

Custard apple information kit

Reprint – information current in 1998



REPRINT INFORMATION – PLEASE READ!

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

This publication has been reprinted as a digital book without any changes to the content published in 1998. We advise readers to take particular note of the areas most likely to be out-of-date and so requiring further research: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- Financial information—costs and returns listed in this publication are out of date.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.deedi.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 1998. 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 custard apple production. 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

Problem **SOLVER**



Every crop will have a problem or two. The key to dealing with problems is prompt identification, and where appropriate, prompt treatment. This section helps you with both these decisions. The common problems are shown in a series of pictures grouped according to the main symptom. From the contents, find the symptom that best fits your problem. On that page you will find photos of the symptoms, the main causes and the recommended solutions.

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Young leaves yellow



Iron deficiency

Cause: Insufficient iron available to the tree. Generally caused by poor root health or over-liming.

Identification notes: Causes an overall yellowing or whitening of leaves with the veins remaining green.

Treatment: Apply a foliar spray of iron chelate or soluble ferrous sulphate.

Prevention: Do annual leaf and soil analyses to monitor nutrient levels. To avoid over-liming, calculate lime or dolomite rates carefully in accordance with soil analysis results. Mulch trees to improve root health.



Sulphur deficiency

Cause: Insufficient sulphur available to the tree.

Identification notes: Healthy leaf (bottom) for comparison. Causes a uniform yellowing of the leaves but the veins do not remain green. Rarely seen in well-managed orchards.

Treatment: Not serious enough to warrant treatment.

Prevention: Do annual leaf and soil analyses to monitor nutrient levels. Where deficient, use fertilisers with a higher sulphur content.



Zinc deficiency

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

Identification notes: Affected leaves are yellow-green with green veins, smaller than usual, narrow and slightly distorted. Also see symptom on page 4.

Treatment: Apply zinc to the ground under the tree. In severe cases, also spray chelated zinc onto the spring flush.

Prevention: Do annual leaf and soil analyses to monitor nutrient levels. Apply zinc to the ground under the trees annually according to leaf and soil analysis results.



Manganese deficiency

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

Identification notes: Affected leaves are a mottled pale-green, with green veins. Yellowing is more pronounced towards the leaf tips. Rarely seen in well-managed orchards.

Treatment: Generally not serious enough to warrant treatment. A foliar spray of manganese sulphate and urea should alleviate symptoms.

Prevention: Do annual leaf and soil analyses to monitor nutrient levels. Apply manganese to the soil when indicated by leaf and soil analysis results.

Young leaves yellow



Herbicide damage

Cause: Uptake of diuron herbicide from the soil.

Identification notes: Yellowing is severe but unevenly distributed over the leaves.

Treatment: No treatment available.

Prevention: Avoid planting custard apples in areas where persistent herbicides have been used in the past five years.

Older leaves yellow



Magnesium deficiency

Cause: Insufficient magnesium available to the tree. Generally results from excessive use of potassium.

Identification notes: Yellowing occurs in bands on either side of the midrib while the margin of the leaf remains green. A reddish-brown discoloration sometimes develops in the yellow areas. Most common in acid sandy soils.

Treatment: Do leaf and soil analyses to check soil pH and magnesium levels. Apply dolomite or magnesium oxide (choice depends on pH level). A short-term response can be achieved with a foliar spray of Epsom salts and urea.

Prevention: Do annual leaf and soil analyses to monitor soil pH and nutrient levels. Apply magnesium to the ground under the trees according to leaf and soil analysis results. Do not apply excessive amounts of potassium fertiliser.



Nitrogen deficiency

Cause: Insufficient nitrogen available to the tree.

Identification notes: Left: mild symptom showing the pale-green leaves. Right: severe symptom where the oldest leaves turn bright yellow and fall prematurely.

Treatment: Do a leaf analysis to confirm the diagnosis. Adjust the fertiliser program according to the leaf analysis results.

Prevention: Do annual leaf and soil analyses to monitor nutrient levels. Apply appropriate amounts of nitrogen fertiliser throughout the growing season.



Manganese toxicity

Cause: High uptake of manganese from the soil. Occurs in soils with high manganese levels when pH falls below 5.5 (1:5 water test).

Identification notes: Affected leaves have an irregular yellow or whitish margin. Also see symptom on page 6.

Treatment: Do a leaf analysis to confirm the diagnosis. Apply lime or dolomite to raise soil pH to 6.5 (1:5 water test).

Prevention: Do annual leaf and soil analyses to monitor nutrient levels. In high manganese soils, maintain soil pH at 6.5 or above (1:5 water test).

Older leaves yellow



Boron toxicity

Cause: High uptake of boron from the soil. Generally caused by applying boron unevenly or at high rates.

Identification notes: Left: mild symptom showing the yellowing worst near the margin. Note the small brown spots near the margin. Right: severe symptom showing the burnt margin as well as yellowing. Also see symptom on page 6.

Treatment: No treatment available.

Prevention: Do annual leaf and soil analyses to monitor boron levels. Take particular care to apply boron at the correct rates. Apply boron evenly when spraying it on the ground or applying it by fertigation.



Potassium deficiency

Cause: Insufficient potassium available to the tree. Generally caused by an imbalance of potassium, calcium and magnesium in the soil. More common in light soils where heavy leaching occurs and in trees with heavy crop loads.

Identification notes: Yellowing begins at the margin of the leaf and spreads towards the veins. Small black spots develop within affected areas. Also see symptom on page 5.

Treatment: Do a leaf analysis to confirm the diagnosis. Adjust the fertiliser program according to the results.

Prevention: Do annual leaf and soil analyses to monitor nutrient levels. Apply appropriate amounts of potassium fertiliser throughout the growing season.



Bacterial wilt

Cause: The bacterium *Pseudomonas solanacearum*.

Identification notes: Affected tree (right) compared to a healthy tree. Most leaves are pale or yellow. Diagnosed by examining the trunk at ground level for discolouration of wood under the bark (see symptom on page 24).

Treatment: No treatment available. Mulching and reducing crop load may help to prolong the life of affected trees.

Prevention: Avoid planting in areas that have grown tomatoes, potatoes, eggfruit or capsicums within the past two years. Do not plant in poorly drained sites and improve drainage by mounding. Use cherimoya rootstocks.

Small leaves



Zinc deficiency

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

Identification notes: Affected leaves are yellow-green and much smaller than usual. Healthy leaf at left. Also see symptom on page 2.

Treatment: Apply zinc to the ground under the tree. In severe cases, also spray chelated zinc onto the spring flush.

Prevention: Do annual leaf and soil analyses to monitor nutrient levels. Apply zinc to the ground under the trees annually according to leaf and soil analysis results.

