

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

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Climatic conditions aside, the variety (V) planted, the nitrogen (N) level and the harvest date (HD), assuming other cultural and chemical practices are at optimum, will affect the profitability of a given field. Pre-pile harvest quality is historically low. To offset this, producers have suggested planting high-sugar type varieties and reducing nitrogen rates on this acreage. The advent of easy to use variable rate technology has resulted in reduced N levels on headlands, but not in the field openings to any degree. Planters capable of varying varieties, without cleaning and refilling seed hoppers, is not yet available and thus not practical. Some producers now plant higher-sugar, lower-tonnage type varieties, and may vary N rate, depending on when a particular field is to be harvested during pre-pile or regular harvest to maximize profitability. Previous research by this author has shown that high-sugar type varieties vs. high-tonnage, lower-sugar content varieties harvested early gave the highest gross return per acre. On the other hand, the high-tonnage, lower-sugar types harvested later in the harvest season, have given equal or greater gross returns.

Rhizomania has now spread across most of the sugarbeet growing regions of MN and ND. The degree and severity of this devastating disease on sugarbeet yield and quality varies greatly. In the southern Minnesota beet growing region, over 85% of the varieties planted are rhizomania resistant or tolerant. In the northern part of the Red River Valley, few producers plant these types of varieties as the disease is new to them, and there is a general concern that planting resistant or tolerant rhizomania varieties will reduce their return, due to lower sugar content and yield in the absence of rhizomania or weather conditions conducive for its full affect.

In 2003, a study was initiated at the Northwest Research and Outreach Center, Crookston, MN to determine how planting varieties differing in the level of rhizomania resistance, as well as yield and quality, at different N rates, and different harvest dates would affect profitability under non-rhizomania conditions.

Methods and Materials:

Nitrogen rates of 66%, 100% and 133% of the new recommended N rates (87, 130 and 173 lb/A total N-0-4 ft respectively) were spring applied as urea. Two rhizomania resistant (tolerant) varieties Beta 4811 and VDH46177 differing in quality, and Crystal 999 (susceptible check) were planted April 29, 2003. All cultural, herbicide, insecticide and fungicide treatments were applied to insure maximum yield and quality. Harvest dates were September 10, September 23, October 6 and October 20, 2003. Quality traits were determined at the ACSC Quality Laboratory, East Grand Forks, MN.

Results and Discussion:

The statistical analysis of the variables measured is shown in [Table 1](#). Harvest date (HD), nitrogen rate (N) and variety (V) showed highly significant differences for all variables. Harvest date x V interactions were significant for recoverable sugar per acre (RSA) and yield. No other interactions were statistically significant.

The main effects of HD (averaged over V and N) is shown in [Table 2](#). The largest increase in RSA and yield occurred between the first and second harvest dates. The six-ton increase in yield and reduction in RST is believed related to 3.17 inches of rainfall that occurred between the harvest dates. Extremely dry conditions preceded the September 10 harvest and essentially no rainfall occurred between the second and third harvest dates. RSA, RST, yield, net sucrose % and gross return per ton and acre increased 3364 lb, 36 lb, 8.1 ton, 1.8% , \$8.10 and \$502 respectively between the first and last harvest dates.

The main N effect (averaged over V and HD) is shown in [Table 3](#). The recommended N rate produced the highest RSA and yield. The recommended N rate was not statistically different from the reduced rate in RST or net sucrose %. The high N rate significantly reduced all variables except yield and had a gross return of \$71/A less than the recommended N level.

The main V effect (averaged over HD and N) is shown in [Table 4](#). The two rhizomania resistant (tolerant) varieties differed significantly in all variables measured. Both varieties produced significantly lower RSA, RST, yield and net sucrose % than the susceptible check, Crystal 999.

The effects of HD and N for the three varieties used in this study on yield, quality and gross return are shown in [Table 5](#). The non-rhizomania resistant variety Crystal 999 had the highest RSA, RST and gross return/A across N rates and harvest dates, while the high rhizomania resistant variety, Beta 4811, had the lowest. The variety VDH46177 lagged in these traits in the first two harvests, but was not significantly different from Crystal 999 at the final harvest date.

The gains in RSA and gross return/A for the varieties used in this study, between harvest dates at the various N levels, are shown in [Tables 6 and 7](#). Beta 4811 had the largest gain in RSA and gross return between the first and second harvest dates, but the lowest between the third and fourth harvest dates at the reduced N rate (66%). This suggests that this level of N was insufficient to maintain yield, as compared to the increases at the 100 and 133% N rates. Crystal 999 by comparison had the largest gain in RSA at the reduced N rates between the third and fourth harvest dates, but a reduction in RSA at the 100 and 133 % N rates, whereas VDH46177 had RSA increases equal over the three N rates.

The increases noted for the Van der Have variety are consistent with other research in similar trials by the author.

In summary, the rhizomania susceptible variety Crystal 999 performed well at all harvest dates, especially the first two under a non disease situation. VDH46177 performed close to or equal to Crystal 999 at the third and fourth harvest dates. While delaying harvest of Beta 4811 increased RSA and gross return, it was at a decreasing rate compared to the other two varieties. Relative to N rates, there does not appear from this trial, that there is any reason to reduce or increase N rates from the NEW recommendations as is being suggested by some seed companies. Based on this **ONE YEAR** trial reducing N rate on Beta 4811, if it is to be harvested late in the season, can reduce RSA and gross return.

Table 1. ANOVA

Source	RSA (lb/A)	RST (lb/T)	Yield (T/A)	Net Sucrose ¹ (%)	LTM (%)
HD	„2	”	”	”	”
N	”	”	”	”	”
HD x N	NS	NS	NS	NS	NS
V	”	”	”	”	”
N x V	NS	NS	NS	NS	NS
HD x V	”	NS	’	NS	NS
HD x N x V	NS	NS	NS	NS	NS

¹. Net sucrose = % sucrose - % LTM

². **, * statistically significant at the 1% and 5% levels respectively.

