°C within three days of pollination. Boron deficiency may exacerbate the problem.

Identification: Affected fruit are 50 to 100 mm long, slender and sausage-shaped. When cut in half lengthways, the seed cavity is generally narrow and hollow, sometimes with the partially degenerated seed coat. Fuerte is particularly susceptible. Fruit is marketable as 'cocktails'.

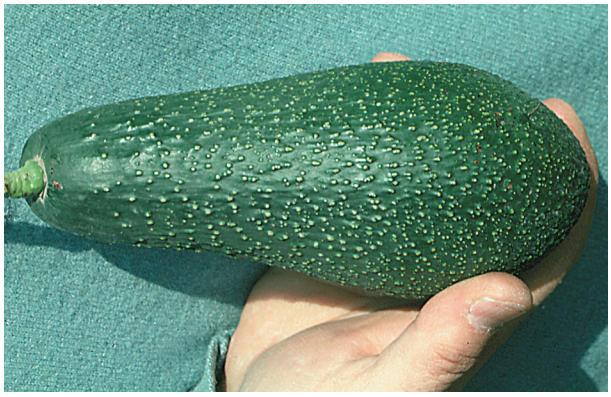
Treatment/prevention: There is little that can be done in existing orchards apart from avoiding any additional stress from boron deficiency during flowering and fruit set. In future, select varieties climatically suited to your area.

Chimera ridging of Shepard fruit

Cause: A mutation (genetic alteration).

Identification: Affected fruit are abnormally shaped with a distinct ridge running around the circumference of the fruit. The colour and skin texture between the two sections may vary substantially. The lower part of the fruit often shows a brown-streaked russet of the skin.

Treatment/prevention: The problem may show on parts of a tree or a whole tree. Prune out affected branches. If the problem persists, remove the tree and replant. In future, use only budwood and seed for rootstocks from trees of proven genetic performance.



Neckiness

Cause: Either water stress or cold weather during early fruit development.

Identification: Fruit are excessively elongated, often with the length more than twice the diameter. Elongated fruit are healthy in all other respects, but are more difficult to pack.

Treatment/prevention: Maintain adequate soil moisture at all times, but particularly during peak demand periods such as flowering and fruit set. Use soil moisture monitoring devices to schedule irrigation accurately. Mulch trees in spring to reduce moisture loss. Ensure root systems are well protected against root rot disease.

Whitish lumps or powder on fruit or fruit stalk

Copper spray residue

Cause: Deposits remaining from copper sprays applied for anthracnose control.

Identification: The deposit appears as a greenish-white residue, particularly on the bottom of the fruit, where it is sometimes difficult to remove with brushing.

Treatment/prevention: Avoid excessive applications of copper fungicide. Calculate rates carefully and regularly calibrate spray equipment.

Fruitspotting bug damage

Cause: The insects *Amblypelta nitida* (fruitspotting bug) and *Amblypelta lutescens lutescens* (banana-spotting bug).

Identification: A fruit with a 'sting' showing the secretion of sap, which dries to a white powder around the damaged site. Occurs in eastern Australia only. Bug damage is worst in orchards adjacent to rainforest or scrub. Thin-skinned varieties such as Fuerte and Sharwil appear to be more susceptible, but all varieties can be severely attacked. See pages 25, 30 and 41 for other symptoms of fruitspotting bug damage and photos of the bugs.

Treatment/prevention: Spray with an appropriate chemical from the *Problem Solver Handy Guide*. Follow label directions. In areas adjacent to rainforest and scrub, spraying may need to start at fruit set and continue at fortnightly intervals until harvest. Monitor the orchard in spring to determine when spraying should start. Particular trees or areas in an orchard seem to be attacked each year, so monitoring should concentrate on these hot spots. In other less susceptible areas, regularly monitor the orchard, so that spraying can start when damage is first detected.

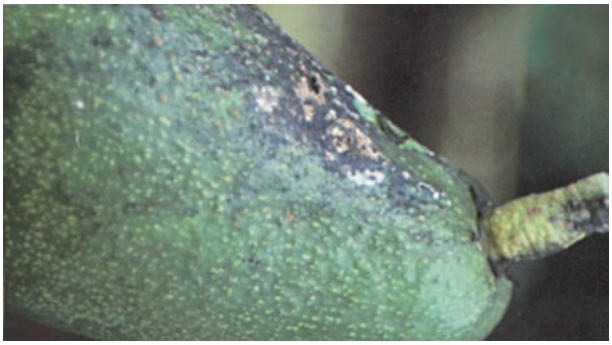
Scale insects

Cause: The scale insects *Hemiberlesia lataniae* (latania scale) and *Gascardia destructor* (white wax scale).