Holes in leaves



Triangle butterfly damage

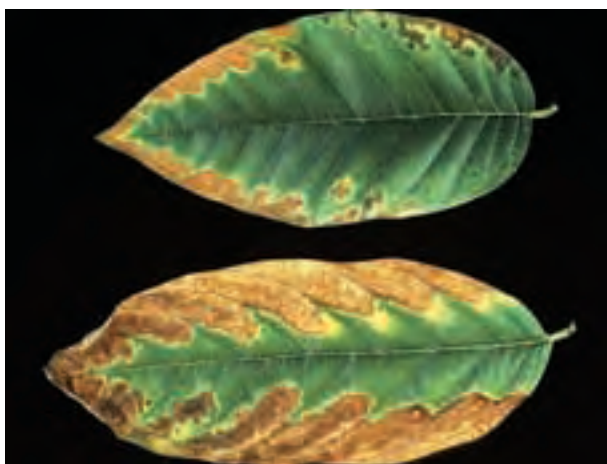
Cause: The palegreen triangle butterfly *Graphium eurypylus lycan*.

Identification notes: Upper: neat holes cut in the leaves. Lower: larvae of the butterfly showing the range of colours. Also affects fruit — see symptom on page 14.

Treatment: Not necessary unless fruit is being attacked or damage is severe on very young trees. Where required, spray with an appropriate chemical from the *Problem solver handy guide*.

Prevention: Not generally necessary for leaf damage.

Brown margins on leaves



Severe potassium deficiency

Cause: Insufficient potassium available to the tree. Generally caused by an imbalance of potassium, calcium and magnesium in the soil. More common in light soils where heavy leaching occurs and in trees with heavy crop loads.

Identification notes: Symptoms are a marginal burn and interveinal scorch. Note how the scorch extends well in towards the veins. Milder symptom shown on page 4.

Treatment: Do a leaf analysis to confirm the diagnosis. Adjust the fertiliser program according to the leaf analysis results.

Prevention: Do annual leaf and soil analyses to monitor nutrient levels. Apply appropriate amounts of potassium fertiliser throughout the growing season.



Fertiliser burn

Cause: Uptake of too much urea fertiliser after excessive or uneven applications.

Identification notes: Note how the marginal burn is very uneven. Generally a problem in young, newly planted trees.

Treatment: Water heavily to leach fertiliser out of the root zone.

Prevention: It is best not to use urea or other highly soluble nitrogen fertilisers on young trees. If these are used on young trees, apply them very carefully, preferably in small doses. Also apply them evenly over the root area, particularly on sandy soils. Water thoroughly after application.

Brown margins on leaves



Herbicide damage

Cause: Uptake of glyphosate herbicide. Generally results from drift of herbicide onto low-hanging leaves.

Identification notes: The herbicide is translocated upwards to other leaves where it causes a yellow to brown margin and leaf distortion.

Treatment: No treatment available.

Prevention: Apply herbicides very carefully, avoiding contact with the leaves. Prune tree skirts to remove low-hanging branches. Also use shielded, low-pressure fan or flood nozzles when applying herbicides.



Salt burn

Cause: Irrigation with salty water or overuse of fertilisers.

Identification notes: Left: the marginal burn is generally fairly even and extends in towards the veins. Right: salt burn is often more evident on trees affected by bacterial wilt.

Treatment: Do not apply fertiliser until the problem has been investigated. Get analyses done on soil, plant tissue and irrigation water. Also check the rates of fertiliser being applied and re-adjust if excessive. Water heavily to leach the salt out of the root zone. If water analysis confirms salty water, use another water source.

Prevention: In future, get a water analysis done before the start of each season. Follow the recommended fertiliser program to avoid over-fertilising.



Manganese toxicity

Cause: High uptake of manganese from the soil. Occurs in soils with high manganese levels when pH falls below 5.5 (1:5 water test).

Identification notes: The affected margin often disintegrates, leaving a tattered leaf (top). Also see symptoms on pages 3 and 7.

Treatment: Do a leaf analysis to confirm the diagnosis. Apply lime or dolomite to raise soil pH to 6.5 (1:5 water test).

Prevention: Do annual leaf and soil analyses to monitor nutrient levels. In high manganese soils, maintain soil pH at 6.5 or above (1:5 water test).



Boron toxicity

Cause: High uptake of boron from the soil. Generally caused by applying boron unevenly or at high rates.

Identification notes: Note the small brown spots developing inside the burnt margin. Also see symptom on page 4.

Treatment: No treatment available.

Prevention: Do annual leaf and soil analyses to monitor boron levels. Take particular care to apply boron at the correct rates. Apply boron evenly when spraying it on the ground or applying it by fertigation.

Dead leaves

See Decline and death of whole trees on pages 23 and 24.

Spots or marks on leaves



Spray burn

Cause: Damage from emulsifiable concentrate insecticides, certain wetting agents or pesticide mixtures, sprayed under hot or slow drying conditions.

Identification notes: Spots have a glassy appearance and are scattered unevenly over the leaf surface.

Treatment: Check the labels of chemicals used to make sure they are compatible and are being used at the correct rates.

Prevention: Avoid spraying on days when temperatures exceed 30°C or when relative humidity is high. Spray during the morning when the spray dries more quickly. Possible phytotoxicity of wetting agents and all suspect pesticides should be evaluated first on a few trees. Regularly calibrate the sprayer and check nozzles for wear and tear.



Frost damage

Cause: Temperatures below 0°C.

Identification notes: Affected leaves have an overall bronzed appearance.

Treatment: There is no treatment for affected leaves.

Prevention: Avoid planting in frost-prone areas. Keep soil moist and interrow spaces mown during frost-susceptible periods.



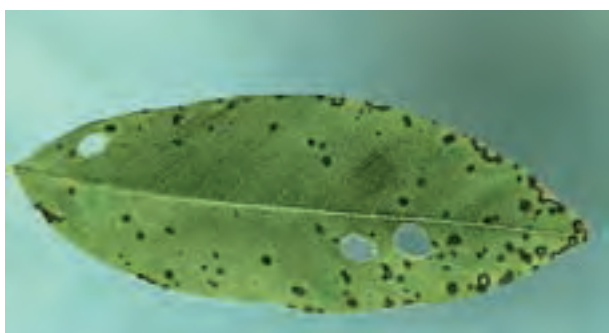
Cylindrocladium leaf spot

Cause: The fungi *Cylindrocladium colhounii* and *Cylindrocladium scoparium*. Generally only a problem after prolonged wet weather.

Identification notes: Spots are large, circular and dark, and sometimes extend down the margin of the leaf. May cause leaf drop when severe. Also see fruit symptom on page 12.

Treatment: Rarely required in well-managed orchards. Where a severe outbreak occurs, copper fungicides, used for the control of other diseases, should provide control.

Prevention: Mulch under trees to reduce soil splash. Remove dead twigs and mummified fruit each season. Prune tree skirts to 50 cm above the ground.



Manganese toxicity

Cause: High uptake of manganese from the soil. Occurs in soils with high manganese levels when pH falls below 5.5 (1:5 water test).

Identification notes: Small dark spots are scattered evenly over the leaf. Note that the holes in the leaf are from triangle butterfly. Also see symptoms on pages 3 and 6.

Treatment: Do a leaf analysis to confirm the diagnosis. Apply lime or dolomite to raise soil pH to 6.5 (1:5 water test).

Prevention: Do annual leaf and soil analyses to monitor nutrient levels. In high manganese soils, maintain soil pH at 6.5 or above (1:5 water test).

