Phosphorus Responses in Wheat and Canola

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Background

Phosphorus (P) responses continue to be achieved across large areas of southeastern Australia, and in particular, central NSW. Previous P work in the central west of NSW has seen grain yield increases in wheat from 5-95%, and in canola from 10-67%. These gains have been extremely economic, with returns up to $7 for each $1 invested in P. These trials, as a follow up to the previous work, were aimed at quantifying these grain yield increases achievable in wheat and canola in the central west of NSW through varying P rate experiments.

Method

Both wheat and canola were sown at Alectown, NSW. Each site was treated as part of the paddock for weed control, which was conducted by the co-operator.

Wheat

Janz was sown 4-5 cm deep at a seeding rate of 60kg/ha, into ideal moisture on the 24lh of May 2001. The site received a small fall of rain within the first week after sowing. Additional N (as urea), to the starter fertiliser N, was deep banded at sowing to make the total N applied to each treatment up to 50 kg N/ha. P rates varied from 0-40 kg P/ha. The trial was arranged as a randomised block design with four replicates.

Canola

Oscar was sown at a seeding rate of 4 kg/ha, into satisfactory moisture on the 19lh of April 2001. The site received 28mm of rainfall 2 days later. Urea was deep banded at sowing to balance the total N applied to each treatment to 80 kg N/ha. P rates varied from 0 - 40 kg P/ha. The seed was sown by dropping it on the surface and lightly harrowing. The trial was arranged as a randomised block design with four replicates.

Table 1. Soil test details

Location	**Soil** type	**pH ($CaCl_2$)**	**P (Cohwell) (ppm)**	**CEC meq/100g**	**Exch. Al (%)**	**Profile N (0-60cm) kg/ha**
Wheat	Red Loam	5.8	**27**	12.0	**0.0**	192
Canola	Red Loam	5.0	**17**	**8.8**	**0.3**	149

Table 2. Monthly rainfall

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
36	60	95	79	22	53.5	80.5	27	32	60	31.5	20

Results

Wheat

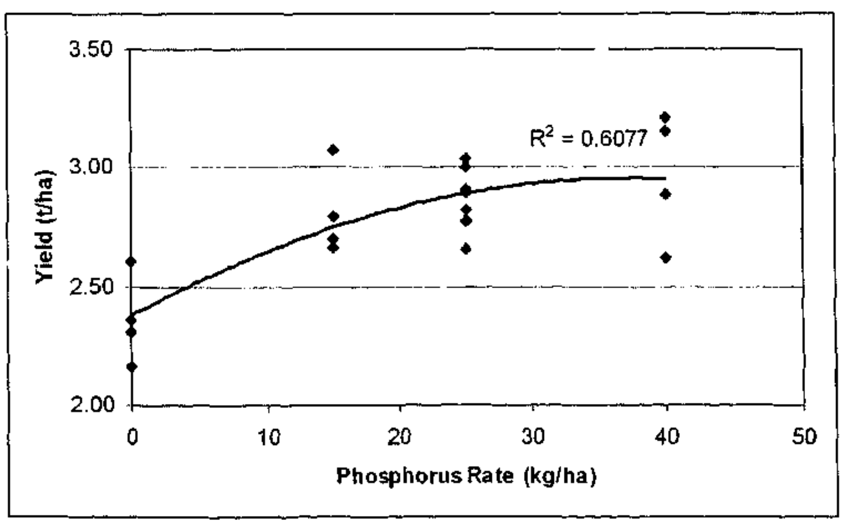
The phosphorus response this year was not as large as last year's, but still present. This can be attributed to two factors; the soil P level at this year's site is higher (Colwell 29 vs 16 last year), and the yields are lower. A hail storm hit the trial in mid October, causing substantial damage, lowering yields and creating large variability, with losses estimated at a minimum of 30%, whilst only modest August - September rains may have also contributed to the lower yields. There appears to have been a dilution in protein concentration from the yield response to P. This happened last year with the higher yields also.

Table 3. Wheat grain yield and protein

Treatment (kg P/ha)	**Yield (t/ha)**	**% of Nil**	**Protein** (%)
0	2.36	100	14.15
15	2.81	119	13.88
25	2.86	121	13.96
40	2.97	126	13.75
Mean	**2.76**		**13.95**
LSD 5%	**0.23 (|)<0.05)**	**9.7**	**0.36 (ns)**
CV	**5.6**		**1.8**

Significant ($p<0.05$) responses to phosphorus were recorded. The magnitude of these responses, over that of the district practice, is reduced when soils have a higher soil P level. No other significant outcomes have occurred in this trial.