Identification: Upper: latania scale. Scales are 1 to 1.3 mm across and creamy-brown. Latania scale is also common on leaves and twigs (see pages 2 and 17). Lower: white wax scale on the fruit stalk. Scales are 5 mm in diameter with a thick waxy covering. They rarely infest fruit, preferring fruit stalks and twigs.

Treatment/prevention: First check that the infestation is serious enough to warrant treatment. For latania scale, there needs to be 4 (rough-skinned varieties) to 20 (smooth-skinned varieties) scales per fruit to justify treatment. Smooth-skinned varieties have a higher action level as it is much easier to brush scales off in the packing shed. White wax scales need to be very obvious, with sooty mould present, to justify action. Where required, spray with an appropriate oil spray from the *Problem Solver Handy Guide*. Avoid spraying during hot weather. Avoid continuous use of insecticide sprays that are disruptive to beneficial insects. Regularly monitor the orchard so that action can be taken before there is a significant build-up of scale.

Whitish lumps or powder on fruit or fruit stalk



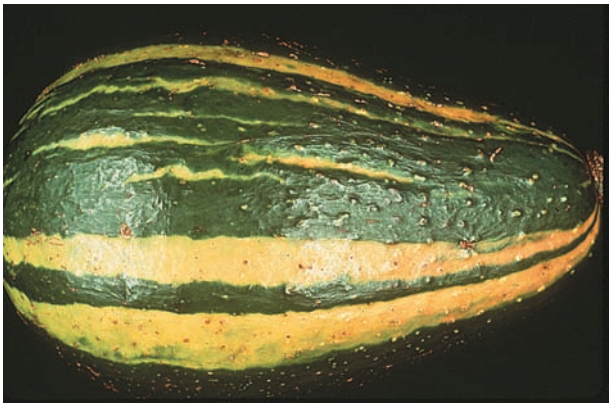
Planthoppers

Cause: The insect *Siphanta galeata*.

Identification: Upper: affected fruit showing the feeding sites. Sooty mould has developed on the fruit and fruit stalk as a result of honeydew secretions of the insect. Lower: an adult planthopper (about 10 mm long) and nymphs resting on a twig.

Treatment/prevention: The spray program applied for fruitspotting bug and other pests will generally control planthoppers. Avoid continuous use of insecticides that are disruptive to beneficial insects.

Pale yellow or bleached fruit



Chimera

Cause: A mutation (genetic alteration).

Identification: Affected fruit may be abnormally coloured, shaped and textured. A whole fruit or just a part of the fruit may be affected. Do not confuse this problem with sunblotch viroid symptoms (see page 21).

Treatment/prevention: There is no treatment for affected trees. Prune out affected branches. If the problem persists, remove the tree and replant. In future, use only budwood and seed for rootstocks from trees of proven genetic performance.

Fruit touching soil or mulch

Cause: Lack of chlorophyll development and skin discolouration as a result of the fruit touching the soil or mulch cover, away from sunlight.

Identification: Causes a pale yellow to white skin, which varies over the fruit according to the amount of light received. Affected fruit at left compared to normal fruit. Variably shaped, dark brown marks or blotches may develop at the point where the fruit contacts the mulch (see page 25).

Treatment/prevention: As only a small number of fruit are affected, no particular action is generally necessary. Skirting of trees to remove the risk of low-hanging fruit may be beneficial.

Brown marks on fruit stalk (ringneck)

Water stress

Cause: Insufficient water supply to the tree. May be a result of insufficient soil moisture or the lack of an effective root system because of root rot disease.

Identification: Causes a corky ring of tissue of varying width on the fruit stalk. The dead tissue may peel and flare. Water stress may also cause a cracking of the skin near the stem end (see page 28) and premature death of the seed coat (see page 31).

Treatment/prevention: Maintain adequate soil moisture at all times, but particularly during peak demand periods such as flowering and fruit set. Use soil moisture monitoring devices to schedule irrigation accurately. Mulch trees in spring to reduce moisture loss. Ensure root systems are well protected against root rot disease.

Black shrivelled fruit on tree

Fruitlet abscission

Cause: Natural fruit thinning where the fruit stay attached to the fruit stalk.

