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Banded P Increases Sugarbeet Yields

Idaho studies show deep-banded APP produced the most significant increases in sugarbeet production.

Summary: *One location (Rockford) showed significant responses to treatments, with APP at three depths and the surface and 3-inch deep UAN producing significant increases in sugarbeet tonnage. However, only surface UAN and the 6-inch deep APP bands resulted in significantly increased sugar production when sugar percentage was combined with tonnage. Although some inconsistencies exist between locations over the years of the study, the APP band at the 6-inch depth resulted in the highest total sugar production for three of the five site years of data. Shallower placement (3-inch) or surface banding also resulted in increased yields in a previous study, but the effect was neither as great nor as consistent as the deep-banded treatment when evaluating the findings of this study over three years. In general, starter UAN bands did not enhance sugar production, although a significant increase in sugar yield was observed at one site in 2004 with surface band-applied UAN. Although additional studies are planned, the results of this study, in combination with the work from previous years, show that deep banding P on sugarbeets enhances P uptake and, as a result, sugar production.*

Studies in the North-Central U.S. in 2001 showed yield increases with the use of 12 to 20 lbs/A of P_2O_5 as ammonium polyphosphate (APP, 10-34-0) starter in sugarbeets. Researchers found increased yields when a starter band was placed: 1) in direct seed contact, 2) two inches below the seed, and 3) two inches below and two inches to the side of the seed. The magnitude of the response, however, was delayed and reduced as the distance between the seed and the starter fertilizer band increased. Researchers concluded that direct seed contact was the best option due to the rapid, vigorous response and because much of the soil in which the sugarbeets are being grown in that region is high in clay and susceptible to implement/soil interface compaction, thus creating a poor seed bed. Other research also supports the fact that optimal placement of phosphorus (P) for sugarbeets seems to be directly below the seed.

Idaho studies have shown that banded P may enhance subsurface P uptake if placed relatively deep in the path of the sugarbeet tap root. The initial objective of the project reported in this article, therefore, was to determine if deep-banded P enhances sugarbeet P nutrition and, if so, how does this impact final yield and sugar content?

In the first year (2002) of this project, banded applications of APP resulted in increased sugarbeet yield, regardless of rate or placement depth. Broadcast and banded phosphoric acid (PA) applications did not increase sugarbeet yield. Percent sugar content was not significantly different for any treatment. However, when combined with yield to calculate sugar production, the deep-banded (6-inch) APP treatments generally resulted in increased sugar production. Surface and 2-inch starter bands of APP also resulted in increased sugar yield, but the differences were not statistically significant from the check. Surprisingly, the PA treatments did not result in an increase in sugar yield, which leaves the reasoning for the response of the APP in doubt. Was the

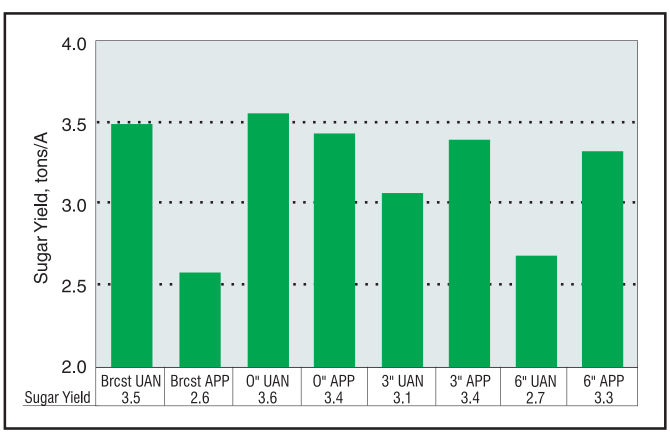

Figure 1. Sugarbeet N and P placement effect on sugar yield for the Minidoka location, 2004.

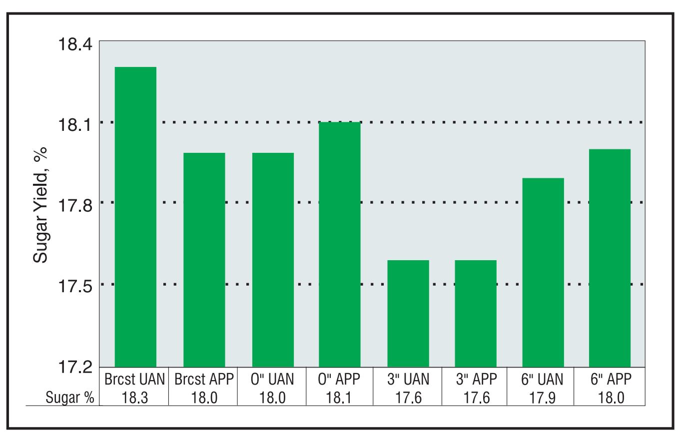

Figure 2. Sugarbeet N and P placement effect on sugar percent for the Rockford location, 2004.

response to APP simply due to nitrogen (N) or the combination of N and P? Or, did the PA bands result in reduced P availability as the season progressed? Thus, the study treatments were changed in 2003 and 2004 to better answer the question of whether or not banded APP enhances P uptake and increases yield.

