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# A Pictorial Guide for Cotton Disease Symptoms

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**A**LTERNARIA leaf spot is caused by a fungal pathogen that can be carried over on infected cotton residues from the previous season.

### Symptoms

Brown, grey brown or tan lesions (spots) on cotyledons, leaves, bracts and bolls varying from 1 to 10mm in diameter.

Rapid defoliation can occur when a susceptible crop (eg. Pima varieties) is exposed to favourable conditions. Affected leaves develop an abscission layer, senesce and drop to the ground.

Symptoms generally more severe on lower leaves.

Plants are most susceptible at the seedling stage

and late in the season when the crop begins to 'cut out', especially following premature senescence.

Lesions can have dark brown or purple margins and sometimes have obvious concentric zones.

### Environmental factors

Favoured by either repeated heavy dews or extended periods of wet weather.

Favoured by physiological or nutritional stress (eg. heavy fruit load or low potassium).

### Looks like

See pages: 11, 23, 25, 33, 36, 37, 66, 68, 70.



**B**ACTERIAL blight was a problem. Most Australian cotton varieties are resistant and only some of the older Pima varieties are susceptible.

### Symptoms

Dark green, watersoaked, angular lesions, 1 to 5mm across on cotyledons, leaves and bracts. Spots are more obvious on the lower leaf surface. Lesions darken and become black with age. Leaves can shed prematurely resulting in extensive defoliation.

Large dark green watersoaked lesions may develop along leaf veins and on stems and branches ('black-arm').

Symptoms are usually more prevalent on lower leaves than on upper leaves.

Dark green, watersoaked, greasy, circular lesions, 2 to 10mm across can occur on bolls, especially at the base of the boll under the calyx crown. As the boll matures the lesions dry out and prevent normal boll opening.

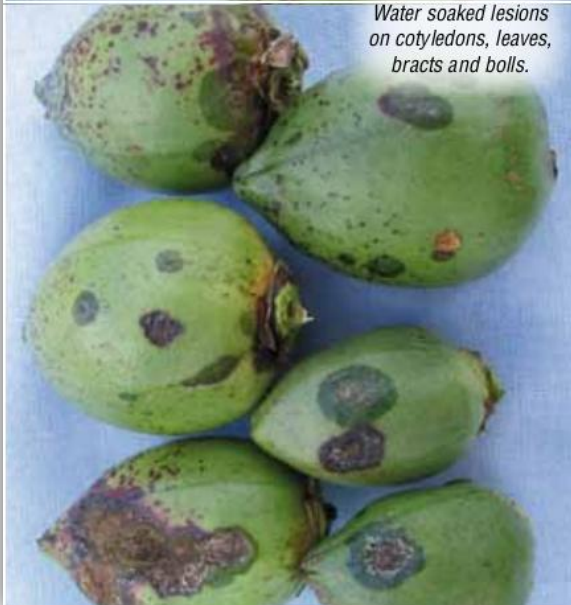
### Environmental Factors

Wind driven rain, hail and sand-blasting increase disease severity.

Can survive on plant residues.

### Looks like

See pages: 10, 23, 25.



*Water soaked lesions on cotyledons, leaves, bracts and bolls.*



*'Blackarm'.*



**B**ACTERIAL stunt occurs when soilborne bacteria infect cotton roots.

### Symptoms

Uniformly stunted, slow growing plants. Growth will generally improve later in the season. Severity varies from season to season, but the distribution in fields does not vary.

Look for rapid development of root browning in seedling plants.

When infected roots are cut into a drop of water, bacteria can be seen flowing out (bacterial streaming).

### Environmental factors

Bacterial stunt is most severe on heavy grey clays and is easier to identify when soil type varies within one field.

### Looks like

See pages: 13, 31, 33, 49, 50, 51, 52, 59, 66.



**B**LACK root rot delays development of the crop.

### Symptoms

Seedlings are stunted and slow growing early in the season compared with healthy plants from the same field. Roots appear black and there are generally few lateral roots. The black layer can be removed by thumb and forefinger exposing a white centre. As the season gets warmer the black layer sloughs off and normal growth resumes.

