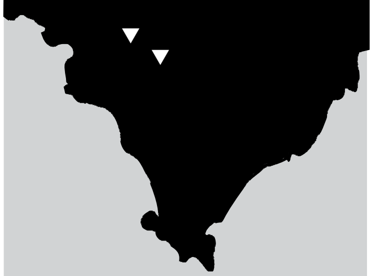
Investigating the Impact of Carbon Inputs on Disease Suppression

Amanda Cook, Nigel Wilhelm and Wade Shepperd

SARDI, Minnipa Agricultural Centre

Searching for answers



Location: Poochera
I & J Gosling

Rainfall
Av. Annual: 324 mm
Av. GSR: 245 mm
2009 Total: 418 mm
2009 GSR: 336 mm

Yield
Potential: 5.4 t/ha (W)
Actual: 2.9 t/ha (W)

Paddock History
2009: Pasture/trial treatments
2008: Wheat/trial treatments
2007: Oats

Soil
Grey calcareous loam

Plot size
40 m x 4 reps

Location: Minnipa
B and K Heddle

Rainfall
Av. Annual: 325 mm
Av. GSR: 236 mm
2009 Total: 421mm
2009 GSR: 333 mm

Yield
Potential: 5.2 t/ha (W)
Actual: 3.9 t/ha (W)

Paddock History
2009: Wheat
2008: Wheat
2007: Medic

Soil
Brown calcareous sandy loam

Plot size
40 m x 4 reps

Key messages

- **Differences in C input (dry matter production plus any additions) between the treatments were 24 t/ha at Minnipa, and 31 t/ha at Poochera over the last two seasons.**
- **Wheat at Minnipa produced between 0.5 t/ha of stubble in a poor season (2008) and 8.8 t/ha in a good season (2009).**
- **Doubling the seeding rate of wheat at Minnipa produced 1.4 t/ha extra stubble compared to the wheat control in 2009.**
- **Barley and vetch brown manures produced the lowest dry matter at both sites.**

Why do the trial?

This research is the second year of a SAGIT funded project which aims to understand the impact of soil carbon and nitrogen cycling on disease suppression. The 2009 season again showed the impact of Rhizoctonia within our farming systems, with late sown crops having significant yield losses to the disease.

Trials have been established on two calcareous soils to see if disease suppression can be stimulated by increasing carbon inputs into farming systems under local conditions. The dynamics of disease suppression to Rhizoctonia is not fully understood but increased microbial activity and increased competition with Rhizoctonia is an important factor. Vibrant microbial populations need lots of carbon (as a food source) for maintenance and growth in the soil.

The impact of different amounts of carbon inputs over two years will be assessed on rhizoctonia infection in barley in year 3 (2010).

How was it done?

Identical trials were established on a grey calcareous soil at Poochera and a red calcareous soil at Minnipa, to manipulate carbon input into soil with different crops and management practices. Treatments were: extra cereal stubble added as chaff (5 or 10 t/ha); wheat, barley or canola at high seeding rates with fluid fertiliser (to encourage high dry matter production) and wheat, Wyalkatchem @ 60 kg/ha with DAP @ 60 kg/ha as a control. The fluid fertiliser used was APP and UAN at the same nutrient rate as granular (12 kg P/ha and 10 kg N/ha). Barley and vetch was included as a brown manure treatment sprayed out at late tillering. Zinc was drilled below the seed on all treatments except the fallow as a fluid at 1 kg Zn/ha.

The stubble treatment was added to the soil surface a month before seeding. The Minnipa trial was sown on 5 May in 2009 under ideal conditions and the Poochera trial was sown on 6 May into reasonable moisture. Trials were started in 2008 with identical treatments applied to the same plots in 2009.

In 2010, each trial will be seeded with barley and the impact of the prior carbon inputs on Rhizoctonia assessed.

What happened?

The trial sites were chosen for high Rhizoctonia disease levels and low production. Initial soil tests were taken to characterise the soils at each site (Table 1). Soil pH down the profile is similar for both soils. The Minnipa site has higher boron at a depth of 20-40 cm compared to Poochera. Organic carbon levels at the sites are typical for the upper EP; being relatively low in the surface profile and decreasing with depth. The Poochera site had a much higher level of nitrate-N throughout the profile (total of nearly 400 kg N/ha compared to Minnipa at 180 kg N/ha). Soil Colwell P levels were only moderate for the highly calcareous soils at Minnipa and Poochera. These sites have high levels of calcium carbonate (free lime) throughout the profile.

Soil water contents were the same for all treatments before seeding and at harvest. There was no difference in total soil profile nitrate N sampled in March (range was 59 to 74 kg N/ha at Minnipa and 72 to 88 kg N/ha at Poochera), although the distribution was more even down the profile at Poochera and mostly in the top 20 cm at Minnipa. The barley treatments at both sites showed higher levels of Rhizoctonia patches early in the season.

Early dry matter production at the Poochera site was highest with the 10 t/ha added stubble treatment having greater growth (0.96 t/ha) than the control treatments (0.57 t/ha), despite no differences in soil moisture before seeding, This difference in growth was carried through to late DM and resulted in a higher grain yield (Table 2).

