

microbiology  
laboratories  
australia

agriculture • forestry • environmental



# A predictive diagnostic test for Black Root Rot in cotton soils

Dr Maria Manjarrez

Microbiology Laboratories Australia

Kieran O'Keeffe

CottonInfo Southern NSW

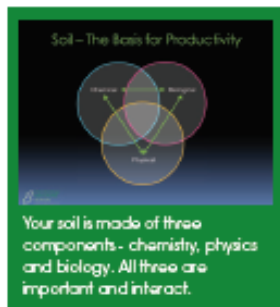
# Microbe Labs Australia: Who we are?

# Affordable, easy-to-understand tests that put you in control

BETTER SOILS GUIDE

BETTER SOILS GUIDE

Microbe Labs' soil microbiology tests can help you find the missing piece in the picture of your soil's productivity, here's how:



Ordinary soil nutrient tests only give you part of the picture - a snapshot of the chemistry in your soil at one moment in time. They don't take into account the effects of microbiology, which has a large effect on nutrient availability and uptake, disease suppression, drought resistance, residue breakdown, carbon accumulation, and the ability to keep your soil productive despite changing environmental conditions.

Microbe Labs' tests give you all this information and show the relationships between soil microbiology, nutrients and structure. This means you can make better, more informed management decisions to improve soil and crop productivity.

Here's some of our best value tests - bundle and save (see back page)

## Microbe Wise

Microbe Wise measures the biomasses of 12 key groups of microbes important to soil processes. Microbe Wise uses molecular markers unique to each group of microbes to accurately measure what and how many microbes are in your actual soil samples. The measurements are taken directly from the samples you send in. The measurements are used to estimate several soil indicators that show how your soil rates on important soil processes related to soil and crop productivity.



## Microbe Activity Wise / Plus

Microbe Activity Wise reports the activity of the microbes in your samples by measuring their CO<sub>2</sub> respiration (breathing) rate. This measurement is also used to calculate soil based respiration (SBR) and soil microbial biomass carbon (SMBC).

The Microbe Activity Wise Plus version involves estimates of how much nitrogen (N) and phosphorus (P) are released from dry soil on rewetting, which can be a substantial source of xxxxxxxx nutrition for non-irrigated crops.



## N Wise & P Wise

N Wise and P Wise are unique, advanced soil tests that are 'hybrids' between nutrient and microbiology tests. They measure the effects of microbiology on soil nitrogen (N) and phosphorus (P). Unlike ordinary nutrient tests that only give you a snapshot in time, N Wise and P Wise measure the amount of N and P produced over time by microbial processes, as if under a crop. By measuring all the pools of N and P in the soil, N Wise and P Wise give you the whole picture, to enable you to benchmark your soil and optimise fertilisation.



## VAM Wise & Glomalin Wise

Mycorrhizal fungi (VAM) live in a symbiotic relationship with most plant types, including the majority of agricultural and horticultural crops. They increase plant nutrient uptake, particularly phosphorus, and also nitrogen, potassium, magnesium, zinc and other nutrients. They can also improve plant drought tolerance and disease resistance, and produce a carbon-rich exudate called glomalin which binds soil particles to form aggregates. Soil glomalin is highly correlated with soil structure. VAM are the single most important indicator of soil health.



## Residue Wise & Humus Wise

Residue Wise is a unique, advanced analysis that helps manage crop residues better. It measures the rate of plant residue breakdown in your samples to calculate the number of days until 75% of the residue is broken down and how much of that residue will remain as resistant carbon, such as humus.

Humus Wise measures the amount of humic substances (humic and vulvic acids) in your samples. Humic substances are forms of recalcitrant carbon that have a positive effect on soil nutrient availability.



## Crop Saver

This test helps you to improve your bottom line by getting on top of soil-borne disease when it counts, while eliminating unnecessary management actions. It predicts the baseline severity of disease in your crop before you even plant, giving you a valuable time advantage. Unlike other disease tests, Crop Saver measures the amount of disease a plant actually gets, directly from your soil. Available for Phytophthora, Phythium and Rhizoctaria.