Identification: Left: early stages where the abscissed fruit discolours and starts to mummify on the tree. Right: a more advanced stage showing the extended mummification of the fruit. More common in areas with low humidity such as Western Australia.

Treatment/prevention: No treatment is necessary as the event is a natural phenomenon.

Fruit fall

Immature fruit fall

Cause: Either natural thinning of excess fruit or stress from insufficient or excessive water, or heat.

Identification: Fallen fruit from the two natural thinning events range from pea-size up to almost full size. The fruit at left show another stage of immature fruit fall caused by stress or other factors, in this case hail.

Treatment/prevention: Thinning of excess fruit is a natural phenomenon and there is no need for concern. However, to prevent excessive natural thinning, maintain adequate soil moisture, particularly during the peak demand period at fruit set and during the second fruit fall period in early summer. Use soil moisture monitoring devices to schedule irrigation accurately. Mulch trees in spring to reduce moisture loss. Ensure root systems are well protected against root rot disease.

Note: Mature fruit can also fall. This is caused by excess soil moisture, generally as a result of heavy rain close to fruit maturity. This fruit should not be marketed. Although the fruit may be physiologically mature, it often fails to ripen properly and the fall may cause bruising and other damage. There is also an associated food safety risk from soil contaminants.

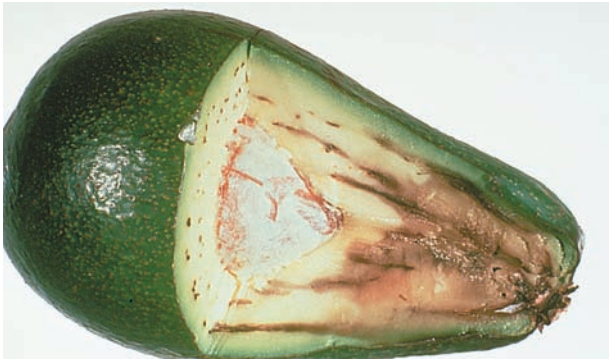
Spots or marks on skin surface of fruit (postharvest)

Anthracnose disease

Cause: The fungus *Colletotrichum gloeosporioides*.

Identification: Upper: spots are initially small, light brown and circular. These darken with age, centres become sunken, and in moist conditions pinkish spore masses may form on the spots. Lower: severe breakdown showing the extensive development of the pinkish spore masses. See page 38 for internal fruit symptoms. Also produces symptoms on immature fruit still on the tree (see page 20).

Treatment/prevention: Treat fruit after harvest with an appropriate chemical from the *Problem Solver Handy Guide*. Spray fruit in the field with an appropriate chemical from the *Problem Solver Handy Guide* at regular intervals from fruit set to harvest. Pre-cool fruit before transport if the time from harvest to delivery at the wholesale market exceeds two days (see 'Skin damage due to chilling' on page 37 for appropriate cooling temperatures). At the wholesale market, ripen fruit at 16 to 18°C with ethylene, then store fruit until sale at 2 to 5°C. Follow the cultural recommendations on page 20 for anthracnose control in the field. The longer the period between harvesting and consumption the worse the disease, so minimise delays in marketing wherever possible.



Stem-end rot disease

Cause: The fungi *Dothiorella* spp., *Phomopsis perseae* and *Lasiodiplodia theobromae*.

Identification: Upper: a dark brown to black rot begins at the stem end as a dark brown ring and the rot proceeds towards the other end. Lower: internal symptoms. Anthracnose disease (*Colletotrichum gloeosporioides*) may cause a similar stem-end rot.

Treatment/prevention: Treat fruit after harvest with an appropriate chemical from the *Problem Solver Handy Guide*. The field spray program for anthracnose helps to minimise the disease. As water stress may predispose fruit to infection, manage irrigation and root rot control carefully. Store and ripen fruit as recommended for anthracnose above. The longer the period between harvesting and consumption the worse the disease, so minimise delays in marketing wherever possible.

Spots or marks on skin surface of fruit (postharvest)

Nodule damage (Hass variety)

Cause: Abrasion damage during harvesting and postharvest handling. Excessive brushing and dropping of fruit are common causes of abrasion damage. Symptoms are more severe after cool storage.

Identification: The nodules (or pimples) on the surface of the fruit turn dark brown or black. The most likely reason for more obvious symptoms after cool storage is moisture loss through the damaged nodules, causing them to shrivel and blacken further.

