

Fluids Excel Over Granular On Australian Calcareous Soils

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Summary: There is no doubt that fluid fertilizers, including suspensions, have the potential to make a significant improvement in fertilizer efficiency on many calcareous soils, especially those with high concentrations of calcium carbonate and possibly a wide range of other alkaline and acid soils as well. Of the 52 wheat experiments conducted on grey highly calcareous soils, 47 gave positive yield increases with fluid fertilizers, with the mean increase depending on the form of fluid used. On red-brown sandy loam soils, 38 experiments were conducted with 22 positive yield increases due to fluids and 16 with no difference. On red-brown loamy sand, 13 experiments were conducted, with only one positive result with fluids, four positive with granular, and eight experiments with no differences. The positive increase rate with fluids was much greater when micronutrients were applied in solution with phosphorus (P) and nitrogen (N). Technical grade (TG) MAP solutions (acidified with phosphoric acid) with micronutrients were generally the most consistent form of fluid fertilizer tested. P supplied with N and Zn in acidified TGMAP solutions in rate-response experiments was four to 15 times more efficient in supplying P to wheat on highly calcareous soils than was granular MAP. Overall, 70 of 103 experiments showed positive yield increases when fluid fertilizers were applied.

Prior to 1998, there was no reason to believe that soil-applied fluid and granular fertilizers would perform differently, in terms of fertilizer efficiency, on any soil used for cereal production in South Australia. Hence, the initial investigations of fluid fertilizers on the Eyre Peninsula produced results that were unexpected.

The earliest field experiments with fluid fertilizers were based on simple comparisons between clear liquid and granular formulations. At the time, more emphasis was placed on assessing differences in performance than on economic or practical considerations.

Eight years later, more than 100 statistically based field comparisons between fluid and granular alternatives, coupled with detailed laboratory experiments, have provided good evidence for the greater efficiency of fluid fertilizer than equivalent granular formulations on highly calcareous soils on the Eyre Peninsula. There is also evidence that multi-nutrient fluid fertilizers will improve nutrient efficiency for cereals and alternative crops on other alkaline and acid soils, particularly those that rapidly immobilize P.

Calcareous soils

APP. A total of 25 wheat comparisons were conducted between ammonium polyphosphates (APP) and granular fertilizers on grey highly calcareous soils. Of these, APP produced a mean yield increase of 15 percent over granular in 23 of 25 trials. In the remaining two experiments there were no yield differences. In one of these, no micronutrients were added as basal fertilizer and in the other the addition of manganese caused the APP to precipitate. The addition of phosphoric acid to APP to improve solubility of zinc sulfate led to improved zinc uptake.

Phosphoric acid. A total of 13 comparisons were conducted, with the fluid producing a mean yield increase of 21 percent in 10 of the experiments. In three of the comparisons there were no yield differences.

TGMAP/DAP. In all there were 14 comparisons between soluble technical grade (TG) MAP or DAP and granular products. There was a mean yield increase from the fluid of 18 percent over all comparisons. Micronutrients were mainly applied in the NP solution at planting. Overall, there were 52

comparisons on the grey calcareous soils, 47 showing a positive yield increase with fluid and five with no yield difference.

Sandy loams

APP. There were 13 comparisons between APP and equivalent granular fertilizers on red-brown sandy loams, with a mean grain yield increase of 14 percent due to APP in 10 of these.

Phosphoric acid. In 16 comparisons there were nine instances of yield increases with fluids and a mean yield increase of 11 percent. In each of the nine positive responses, basal micronutrients were applied in solution with the phosphoric acid and urea. In the case of the granular equivalent fertilizers, micronutrients were applied either coated on the granule or incorporated with it. In seven comparisons where there were no yield differences between fluid and granular, no basal micronutrients were applied or they were surface or foliar applied preplant. This occurred when comparing NP fertilizers alone.

TGMAP/DAP. Of nine experiments conducted on red-brown sandy loams there were no yield differences between fluid and granular in six. In three cases

where micronutrients were applied in solution with TGMAP at planting, there were yield increases, with a mean increase of 15 percent. Overall, there were 38 comparisons, 22 with positive increases using fluids and 16 with no yield differences.

Loamy sand

APP. Of eight trials conducted on red-brown loamy sand there were no yield differences between APP and granular fertilizers in six, and a mean yield decrease of 10 percent in three of the trials.

Phosphoric acid. There was a single experiment comparing a phosphoric acid-based product with an equivalent granular product on this soil with a grain yield decrease of seven percent with the fluid.