Why wait? Bundle and save!

MINIMISE UNCERTAINTY, MAXIMISE RETURNS

[www.microbelabs.com.au](http://www.microbelabs.com.au)

[www.microbelabs.com.au](http://www.microbelabs.com.au)



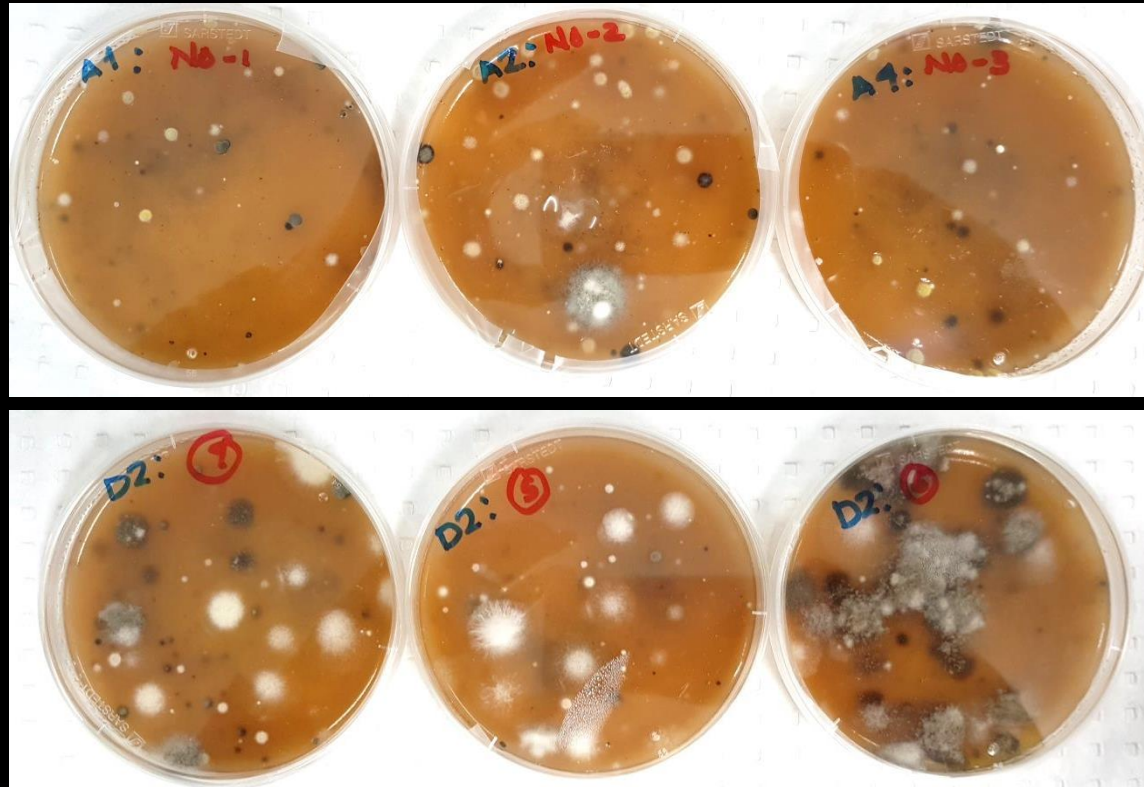
Can we develop a test that can correlate Black Root Rot levels in the soil with the plant symptoms?

