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APP Fluid Surpasses Granular In Australian Grain Trials

Mean grain yield was 5 percent higher on residual fluid APP plots than on granular TSP plots.

Summary: *In 2002, 7.2 lbs/A (16.7 lbs/A of P_2O_5) of phosphorus (P) with fluid 10-34-0 ammonium polyphosphate (APP)-based fluid produced 14 percent more dry weight of Tahara triticale shoots than the granular fertilizer used. The response rate to increasing P applications was also greater with APP. In 2003, wheat shoots grown on residual APP plots at the application rate of 7.2 lbs/A of P produced 15 percent more dry weight of shoots than when grown on residual granular plots. There was a 38 percent increase in production of shoot biomass with fluid P at 7.2 lbs/A of P. Phosphorus concentrations in wheat shoots were higher at equivalent P rates on the residual APP plots and P uptake was higher with APP at the highest application rate of 31 lbs/A of P (72 lbs/A of P_2O_5). Mean grain yield was 5 percent higher on residual fluid APP plots than on granular 13:15Mn6%/ triple superphosphate (TSP) plots. Plants grown on residual APP plots produced 8 percent higher density of fertile heads than on residual granular plots. This difference increased to 16 percent in plots fertilized in 2003. There was also a slight but significant increase in grain size with the fluid residual plots.*

Though South Australia is the most arid state in Australia, it relies heavily on agriculture as a major source of income. Only a small portion of its land receives sufficient rainfall for arable agriculture. The largest area of cereal production occurs in the region receiving between 12 and 14 inches annual rainfall. There is insufficient water for large-scale irrigation of crops other than for horticulture. The majority of soils used for cereal production is alkaline and many of these are calcareous. The soils are naturally low in P and P deficiency is endemic. About half the area devoted to wheat production in the state occurs on the Eyre Peninsula and in the low rainfall northern and western regions of the peninsula. Many of the soils are based on sea floor material blown inland and are highly calcareous, ranging from 5 to 90 percent calcium carbonate.

Late in the nineteenth century, a general decline in cereal yields was halted by the discovery of the benefits of superphosphate and South Australia was the first state to use single superphosphate (SSP) to correct P deficiency in crops.

By 1983 the price of SSP and fertilizer in general rose steeply and the practice of fertilizing pastures as well as crops in cereal growing areas declined. Fertilizer companies began to import high-analysis fertilizers such as mono- and diammonium phosphate (MAP, DAP) and triple superphosphate (TSP).

During the past forty years, the basis of P fertilizer recommendations in South Australia has been a sodium bicarbonate soil extraction test based on the Colwell method. The test is intended to provide an indication of the plant-available residual P in the soil and also as a guide as to how much fertilizer should be applied at planting. However, only 18 percent of the 580 experiments were conducted on the Eyre Peninsula to assess the response of grain yields to applied P and to calibrate soil P tests to yield response. Recent research has shown that the Colwell test in fact extracts a quantity of plant-unavailable P from highly calcareous soils and therefore overestimates soil P status.

Since 1998, studies of fluid sources

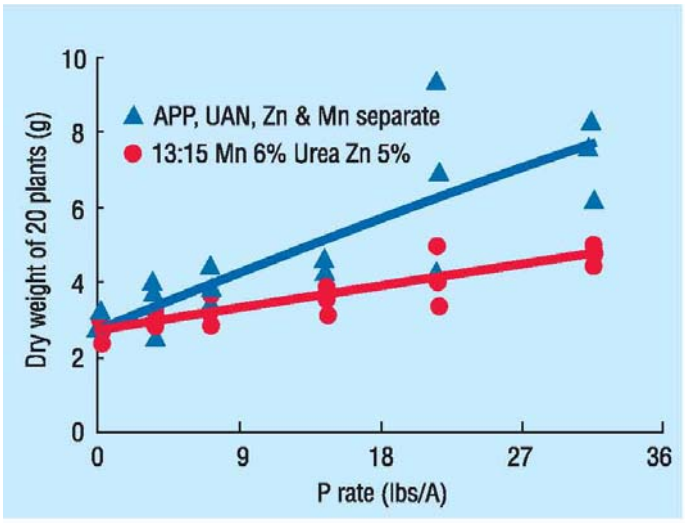

Figure 1. Relationship between dry weights of Tahara triticale shoots and rate and form of fertilizer applied to a calcareous sandy loam soil, 2002.

