

Potassium by Nitrogen Rate Trial

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Introduction: Nitrogen management is a top 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 varied levels of nitrogen.

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

Materials and Methods: This trial was conducted as a 3 x 5 factorial with four replications following field corn south of Hector, MN. Soil samples were taken in the spring prior to treatment application (Table 1). The nitrogen fertilizer rates were 0, 95, and 165 lb N/A. The potassium fertilizer rates were 0, 30, 60, 90, and 120 lb K/A. The potassium and nitrogen treatments were applied broadcast in the spring and incorporated using a small field cultivator. The nitrogen source was urea, and the potassium source was potash. The site was planted using SES 863 with 3 gallons of 10-34-0 in-furrow at planting. Dual Magnum was applied as a pre emerge and as a layby application with Roundup Powermax to keep the site weed free. The center two rows of each six row plot were harvested on September 29th using a six row defoliator and a two row research lifter. The beets harvested from the center two rows were weighed on the lifter 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: Soil test results for Hector location from spring soil sample in 2021.

Soil test	Hector
Soil nitrate-N 0-4 ft. (lb N/A)	76
Olsen -P 0-6 in. (ppm)	4
K 0-6 in. (ppm)	168
pH 0-6 in. (unitless)	7.7
Organic matter 0-6 in. (%)	4.7

Results: The application of potassium had no impact on the 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 root yield but had a negative impact on beet quality (Table 3 and Figure 1). There was a significant interaction between potassium and nitrogen for tons per acre (TPA) and extractable sucrose per acre (ESA). However, potassium application did not affect TPA or ESA at any of the nitrogen rates. The nonresponse of potassium was slightly different between the 165lb nitrogen rate and the other rates causing an interaction in the analysis.

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

TRT	Percent Sugar	Tonsperacre	Percent Extractable Sugar	Extractable Sugar per Ton (lbs.)	Extractable Sugar per Acre (lbs.)	Percent Purity
K-0	15.4	37.0	12.6	252.6	9318.8	89.3
K-30	15.4	36.9	12.6	252.7	9300.1	88.9
K-60	15.7	38.0	12.9	258.6	9786.1	89.4
K-90	15.6	37.3	12.8	256.5	9564.9	89.3
K-120	15.5	38.0	12.8	255.4	9686.5	89.2
Mean	15.5	37.42	12.7	255.0	9540.8	89.2
CV%	3.7	7.0	4.9	4.9	8.1	1.2
Pr>F	0.72	0.75	0.73	0.75	0.45	0.86
lsd (0.05)	ns	ns	ns	ns	ns	ns

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

TRT	Percent Sugar	Tonsperacre	Percent Extractable Sugar	Extractable Sugar per Ton (lbs.)	Extractable Sugar per Acre (lbs.)	Percent Purity
N-0	15.8 a	32.8 b	13.1 a	261.9 a	8611.4 b	89.8 a
N-95	15.5 ab	39.8 a	12.7 ab	254.8 ab	10135.6 a	89.2 ab
N-165	15.2 b	39.6 a	12.4 b	248.8 b	9846.7 a	88.7 b
Mean	15.5	37.42	12.7	255.0	9540.8	89.2
CV%	3.7	7.0	4.9	4.9	8.1	1.2
Pr>F	0.0273	<.0001	0.007	0.0093	<.0001	0.011
lsd (0.05)	0.36	1.68	0.395	8.0	496.1	0.679

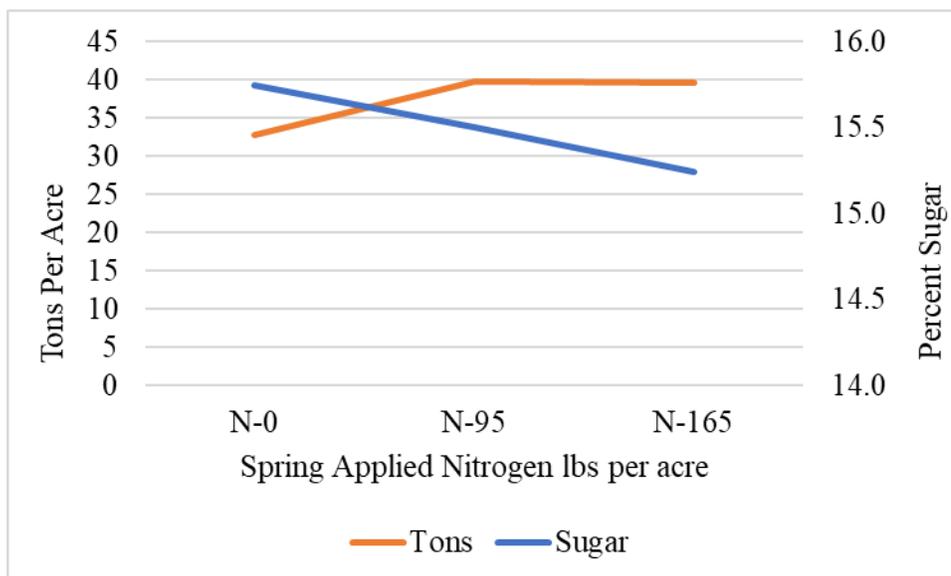


Figure 1: The effect of fertilizer N on tons and percent sugar.

Conclusion: No response was seen to increasing the rate of potassium applied with any rate of nitrogen. It was speculated that as nitrogen rates increase that the rates of other nutrients, such as potassium, would also need to be increased. Based upon the results of this study increasing potassium rates as nitrogen rates increase does not have any impact. However, this trial did reaffirm that increasing nitrogen rates beyond sufficiency levels can have a negative impact on the quality of the sugar beet crop and result in less extractable sugar per acre.