Usually first observed as patches of stunted, slow growing cotton seedlings apparent only early in the growing season. In subsequent seasons

the patches may no longer be obvious as the pathogen spreads throughout the field.

Fungus can infect the centre of the tap root causing a 'black heart'.

### Environmental factors

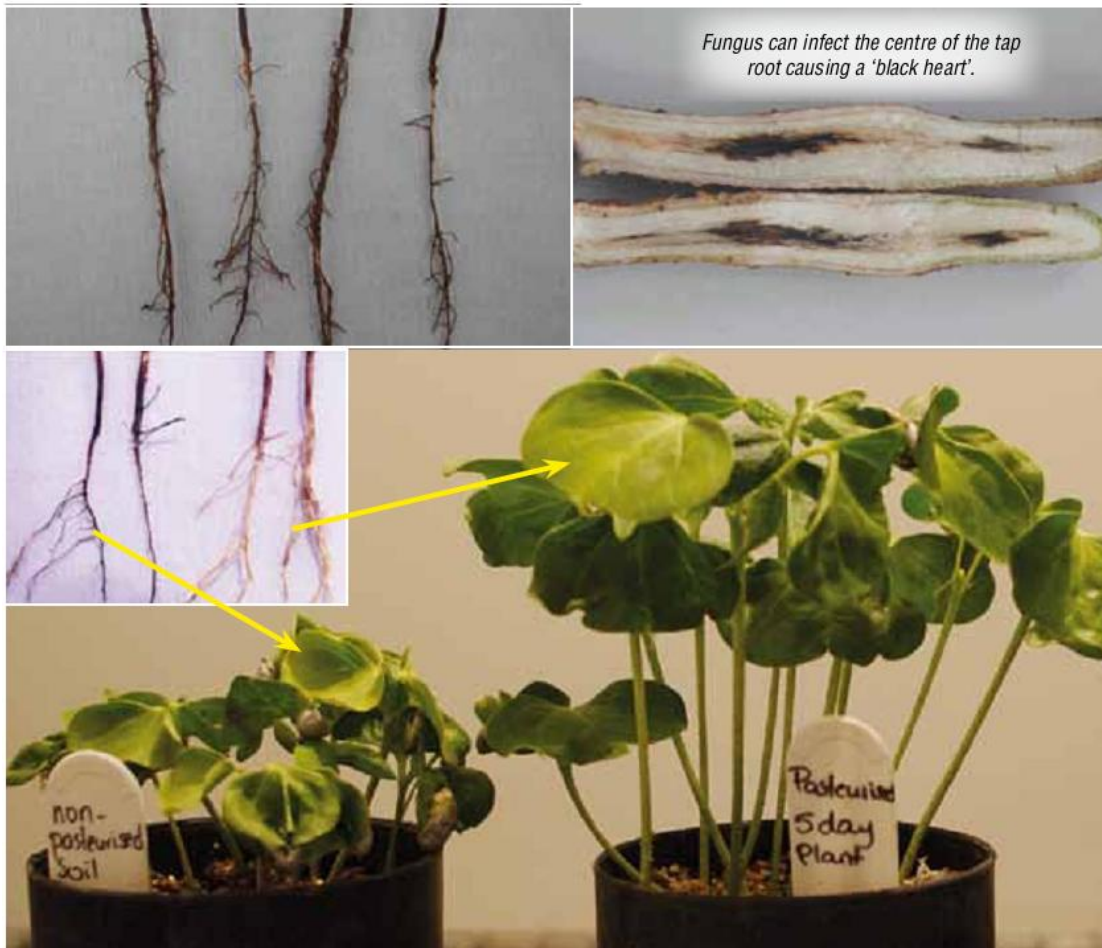
Favoured by cool wet conditions.

Symptoms will be more severe in medium to heavy clay soils.

Favoured by cotton following susceptible crops, including most legumes and cotton.

### Looks like

See pages: 12, 20, 31, 33, 49, 50, 51, 52, 59.



**B**OLL rots are caused by a number of pathogens, including fungi and bacteria. Tight lock refers to a type of boll rot, where the lock remains hard and fails to fluff out.

#### Symptoms

*Alternaria* boll rot begin as small spots with dark margins. The spots enlarge and eventually may affect the whole boll.

