

# Split Nitrogen Applications in Southern Minnesota 2020 – non-irrigated heavy textured soils.

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## Introduction and Objective:

Producing sucrose in Minnesota requires growers to optimize their N application for increasing root yield with the decreasing effect of N application on sucrose concentration and purity. The optimum N rate has been the topic of many research studies with the N fertilizer being applied pre-plant. There has been interest in splitting the N application between pre-plant and sometime during the growing season to “spoon feed” the sugar beet root for optimum root yield while not having negative effects on sucrose concentration and purity. The objective of this study was to determine if split applications of N fertilizer can improve root yield without decreasing root quality. The sub-objectives were A: to conduct an N rate study to supply more information for the N fertilizer recommendations and also determine if the site was responsive to N application and B: to determine if a split N application was superior to a pre-plant or an in-season application.

## Methods and Materials:

To meet the objectives, a study was conducted during the 2020 growing season at one location within the Southern Minnesota Beet Sugar Cooperative growing area. The initial soil test values are reported in Table 1. Ten treatments, Table 2, were established. Treatments 1 through 6 were used to determine the response to N application while treatments 3, 4, 7, 8, 9, and 10 were used to compare N application timing responses. The experiment was a randomized complete block design with six replications. The plots were six – 22 inch rows wide and 35 ft. long. The pre-plant N applications were broadcast treatments of urea (46-0-0). The urea was incorporated immediately after application. The in-season N applications were injected between the sugar beet rows as liquid urea ammonium nitrate solution (32-0-0). The Blomkest location was planted on April 25, 2020 to SES 863 and the in-season N application occurred on May 26, 2020. This site was harvested on October 14, 2020. The previous crop was soybean.

Table 1. Soil test information for 2020 in-season N location.

Soil test and depth	Blomkest
Nitrate-N (lb/A) 0-48 inches	43
Olsen P (ppm) 0-6 inches	18
Soil test K (ppm) 0-6 inches	194
pH (unitless) 0-6 inches	7.4
Organic matter (%) 0-6 inches	5.4

Table 2. Treatments for N application study at Blomkest location, 2020.

Treatment number	Total N applied (ST* + Fertilizer)	Preplant*	Split
	----- lb N/acre -----		
1	43	0	0
2	63	ST+20	0
3	93	ST+50	0
4	123	ST+80	0
5	153	ST+110	0
6	183	ST+140	0
7	93	25	25
8	123	40	40
9	93	0	50
10	123	0	80

\*ST = Soil test nitrate-N to a depth of four ft.

The treatments were based on the nitrate-N soil test taken to a depth of 4 feet. The soil test was 43 lb N/A in the 0-4 ft depth.

### Results and Discussion:

This study was analyzed as a randomized complete block design. With this analysis, the response to pre-plant N application and the effect of different methods of application was evaluated. The conditions for growth in 2020 were very good. The root yield and extractable sucrose per acre for the check plot was 40.3 tons per acre and 12,354 lbs sucrose per acre.

#### Nitrogen fertilizer response:

Of the measured parameters, nitrogen fertilizer application affected extractable sucrose per ton, Table 3. Root yield, purity, and extractable sucrose per acre were not affected by N application.

*Extractable sucrose per ton:* Extractable sucrose per ton was affected by N application, Table 3. The N response was linear with a maximum extractable sucrose at the 183 lb N per acre, soil test nitrate-N plus fertilizer N applied, Figure 1. This response to N fertilizer was not maximized.

#### Nitrogen fertilizer and timing:

Three different application methods and timings at two N fertilizer rates were applied in 2020. The treatments were N application at pre-plant, at side-dressing and half the N applied at pre-plant and half at side-dressing. The N rates used were 50 and 80 lb N/A. These treatments did not affect any of the measured parameters; root yield, purity, extractable sucrose per ton, or extractable sucrose per acre Table 3. The split treatment root yield, purity, extractable sucrose per ton, and extractable sucrose per acre were not different from the check.