Treatment/prevention: Minimise abrasion or mechanical damage at all times by taking particular care during harvesting, unloading onto the packing line, brushing and packing-line handling. Do not brush fruit for more than 60 seconds. Replace worn or stiff brushes. Take extra care when picking fruit during wet weather.

Lenticel damage (green skin varieties)

Cause: Moisture loss during cool storage and ripening.

Identification: As the fruit ripens, the lenticels (or breathing pores) on the skin darken, giving the fruit a spotted appearance. In severe cases, the spots may coalesce to form dark blotches.

Treatment/prevention: Ensure fruit are stored and ripened at a relative humidity of 85 to 90%.

Skin damage due to chilling

Cause: Fruit stored at temperatures below about 3°C for longer than about 10 days. An occasional problem in fruit stored at standard temperatures of 4 to 5°C, but in these cases is generally related to some predisposing factor in the field or during postharvest handling.

Identification: The symptom generally develops from damaged nodules (pimples), resulting in large black and sunken areas between them. In severe cases, large parts of the fruit surface may be black. Symptoms generally develop after about 10 to 14 days at low temperatures, but may worsen considerably after one to two days of removal to room temperature. Internal fruit damage may range from diffuse flesh discolouration to vascular browning (see page 39).

Treatment/prevention: Store fruit at temperatures that are appropriate to the stage of ripeness. Green mature fruit: 4 to 5°C for Hass (maximum four weeks) and 6 to 8°C for other varieties (maximum two weeks). Ripening fruit: no lower than 12°C. Near ripe fruit: 2 to 5°C (maximum 10 days).

Spots or marks on skin surface of fruit (postharvest)

Mechanical damage

Cause: Poor handling of fruit during harvesting and postharvest handling.

Identification: There is a wide range of symptoms. Upper left: cuts. Upper right: bruising from dropping. Lower left: sharp object gouge. Lower right: pulled stem from plucking the fruit during harvesting rather than cutting it.

Treatment/prevention: Handle fruit carefully during harvesting and packing. Avoid dropping fruit more than 20 cm during harvesting, grading and packing. Cut fruit from the tree, leaving 4 mm of stem on the fruit. (Note that Hass fruit is normally plucked from the tree as long as the stalk removes cleanly without tearing the flesh). Ensure there are no sharp edges on picking containers, field bins and grading and packing equipment.

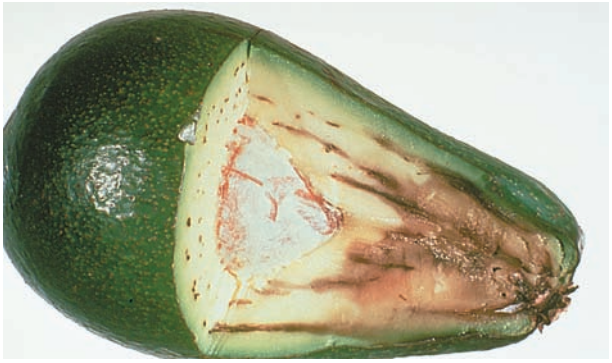
Internal flesh disorders of fruit (postharvest)

Anthracnose disease

Cause: The fungus *Colletotrichum gloeosporioides*.

Identification: The disease produces spots on the skin (see photos on pages 20 and 36). Internally, the rot penetrates deeply into the flesh in a hemispherical pattern.

Treatment/prevention: Follow the recommendations under 'Anthracnose disease' on page 36.



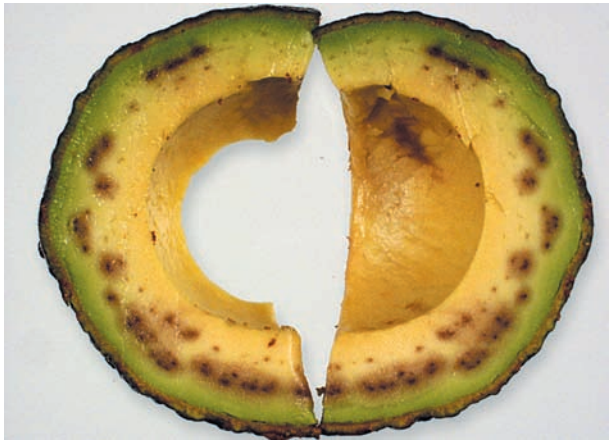
Stem-end rot disease

Cause: The fungi *Dothiorella* spp., *Phomopsis perseae* and *Lasiodiplodia theobromae*.

