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Fluids Outdual Granular In Australian Wheat Trials

Fluid sources of P, N, and Zn performed markedly better than granular fertilizers in terms of promoting dry matter, P uptake, and grain yield.

Summary: *Shoot dry weight increased 27 percent by adding 9 lbs/A of fluid N, versus no response to granular application. Similarly, the application of 9 lbs/A of fluid N increased P uptake in shoots by 29 percent, Mn uptake by 31 percent, and N uptake by 30 percent. No differences were recorded with granular applications. Adding N or Zn had no effect on grain yield with granular fertilizer treatments but with fluids significant positive yield responses occurred with applications of 9 and 18 lbs/A of N. Grain yield at the 18-lb/A rate of N application was 11 percent higher with fluid than with granular. Similarly, additions of 2.2 lbs/A of fluid Zn increased grain yield by 11 percent, versus no response with granular treatments.*

Operational funds provided by the Fluid Fertilizer Foundation enabled wheat trials to be conducted at Miltauburra, Emerald Rise, and Yandra on the Upper Eyre Peninsula, South Australia, in 2000. Experiments were designed to investigate different aspects of fluid and granular fertilizers on highly and moderately calcareous soils. Farmers have been enthusiastic about the prospects for using fluid fertilizers on a commercial scale.

Miltaburra

Zinc uptake in shoots was significantly affected by form of fertilizer and by the application of Zn. The application of 2.2 lbs/A of Zn increased zinc uptake by 17 percent.

P uptake was increased 37 percent when applied in the fluid versus granular form. Adding 9 lbs/A of N increased P uptake by 12 percent. Adding 2.2 lbs/A of Zn increased P uptake by 8 percent.

Manganese uptake in whole shoots increased 17 percent when applications were in the fluid versus granular form. Although a limiting role for Mn has not been clearly determined on these soils, Mn deficiency in cereals tends to increase toward the coastal areas on the Eyre Peninsula, where calcium carbonate concentrations in the soil increase to upwards of 90 percent. It is possible that the requirement for Mn is modified by low levels of available P in these soils. Although research is needed to clearly define the issue, the role of Mn may be of considerable importance in these soils where Mn deficiency can occur and root disease is endemic. Tissue tests generally indicate "adequate" concentrations of Mn in wheat grown on these soils, although it is possible that if concentrations of P can be increased, this may lead to deficiency of some micronutrients, particularly Mn.

Total N concentration in whole shoots was a function of a three-way interaction between form of fertilizer, N, and Zn application (Figure 1). Note how

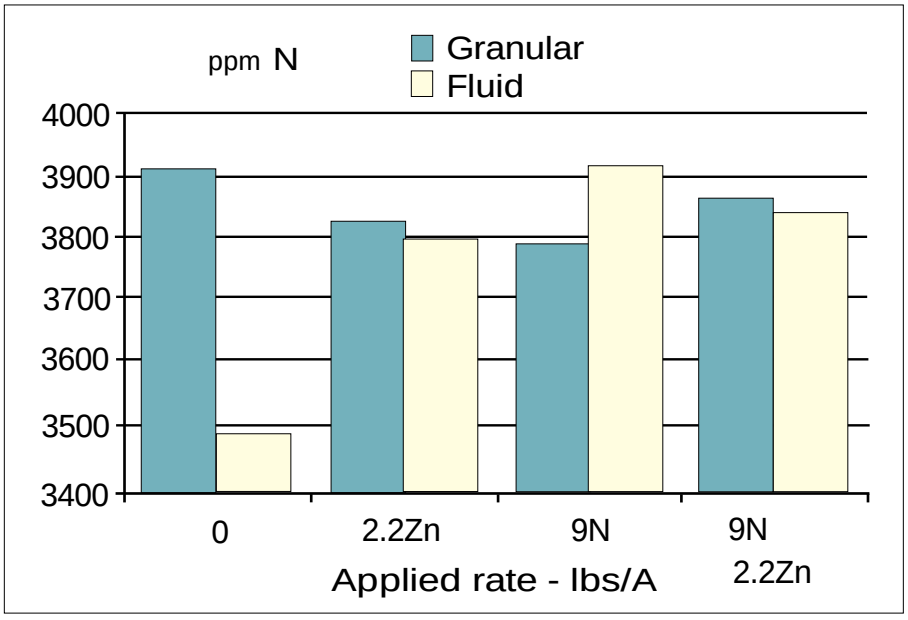

Figure 1. Effect of fertilizer source (fluid or granular) and n/Zn rates on N concentration in Frame wheat whole shoots at Haun 5 growth stage, Miltaburra, 2000.