Black discolouration on leaves



Sooty mould

Cause: Several dark-coloured fungi that live on the honeydew secretions of scale insects and mealybugs.

Identification notes: The mould is superficial and may grow on leaves, twigs and fruit. The sooty mould in the photo is associated with nigra scale, which can be seen on the twig in the centre. Also see Nigra scale below.

Treatment: Generally only required where the mould is severe and affecting the fruit. In these cases, treat the scale or mealybug infestation and control ants. Use appropriate treatments from the *Problem solver handy guide*.

Prevention: Regularly monitor pest levels during the season so that appropriate treatments can be applied before the problem gets too severe. Ants, which protect mealybugs and scales from their natural enemies, also need to be controlled.

Lumps or marks on twigs



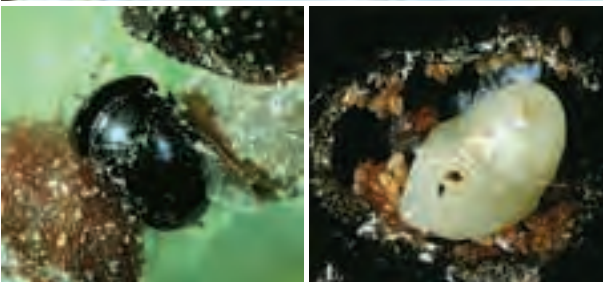
Nigra scale

Cause: The insect *Parasaissetia nigra*.

Identification notes: Upper: scales and associated sooty mould on a twig. Centre: close-up of the scales. Lower: scale parasite, *Scutellista cyanea*—adult on left, larvae on upturned scale on right. Also see Sooty mould above.

Treatment: First check that the problem is worth treating. An infestation of at least 20 live scale on any one-year old lateral is required to make it worth spraying. Where required, spray with an appropriate chemical from the *Problem solver handy guide*. Spot spraying of infested trees is recommended.

Prevention: Regularly monitor pest levels during the season so that appropriate treatments can be applied before the problem gets too severe. Minimise spraying because it kills the natural enemies of nigra scale. Spot spraying of infested trees is recommended.



Banana spotting bug

Cause: The insect *Amblypelta lutescens lutescens*.

Identification notes: Note the oval patches on the twig caused by the feeding of the bug. Also see fruit symptom on page 11.

Treatment: Generally not required except where it is severe on very young trees and is distorting the new growth. In this case, spray with an appropriate chemical from the *Problem solver handy guide*.

Prevention: Not serious enough to warrant special preventative measures.

Lumps or marks on twigs



Elephant weevil

Cause: The insect *Orthorhinus cylindrirostris*.

Identification notes: Upper: pieces of bark chewed from a fruit stalk. Lower: close-up of the weevil and the chewing damage. Where damage is severe, fruit may drop.

Treatment: Sporadic pest which occasionally causes serious damage. Generally not serious enough to warrant treatment.

Prevention: Generally not serious enough to warrant special preventative measures.

Problems with trunks and branches



Collar rot (bacterial wilt)

Cause: The bacterium *Pseudomonas solanacearum*.

Identification notes: The bark around the crown at or just below ground level decays. Here, a slice of bark has been removed from above the affected area to show the dark discoloration of the water-conducting tissue. Also see symptoms on pages 4 and 24.

Treatment and prevention: See Bacterial wilt on page 4.



Pink disease

Cause: The fungus *Corticium salmonicolor*.

Identification notes: Patches of pale pink or white fungal growth form on branches. Affected limbs may be killed and gum may be produced on diseased areas. More common after prolonged wet weather in high-density orchards.

Treatment: Remove and burn infected limbs. Where this is not possible, treat affected areas with a slurry of copper oxychloride and water.

Prevention: Generally does not warrant special preventative measures. Where the problem is persistent, spray branches and trunks with a protectant fungicide before and during the wet season. Prune trees to open up the canopy and allow better air circulation.



Trunk splitting

Cause: Wind damage at narrow crotch angles.

Identification notes: Weak crotch angles are those where the bark is folded into the crotch.

Treatment: Remove the broken branch and paint the exposed cut and split with a tree-sealing compound. Trees that have not split badly may be propped and bolted together.

Prevention: During the first three to four years, train trees carefully to develop strong crotch angles. Establish effective windbreaks.

Problems with trunks and branches



Sunburn

Cause: Exposure of branches to the sun during hot weather. Generally only a problem in unhealthy trees, which have lost their leaf cover, or in pruned or topworked trees.

Identification notes: Symptoms are dead, sunken areas of bark with cracking and splitting. Also see fruit symptoms on pages 14 and 18 .

Treatment: There is no treatment for affected branches.

Prevention: Keep trees in a healthy condition to maintain good leaf cover. If branches are exposed to direct sun during summer, paint the exposed surfaces with white paint.



Frost damage

Cause: Freezing of the sap from temperatures below 0°C.

Identification notes: Left: section through an affected branch showing death of the sapwood. Right: eruptions on the surface of an affected branch from freezing and subsequent tissue breakdown.

Treatment: There is no treatment for affected branches.

Prevention: Avoid planting in frost-prone areas. Keep soil moist and interrow spaces mown during frost periods.



Weevil damage

Cause: An unidentified weevil. Generally only a problem in elevated cooler growing areas.

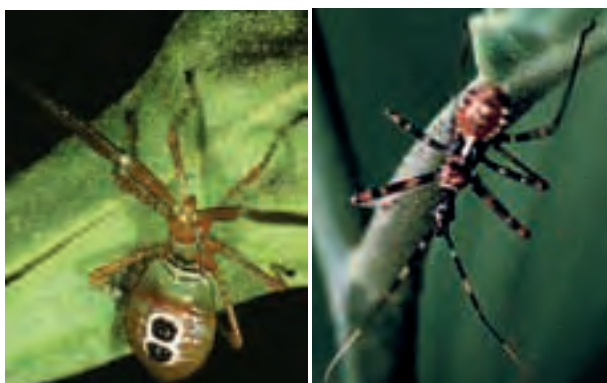
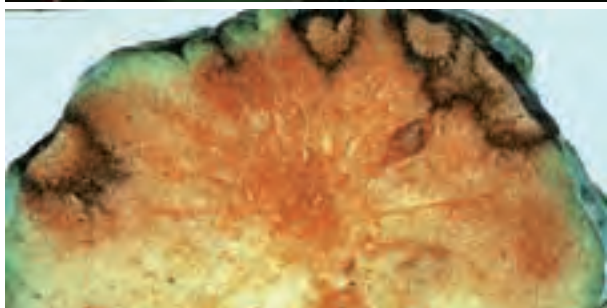
Identification notes: Upper: weevil damage to trunk base and a major branch (top of photo). Lower: close-up of bark damage.

Treatment: Sporadic pest which occasionally causes serious damage. No effective treatment available.

Prevention: Generally not serious enough to warrant special preventative measures.



