SUGARBEET PROFITABILITY AS AFFECTED BY NITROGEN RATE, VARIETY, AND HARVEST DATE, YEAR 2 GLYNDON

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Introduction

Sugarbeet variety selection has seen a large shift to Rhizomania resistant cultivars with the increasing Rhizomania pressure observed across the sugarbeet-growing regions of ND and MN in the past 4-5 years. About 80% of ACSC acreage was planted to resistant varieties in 2006, up from just 28-30% in 2005. Because of the dry weather in 2006, Rhizomania was not the problem that it has been in wetter years; however, improved disease resistance and other beneficial qualities of the resistant varieties is partially responsible for the record-breaking yields observed in 2006.

In 2005, a study was initiated at the Northwest Research and Outreach Center (NWROC) in Crookston, MN to examine how Rhizomania resistant sugarbeet varieties were affected by different N fertilizer application rates and harvest dates. In that study, Smith et al. determined that sugar content averaged approximately 0.5% less in Rhizomania resistant varieties compared to non-resistant varieties harvested at similar times. They also determined that the Rhizomania resistant varieties provided an average gross return of $21/A more than the non-resistant types. The authors concluded that they could not recommend a change in the N application rate based on the data they collected in one site year.

This study was reproduced in 2006 at two site locations: the NWROC in Crookston for a second year and at a second location in Glyndon, MN. The same quality parameters, namely recoverable sugar, percent sugar, yield, loss to molasses, and gross return, were evaluated for all treatment effects and interactions. The research conducted at the Crookston location will be published separately. Only the Glyndon research data will be discussed here.

Materials and Methods:

The field experiment at the Glyndon site was established on Wyndmere fine sandy loam. 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'). Four nitrogen rates, 85, 100, 130, and 155 lbs/A total N (to 4' sampling depth) were spring applied as urea. Three sugarbeet varieties, Beta 1305 and Van der Have 46519, both diploids, and Crystal R308, a triploid variety, 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-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 three harvest dates were September 11, September 26, and October 10. The middle two rows of each 6-row plot were harvested. Yield determinations were made and quality analysis performed at American Crystal Sugar Quality Tare Lab, East Grand Forks, MN.

Results and Discussion

Statistical analysis of the data collected in this study is shown in Table 1. Harvest date was a highly significant treatment effect ($p<0.0001$) for all parameters measured. Nitrogen rate produced statistically significant differences for recoverable sugar per acre and yield. Variety selection resulted in statistically significant differences for all measurements except for recoverable sugar per acre. Significant interactions were determined between harvest date and nitrogen rate treatments and in one case for harvest date and variety treatments. No other treatment interactions were statistically significant.

The main treatment effect of harvest date averaged over variety and nitrogen rate treatments is seen in Table 2. There was a 29% increase in recoverable sugar and a 47% increase in gross return from harvest date 1 to 3. This can be compared with the 18% and 27% increase from harvest date 1 to 2 and the increase of 9% and 16% increase from harvest 2 to 3 for recoverable sugar and gross return, respectively.

The main treatment effect for nitrogen rate averaged over harvest date and variety is shown in Table 3. The highest N rate, 155 lbs N/A did not significantly outperform the current recommendation of 130 lbs N/A for any of the measurements. It was observed that recoverable sugar per acre increased with increasing N rate up to the 155 lb/A rate; however, there was a corresponding decline in percent sucrose as the N rate increased. The significant increase in recoverable sugar per acre is a result of the increased yield observed at higher N rates. Sugarbeet yield increased significantly from the 100 to 130 lb N/A rate. The gross return, however, did not change significantly as a result of increased N fertilizer. The increase in yield and recoverable sugar per acre resulting from high N rates is not common in most sugarbeet production years, and was probably the result of the highly favorable conditions for sugarbeet production in 2006. The response to the high fertilizer rate applications may also 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. As a result of the favorable growing conditions and low residual N, sugarbeet were able to fully utilize the higher N rates applied in this study. Because the differences between the current recommended rate and the higher rate were not significantly it is not possible to recommend the higher use of N fertilizer rates as a general crop production practice.