Table 3. Root yield, purity, extractable sucrose per ton, and extractable sucrose per acre for all treatments in 2020 at the Blomkest location, LSMEANS.

N rate (lb N/A)		Total N*	Root yield	Purity	Extractable sucrose	
Pre-plant	In-season	lb N/A	ton/A	%	lb/ton	lb/A
0	0	43	40.3	90.7	299	12354
20	0	63	42.3	90.7	297	12576
50	0	93	41.5	91.2	305	12648
80	0	123	42.1	91.3	305	12833
110	0	153	40.7	91.3	315	12818
140	0	183	39.4	91.0	308	12138
25	25	93	42.3	91.4	305	12907
40	40	123	41.7	90.6	298	12423
0	50	93	42.4	90.4	293	12405
0	80	123	40.8	90.8	301	12307
Grand mean			41.4	90.9	303	12562
			Statistical Analysis			
Treatment			0.29	0.17	0.004	0.52
N rate			0.19	0.52	0.03	0.52
Check vs Split trts			0.16	0.43	0.54	0.49
C.V. (%)			5.0	0.7	2.7	5.1

\*Total N is the amount of nitrate-N in soil to four feet plus fertilizer applied.

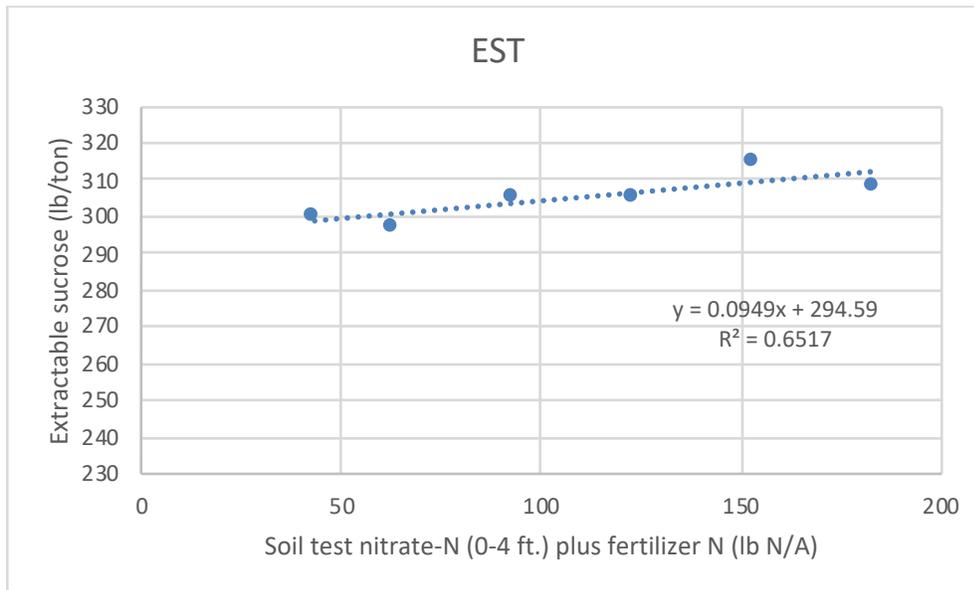


Figure 1. The effect of soil nitrate-N plus fertilizer N on extractable sucrose per ton at the Blomkest location in 2020.

**Summary:**

In 2020, weather conditions were near ideal for sugar beet production. Even with a low soil test nitrate-N, root yield, purity, and extractable sucrose per acre did not respond to the addition of N fertilizer. Extractable sucrose per ton was increased with increasing N application. Because of the lack of response to N application for root yield, purity, and extractable sucrose per acre, the time of N application did not affect those parameters. Even though extractable sucrose per ton was affected by N application, the split treatments did not significantly affect extractable sucrose per ton. The evaluation of this information would indicate that the use of split applications of N fertilizer did not help or hurt sugar beet production at this location in 2020.