Variable Rate Fertiliser Application

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Aim

To evaluate the economics of a variable rate approach to fertiliser applications over the 2011 growing season. This trial was also designed as a proof of concept trial for CSBP's Fertlogic Variable Rate Technology (VRT) platform.

Background

Fertiliser is usually the highest cropping input cost, so it makes sense to target applications to increase fertiliser use efficiencies and return on investment.

Fertiliser requirements depend upon nutrient supply and demand. Demand depends upon yield target and constraints. Yield is ultimately dependent upon rainfall, but soil constraints can often be managed.

A paddock was assessed for variability using Fertlogic. Using biomass imagery, the paddock was zoned up into 3 production zones- 'High', 'Medium' and 'Low'. The zone map was discussed with Rod (farmer) and Justin (operations manager) to check whether the biomass imagery was consistent with their knowledge of past paddock performance. Discussions also led to realistic yield potentials being set for each of the zones. Soil samples were conducted in each zone to understand any nutritional factors that could explain the variation across the paddock. Soil testing and realistic yield targeting are two of the more important aspects of variable rate farming. Soil test results were run through NULogic to vary nutrient rates according to our yield targets. Each trial had 4 treatments: Nil fertiliser, Farmer practice (blanket application), NU Logic recommendation, and 'High' fertiliser inputs.

The crop was monitored throughout the season and at stem elongation tiller counts were done in each zone to determine yield potential. It was established that yield potential was much higher than originally targeted. The NULogic plot in the 'High' zone was visually N deficient. Further analysis included running the rainfall figures through the rainfall model to establish yield potential. From these assessments a decision was made to apply another 50 L/ha Flexi-N to the 'High' zone. Additional N was not applied to the 'Medium' zone because there was only 20cm rooting depth over rock. Calculations showed that another 50mm of rain in August was needed to justify the investment in N. As it turned out, the area experienced a magnificent spring and the N would have been highly profitable.

Trial Details

Property:	Catalina Farms, East Coorow
Plot size & replication:	20m x 2.5m x 3 replications
Soil type	Sandy Loam
Sowing date:	19/5/11
Seeding rate:	65 kg/ha Mace
Fertiliser:	As per treatment
Growing Season Rainfall:	330mm

Soil Test Results

Table 1: Low Zone.

	Description	pH	EC	OC	N(Nit)	N(Amm)	P	PBI	K	S	Al
0-10	Sandy Loam	4.9	0.07	0.8	18	5	56	37	85	12	4
10-20		4.6	0.02	0.3	2	2	21	24	44	6	5
20-30cm		5.4	0.02	0.1	1	1	6	15	40	4	1

Table 2: Medium Zone.

	Description	pH	EC	OC	N(Nit)	N(Amm)	P	PBI	K	S	Al
0-10	Sand over clay	5.4	0.08	0.9	16	3	53	30	130	13	1.8
10-20		4.9	0.04	0.4	4	2	9	46	90	11	2
20-30cm		4.7	0.04	0.4	4	2	7	49	100	12	2.1

Table 3: High Zone.

	Description	pH	EC	OC	N(Nit)	N(Amm)	P	PBI	K	S
0-10	Clay loam	6.5	0.07	0.5	15	1	63	23	120	9
10-20		6.8	0.05	0.2	1	1	26	28	64	4
20-30cm		6.6	0.05	0.1	1	1	6	19	75	8

Site Interpretation

Very strong phosphorous (P) levels and adequate potassium (K) in all zones.
Low Zone: pH slightly acid in the sub soil (Aluminum up to 5 mg/kg at 10-20cm) – could be limiting.
Medium Zone: Soil depth limited to 30cm.
Nitrogen (N) appears to be the most likely limiting nutrient across all 3 zones.
Organic Carbon (OC) levels were low across all 3 zones.

Plant Tests (20 July)

Nitrogen is the most limiting nutrient across all zones. Excellent uptake of all other nutrients – can be confident that no other nutrients will limit responses to N top ups.

Results

Table 4: Fertiliser use, yield and grain quality in Low Zone.