Bolls infected by *Phytophthora* boll rot appear dark brown to black, sometimes with areas of white mould on the surface. Locks remain hard, don't fluff out (tight lock) and often have a brown stain. Affected bolls either don't open at all, or

open prematurely, with the compact locks easily dislodged and falling to the ground. *Phytophthora* boll rot usually occurs when soil is splashed up onto low bolls that are beginning to crack open or when low bolls are subject to inundation by tail water backing up into rows.

*Sclerotinia* boll rot characteristically has black fungal structures (2 to 10mm diameter) within and/or on the surface of the rotted bolls. A white cottony fungal growth may be present and the branch adjacent to the boll may also be affected.

Bacterial blight produces circular, dark green and greasy spots on young, green developing bolls.



*Sclerotinia* boll rot.



*Phytophthora* boll rot.



When spots develop under the calyx crown at the base of the boll then affected bolls do not open properly. Secondary fungal growth sometimes develops in old spots on mature bolls.

Several other fungi can cause secondary boll rots in cotton. These fungi usually require an injury or a wound, such as that caused by an insect pest, to allow infection to take place.

#### **Environmental factors**

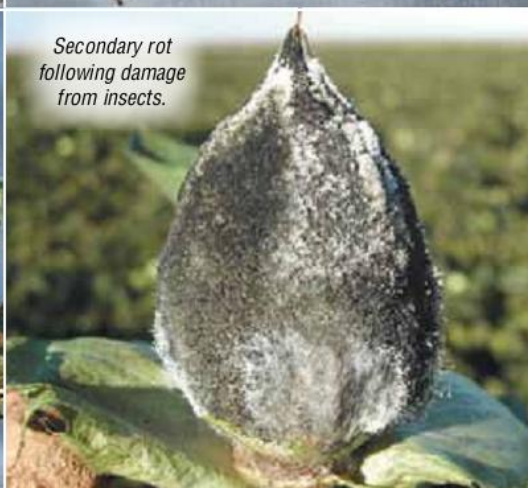
Favoured by wet weather and humidity deep in the plant canopy.

Favoured by rank growth.

Boll rots and tight locks can also develop when bolls that are opening are exposed to wet weather.

#### **Looks like**

See page: 19.



**C**OTTON bunchy top is a virus spread by cotton aphids.

### Symptoms

New growth is characterised by small leaves, short internodes and small bolls.

Leaves have pale green angular patterns around the margins and darker green centres (mottle). This leaf mottle may turn red on the upper surface of the leaf. The leaves also have a leathery texture.

Early infection results in the crop taking on a compact, stunted, 'climbing ivy' appearance.

Roots appear hairy and dark brown and form small knots on the secondary root branches.

### Environmental factors

Favoured by wet winter/spring as this favours the build up of hosts for the disease and the aphid vector, such as cotton volunteers/ratoons or marshmallow.

There is a 3-5 week delay from infection to obvious symptoms.

Symptoms can be difficult to distinguish in perennial volunteer cotton and late crops (post cut out) where there has been insufficient new growth to show symptoms.

### Looks like

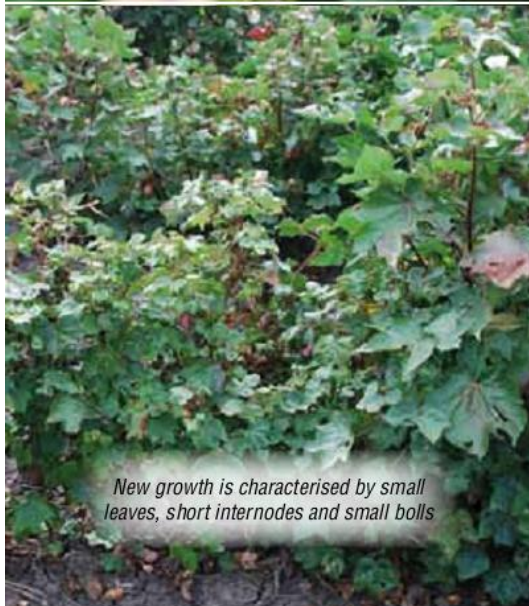
See pages: 17, 24, 26, 28, 30, 31, 40, 44, 45, 70.



