Fluid phosphorus fertilisers offer considerable potential in Victoria

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This trial aims to investigate the comparative efficacy of fluid forms of Phosphorus (P) fertiliser compared to the current granular forms for application to grain crops grown on alkaline soils of Victoria.

Summary: Fluid forms of Phosphorus such as Ammonium Polyphosphate (APP) and Phosphoric Acid have been shown to significantly increase the growth and grain yield of crops on highly calcareous soil on the Eyre Peninsula of SA compared to granular fertiliser forms such as DAP and Triple Super. Field trials conducted at three sites in 2003 in Victoria on alkaline soils (central and southern Mallee and Wimmera Plains) demonstrated that fluid forms of P fertiliser promoted the growth of wheat more than granular forms at all sites but this was translated to a yield response at only one site (Birchip). There is no reliable diagnostic tool however presently available for predicting under what circumstances fluid forms will outperform granular forms of P. Experimentation will continue at the same sites in 2004.

Background

Fluid forms of fertiliser are widely used in the United States due to ease of handling compared to granular fertilisers and the potential to create mixes of nutrients and other agro-chemicals. However recent research on the Eyre Peninsula of South Australia by Bob Holloway and his co-workers has firmly established that fluid fertiliser forms can be significantly more efficient (ie. greater amount of grain produced per unit of P applied) than granular fertiliser forms. Because the Eyre Peninsula environment is similar to large parts of the Victorian Mallee (highly alkaline soils with annual rainfall less than 375mm), the question was raised whether the results found with fluid fertiliser forms of P were also applicable to Victoria. These trials form part of a large project funded by GRDC (CSO231) involving SARDI, CSIRO L&W and PIRVic to develop a greater understanding of the potential of fluid fertiliser forms to improve grain yields on alkaline soils of southern Australia.

Methods

Field trials were established at Walpeup (Calcarosol; 325mm annual rainfall; Colwell P 7 mg P/kg) and Birchip (Sodosol; 375mm; 12mg P/kg) in the Mallee and at Kalkee (Vertosol; 420mm; 17mg P/kg) in the Wimmera. The dry matter and grain yield response of wheat (cv. Yipti) to two forms of fluid fertiliser: ammonium polyphosphate (APP) and phosphoric acid (PA) or two granular forms: di-ammonium phosphate (DAP) and triple superphosphate (TSP) was assessed. Fertiliser P was applied at 0, 4, 8, 12, 16 and 24kg P/ha in a randomised block design with four replicates. Due to differences in nitrogen content of the different fertiliser products, varying rates of granular urea was applied at sowing to ensure that all plots received the equivalent of 50kg N/ha at all sites. A basal application of Zinc (applied as Supra-Zinc) was also applied to the soil immediately prior to sowing.

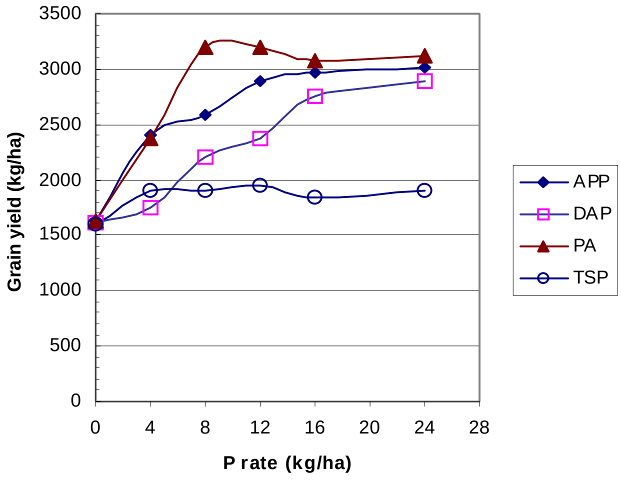
Results

Growing season rainfall was below average at all three sites, with a particularly dry finish (see Table1). There was significant dry matter (at mid tillering) and grain yield responses to P at all three sites, reflecting the low plant available-P status of the field sites. Generally the two fluid fertiliser forms of P (APP and PA) produced significantly ($P < 0.05$) more dry matter at mid tillering than the two granular forms (DAP and TSP), especially at Birchip and Kalkee. PA produced greater dry matter response than APP and DAP more dry matter than TSP at all sites, especially at the lower rates of applied P (Figure 1). However, the superior dry matter production from the fluid treatments translated into greater grain yield at only one site, Birchip, where PA produced up to 0.99t/ha (45%) more grain than DAP and 1.29t/ha (67%) more grain than TSP at an equivalent rate of P (Figure 1). However at the highest (non commercial) rate of P application (≥ 16 Kg P/ha), DAP performed similarly to the fluid forms of P.