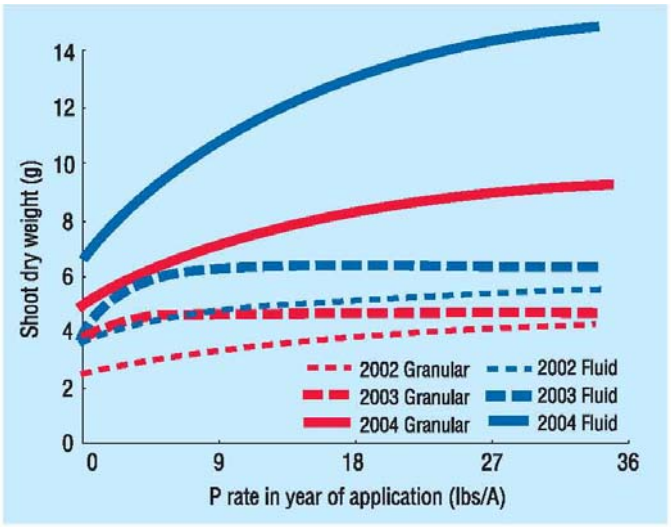

Figure 2. Relationships between dry weights of Frame wheat shoots and rate and form of fertilizer applied to a calcareous sandy loam soil in 2002 (residual effect) and 2003.

of P have shown that compared with granular MAP dissolved technical grade MAP (TGMAP), fluid APP, and phosphoric acid (PA) are superior sources of P for cereal production on highly calcareous soils. Moreover, the chemical nature of this difference has been partly established in the laboratory. In one field experiment, fluid P (as TGMAP), applied with N and Zn, was 4 to 15 times more effective than an equivalent granular source, depending on the rate of P applied.

Although laboratory studies have noted that fluid P is less subject to rapid immobilization than granular MAP, there has been no field study undertaken on the comparative residual characteristics of fluid and granular fertilizers on the highly calcareous soils of the Eyre Peninsula. Thanks to the support of the Fluid Fertilizer Foundation we initiated such a study and the two year results are reported here.

Fluids shine

Shoot dry weight. The results of shoot dry weights are shown in Figures 1 and 2. Figure 1 indicates increased shoot production at each level of P application with APP compared with 13:15/TSP, and also a greater rate of increase with increasing P. At a commercial application rate of 7.2 lbs/A of P, the increase in shoot dry weight due to APP was 14 percent. Figure 2 shows the response of wheat shoots to P applied the previous year (2002) and also in 2003. There was a significant difference between the linear equations describing the responses to the residual P from 2002. The increase in dry weight of shoots due to APP applied the previous year was 15 percent at an application rate of 7.2 lbs/A of P. There was a 38 percent increase in shoot weight at 7.2 lbs/A of P (APP) applied in 2003.

P/Zn uptake. In 2002, there was no significant interaction between the rate of P and form of P applied on P concentration in shoots. However, P concentrations increased as the rate of P applied increased. Mean P shoot concentrations in APP-treated plants and 13:15/TSP-treated plants were 2,226 and 2,100 ppm, respectively, a difference of 6 percent. Conversely, Zn concentration in shoots decreased with increasing P supply, presumably due to growth dilution, although mean Zn concentrations were 7 percent higher in fluid-treated shoots. Zinc uptake increased with increasing P and was 39 percent higher with fluid fertilizer. At 7.2 lbs/A of P, uptake was 30 percent higher in the fluid-treated shoots (Figure 3). Concentrations of P in shoots of Frame wheat grown on the residual plots in 2003 were significantly higher with APP applied in 2002 than with 13:15/TSP (data not shown). Similarly, uptake of residual P in shoots was significantly higher in the year following APP application at the highest rate (31 lbs/A of P) compared with 13:15/TSP (Figure 4). There were significant residual effects on P uptake with both fluid and granular fertilizers. Zinc uptake (not shown) was higher than all granular applications following treatments of APP applied at the rate of 31 lbs/A in both 2002 and 2003. This is likely a reflection of improved P availability both in the year of application and the residual effect from the previous season, resulting in better early- and mid-season shoot growth.