Identification: The rot produces dark streaking of the water-conducting tissues. External symptoms are shown on page 36. Anthracnose disease (*Colletotrichum gloeosporioides*) may also cause stem-end rot, but does not produce the dark streaking of the water-conducting tissues.

Treatment/prevention: Follow the recommendations under 'Stem-end rot disease' on page 36.

Internal flesh disorders of fruit (postharvest)



Vascular browning

Cause: Either chilling injury from storing fruit at low temperatures for excessive periods or fungal disease caused by the stem-end rot organisms *Dothiorella* spp., *Phomopsis perseae* and *Lasiodiplodia theobromae*. Symptoms are exacerbated where fruit has been left in the sun after harvest or where fruit has been hanging in full sun on root rot-affected trees.

Identification: The vascular or water-conducting strands running down the length of the fruit become dark brown to black. Upper: skin peeled away to show the discoloured strands running the length of the fruit. Lower: cross-section through fruit. Vascular browning due to stem-end rot disease is normally associated with the rotting of the adjacent flesh starting from the stem end (see 'Stem-end rot disease' on page 38).

Treatment/prevention: For vascular browning due to chilling, follow the recommendations under 'Diffuse flesh discolouration' below. For vascular browning due to stem-end rot disease, follow the recommendations under 'Stem-end rot disease' on page 36.

Bacterial soft rot disease

Cause: The bacterium *Erwinia* sp. May occur in the field, but is most common as a postharvest problem in fruit harvested during rain.

Identification: Externally, the fruit has a darkened metallic sheen. Internally, the flesh is grey to black and soft with a putrid smell. Fruit at left: early symptoms. Fruit at right: advanced breakdown. Fruit of Fuerte, Sharwil and Reed varieties is most susceptible, particularly when over-mature at harvest.

Treatment/prevention: Harvest fruit carefully to avoid skin injuries. Avoid harvesting during wet weather.

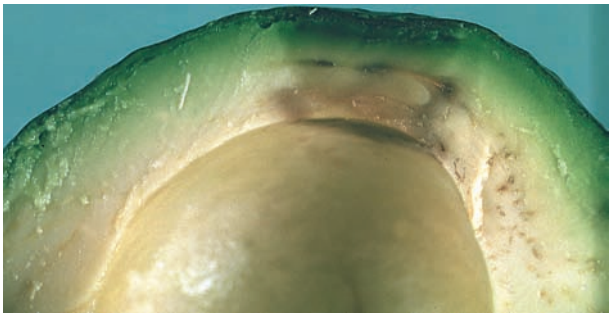
Diffuse flesh discolouration

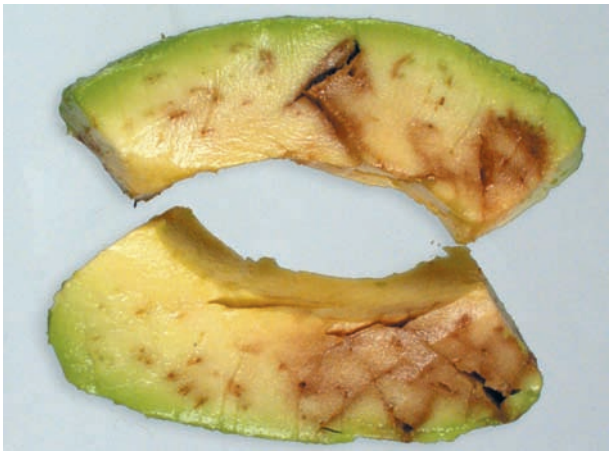
Cause: Chilling injury from storing fruit at low temperatures for excessive periods.

Identification: External symptoms of chilling injury can be seen on page 37. However, fruit with external chilling symptoms do not necessarily have internal symptoms. Internal damage consists of diffuse areas of discoloured flesh with no well-defined margin. The discolouration is generally grey or grey- brown, but may be black in severe cases. The damage generally starts at the basal end of the fruit adjacent to the seed and spreads upwards and outwards.

Treatment/prevention: Store fruit at temperatures appropriate to the stage of ripeness. Green mature fruit: 4 to 5°C for Hass (maximum four weeks) and 6 to 8°C for other varieties (maximum two weeks). Ripening fruit: no lower than 12°C. Near ripe fruit: 2 to 5°C (maximum 10 days).

