

Previous Crop Trial

David Mettler¹, Mark Bloomquist², and John A. Lamb³,

¹Research Agronomist, ²Research Director, SMBSC, Renville, MN

³Professor Emeritus University of Minnesota, St. Paul, MN

Nitrogen management is a priority for production of high-quality sugar beets. Previous crop can affect nitrogen availability and earlier harvested crops like sweet corn and spring wheat tend to have less residue potentially leading to better planting conditions for the following sugar beet crop.

Research Objective

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

Methodology

A two-year trial was conducted near Bird Island (2021-2022) and near Hector (2022-2023) as a split block with four replications. In the first year of the trials four rotational crops were planted in randomized blocks: field corn, soybean, sweet corn, and spring wheat. Soil samples were taken in the spring prior to planting the four rotational crops and fertilizer applications were made using University of Minnesota recommendations for each crop. The fertilizer treatments were applied broadcast in the spring and incorporated using a small field cultivator. Standard practices were used to keep the four rotational crops weed and disease free. Important dates and average yields are reported in Table 1. The previous crops were machine harvested with small research combines except for the sweet corn (Photo 1). The sweet corn was hand harvested and then mowed to chop up the stalks. The 2021 crop year was abnormally dry, especially in the area where this trial was located as illustrated with the large soil cracks (Photo 2). As a result, the yields were somewhat suppressed, most notable the field corn.

For the second year of the trials, sugar beets were planted into each of the previous crops. The previous crop blocks were soil sampled to a depth of four feet in the fall prior to planting sugar beets. Prior to planting, the blocks were separated into 3 treatments for each crop. These treatments were residual nitrogen only, 110 lbs total N per acre, and 150 lbs total N per acre (Tables 2 and 3). Each of these plots were 6 rows wide. Nitrogen treatments were applied as urea and incorporated with a small field cultivator. The Bird Island site was planted on May 23, 2022 using Crystal M089 and the Hector site was planted on May 10, 2023 using Crystal M089. Standard grower practices were used to keep the site weed and disease free. The center two rows of each six-row plot were harvested on September 20, 2022 at Bird Island and October 5, 2023 at Hector using a six-row defoliator and a two-row research harvester. The sugar beet roots harvested from the center two rows were weighed on the harvester and two samples of those beets from each plot were used for a quality analysis at the SMBSC tare lab. The data were analyzed for significance using SAS GLM version 9.4.

Table 1. Planting date, harvest date, and yield for the four rotational crops in 2021 near Bird Island and in 2022 near Hector.

Previous Crop	Planting Date	Harvest Date	Yield per Acre
<i>Bird Island, 2021</i>			
Field Corn	May 6 th	October 19 th	140 bushels
Soybean	May 7 th	October 6 th	55 bushels
Sweet Corn	May 6 th	August 10 th	9 tons
Spring Wheat	April 22 nd	August 2 nd	51 bushels
<i>Hector, 2022</i>			
Field Corn	May 7 th	October 14 th	203 bushels
Soybean	May 7 th	September 29 th	59 bushels
Sweet Corn	May 7 th	August 9 th	8.8 tons per acre
Spring Wheat	May 6 th	August 17 th	50 bushels

Photos 1 & 2. Combine used to harvest the spring wheat. Sweet corn in the dry summer conditions during the 2021 season.



Table 2. The Bird Island previous crop trial had 12 treatments that were based upon previous crop and total N (Residual + Applied).

Treatment	1	2	3	4	5	6	7	8	9	10	11	12
Previous Crop	Field Corn	Field Corn	Field Corn	Soybean	Soybean	Soybean	Sweet Corn	Sweet Corn	Sweet Corn	Spring Wheat	Spring Wheat	Spring Wheat
Residual N (lbs/A)	42	42	42	47	47	47	76	76	76	11	11	11
Applied N (lbs/A)	0	68	108	0	63	103	0	34	74	0	99	139
Total N (lbs/A)	42	110	150	47	110	150	76	110	150	11	110	150

Table 3. The Hector previous crop trial had 12 treatments that were based upon previous crop and total N (Residual + Applied).

Treatment	1	2	3	4	5	6	7	8	9	10	11	12
Previous Crop	Field Corn	Field Corn	Field Corn	Soybean	Soybean	Soybean	Sweet Corn	Sweet Corn	Sweet Corn	Spring Wheat	Spring Wheat	Spring Wheat
Residual N (lbs/A)	39	39	39	39	39	39	90	90	90	24	24	24
Applied N (lbs/A)	0	71	111	0	71	111	0	20	60	0	86	126
Total N (lbs/A)	39	110	150	39	110	150	90	110	150	24	110	150

Results

The crop planted in the year prior to sugar beets had a significant impact on the sugar beet root yield (Figure 1). Sugar beet planted after sweet corn had higher root yield compared to those following the other three crops tested in this trial. The sugar beet planted after spring wheat had a greater root yield than field corn and soybean in 2023 but not in 2022. Nitrogen rate also had a significant impact on root yield (Figure 1) and quality (Table 4). In 2022 increasing the nitrogen rate to 110 lbs per acre of total N dramatically increased root yield following all previous crops, with only a slight increase following sweet corn. Root yields did not substantially increase when the nitrogen rate was increased to 150 lbs per acre of total N. In 2023 the response to N was mixed with a less dramatic increase in root yield with increasing N, however, the root yield still increased slightly with greater rates of N, with the exception of sugar beet following sweet corn. Increasing the rate of N had a consistent negative impact on quality in both 2022 and 2023 (Table 4).

Table 4. The effect of nitrogen rate on sugar beet quality across previous crops for 2022 and 2023.