*Leaves have pale green angular patterns around the margins and darker green centres (mottle).*



*Leaves are small and have a leathery appearance. Leaf mottle may turn red.*



*New growth is characterised by small leaves, short internodes and small bolls*



**F**USARIUM wilt is a disease of cotton caused by the soil inhabiting fungus *Fusarium oxysporum* f.sp. *vasinfectum* (Fov).

**Symptoms**

External symptoms, including stunting, yellowing, wilting and plant death, occur at any time during the season. This often results in a 'gappy' stand.

Movement of the pathogen in irrigation water may result in 'tear shaped' patches or strips. Fusarium wilt is often first observed as dead plants at the tail drain.

A feature of Fusarium wilt is solid the brown discolouration throughout the woody part of the

stem and tap root. Browning may fill the whole stem. Some leaves develop a yellow mottle.

Plants die back from the top and may re-grow from the base later in the season.

**Environmental factors**

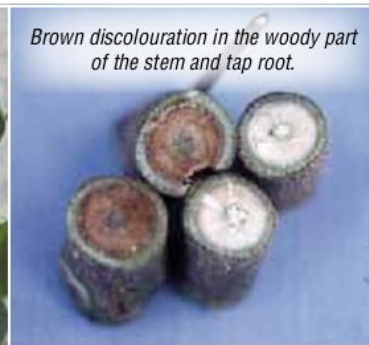
Favoured by wet and cool conditions in spring.

In the more resistant varieties, symptoms may include stunting, a 'gappy' stand, or uneven plant height, but not necessarily wilting and death.

Stem discolouration is always present.

**Looks like**

See pages: 21, 24, 28, 29, 30, 41, 53, 56.



*Brown discolouration in the woody part of the stem and tap root.*



*Often first observed as dead plants at the tail drain.*

**P**OST harvest rot occurs when rain delays harvest or water gets into modules and micro-organisms (bacteria and fungi) attack the cellulose in the cotton fibres. This can significantly affect fibre quality.

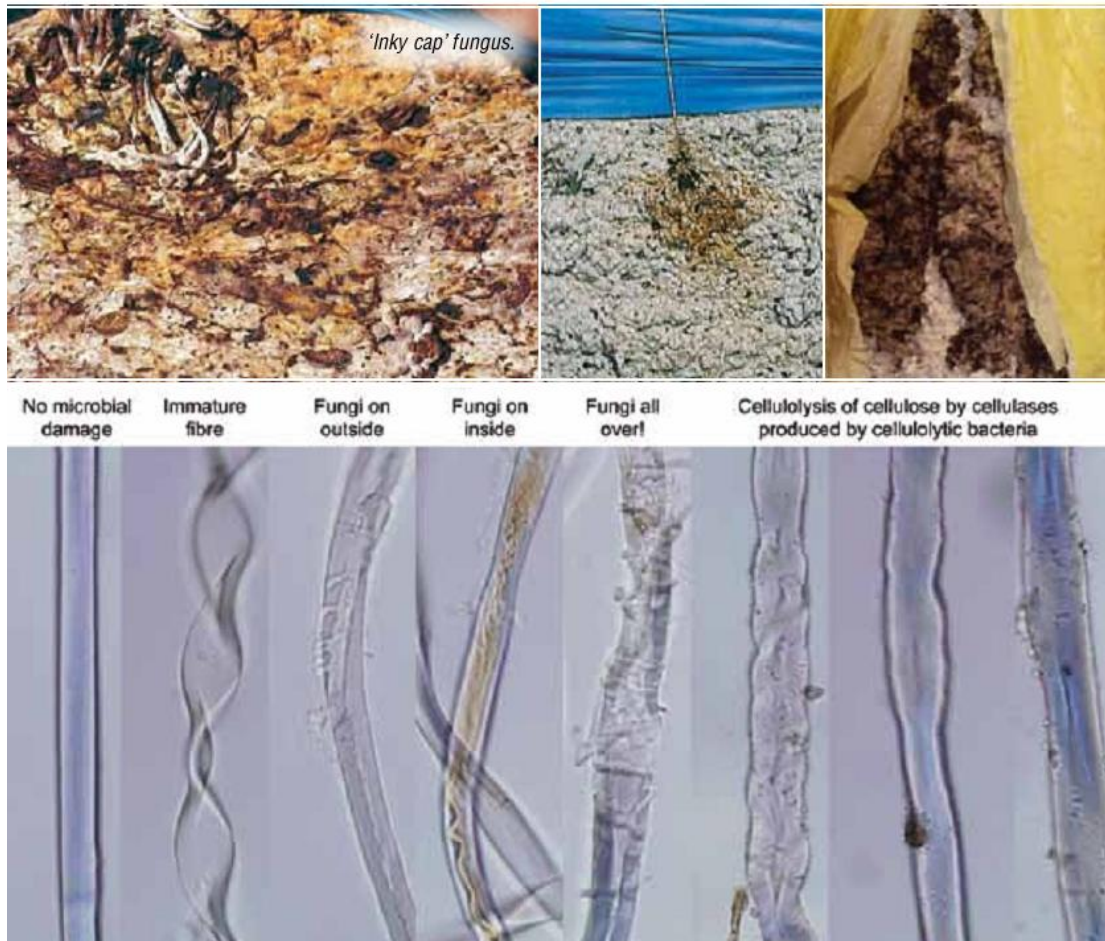
Microscopic inspection of the fibres when mounted in 18% sodium hydroxide reveals the presence of microbes in and on the fibres. Unaffected fibres are smooth and cylindrical while the breakdown of cellulose is indicated by bumps and swellings.