- ✓ Cost
- ✓ Practical – pre-plant
- ✓ Useful results for farmers

# Predictive Test for BRR in soils

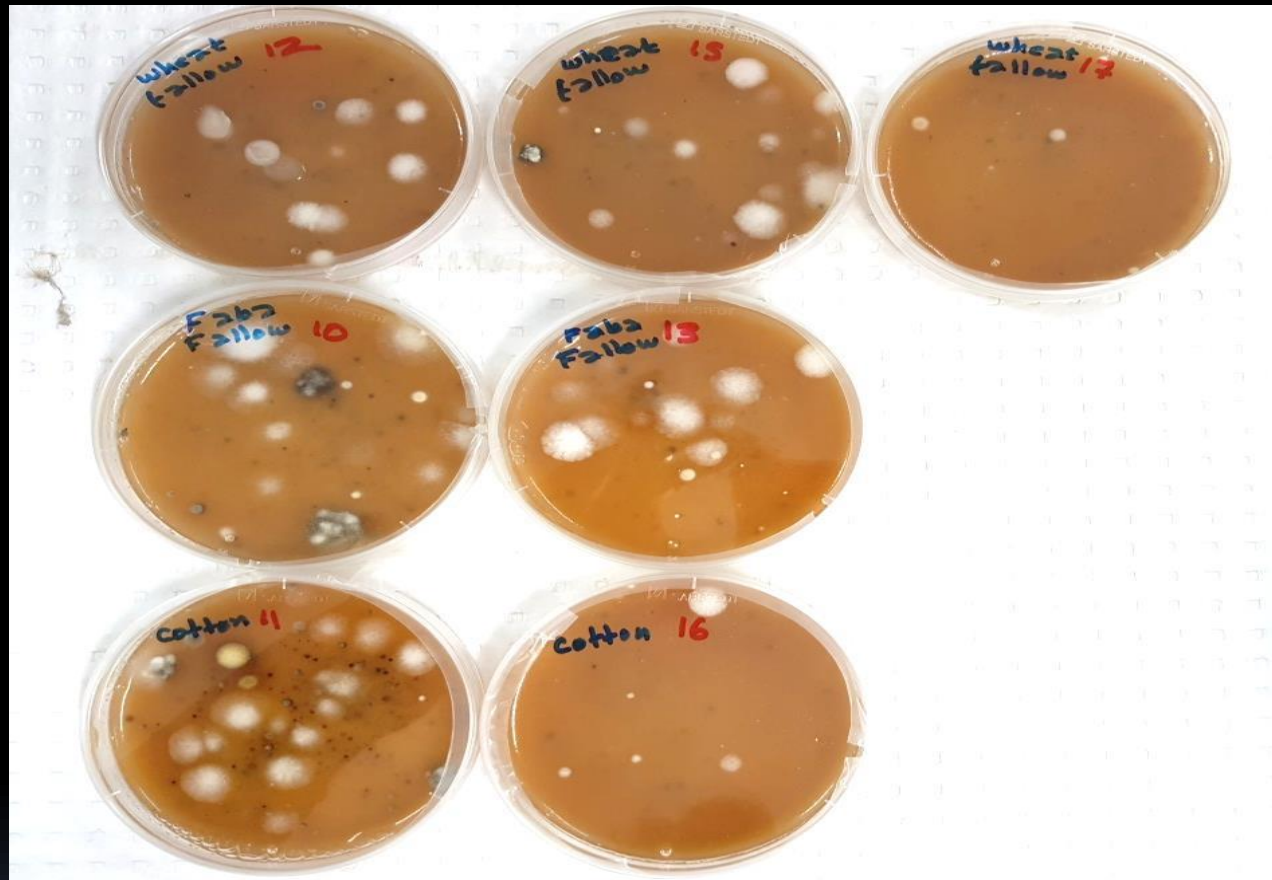
GUNDALINE Black Root Rot Sampling						
Field	Date Sampled	Date Sampled	2014 Crop	2015 Crop	2016 Crop	Visual Severity of BRR
A1		20/05/2016	Cotton	Faba Beans	Fallow to Cotton	Low/Med
B1		20/05/2016	Cotton	Faba Beans	Fallow to Cotton	Med
B2		20/05/2016	Cotton	Faba Beans	Fallow to Cotton	Low/Med
B4	30/11/2015	20/05/2016	Wheat	Cotton Removed - Biofumigant Sorghum	Wheat	Very High
B7		20/05/2016	Cotton	Wheat	Wheat	Low/Med
C1		20/05/2016	Cotton	Faba Beans	Fallow to Cotton	Med
C2		20/05/2016	Cotton	Faba Beans	Fallow to Cotton	Med
C3		20/05/2016	Wheat	Cotton	Wheat	High
C4	30/11/2015	20/05/2016		Cotton Removed - Flooded for 36 days	Wheat	Very High
D2		20/05/2016	Wheat	Cotton	Cotton	Very High
D4		20/05/2016	Cotton	Wheat	Wheat	Med
Po6 - Nil BRR		20/05/2016	Pasture	Pasture	Pasture	Nil