The main treatment effect for sugarbeet variety averaged over harvest date and N rate can be seen in Table 4. Despite producing lower yields, Crystal R308 yielded greater gross returns as a result of higher sugar percentage and lower loss to molasses. The Crystal variety did not perform

particularly well relative to other varieties at the earliest harvest date (see Table 5), but generally out-performed the other varieties at the middle and late harvest dates. It should be noted that under high Rhizomania pressure triploid varieties, such as Crystal R308, would not be expected to provide the same level of disease resistance as diploid varieties, such as Beta 1305 and Van der Have 46519.

The effect of harvest date on gains in recoverable sugar per acre (RSA) at each N rate is provided in Table 5. The individual effects of harvest date and nitrogen rate for each variety tested can be seen in Table 6. VDH46519 displayed notable increases in RSA (Table 5) and gross return (Table 6) from the first to third harvest dates, particularly for the two lowest N rates. Beta 1305, on the other hand, showed a slow but steady increase in most measured parameters from the first through third harvests (Table 5). Crystal R308 clearly provides greatest return when harvested later due to the high rate of increase in sugar production (% sucrose) and recoverable sugar observed between the second and third harvest dates (Table 6).

Summary

Based on the results of this study, no change in N rate can be recommended. For Rhizomania-resistant varieties with higher sugar levels, such as Crystal R308, it appears that the later harvest dates allowed greater sugar to accumulate, resulting in higher percent sucrose values. This may have been highly correlated with weather, however, and should not be considered a general rule until confirmed with further research.

Table 1. Analysis of Variance; NS = not significant at $p<0.05$;
*, **, and *** indicate significance at $p< 0.05$, 0.01, and 0.0001, respectively
HD = Harvest Date; NR = Nitrogen Rate; V = Variety; RSA = Recoverable Sugar per Acre;
RST = Recoverable Sugar per Ton; LTM = Loss to Molasses

	Significance Level					
Source	**RSA (lb/A)**	**RST (lb/T)**	**Yield (T/A)**	**Sucrose (%)**	**LTM (%)**	**Gross Return ($/A)**
HD	***	***	***	***	***	***
NR	**	NS	***	NS	NS	NS
HD X NR	NS	**	NS	**	**	NS
V	NS	***	**	***	***	*
HD X V	NS	NS	NS	NS	**	NS
NR X V	NS	NS	NS	NS	NS	NS
HD X NR X V	NS	NS	NS	NS	NS	NS

Table 2. Main plot treatment effects of harvest date (averaged over nitrogen rate and variety)

Harvest Date	Average Values RSA (lb/A)	RST (lb/T)	Yield (T/A)	Sucrose (%)	LTM (%)	Gross Return ($/A)
11-Sep	8367	290	29.1	15.7	1.17	897
26-Sep	9891	309	32.1	16.7	1.28	1138
10-Oct	10774	327	33.4	17.6	1.23	1322
LSD	1657	8.89	NS	0.33	NS	177

Table 3. Main plot treatment effects of nitrogen rate (averaged over harvest date and variety)

N Rate (lbs N/A to 4')	Average Values RSA (lb/A)	RST (lb/T)	Yield (T/A)	Sucrose (%)	LTM (%)	Gross Return ($/A)
85	9418	311.4	30.4	16.79	1.21	1103
100	9333	308.1	30.2	16.6	1.2	1080
130	9833	305.9	32.7	16.55	1.26	1124
155	10125	308.7	32.8	16.66	1.22	1169
LSD	776	NS	2.17	NS	NS	NS

Table 4. Main plot treatment effects of variety (averaged over harvest date and nitrogen rate)

