Long Term Disease Suppression Trial at Streaky Bay

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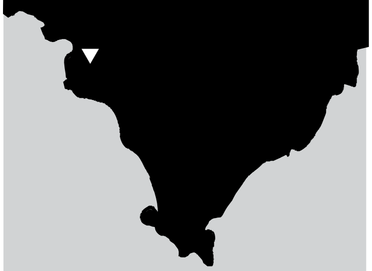
RESEARCH

Searching for answers



Location: Streaky Bay
K, D and K Williams
Streaky Bay Ag Bureau

Rainfall
Av. Annual: 298 mm
Av. GSR: 243 mm
2009 Total: 356 mm
2009 GSR: 323 mm

Yield
Potential wheat: 4.4 t/ha
Actual: 2.7 - 4.9 t/ha

Paddock History
See Table 1

Soil
Highly calcareous grey loamy sand

Plot size
60 m x 1.48 m

Other factors
Disease
Rhizoctonia
Livestock
Trial has not been grazed since established in 2004
Economic
Cost of adoption risk: No income from livestock enterprise

Key messages

- **The higher input brassica break system had higher cereal yields than the other systems in 2009.**
- **Rhizoctonia inoculum levels were higher under the continuous cropping systems compared to the medic pasture and brassica break crops.**
- **The different rotations and fertiliser systems have resulted in differences in the microbial community (number) and microbial diversity (their ability to use different sources of carbon).**
- **Disease suppression is still the same in all rotations.**

Why do the trial?

This long term trial was established at Streaky Bay in 2004 to determine if disease suppression against rhizoctonia is achievable in a grey highly calcareous soil using alternative rotational systems and crop inputs in an upper EP environment and if soil microbial populations can be influenced by rotation and fertiliser inputs.

How was it done?

This trial was established in 2004 with the fertiliser treatments and rotations listed in Table 1. In the 2009 season all treatments were sown with Wyalkatchem wheat at 60 kg/ha on 22 May with different fertiliser treatments. The trial received 1.5 L/ha each of Roundup and Sprayseed pre-seeding, and 400 g/ha Achieve (for ryegrass and barley grass control) and 250 ml Lontrel during the season.

Soil was collected in March for RDT (Root Disease Testing) and soil mineral N levels. Soil samples were also collected for the disease suppression bioassay and a sample also sent to CSIRO to measure the functional diversity of the microbial community using carbon substrate utilisation. A soil sample containing soil microbes is added to an assay with 31 different types of carbon. The amount of CO_2 released and the type of carbon used is measured as the microbes break down the carbon substrates. The catabolic potential or the amount of carbon the microbes can use, and the catabolic diversity or the ability of the microbes to use different types of carbon substrates, is measured.

Plants were collected at 6 weeks to score plant roots for Rhizoctonia and early dry matter. Late dry matter cuts were taken before harvest, and grain yield and quality were assessed.

What happened?

District Practice treatments in 2008 had very poor medic growth, almost a fallow, due to poor establishment and strong winds, and possibly due to Midas residues still being present from 2007. This may have resulted in increased soil moisture under these treatments.

The risk in all treatments was low for all diseases except Rhizoctonia. At the start of 2009 district practice and brassica breaks had low to medium risk of Rhizoctonia. Both continuous cereal treatments had a high risk of disease. Rhizoctonia disease on plant roots was substantial but similar for all treatments on seminal roots. Infection on crown roots was much lower than on seminals but highest in high input continuous cereal (Table 2).

Early plant growth was greater in the high input brassica break system resulting in the highest yield. There was no difference in yield this season between the district practice, which was almost a fallow with a little medic, and the district practice brassica break.

Table 1 Rotations and treatments used in the Long Term Disease Suppression trial

Rotation	Fertiliser each season	2004	2005	2006	2007	2008	2009
District Practice	14kg P/ha and 16 kg N/ha applied as DAP @ 60 kg/ha	Excalibur Wheat @ 55 kg/ha	Keel Barley @ 60 kg/ ha	Angel Medic @ 5 kg/ha	Clearfield Stiletto Wheat @ 60 kg/ha	Herald Medic @ 5 kg/ha	Wyalkatchem Wheat @ 60 kg/ha
Intensive Cereal - District Practice Inputs	14kg P/ha and 16 kg N/ha applied as DAP @ 60 kg/ha	Excalibur Wheat @ 55 kg/ha	Keel Barley @ 60 kg/ha	Angel Medic @ 5 kg/ha	Clearfield Stiletto Wheat @ 60 kg/ha	Herald Medic @ 60 kg/ha	Wyalkatchem Wheat @ 60 kg/ha
Intensive Cereal - High Inputs as fluids	20 kg P/ha applied as APP, 18 kg N/ha as UAN and TE (Zn, Mn, Cu)	Excalibur Wheat @ 55 kg/ha	Keel Barley @ 60 kg/ha	Ticket Triticale @ 60 kg/ha	Clearfield Stiletto Wheat @ 60 kg/ha	Clearfield Janz Wheat @ 60 kg/ha	Wyalkatchem Wheat @ 60 kg/ha
Brassica Break - District Practice inputs	16 kg P/ha applied as MAP @ 60 kg/ha	Rivette Canola @ 5 kg/ha	Keel Barley @ 60 kg/ha	Stubby Canola @ 5 kg/ha	Clearfield Stiletto Wheat @ 60 kg/ha	44C73 Canola @ 5 kg/ha	Wyalkatchen Wheat @ 60 kg/ha
Brassica Break - High Inputs as fluids	20 kg P/ha ap- plied as APP, 18 kg N/ha as UAN and TE (Zn, Mn, Cu)	Rivette Canola @ 5 kg/ha	Keel Barley @ 60 kg/ha	Stubby Canola @ 5 kg/ha	Clearfield Stiletto Wheat @ 60 kg/ha	44C73 Canola @ 5 kg/ha	Wyalkatchem Wheat @ 60 kg/ha

