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Section 5

Nutrition

Crop Production Using Replacement P Rates

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RESEARCH

Searching for answers

Location:
Minnipa Ag Centre
Rainfall
Av. Annual: 325 mm
Av. GSR: 242 mm
2010 Total: 410 mm
2010 GSR: 346 mm
Yield
Potential: 4.7 t/ha (W)
Actual: 4.4 t/ha (20kg/ha P - good zone) (W)
Paddock History
2009: Wheat
2008: Wheat
Soil Type
Red sandy loam
Plot size
1.4 x 9 m
Yield Limiting Factors
Nil
Water Use
Runoff potential: Low
Resource Efficency
Energy/fuel use: Standard
Greenhouse gas emmisions (CO_2, NO_2, methane): Cropping and livestock
Social/Practice
Time (hrs): No extra
Clash with other farming operations: Standard practice
Economic
Infrastructure/operating inputs: High input system has higher input costs
Cost of adoption risk: Medium

Key messages

- **A replacement P strategy produced similar yields to 10 and 20 kg/ha P rates in 2010.**
- **The trial indicated an economic benefit in increasing P rates up to 20 kg/ha on a deep sandy loam in 2010.**

Why do the trial?

Adequate levels of P are essential to achieve optimum crop yield. However there is an opportunity to minimise the cost of the P applications by adjusting the amount of P applied based on P soil reserves, seasonal and known soil based limitations.

Historically, recommended P rates have exceeded plant requirements, taking into account P requirements for regular annual medic pasture phases in the rotation. This has resulted in high levels of P in the soil. However recently a change in rotation practices where cereals may be grown continuously for a number of years combined with a string of poor seasons and increasing fertiliser prices has resulted in farmers reassessing the amount of fertiliser they use, and if they can utilise the P reserves in the soil strategically in high production seasons, where crop usage of 3 kg of P/ha/t of grain may surpass applications of applied P.

The aim of this ongoing study is to monitor crop production and economic outcomes from applying P at nil, replacement, average and twice average rates on both a deep sandy loam and a shallow constrained soil.

How was it done?

Two replicated trials were established in Paddock North 1 (N1) on Minnipa Agricultural Centre (MAC) in 2009; one on a deep red sandy loam (good zone) that has been P responsive and a second on a shallow, heavy soil (poor zone) that has been non-responsive to P. In 2009, pre-seeding Colwell P levels were 25 and 35 mg/kg on the deep and shallow soil respectively.

There are 4 treatments which are repeated each year on the same plots (Table 1). P is applied as DAP banded at seeding with N balanced with urea to give a total 18 kg N/ha on all treatments. In 2010, both trials were sown with Wyalkatchem wheat at 60 kg/ha on 3 June.

Table 1 shows 2009 yields, P rates and DAP and urea rates applied to each treatment. Measurements during 2010 included plant establishment, dry matter at end of tillering, grain yield and quality (Table 2).

What happened?

Soil tests taken before seeding in 2010 indicated that the Colwell P levels at both trial sites had increased to levels greater than 35 mg/kg (good zone - deep sandy loam) and greater than 50 mg/kg (poor zone – shallow, heavy soil).

Table 1   2009 wheat yields, phosphorus, DAP and urea (kg/ha) applied in 2010

Good zone: Deep, light soil (moderate Colwell P levels in 2009)	**Yield 2009 (t/ha)**	**P applied in 2010 (kg/ha)**	**DAP applied in 2010 (kg/ha)**	**Urea applied in 2010 (kg/ha)**
0	3.9	0	0	40
Replacement P	4.2	13.3	66	18
10	4.4	10	50	25
20	4.6	20	100	0
Poor zone: Shallow, heavy soil (high Colwell P levels in 2009)				
0	2.9	0	0	40
Replacement P	2.8	8.4	42	27
10	2.8	10	50	25
20	3.1	20	100	0

Table 2   Wheat performance in P replacement trial, 2010

kg/ha P applied	**Early DM (kg/ha)**	**Yield 2010 (t/ha)**	**Test Weight (kg/hL)**	**Protein (%)**	**Screenings (%)**	**Gross Income[1] ($/ha)**
Good zone (moderate Colwell P in 2009)						
0	291	3.9	79.7	9.8	2.3	966
Replacement P	532	4.3	79.8	10.0	2.4	1,078
10	393	4.0	79.5	10.1	2.5	1,007
20	560	4.4	79.8	10.1	2.4	1,085
LSD (P=0.05)	*133*	*0.4*	*NS*	*0.2*	*NS*	
Poor zone (high Colwell P in 2009)						
0	347	3.5	81.4	10.5	2.5	859
Replacement P	410	3.9	78.3	10.3	3.1	982
10	476	3.7	79.4	10.2	2.8	927
20	526	3.9	79.0	10.4	2.3	951
LSD (P=0.05)	*89*	*0.3*	*NS*	*NS*	*NS*	

It is not clear if this is caused by P mineralisation after an exceptional growing season in 2009 or an example of the inaccuracy of the Colwell P test for calcareous soils.

In 2010 there was a response in early dry matter, grain yield and protein to P rates above 10 kg/ha in the good zone compared to the nil P treatment. The nil P treatment had less dry matter than P applied at 10 kg/ha in the poor zone, and generally less grain yield than all P treatments. Protein levels were similar across all treatments. Test weights were greater than 78 g/hL and screenings were 3.1% or less for all treatments.

A basic gross income analysis on all treatments shows that P increased the gross income in 2010 compared to the nil P strategy. The highest gross income in the good zone was produced by the 20 kg/ha P treatment. The replacement P strategy returned the highest gross income in the poor zone.

What does this mean?

At this early stage of the trial a replacement P fertiliser strategy appears to be a sound risk management tool (see EPFS Summary 2009 pp 162-163 to determine P replacement strategy). Both the poor zone and the good zone showed no production loss in 2009 when a replacement rate of P was applied compared to the average (10 kg/ha) and twice average (20 kg/ha) treatments, and there was a yield increase in 2010 compared to the nil P treatment. This yield increase provided a 10% increase in gross income in the good zone and a 12% increase in the poor zone.

The trial will continue over the next 2 seasons with appropriate soil analysis carried out to measure any changes in soil P and if there is any impact of differing P regimes on crop performance. The results from this trial will undergo a financial assessment to evaluate the merits of each system in subsequent years.

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