Variety	Average Values RSA (lb/A)	RST (lb/T)	Yield (T/A)	Sucrose (%)	LTM (%)	Gross Return ($/A)
VDH 46519	9715	301.5	32.3	16.3	1.19	1096
Beta 1305	9553	306.7	31.5	16.6	1.31	1097
Crystal R308	9764	317.3	30.7	17	1.17	1164
LSD	NS	4.97	1.11	0.22	0.05	62.6

Table 5. Gain in recoverable sugar per acre between harvest date and nitrogen rate

Variety	HD	NR (lb/A to 4')			
		85	**100**	**130**	**155**
VDH46519	1-2	4180	1057	962	1195
	2-3	206	2032	1119	1391
	1-3	4386	3090	2081	2586
Beta 1305	1-2	1107	2345	554	1117
	2-3	931	514	174	-112
	1-3	2038	2859	728	1005
Crystal R308	1-2	1779	1939	1274	774
	2-3	607	585	1043	2107
	1-3	2386	2524	2317	2881

Table 6. Variety, harvest date, and nitrogen rate effects on yield, quality, and return parameters

Variety	HD	NR lbs N/A (4')	RSA (lb/A)	RST (lb/T)	Yield (T/A)	Sucrose (%)	LTM (%)	Gross Return ($/A)
VDH46519	11-Sep	85	6476	289	25.04	15.59	1.15	689
	11-Sep	100	7546	275	27.25	14.97	1.28	759.03
	11-Sep	130	9104	288	31.75	15.45	1.1	961.24
	11-Sep	155	9223	282	32.75	15.28	1.15	950.59
	26-Sep	85	10656	309	34.6	16.65	1.23	1228
	26-Sep	100	8603	295	29.55	15.96	1.23	926
	26-Sep	130	10066	298	33.98	16.18	1.28	1108
	26-Sep	155	10418	301	34.48	16.2	1.13	1174
	10-Oct	85	10862	322	33.73	17.26	1.15	1312
	10-Oct	100	10635	328	32.28	17.47	1.08	1314
	10-Oct	130	11185	307	36.53	16.7	1.35	1280
	10-Oct	155	11809	326	36.25	17.47	1.2	1444
Beta 1305	11-Sep	85	8351	303	27.5	16.24	1.08	945
	11-Sep	100	7589	283	26.73	15.37	1.25	792
	11-Sep	130	9209	305	30.13	16.34	1.1	1052
	11-Sep	155	9145	282	32.6	15.37	1.28	937
	26-Sep	85	9458	306	30.75	16.73	1.4	1087
	26-Sep	100	9934	305	32.85	16.56	1.35	1120
	26-Sep	130	9763	301	32.45	16.5	1.45	1094
	26-Sep	155	10262	310	33.1	16.86	1.35	1191

	10-Oct	85	10389	317	32.98	17.26	1.45	1227
	10-Oct	100	10448	331	31.6	17.79	1.23	1297
	10-Oct	130	9937	312	36.88	17.07	1.48	1176
	10-Oct	155	10150	329	30.9	17.77	1.33	1251
Crystal R308	11-Sep	85	8135	292	27.78	15.79	1.18	882
	11-Sep	100	8261	295	27.93	15.96	1.18	909
	11-Sep	130	8548	291	29.48	15.66	1.13	916
	11-Sep	155	8821	296	29.85	15.95	1.15	968
	26-Sep	85	9914	324	30.6	14.41	1.2	1206
	26-Sep	100	10200	321	32.05	17.2	1.18	1217
	26-Sep	130	9822	322	30.6	17.33	1.25	1182
	26-Sep	155	9595	313	30.68	16.92	1.3	1124
	10-Oct	85	10521	343	30.73	18.23	1.1	1348
	10-Oct	100	10785	342	31.48	18.18	1.08	1383
	10-Oct	130	10865	332	32.83	17.78	1.2	1350
	10-Oct	155	11702	340	34.6	18.13	1.13	1483

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