Responsive Farming for Soil Type at Mudamuckla

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RESEARCH

Location: Mudamuckla Muddy/Nunji/Wirrulla Ag Bureau

Rainfall
Av. Annual: 291 mm
Av. GSR: 219 mm
2010 Total: 347 mm
2010 GSR: 275 mm

Yield
Potential: 2.5 t/ha (C)
Actual: 1.1 t/ha (C - Medium Zone 8 kg/ha P)

Paddock History
2009: Wheat
2008: Wheat
2007: Self sown barley

Soil test
Outlined in article

Diseases
Rhizoctonia

Resource Efficiency
Energy/fuel use: Standard
Greenhouse gas emissions (CO_2, NO_2, methane): Standard

Social/Practice
Time (hrs): Standard
Clash with other farming operations: Standard
Labour requirements: Standard

Economic
Infrastructure/operating inputs: VRT technology
Cost of adoption risk: Low if improving returns

Key messages

- **4 kg/ha of P as a blanket application increased grain yields and gross margins over nil P in all 3 soil zones, however applying a variable rate to the medium soil zone of 8 kg P/ha improved gross margins over the 4 kg/ha rate.**

Why do the trial?

It is important that our low rainfall farming systems are low risk, flexible and responsive. Paddock inputs need to balance the best agronomic and economic advice with the need to ensure reliable outcomes at low cost. At Mudamuckla, one of three focus paddocks in the current farming systems project, the emphasis is on managing risk through tailoring inputs to the different production zones potential by using variable rate technology. Yield Prophet® is also being evaluated as a decision making tool by matching nutrition to plant available water with modelling of climatic conditions.

Changing inputs according to the production capability of different paddock zones or soil types may provide an opportunity to improve gross margins for the whole paddock.

How was it done?

Paddock 8 at Mudamuckla was segregated into zones of good, medium and poor production zones in 2009 using 5 years of yield maps and an elevation map (EPFS 2009 pp 97-103).

The paddock was sown to canola after the opening rain on 26 May as a break crop to control grassy weeds. Fertiliser application strips were applied at 0, 4 and 8 kg P/ha (as phosphoric acid) over 4 permanent sampling points in each of the good, medium and poor zones identified in 2009.

Incorrect adjustment of the seed roller covers for small seeds resulted in the strips having canola sown on one half only of each machine pass at double the intended seeding rate. The result was bands of mostly canola and bands of volunteer medic and wild turnip. Targa® was used to control the grasses across the paddock, however no broad leaf weed control was attempted to protect the volunteer medic and maintain groundcover.

All crop measurements were taken in strips of 43C80 canola sown at 3 kg/ha (double the planned rate of 1.5 kg/ha), no nitrogen was applied. Measurements collected included soil chemical analysis, plant establishment, dry matter at anthesis, soil water measurements (sowing and harvest) and grain yield.

What happened?

Colwell P soil measurements were high and had increased in all zones from 2009. The high total mineral N also showed an increase from 2009, these levels are due to a history of good medic based pasture and fertiliser applications exceeding production requirements. *Rhizoctonia solani* AG8 inoculum levels constituted a high infection risk on the good zone at seeding, a medium to high risk on the medium zone and a low risk on the poor zone. From soil analysis done at harvest disease risk levels had increased in the medium and poor zones. The poor zone, which represents 15% of the paddock, has toxic levels of boron at 40 cm and chloride at a depth of 20 cm which will restrict productivity, except in wet years when frequent rainfall events may leach some of the hostile elements deeper into the soil profile.

The medium and good zones do not have constraints that will severely restrict root growth until 70 cm (EPFS 2009 pp 97-104), these zones represent 45% and 40% of the paddock respectively.

There were less plants established on the good zone compared to the medium and poor zones. There were generally less canola plants established, less biomass at anthesis and lower grain yields with no applied P. Water use efficiency variations between treatments of less than 1 to up to 7 kg/ha/mm of available water (160 mm) was much less than a potential 12 – 14 kg/ha/mm given the plant available water. Gross margins were negative at nil P on all soil zones.

Yield Prophet® reports were run for the 3 soil zones on 4 dates over the growing season, 5 August, 24 August (poor and good zone only), 27 September and 27 October (Table 3). The narrow range of yields between projections with available N and N unlimited indicate that N is not a yield limiting factor. In this paddock there was no indication of a nitrogen deficiency in the yield projections and plant available water was in the positive until 27 October on the medium zone, which was rectified with 48 mm over the period 29 - 31 October.

The VRT combinations are the same as those applied to the Minnipa focus paddock and are outlined in Table 4. These VRT combinations were then compared to the potential gross margins if the different input rates had been applied to the whole paddock (Table 5) taking into account the percentage that the different production zones represent. A high input blanket approach gave the best gross margin in 2010, with a low input and the 'Hold the Gold!' approach resulting in a significantly lower gross margin than the medium input blanket approach.