The Minnipa site produced greater total dry matter in 2009 than Poochera, the opposite of 2008 (Table 2 and Table 3). This has resulted in overall amounts of total dry matter production over the two seasons being similar for the various treatments at both sites. The difference in dry matter production and addition between the greatest (added 10t/ha stubble) and least (barley vetch brown manure) of the treatments over the two seasons was 24 t/ha at Minnipa, and 31 t/ha at Poochera. The added stubble treatments at Poochera have 25 t/ha extra dry matter input than the control wheat plots, and 23 t/ha at Minnipa.

There were no differences in grain yield at Minnipa, possibly due to the exceptional season. Grain quality was acceptable at both sites except for a high level of screenings in the high seeding rate barley treatment. Grain protein levels were low which would be expected in a good season due to a dilution of the grain protein level as extra carbohydrates are accumulated in the seed.

Wheat sown at 60 kg/ha at Minnipa produced 0.5 t/ha total dry matter in a poor season (2008) and 8.8 t/ha in a good season (2009), while Poochera produced 2.3 t/ha and 6.9 t/ha in 2008 and 2009 respectively. The barley and vetch brown manure, sprayed out at late tillering provided the lowest dry matter input at both sites. Doubling the seeding rate of wheat at the Minnipa site produced an extra 1.4 t/ha total dry matter than the control wheat treatment in 2009.

We are only measuring the dry matter accumulation and input above the ground, as it is much easier to measure, but plant roots are also contributing additional carbon to the soil pool (possibly another third).

Table 1 Soil characteristics at Minnipa and Poochera trial sites, February 2008

Soil	Depth (cm)	pH $CaCl_2$	Boron (mg/kg)	Org C (%)	Nitrate N (mg/kg)	P (mg/kg)	$CaCO_3$ (%)
Minnipa	0 - 10	8	2.7	1.3	43	24	29
	10 - 20	8	5.5	0.9	44	8	32
	20 - 40	8.1	18.8	0.7	13	5	41
	40 - 60	8.3	18.5	0.6	7	2	55
	60 - 80	8.2	19.2	1.1	5	4	57
	80 - 100	8.1	21.2	0.4	4	4	55
Poochera	0 - 10	7.9	1.4	1.2	29	25	49
	10 - 20	7.9	2.3	1.2	22	10	52
	20 - 40	8.1	2.4	0.6	40	6	48
	40 - 60	8.3	4.7	0.5	39	3	46
	60 - 80	8.8	6.9	0.4	22	3	50
	80 - 100	8.7	6.5	0.4	17	3	53

Table 2 Dry matter and yield results from Poochera

Treatment	Seeding Rate (kg/ha)	Dry Matter at pre-harvest 2009 (t/ha)	Total Dry Matter accumulated 08 and 09 (t/ha)	Yield (t/ha)	Protein (%)	Screenings (%)
Barley DM*	120	8.80	10.77	2.61	11.93	5.14
Barley & Vetch	50 + 15	1.53	3.24	-	-	-
Control wheat	60	6.99	9.32	2.30	10.24	3.26
Canola*	10	3.70	6.40	**	-	-
Wheat DM*	120	7.88	10.77	2.47	10.33	2.97
Stubble 5t	60	8.07 (+5)	20.15	2.57	10.11	4.19
Stubble 10t	60	8.13 (+10)	34.38	2.90	10.10	4.03
LSD (P=0.05)		*1.12*	*2.18*	*0.21*	*0.19*	*1.19*

**Fluid fertiliser treatments and these treatments accidentally received double fertiliser rates in 2008*
*** Accidentally but selectively grazed by 4 fat lambs over 3 days*

Table 3 Dry matter and yield results from MInnipa

Treatment	Seeding Rate (kg/ha)	Dry Matter at harvest 2009 (t/ha)	Total Dry Matter accumulated 08 and 09 (t/ha)	Yield (t/ha)	Protein (%)	Screenings (%)
Barley DM*	120	10.49	9.25	3.54	12.32	12.19
Barley & Vetch	50 + 15	1.89	8.93	-	-	-
Control wheat	60	8.78	9.30	3.57	9.98	3.77
Canola*	10	5.62	9.31	1.13	-	-
Wheat DM*	120	10.21	8.37	3.86	10.23	3.33
Stubble 5t	60	9.01 (+5)	17.91	3.83	10.09	4.03
Stubble 10t	60	8.90 (+10)	32.81	3.65	10.30	4.31
LSD (P=0.05)		*0.60*	*2.18*	*1.49*	*0.80*	*4.30*

**Fluid fertiliser treatments*

What does this mean?

A great season at Minnipa in 2009 has resulted in similar total dry matter production being achieved at both sites over the two years. The treatments have produced different amounts of carbon inputs to the soil which will provide a range of levels of food sources for soil microbes.

Next year all treatments will be sown to barley, the crop which shows the most obvious visual symptoms of Rhizoctonia. Further monitoring of soil carbon and nitrogen, microbial activity and changes in Rhizoctonia inoculum and infection levels will give us a better understanding of the soil biology in our low rainfall farming systems, and whether it is possible to increase the microbial populations. In turn, the impact of these changed populations on Rhizoctonia will be assessed.

Both trials are now in very good shape to test the impact of organic matter inputs from two growing seasons on rhizoctonia in 2010.

Acknowledgements

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