### Symptoms

Post harvest rot of seed cotton develops when water enters the module through a hole in the module tarp or along the ropes holding the module tarp in place. An 'inky cap' fungus (*Coprinus species*) is often present in these areas of rotted seed cotton.

### Environmental factors

Favoured by high moisture from picking too wet, too much trash, from poor storage of modules/bales or damage to plastic/tarps.



**S**EED rot refers to boll rot that begins in the seed. Recent overseas research indicates that pathogens spread by sucking pests such as green vegetable bug and pale cotton stainers may be responsible.

**Symptoms**

Small black spots 1-2mm diameter on the surface of the bolls indicate the feeding of sucking insects on developing seed within the boll.

Seeds within the maturing green bolls are swollen and discoloured yellow or brown.

When affected bolls open the locks with infected seed fail to 'fluff out' and remain compact and discoloured.

Seed rots do not necessarily affect the whole boll and may be limited to one or two locks.

**Environmental factors**

High numbers of sucking pests such as green vegetable bug and pale cotton stainers soon after flowering can increase the likelihood of seed rots.

**Looks like**

See pages: 14.



**S**EEDLING diseases may be caused by numerous pathogens acting alone or in combination that commonly cause reduced plant stand.

### Symptoms

Seedlings die off before or after emergence, as single plants or in patches. Roots may be damaged resulting in poor growth. Patterns of seedling death can occur across rows.

*Pythium* spp. usually causes a soft rot and stem collapse leading to death of seedlings.

*Rhizoctonia* sp. causes sunken red/brown lesions on the lower stem and roots often leading to girdling (sore shin).

A collar rot caused by *Sclerotium rolfsii* affects a large range of different crops. Distinctive white to brown sclerotia (balls 0.5-2.0mm) form on a white cottony collar at or just below ground level.

Anthraxnose (*Colletotrichum gossypii*) is rarely seen in Australia but has been reported in Northern Australia and Queensland. All parts of the plant may be attacked. Typical symptoms include a girdling of the stem at or near ground level.

### Environmental factors

Favoured by weather conditions and soil characteristics that delay germination and emergence.

Incidence can be higher where other factors have stressed plants (poorly drained areas, fertiliser placement, herbicide application, planting depth etc). High stubble load (cotton or rotation crops especially legumes) can contribute to disease development.

### Looks like

See pages: 13, 17, 28, 31, 33, 34, 35, 36, 37, 39, 41, 48, 50, 51, 52, 53, 56, 60.



**S**UDDEN wilt is caused by a weakly pathogenic species of *Fusarium* (NOT the species that causes Fusarium wilt).

### Symptoms

Plants wilt suddenly and defoliate, usually in hot weather after irrigation or rainfall.

