EFFECT OF N FERTILIZER RATE ON YIELD & QUALITY OF HIGH TONNAGE AND HIGH SUGAR TYPE SUGARBEET VARIETIES

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Introduction

With the large increase seen in sugarbeet acreage planted to Rhizomania resistant varieties last year, a corresponding interest in N fertility requirements among the different varieties ensued. Of particular interest is the difference in Rhizomania resistant varieties that characteristically provide either higher sugar levels or higher tonnage of roots, relative to other resistant varieties. In general, Rhizomania resistant varieties typically average about 0.5% less sugar than non-resistant varieties harvested on the same date (Smith et al., 2005). However, some Rhizomania resistant varieties, such as Crystal R308, produce greater sugar levels than other resistant varieties. Likewise, some resistant varieties, like Van der Have 46519, produce higher tonnage of roots at harvest than other resistant varieties. It is possible that the different types (i.e. high sugar and high tonnage varieties) may require different N fertility application rates in order to capitalize on each variety's strength. The objective of this study was to determine if the sugar and tonnage measurements of high sugar and high tonnage varieties of sugarbeet are significantly affected by N fertilizer application rates.

Materials and Methods

The field experiment was established at a Glyndon site on a Glyndon silt loam (Coarse-silty, mixed, superactive, frigid Aeric Calciaquolls). A soil test report of samples taken prior to planting indicated that soil N levels to a depth of 4 feet were very low (average value of 52 lb NO_3^--N/A to 4'). Six nitrogen rates, 75, 100, 125, 150, 175, and 200 lbs N/A (to 4' sampling depth) were spring applied as urea. Three sugarbeet varieties, Van der Have 46519, a diploid, and Crystal R308, a triploid, were planted on April 27, 2006, with a John Deere MaxEmerge II planter. Sugarbeet seeds were planted in 22-inch rows at 1.25 inch depth and with 3 inch in-row spacing. Plants were later thinned to uniform populations of about 35,600 plants per acre. Counter was surface band applied at 11.9 lbs/A, and incorporated with a drag chain at planting.

Planting was arranged in a split plot design with four replications. Individual treatment plots measured 11 feet wide and 30 feet long. Four post emergence micro-rate herbicides, two cultivations and hand labor was used as needed for weed control. Three fungicide applications, Eminent, Supertin and Headline were applied for Cercospora Leafspot control.

The middle two rows of each 6-row plot were harvested on September 26, 2006. Yield determinations were made and quality analysis performed at American Crystal Sugar Quality Tare Lab, East Grand Forks, MN.

Data was analyzed by statistical analysis of variance with least significant difference comparisons among treatments.

Results and Discussion
Table 1 demonstrates individual effects of variety and N rate selection. No significant differences were determined for the whole model. The Crystal variety did not show any response in sucrose content to N application rate. There was 0.6% decrease in sucrose content at the highest N rate for the Van der Have variety. Both varieties responded to increasing N rate with increasing root yield. The Van der Have variety demonstrated a 7 ton/A root yield increase as N application rate increased from 150 to 175 lb N/A. This rate of increase in root yield is probably the result of very favorable growing conditions in 2006, resulting in unusually high yields for all treatments. Therefore it is not possible to recommend a higher N application rate based on the data produced from this single site year and location.

Main treatment effects of N fertilizer application rate averaged over varieties is seen in Table 2. There were significant differences between fertilizer application rates for the following measurements: root yield, recoverable sugar per acre, beets per 100 ft of row, and gross return per acre. The 75 lb N/A rate yielded significantly less root yield per acre than all other treatments. There was no significant difference between the 100, 125, and 150 lb N/A rates for root yield, but these rates yielded significantly fewer roots than the 175 and 200 lb N/A rates. Percent sucrose did not differ significantly among N rates. The 75 lb N/A rate yielded significantly less recoverable sugar per acre than all other N treatments. There was not a significant difference in recoverable sugar per acre for the 100, 125, 150, and 200 lb N/A rates of N. The 175 lb N/A rate yielded significantly greater recoverable sugar per acre than other treatments. Recoverable sugar per ton did not vary significantly as a result of N application rates. Gross return was significantly lower for the 75 lb N/A treatment when compared to all other treatments. Gross return per acre did not differ significantly between the 150, 175, and 200 lb N/A rates; however, these rates were significantly greater than the 100 and 125 lb N/A rates.

