

# Nitrogen Rate Trials for 2020

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## Justification:

Nitrogen management is a top priority for production of high-quality sugar beet. With the continued changes in sugar beet production, it is important to continue to update N fertilizer guidelines with new information.

## Objective:

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

## Methods and Materials:

In 2020, two locations in the Southern Minnesota Beet Sugar Cooperatives growing area had studies that had a N fertilizer rate component to them. One location near Wood Lake and the other near Blomkest. Soil samples were taken for each location prior to the study. The results are reported in Table 1. The soil nitrate-N to a depth of four feet was low at each location, 30 and 43 lb N/A. The N fertilizer rates at the Wood Lake location were 0, 30, 60, 90, 120, 150, 180, and 210 lb N/A and 0, 20, 50, 80, 110, and 140 lb N/A at the Blomkest location. The Wood Lake location had 12 replications of the N rates and the Blomkest location had six. The fertilizer N source was urea applied prior to planting. Stand counts were taken after emergence. The locations were harvested by machine in October and quality samples were taken at that time. Quality was determined in the Southern Minnesota Beet Sugar Cooperative tare lab.

Table 1. Soil test results for Wood Lake and Blomkest locations in 2020.

Soil test	Wood Lake	Blomkest
Soil nitrate-N 0-4 ft. (lb N/A)	30	43
Olsen -P 0-6 in. (ppm)	69	18
K 0-6 in. (ppm)	274	194
pH 0-6 in. (unitless)	7.5	7.4
Organic matter 0-6 in. (%)	4.5	5.4

## Results:

The 2020 growing season was significantly better than 2018 and 2019. The average root yield was 35 tons/A and the average sucrose was 18 % at the Wood Lake location and 41.1 tons/A and 17.9 % at the Blomkest location.

Wood Lake:

The addition of N fertilizer significantly affected root yield, extractable sucrose per ton, and extractable sucrose per acre at the Wood Lake location in 2020, Table 2 and Figures 1, 2, and 3. The response was linear for all variables. The soil test nitrate-N was low and a positive response for root yield and extractable sucrose per acre was expected. The positive response of root yield and extractable sucrose per acre maximized at the top N rate applied. This rate was 210 lb N/Acre of fertilizer with a soil test nitrate-N plus fertilizer N of 240. This is greater than the current guideline. Also unexpected was the increase in extractable sucrose per ton with N application. While the increase was small, normally the application of N fertilizer reduces extractable sucrose per ton.

Table 2. The effect of nitrogen on root yield, extractable sucrose per ton, and extractable sucrose per acre at the Wood Lake location in 2020. (Data provided by Dan Kaiser U of MN)

Soil test nitrate-N plus fertilizer N lb N/A	N rate lb N/A	Root yield ton/A	Extractable sucrose per ton lb/ton	Extractable sucrose per acre lb/A
30	0	28.6	296	8477
60	30	30.3	296	9034
90	60	34.4	293	10342
120	90	34.1	299	10117
150	120	37.6	293	10973
180	150	36.0	303	10938
210	180	38.5	305	11747
240	210	40.9	297	12116
Statistics	N rate	0.0001	0.04	0.0001
	C.V.	7.4	3.2	8.4
	Mean	35.1	298	10429