Spots or marks on fruit



Fruitspotting bugs

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

Identification notes: Top: small, black, round spots on young fruit. Most damage is on the shoulders of the fruit. Centre: the damage penetrates about 1 cm into the fruit. Lower left: close-up of a nymph of banana spotting bug. Lower right: close-up of predatory assassin bug. Fruitspotting bugs are more likely to be a problem in orchards adjacent to bushland. Bugs may also cause spots on flowers and twigs (see twig symptom on page 8).

Treatment: First make sure that the damage is serious enough to warrant treatment. At least 2% of sampled fruit need to have fresh bug damage to make it worth spraying. Remove damaged fruit at each monitoring to avoid confusing the results at the next monitoring. Where required, spray with an appropriate chemical from the *Problem solver handy guide*.

Prevention: Monitor pest levels weekly from September to May so that appropriate treatments can be applied before the problem gets too severe. The main risk period for fruit is from December to March. When monitoring, pay particular attention to 'hot spots' (areas of intense bug activity) within the orchard.

Black canker disease

Cause: The fungus *Phomopsis ammonacearum*.

Identification notes: Left: irregularly shaped spots ranging from small specks to large blotches. Spots have an indistinct 'feathered' edge. Right: tissue damage under the spots is no more than 10 mm deep. **Note: very difficult to distinguish from *Cylindrocladium* fruit rot, *Pseudocercospora* fruit spot and Disease X.** See pages 12 and 13.

Treatment: Rarely required in well-managed orchards. Where an outbreak occurs, spray with an appropriate chemical from the *Problem solver handy guide*.

Prevention: Mulch under trees to reduce soil splash. Remove dead twigs and mummified fruit each season. Prune tree skirts to 50 cm above the ground. Spray with a copper fungicide before dormancy. Regularly monitor fruit for infection during the season so that spraying can start before the problem gets too severe. Where the disease is an ongoing problem, regular spraying may be required.

Spots or marks on fruit



Cylindrocladium fruit rot disease

Cause: The fungi *Cylindrocladium colhounii* and *Cylindrocladium scoparium*.

Identification notes: Upper: dark purple spots about 1 to 2 mm in diameter develop first on the shoulders of the fruit and then spread down the sides. Spots enlarge and then later dry out and crack. Similar in appearance to spotting bug damage, but spots are irregular in shape whereas spotting bug lesions are round, and damage does not extend very far into the fruit (lower). Also see leaf symptom on page 7. **Note: very difficult to distinguish from black canker, Pseudocercospora fruit spot and Disease X.** See pages 11 and 13.

Treatment: Generally serious only after prolonged wet weather in autumn. Where a severe outbreak occurs, regular sprays of copper fungicide, used for the control of other diseases, should provide adequate control.

Prevention: Mulch under trees to reduce soil splash. Remove dead twigs and mummified fruit each season. Prune tree skirts to 50 cm above the ground. Regularly monitor fruit for infection during the season so that spraying can start before fruit diseases get too severe. Where fruit diseases are an ongoing problem, regular spraying may be required.



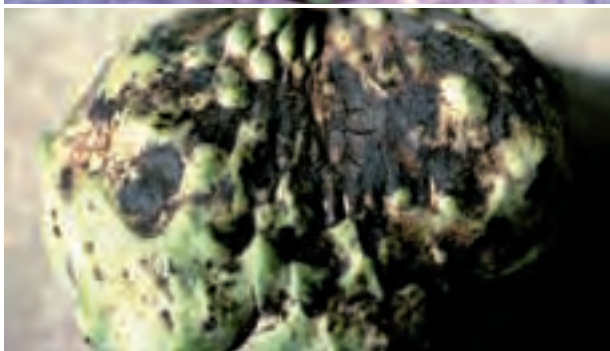
Disease X

Cause: As yet undetermined but the fungi *Pseudocercospora* sp., *Phomopsis* sp. and *Colletotrichum* sp. are regularly associated with affected fruit.

Identification notes: Upper: spots first appear in the indentations on the fruit surface. Spots are small (ranging in size up to 15 mm) and dark purple to grey. Centre: spots often coalesce to form large disfigured areas. Lower: in advanced cases, superficial cracks appear in the skin, and the hardened skin prevents normal fruit development. In severely infected fruit, large deep cracks appear. A widespread and increasing problem in all areas, mainly in fruit of the variety African Pride. **Note: very difficult to distinguish from black canker, Pseudocercospora fruit spot and Cylindrocladium fruit rot.** See pages 11 and 13.

Treatment: Regular sprays of copper fungicide, used for the control of other diseases, should help to keep symptoms in check. However, the problem is difficult to control, once symptoms are well established. For this reason, follow the preventative measures below.

Prevention: As the exact cause of the problem is as yet undetermined, general disease prevention measures, as detailed for other diseases, are recommended. These include: mulching under trees to reduce soil splash; removing dead twigs and mummified fruit each season; pruning tree skirts to 50 cm above the ground; and regular spraying with copper fungicide. The critical time for spray protection is from fruit set to six weeks before estimated harvest. Good coverage is important. Avoid using wetting agents where possible, as some may cause fruit damage when used with copper fungicides.



Spots or marks on fruit



Pseudocercospora fruit spot disease

Cause: The fungus *Pseudocercospora* sp.

Identification notes: Spots first appear in the indentations on the fruit surface. Spots range in size up to 15 mm, are dark purple to grey and often coalesce to form large disfigured areas. **Note:** very difficult to distinguish from black canker, *Cylindrocladium* fruit rot and Disease X. See pages 11 and 12.

Treatment: Generally serious only in North Queensland after prolonged wet weather. Where a severe outbreak occurs, regular sprays of copper fungicide, used for the control of other diseases, should provide adequate control.

Prevention: Mulch under trees to reduce soil splash. Remove dead twigs and mummified fruit each season. Prune tree skirts to 50 cm above the ground. Regularly monitor fruit for infection during the season so that spraying can start before fruit diseases get too severe. Where fruit diseases are an ongoing problem, regular spraying may be required.



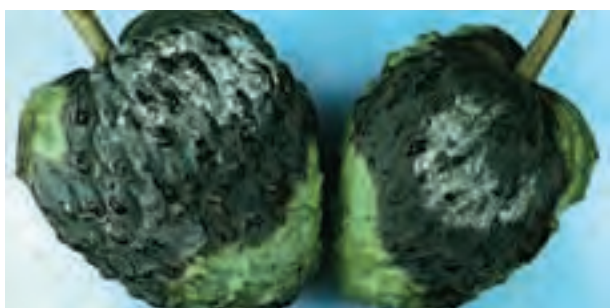
Diplodia rot

Cause: The fungus *Lasiodiplodia theobromae*.

Identification notes: Spots are very dark, irregular in shape and with a distinct edge. They become hard and cracked. Internal discolouration extends well into the fruit, producing a brown, dry, corky appearance.

Treatment: Rarely required in well-managed orchards. Where an outbreak occurs, spray with an appropriate chemical from the *Problem solver handy guide*.

Prevention: Mulch under trees to reduce soil splash. Remove dead twigs and mummified fruit each season. Prune tree skirts to 50 cm above the ground. Spray with a copper fungicide before dormancy. Regularly monitor fruit for infection during the season so that spraying can start before the problem gets too severe. Where the disease is an ongoing problem, regular spraying may be required.