Internal flesh disorders of fruit (postharvest)



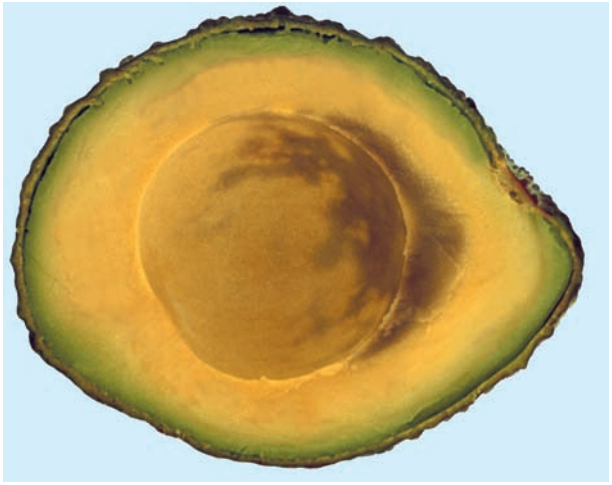


Discrete flesh discolouration

Cause: Poor handling during picking, packing and wholesale/retail marketing.

Identification: External symptoms of damage are not obvious except for severe injury to ripe fruit. Upper: internal damage appears as brown to black bruised areas with distinct margins. Sometimes the bruised flesh separates to form small air pockets. Susceptibility to damage increases significantly as the fruit ripens. Lower: the flesh may also 'shatter' with damaged areas taking on a honeycomb appearance. It is thought that this is the result of impact damage to hard green fruit.

Treatment/prevention: Handle fruit carefully. Avoid dropping hard green fruit more than 20 cm and sprung to ripe fruit more than 5 cm during harvesting, grading and packing.



Seed cavity browning (boron deficiency)

Cause: Cool storage of fruit harvested from boron-deficient trees.

Identification: The flesh at the top end of the seed cavity shows a diffuse grey to brown discolouration. Symptoms develop only on ripening. Boron deficiency also causes leaf, twig, trunk, flower and fruit symptoms (see pages 7, 13, 15, 19, 20, 30 and 44).

Treatment/prevention: For suspected boron-deficient trees, get leaf and soil analyses done to confirm the diagnosis. Apply borax or Solubor to the ground under the trees at rates determined by either the AVOMAN software or a qualified agronomist. Apply evenly to avoid toxicity. This is best achieved by mixing it in water and spraying it on the ground or applying it by fertigation. Do regular leaf and soil analyses to monitor nutrient levels.

Seed cavity browning (poor handling)

Cause: Poor handling during picking, packing and wholesale/retail marketing.

Identification: Damage appears as discrete brown areas in the seed cavity. Photo shows a range of typical symptoms from mild to severe. Susceptibility to damage increases significantly as the fruit ripens. Damage may be more prevalent in windfall fruit.

Treatment/prevention: Handle fruit carefully. Avoid dropping hard green fruit more than 20 cm and sprung to ripe fruit more than 5 cm during harvesting, grading and packing.

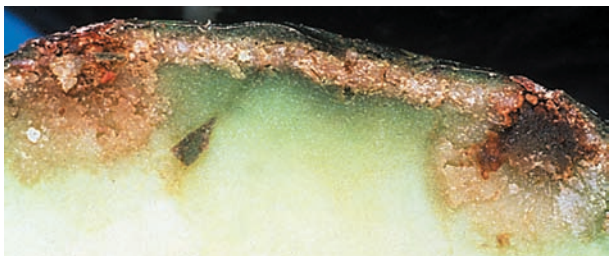
Internal flesh disorders of fruit (postharvest)

Uneven ripening with rubbery flesh

Cause: Excess soil moisture close to the time of fruit maturity. Generally results from root loss due to heavy rainfall. The reduced root system cannot then keep up with the transpiration demands of the leaves and fruit.

Identification: Affected fruit appear normal externally, but sections of the fruit fail to ripen, remaining firm and rubbery. Sometimes the firm tissue darkens and becomes stone-like, usually at the basal end of the fruit and around the seed.

Treatment/prevention: As the problem is related to rainfall, there is little that can be done. However, ensure an effective root rot prevention program is in place to minimise the effects of the heavy rain on the root system.



Stones in flesh (fruitspotting bug damage)

Cause: Feeding damage from the fruitspotting bugs *Amblypelta nitida* (fruitspotting bug) and *Amblypelta lutescens lutescens* (banana-spotting bug).

