SIDE-DRESS FOLIAR NITROGEN STRATEGIES FOR INCREASING SUGAR BEET ROOT YIELD AND QUALITY

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Justification of Research: Sugar beet growers are concerned about sugar beet root yield and quality. To remain competitive, the growers must fine-tune their nitrogen fertilizer management to increase sugar beet quality and thus making a better economic situation for sugar production. Since 2002, the Southern Minnesota Beet Sugar Cooperative has had a goal of better quality. The purity of the root has increased from 87 % to 92 % during this time. This has occurred from a combination of refined varieties, harvest management, and nitrogen fertilizer application. The nitrogen fertilizer recommendation for this area has been reduced 50 lb/A since this time. This reduction has not reduced root yields. In fact, average root yields have increased from a cooperative average of 21 ton/A to 28 ton/A. The increase in percent sucrose in the root has not occurred. The reasons for this include, the large amount of soil organic matter (N) in this area, rainfall occurring just before harvest that increases N mineralization from the organic matter, and frost occurrence during the early harvest that causes the plant to re-grow and thus using the sucrose accumulated in the beet for an energy source. There is a need to explore and review other nitrogen fertilizer management practices. This proposed project will look at the effect of 'feeding' nitrogen to the sugar beet during the growing season by using foliar applications of nitrogen during the growing season. The foliar applications will be timed with herbicide and fungicide applications. This slow spoon feeding may be able to supply enough nitrogen for root growth while not reducing the sucrose in the beet.

Summary of Literature Review: The current fertilizer guideline for growing sugar beet is a total of 130 lb N/A as soil nitrate-N to a depth of four feet and fertilizer nitrogen applied (Lamb et. al 2001a). This guideline was revised for the southern Minnesota and published in the 2010 Sugarbeet Production Guide to 100 lb N/A. There has been a considerable amount of research that has been done with nitrogen management since 1996, Lamb et al. 2006a, 2006b, 2005, 2004, 2003, 2001b, 2000, and 1999). Most of that work was to determine the optimum nitrogen rate for economic sugar beet production.

Lamb and Moraghan 1993 reported on the effect of foliar applications during the growing season in addition to the initial pre-plant soil applications on sugar beet root yield and quality. They concluded that the later the foliar N application was made, the more the root quality reduced. Root yield was not affected. The varieties have changed dramatically since this study was conducted.

Sims, 2010 reported new work on the use of a slow release nitrogen product called ESN by Agrium. The release of nitrogen is controlled by coating a urea prill with a poly coating. The speed of release is governed by the amount moisture and temperature in the soil. It is thought that the slower release may be beneficial to sugar beet root growth and quality. In 2009, the use of ESN in the RRV did not perform any better than urea. This was one year of data.

Split applications of nitrogen to the soil have been investigated in the RRV and SMBSC growing areas in Minnesota, Lamb, 1986, 1987, 1988, and 1989. The results were neutral for root yield and quality when the nitrogen fertilizer was split applied a pre-plant and four weeks after emergence. The sugar beet varieties have changed since that time.

Objective:

1. Determine if side-dress foliar applications of N can increase root yield and quality.

Materials and Methods: In 2013, an experiment at two locations was conducted to meet the objective. One of the sites was near Cosmos, Minnesota on a non-irrigated Canisteo-Seaforth complex (1381). The second site was near Holloway, Minnesota on an irrigated Renshaw loam (1380). A summary of the

treatments are listed in Table 1. The soil part of the treatments was based on the soil test nitrate-N (0 to 4 feet) + fertilizer application. The difference between the soil test value and the soil treatment amount was made up with a pre-plant broadcast urea application. The urea was incorporated after application. The foliar applications (App) were timed with in-season herbicide and fungicide application. The fertilizer will be the carrier for the herbicide/fungicide. The study had five replications. The plots were harvested in October and quality was determined at the Southern Minnesota Beet Sugar Cooperative Tare Lab.

Table 1. Treatments for the foliar N study in 2013.

Treatment	Soil*	App1	App2	App3	App4	App5	App6	Total
	lb N/A	Gallons of N product per acre**						lb N/A
1	60	0	0	0	0	0	0	60
2	60	3	3	3	3	3	3	114
3	60	3	3	3	0	0	0	87
4	60	0	0	0	3	3	3	87
5	80	0	0	0	0	0	0	80
6	80	3	3	3	3	3	3	134
7	80	3	3	3	0	0	0	107
8	80	0	0	0	3	3	3	107
9	100	0	0	0	0	0	0	100
10	100	3	3	3	3	3	3	154
11	100	3	3	3	0	0	0	127
12	100	0	0	0	3	3	3	127
13	120	0	0	0	0	0	0	120
14	120	3	3	3	3	3	3	174
15	120	3	3	3	0	0	0	147
16	120	0	0	0	3	3	3	147

*The soil treatment is the amount of soil test nitrate-N 0-4 ft. + fertilizer N.
**The 3 gallons is a product that is approximately 28 % N with a specific gravity of 10.4 pounds/gallon = 9 pound N.