2004 results

Minidoka. Results from this location showed no significant difference for any harvest parameters measured. The yields were very poor in this field due to severe weed pressure, water availability, and a possible herbicide carryover effect. Although there were large differences in total yield, there were no apparent trends and the differences were likely due to massive spatial variability across plots (Figure 1).

Rockford. The results from this field showed significant differences in beet root nitrate concentrations, with only the 3-inch APP treatment showing an increase over the broadcast UAN check. No significant differences were observed with electrical conductivity, a measure of yield quality. Fertilizer addition to sugarbeets is often accompanied by increases in various salts within the root (magnesium, sodium, potassium, iron, nitrate, etc.), which is an important quality factor during the sugar extraction process. The salts tend to bind with the sugar compounds, effectively reducing sugar extraction efficiency. The sugar companies measure the electrical conductivity and the nitrate concentrations in order to offer financial incentives for growers to reduce these problematic interactions. Sugar percentage declined with fertilizer application, particularly with both sources of fertilizer at the 3-inch depth (Figure 2). Again this is not surprising, as fertilizer application often results in a reduction of sugar percentage in sugarbeets. Total yield and the net total sugar production proved to have significant differences as well. All three depths for the APP and the top two depths for the UAN showed significant increases in total yield in relation to the check.

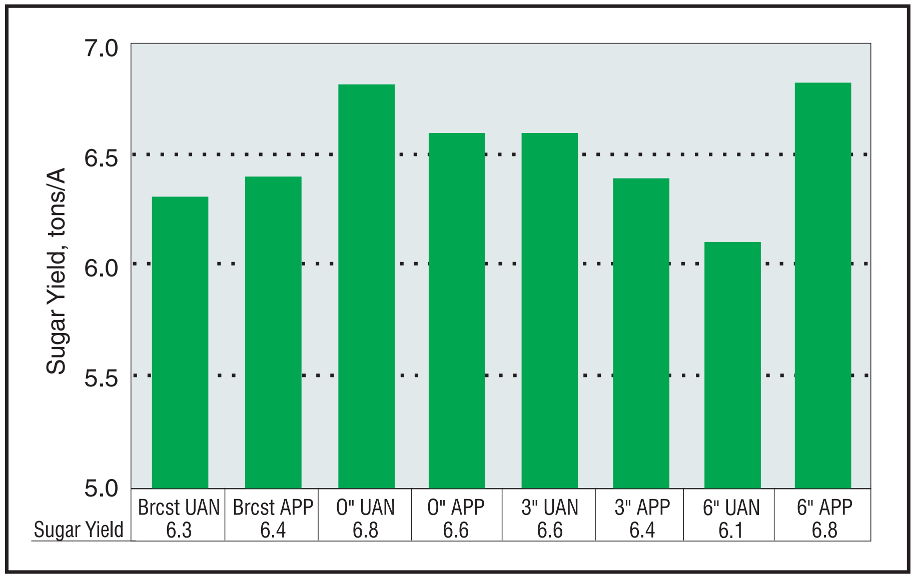

Figure 3. Sugarbeet N and P placement effect on sugar yield for the Rockford location, 2004.

A similar trend existed with sugar percentage for net sugar yield. The surface band applied UAN and the APP applied 6 inches below the soil surface were the only treatments significantly greater than the broadcast UAN check (Figure 3). The results are similar to those from the previous year, in which there was no response at one trial location and the APP performed best at the other. However, the surface UAN band treatment did not increase sugar yield in the previous year at either location, as it did at the Rockford location in 2004.

Depth counts

The inclusion of the UAN treatments in these studies effectively separates the N contribution of the starter. Although the results from the various trials over the past three years are slightly different, it is interesting to note that the APP band 6 six inches below the soil surface performed better than all other treatments for three of the five locations. In both nonresponsive locations, the yields were relatively low. These results suggest that response to starter P is most effective under high-yielding environments.

During the first 6 to 9 weeks, sugarbeet roots are oriented dominantly downward, as compared to a diagonal orientation for most other plant species. The early architecture of sugarbeet roots results in more subsoil exploration and less of the surface soil. Subsurface P concentrations tend to be low, especially in alkaline, calcareous soils common in the western states, even if the surface soil is high in P. This combination of sugarbeet roots not effectively exploring the surface soil and low subsoil P levels results in a potential problem for P availability early in the season. Deep banding APP seems to correct this problem.

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