Phosphorus rate by timing in wheat

The aim of this trial was to investigate the possible interaction between time of sowing and the phosphorus requirement of the crop at two locations (Birchip and Murtoa).

Summary

In 2003, a three week delay in sowing after mid/late May resulted in a 0.3t/ha (Murtoa) and 0.5t/ha (Birchip) yield penalty. Further delay in sowing (to July) caused similar decreases in yield.

There was no consistent yield or grain quality response to the rate of phosphorus applied at both Birchip and Murtoa. Both sites had reasonable Colwell P levels, (Birchip 32ppm and Murtoa 13ppm). There was also no indication in terms of yield response or grain quality that wheat crops sown later in the season (June, July) require more P fertiliser applications to reach maximum yield.

Reducing P inputs to between 6 and 12kg/ha will not compromise short-term soil fertility and crop production on sites with a good fertiliser history and soil P fertility. In the longer term P inputs should be in balance with the amount of P exported out of the paddock in grain and stubble.

Background

Australian soils are naturally low in plant available phosphorus - a result of the soils being geologically ancient and their highly weathered nature. Along with this, phosphorus fertilisers are a major input in Australian farming systems, and cost between 8 - 15% of total farm income.

Previous BCG results have indicated that grain yield responses to granular P fertilisers were variable and that granular P fertilisers were unlikely to produce a yield response even at Colwell P levels less than 25ppm. This might be explained by the highly alkaline nature of Mallee soils, which tend to have a high capacity to fix phosphorus and consequently a high proportion remains unavailable to the crop. Work undertaken in the region by DPI with liquid P will help in gaining a better understanding of the mechanism of P fixation and release on alkaline soils.

It has been reported that the uptake and utilisation of phosphorus by cereal crops is influenced by the growing period of the crop. Work done in NSW showed that the largest responses to P fertiliser occurred in late sown cereal crops, as opposed to early sown crops which showed little response.

Methods

This trial was conducted using a fully replicated (x4) randomised block design at the Birchip and Murtoa sites.

Yitpi wheat was sown at Birchip on May 13, June 11 and July 15 at 80 kg/ha. Urea was pre-drilled prior to sowing at 50kg/ha. LVE MCPA® at 400ml/ha and Lontrel® at 75ml/ha were applied on June 11.

Yitpi wheat was sown at Murtoa on May 26, June 20 and July 7 at 97kg/ha. Urea was pre-drilled prior to sowing at 80kg/ha and topdressed on August 19 at 60kg/ha. Triflur 480® was applied at 0.8L/ha and incorporated prior to sowing. Ally® at 3g/ha, Jaguar® at 300ml/ha, LVE MCPA® at 250ml/ha, Lontrel® at 100ml/ha and wetter at 0.1% were applied on August 19; Topik® at 65ml/ha was applied on September 4.

Five different amounts of phosphorus (from 0 to 24 kg P/ha) were applied across each time of sowing (Table 1).

Critical growth stages were monitored throughout the season (plant, tiller and head densities) and yield, screenings and protein were recorded at harvest.

Results

Colwell P status of the soil (0-10cm depth) at Birchip was 32ppm and Murtoa 13ppm.

There was a large negative affect of sowing time at both sites (eg. Birchip 2.6, 2.0, 1.5t/ha for May, June and July sowing respectively) but there was no affect of P application at either site (Table 1).

Table 1. The influence of sowing date and phosphorus application on grain yield and quality at Birchip and Murtoa.