TGMAP solution was compared in four experiments with granular MAP. In one case, TGMAP produced higher grain yield over three rates of P (10, 20, and 40 lbs/A of P₂O₅) than MAP (4%, P<.0.01) and in the other three cases there were no significant differences in grain yield.

Summing up, there were 13 comparisons on this soil, with four yield decreases with fluids (APP and phosphoric acid), one increase with fluids (TGMAP), and nine with no yield differences recorded. There are likely to be highly complex relationships between how mobile (N) and immobile (P) nutrients with different solubility behave when applied together to the soil.

Suspensions

Initial research with suspensions on the three soil types described above has indicated that suspensions are likely to perform in a similar way to other fluids in general but as with clear liquids, fertilizer performance varies widely according to formulation and the combination of nutrients used.

In 2004, rate response experiments were established with suspensions at two sites on grey highly calcareous soils with a further experiment

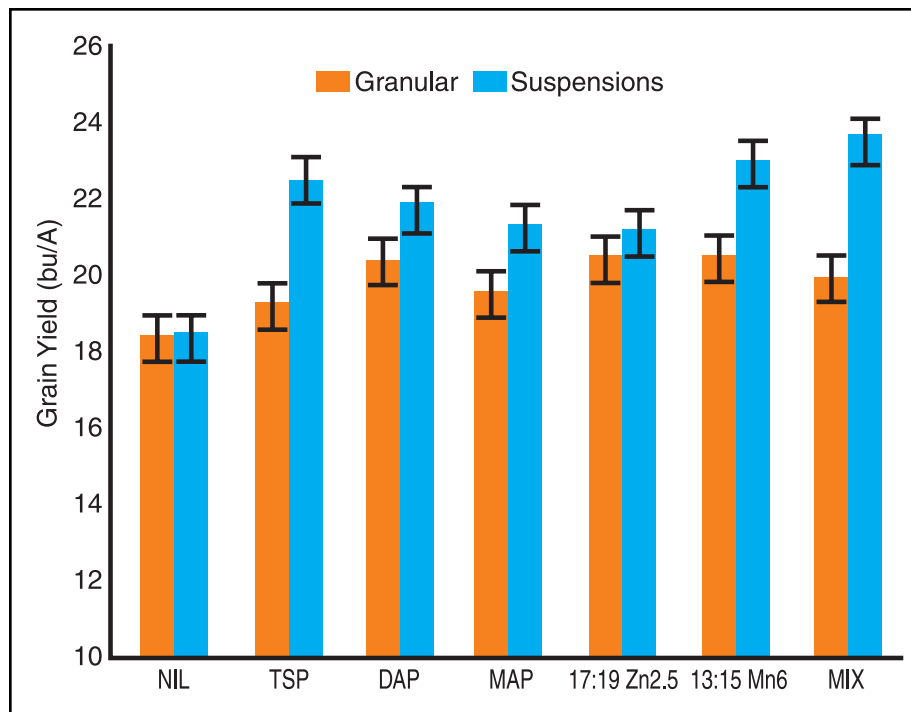


Figure 1. Grain yield of Wyalkatchem wheat with fertilizer applied in granular or suspension forms at Cungenena, 2004.

comparing several commercial fertilizers in granular or suspension form. In this experiment, basal nutrients (N, Zn, and Mn) were applied as granular so that all plots received 20 lbs/A of P₂O₅, 10 lbs/A of N, 2.7 lbs/A of Zn, and 8.2 lbs/A of Mn, respectively. Results are shown in Figure 1. As in the case of most of the suspensions, the only additive besides clay was acid used to increase the breakdown rate of the granules.

Micronutrients

Where possible, micronutrients (Mn, Zn, and Cu) were applied in solutions with fluid fertilizers and integral with granular fertilizers. Both zinc and manganese sulfate can be readily mixed with phosphoric acid-urea solution (warning: phosphoric acid and UAN should never be mixed under any circumstances because of the possibility of explosion).

In 2000, on a calcareous red-brown sandy loam, P was applied at rates ranging from 0 to 29 lbs/A of P₂O₅ as phosphoric acid or TSP. No other

nutrients were applied. There was no yield response to either form of P.

At an adjacent site, P, N, and Zn were applied in a factorial experiment as fluid or granular. There were significant responses to all three nutrients with fluids but not with granular. It is apparent that applying micronutrients in solution with NP fluids is the most efficient way to apply micronutrients on these soils.

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