Trt		Banded (kg/ha)	Z13/14 (L/ha)	Z30 (L/ha)	N	P	Yield (t/ha)	Protein (%)	Hl Wt (kg/hl)	Scrns. (%)
1	Nil	-	-	-	0	0	1.49	8.8	78	1.9
2	Blanket	70 Agstar	-	88 Flexi-N	47	10	2.88	8.5	79	1.6
3	NUlogic (1.5 t/ha)	50 Agstar	55 Flexi-N	-	28	7	2.52	8.9	78	1.5
4	High (3.5 t/ha)	110 Agstar	100 Flexi-N	80 Flexi-N	92	15	4.36	8.4	79	1.3
						Prob	<0.001	0.22	0.44	0.033
						Lsd	0.17	ns	ns	0.33

Table 5: Fertiliser use, yield and grain quality in Medium Zone.

Trt		Banded (kg/ha)	Z13/14 (L/ha)	Z30 (L/ha)	N	P	Yield (t/ha)	Protein (%)	Hl Wt (kg/hl)	Scrns. (%)
1	Nil	-	-	-	0	0	1.96	9.4	79	1.9
2	Blanket	70 Agstar	-	88 Flex-N	47	10	3.36	9.0	78	1.9
3	NUlogic (2.0 t/ha)	65 Agstar	65 Flexi-N	-	37	9	3.10	8.2	78	1.7
4	High (3.5 t/ha)	110 Agstar	100 Flexi-N	80 Flexi-N	92	15	4.54	9.0	79	1.7
						Prob	<0.001	0.17	0.27	0.16
						Lsd	0.22	ns	ns	ns

Table 6: Fertiliser use, yield and grain quality in High Zone.

Trt		Banded (kg/ha)	Z13/14 (L/ha)	Z30 (L/ha)	N	P	Yield (t/ha)	Protein (%)	Hl Wt (kg/hl)	Scrns. (%)
1	Nil	-	-	-	0	0	2.71a	8.2	78	1.3
2	Blanket	70 Agstar	-	88 Flex-N	47	10	4.21b	8.8	78	1.2
3	NUlogic (2.5 t/ha)	80 Agstar	55 Flexi-N	55 Flexi-N	79	11	4.99c	8.1	79	1.4
4	High (3.5 t/ha)	110 Agstar	100 Flexi-N	80 Flexi-N	92	15	5.49d	8.8	79	1.4
						Prob	<0.001	0.47	0.81	0.46
						Lsd	0.18	ns	ns	ns

Table 7: Economic Analysis.

VRT	Area ha	Yield t/ha	Yield t/Zone	Cost $/ha	Cost $/Zone
Low	36	2.5	91	66	2,367
Med	34	3.1	107	82	2,820
High	36	5.0	182	146	5,339
Total	**107**		**380**	**98**	**10,526**
Total Paddock Return- Wheat @ $180/t	$68,365				

Blanket	Area ha	Yield t/ha	Yield t/Zone	Cost $/ha	Cost $/Zone
	107	3.5	372	98	$10,519
Total Paddock Return- Wheat @ $180/t	$67,025			Difference (Blanket- VRT)	-$6.57 **(A)**

(The average blanket yield of 3.5 t/ha was calculated by averaging the yield from the blanket treatments across all 3 zones).

Difference (VRT - Blanket Return)	$1,340 **(B)**
Comparison (Total Possible Return Difference + Cost Saving of Fertlogic(A+B))	$1,334
Benefit- $/Ha.	**$12.46**

The above table indicates the potential cost savings to be had from using VRT. Even though the total cost of nutrients using VRT was marginally higher ($7 over the paddock) than the 'Blanket' application, the variable rate approach grew another 8t of wheat. This equates to an economic benefit of about $1334 or $12.46/ha.

Comments

There were 3 key messages to be taken from this trial:

- This trial showed that varying fertiliser inputs over different zones of a paddock can provide economic benefits over using a "blanket" application approach. This trial also highlighted the value of zone management using the tools available to us.
- Nitrogen was the major limiting factor in each of the zones. The value of applied nitrogen was really highlighted when other limiting factors such as rainfall were taken out of the equation. In seasons like this, nitrogen is a low risk decision.
- By dividing the paddock into 3 zones it was possible to learn a lot more about different parts of the paddock which served to help better manage the paddock over the 2011 season and will help to make more informed decisions about this paddock going forward.

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