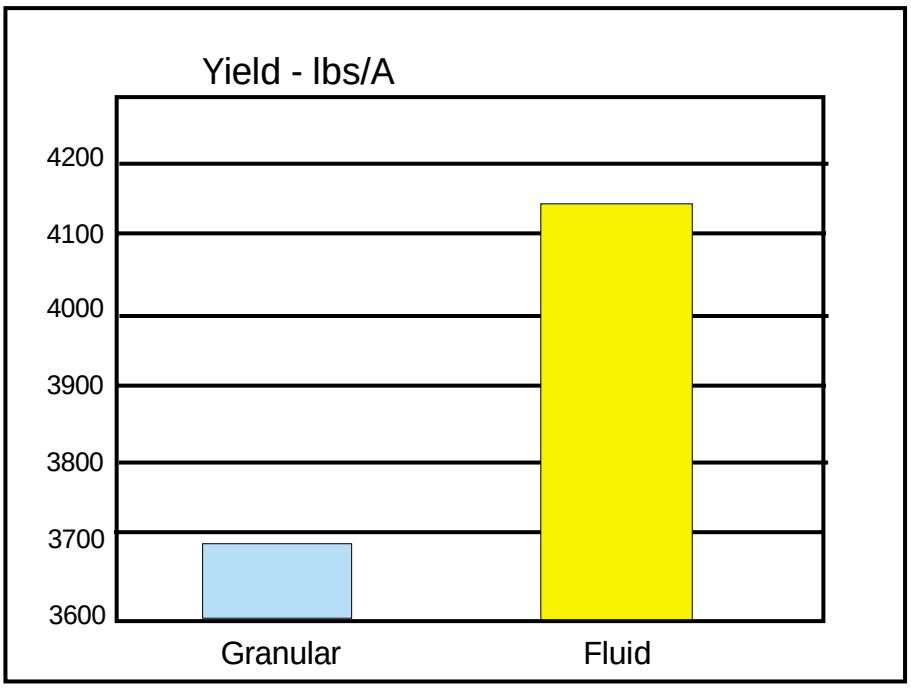

Figure 2. Effects of fertilizer source applied on total dry matter harvest of Frame wheat, Miltaburra, 2000.

granular applications of N had no effect on N concentration in shoots. However, when no N was applied in fluid fertilizer, N concentrations in the wheat plants were significantly increased with the addition of Zn. The addition of N did not change N concentrations significantly above this level. Uptake of N in shoots was significantly affected by form of fertilizer only. Fluid applications increased mean N shoot content by 35 percent, versus granular applications (content = shoot dry weight multiplied by N concentration).

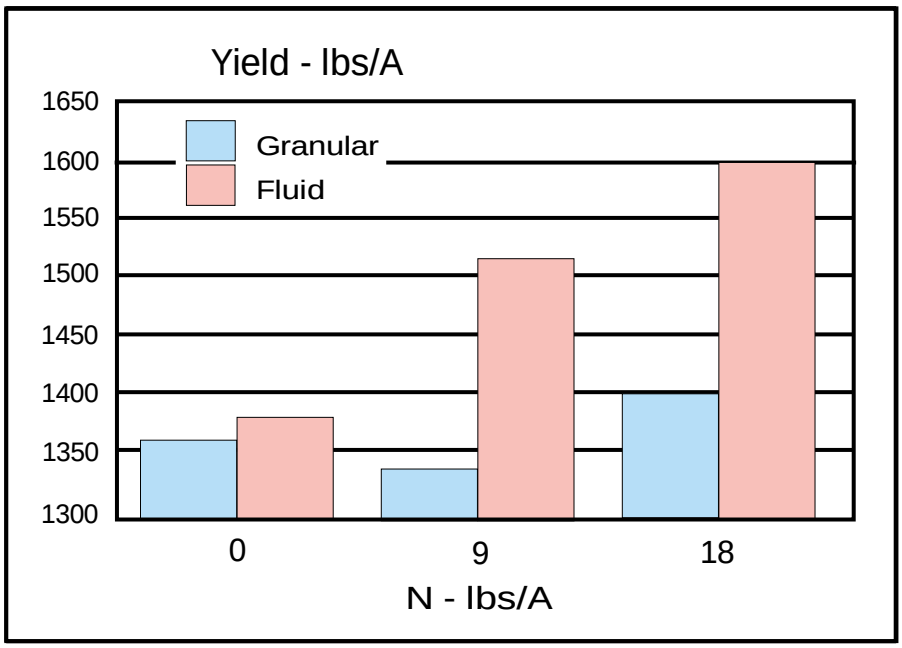

Figure 3. Effect of fertilizer source and application of N on grain yield of Frame wheat, Emerald Rise, 2000.

Grain yield was influenced by fertilizer form, N rate, and Zn rate, with no interactions. Application of fluid fertilizer increased grain yield 14 percent, versus granular. In terms of N application, wheat grain yield was depressed 5 percent when application was increased from 9 to 18 lbs/A, but there were no yield benefits from applying 9 lbs/A (data not shown). Grain yield increased 3 percent with the addition of 2.2 lbs/A of Zn. Other yield parameters are shown in Figure 2. Total dry matter at harvest, density of heads, and harvest index were influenced only by the form of fertilizer applied.