Main treatment effects for variety selection are presented in Table 3. There were no significant differences among the two varieties tested for any of the parameters measured, namely, root yield, percent sugar, recoverable sugar per acre, recoverable sugar per ton, number of beets per row, gross return per acre, and gross return per ton. It was surprising that the Crystal variety, traditionally thought to be a high sugar variety, yielded only 15.6% sucrose in this study, which was only 0.1% greater than the Van der Have variety. Based on the results of other studies, it is likely that if harvest had been conducted a few weeks later that the sugar percent for the Crystal variety would have been greater. The Van der Have variety yielded almost two tons/A greater root mass than the Crystal variety.

Summary
Based on the results of this study, there is no difference in root yield or sugar content between the two sugarbeet varieties tested. It is possible that greater sucrose content would have been determined for the high sugar content variety (Crystal R308) if the harvest date had been postponed. These results indicate that higher N rates (175 and 200 lb N/A) did indeed result in increased root yield and recoverable sugar, but did not produce a greater gross return. The response to the high fertilizer rate applications may be partially explained by the very low N levels present in the soil before planting, meaning there was very little residual N available for the crop to utilize. Furthermore, due to the exceptional growing conditions, it is likely that the increased yield

and sugar values obtained from the high N rates was an unusual response and can not be counted on to occur in all growing years. Based on these results, it is not justifiable to suggest changing the rate of N fertilizer application at this time.

Table 1. The effect of variable nitrogen fertilizer rates, on variety, yield, sucrose percentage, recoverable sugar production, harvest population and gross dollar return. Glyndon, MN. 2006.

Treatment	Root Yield Tons/A	Net Sucrose %	Rec Sugar Lbs/Acre	Rec Sugar Lbs/T	Beets /100 ft of Row	Gross Return $/A	Gross Return $/T
75 Crystal 308	18.1	15.6	5659	312	137	697.2	38.4
75 Vanderhave 46519	18.2	15.7	5709	315	130	706.0	39.1
100 Crystal 308	22.6	15.8	7082	315	148	876.9	39.2
100 Vanderhave 46519	27.3	15.1	8289	303	156	993.3	36.2
125 Crystal 308	24.7	15.7	7784	314	148	968.6	39.0
125 Vanderhave 46519	25.5	15.5	7945	311	138	978.3	38.1
150 Crystal 308	26.6	15.5	8238	310	147	1009.2	38.0
150 Vanderhave 46519	25.8	15.6	8033	312	138	988.0	38.4
175 Crystal 308	27.9	15.5	8642	310	149	1059.0	38.0
175 Vanderhave 46519	32.8	15.8	10368	317	164	1295.3	39.6
200 Crystal 308	30.1	15.4	9295	308	156	1132.4	37.5
200 Vanderhave 46519	31.7	15.2	9194	289	155	1046.7	32.7
Crystal 308	25.0	15.6	7783	312	147	957.21	38.34
Vanderhave 46519	26.9	15.5	8256	308	145	1001.26	37.36
LSD (0.05)	NS	NS	NS	NS	NS	NS	NS

Table 2. The effect of variable nitrogen fertilizer rates on yield, sucrose percentage, recoverable sugar production, harvest population and gross dollar return. Glyndon, MN. 2006.

Treatment	Root Yield Tons/A	Net Sucrose %	Rec Sugar Lbs/Acre	Rec Sugar Lbs/T	Beets /100 ft of Row	Gross Return $/A	Gross Return $/T

75	18.2	15.7	5684	313	133	701.58	38.76
100	24.9	15.4	7686	309	147	935.07	37.69
125	25.1	15.6	7865	313	143	973.48	38.56
150	26.2	15.6	8136	311	143	998.59	38.19
175	30.3	15.7	9505	313	157	1177.14	38.79
200	30.9	15.3	9244	298	156	1089.54	35.10
LSD (.05)	3.7	NS	1292	NS	17	187.78	NS

Table 3. Effect of variety on sugarbeet root yields, sucrose percentage, recoverable sugar production, harvest population and gross dollar return. Glyndon, MN. 2006.

Treatment	Root Yield Tons/A	Net Sucrose %	Rec Sugar Lbs/Acre	Rec Sugar Lbs/T	Beets /100 ft of Row	Gross Return $/A	Gross Return $/T
cry 308	25.0	15.6	7783	312	147.5	957.21	38.34
vdh46519	26.9	15.5	8256	308	145.2	1001.26	37.36
LSD (.05)	NS	NS	NS	NS	NS	NS	NS

References

Smith, L.J.; T.E. Cymbaluk, J.D. Nielsen, and N.C. Cattanach. 2005. Sugarbeet Profitability as Affected by Nitrogen Rate, Variety, and Harvest Date. 2005 Sugarbeet Research and Extension Reports. NDSU Extension Service.

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