Nitrogen Rate and Placement Trials

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Nitrogen management is a priority for 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 2022 using randomized complete block design. One trial was located north of Renville following soybean and the other trial was located south of Renville following field corn. Both sites were soil sampled in the fall of 2021 to develop treatment rates for the trials in 2022 (Table 1). The treatments for each site were not identical but shared similar treatments which included broadcast urea rates, placement of liquid 32% N (UAN), and use of nitrogen fixing biological products (Tables 2 and 3). Both trial sites were planted on May 24th using Crystal M089. Prior to planting, the urea treatments were broadcast by hand and worked in with a small field cultivator. The liquid 32% N treatments were applied at planting using a 360 Bandit system and CO_2 as a propellant for the fertilizer. The 360 Bandit dribbles the liquid three inches either side of the row at a depth of 0.75 to one inch (Photo 2). For the surface dribble treatment, the hoses were removed from the disc and allowed to drag along the soil surface (Photo 3). The biological nitrogen fixing treatments were applied on June 17th for both trials using a bicycle sprayer. The bicycle sprayer was equipped with XR11002 nozzles with a spray volume of 17gpa. Standard sugar beet production practices were used to keep the trial weed and disease free (Photo 1). Each plot was 35ft long and 6 rows wide. The center two rows of each six-row plot were harvested on September 19th for Renville South and October 13th for Renville North 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 a sample of those beets 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 2021.

Soil test	Renville North	Renville South
Soil nitrate-N 0-4 ft. (lb N/A)	45	45
Olsen P 0-6 in. (ppm)	7.5	13
K 0-6 in. (ppm)	128	222
pH 0-6 in. (unitless)	7.8	7.3
Organic matter 0-6 in. (%)	5.6	4.0

Photo 1. Drone image of Renville North trial on September 28th.
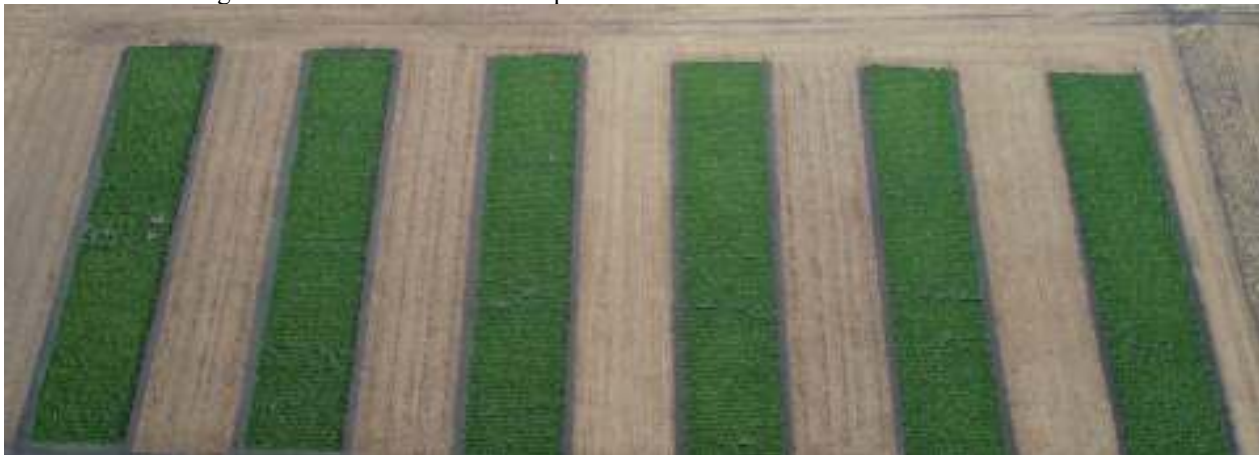
Photos 2 & 3. The 360 Bandit system installed on the 6-row research planter. The dribble treatment visible in the soil surface after planting at the Renville South trial.

Results

The site north of Renville following soybean showed no significant responses for any of the yield or quality parameters (Table 2). The site south of Renville following field corn only responded to N application for extractable sugar per acre (Table 3). For the differences in extractable sugar per acre (ESA), the check, which had no additional nitrogen applied, had lower ESA than most of the other treatments.

