

# Nitrogen Rate and Placement Trials

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Nitrogen management is a priority for the production of high-quality sugar beets. The use of nitrogen placement could offset the input cost of nitrogen and lower the overall use rate through more efficient use and availability.

## Research Objective

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

## Methodology

Two trials were established in 2024 using randomized complete block design. One trial was located near Sacred Heart following soybean and the other trial was located near Roseland following field corn. Both sites were soil sampled in the fall of 2023 to develop treatment rates for the trials and sampled again in the spring of 2024 to identify any changes in soil nitrate (Table 1). The treatments for each site were identical with treatments including broadcast urea rates, placement of liquid 32% N (UAN), and use of additional nutrient management products (Tables 2 and 3). The Sacred Heart site was planted on April 23<sup>rd</sup> using Beta 9284 and the Roseland site was planted on April 25<sup>th</sup> using Beta 9131. Prior to planting, the urea treatments were broadcast by hand and incorporated with a small field cultivator. The liquid 32% N treatments were applied at planting using a 360 Bandit system with CO<sub>2</sub> as a propellant for the fertilizer. The 360 Bandit dribbled the liquid three inches either side of the row at a depth from the soil surface of 0.75 to one inch (Photo 1). For the surface applied UAN dribble treatment, the hoses were removed from the disc and allowed to drag along the soil surface (Photo 2). The Receptor treatment was applied through the infurrow system on the planter with a 6gpa application volume. The Envita SC, Transit Foliar, and Lalstim Osmo treatments were applied with the bicycle sprayer on June 11<sup>th</sup> at both trial sites when the beets were at the 10 leaf stage. The bicycle sprayer was equipped with XR11002 nozzles with a spray volume of 17gpa. Percent canopy cover ratings were taken in late June and mid-July (Figures 1 and 2). Standard sugar beet production practices were used to keep the trial weed and disease free. Each plot was 35ft long and 6 rows wide. The center two rows of each six-row plot were harvested on September 17<sup>th</sup> at Roseland and October 3<sup>rd</sup> at Sacred Heart using a six-row defoliator and a two-row research harvester. The beets harvested from the center two rows were weighed on the harvester and two samples of those beets from each plot were used for 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 the two trial locations from fall soil sample in 2023.

Soil test	Sacred Heart	Roseland
Fall Soil nitrate-N 0-4 ft. (lb N/A)	36	12.5
Spring Soil nitrate-N 0-4 ft. (lb N/A)	80	26
Olsen P 0-6 in. (ppm)	10	5
K 0-6 in. (ppm)	181	178
pH 0-6 in. (unitless)	7.8	7.9
Organic matter 0-6 in. (%)	5.2	6.5

## Results

Both sites had a significant yield response to additional nitrogen (Tables 2 and 3). The Roseland site following field corn had more of a response to higher nitrogen rates than the Sacred Heart site following soybean but neither had a linear response (Figure 1). The differences in root yield between equivalent rates in the nitrogen placement treatments were minimal. The only significant difference in those comparisons was the 30lb surface dribble had less root yield than the 30lb broadcast urea treatment at the Roseland site. This is similar to results in other years. There have generally been no differences in nitrogen placement treatments unless the surface dribble had less root yield. The commercial products tested in furrow or foliar had no impact on yield. The correlation between percent canopy cover ratings and extractable sugar per acre were high with R values of 0.8967 on June 25<sup>th</sup> and 0.9831 on July 18<sup>th</sup> at the Sacred Heart site and R values of 0.9903 on June 24<sup>th</sup> and 0.9914 on July 17<sup>th</sup> at the Roseland site (Figures 2 and 3).

**Photos 1 & 2.** The 360 Bandit system installed on the 6-row research planter. The dribble treatment visible on the soil surface after planting.



### ***Conclusions***

Both sites had very low fall soil nitrate tests in 2023, however the Sacred Heart site following soybean increased significantly in soil nitrate over the warm fall and spring months leading up to planting (Table 1). With the increase in soil nitrate, it is not surprising that the site following soybean had less of a response to additional nitrogen compared to the field corn site with the high amount of corn residue tying up soil nitrate. Based on the spring soil sample the soybean site maxed out yield with 130lbs of total nitrogen and the field corn site maxed out with 160lbs of total nitrogen. However, based on the fall soil sample the soybean site would have maxed out at 100lbs and the field corn site 130lbs of total nitrogen. This stresses the importance of an accurate soil test so that we do not under or overapply nitrogen. A soil test will be more accurate the later it is taken in the fall (lower soil temps), but even better if taken in the spring as mineralization can be significant in some years. The potential increased efficiency of placing nitrogen closer to the row with a 3x1 system over broadcast urea was not realized over the last 3 years of testing and is possibly detrimental to root yield if UAN is applied as a surface dribble. None of the commercial infurrow or foliar applied products proved beneficial this year or in previous years of testing. The high correlation between percent canopy cover and extractable sugar per acre will continue to be investigated to determine if it could be a useful tool in the future to compare treatments when root yields are not able to be collected. Overall, the testing from this year agreed with the current recommendation of 110 to 150lbs of total nitrogen based on a fall soil test.

