Fluid Phosphorus Fertilisers: How did they fare in Victoria in 2005?

R Armstrong, J Nuttall and R Argall (Department of Primary Industries, Horsham VIC); M McLaughlin and E Lombi (CSIRO L&W, Adelaide); B Holloway (SARDI, Minnipa)

Summary

Field trials were conducted at two sites (comprising Sodosol and Calcarosol soil types) in the southern Mallee and one in the Wimmera (Vertosol soil) to assess the responsiveness of wheat to fluid forms of phosphorus (P) fertilisers. Fluid P forms (APP and phosphoric acid) generally produced greater growth during vegetative stages of crop growth compared to granular forms (DAP and Triple Super) at all three sites. However, in a season characterised by a late break and dry conditions prior to flowering, early growth responses to P fertiliser (regardless of form) translated to grain yield responses at only one Mallee site. In contrast there was significant grain yield responses to fluid P at Dooen (Wimmera). At this site, fluid P forms produced 0.24 t/ha (or nearly 10%) more grain on average than granular forms at commercially applicable rates (4 to 12 kg P/ha).

Background

Grower interest in fluid forms of fertiliser has increased markedly in recent years. Bob Holloway and his co-workers have clearly demonstrated the greater efficiency of fluid forms of phosphorus fertiliser compared to traditional granular forms on the highly calcareous soils of the Eyre Peninsula of South Australia. Although preliminary surveys conducted under glasshouse conditions have indicated that fluid forms of phosphorus offer significant growth benefits for crops on the alkaline soils of the Victorian Mallee and Wimmera (McBeath et al. 2004), this has yet to be conclusively demonstrated under field conditions in this region. These trials form part of a large project funded by GRDC (CSO231) involving SARDI, CSIRO L&W, DPI Victoria and Arris Pty Ltd 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 two sites in the southern Mallee near Birchip: one at K, H & L Barber’s property (Sodosol, long term average annual rainfall 375 mm) and the other at the BCG Birchip Replicated Trial site (Calcarosol; 375 mm) and at Dooen (Vertosol; 420 mm) in the Wimmera. The dry matter and grain yield response of wheat (cv. Yanac) to 2 types of fluid fertiliser: ammonium polyphosphate (APP) and phosphoric acid (PA) and 2 granular types: di-ammonium phosphate (DAP) and triple superphosphate (TSP) was assessed. Fertiliser P was applied at 0, 4, 8, 12, 16 and 24 kg P/ha in a randomised block design with 4 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 50 kg 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

Rainfall at the all sites was characterised by extremely dry autumn conditions (< Decile 1) and a late break (mid June in Mallee; late June in Wimmera) followed by good rainfall in early June (Table 1). The subsequent period from July to early September was dry (< Decile 3) but rainfall following flowering (grain filling) was above average at all sites.

There were significant dry matter responses at mid tillering to increasing rates of P fertiliser application at all three sites, with the greatest response (P0/P24: 145%) recorded at Dooen (Figure 1). Fluid forms of P fertiliser (APP and PA) produced greater responses than two granular forms tested (DAP and TSP) by up to 58% at low to moderate rates of applied P (4 to 16 kg P/ha) at two of these sites (BCG-Birchip and Dooen). P application (regardless of type) produced a significant grain yield response at the BCG site but had no major effect at Barbers (data not presented). Fertiliser form (fluid vs granular) had no consistent effect at either of the two Mallee sites (BCG or Barbers). At the Dooen site, both fluid P forms outyielded the granular forms by an average of 0.24 t/ha (or nearly 10%) at low rates (4 to 12 kg P/ha) of applied P (Figure 2).

Table 1: Key soil properties, rainfall and average grain yield at 3 trial sites

Site	Colwell P (mg/kg)	CaCO3 (MIR) (%)	Phosphate buffering capacity (MIR)	DTP zinc	Rainfall (mm)			Mean grain yield (t/ha)
				mg/kg	Jun-Jul	Aug-Sep	Oct-Nov	
Barbers	21	2.4	46.5	1.29	88	55	109	1.79
BCG-Birchip	39	4.6	123.9	1.60	86	56	90	1.78
Dooen	20	1.1	36.7	1.22	59	62	95	2.63

