



**Australian Government**

**Cotton Research and  
Development Corporation**

# FINAL REPORT

## ***Part 1 - Summary Details***

---

*Please use your TAB key to complete Parts 1 & 2.*

**CRDC Project Number: CSD1801**

---

**Project Title: Assessing green manure vetch to reduce the  
impact of Black root rot on cotton production**

---

**Project Commencement Date: 19/06/2017 Project Completion Date: 23/01/2018**

## ***Part 2 – Contact Details***

---

**Administrator: Kieran O’Keeffe and Amanda Thomas**

**Organisation: CottonInfo**

**Postal Address:**

**Ph: 0437 937073**

**Fax:**

**E-mail: [Warwick.waters@crdc.com.au](mailto:Warwick.waters@crdc.com.au)**

---

## ***Part 3 – Final Report***

---

### **Background**

Black Root rot (*Thielaviopsis basicola*) BRR is a major threat to cotton production in southern and central NSW. It has a wide host range of more than 230 species of plants (Pereg 2013). The fungus survives for long periods in the soil as resistant resting spores. Infection of cotton is favoured by soil temperatures below 20 °C, which is normal at planting time in these cooler regions. Research in the USA has shown that severe disease symptoms result when the population of the black root rot fungus reaches 100 spores/g. It delays crop development in a region which already has a constrained growing season.

Populations of 600–700 spores per gram of soil have been found in some Australian cotton fields. Black root rot fungus does not kill seedlings by itself, however severe infection will render cotton more susceptible to other seedling diseases such as *Pythium* and *Rhizoctonia*. Stand losses of 30% or more are common from combinations of these seedling diseases. Seedlings affected by black root rot are stunted and slow growing. In effect, the disease ‘steals’ time from the crop leading to delayed maturity and yield loss. As weather conditions and temperatures improve, infected cotton crops will recover but in poor establishment conditions, yield reductions of 25–50% have been attributed to severe black root rot. The use of Woolly pod vetch as a green manure crop has been shown in previous research to reduce the impact of BRR in fields. This project aims to investigate the use of a bio fumigant crop such as Woolly Pod Vetch based on previous research. The concept of biofumigation

involves planting a crop that releases compounds that are toxic to pests or 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 (brown manuring) or freshly incorporated (green manuring) into the soil prior to planting cotton. The effectiveness of biofumigation relies on the bulk of the crop being incorporated at least four weeks before planting cotton to allow breakdown of the material so there are no phytotoxic effects on the following cotton crop. A number of crop types have been trialed over the years as biofumigant crops including woolly pod vetch, mustard, canola and fodder radish. Three seasons of trials on different fields in northern NSW resulted in a 28–70% reduction in black root rot disease severity from Indian mustard and a 24–61% reduction from woolly pod vetch (Nehl 2004)

## **Objectives**

This project was developed when the Regional Extension Officers in the Macarurie and Southern regions were approached by growers who have identified that high incidence of BRR was limiting production and that they wanted to try management options based on past research. The REO's applied for an Extension Activity Grant to be able to quantify the numbers of BRR spores in the fields both before and after the use of Woolly Pod Vetch as a bio fumigant crop. We engaged the services of Microbiology Labs Australia based on information provided by CRDC around who can do the testing for BRR spores on a commercial basis.

### *Trial Plan*

A Lachlan valley field with known levels of high BRR incidence was sampled in June 2017 and then was sampled after planting in December 2017 (after incorporation of a vetch crop) to determine the effectiveness in reducing BRR spore levels. This was also replicated in the Macquarie Valley on three fields with Woolly Pod Vetch.

The project will look at spore levels of BRR when the vetch is established, then again when the plants are incorporated. The extension project will quantify levels of BRR spores before and after the incorporation of the vetch crop. It will also provide a comprehensive examination of soil health to include arbuscular micorrhiza levels and other nutrient levels to rule out other factors that could have contributed to the yield decline the fields have experienced over the past 3 seasons. Previous yields were very different in the head ditch and tail drains of these fields, so the grower asked that we do some separate testing in the head and the tail of each of the fields to determine the spore levels.