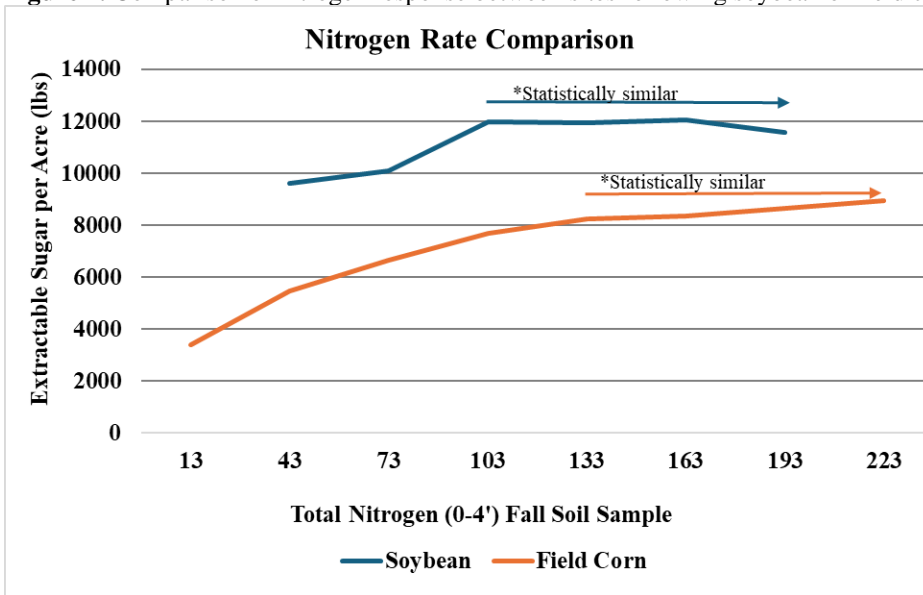
**Table 2.** Root yield and quality data for the Roseland trial following field corn. Trial harvested on September 17<sup>th</sup>.

Entry	Treatment	Applied N	Total N	Percent Sugar	Tons per Acre	Percent Extractable Sugar	Extractable Sugar per Ton (lbs.)	Extractable Sugar per Acre (lbs.)	Percent Purity
1	Check	0	13	16.1 bcd	12.4 g	13.7 abc	273.3 abc	3401.6 g	91.1
2	Broadcast Urea	30	43	16.3 abc	19.8 de	13.8 abc	276.5 abc	5480.5 de	90.9
3	Broadcast Urea	60	73	16.4 abc	23.6 c	14.0 a	280.6 a	6659.7 c	91.7
4	Broadcast Urea	90	103	16.5 abc	27.6 b	13.9 ab	278.4 ab	7703.1 b	90.8
5	Broadcast Urea	120	133	16.5 ab	29.4 ab	14.0 a	280.4 a	8237.2 ab	91.1
6	Broadcast Urea	150	163	16.6 a	29.3 ab	14.2 a	284.7 a	8348.4 ab	91.6
7	Broadcast Urea	180	193	16.5 abc	30.8 ab	14.1 a	281.8 a	8657.6 a	91.7
16	Broadcast Urea	210	223	16.4 abc	32.0 a	13.9 a	279.0 a	8932.3 a	91.2
8	3x1 32%	30	43	16.4 abc	17.6 ef	14.0 a	279.1 a	4914.5 def	91.2
9	3x1 32%	60	73	16.3 abc	21.2 cd	13.8 abc	275.7 abc	5860.9 cd	90.7
10	3x0 32%	30	43	15.8 de	15.5 fg	13.2 cd	264.9 cd	4084.1 fg	90.4
11	3x0 32%	60	73	16.1 cd	21.4 cd	13.3 bcd	266.7 bcd	5697.2 de	89.7
12	Receptor	30	43	15.6 e	18.7 de	13.0 d	259.9 d	4842.6 ef	90.0
13	Envita SC	30	43	16.4 abc	20.8 cde	13.9 ab	278.2 ab	5784.7 cde	91.1
14	Transit Foliar	30	43	16.1 cd	17.8 ef	13.7 abc	274.9 abc	4915.0 def	91.7
15	Lalstim Osmo	30	43	16.4 abc	20.6 cde	13.9 ab	278.1 ab	5721.5 cde	91.1
			Mean	16.3	22.4	13.8	275.8	6202.6	91.0
			CV%	1.8	10.0	3.0	3.0	10.7	1.1
			Pr>F	0.0008	<.0001	0.0085	0.0085	<.0001	0.2651
			lsd (0.05)	0.43	3.18	0.59	11.88	948.52	ns