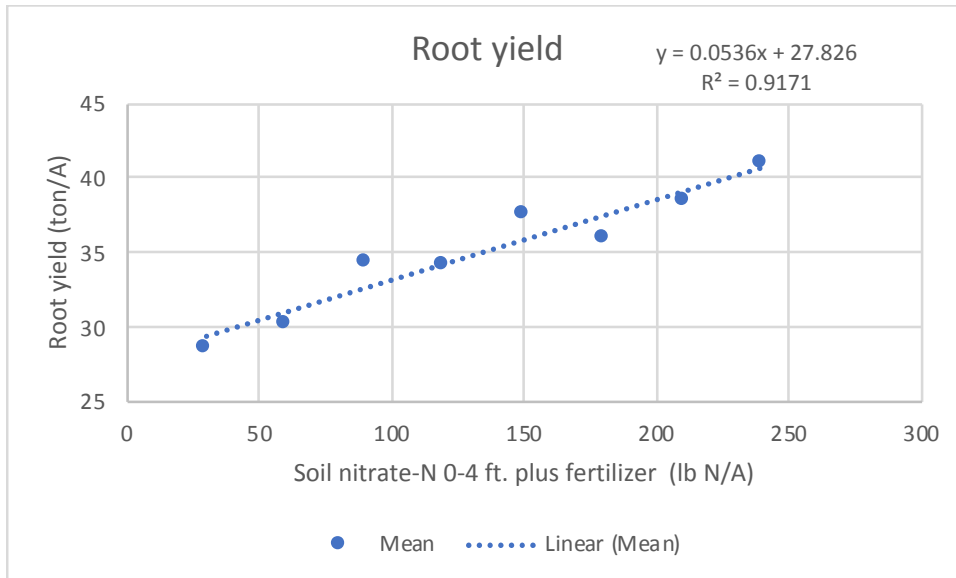


Figure 1. The effect of soil nitrate-N plus fertilizer N on root yield at the Wood Lake location in 2020. (Data provided by Dan Kaiser U of MN).

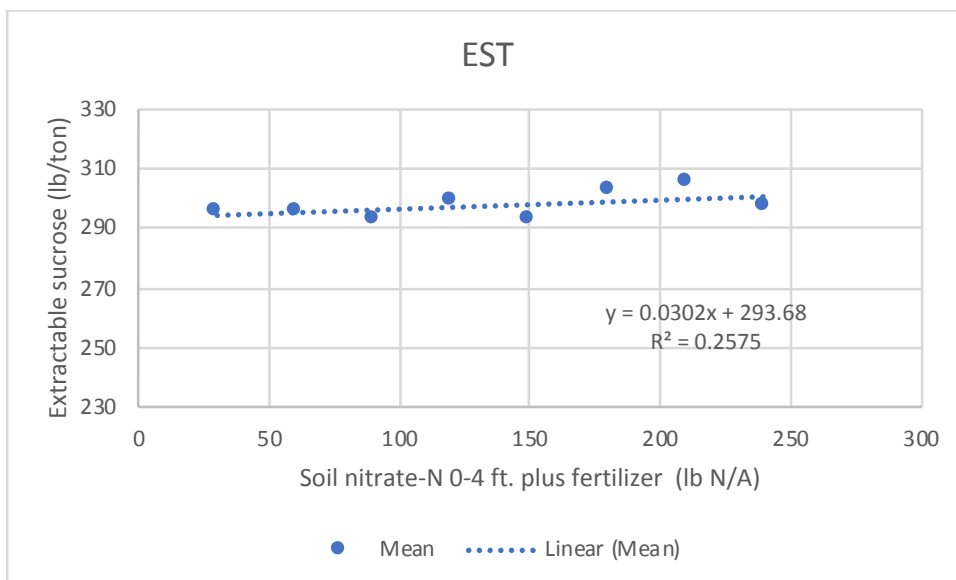


Figure 2. The effect of soil nitrate-N plus fertilizer N on extractable sucrose per ton at the Wood Lake location in 2020. (Data provided by Dan Kaiser U of MN).

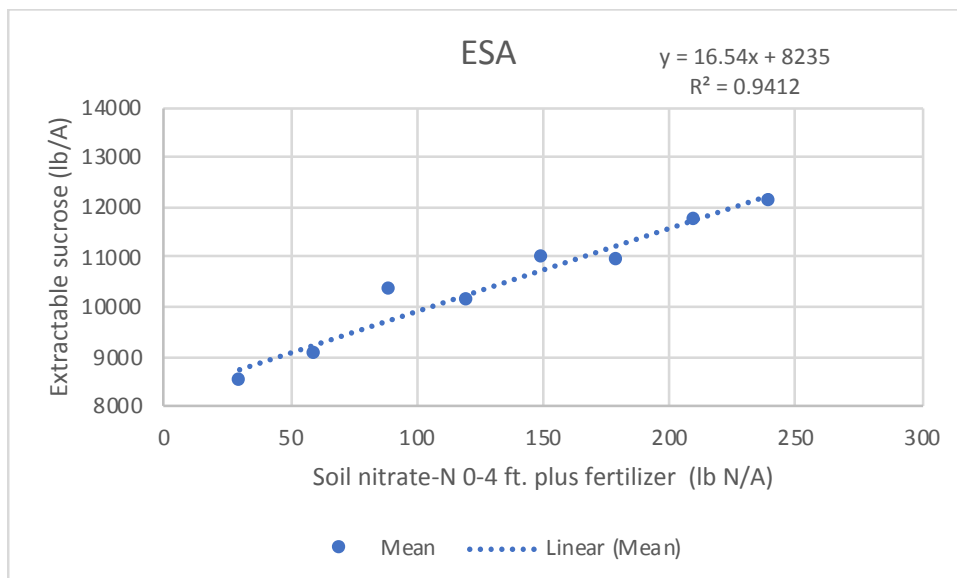


Figure 3. The effect of soil nitrate-N plus fertilizer N on extractable sucrose per acre at the Wood Lake location in 2020. (Data provided by Dan Kaiser U of MN).