Time of sowing	Phosphorus (kg/ha)	Product rate (kg/ha)	Yield (t/ha)		Protein (%)		Screenings (%)	
			Birchip	Murtoa	Birchip	Murtoa	Birchip	Murtoa
May	0	0	2.5	3.5	7.5	11.0	9.1	3.5
May	6	27.5 MAP	2.6	3.4	7.3	10.8	11.9	4.8
May	12	27.5 MAP + 30 Triple Super	2.7	3.4	7.7	10.7	10.5	3.8
May	18	27.5 MAP + 60 Triple Super	2.7	3.5	7.1	10.7	10.7	2.8
May	24	27.5 MAP + 90 Triple Super	2.8	3.4	7.3	10.8	6.6	3.9
June	0	0	2.0	3.0	10.4	12.0	9.1	3.3
June	6	27.5 MAP	1.9	3.2	11.4	12.4	9.9	3.8
June	12	27.5 MAP + 30 Triple Super	2.0	3.2	10.8	12.1	8.9	3.1
June	18	27.5 MAP + 60 Triple Super	2.1	3.2	11.2	11.7	8.5	2.9
June	24	27.5 MAP + 90 Triple Super	2.1	3.0	10.9	12.6	8.6	3.2
July	0	0	1.6	2.8	14.2	14.2	9.9	4.0
July	6	27.5 MAP	1.3	2.9	15.2	13.4	10.0	4.3
July	12	27.5 MAP + 30 Triple Super	1.5	2.8	15.5	13.7	7.9	3.1
July	18	27.5 MAP + 60 Triple Super	1.5	2.8	15.6	13.6	9.1	3.5
July	24	27.5 MAP + 90 Triple Super	1.6	2.7	15.8	13.8	9.8	3.8
		LSD (5%) sowing time	**0.2**	**0.1**	**0.8**	**0.4**	**2.0**	**0.6**
		P fertiliser rate	**0.2**	**0.2**	**1.0**	**0.5**	**2.6**	**0.8**

There was no significant response in yield from applying different rates of phosphorus fertiliser compared to the control (no phosphorus). There was also no response in protein or screenings within each time of sowing after applying different rates of P fertiliser.

However, there was a significant yield and quality response when comparing the different time of sowing treatments for both Birchip and Murtoa. Crops sown in May had the highest yield and lowest protein percentages, whereas July has the lowest yield and the highest protein percentages.

Results are similar at the long-term phosphorus trial, which started in 2003 at the BCG Farming Systems site. At this trial there was no significant improvement in yield from the application of P fertiliser. Yields at this site averaged 3t/ha with no consistent response to the rate of phosphorus applied. Protein levels were 14.5% and screenings 2.8% for this trial.

Interpretation

It has been suggested that sowing date may have a significant influence on yield and P fertiliser requirements of wheat. Crops sown early in the sowing period require smaller inputs of phosphate fertiliser to reach maximum yield and produce grain with a higher concentration of P than crops sown later in the season. This is thought to be due to the warm moist soils at this time of the year. Crops sown early develop extensive root systems and can take up nutrients more effectively.

Crops sown later into colder soils are slower to develop their root systems and it was thought that late sown crops required more fertiliser P to enable the crop to access sufficient P for early growth. Phosphorus promotes early root formation and growth, so crops with optimal P at seedling stage are better equipped to cope with restrictions at a later stage.

If a grower sows early in the season it is thought that similar yields may be achieved with smaller inputs of fertiliser. Similarly, a higher rate of applied P may be required to achieve the yield potential for later sowings.

These suggestions were not seen at the Birchip or Murtoa site this year, as there was no consistent P response over the two sites. These results are also consistent with work conducted previously at the BCG. Over three seasons (1999, 2000 and 2001), at a total of 12 locations, a significant response to P applications were not seen in cereal crops. The consistent nature of these results indicate that responses to phosphorus applications will be marginal on soils with good soil fertility (>15ppmCowell P) and fertiliser histories (a positive P balance).

Commercial Practice

Sowing after mid to late May resulted in a 0.3t/ha (Murtoa) and 0.5t/ha (Birchip) yield penalty for every three weeks that the crop was sown late.

Trial work conducted by the BCG over several years and sites indicate that economic responses generally cannot be expected from high applications of phosphorus fertilisers on the alkaline soils of the Wimmera/Mallee. This applies when paddocks have been reasonably well fertilised over several years and have a soil status above Colwell P of 15ppm.

Reducing P inputs will not compromise short-term soil fertility and crop production.
The best guide for making P fertiliser decisions are:

- P balance – audit P inputs (fertiliser) against P exports (grain). If a paddock has a positive balance 20kg P/ha or more in the last five years it is well fertilised.
- Soil test – if the soil test indicates Cowell P of 15ppm or more the soil has sufficient phosphorus reserves, and
- Total expenditure – if expenditure of P fertiliser is above 8 - 12% of total farm income than this should be revised (taken from FM500 farm performance analysis).