Identification: Upper: water-soaked spots in the flesh in a peeled fruit corresponding to feeding 'stings' of the bug. Lower: many of the 'stings' form into hard lumps or stones in the flesh, as shown in this section of an affected fruit. Occurs in eastern Australia only. Bug damage is worst in orchards adjacent to rainforest or scrub. Thin-skinned varieties such as Fuerte and Sharwil appear to be more susceptible, but all varieties can be severely attacked. See pages 25, 30 and 33 for other symptoms of fruitspotting bug damage and photos of the bugs.

Treatment/prevention: Follow the recommendations under 'Fruitspotting bug damage' on page 25.

Wilting or death of tree

Phytophthora root rot disease

Cause: The fungus *Phytophthora cinnamomi*.

Identification: Affected tree showing severe wilting and leaf fall. See other symptoms on pages 4, 16, 17, 19, 43 and 44.

Treatment/prevention: Use an integrated disease management program of both chemical and cultural measures. Inject or spray affected trees with a registered phosphonate product from the *Problem Solver Handy Guide*. Use the spray option only on healthy or mildly affected trees. Follow label directions and the instructions in *Growing the Crop*. Maintain a deep layer of mulch or compost under the trees. Manage irrigation carefully to keep soil moist, but not over-wet. Ensure there is no ponding of water within the orchard by regularly checking drains. Maintain soil pH at about 5.0 to 5.5 (1:5 water test) and use regular leaf and soil analyses to ensure nutrient levels are adequate at all times. In future plantings, ensure there is adequate drainage, use disease-tolerant rootstocks and buy trees from accredited nurseries.

Note: Leaf wilting can also be caused by wood rot fungus (see *Managing root rot* in *Key Issues*) and severe water stress.

Wilting or death of tree

Waterlogging

Cause: Heavy rains, generally in association with root damage from the fungus *Phytophthora cinnamomi*.

Identification: All or most of the leaves on the tree brown rapidly and remain attached. Do not confuse with Verticillium wilt (see below).

Treatment/prevention: There is no treatment for affected trees, which generally die. In future, plant avocados only in soils that drain freely after heavy rain, and mound rows. Maintain the integrated program against root rot disease as recommended on previous page.

Verticillium wilt disease

Cause: The fungus *Verticillium dahliae*.

Identification: On older trees generally only one part of the tree is affected. Dead leaves remain attached to the tree. Affected branches show a brown discolouration of the water-conducting tissues (see symptom on page 8).

Treatment/prevention: No immediate treatment is required as older trees generally recover. However, remove the dead branches once the dieback has ceased. Avoid planting avocados in land that has previously grown Verticillium-susceptible crops such as tomatoes for long periods. Avoid using mulch from Verticillium-susceptible crops, for example peanut husks.

Frost damage

Cause: Temperatures below about –5°C.

Identification: Two different examples of frost damage are shown. Upper: tree of a susceptible variety (right) compared to a tree of a cold-tolerant variety (left). Lower: trees of a susceptible variety (foreground) compared to a tree of a cold-tolerant variety (background). See a close-up of mild frost damage to a leaf on page 9.

Treatment/prevention: Avoid planting avocados in sites subject to extreme cold temperatures.

Complete loss of leaves on tree

Phytophthora root rot disease

Cause: The fungus *Phytophthora cinnamomi*.

Identification: Affected tree showing loss of leaves and severe dieback. See other symptoms on pages 4, 16, 17, 19, 41 and 44.

Treatment/prevention: Use an integrated disease management program of both chemical and cultural measures. Inject or spray affected trees with a registered phosphonate product from the *Problem Solver Handy Guide*. Use the spray option only on healthy or mildly affected trees. Follow label directions and the instructions in *Growing the Crop*. Maintain a deep layer of mulch or compost under the trees. Manage irrigation carefully to keep soil moist, but not over-wet. Ensure there is no ponding of water within the orchard by regularly checking drains. Maintain soil pH at about 5.0 to 5.5 (1:5 water test) and use regular leaf and soil analyses to ensure nutrient levels are adequate at all times. In future, ensure there is adequate drainage, use disease-tolerant rootstocks and buy trees from accredited nurseries.

Ectropis looper caterpillar damage

Cause: The insect *Ectropis sabulosa*.

Identification: Complete defoliation of a tree by a severe infestation of loopers. See symptoms of fruit damage and a close-up of the looper caterpillar on page 27.