# Predictive Test for BRR in soils



	Thielaviopsis basicola	Other Fungi	
Nil BRR-1	4	78	<i>Clonostachys roseae</i>
Nil BRR-2	1.3	213	<i>Trichoderma</i> spp.
Nil BRR-3	0	9	
High BRR-1	23	82	
High BRR-2	12	48	<i>Alternaria alternata</i>
High BRR-3	220	16	<i>Cylindrocarpon destructans</i>

# Predictive Test for BRR in soils



	Thielaviopsis basicola	Other Fungi	
Wheat Fallow	15	50	
Faba-fallow	10	42	<i>Alternaria alternata</i>
Cotton-cotton-	45	55	<i>Cylindrocarpon destructans</i>

# Predictive Test for BRR in soils



## Microbiology Test

Name: **Kieran O'keefe**

Sample: **Wilga 3, 34,35, 35 146.12.OE**

Analysis no.: **1302-1**

Date: **10/11/2016**

Customer name

Kieran O'keefe

Date received

10/11/2016

Client name

Before Rice-BRR level

Agent

Microbiology Laboratories

Sample name

Wilga 3, 34,35, 35 146.12.OE

Advisor

Crop

Rice (before cotton)

Authorised by

Dr Maria Manjarez

Date sampled

11/10/2016

Analysis no.

1302-1

### Black Root Rot-Cotton

#### Disease Pressure Indicator



#### Data

		Yours	Guide			Yours	Guide
Black Root Rot	Colony Units	180.0	100.0	Disease Pressure Indicator	18	10.0	
infective biomass	Per g/soil						
				Low	Moderate	High	

\* Assumes a sampling depth of 20 cm and a bulk density (BD) of 1.3 g/mL. For other depths and densities use  $\text{mg/kg} \times (\text{depth (cm)}/10) \times \text{BD (g/mL)}$ .

#### Comments

The levels of infective Black root rot complex were almost twice the guide level in this sample. The potential for disease in this soil is likely to be very high. Use the appropriate agronomy note to help minimise and manage crop risk throughout the growth season.

#### Explanations

This test helps you to improve your bottom line by getting on top of disease when it counts while eliminating unnecessary management actions. It predicts the baseline severity of disease in your crop before you even plant, giving you a valuable time advantage. It then helps you predict the likelihood and severity of outbreaks during the season due to weather events.

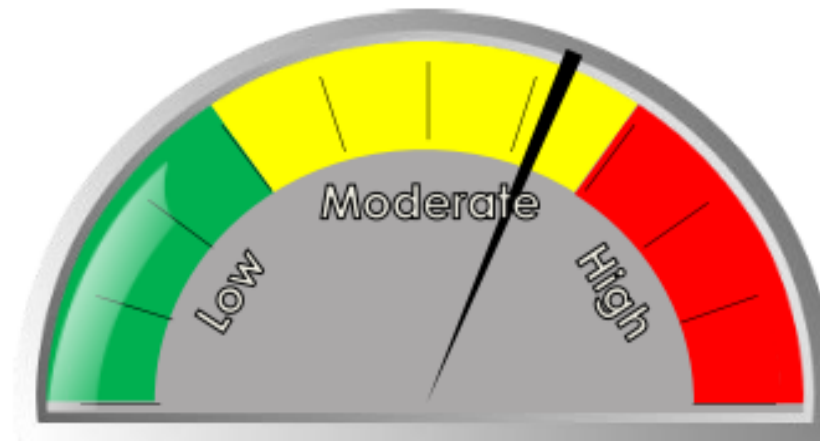
# Black root rot problem field

- Paddock has long history of back to back cotton.
- 2008-9 Cotton
- 09/10 Barley/fallow
- 10/11 Cotton
- 11/12 Cotton
- 12/13 Cotton
- 13/14 Fabas
- 14/15 Cotton
- 15/16 Cotton