Figure 1. Wheat yield response to applied phosphorus



Canola
The treatments applied at the highest P rate (40kg P/ha) were the highest yielding. .There was no yield response to applied zinc, which was an additional treatment applied at 25 kg P/ha. The soil test zinc level indicated a response was not likely.

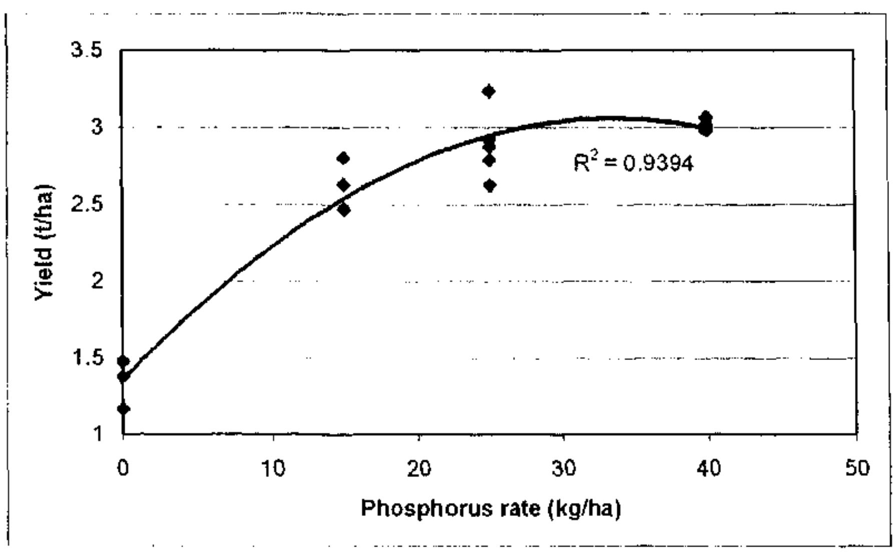
Oil levels were not affected by any of the treatments, including the nil P treatment.

The significant phosphorus response ($p<0.05$) was the only finding.

Table 4. Canola grain yield and oil content

Treatment (kg P/ha)	Yield (t/ha)	Yield % of Nil	Oil Content
0	1.39	100	46.0
15	2.68	193	45.8
25	2.92	210	46.3
40	3.06	221	48.4
Mean	**2.76**		**46.4**
5% LSD	**0.29 (p<.05)**		**4.0 (ns)**
CV	**5.6**		**3.4**

Figure 2. Canola yield response to applied phosphorus



Discussion
Phosphorus is a critical nutrient for plant production, and the plant's P requirements are usually taken up in the first 8-10 weeks. It's main role is in root cell development. The better the plant's root system, the more able the plant is to extract nutrients and moisture from the soil.

From the last two years of trials in this area, the main response has been to P. Increasing rates of P has been the take home message, as yield increases have been significant. Another benefit from these two years of trials is some calibration type work of the Colwell P test, which enhances our ability to predict responsive soils.

Low levels of Colwell P (16 ppm) in 2000 gave wheat grain yield responses of 66%, 80% and 95% above the nil P treatment at 15, 25 and 40 kg P/ha respectively. The same comparison in wheat in 2001, on a soil with a Colwell P of 29 ppm, yielded grain increases of 19%, 21% and 26% respectively. In canola, in 2001, these responses on a soil P level of 17 ppm (Colwell) were 93%o, 110%) and 121% respectively for the same rates of P (ie. 15, 25 and 40 kg P/ha).

These results highlight the increased responsiveness of canola over wheat at the same soil P level. Canola seems to have a higher demand for P than wheat, which was reported last year in some work conducted at Forbes. Thus, the incentive for growers is to build soil P so they don't miss out on yield, and then their 'planting' P rates can be applied at maintenance levels.

What does all this mean?

This years findings mirror those of last year. The trials demonstrated that current P application rates may be sub optimal, and significant grain yield gains may be achieved by applying greater amounts of P. It also indicates that our soil P reserves may still be lower than desired, and that greater efforts to raise the soil P "bank" are likely to be economical.

Whilst increasing yields through the application of additional P, it must be remembered that this increased output will require additional other nutrients. Close monitoring of all other nutrients, particularly N, must be carried out to get the most benefit from such a programme. Soil nutrition is a complete package, and must be managed accordingly.

Acknowledgments

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