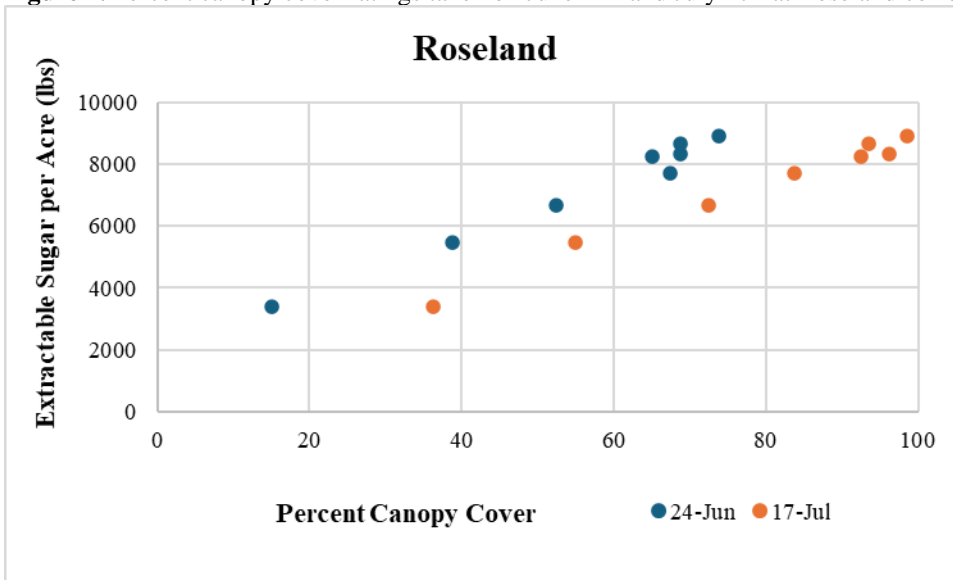
**Table 3.** Root yield and quality data for the Sacred Heart trial following soybean. Trial harvested on October 3<sup>rd</sup>.

Entry	Treatment	Applied N	Total N	Percent Sugar	Tons per Acre	Percent Extractable Sugar	Extractable Sugar per Ton (lbs.)	Extractable Sugar per Acre (lbs.)	Percent Purity
1	Check	0	36	17.3	32.8 g	14.7 bcd	293.3 bcde	9615.2 f	90.8 abc
2	Broadcast Urea	30	66	17.2	34.7 fg	14.6 cd	291.0 de	10088.6 ef	90.6 bc
3	Broadcast Urea	60	96	17.7	39.6 abcd	15.1 a	302.6 a	11984.1 ab	91.3 ab
4	Broadcast Urea	90	126	17.3	40.9 ab	14.6 cd	291.8 de	11931.3 abc	90.3 bc
5	Broadcast Urea	120	156	17.3	41.2 a	14.6 cd	292.2 cde	12043.7 a	90.5 bc
6	Broadcast Urea	150	186	17.1	40.3 abc	14.4 d	287.0 e	11571.3 abcd	90.1 c
7	Broadcast Urea	180	216	17.3	39.7 abcd	14.5 cd	289.6 de	11494.2 abcd	90.1 c
8	3x1 32%	30	66	17.4	36.0 efg	14.7 abcd	294.6 abcde	10619.4 de	90.9 abc
9	3x1 32%	60	96	17.4	37.4 cdef	14.8 abc	295.4 abcde	11011.7 bcde	91.0 abc
10	3x0 32%	30	66	17.5	36.5 def	15.1 ab	301.2 abc	10989.1 cde	91.8 a
11	3x0 32%	60	96	17.4	38.5 abcde	14.7 bcd	293.1 bcde	11292.2 abcd	90.6 bc
12	Receptor	30	66	17.4	35.9 efg	14.8 abc	296.9 abcd	10642.0 de	91.2 ab
13	Envita SC	30	66	17.4	37.5 bcdef	14.9 abc	296.5 abcd	11092.2 abcd	91.2 ab
14	Transit Foliar	30	66	17.5	36.3 defg	15.1 ab	301.0 abc	10896.5 de	91.7 a
15	Lalstim Osmo	30	66	17.6	35.2 efg	15.1 ab	301.6 ab	10611.1 de	91.7 a
			Mean	17.4	37.5	14.8	295.2	11058.8	90.9
			CV%	1.4	6.5	2.1	2.1	6.3	0.8
			Pr>F	0.1235	0.0002	0.0191	0.0210	0.0002	0.0120
			lsd (0.05)	ns	3.5	0.4	9.0	986.3	1.0

**Figure 1.** Comparison of nitrogen response between sites following soybean or field corn based on the 2023 fall soil sample.



**Figure 2.** Percent canopy cover ratings taken on June 24<sup>th</sup> and July 17<sup>th</sup> at Roseland correlated with Extractable Sugar per Acre.



**Figure 3.** Percent canopy cover ratings taken on June 25<sup>th</sup> and July 18<sup>th</sup> at Sacred Heart correlated with Extractable Sugar per Acre.