Blomkest:

The addition of N fertilizer at the Blomkest location did not significantly affect the root yield or the extractable sucrose per acre, Table 3, Figures 4, 5, and 6. This was not expected as the soil test nitrate-N to a depth of four feet was low at 43 lb N/A. Root yield and extractable sucrose per acre were very good, 40.3 tons/A and 12,402 lb/A with no fertilizer N applied. The extractable sucrose per acre was increased slightly by the addition of fertilizer N.

Table 3. The effect of nitrogen on root yield, extractable sucrose per ton, and extractable sucrose per acre at the Blomkest location in 2020.

Soil test nitrate-N plus fertilizer N lb N/A	N rate lb N/A	Root yield ton/A	Extractable sucrose per ton lb/ton	Extractable sucrose per acre lb/A
43	0	40.3	300	12402
63	20	42.3	297	12576
93	50	41.5	305	12648
123	80	42.1	305	12833
153	110	40.7	315	12818
183	140	39.6	308	12188
Statistics	N rate	0.19	0.03	0.52
	C.V.	5.0	2.8	5.4
	Mean	41.1	305	12600

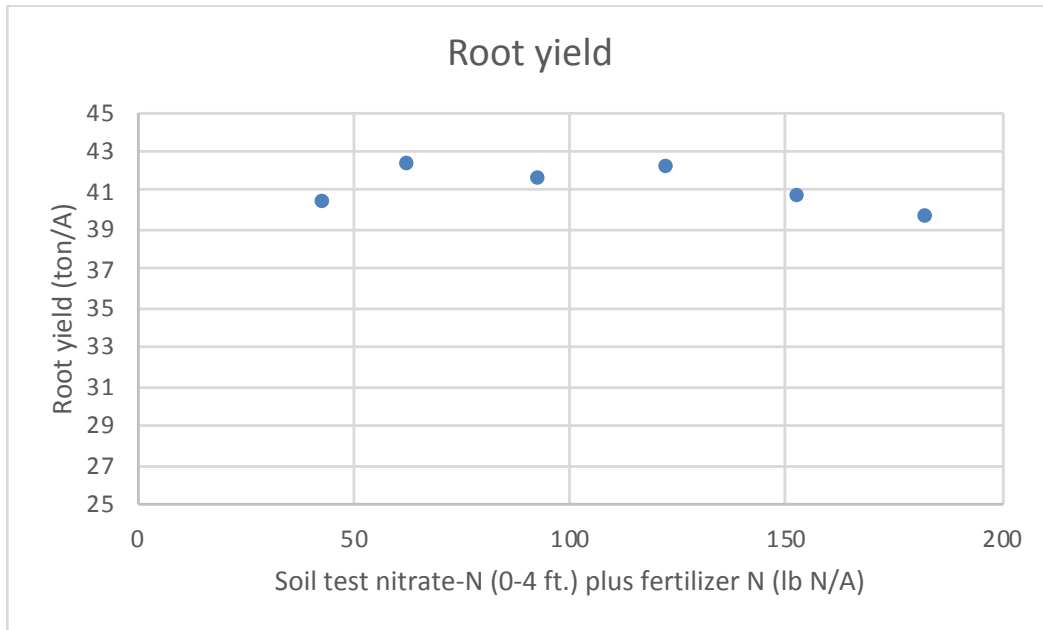


Figure 4. The effect of soil nitrate-N plus fertilizer N on root yield at the Blomkest location in 2020.