Results 2013:

Non-irrigated 1381 Root yield at the non-irrigated site were very good in 2013. The soil and foliar treatments did not statistically influence root yield, Table 2. The interaction between soil N and foliar N was significant but other than the foliar N treatments behaved different at each soil N level, no consistant pattern can be found, Figure 1. The soil N treatments did influence the extractable sucrose per ton at this site, Figure 1 and Table 2. There also was an interaction between the soil N and foliar N treatments. In general, as the amount of soil N increased, the extractable sucrose decreased. The exception was the 100 lb N/A treatment. It was much lower in quality than expected. A significant interaction between the soil and foliar N treatments. Similar to root yield, the effects on the foliar treatment were different at each soil N level. These effects do not fit a pattern the can be explained.

Table 2. The statistical analysis for the soil and foliar treatments on root yield and extractable sucrose per ton at the non-irrigated 1381 site and irrigated site 1380 in 2013.

	Non-irrigated (1381)		Irrigated (1380)	
	Root yield	Extractable sucrose	Root yield	Extractable sucrose
Statistic term	---------- P > F ----------			
Soil N	0.85	0.0003	0.05	0.0001
Foliar N	0.16	0.26	0.009	0.02
Soil N X Foliar N	0.05	0.0003	0.09	0.02
C.V (%)	6.1	4.2	8.4	2.3

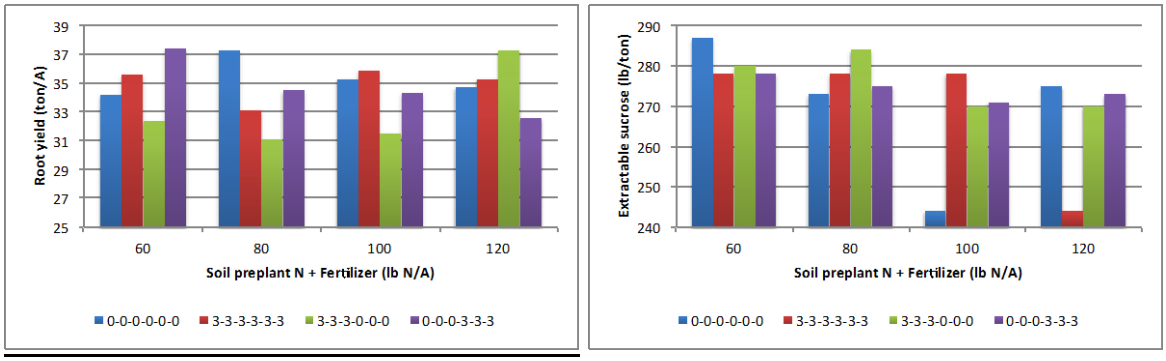

Figure 1. Sugarbeet root yield and extractable sucrose per ton as affected by soil and foliar N applications at 1381 in 2013.

Irrigated 1380 The root yields at the irrigated site 1380 were good in 2013. There was a significant effect in root yield from the use of soil N and foliar N, Table 2. There was also an interaction between soil N and foliar N on root yield, Figure 2. The use of soil N increased the root yield up to the 100 lb N/A level. At the 60 lb N/A soil level, the use of foliar N increased root yield. At the other soil N levels, the effect of foliar N application was mixed and did not increase root yields. Extractable sucrose per ton not significantly affect by the treatments except at the 120 lb N/A soil N treatment, Table 2, Figure 2. At the 120 lb N/A soil N level, the use of foliar N reduced the extractable sucrose per acre. At the 100 lb N/A soil N treatment, only the 3-3-3-0-0-0 foliar treatment reduced extractable sucrose per ton and at the 60 and 80 lb N/A soil N treatment, foliar N application did not affect the quality.

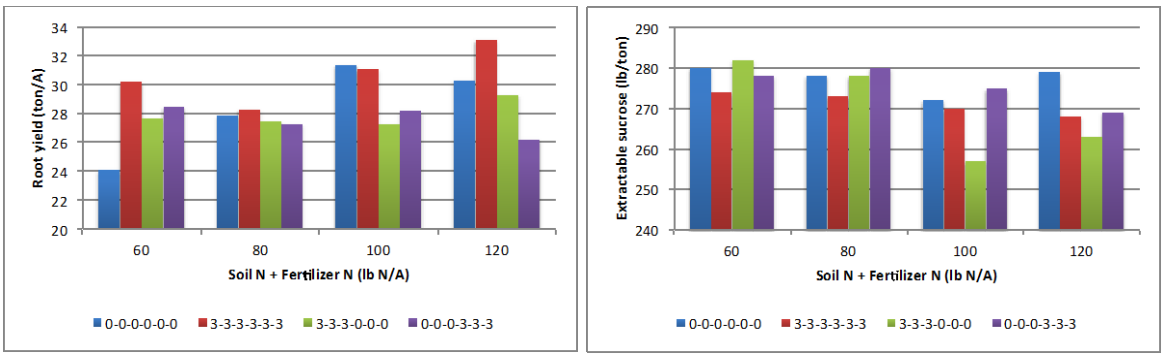

Figure 2. Sugarbeet root yield and extractable sucrose per ton as affected by soil and foliar N applications at 1380 in 2013.

Summary: In 2013, the use of foliar N applications at any soil N level did not cause consistent increases in root yield or quality. More work must be done before this practice can be adopted.

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