Plants die or occasionally re-grow.

Affects single plants or small patches.

Does not re-occur in the same place.

Brown discoloration is confined to the woody parts of the roots and lower stem only.

### Environmental factors

Symptoms almost always appear in hot weather after irrigation or rainfall.

Root damage from late cultivation can contribute.

### Looks like

See pages: 17, 24, 28, 29, 30, 52, 56.



**T**OBACCO streak virus (TSV) is transmitted by infected pollen, which can be spread by wind, or carried by insects. Thrips are the only known insect vector and are required for TSV infection to occur.

#### Symptoms

Dark purple, spreading lesions on leaves, occasionally forming numerous diffuse ring spots.

On plants with numerous lesions the upper leaves may also display chlorotic mottle.

Symptoms in affected cotton crops are typically mild and consist of one or more, diffuse purple lesions on one leaf of the infected plant.

#### Environmental factors

Favoured by conditions which enable high thrip populations to develop, and large amounts of infective pollen to be produced by the major alternative weed host, Parthenium weed. These conditions generally occur during warmer months. This disease is currently only found in Queensland where Parthenium weed is abundant.

#### Looks like

See page: 23, 47.



**T**ROPICAL rust is common on feral cotton and tree cotton in parts of northern Australia.

**Symptoms**

Numerous small spots develop on older leaves.

Spots are purple with a red/brown centre on the upper side of the leaf and brown, powdery pustules underneath.

**Environmental factors**

More severe during the dry season.

**Looks like**

See pages: 11, 22, 25.



*Numerous small spots develop on older leaves.*



*Purple spots with red-brown center on upper side.*

**V**ERTICILLIUM wilt of cotton is caused by *Verticillium dahliae*, a soil borne fungus that enters the roots and grows into the vascular system of the plant.

### Symptoms

Vascular discolouration or browning extending throughout the stem and into the petioles.

Plants rarely wilt but may defoliate prematurely at the end of the season.

Leaves develop a characteristic yellow mottle, at the edges and between the veins.

Lower leaves are usually affected first.

Dead tissue develops at the leaf edges and may replace the mottled areas.

The mottle can be diffuse or angular.

### Environmental factors

Favoured by cool seasons.

Most severe during extended wet weather and/or waterlogging and in late maturing crops.

The disease is favoured by excessive use of nitrogen which results in late season growth and also by potassium deficiency.

### Looks like

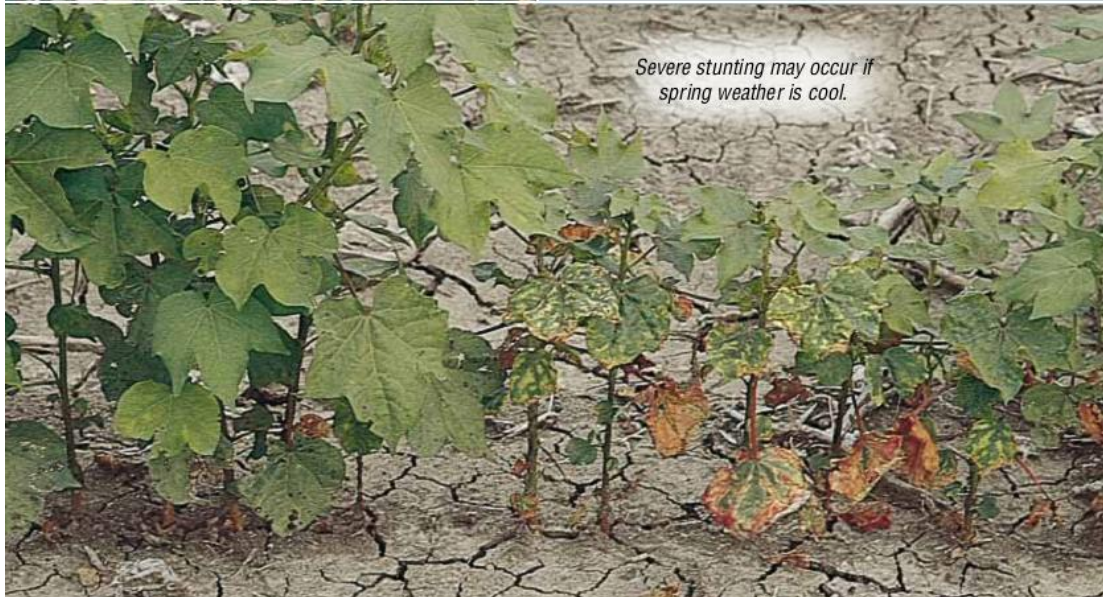
See pages: 17, 21, 28, 29, 30, 58, 60.