Emerald Rise

Shoot dry weight was not affected by the form of fertilizer applied when N was absent. Even when N was applied, granular showed no significant increase in shoot dry weight. However, the addition of 9 lbs/A of fluid N showed a 27 percent increase in shoot dry weight over a zero N application.

P uptake was significantly increased above all other treatments by the addition of 9 lbs/A of N to the fluid fertilizer. The increase in P uptake above the zero N fluid treatment was 29 percent. It was 35 percent above the 9 lbs/A of N granular treatment.

Mn uptake in whole shoots was significantly higher in fluid applications at both rates of N. However, while the addition of 9 lbs/A of N increased Mn uptake by 31 percent in fluid treated wheat plants, the addition of N had no effect on Mn uptake in granular-treated plants.

Zinc uptake was not affected by treatments.

Grain yield was a function of interactions between form of fertilizer and N application, and form of fertilizer and Zn application. Grain yield was not affected by application of N (Figure 3) or Zn (Figure 4) fertilizer in the granular

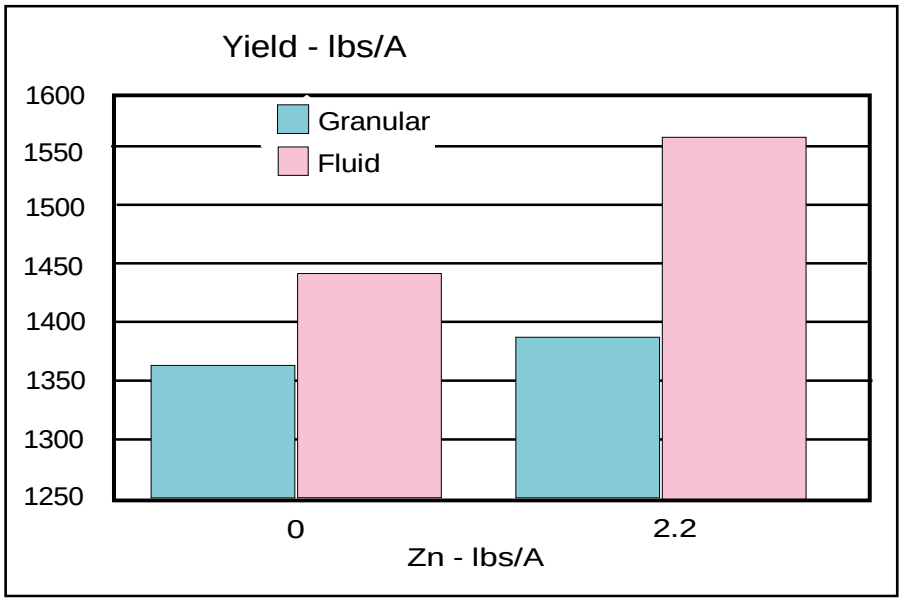

Figure 4. Effect of fertilizer source and application of Zn on grain yield of Frame wheat, Emerald Rise, 2000.

application, but in the fluid application, increasing rates of application had significant positive effects on yield. At zero N, grain yields from fluid and granular applications were not different. But when N was applied, grain yields were significantly greater with fluid than with granular. At the 18- lb/A rate of N, fluid-treated plots produced 11 percent more grain than the granular-treated plots. The application of Zn did not affect grain yield with granular treatments, but yields with fluid treatments were significantly greater when Zn was added.

Methodology

Rainfall. Annual rainfall at Miltaburra was 13.6 inches (above average) and 11.8 inches at Emerald Rise. Data from previous seasons and comparisons between higher and low rainfall sites indicate that the efficiency of fluid fertilizer (compared to granular) may be relatively greater in drier environments and at lower rates of application.

Soil at Miltaburra is a grey, highly calcareous sandy loam. At Emerald Rise, it is a red brown calcareous sand loam.

Dilution rate. Previous experiments, including these reported, were designed on the assumption that a relatively high dilution rate was required to ensure maximum distribution of the fertilizer, and that this would improve the availability of nutrients, particularly P in calcareous soils. The dilution rate experiments at Yandra and Miltaburra (data not shown) were conducted to assess the affect of dilution rate of fluids at two rates of P. At Yandra, grain yield was significantly reduced by applying fluid at less than 13 gal/A, the first rate of dilution above the application of neat fertilizer. At Miltaburra, dilution rate had no effect on grain yield, although more research is needed in dry seasons, given the visible differences early in the season at both sites.

Design. At Miltaburra and Emerald Rise, combinations of P, N, and Zn were applied in a factorial design with four replications.

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