Purple blotch

Cause: The soil-borne fungus *Phytophthora palmivora*. The disease is favoured by prolonged wet weather.

Identification notes: Upper: small purple spots quickly grow to cover the entire fruit surface. Note the white fungal growth, which develops under moist conditions. Affected fruit drop readily. Lower: internal discolouration is extensive and may affect all of the flesh.

Treatment: Rarely required in well-managed orchards. Where an outbreak occurs, spray with an appropriate chemical from the *Problem solver handy guide*.

Prevention: Mulch under trees to reduce soil splash. Remove dead twigs and mummified fruit each season. Prune tree skirts to 50 cm above the ground. Spray with a copper fungicide before dormancy. Regularly monitor fruit for infection during the season so that spraying can start before the problem gets too severe. Where the disease is an ongoing problem, regular spraying may be required.



Spots or marks on fruit



Triangle butterfly damage

Cause: The pale green triangle butterfly *Graphium eurypylus lycaon*.

Identification notes: Spots (arrowed), are dark and corky, and are generally more pronounced on the tips of carpels. Also see leaf symptom on page 5.

Treatment: First check that the problem is worth treating. At least 5% of fruit need to be damaged to make it worth treating. Where required, spray with an appropriate chemical from the *Problem solver handy guide*.

Prevention: Specific preventative measures are generally not necessary. Regularly monitor pest levels during the season so that appropriate treatments can be applied before the problem gets too severe.



Sunburn

Cause: Exposure of fruit to the sun during hot weather. Generally only a problem in unhealthy trees, which have lost their leaf cover.

Identification notes: Affected fruit have reddish-brown or black areas on exposed surfaces. Yellowing is sometimes also present around the burnt areas (right). Also see fruit symptom on page 18.

Treatment: There is no treatment for affected fruit.

Prevention: Keep trees in a healthy condition to maintain good leaf cover. This means paying attention to nutrition, irrigation, pruning, pest and disease control, mulching and weed control.



Bird damage

Cause: Damage from bird feeding.

Identification notes: The surface of the fruit and flesh is eaten away in irregular patches.

Treatment: Generally not serious enough to warrant treatment.

Prevention: Generally not serious enough to warrant protective measures.



Wind rub

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

Identification notes: Two types of damage are shown. Left: rub damage from leaves. Note how the protuberances are most blackened. Right: rub damage from twigs. Note the more distinct lines of damage from the more abrasive twigs.

Treatment: There is no treatment apart from removing leaves and twigs when hand pollinating or thinning fruit.

Prevention: Where hand pollinating, set fruit clear of branches. Establish effective windbreaks.

Dark lines on fruit



Suture line darkening

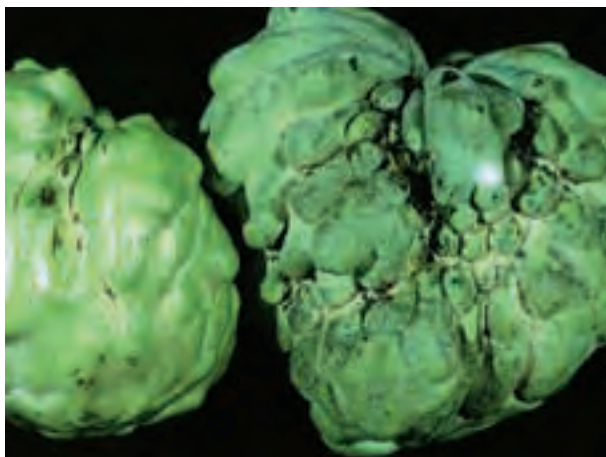
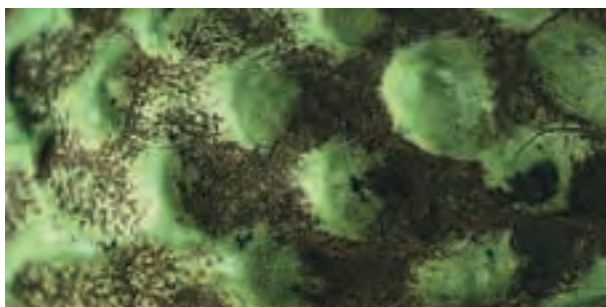
Cause: Undetermined but thought to be due to rapid changes in water content of the fruit during development.

Identification notes: Thin dark lines develop on the suture lines between adjacent fruit segments (carpels).

Treatment: There is no treatment for affected fruit.

Prevention: Ensure an even supply of moisture to the developing fruit. The best way to do this is to schedule irrigation by using soil moisture monitoring systems.

Overall discolouration of the skin of fruit



Cold russet

Cause: Exposure of mature fruit to either temperatures below about 13°C or cold, dry winds. Late-set fruit, which develops in cold weather but matures in the warmer spring, generally avoids russetting.

Identification notes: Upper: fruit severely damaged by low temperatures. When large numbers of skin cells are damaged, the skin dries to give a blackened, hard appearance. Splitting generally follows. Lower: close-up of skin of affected fruit. Note how the russet is more severe between the protuberances where the skin is thinnest.

Treatment: There is no treatment for affected fruit.

Prevention: Establish effective windbreaks to reduce the impact of cold, dry winds. However, remember that poorly-designed windbreaks may exacerbate frost damage. In sites subject to frost, manage the crop to avoid fruit maturing during July. Harvest fruit promptly once it is mature. Avoid planting in areas susceptible to frosts or cold temperatures.

Sooty mould

Cause: Several dark-coloured fungi that live on the honeydew secretions of scale insects and mealybugs.

Identification notes: Affected fruit (right) compared to clean fruit. The mould is superficial and may grow on leaves, twigs and fruit. The sooty mould in the photo is associated with mealybugs. Also see Mealybugs on page 17.

Treatment: Treat the scale or mealybug infestation and control ants. Use appropriate treatments from the *Problem solver handy guide*.

Prevention: Regularly monitor pest levels during the season so that appropriate treatments can be applied before the problem gets too severe. Ants, which protect mealybugs and scales from their natural enemies, also need to be controlled.

White or brown lumps on fruit



1



2



3



4



5

Yellow peach moth

Cause: The insect *Conogethes punctiferalis*.

Identification notes: 1: Typical appearance of infestation. Note the webbed insect frass (droppings) around the entry hole into the fruit. 2: Close-up of entry hole and insect frass. 3: Adult moth. 4: Tunnel in sectioned fruit. 5: Close-up of larva inside a fruit. 6: Pupa of yellow peach moth (large brown case) with a pupa and adult of the main parasite, a tachinid fly (*Argyrophylax proclinata*).

Pinks Mammoth and Hillary White are highly susceptible. The pest especially attacks large fruit. It is active from February to May but is most serious during April/May.