*Characteristic yellow mottle*



*Vascular discolouration.*



*Severe stunting may occur if spring weather is cool.*



**B**ACTERIAL blight is already present in Australia. However all current varieties are resistant to the strains that are present. Exotic strains (races) which are described as being 'hypervirulent' have developed in several African countries and have spread to the US. All current varieties would be susceptible to the hypervirulent strains if they were introduced to Australia.

### Symptoms

Dark green, watersoaked, angular lesions, 1 to 5mm across on cotyledons, leaves and bracts. Spots are more obvious on the lower leaf surface. Lesions darken and may become black with age.

Leaves may be shed prematurely resulting in extensive defoliation.

Large dark green watersoaked lesions may develop along leaf veins and on stems and branches ('black-arm').

Symptoms are usually more prevalent on lower leaves than on upper leaves.

Dark green, watersoaked, greasy, circular lesions, 2 to 10mm across can occur on bolls, especially at the base of the boll under the calyx crown. As the boll matures the lesions dry out and prevent normal boll opening.

### Environmental factors

The disease is seed borne allowing easy dispersal and introduction of new races into new areas.

Bacterial blight is favoured by high temperatures, humidity and rainfall. In the absence of favourable conditions, it can survive on leaf surface with no symptoms.

### Looks like

See pages: 10, 11, 23.



**B**LUE disease is caused by cotton leaf roll dwarf virus, a cotton virus that is spread by the cotton aphid.

#### Symptoms

Affected leaves tend to be smaller, thick, more brittle and leathery and have an intense green to bluish colour with yellow veins.

Reddening of stem petioles and leaf veins can occur in some infections.

Leaf edges tend to roll downwards and under.

Plants become stunted due to a shortening of the branch internodes and produce many branches, giving a bunchy zig-zag stem habit.

Cotton leaf roll virus is a very similar aphid vectored virus. Neither cotton leaf roll dwarf virus or cotton leaf roll virus are present in Australia.

#### Environmental factors

Favoured by conditions that promote aphids.

#### Looks like

See pages: 16, 40.



**C**OTTON leaf curl disease CLCuD, (Gemini virus), is spread by a whitefly vector, such as silverleaf whitefly. There are at least seven different begomoviruses and several different DNA satellite molecules associated with CLCuD. A cotton plant needs to be infected with at least one begomovirus and one satellite to develop CLCuD.

**Symptoms**

Symptoms on leaves appear as a swelling and darkening of leaf veins, followed by a deep downward cupping of the youngest leaves then either an upward or downward curling of the leaf margins.