Treatment/prevention: As these pests are normally kept under reasonable control by beneficial insects, treatment is generally only necessary where damage is severe and the beneficial insects are absent. Where required, spray with an appropriate chemical from the *Problem Solver Handy Guide*. Regularly monitor the orchard so that action can be taken before damage gets too severe. Avoid prolonged use of insecticides that are disruptive to beneficial insects.

Stunting of tree

Sunblotch viroid disease

Cause: Avocado sunblotch viroid.

Identification: Affected trees are stunted and have a low scrambling growth habit. Other symptoms on leaves, twigs and fruit are shown on pages 5, 18, 21 and 31. Difficult to distinguish from boron deficiency (see page 44).

Treatment/prevention: There is no treatment for affected trees. They must be destroyed to avoid transmission to healthy trees. Select budwood and rootstock seed only from viroid-tested trees. Plant trees propagated from viroid-tested material at least 15 m from untested trees to avoid transmission from natural root grafting. Reserve a special set of pruning, injecting and harvesting implements for these trees to avoid transmission through sap. Alternatively, disinfect cutting tools thoroughly with a 1.5% solution of sodium hypochlorite before using on viroid-free trees.

Stunting of tree

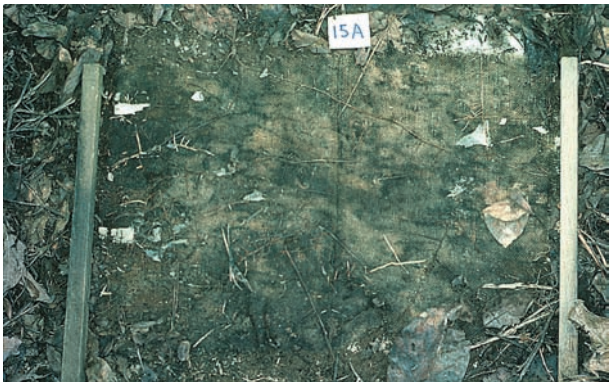
Boron deficiency

Cause: Insufficient boron available to the tree.

Identification: Affected trees are yellow and stunted—compare affected tree in the foreground with the healthy trees in the background. Trees also tend to have a low scrambling growth habit as a result of the loss of apical dominance. This symptom sometimes makes it difficult to distinguish boron deficiency from sunblotch viroid disease (page 43). Yellowing is generally associated with leaf distortion and holes in leaves—see symptoms on pages 7, 13 and 15. Other symptoms on the trunk, branches, flowers and fruit are shown on pages 19, 20, 30 and 40.

Treatment/prevention: Get leaf and soil analyses done to confirm the diagnosis. Apply borax or Solubor to the ground under the trees at rates determined by either the AVOMAN software or a qualified agronomist. Apply evenly to avoid toxicity. This is best achieved by mixing it in water and spraying it on the ground or applying it by fertigation. Do regular leaf and soil analyses to monitor nutrient levels.

Death of roots



Phytophthora root rot disease

Cause: The fungus *Phytophthora cinnamomi*.

Identification: Upper: mulch removed from under a badly infected tree showing the extensive loss of roots to the disease. Compare this with the centre photo where mulch has been removed from under a healthy tree. Lower: close-up of root showing blackening of the root tip. Besides root rot, avocado roots can die from water stress, in which the outer part of the root rots but the white stele (or centre part of the root) remains intact. With root rot disease, the whole root section rots and dies. There is also a natural dieback of feeder roots at flowering time, which unless accompanied by significant leaf fall, is not a problem. Root death can also be caused by wood rot fungus (see *Managing root rot* in *Key Issues*). See other symptoms of Phytophthora root rot on pages 4, 16, 17, 19, 41 and 43.

Treatment/prevention: Use an integrated disease management program of both chemical and cultural measures. Inject or spray affected trees with a registered phosphonate product from the *Problem Solver Handy Guide*. Use the spray option only on healthy or mildly affected trees. Follow label directions and the instructions in *Growing the Crop*. Maintain a deep layer of mulch or compost under the trees. Manage irrigation carefully to keep soil moist, but not over-wet. Ensure there is no ponding of water within the orchard by regularly checking drains. Maintain soil pH at about 5.0 to 5.5 (1:5 water test) and use regular leaf and soil analyses to ensure nutrient levels are adequate at all times. In future plantings, ensure there is adequate drainage, use disease-tolerant rootstocks and buy trees from accredited nurseries.