Table 1. Plant available P status (Colwell P) and growing season rainfall (mm) for 2003 season trials at Walpeup, Birchip and Kalkee.

Site	Soil P (mg/kg)	Pre-anthesis Rainfall (mm)	Post anthesis rainfall (mm)	Mean grain yield (t/ha) across all treatments at highest rate of P
Walpeup	7	103 (11 Jun – 1 Oct)	47 (1 Oct – 27 Nov)	2.05
Birchip	12	141 (22 May – 8 Oct)	29 (8 Oct – 1 Dec)	2.73
Kalkee	17	172 (17 Jun – 4 Nov)	6 (4 Nov – 12 Dec)	3.87

Figure 1: Effect of P fertiliser form on the grain yield of wheat (Birchip 2003)
l.s.d. (5%); Form = 88.8 ; P rate = 105.1 ; Intn = 210.2



Discussion

Previous (unpublished) reports of the responsiveness of grain crops to fluid fertiliser forms of P in north western Victoria have been inconclusive. This contrasts to the Eyre Peninsula where fluid fertilisers have been shown to produce on average up to 25% greater yields than granular forms at equivalent rates of P (Holloway et al. 2001).

Trials reported in this article however suggest that fluid fertiliser forms of P offer the potential to significantly improve the growth and grain yields of grain crops on the alkaline soils of Victoria. Other studies (Lombi et al. 2004) indicated that the greater ability of fluid forms of P to improve grain yields results from both decreased rates of chemical 'fixation' of P in the soil and a greater mobility (diffusion rate) of P compared to granular forms. Results obtained from field trials, located on three different soil types that represent the major soil types used for cropping in northwest Victoria, lend support to those obtained from a major glasshouse trial conducted in Horsham in 2002. The glasshouse trial, where soil water was kept non-limiting to plant growth, tested over 30 soil types collected from the major grain growing regions of Victoria and South Australia, and found that fluid fertiliser forms of P are generally (but not always) superior to those of current granular forms.

One challenge to the wider scale adoption of fluid fertilisers is our current inability to identify under what circumstances fluid fertilisers out-perform granular forms. Under glasshouse conditions, there was a strong trend for fluid forms to perform best at both low (< 5.5) and high (> 8.5) soil pH's and where levels of calcium carbonate are high. However this trend was not repeated in the field trials reported in this article as the soil pH were greater (although Colwell P was lowest) at the Walpeup site, where the comparative yield response to fluid P was lower than at Birchip and Kalkee. Interestingly, the highly significant growth responses to fluid P forms recorded at mid tillering at Kalkee did not translate to differences in grain yield suggesting some other factor may be influencing fertiliser efficacy. This type of growth response to P (as opposed to N) is unusual, as generally early dry matter responses of this magnitude will be maintained throughout the season. This may reflect the seasonal conditions, as although the crop at Kalkee yielded on average the most of all three sites, it experienced severe water stress during the latter part of the season as reflected in the post anthesis rainfall of 6mm (Table 1). However the trial at Birchip also experienced a very dry finish, although not to the same extent. These trials will be repeated in 2004 to help clarify to what extent seasonal conditions influenced the comparative responses to fertiliser form.

Commercial Practice

At present fluid forms of P cost between 1.3 and 2 times more per unit of P than granular forms (although this difference is decreasing rapidly as the value of the $A increases). Although the use of fluid forms of P produced financial benefits at lower rates of application at Birchip, growers should refrain from converting to fluid P forms until our ability to predict when and where fluids forms of P perform best is better developed.

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