fact sheet

September 2021

Managing for
black root rot

The pathogen

Black root rot is caused by the pathogen *Berkeleyomyces rouxiae* (formerly *Thielaviopsis basicola*). *Berkeleyomyces rouxiae* is an early season pathogen that stalls crop growth and crop development and delays the onset of flowering. The fungus blackens the tap root and cortex (exterior) of the hypocotyl and reduces lateral root growth. As soil temperatures warm, normal root growth resumes and the fungus sloughs off the roots and adds to the spore load in the field for the next host crop. The pathogen can infect the centre of the tap root, causing a 'black heart'.

Black root rot (BRR) occurs in all cotton growing regions however the regions that experience cooler planting temperatures show higher incidence and severity of the disease. Cooler starting temperatures will slow cotton seedling development and it makes it difficult for seedlings to 'outrun' disease.

Black root rot and the interaction with the other seedling diseases can stall a crop's development. Black root rot steals crop development time in short-season environments. Black root rot pathogen spores will build up over time when a host is grown in the field. Cotton is the main host and we are now seeing patches of black root rot in new growing regions after five or six cotton crops — even with rotation with cereals. However, a sensible cotton–wheat–fallow rotation or other non-host crops will delay disease build-up and help reset any compaction in the field.

Growers and advisors in southern NSW have measured the impact of BRR and in worst-affected fields it is necessitating re-planting or abandoning the crop completely. Where the crop is grown through to picking, BRR frequently reduces yields by 2 to 4 bales/ha.

Typical black root rot symptoms.

Previous and ongoing research

Fungicides

Extensive trials over the last 20 years have looked at potential seed fungicide treatments and combinations to reduce the incidence and severity of BRR. Results have been variable with only a few candidates showing some degree of promise.

The search continues – ongoing field and laboratory trials of novel chemistries and biological products is being conducted each season by cotton pathologists. The current recommendation for fields with BRR incidence is to use the seed treatment fungicide Vibrance® Complete which contains Acibenzolar -S -methyl (Bion®).

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Biofumigant crops

Biofumigation involves planting a crop that releases compounds that are toxic to pests of pathogens in the soil. It involves growing and harvesting the biofumigant plant as either a rotation crop or as a sacrificial crop that is sprayed out and incorporated or freshly incorporated into the soil prior to planting cotton. The effectiveness of the green or brown manure biofumigant relies on the bulk of the crop being incorporated at least 4 -6 weeks before planting the cotton crop to allow breakdown of the material so there is no phytotoxic effect carry over to the following cotton crop.

Several crop types have been trialled over the years as biofumigant crops for reducing Black Root Rot. Three seasons of trials on different fields in Northern NSW resulted a 28% to 70% reduction in disease severity from Indian mustard (Kirkby 2016). Although biofumigation does not eradicate the disease from the soil it does reduce disease severity enough to warrant its use.

Summer flooding

Flooding is used for control of soil borne diseases of cotton in parts of California. Growers report that the severity of black root rot is reduced substantially in at least the next four cotton crops after flooding. Temperature is an important factor. Flooding is most effective during summer, requiring a minimum of 30 days with maximum air temperature at 30 degrees C or more. In Australia, the population density of the pathogen was decreased dramatically by flooding a field for approximately 57 days, during February and March 2000 (See Table 1), D. Nehl.

Sampling position	50m from head ditch	50m from tail ditch
Water depth (cm)	30	55
Soil temp Max degrees C	26.2	25.6
Soil temp Min degress C	23.8	24.1
Population before (spores/g soil)	359	485
Population after (spores/g soil)	8	19
Population reduction	98%	96%

Table 1. Decline in BRR spore population after summer flooding of a field at Merah North (David Nehl 2001).

The summer flooding tactic is limited by water availability and layout of the field. In high water availability years, growing rice in these fields is an alternative option for some southern irrigators.

The growth difference between healthy plants (right) vs plants infected with Black root rot (left). The plants on the left are also expressing symptoms of black root rot through the black tap root and lateral roots. (Photo: Stephen Allen)

fact sheet

Breeding

Dr Warwick Stiller from the CSIRO Cotton Breeding team is developing cotton that has resistance to black root rot. As part of a Cotton Breeding Australia (CBA) project, Warwick has been looking into ways to breed for resistance for the past 15 years. Resistance to this disease is not found in any cotton variety anywhere in the world so CSIRO has gone to related species to identify and transfer resistance. This research has now progressed to a proof of concept stage with a trial in 2020 showing the resistance does result in improved early season growth in the field (see image below). So far this is looking great so it will move to the next phase of research to develop agronomically acceptable varieties. If breeding progress continues it will be 6-8 years before an elite variety resistant to black root rot is potentially released to industry.

CSIRO BRR resistance breeding trial, December 2020. Photo: J. Millyard.

Currently growers and advisors will need to follow an integrated disease management approach to minimise black root rot impacts.

1. Ensure fields are level to manage poor drainage areas.
2.Good bed preparation to optimise stand establishment and seedling vigour.
3. Pre-irrigate if possible, in preference to water up.
4. Delay sowing until later in the planting window to avoid cool temperatures.
5. Practice good farm hygiene.
6. Rotate with non-host crops (cereals, canola) for up to three seasons if possible.
7. Biofumigation crops should be considered in problem fields.
8. Avoid rotation with legumes, including pigeon pea.
9. Control weeds in fallows.
10. In high water availability years, flooding of fallow fields for 30 days during summer will help reduce spore loads.

References

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Best Practice