Table 1 Colwell P, total mineral N and Rhizoctonia infection risk measured pre-seeding and post harvest on the 3 (good, medium and poor) zones at the Mudamuckla focus paddock in 2010

	Colwell P (mg/kg) 0-10 cm		Total Mineral N (kg/ha) 0-60 cm		*Rhizoctonia solani* AG8	
	2009	2010	2009	2010	pre-seeding	post harvest
Good	38.5	43	142	168	High	High
Medium	42.7	44	158	273	Medium	High
Poor	43.2	50	231	272	Low	Medium-Low

Table 2 Plant establishment, biomass at tillering, anthesis and maturity and harvest index from the 3 paddock zones

Zone	P applied (kg/P/ha)	Establishment (plants/m^2)	DM at anthesis (t/ha)	Grain Yield (t/ha)	WUE (kg/ha/mm)	Gross Margin[1] ($/ha)
Good	Standard	50	1.2	0.5	3.1	
Medium	Low	59	1.6	0.6	3.8	
Poor	Standard	59	1.4	0.6	3.8	
LSD (P=0.05)		*8.2*	*0.3*	*NS*		
	0	51	1.1	0.2	1.3	-28
	4	59	1.4	0.6	3.8	215
	8	59	1.8	0.9	5.6	398
LSD (P=0.05)		*NS*	*0.4*	*0.2*		
Good	0	42	0.7	0.1	0.6	-69
	4	59	1.5	0.6	3.8	225
	8	50	1.5	0.8	5.0	337
Medium	0	48	1.3	0.2	1.3	-8
	4	63	1.5	0.6	3.8	225
	8	66	2.0	1.1	6.9	520
Poor	0	62	1.2	0.2	1.3	-8
	4	54	1.3	0.7	4.4	286
	8	62	1.9	0.8	5.0	337
Within soil type LSD (P=0.05)		***14.3***	***0.5***	***0.2***		
Zone x Rate LSD (P=0.05)		***16.4***	***0.6***	***0.3***		

** Gross margin is yield x price less seed, fertiliser and variable costs delivered to cash pool Port Lincoln 20 January 2011*

Table 3 Yield Prophet® yield projections, decile at the time of simulation and estimated plant available water at 4 dates on 3 soil zones over the 2010 growing season

Date	Zone	Yield range (t/ha) with available N	Yield range (t/ha) with unlimited N	Decile ranking	PAW (mm)
5 August	Good	0.5 - 2.2	0.2 - 3.0	7	39
	Medium	0.3 - 2.2			20
	Poor	0.2 - 1.3	0.2 - 1.3		46
24 August	Good	0.7 - 2.2	0.7 - 2.8	6	27
	Medium	na	na		na
	Poor	0.3 - 1.5	0.5 - 1.5		37
27 September	Good	1.7 - 2.1	1.8 - 2.2	7	14
	Medium	1.5 - 2.1	1.6 - 2.1		1
	Poor	1.0 - 1.5	1.1 - 1.6		29
27 October	Good	1.7	1.8	6	1
	Medium	1.5	1.6		-6
	Poor	1.1	1.2		14

Table 4 Treatments applied (kg P/ha as phosphoric acid) to VRT gross income analysis for Mudamuckla 2010, sown with canola at 3 kg/ha (double planned rate of 1.5 kg/ha)

Paddock Zone	VRT - Go for gold!	kg P/ha	VRT - Hold the gold!	kg P/ha
Good	High	8	Standard	4
Medium	Standard	4	Low	0
Poor	Low	0	Low	0

Table 5 Comparison of the gross income of different sowing regimes vs. VRT combinations across the whole 200 ha paddock

Treatment	Gross Margin[1] ($/ha)	Gross Margin compared to standard input treatment ($/200 ha paddock)
VRT - Go for gold!	235	109
VRT - Hold the gold!	85	-29,895
High input	419	36,976
Standard input	235	0
Low input	-33	-53,419

What does this mean?

The 2010 growing season was above average for rainfall, with canola yields only reaching 1.1 t/ha indicating there were significant constraints. Weed competition was an issue due to the lack of broad leaf weed control to maintain groundcover on unsown strips (50% of paddock). *Rhizoctonia solani* AG8 was at high levels on the medium to good zones which may have reduced yield. Canola is known to be a poor host for *Rhizoctonia solani* AG8, however in situations when there are extremely high levels of inoculant it can be attacked by this disease (pers comm, Alan McKay). The disease levels in this paddock will be reassessed before seeding to assess if there has been any change over summer.

Yield Prophet® was not accurate at predicting the yields in the medium and good zones. At this stage it has not been well calibrated for canola in low rainfall cropping areas (pers comm, Tim McClelland).

In 2010 there was a benefit in grain yield in the high P rates on the medium zone, compared to the poor zone, but not on the good zone. The reason for this is unclear, an unidentified soil constraint may have had an impact on canola production in the good zone. This is partly suggested from the comparative good and medium zone anthesis biomass figures, where the good zone production is similar or less than the medium zone.

The effects of rotation choice and the different treatments on the different zones, as well as the overall economic impact of the different approaches will be monitored for the next 2 years.

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