Long-term Phosphorus trial

The aim of this trial is to establish the most economical rate of phosphorus usage in a southern Mallee cropping systems over time.

Summary

Phosphorus responses were undertaken in 2004 on a barley crop. This is a long-term trial to determine the effect of a range of fertiliser application rates of phosphorus (P) on long-term grain yields and soil phosphorus reserves. Results indicate that in paddocks with a good phosphorus history little response, in terms of grain yield and protein, will be gained from higher rates of P. However grain yields and protein were significantly higher where some P was applied compared to no P.

Reducing phosphorus inputs to between 6 and 12kg P/ha will not compromise short-term soil fertility or crop production.

Work will continue on the long-term P trial site to determine if soil phosphorus levels are altered under the different treatments or if crop choice has an influence on soil reserves and phosphorus recommendations.

Background

Australian soils are naturally low in plant available phosphorus – a result of soils being geologically ancient and their highly weathered nature. However phosphorus is an essential component of cell membranes and is important during the cell division stage of early plant growth. Therefore phosphorus fertilisers have become a major input in Australian farming systems and cost between 8-15% of total farm income. Around $600 million worth of phosphorus fertiliser is applied across rural Australia each year, but it often binds with soils to form compounds unusable by most plants.

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 Cowell P levels less than 25ppm. This might be explained by the highly calcareous nature of Mallee soils, which tend to have a high capacity to fix phosphorus and consequently a high proportion remains unavailable to the crop. Previous BCG work has been conducted on single sites however in 2003 the BCG established a long term P trial to see if the results are consistent over a number of years.

Methods

This trial was conducted using a fully replicated (x4) randomised block design at the Birchip Farming Systems site.
The trial was established in 2003 where Yitpi wheat was sown.
Previous paddock history includes:

2001 : Chemical fallow
2002 : Fallow
2003 : Wheat

In 2004, Sloop S.A. barley was sown on May 21. Fertiliser used in the trial were MAP (NPKS 10-22-0-1.5) as the base rate of fertiliser and TripleSuper (NPKS 0-20.2-0-1) as the treatment fertiliser. The table below indicates the rates that each fertiliser was applied.

Table 1. Rates of fertiliser applied for each treatments

Treatment	Phosphorus rate (kg P/ha)	Triple Super (kg/ha)	MAP (kg/ha)
1	0	0	0
2	5	25	145gMAP
3	10	50	145gMAP + 155g Triple
4	15	75	145gMAP + 310g Triple
5	20	100	145gMAP + 465g Triple
6	25	125	145gMAP + 620g Triple

Results

The initial soil phosphorus levels at the establishment of the trial was ……
Colwell P status of the soil in 2004 (0-10cm depth) at the BCG Farming Systems site was ……..

Table 2. Grain yield and quality at the long-term phosphorus trial at the Farming Systems Site

Treatment	Yield t/ha	Protein
0	0.56	17.0
5	0.85	15.3
10	0.93	15.8
15	0.96	15.7
20	0.91	15.6
25	0.87	14.5
LSD (5%)	0.23	1.8

There was a significant response in both grain yield and grain protein when comparing no phosphorus to some applied phosphorus. However there was no difference in yield or quality between the different rates of phosphorus applied.

Treatments with no phosphorus applied had significantly lower grain yields and significantly higher protein levels compared to those treatments with applied phosphorus.

Interpretation

BCG results over a number of years suggest that responses to phosphorus applications above 6kg P/ha will be marginal on soils with good soil fertility (>15ppm Cowell P) and fertiliser histories (a positive P balance).

Commercial Practice

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 where paddocks have been reasonably well fertilised over several years and have a soil status above Cowell P of 15ppm or higher.

The rate of phosphorus application is dependent on crop type and yield.

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 5 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 total expenditure of P fertiliser is above 8-12% of total farm income than this should be revised (taken from FM500 farm performance analysis).