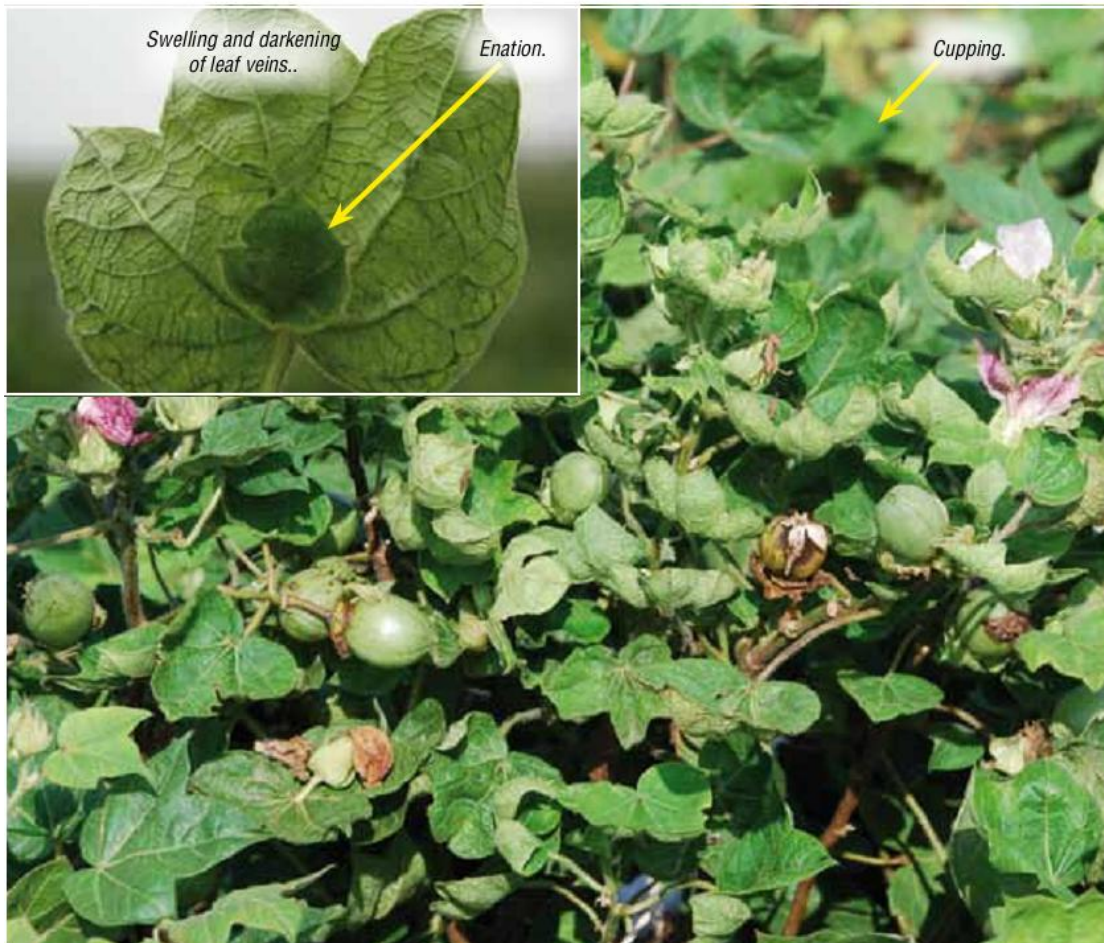
Leaf-like structures (enations) on the underside of leaves are common and vary in size from only a few millimetres in diameter to almost the size of a normal leaf.

**Environmental factors**

Low levels of silver leaf whitefly vector can spread virus.

**Looks like**

See pages: 44, 45.



**F**USARIUM wilt in Australia is caused by strains that have developed in Australia and are unique to Australia. New strains (races) of the pathogen have developed in the US, Egypt, India, Africa and China. Race 4, which was first reported in India, has been reported in California in recent years and is spreading very rapidly causing great concern. Some exotic strains require co-infection with a nematode to enable symptoms to develop. Some are able to infect other hosts such as soybean, tobacco and lupin.

**Symptoms**

Symptoms include death of seedlings, wilting and stunting. Some plants may appear unaffected but all plants will develop a brown discoloration in the vascular tissue throughout the stem.

**Environmental factors**

Australian strains are favoured by cool wet conditions. Most exotic strains prefer higher temperatures and symptoms disappear under cool temperatures.

**Looks like**

See pages: 17, 21, 24, 30, 56.



**V**ERTICILLIUM wilt in Australia is caused by non-defoliating strains of the pathogen which are considerably less virulent than the 'defoliating' strains that originated in the US and have since been observed in Peru, Spain, Greece, Iran, Turkey, South Africa and China.

#### Symptoms

Symptoms are initially similar, but sometimes more severe, than those caused by the Australian strains of the pathogen (see page 24). As the disease progresses there is a sudden and almost total defoliation and shedding of bolls. There is a rapid down-curling of the terminal leaves

resulting in severe epinasty (downward bending leaves).

#### Environmental factors

Temperature is very important. Plants become more susceptible as temperatures decrease and more resistant at higher temperatures.

#### Looks like

See pages: 17, 21, 24, 28, 56.

