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A Look At The Rise Of Fluid Fertilizers In Australia

R&D is paving the way by introducing and attracting more and more producers to the benefits of fluids over granular.

Farmers continue to increase their use of fluid fertilizers in South Australia (SA) and Western Australia (WA), the main focus turned on the application of fluid nitrogen. R&D has been impressive enough to lure more and more growers into investigating the benefits of using fluid nitrogen (N) fertilizers over granular N fertilizers to improve crop yields and quality, and identify any knowledge gaps via further R&D. Adoption of fluid N is predicted to further increase in WA because the cost of using fluid N fertilizer is only marginally higher than solid fertilizers (such as urea).

Research also has shown the benefits of fluid phosphorus (P), reporting more efficient uptake and improved yields of wheat on calcareous soils. If consistent benefits can be found on low pH soils with high iron and aluminum levels, which usually lower the availability of soil P, the use of fluid P will expand further, the main areas being SA, Victoria, and small parts of WA.

Fluid N

Effect on grain yield. In trials conducted in WA, fluid N and granular urea were applied at two

or three rates of N, often including application immediately before sowing and four to twelve weeks after sowing. In 107 of the 132 comparisons of UAN and granular urea at the same rate of N and time of application, there was no difference between fluid N and granular urea for grain yield. Despite differences in N form, fluid N applied through a boom spray was as effective as broadcast-applied urea for the vast majority of wheat and canola crops in WA. In a paddock scale trial, topdressing granular N resulted in uneven application compared with the boom spray application of fluid N. Uneven distribution could reduce crop performance and thus profitability.

In ten studies over three years, fluid N banded near the seed was compared with fluid N applied through the boom and granular urea banded and/or topdressed. In seven out of the ten studies, there was no significant difference in yield between either product when topdressed or banded, although early nutrient uptake and growth were improved with banding.

There has been a growing interest among WA farmers in the application of fluid N through liquid injection systems on seeders. The results from 22 trials conducted suggested that compared with fluid N boom sprayed, banded fluid N improved N-use efficiency, which could lead to a decrease in N application rate while still maintaining the same yield.

Effect on grain protein. There is very limited published information available to review on this subject in WA. Trials conducted at Buntine and Kojonup showed that in high-yielding situations, late application of fluid N could be used to boost wheat protein content and profits but suggested that more work would be needed to avoid the problem of leaf scorch or burn when using such late fluid N applications. Post-emergence applications of fluid N can cause leaf scorch or burn so that the reduction of the leaf area of the damaged crop might slow its growth and limit final yield. Leaf scorch has been considered an important problem in limiting use of fluid N.

Late applications of granular urea or UAN at flowering to boost wheat grain protein content could be risky in WA climatic conditions where flowering often coincides with periods of water deficit that could affect the capacity of crops to use fluid N. However, in dry conditions, fluid N could be absorbed through the plant's leaves and should provide a more reliable protein boost than topdressed granular urea since fluid N can only be used to lift protein when significant amounts of rain wash N into the rooting zone. The extent of dryness of soil or the incidence of rainfall during late applications of N will most likely determine how effectively fluid N could improve protein compared with granular urea. A significant aspect of fluid N use is the potential for late N applications to adjust N supply in line with yield expectations and improve protein content of the grain.

Fluid N will be best suited as a tactical N management tool for boosting protein in crops that are likely to exceed target yields and where dry surface soil conditions limit the capacity of roots using N applied as granular.

Table 1. Summary of sites where fluid P produced significantly greater yield than equivalent rates of granular P in WA.

Site	Year	Soil type	Soil pH (CaCl)	Yield increase (%)
Dandaragan	2000	Sandy loam	5.5	9
Salmon Gums	2001	Clay loam	8.0	11
Mukinbudin	2001	Loam	7.5	8
South Cross	2003	Sandy loam	4.4	31
West Dale	2003	Gravelly loam	5.4	29
Newdegate	2005	Loamy sand	5.2	8

Fluid P

Effect on grain yield. One study over the period 2000 to 2005, for example, reported that fluid P applications resulted in 8 to 31 percent increases when compared to granular P (Table 1). All response sites had high P-fixing soils.

Increased efficiency. Depending on soil pH, P in soil solution generally occurs as the anions, $H_2PO_4^-$ or HPO_4^{2-}. These anions readily react with soil cations, such as Ca, Mg, Fe and Al, to form various phosphate compounds of low water solubility. Phosphorous reactions vary with soil pH. Highly weathered low pH soils generally contain large amounts of soluble Fe and Al that react with soluble P compounds in the soil to form Fe- and Al-phosphates, whose solubility and availability to plants are low. In high pH (calcareous) soils, P reacts with Ca to form Ca-phosphate compounds. Soluble P controls the formation of Ca-phosphate compounds and the rates of their transformation from insoluble to soluble form, thus decreasing the plant availability of applied P in high pH soils.

Phosphorus tends to be more strongly adsorbed or precipitated as insoluble Ca-P minerals in high pH soils, whereas in acid soils, insoluble Al and Fe products dominate. Thus, to improve P efficiency, what is required is a fertilizer with a great rate of P diffusion and a supply of P that remains available to the plant under these conditions. Plant roots also play an important role in exploring P for uptake in moist soils. Another study applied technical grade MAP in fluid and granular forms to a highly calcareous soil (67% free $CaCO_3$). The results indicated that P diffused to a greater distance and remained in a more available chemical form when MAP was applied in fluid form. Yet another study showed that about 12 percent of the P from granular MAP remained in granular form five weeks after application, suggesting that a significant fraction of water soluble P had been converted to an insoluble form. This further suggested that the greater ability of fluid forms of P to improve growth and P uptake of wheat was a result of decreased rates of chemical 'fixation' of P in the soil (available chemical form) and increased mobility (diffusion rate) of P compared to granular forms.

Table 2. Approximate prices of a range of fluid P fertilizers compared with granular P and the breakeven wheat yield increase required to cover the cost of fluid P.

Fertilizer	$/tonne	Cost $/ha	Break even yield increase (%)
Granular	497	26.16	
Phosphoric acid	800–1,500	41.48-67.59	6.2-16.7
APP	842-1,029	57.51-68.93	12.7-17.3
Liquid NP	380	37.10	4.4
TGMAP	800-1,200	37.59-52.40	4.6-10.6

In terms of economics, breakeven point for fluid P in wheat yield increase ranged from 5 to 17 percent (Table 2). Thus, if crop yield benefit was consistently obtained, application of fluid P could be profitable in WA.

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