This result is similar to trials at Miltaburra where growing a brassica and fallow treatment resulted in similar yields of barley the following season despite increased soil moisture under the fallow plots (EPFS 2008 Summary, p 122).

The high input system uses APP as the base of the fluid fertiliser which has increased the cost of this system significantly. The continuous cereal district practice system had the lowest yield. Grain protein was higher at this site than in other areas, but the high levels of screenings indicate the hot week in November may have impacted on grain filling.

Microbial communities depend on carbon input from roots and stubble, and the breakdown of these influence plant available nutrients. The soils from the treatments were tested for microbial catabolic potential and diversity. Figure 1 shows the catabolic potential of the different treatments and both the higher input fluid fertiliser systems show greater catabolic potential meaning the microbes under these systems can use more carbon or have greater microbial activity.

Figure 2 shows the catabolic diversity of the treatments or the ability of the microbes to utilise a variety of carbon substrates. The treatments which are closer together show greater similarity in microbial communities, compared to treatments which are further away indicating greater diversity. The microbial community diversity under high input treatments is different from the district practice treatments and brassica high input system has a different grouping of microbes again.

Soils from the rotation and fertiliser treatments were assessed for potential disease suppression in 2006 and 2009 using the pot bioassay. Disease suppression in the pot bioassay is still the same in all rotations.

Table 2 Soil, disease and quality data collected from the Long Term Disease Suppression trial, 2009

Rotation	Rhizo RDT level pg DNA/g soil	Rhizo Infection of Seminal roots	Rhizo Infection of Crown roots	Soil N kg N/ha (0-120 cm)	Early DM (g/plant)	Late DM (t/ha)	Harvest Index	Protein	Screen-ings (%)	Test wgt (g/hL)
District Practice	36 (Low risk)	1.78	0.49	65.6	0.26	8.9	0.49	10.5	8.6	84.7
Intensive Cereal District Practice Inputs	319 (High risk)	1.31	0.47	51.3	0.19	7.5	0.43	11.3	12.7	82.9
Intensive Cereal High Inputs	418 (High risk)	2.02	0.56	49.4	0.29	10.0	0.52	11.1	11.3	84.1
Brassica Break District Practice Inputs	12.5 (Low risk)	1.35	0.44	70.2	0.25	9.8	0.51	11.0	6.9	83.8
Brassica Break High Inputs	65 (Medium risk)	1.31	0.47	67.6	0.38	9.9	0.55	11.0	7.1	84.5
LSD (P=0.05)		*ns*	*0.06*	*ns*	*0.09*	*ns*	*ns*	*0.3*	*4.6*	*ns*

Table 3 Historic yields for the trial and yield, input costs and fertiliser margins of rotations in 2009

Rotation	2005 Yield (t/ha)	2006 Yield (t/ha)	2007 Yield (t/ha)	2008 Yield (t/ha)	2009 Yield (t/ha)	2009 Input Costs ($/ha)	2009 GM ($/ha)	Overall GM ($/ha)
District Practice	0.88 All Keel Barley	*not harvested* Angel Medic	0.65 All Cleafield Stilleto Wheat	*Not Harvested* Herald Medic	3.95 All Wyalkatchem Wheat	142	739	597
Intensive Cereal District Practice Inputs	0.81	0.23 Ticket Triticale	0.77	1.39 Clearfield Janz	2.74	142	512	370
Intensive Cereal High Inputs	1.16	0.42 Ticket Triticale	0.73	1.61 Clearfield Janz	4.06	410	410	349
Brassica Break District Practice Inputs	2.08	0.03 ART - Stubby Canola	0.77	0.43 44C73 Canola	3.88	142	726	584
Brassica Break High Inputs	2.43	0.05 ART - Stubby Canola	0.64	0.57 44C73 Canola	4.93	410	922	512
LSD(P=0.05)	*0.16*	*0.03*	*ns*	*0.11*	*0.30*			

GM calculated using prices - Wheat $140/t and Canola $302/t for 2004, Barley $126/t for Feed 1 in 2005, Triticale $220/t and Canola $480/t for 2006, AH $377/t for 2007, Wheat $276/t and Canola $520 for 2008 delivered to Port Lincoln (less $30/t freight), 2009 Wheat $217/t delivered to Port Lincoln (less $22/t freight). Cost taken from Rural Solutions 2009 Farm Gross Margin guide. No income estimated for the pasture phases.