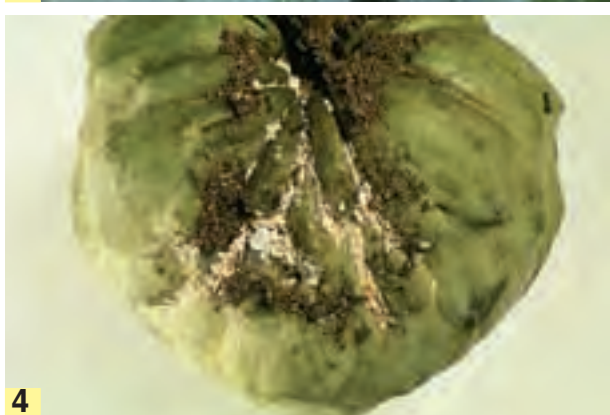
Treatment: First make sure that the damage is serious enough to warrant treatment. At least 2% of sampled fruit need to be infested to make it worth spraying. Where required, spray with an appropriate chemical from the *Problem solver handy guide*.

Prevention: Monitor pest levels regularly during the season so that appropriate sprays can be applied before the problem gets too severe. Regularly collect infested fruit from the orchard and around the packing shed and bury it deeply or preferably place under water in a drum.



6

White or brown lumps on fruit



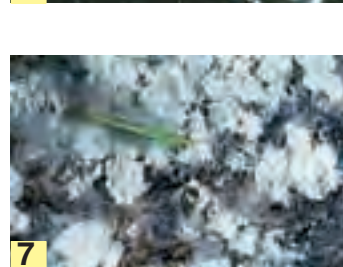
Citrus mealybug

Cause: The insect *Planococcus citri*.

Identification notes: 1: Typical appearance of a mealybug infestation in fruit crevices (the black patches are sooty mould). 2: Severe infestation. In some cases, mealybugs may cover the entire fruit surface. 3: The coastal brown ant (*Pheidole megacephala*) tends the mealybugs for their honeydew. They move the mealybugs around and fend off their natural enemies. The black house ant (*Iridomyrex glaber*) acts similarly. 4: Fruit touching the ground is often covered with tunnels of dirt from ant activity. 5: Adult and pupae of *Leptomastix dactylopii*, an introduced wasp parasite of the mealybug. 6: Adults and white cottony larva (resembles mealybug but when mature is much larger) of the mealybug ladybird (*Cryptolaemus montrouzieri*). 7: An adult lacewing (*Oligochrysa lutea*), a useful predator of the mealybug. 8: A lacewing larva (note the prey remains attached to its back as camouflage).

Treatment: Make sure that the damage is serious enough to warrant treatment. At least 25% of sampled fruit need to have one or more large mealybugs to make it worth treating. The decision to act then depends on the activity of natural enemies such as those pictured in photos 5 to 8. Action is recommended when natural enemies are present on less than 20% of sampled fruit (less than 50% from April to July). Action involves either releasing *Leptomastix* wasps or spraying with an appropriate chemical from the *Problem solver handy guide*. Control ants (see *Prevention* below).

Prevention: Release *Leptomastix* wasps each spring, then monitor mealybug and parasite levels so that appropriate treatments (chemical or more parasites) can be applied before the problem gets too severe. The main risk period is from December to March. Monitor ant activity in August, December and February, and spray the tree trunk and the soil for about half a metre around the trunk if required. Also prune tree skirts to stop ants moving up into the trees. Use an appropriate chemical from the *Problem solver handy guide*.



Cuts and splits in fruit



Cut

Cause: Mechanical damage during handling. May result from harvesting clippers or sharp surfaces on picking bins and other postharvest handling equipment.

Identification notes: Sections of fruit are cleanly cut.

Treatment: No treatment available.

Prevention: Harvest fruit carefully—cut the fruit stalk at a point well above the shoulders of the fruit and when it is in the hand, then trim the fruit stalk to a point below the shoulders. Ensure there are no sharp surfaces on picking bins and other fruit storage and handling equipment. Place fruit into packing bins—do not allow it to drop or tumble. Line packing shed tables with a soft material.



Longitudinal and radial cracking

Cause: The factors involved in longitudinal cracking include water fluctuations in the fruit, cold temperatures during fruit maturation, the sugar content of the fruit and variety. Some thin-skinned varieties, such as QAS, are highly susceptible. Excessively large fruit, particularly during the first harvest in warmer areas, are extremely turgid and will crack more readily. Radial cracking can be caused by fruit storage at too low a temperature. It is occasionally seen in over-ripe fruit in the field. Also see symptom on page 22.

Identification notes: Upper: longitudinal crack. Cracks generally run from near the stem-end to the bottom of the fruit. Lower: radial crack where the skin splits away from the fruit stalk.

Treatment: No treatment available.

Prevention: For longitudinal cracking, manage irrigation carefully using soil moisture monitoring systems. Avoid planting in areas where frosts or cold temperatures occur. Establish effective windbreaks to reduce the impact of cold, dry winds. In sites subject to cold temperatures during July, manage the crop to avoid fruit maturing during this month. In North Queensland, where fruit growth rates are high, increase the crop load to avoid excessively large fruit. For radial cracking, harvest fruit promptly when mature, and store at appropriate temperatures.



Yellowing and/or softening of fruit



Sunburn

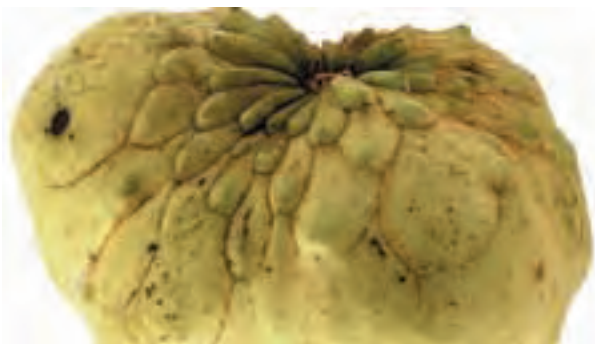
Cause: Exposure of fruit to the sun during hot weather. Generally only a problem in unhealthy trees which have lost their leaf cover.

Identification notes: Affected fruit have bleached yellowish areas on exposed surfaces. Also see symptom on page 14.

Treatment: There is no treatment for affected fruit.

Prevention: Keep trees in a healthy condition to maintain good leaf cover. This means paying attention to nutrition, irrigation, pruning, pest and disease control, mulching and weed control.

Yellowing and/or softening of fruit



Over-mature fruit

Cause: Fruit not being harvested when mature.

Identification notes: Affected fruit become yellow, soften on the tree and eventually drop off.

Treatment: Harvest fruit promptly when mature.

Prevention: In future, check fruit maturity indicators to ensure that fruit are harvested at the correct stage of maturity.



Queensland fruit fly damage

Cause: The insect *Bactrocera tryoni*.

Identification notes: It is virtually impossible to detect symptoms of fruit fly in unripe fruit. In near-ripe fruit, fruit soften around the egg-laying sites, sometimes with associated yellowing. Egg laying is most common around the stalk end of the fruit. Upper: Queensland fruit fly. Lower: larvae (maggots) of the fly in the tissue of a fruit. African Pride is more susceptible to attack than Pinks Mammoth and Hillary White. The variety Paethorpe appears to be highly susceptible.