# Black root rot levels after rice

## Black Root Rot-Cotton

### Disease Pressure Indicator



### Data

		Yours	Guide
Black Root Rot Infective biomass	Colony Units	65.0	100.0
	Per g/soil		

		Yours	Guide
Disease Pressure Indicator		6.3	10.0
Risk key		Low	Moderate
			High

\* Assumes a sampling depth of 20 cm and a bulk density (BD) of 1.1 g/mL. For other depths and densities use  $\text{mg/kg} \times (\text{depth (cm)}/10) \times \text{BD (g/mL)}$ .

#### Comments

The levels of infective Black root rot complex were moderate this sample. Black root rot colonies were slower to develop than in previous samples. The potential for disease in this soil is unlikely to be very high. Use the appropriate agronomy note to help minimise and manage crop risk throughout the growth season.

# Seedlings grown by Andrew Watson NSW DPI Yanco

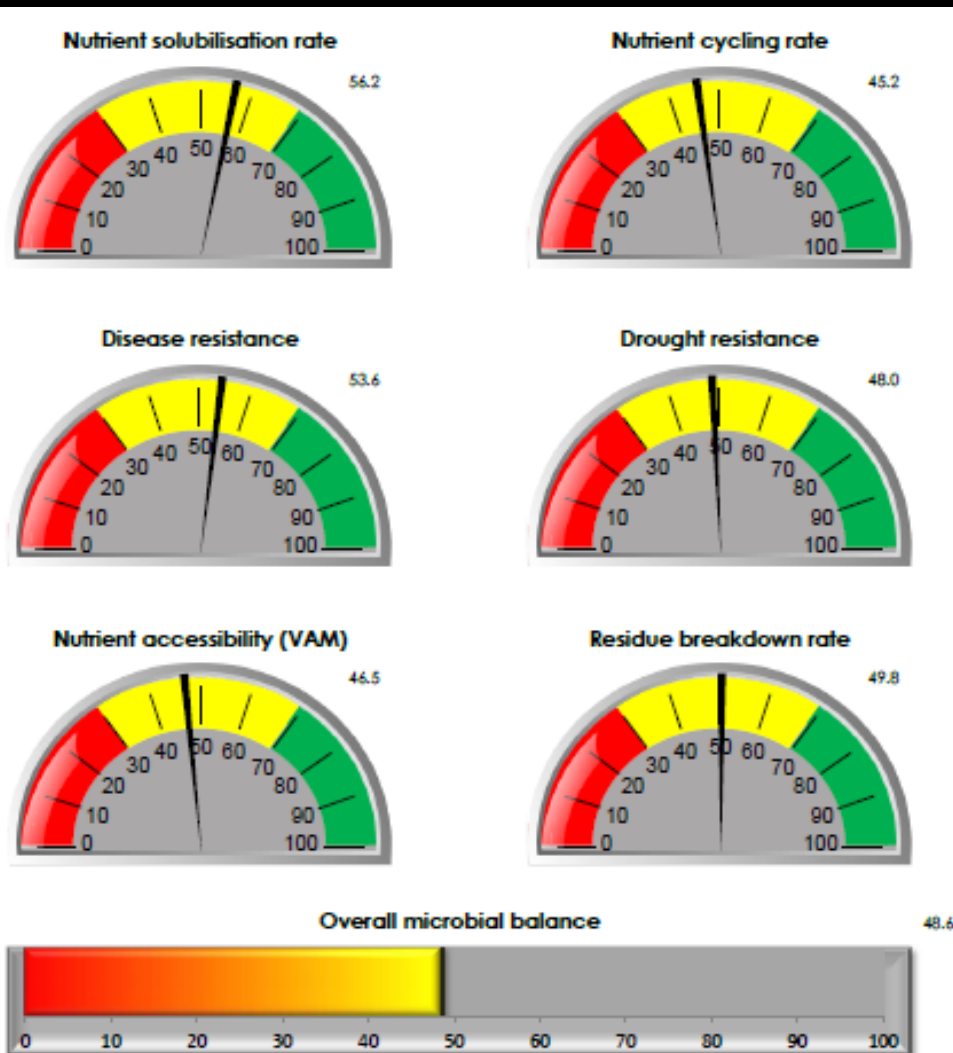


cotton - cotton



cotton - rice - cotton