Conclusions

The results of these trials are not entirely surprising. In the last decade of nitrogen research at SMBSC, most nitrogen trials fail to generate a positive response to the addition of more nitrogen over the residual nitrogen that's already present in the field. In the most recent years, trials following field corn have generally had a greater response to additional nitrogen compared to trials following soybean. Because of the lack of response to the addition of nitrogen, the comparison of methods of application cannot be made at the site located south of Renville while the response to nitrogen for extractable sugar per acre at the northern site was to the addition of the first unit of nitrogen. There were no statistical differences between the application methods. These nitrogen placement trials will be conducted again in 2023.

Table 2. Yield and quality data for the site north of Renville following soybean harvested on October 13th.

Entry	Treatment	Applied N	Total N	Sugar	Tons per Acre	Percent Extractable Sugar	Extractable Sugar per Ton (lbs.)	Extractable Sugar per Acre (lbs.)	Percent Purity
1	Check	0	45	16.2	31.6	13.1	262.4	8294.9	88.2
2	Broadcast Urea	30	75	16.6	32.2	13.6	271.9	8749.2	88.8
3	Broadcast Urea	60	105	16.5	31.7	13.6	271.2	8591.8	88.7
4	Broadcast Urea	90	135	16.4	33.1	13.5	270.6	8960.5	89.2
5	Broadcast Urea	120	165	16.6	32.1	13.6	271.9	8739.4	88.8
6	Broadcast Urea	150	195	16.0	31.5	13.1	262.3	8254.0	88.7
7	Broadcast Urea	180	225	16.5	32.1	13.7	273.9	8801.8	89.5
8	Broadcast Urea	210	255	16.7	30.1	13.8	276.3	8331.6	89.3
9	2x2	30	75	16.3	32.6	13.3	265.7	8677.4	88.5
10	2x2	60	105	16.3	32.9	13.3	265.6	8724.1	88.3
11	Urea + Utrisha N	30	75	16.4	32.8	13.4	267.8	8784.9	88.3
12	Urea + Envita	30	75	16.2	32.6	13.2	263.0	8583.8	88.1
13	2x0 Dribble	30	75	16.4	32.1	13.4	268.6	8611.1	88.6
14	2x0 Dribble	60	105	16.5	32.7	13.6	271.6	8866.2	89.0
			Mean	16.4	32.1	13.4	268.8	8640.8	88.7
			CV%	2.4	5.3	3.7	3.7	6.6	1.0
			Pr>F	0.29	0.27	0.29	0.29	0.61	0.20
			lsd(0.05)	ns	ns	ns	ns	ns	ns

Table 3. Yield and quality data for the site south of Renville following field corn harvested on September 19th.

Entry	Treatment	Applied N	Total N	Sugar	Tons per Acre	Percent Extractable Sugar	Extractable Sugar per Ton (lbs.)	Extractable Sugar per Acre (lbs.)	Percent Purity
1	Check	0	45	14.6	34.4	11.8	235.4	8070.2 c	88.6
2	Broadcast Urea	30	75	14.8	37.8	12.3	244.9	9254.4 a	89.6
3	Broadcast Urea	60	105	14.8	38.4	12.0	240.5	9237.1 a	88.6
4	Broadcast Urea	90	135	14.8	39.3	11.9	237.7	9347.5 a	88.0
5	2x2	30	75	14.8	36.3	12.1	240.9	8738.2 abc	88.7
6	2x2	60	105	14.9	36.7	12.2	244.2	8965.6 ab	89.0
7	2x2	90	135	14.8	39.2	12.2	243.2	9534.3 a	89.3
8	Urea + Entiva	30	75	14.8	37.9	12.0	239.0	9045.5 ab	88.1
9	Urea + Utrisha N	30	75	14.7	39.8	11.9	236.8	9408.2 a	88.3
10	Urea + Terramar	30	75	15.0	38.0	12.1	242.9	9253.1 a	88.5
11	2x0 Dribble	60	105	14.5	37.4	11.7	233.3	8722.2 abc	88.3
12	2x0 Dribble	90	135	14.6	38.4	11.9	237.6	9114.5 ab	89.0
			Mean	14.7	37.6	12.0	239.5	9006.4	88.7
			CV%	2.0	6.4	2.5	2.5	6.3	0.8
			Pr>F	0.38	0.11	0.18	0.18	0.03	0.09
			lsd(0.05)	ns	ns	ns	ns	812.5	ns