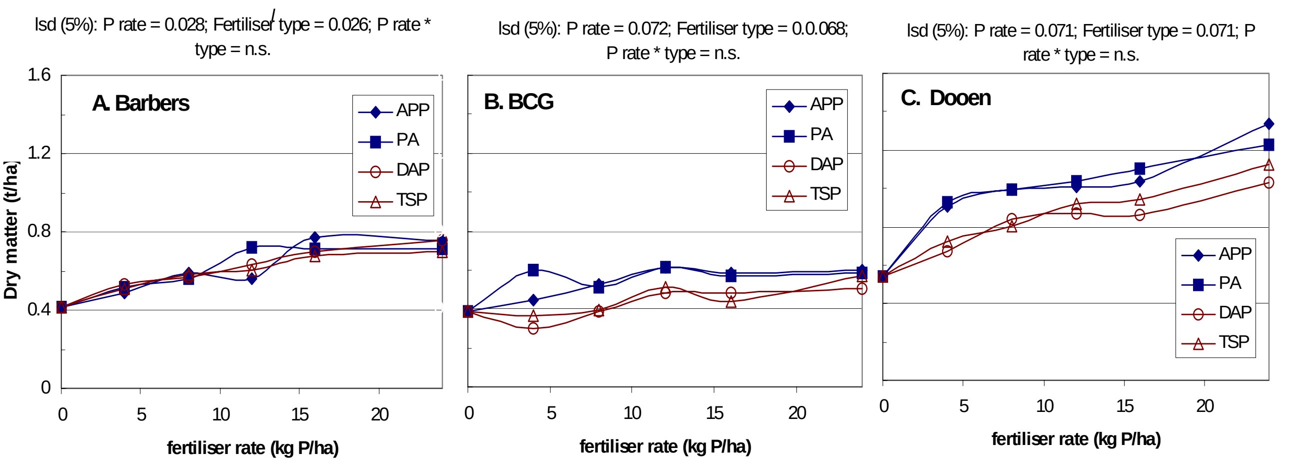

Figure 1: Dry matter response at mid tillering of wheat cv. Yanac to either fluid or granular P fertilisers at three sites: A. Barbers (Birchip), BCG site (Birchip) and Dooen in 2005.

Trials similar to those reported in this article were conducted at two of the three sites (within the same paddock or on the same soil type across the fence to minimise the risk of disease) in

2003 and 2004. This strategy was used to gain a better understanding of the effect of seasonal conditions on crop responsiveness to fertiliser P form. In the previous trials, fluid fertilisers clearly outperformed granular forms of P fertiliser at the Barbers site in 2003 but had no effect in 2004, which was characterised by low growing season rainfall (< Decile 2) and crop failure. Fluid fertilisers outperformed granular forms (at equivalent rates of applied P) during the vegetative stages of growth (mid tillering) at Dooen in 2003.

The 2005 trials produced a very different pattern, with fluids outperforming the two granular P fertilisers at the Dooen (Wimmera) site but having no effect at Barbers (southern Mallee). This result may reflect two different processes. Firstly, the 2003 season was characterised by average rainfall between sowing and flowering followed by severe water stress during the grain fill period. This contrasts with 2005 where soil water was potentially limiting in the vegetative growth stages (due in part to a large number of small rainfall events of 1 – 2 mm that did not effectively contribute to soil water storage) whereas relative good rainfall occurred between flowering and grain maturity (Table 1). This rainfall pattern allowed the early growth advantage of fluid P treatments at Dooen to ultimately be converted to grain yield. Experimentation is currently in progress at DPI (Horsham) and CSIRO (Adelaide) to improve our understanding of the effect of water availability (including its timing) on the relatively efficacy of fluid and granular forms of P.

More perplexing is the very differing response of wheat to fluid fertilisers in 2003 and 2005 at the Barbers (Birchip) site. Although both trials were conducted in the same paddock, it must be recognised that soil type can vary markedly over relative small distances in the Mallee (Nuttall et al. 2003). We are currently planning to assess the effect of soil spatial variability on crop responsiveness to fertiliser form. It is anticipated that this knowledge will assist growers to better assess whether it is financially feasible to convert their farming operations to using fluid fertiliser forms.

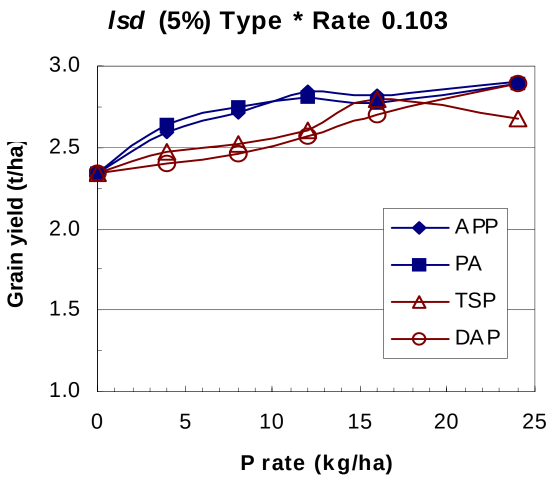

Figure 2: Grain yield response of wheat cv. Yanac at Dooen to P fertilisers in 2005.

References

McBeath, T. et al. (2005). Responsiveness of wheat (Triticum aestivum) to liquid and granular phosphorus fertilisers in southern Australian soils. AJSR 43, 203-212.

Nuttall, J. et. al. (2003). 'Interrelationships between soil factors potentially limiting cereal growth on alkaline soils in NW Victoria' Aust. J. Soil Res. 41, 277-292.

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