Australian Cotton
Cooperative Research Centre

COTTON information sheet

Black Root Rot Update

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Black root rot poses a significant threat to cotton production, particularly in cooler regions. Although this disease does not kill seedlings directly, it stunts cotton growth and, in effect, 'steals time' from the crop. Yield losses of 25 to 50 % have been recorded in severely affected crops.

Distribution

In Australia, the disease black root rot was first detected in cotton in 1989. Black root rot is now widespread in all cotton growing areas of NSW, except Menindee, as well as being present in south west Queensland and the Darling Downs. Disease surveys have shown a steady rise in the number of farms with the disease (Figure 1) and more than 50% of cotton crops on these farms are affected.

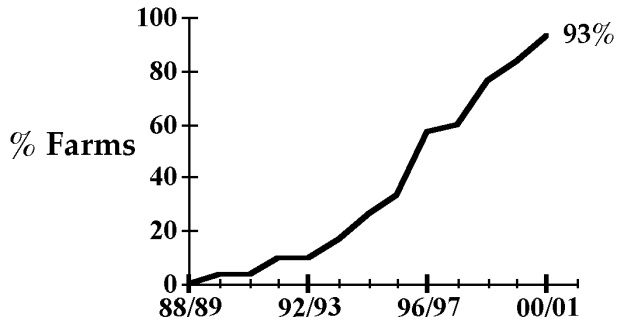

Figure 1. The increase in distribution of black root rot in farms surveyed annually in the Macintyre, Gwydir, Namoi and Macquarie valleys.

Dispersal

The disease is spread by movement of fungal spores in soil attached to vehicles or machinery or suspended in water. Soil in tail-water tends to settle out relatively quickly but soil adhering to floating trash makes a very efficient method of disease spread in irrigation and flood water.

Life cycle

Black root rot is caused by a soil-borne fungus, *Thielaviopsis basicola*. This fungus produces thick walled spores that can survive in the soil for several years. The black root rot fungus can only grow on living host plants, it will not grow on crop residues and it enters a dormant state when no suitable hosts are present. Hence, stubble management is not an issue for control. Farming systems trials are being conducted to study the long-term survival of the fungus in Australian soils. The status of weeds as alternative hosts for the fungus has not been studied in detail. However, to date, the disease has not been observed on commonly occurring weeds.

The fungus can produce a massive quantity of spores in the presence of the right host and soil conditions; as many as 800,000 spores per gram of cotton root in three weeks. Repetitive cropping with cotton deposits an ever-increasing number of spores in the soil (irrespective of rotation with non-host crops) and disease severity increases accordingly.

Optimum conditions for disease

Black root rot is a major problem in cooler regions and less of a problem in warmer regions, unless seasonal conditions are unusually cool.

- The optimum soil temperature for the disease is 16 to 20°C. Infection will continue to progress at soil temperatures up to 25°C.
- Wet conditions favour the build up of the black root rot fungus. In the cooler months of the season wet conditions also increase the chance of soil temperatures falling below 20°C.

In 1999 and 2000, cool conditions during October and November were ideal for the build up of the black root rot fungus in the soil.

Soil type and disease severity

The severity of black root rot varies with soil type. Medium to heavy clay soils appear to be more suited to

survival and proliferation of the black root rot fungus, compared to very heavy clays or lighter soils.

Disease symptoms

Black root rot causes stunted cotton growth early in the season and, in effect, 'steals time' from the crop. The degree of stunting is closely correlated with the severity of the disease and spore levels in the soil. Examination of the roots will reveal a characteristic blackening. This damage to the outer layers of the root reduces the plant's capacity to absorb nutrients. Infection also reduces colonisation of the roots by VAM (beneficial fungi).

Infection with the black root rot fungus will cause the death of some lateral roots but the main vascular tissue of the plant is usually not invaded. The taproot survives so that, as the season progresses and warms up, plant growth continues and the expanding roots slough off the dead tissue. If cool conditions continue, black root rot infections may occur or continue later in the season. Some older plants may develop an internal stem rot in severe cases. Severe black root rot can delay fruit development and maturity by up to four weeks. Yield losses of 25-50% are possible in these cases.

Causes of seedling death

Black root rot generally does not cause seedling death. However, severe black root rot may increase the plant's susceptibility to *Rhizoctonia* and *Pythium*, which can kill the plant and cause plant stand losses.

Management options

- **Planting** Time planting to coincide with soil temperatures of 16°C or more and rising. This is an important way to minimise the risk of seedling diseases, including black root rot. Ideally temperatures above 20°C would be best for sowing but this is generally not practical. Replanting decisions should be based on plant stand loss, not on the degree of stunting.

  To help minimise the risk of cool, wet soil conditions during the seedling stage, pre-irrigating would be more favourable than 'watering up'

- **Varieties** At this stage there has been no resistance to black root rot detected in any commercial or trial line varieties. If suitable for your region, choose varieties that have the capacity to 'catch up' later in the season.

- **Rotation** Rotation with cereals does not decrease, or increase, the population of the black root rot fungus in the soil. Many legumes used in rotation with cotton are hosts to the disease and should be avoided.

- **Biofumigation** This method involves sowing a 'green manure' crop that can release substances into the soil that are toxic to the black root rot fungus. Vetch has proved successful against black root rot in the USA. In eight out of eleven field trials with vetch or mustards in Australia, disease severity in the following cotton crop was decreased significantly (by 24 to 70%). The success of biofumigation depends upon the growth of the biofumigation crop and good incorporation (at least four weeks before cotton). Vetch also provides a nitrogen bonus to the soil (as much as 200 units of N per ha).

  A single biofumigation crop will not reverse a severe infestation of black root rot. However, with ongoing research, biofumigation may prove to be a successful tool for integrated management of this disease, with additional benefits to cotton farming systems.

- **Fungicides** There are no fungicides currently available that control black root rot effectively.

- **Summer flooding** Flooding does not eradicate the black root rot fungus but will decrease the population dramatically (down by 96 to 98% in a trial near Wee Waa). Studies in California indicate reductions in black root rot severity for up to four seasons. Flooding is most effective during summer and requires maximum air temperatures of 30°C or more for at least 30 days. Flooding will not be feasible in most situations.

- **Exclusion** Pathogen exclusion is a useful disease management tool. Castrol Farmcleanse (used at 10%) is able to kill the black root rot fungus and, after mud is removed, is a useful aid to decontaminate vehicles. Although black root rot is widespread, many fields and farms, especially in new areas, do not have the disease and are better off without it! Prevention is better than cure and good farm hygiene should be adopted to prevent infection in the first place.

COME CLEAN, GO CLEAN!

The future with black root rot

Moderate infections with subsequent maturity delays may be tolerated in most years, especially in longer season areas. Yield losses associated with severe black root rot can make cotton growing unsustainable. An integrated approach, using a combination of the listed management options, along with good crop agronomy, will be the best way to live with black root rot in the future.

For further information please contact:

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OR

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