Treatment: Apply weekly bait sprays starting six weeks before first harvest and continue until the end of harvest, according to ICA-18 guidelines. Use an appropriate bait spray chemical from the *Problem solver handy guide* mixed with yeast autolysate. An alternative treatment is an overall cover spray of an appropriate insecticide from the *Problem solver handy guide*, but this is not recommended because of its effects on beneficial insects.

Prevention: In conjunction with bait sprays, monitor fruit fly levels using male lure traps. Queensland fruit fly can occur all year round but the main activity is from spring to autumn.



Blackening of fruit at the blossom end



Calcium deficiency

Cause: Insufficient calcium available to the fruit. Generally caused by a combination of low available soil calcium and dry soil conditions. Availability of calcium from the soil is often restricted by an imbalance of potassium, calcium and magnesium.

Identification notes: Affected fruit show a dark rot at the blossom end. The remainder of the fruit is generally unaffected. Note the distinct margin of the discoloured area.

Treatment: Do leaf and soil analyses to confirm the diagnosis. Apply lime, dolomite or gypsum according to the analysis results. A foliar spray of calcium nitrate provides a short-term response. Spray to thoroughly wet the developing fruit.

Prevention: Do annual leaf and soil analyses to monitor nutrient levels. Apply appropriate amounts of liming materials as required. Ensure adequate water is applied during the fruit development period.

Poorly shaped fruit



Poor pollination

Cause: Inadequate pollination of the female flower parts.

Identification notes: Fruit are unevenly shaped with the carpels (fruit segments) close together in the poorly pollinated parts. Pinks Mammoth is most severely affected.

Treatment: There is no treatment for affected fruit. However, fruit are normal in all other respects and are marketable but at reduced prices.

Prevention: Hand pollinate flowers of Pinks Mammoth and Hillary White varieties.

Internal disorders of fruit



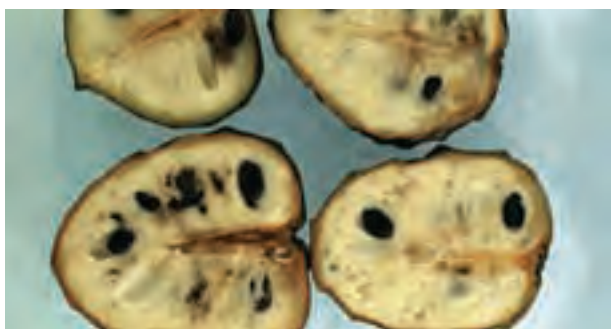
Woodiness

Cause: Thought to be caused by calcium and/or boron deficiency. The availability of calcium and boron in the fruit is influenced by the availability of calcium and boron in the soil; the balance between magnesium, potassium and calcium in the soil; very wet or very dry soil conditions; and excessive tree vigour.

Identification notes: Hard brown areas form around the centre core and the seeds. The seed coat may disintegrate. Upper: mild symptom. Lower: severe symptom.

Treatment: Difficult to treat in the short-term. Do leaf and soil analyses to confirm the diagnosis. Apply lime, dolomite or gypsum according to the analysis results. A foliar spray of calcium nitrate and/or Solubor may provide a short-term response. Improve irrigation during dry spells.

Prevention: Do annual leaf and soil analyses to monitor nutrient levels. Apply appropriate amounts of calcium and boron fertiliser as indicated by the analyses. Ensure adequate water is applied during the fruit development period. Prune strong shoot growth in summer and avoid heavy spur pruning of young vigorous trees.



Brown pulp

Cause: Under investigation but thought to be calcium and/or boron deficiency induced by excessive shoot growth. See *Woodiness* above.

Identification notes: Brown pulp as well as brown spots are scattered through the flesh. May be associated with *Woodiness* (above).

Treatment: As for *Woodiness* (above).

Prevention: As for *Woodiness* (above).



Secondary disease

Cause: An unidentified postharvest rot. Thought to be associated with over-mature fruit. Under investigation.

Identification notes: Fruit have a soft wet rot of the centre core area extending from the stem end.

Treatment: There is no known treatment at this stage.

Prevention: Harvest fruit promptly when mature.

Internal disorders of fruit



Preharvest cold damage ('field chilling')

Cause: Exposure of mature fruit to either cold temperatures below about 13°C or cold, dry winds. Late-set fruit, which develops in cold weather but matures in warmer spring weather, generally avoids damage.

Identification notes: Upper: affected fruit develop translucent areas, generally with a slight brown discolouration, in the flesh. Lower: unaffected fruit for comparison. African Pride is very susceptible to damage. Also see symptoms on page 15.

Treatment: There is no treatment for affected fruit.

Prevention: Avoid planting in areas susceptible to frosts or cold temperatures. Windbreaks may reduce the impact of cold, dry winds. However, remember that poorly designed windbreaks may exacerbate frost damage. In sites subject to frost, manage the crop to avoid fruit maturing during July. Harvest fruit promptly once it is mature.



Immature fruit

Cause: Fruit harvested before it is physiologically mature.

Identification notes: Immature fruit have a slightly translucent flesh and a high proportion of seeds to flesh. Also note that the ring of outer flesh is distinct from the inner seed cavity. Compare this with the fruit in the photo above where the flesh throughout the fruit is a similar colour and density. Generally only a problem in African Pride, where maturity is difficult to determine on external appearance.

Treatment: Harvest fruit when they are mature.

Prevention: Learn to recognise the subtle signs of fruit maturity in African Pride. See *Key issues*, page 122.



Translucent pulp

Cause: Unknown.

Identification notes: Translucent areas develop around the seeds and sometimes in a ring around the seed cavity.

Treatment: There is no known treatment for this problem.

Prevention: There is no known prevention for this problem.

Postharvest skin disorders of fruit



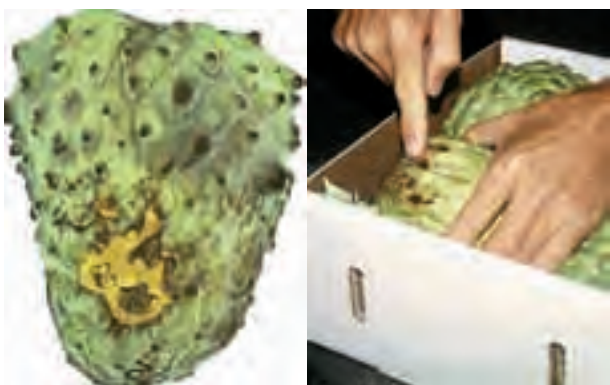
Chilling damage from refrigeration

Cause: Storage of fruit for too long at temperatures below 13°C. Fruit which has been exposed to rain within 48 hours prior to harvest, is particularly susceptible to blackening during refrigeration.

Identification notes: Affected fruit initially show a distinct bronzing of the skin. With longer storage, affected fruit darken to become almost black. Prolonged storage generally causes internal breakdown and discolouration. Compare this with 'field chilling' (page 21), where internal discolouration produces relatively mild damage.

Treatment: There is no treatment for affected fruit.

Prevention: Store fruit for no more than six days at temperatures below 13°C.



Transport damage

Cause: Rub or pressure damage from carton surfaces or from fruit rubbing together.