Grain yield. In 2002, grain yield increased significantly with increasing P rate. Mean yield with APP treatments was 20.6 bu/A and with 13:15/TSP treatments 18.6 bu/A, an increase of 11

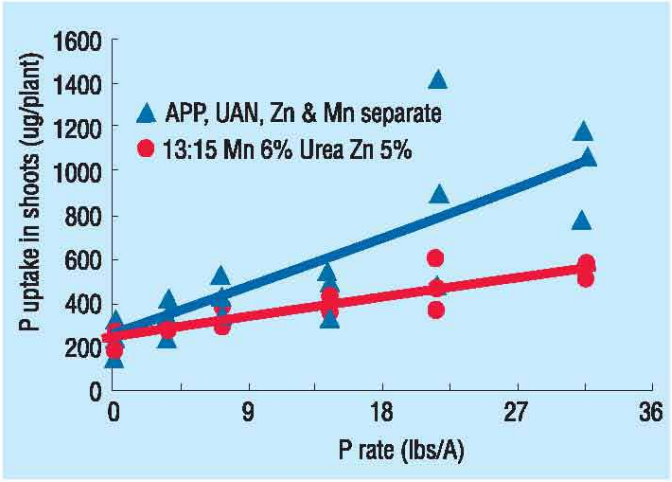

Figure 3. Relationship between P uptake in shoots of Tahara triticale and rate and forms of fertilizer applied to a calcareous sandy loam soil, 2002.

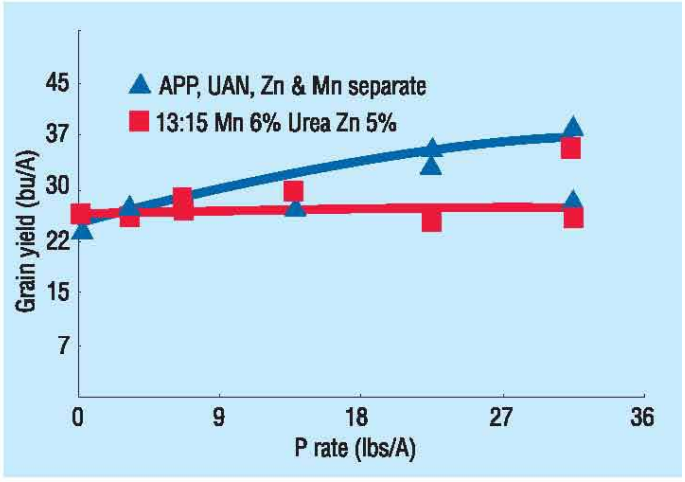

Figure 5. Relationship between grain yield of Frame wheat and rate and forms of fertilizer applied in 2003 on a calcareous sandy loam soil.

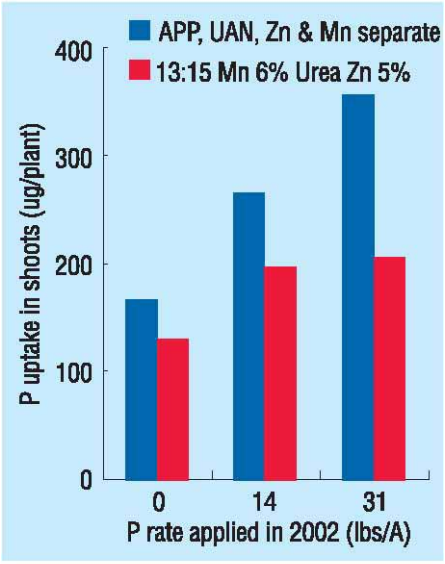

Figure 4. Relationship between uptake of residual P in shoots of Frame wheat in 2003 and rate and forms of fertilizer applied in 2002 on a calcareous sandy loam soil.

percent with the APP. There was no significant interaction between P rate and formof fertilizer.

In 2003, grain yield on the residual plots increased with increasing P rate. Mean yield over all APP treatments was 30 bu/A and for all 13:15/TSP treatments 28.5 bu/A, a difference of 5 percent. There was a significant interaction between form of fertilizer and application rate (Figure 5).

Overall, plants grown on residual APP produced 8 percent more fertile heads than those grown on 13:15/TSP. Plants grown on plots fertilized with APP produced 16 percent more grain heads than those grown on plots fertilized with 13:15/TSP.

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