

Nutrition

Optimising phosphorus fertiliser rates on alkaline soils

SUMMARY

Fertiliser P trials were undertaken on wheat, barley, canola, field pea, lentil and faba beans at four sites over two seasons (1999 and 2000). Fertiliser P is rapidly fixed and becomes unavailable to plants on neutral to alkaline soils. P responses over the two seasons indicate that for wheat, barley, canola and field pea the responses to P fertiliser were insignificant or if a response did occur it occurred from 0 to 6 kg P/ha. It appears that faba beans do respond to higher rates of P (up to 18 kg P/ha), which was a consistent result in both years. It is not clear how lentils respond to P fertiliser.

It is recommended to base a P fertiliser application rate on:

- Long-term P balance (P fertiliser applied minus the P exported in grain)
- Soil test result (soil P test of above 15ppm Colwell appears to indicate adequate Phosphorus levels)
- Whole farm expenditure (not more than 10 to 12% of gross farm income expenditure on fertiliser (inclusive of N and S) - as an average of a minimum of five years)

The aim of this long-term trial is to identify the critical P fertiliser rates for a broad range of crops on different soil types in the southern Mallee and northern Wimmera. This trial was also undertaken in 1999.

BACKGROUND

The BCG in previous work, and in reviewing other trials done in the region, have observed a very inconsistent story in relation to P requirements for different crops grown on alkaline soil types on paddocks with different histories. The BCG in conjunction with the Avon Richardson cropping group have set up long term P trials to investigate P responses over three different seasons. This report deals with the results for the second year.

Alkaline soils with a high Calcium status can bind soluble P (from fertiliser) quite rapidly (within six weeks of sowing depending on the soil water content). After the soluble P has been bound to the Calcium in the soil it becomes part of the organic P pool which is unavailable to plants. The crop is then dependent on the mineralisation of P from the organic P pool in the soil to supply it with sufficient P for the rest of the season. Broad acre cropping farmers spend between 5 and 10% of their gross annual income on P fertiliser - it is essential that this single large expenditure is carefully considered so that inputs are applied where required.

METHOD

Phosphorus fertiliser response trials were undertaken at Birchip, Sea Lake, Charlton and Donald (Table 1). The site at Donald was managed by the Avon Richardson cropping group. At each site five crops were sown with five rates of P fertiliser (0, 6, 12, 18 and 24kg of P/ha) as triple super. All treatments were replicated.

Table 1. Soil type and nutrient profiles for 2000 sites

	Soil type	Soil pH (in water)	Soil P (Colwell ppm)	4 year P balance (kg/ha)#
Birchip - vetch	Mallee clay loam	8.1	24	+8
Birchip - stubble	Mallee clay loam	8.5	31	+13
Sea Lake	Sand	8.7	15	+19
Charlton	Red duplex	7.6	47	+37
Donald	Medium clay	6.4	23	+1

calculated balance over four years from P fertiliser added to the system minus the P exported in grain

RESULTS

Most sites produced good crops (Table 2) - crop failure in pulses occurred at Sea Lake with simazine and frost damage; and at Charlton with frost damage. Pulses at these latter sites were not harvested.

Table 2. Average crop yield for the P trials at each site (Beans were only grown at Donald).

	Wheat	Barley	Canola	Field Pea	Lentil	Faba bean
Birchip	2.4	2.4	0.9	1.3	1.0	-
Sea Lake	3.7	2.6	1.3	-	-	-
Charlton	3.6	2.7	0.7	-	-	-
Donald	3.2	3.5	1.0	2.9	-	1.5

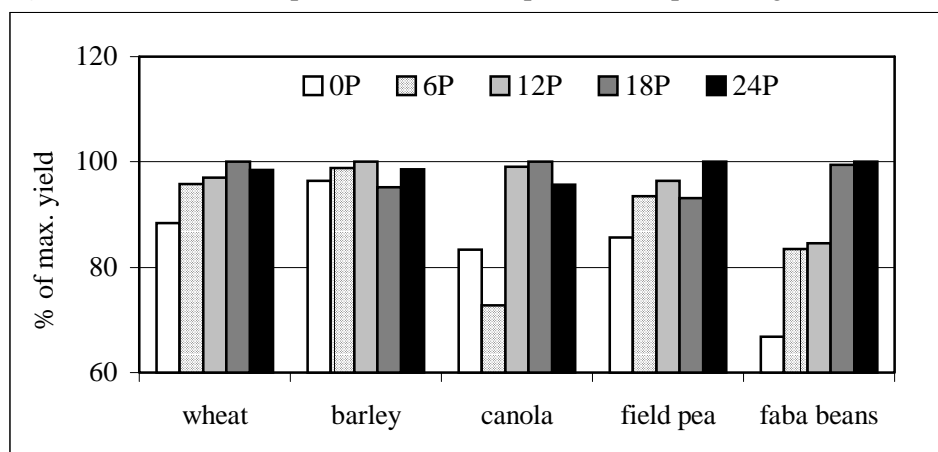
Fertiliser P responses were found from the zero rate to the 6 kg P/ha rate for some crops at some sites, except for faba beans at Donald where P responses were highly significant at higher rates (Table 3). For most crops there were few if any responses to P fertiliser, with the exception of at Sea Lake where there was a yield response from 18 to 24 kgP/ha.

Table 3. Yield response to P fertiliser. (NR = no response, 0→6 = response from 0 to 6kg of P but not at higher rates.)

	Wheat	Barley	Canola	Field Pea	Lentil	Faba bean
Birchip	NR	0→6	NR	NR	#	-
Sea Lake	18→24	NR	NR	-	-	-
Charlton	NR	NR	NR	-	-	-
Donald	0→6	NR	NR	NR	-	0→6 12→18

for lentils at Birchip the data was not clear, there was a response at the highest rate of P but the responses from 0 to 6 and from 6 to 12 kg of P/ha were not consistent.

The site with the most consistent response to P fertiliser was at Donald. The only significant and economic yield response was in wheat and faba beans - the significant response to P fertiliser from the 0 to 6 kg P/ha in wheat resulted in a 0.25 t/ha gain in yield. For faba beans there was a response from the 0 to 6 kg P/ha rate (0.29 t/ha) and from 12 to 18 kg P/ha (an additional 0.26 t/ha) (see Figure 1).

Figure 1. P fertiliser response at Donald, expressed as a percentage of maximum yield.

INTERPRETATION

These results confirm the findings from previous years, that on sites with reasonably good fertiliser histories and relatively fertile soils (above 15ppm Colwell P) responses above 6 kg P/ha are marginal, except for in faba beans where responses are found at 18 kg P/ha or more.

COMMERCIAL PRACTICE

If a paddock has been reasonably well fertilised over the last 5 years (ie. the paddock has a positive P balance) and the soil status is above 15 ppm Colwell it then P responses above 6 kg P/ha will be marginal for all crops except faba beans. There is insufficient data for lentils at this stage to make a recommendation in relation to P requirements.

The best guidelines for making a P fertiliser decision are:

- P balance - if the paddock has a positive balance of 15 kg P/ha or more in the last four years, it is well fertilised
- Soil test - if the soil P test is above 15ppm Colwell it is reasonably fertile
- Total expenditure - if expenditure on P fertiliser is above 10% of total farm income then this should be reviewed
- Faba beans appear to be more responsive to P fertiliser compared to other crops, and there is insufficient data for lentils to make a recommendation