## **Outputs for Extension Activity**

An indication of the effect of green manure vetch on BRR spore levels in the soil.

## **Outcomes**

### *Hillston Outcome*

A pivot in the Hillston district was chosen to assess before and after vetch was grown in the field. A protocol for soil sampling was developed (see attached) and soil samples were taken from GPS referenced parts of the field. This field was also included in the early season disease survey and it had 90 % of plants showing Black root rot symptoms in the 2015/16 season. The first testing was completed on the 28<sup>th</sup> of June 2017 and came back at 65 spores/g of soil which was in the moderate category of disease pressure incidence (see appendix for results). The vetch crop was vigorous and had good ground cover (see Photo 1). However the grower did get nervous about the condition of the seed bed prior to planting the cotton and as a result did not want to incorporate the vetch into the field so the vetch was

sprayed out and dragged onto the edge of the field, thus not effectively fumigating the fungus in the soil (see Photo 1).



Photo 1: Vetch crop growing on left and the crop sprayed out and raked on right

The variety 714 BRF was planted on the 11<sup>th</sup> October at 15 seeds/m. The subsequent cotton crop had a high incidence of BRR evident on the roots and stunted patches of plants. The percentage of plants with BRR was from 80 to 100 percent of plants inspected. Plants established per metre varied from 6 to 15 with average establishment at 11.4 plants/metre.

The next set of soil testing was done post cotton planting on the 1<sup>st</sup> of December 2017 the BRR spore load had increased from 65 spores/g to 460 spores/g. This was considered a very high reading and report stated that “the BRR colonies in the soil varied from 320 colonies to 700, indicating patchiness of the inoculum” It also states that “the potential for disease in this soil is likely to be very high”.



Photo 2. Seedlings from Pivot 11.



Photo 3. Left: Stunted growth 1st December. Right: NDVI on 16th Jan 2108

The crop showed variable growth through the season due to poor establishment and incidence of disease. This can be seen in Photo 3 on the right-hand side. Note there is an obvious quadrant of the pivot where Pidgeon peas were grown. The grower has indicated that the pivot yielded 2 to 2.5 bales/ha lower than other pivots with low BRR levels. The grower still sees benefit in including vetch in the rotation but will not incorporate the vetch

### ***Macquaire Outcome***

Three fields on “Muntham” Quigley farms near Trangie were taken out a production due to yield loss apparent in the previous cotton crop. It was thought that black root rot played a large role in the poor plant stands and yield. The field history was long fallow then wheat then cotton based on research conducted in the Macquarie Valley by Dr David Nehl [final report on BRR](#). The three fields were planted with vetch with the intention of ploughing the crop into the field to bio fumigate the fields. On the 23<sup>rd</sup> of August the samples were collected from both the head and tail drain along four locations across the fields and put into a combined sample so that each field had a head and tail sample sent to the labs.

The results of the pre-season were surprising in that all of the fields showed a low rate of BRR spores that was not homogenous in any of the samples, indicating patchiness of the inoculum. There were other pathogens such as fusarium spp, Stchacybotrys chartarum and Nectria sp. However, the fields were not likely to have a high potential for disease according to the lab results.

The soil indicators were fair and the total mass of the microbes in the soil was also in the fair category. There was some indication of the soil being recently waterlogged or compacted. The tests showed that the soil was low in Actinomycetes (these are important for protection against pathogens).

The balance of bacteria and fungi was in favour of fungi in all three fields. This is a result of the high levels of cotton residue that is mostly broken down by Fungi.

Field 7 had very good levels of arbuscular mycorrhiza however as with the other fields the levels of Gram-negative bacteria were low, the results suggest this could be affecting the nutrient cycling especially the N and this could impact the overall yield potential of the fields.

The recommendation for all three fields was to build the bacteria biomass (especially gram negative) and Actinomycetes.