# Microbial communities in soils with BRR – before rice (flooding)



For more information about these indicators visit us at [www.microbelabs.com.au](http://www.microbelabs.com.au)

Key Microbe Groups

Group	Biomass (mg/kg)	
	Yours	Guide
Total microorganisms	22.8	50.0
Total bacteria	4.8	15.0
Total fungi	17.3	33.8
<b>Bacteria</b>		
Pseudomonas	0.659	1.000
Actinomycetes	0.485	1.000
Gram positive	1.983	4.000
Gram negative	2.781	11.000
Methane oxidisers	0.000	0.500
Sulphur reducers	0.000	< 0.005
True anaerobes	0.097	< 0.005
<b>Eukaryotes</b>		
Protozoa	0.724	1.300
Mycorrhizal fungi (including VAM)	4.649	10.000

Useful Indicators	Yours		Guide
	Yours	Guide	
Microbial diversity	50.2	80.0	
Fungi : Bacteria	3.6	2.3	
Bacterial stress	0.4	< 0.5	

Nutrients held in microbes	Concentration (mg/kg)	
	Yours	Guide
Nitrogen (N)	1.460	3.450
Phosphorus (P)	0.684	1.500
Potassium (K)	0.228	0.500
Sulphur (S)	0.228	0.500
Calcium (Ca)	0.228	0.250
Magnesium (Mg)	0.228	0.250
Carbon (C)	10.528	22.688

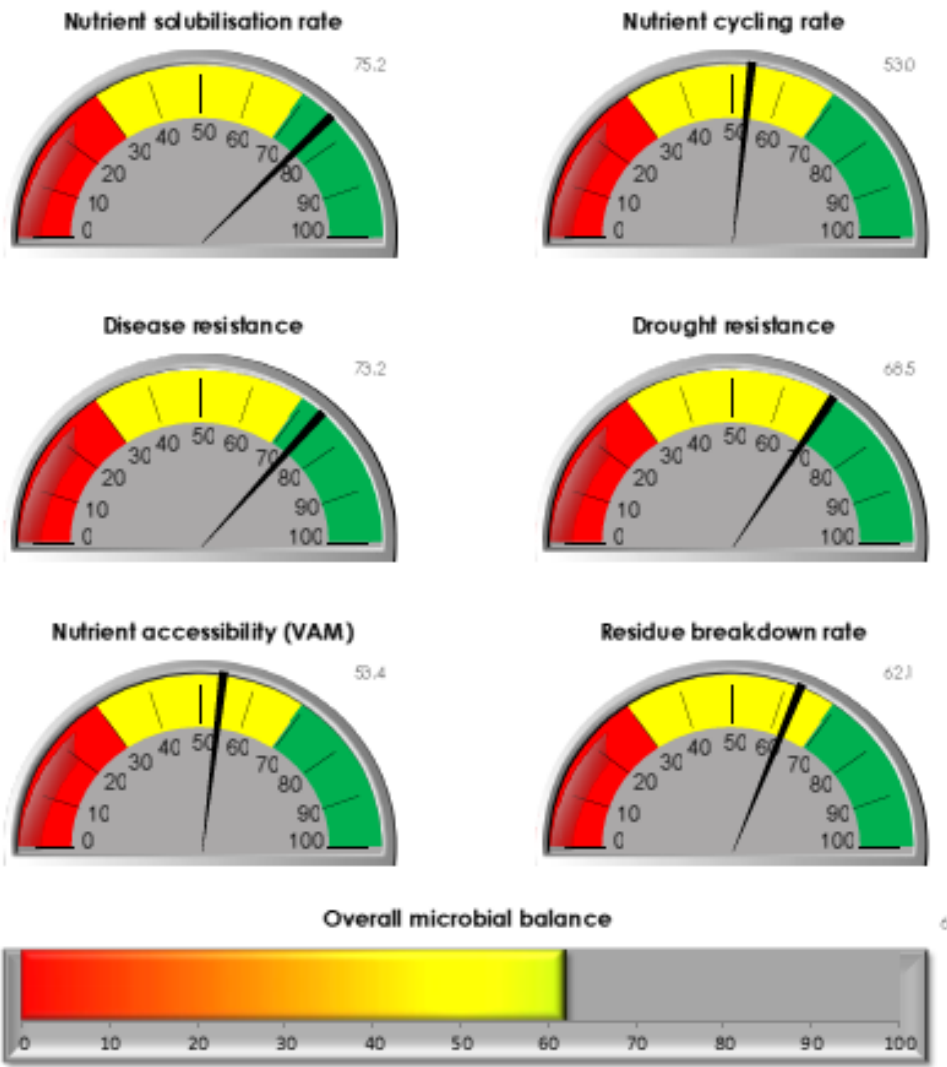
Key \*BDL = Below Detectable Limit (0.001 mg/kg)