Identification notes: Left: early stages of damage showing the fruit resin exuded onto the surface of the skin. Right: spots darken with time. Fruit rubbing on the side or lid of the carton has caused this damage.

Treatment: There is no treatment for affected fruit.

Prevention: Use 10 mm bubble wrap as a liner on the bottom and top of the carton to prevent carton rub damage. Use polysocks to prevent fruit rubbing together within the carton.



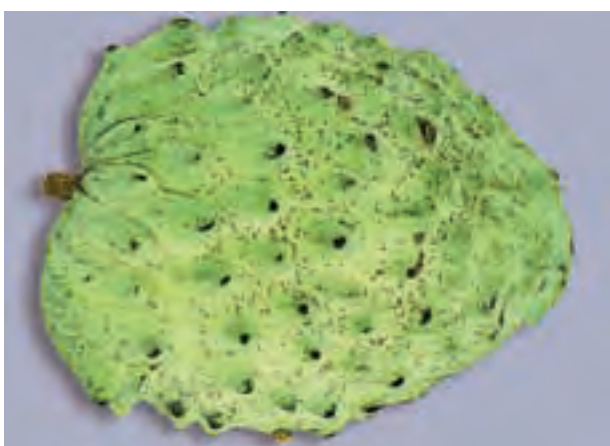
Skin splitting

Cause: Unknown. Occurs in large fruit with high sugar levels harvested early in the season.

Identification notes: Fruit 'burst' open during harvesting, transport or storage when bumped or handled roughly.

Treatment: Handle large early season fruit with extreme care during harvesting and postharvest handling.

Prevention: In future seasons, slightly increase the crop load to reduce fruit size a little.



Pepper spot

Cause: The fungi *Glomerella cingulata* and *Cladosporium* sp. cause one form of this disease.

Identification notes: Tiny dark specks form in the natural depressions on the fruit surface. Spots rarely develop beyond this stage, giving the appearance of a 'peppered' surface.

Treatment: Unknown at this stage.

Prevention: Unknown at this stage.

Decline and death of whole trees



Armillaria root rot

Cause: The fungus *Armillaria luteobubalina*.

Identification notes: 1: The fungus causes a slow decline of trees with dieback of twigs and leaves. 2 and 3: The disease can be diagnosed by the white plaques of fungal growth under the bark of the trunk (2), and the black 'shoestrings' of the fungus on the major roots (3). 4: After wet weather, honey-coloured mushrooms of the fungus may be found growing at the base of affected trees.

Losses are most likely when custard apples are planted into land recently cleared of trees susceptible to the disease. Yellow box (*Eucalyptus melliodora*) is a common tree host.

Treatment: No treatment available.

Prevention: Before planting, remove as many roots as possible of previous trees. This requires stick raking, deep ripping and tining. Individual replant tree sites may also be fumigated before planting new trees.



Decline and death of whole trees



1



2



3

Bacterial wilt

Cause: The bacterium *Pseudomonas solanacearum*.

Identification notes: 1: Young trees may rapidly wilt and decline, often with severe defoliation. 2: Leaves that stay on the tree are dull green and hang almost vertically. 3: In older trees, a slow decline occurs over about two years, generally with little or no yellowing of the leaves. 4: Affected trees have a dark discoloration of the water-conducting tissues in the basal trunk and large roots. The bark around the crown has been cut away here to show the discoloration. 5: A transverse and longitudinal section of the trunk at ground level, showing the extensive discoloration of the outer growth rings. Also see symptoms on pages 4 and 9. Often occurs on trees that have just started cropping. Wilting is most common in late summer.

Treatment: No treatment available. Mulching and reducing crop load may help to prolong the life of affected trees.

Prevention: Avoid planting in areas that have grown tomatoes, potatoes, eggfruit or capsicums within the past two years. Do not plant in poorly drained sites and improve drainage by mounding. Use cherimoya rootstocks.



4



5

Yellowing and poor growth of whole trees



Bacterial wilt

Cause: The bacterium *Pseudomonas solanacearum*.

Identification notes: Generally a problem in young trees. Leaves are pale yellow and stand in stark contrast to those of the healthy tree at left. See previous page for trunk symptoms.

Treatment: No treatment available. Mulching and reducing crop load may help to prolong the life of affected trees.

Prevention: Avoid planting in areas that have grown tomatoes, potatoes, eggfruit or capsicums within the past two years. Do not plant in poorly drained sites and improve drainage by mounding. Use cherimoya rootstocks.



Root damage

Cause: Waterlogging from poor soil drainage, or root dehydration from inadequate irrigation and mulching. The fungi *Cylindrocladium* spp., *Pythium* spp. and possibly other fungi are often associated with root damage.

Identification notes: Upper: affected tree showing pale yellow foliage and weak vegetative flushes. Centre: roots of the affected tree showing blackening and rotting of the fine root tips. Lower: a healthy network of roots for comparison. This photo was taken under a well-mulched tree with the mulch removed.

Treatment: Immediately apply mulch under the trees. Lightly prune to restore a balance between foliage and roots. Improve the frequency and timing of irrigation.

Prevention: Transplant potted plants into the field as soon as possible as young trees left too long in pots commonly have twisted root systems that do not grow normally after transplanting. In less severe cases, water and nutrient uptake are reduced; in severe cases, trees die.

As yet, cherimoya rootstocks have not been specially selected for resistance to soil fungi and bacterial wilt. In any group of grafted plants, a small percentage will be susceptible to root diseases, and every year, some trees may die. More research needs to be done to identify elite rootstocks.

Mulch trees at least annually to maintain a favourable root environment. Addition of an organic fertiliser such as pelleted poultry manure is beneficial. Improve soil drainage where waterlogging occurs after heavy rain. Ensure irrigation is adequate. The best way to do this is to use a soil moisture monitoring system such as tensiometers, gypsum blocks, neutron probe or capacitance probes.



Yellowing and poor growth of whole trees



Nitrogen or iron deficiency

Cause: Insufficient nitrogen or iron available to the tree. Iron deficiency is generally caused by poor root health or over-liming.

Identification notes: Nitrogen deficiency initially causes leaves to go a pale green but as the deficiency worsens, leaves turn bright yellow and fall prematurely. Iron deficiency causes an overall yellowing or whitening of leaves with the veins remaining green. See a close-up symptom of nitrogen and iron deficiency on pages 2 and 3 respectively.

Other problems causing yellow leaves (see pages 2 to 4) generally do not affect the whole tree. They affect the younger or older leaves but rarely both at the same time.

Treatment: Do leaf and soil analyses to confirm the diagnosis. If nitrogen deficiency is confirmed, adjust the fertiliser program according to the leaf analysis results. If iron deficiency is confirmed, apply a foliar spray of iron chelate or soluble ferrous sulphate.

Prevention: Do annual leaf and soil analyses to monitor nutrient levels. For nitrogen, apply appropriate amounts of nitrogen fertiliser throughout the growing season. For iron, it is important to avoid over-liming. To do this, calculate lime or dolomite rates carefully in accordance with soil analysis results. Mulch trees to improve root health.