Unfortunately, the lack of winter rainfall in the region had a large impact on the vetch crop and limited the biomass produced, however it was still incorporated into the seed beds. The soil was tested again in the same positions in the head and the tail drains and the results

showed that some spores levels had reduced however field 8 in the tail and Field 7 in the head had both increased in spore numbers. The level of spores from these two locations would still be considered as low risk for disease.

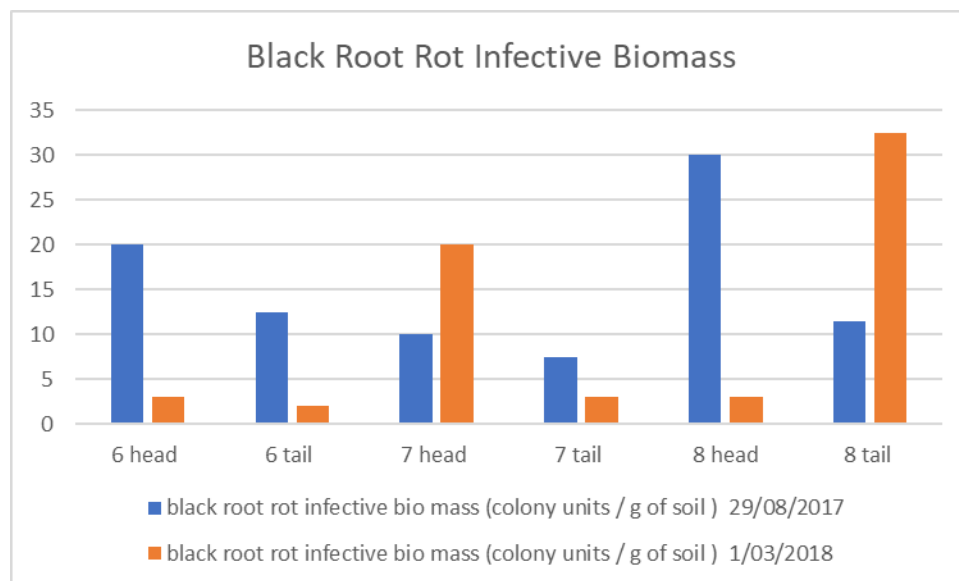


Fig 1. Spore levels before and after the vetch crop in the head and tail drains of the three fields

This farm was also added to the disease surveys in early season and soil samples were taken from the farm (these were not the fields sampled for the trial as they were fallow this season). It was found to have a high incidence of BRR (90%) in the early season samples in the fields that were sampled. In the 2017/ 2018 early season surveys across the Macquaire BRR was detected on every field with an average incidence of **54.8%** (range 11.5-95.5%). Macquaire often has seedling mortality around 38% in some years and many growers are concerned about early season vigour and getting the plants out of the ground.

## Conclusion

The effectiveness of using vetch to reduce Black root rot spore loads in cotton fields has not been proven by this preliminary extension project. The investigation at Hillston was compromised by the vetch not being incorporated into the soil.

The fields in the Macquaire did not receive enough rainfall to establish the biomass required and this may have impacted on the overall results. We also did not detect levels of spores that were in the high category in any of the samples.

This work has raised several questions from growers that warrant further investigation.

- Can the BRR test be validated so growers have confidence in what is an acceptable level of BRR spore load?
- Can biofumigant crops be practically managed as part of the solution in shorter season areas?
- Does delayed sowing time till late October/early November overcome most of the risks of BRR in the Lachlan and Macquarie valleys?
- Is there a correlation between spore load and disease incidence?

- Are there any potential fungicides that can be trialled in fields?

The disease problems in these valleys remains as the major threat to long term profitability and sustainable cotton production. A discussion group of concerned growers is being planned for the 2018/19 season. The discussion group will improve communication between industry, growers and consultants on how they are planning to manage problem BRR fields for the 2018/19 season.

#### References

- David B. Nehl, Om P. Jhorar and Anowar H. Modal, 2004, Managing Black Root Rot of Cotton, CRDC Project No Dan153C
- Lily L. Pereg, 2013, Black root rot of cotton in Australia: the host, the pathogen and disease management, CSIRO Publishing