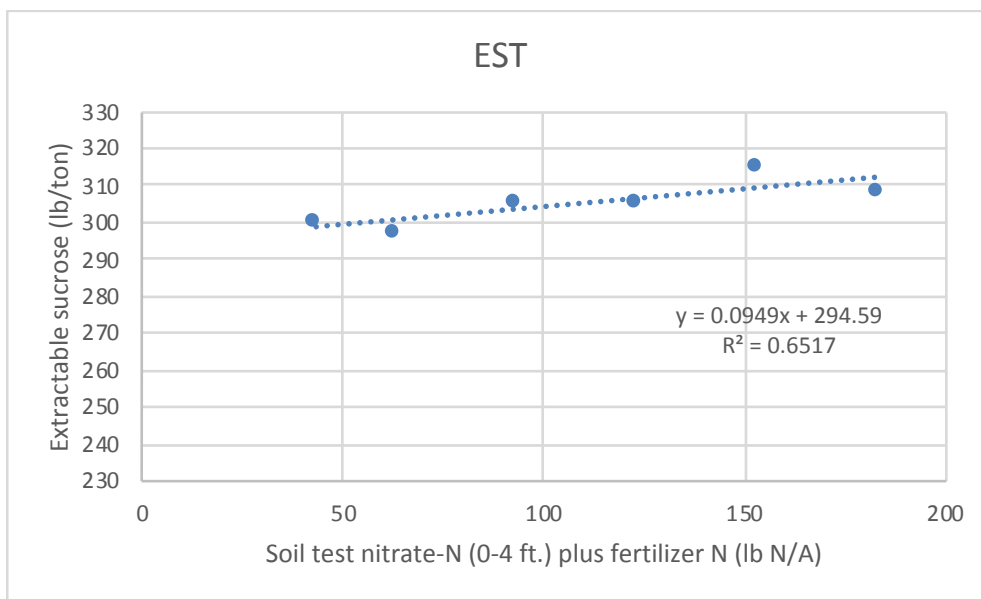


Figure 5. The effect of soil nitrate-N plus fertilizer N on extractable sucrose per ton at the Blomkest location in 2020.

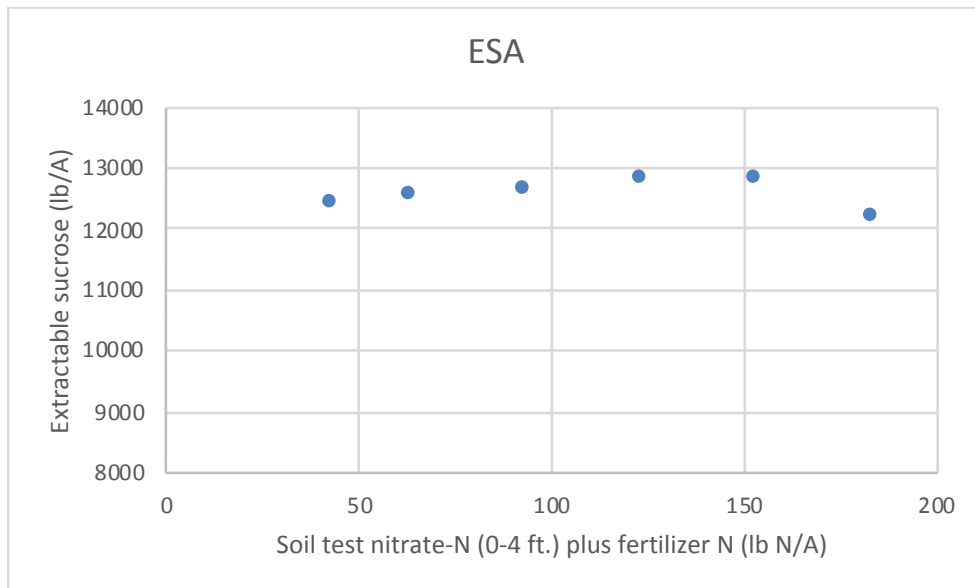


Figure 6. The effect of soil nitrate-N plus fertilizer N on extractable sucrose per acre at the Blomkest location in 2020.

**Summary:**

The responses to N application were not as expected for root yield, extractable sucrose per ton, and extractable sucrose per acre at either location in 2020. With the low soil test nitrate-N, we expected the application of N fertilizer to increase the root yield and extractable sucrose per acre at both locations. At Wood Lake, both of these parameters increased but did not maximum at the greater N rates. At the Blomkest location, we did not get a response to N fertilizer even though the soil test nitrate-N was low. Why did this happen? There was a difference in organic matter between the locations of about 0.9 %. While that could explain some of the difference, it does not explain it all. Another difference between these two sites was the previous crop. The Wood Lake site followed field corn while the Blomkest site followed soybean. The difference in the amount of plant residue from the previous crop may have impacted the amount of nitrogen available at these two locations. The small increase in extractable sucrose per ton was also not expected nor is it explainable.

What does this mean for the N fertilizer guideline currently used? This guideline is based on many locations of data and because the information for the Wood Lake site had a positive response, it will be added to that information. Current guidelines based on research from 2010 to 2020 indicate that the optimum extractable sucrose per acre can be achieved with 123 lb N/A as soil test nitrate-N to a depth of four feet plus fertilizer N.