- ✓ Total Bacteria were poor
- ✓ Actinomycetes, AM: fair to poor
- ✓ Fungi: bacteria ratio

# Microbial communities in soils with BRR – after rice (flooding)

## Soil Indicators



For more information about these indicators visit us at [www.microbelabs.com.au](http://www.microbelabs.com.au)

Name: *Celia Research and Development Corporation* Sample: 19 May 2017

Analysis no: 14451-8802 Date: 5/5/2017

## Key Microbe Groups

Group	Biomass (mg/kg)	
	Yours	Guide
Total microorganisms	27.2	50.0
Total bacteria	7.9	15.0
Total fungi	18.6	33.8
<b>Bacteria</b>		
Pseudomonas	0.970	1.000
Actinomycetes	0.691	1.000
Gram positive	3.347	4.000
Gram negative	4.581	11.000
Methane oxidisers	0.000	0.500
Sulphur reducers	0.000	<0.005
True anaerobes	0.174	<0.005
<b>Eukaryotes</b>		
Protozoa	0.598	1.300
Mycorrhizal fungi (including VAM)	5.341	10.000

Useful indicators	Yours	Guide
Microbial diversity	46.1	80.0
Fungi : Bacteria	2.4	2.3
Bacterial stress	0.4	<0.5

Nutrients held in microbes	Concentration (mg/kg)	
	Yours	Guide
Nitrogen (N)	1.939	3.450
Phosphorus (P)	0.815	1.500
Potassium (K)	0.272	0.500
Sulphur (S)	0.272	0.500
Calcium (Ca)	0.272	0.250
Magnesium (Mg)	0.272	0.250
Carbon (C)	12.654	22.688

Key \*BDL = Below Detectable Limit (0.001 mg/kg)



Comments

- ✓ Total Bacteria were fair
- ✓ Actinomycetes were fair to good
- ✓ AM: fair
- ✓ Fungi: bacteria ratio

# BRR test validation

- Can we validate these BRR tests as a predictive tool?
- Levels of BRR in soil need to be calibrated/assessed to be able to set a reliable threshold
- Is BRR only occurring on grey soils?
- CottonInfo looking at BRR spore loads in soil samples before and after growing vetch in some BRR problem fields in Warren and Hillston.\*

# BRR investigation 2017 season

- Best advice – Don't get to this point
- Rice could be an option for some fields in Southern NSW to reduce BRR incidence. Layout and soil type needs to be suitable
- A rice crop will use 14 to 16 ML/ha depending on the amount of deep percolation so the availability and cost of water needs to be factored in.
- Don't grow multiple back to back cotton and host crops. Use rotation
- If rice comes into the rotation grow a wheat crop (not fully irrigated) and summer fallow before return cotton

# Got Questions?