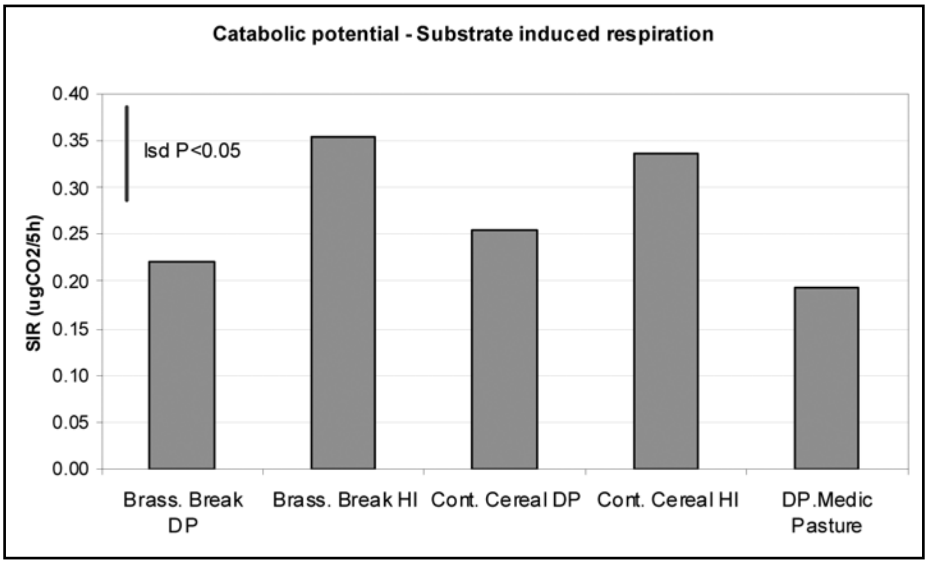


Figure 1 Catabolic potential of the rotation and fertiliser treatments of the Long Term Disease Suppression trial at Streaky Bay, 2009

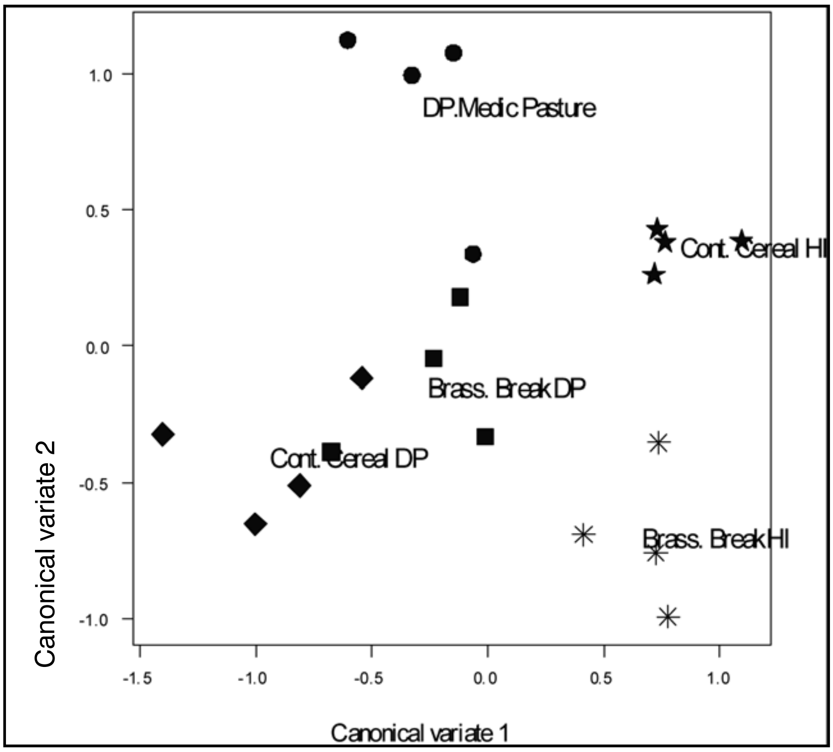


Figure 2 Catabolic diversity of the rotation and fertiliser treatments of the Long Term Disease Suppression trial at Streaky Bay, 2009

What does this mean?

The higher input brassica break system yielded higher than the other rotations this season, and the Rhizoctonia inoculum levels were lower under the brassica break and medic/fallow phase compared to the continuous cropped systems. These results are similar to the Miltaburra brassica trials which showed we can decrease Rhizoctonia inoculum levels for one season using a grass free canola crop or a chemical fallow.

The different rotations and fertiliser systems have resulted in differences in microbial community (number) and microbial diversity (ability to use different sources of carbon) but the level of disease suppression measured using the pot bioassay has not increased.

The high input system uses APP as the base of the fluid fertiliser which has significantly increased the cost of this system. A similar result may be achieved using phosphoric acid at a much lower cost, or increasing the rate of fertiliser we are using in our current farming systems. The continuous cereal district practice system has the lowest yield indicating that our fertiliser management was inadequate to exploit a very good season at this site.

Acknowledgements

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Disease