Potassium by Nitrogen Rate Trial

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Nitrogen management is a priority for production of high-quality sugar beets. However, many other nutrients also play a role in plant growth. It is important to understand how the availability of other major nutrients may be impacted by varying levels of nitrogen.

Research Objective

- Provide potassium and nitrogen fertilizer guidelines for sugar beet production in the Southern Minnesota Beet Sugar Cooperative growing area.

Methodology

This experiment was conducted over 3 years as a 3 x 5 factorial with four replications. Soil samples were taken in the fall prior to treatment application (Table 1). The nitrogen fertilizer rates were varied due to differences in residual nitrogen between the sites. However, for the combined analysis the rates will be presented as low, medium, and high. The low rate is the control with no additional nitrogen applied (52lbs average total N). The medium rate is the middle of the recommended range for total nitrogen (128lbs average total N). The high rate is on the high side or above the recommended nitrogen rate (198lbs average total N). The potassium fertilizer rates were 0, 30, 60, 90, and 120 lb K_2O/A. The potassium and nitrogen treatments were applied broadcast in the spring and incorporated using a small field cultivator. The nitrogen source was urea (46-0-0), and the potassium source was potash (0-0-60). The sites were planted with a good root disease variety to mitigate any impacts from disease. Dual Magnum was applied preemergence and other standard practices were used post emergence to keep the sites weed free. The center two rows of each six-row plot were harvested using a six-row defoliator and a two-row research harvester. The planting and harvest dates for each site can be found in Table 1. The beets harvested from the center two rows were weighed on the harvester and a sample of those beets were used for a quality analysis at the SMBSC tare lab. The data was analyzed for significance using SAS GLM version 9.4.

Table 1. Fall soil sample results and important dates for all three locations.

Soil test	Hector, 2021	Redwood Falls, 2022	Renville, 2023
Soil nitrate-N 0-4 ft. (lb N/A)	45	77	33
Olsen P 0-6 in. (ppm)	7	14	3
K 0-6 in. (ppm)	168	228	224
pH 0-6 in. (unitless)	7.7	7.7	8.0
Organic matter 0-6 in. (%)	4.7	5.6	5.3
Previous Crop	Field corn	Field corn	Soybean
Planting Date	April 30th	May 16th	May 4th
Harvest Date	September 29th	October 6th	September 18th

Results

Across all three years the application of potassium had no impact on the root yield or quality of sugar beets regardless of the amount of nitrogen applied (Table 2). The increased rate of nitrogen applied had a positive impact on tons per acre and extractable sugar per acre (Table 3). There was also an interaction between nitrogen and year for the quality parameters. This interaction occurred because the impact of nitrogen on the quality parameters varied between the 3 years that this study was conducted (Figure 1).

Conclusions

It was speculated that as nitrogen rates increase the rates of other nutrients, such as potassium, would also need to be increased. However, increasing potassium rates as nitrogen rates increase does not have any impact if there are already sufficient levels of potassium. The impact of nitrogen on root yield was expected with an increase from the control to the rate that was within the recommended range, but no increase in root yield occurred as the rate of nitrogen was increased beyond the recommended range. Increasing nitrogen rates beyond the recommended range had a negative impact on quality two out of three years. The environment

plays a large role in nitrogen availability, and we do not always get the response we may expect. Most of the time applying a high rate of nitrogen will likely have a negative impact on quality, however, there are times when the opposite can happen, as was the case with this study in 2022. Nitrogen remains a very important nutrient for growing a profitable sugar beet crop. However, growers need to be aware of the risk and reward of applying too much or too little nitrogen.

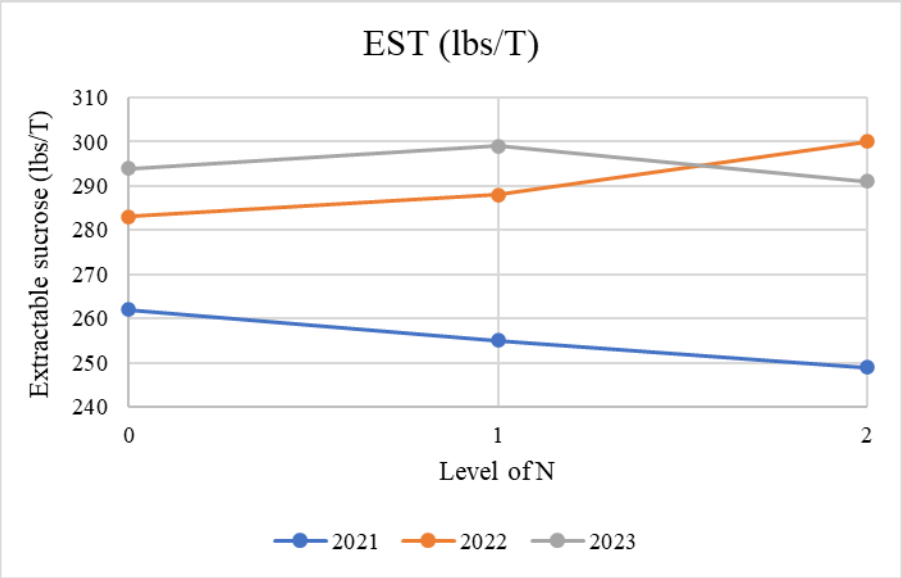
Table 2. The effect of fertilizer K_2O on root yield and quality averaged across N rates.

Level of K_2O (lbs)	Percent Sugar	Root Yield Tons/Acre	Percent Extractable Sugar	Extractable Sugar per Ton (lbs)	Extractable Sugar per Acre (lbs)	Percent Purity
0	16.8	34.2	13.9	279.0	9481.0	89.4
30	16.9	34.0	14.0	279.3	9431.1	89.2
60	16.9	34.4	14.0	280.4	9591.4	89.4
90	16.9	34.6	14.0	280.4	9677.5	89.4
120	17.0	34.7	14.1	281.6	9726.1	89.3
Mean	16.9	34.4	14.0	280.1	9591.4	89.3
CV%	3.0	7.8	3.8	3.8	8.1	0.8
Pr>F	0.4448	0.4225	0.5676	0.5636	0.2223	0.0862
lsd (0.05)	ns	ns	ns	ns	ns	ns

Table 3. The effect of fertilizer N on root yield averaged across K rates.

Level of N (lbs)	Root Yield Tons/Acre	Extractable Sugar per Acre (lbs)
Low (52)	30.6 a	8535.6 a
Med (128)	36.1 b	10049.1 b
High (198)	36.6 b	10159.7 b
Mean	34.4	9591.4
CV%	7.8	8.1
Pr>F	0.0011	0.0015
lsd (0.05)	2.9	854.8

Figure 1. The effect of fertilizer N on EST in all years of the study. Other quality parameters had similar results.



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