Total N (lbs/A)	2022			2023		
	Extractable Sugar %	Extractable Sugar Per Ton	Purity %	Extractable Sugar %	Extractable Sugar Per Ton	Purity %
Residual N*	12.4c	247b	90.0b	13.9bc	277b	90.0b
110	12.1b	242b	89.6ab	13.8b	276b	89.8ab
150	11.8a	235a	89.3a	13.6a	272a	89.6a
LSD _(0.05)	0.21	3.9	0.50	0.16	3.2	0.23

*Residual N = residual N depends on the previous crop (Tables 2 and 3).

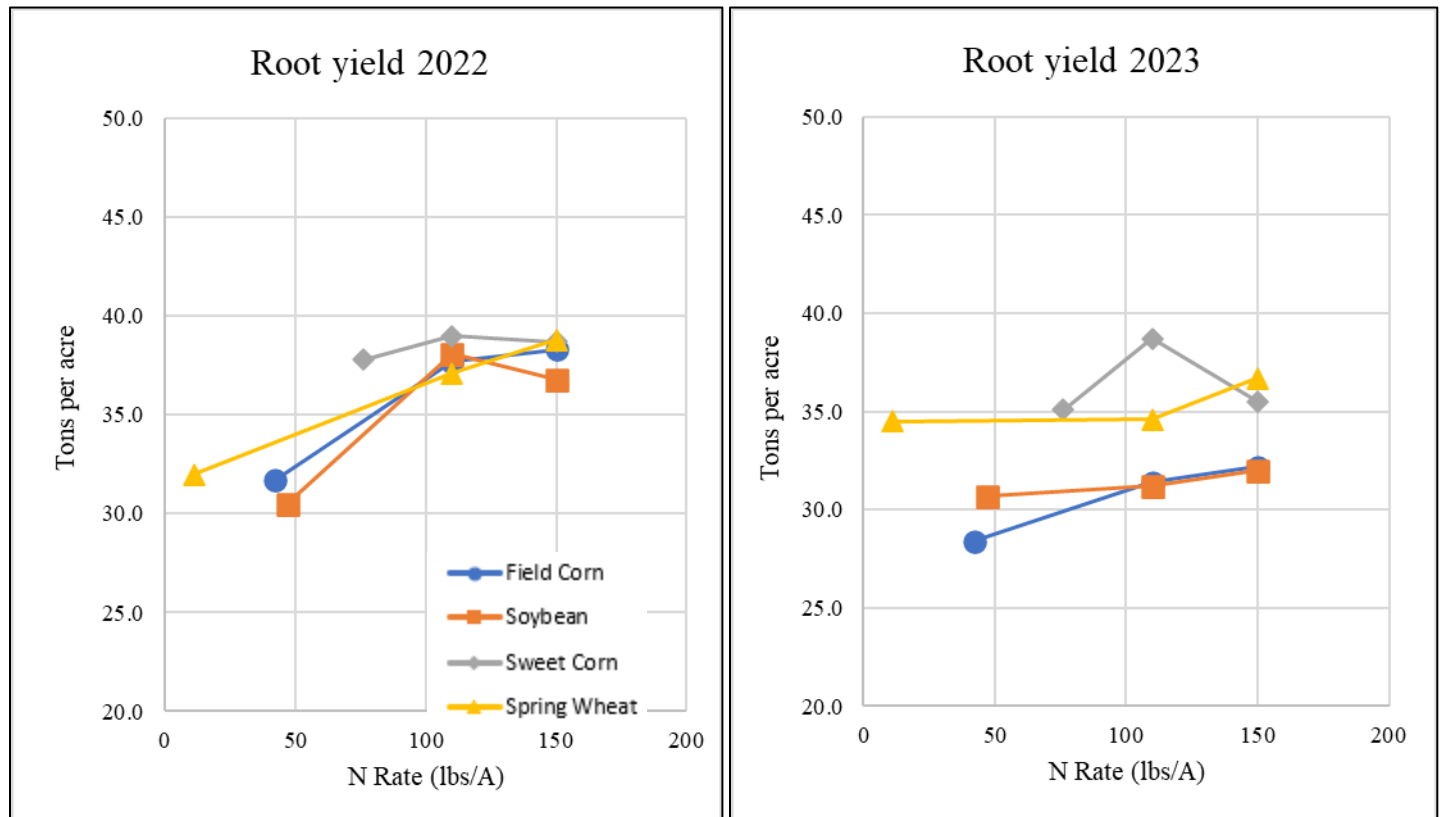


Figure 1. The effect of nitrogen and previous crop on root yield.

Conclusions

Root yields in the SMBSA Agronomic Practice Database have indicated that canning crops such as sweet corn and peas have a positive impact on the following sugar beet crop. This could be caused by the early harvest of the canning crops and lower crop residue levels. The early harvest of these crops gives the residue ample time to breakdown, which leads to less tie-up of nitrogen in the next year and potentially creates a better seed bed to plant sugar beets. Spring wheat also has the benefit of an early harvest, however, if the grain that is dropped during harvest is allowed to grow, like it was in this trial, then the volunteer wheat cover crop can also tie-up nitrogen and create a less ideal seed bed than if the volunteer wheat cover crop was terminated earlier.

Fertilizing each of the previous crops up to 110 and 150 lbs per acre of total N had a consistent negative impact on quality in 2022 and 2023. This negative impact was not drastic but something to consider when applying nitrogen, especially if it's not needed. The results from these trials would indicate that less nitrogen is needed following sweet corn to optimize root yield. These trials would also indicate that the benefit of increasing total N from residual levels to 110 is substantial, while the further increase to 150 lbs per acre of total N is less beneficial and often not significant.