Table 2. Effects of HD (ave. over V & N levels) on yield and quality.

Harvest Date	RSA (lb/A)	RST (lb/T)	Yield (T/A)	Net sucrose ¹ (%)	LTM (%)	Gross Return ² (\$/T)	(\$/A)
Sept 10	5701	313.2	17.8	15.66	1.26	36.16	644
Sept 23	7412	319.8	23.7	15.99	1.10	37.45	892
Oct 6	7968	336.7	23.7	16.83	1.10	41.45	982
Oct 20	9062	349.2	25.9	17.46	1.17	44.26	1146
LSD ₀₅	191	7.2	0.9	0.36	0.06		

¹. Net sucrose = % sucrose - % LTM

². Gross return based on ACSC Nov. 15, 2003 payment

Table 3. Main effects of N rate (ave. over V & HD) on yield & quality.

N rate	RSA (lb/A)	RST (lb/T)	Yield (T/A)	Net sucrose (%)	LTM (%)	Gross Return (\$/T)	(\$/A)
66 %	7490	335.4	22.2	16.78	1.10	41.16	914
100 %	7722	333.3	23.1	16.67	1.14	40.68	940
133%	7394	320.4	23.0	16.02	1.24	37.78	869

LSD₀₅ 146 4.6 0.5 0.23 0.04

Table 4. Main effects of V (ave. over HD and N rate) on yield & quality.

Variety	RSA (lb/A)	RST (lb/T)	Yield (T/A)	Net sucrose (%)	LTM (%)	Gross Return	
						(\$/T)	(\$/A)
Beta 4811	6982	312.7	22.3	15.63	1.22	36.05	804
VDH46177	7635	334.5	22.8	16.72	1.14	40.96	934
Crystal 999	7990	342.0	23.3	17.10	1.12	42.64	994
LSD ₀₅	139	3.7	0.4	0.18	0.03		

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Table 5. Harvest date, nitrogen & variety effects on yield, quality and return.

Variety	Harvest Date	N Rate % of recommended			Yield	Sucrose	LTM	Gross Return ¹
			RSA	RST	T/A	(%)	(%)	\$/A
Beta 4811	1	66	5092	301.5	16.9	16.30	1.23	567
	1	100	5491	310.0	17.7	16.80	1.30	627
	1	133	5202	295.0	17.6	16.20	1.45	565
	2	66	7210	311.5	23.2	16.63	1.05	827
	2	100	7365	304.5	24.2	16.33	1.10	827
	2	133	6557	275.0	23.8	15.03	1.28	658
	3	66	7739	333.0	23.2	17.80	1.15	944
	3	100	7404	316.5	23.4	16.98	1.15	863
	3	133	6973	306.5	22.7	16.60	1.28	788
	4	66	7960	237.0	23.6	18.05	1.20	980
	4	100	8549	342.0	25.0	18.25	1.15	1065
	4	133	8223	319.5	25.8	17.30	1.33	966
Crystal 999	1	66	6086	335.5	18.2	17.93	1.15	745
	1	100	6279	333.0	18.8	17.83	1.18	766
	1	133	6010	322.0	18.7	17.45	1.35	711
	2	66	7731	334.5	23.1	17.70	0.98	946
	2	100	7866	327.5	24.0	17.48	1.10	945
	2	133	7607	310.5	24.5	16.70	1.18	871
	3	66	8213	358.0	23.0	18.90	1.00	1060
	3	100	8842	353.0	25.1	18.68	1.03	1127
	3	133	8625	352.0	24.5	18.63	1.03	1099
	4	66	9460	363.0	26.1	19.23	1.08	1234
	4	100	9791	364.5	26.9	19.35	1.13	1281

VDH46177	4	133	9339	351.0	26.6	18.80	1.25	1188
	1	66	5719	329.5	17.4	17.63	1.15	691
	1	100	5882	328.0	17.9	17.60	1.20	708
	1	133	5533	324.0	17.1	17.58	1.38	659
	2	66	7423	322.5	23.0	17.18	1.05	881
	2	100	7494	321.5	23.3	17.17	1.10	887
	2	133	7434	311.5	23.9	16.65	1.08	854
	3	66	7899	342.0	23.2	18.15	1.05	983
	3	100	8129	341.0	23.8	18.18	1.13	1011
	3	133	7873	328.0	24.0	17.53	1.13	947
	4	66	9323	357.5	26.1	18.98	1.10	1203
	4	100	9548	358.5	26.6	19.03	1.10	1233
4	133	9339	350.0	26.7	18.70	1.20	1185	

¹. Gross return based on ACSC Nov. 15, 2003 payment.

Table 6. Gain in RSA between harvest dates at the various N rates.

Variety	Harvest Dates ¹	N Rates			
		66 %	100 %	133%	0
Beta 4811	1-2	2118	1874	1355	1782
	1-3	2647	1913	1771	2110
	1-4	2868	3058	3021	2982
Crystal 999	1-2	1721	1587	1997	1635
	1-3	2127	2563	2615	2435
	1-4	3374	3512	3329	3405
VDH46177	1-2	1704	1612	1901	1739
	1-3	2180	2247	2340	2256
	1-4	3604	3666	2806	3692
Beta 4811	2-3	529	39	416	328
	2-4	750	1184	1666	1200
Crystal 999	2-3	482	976	1018	825
	2-4	1729	1925	1730	1795
VDH46177	2-3	476	635	439	517
	2-4	1900	2054	1905	1953
Beta 4811	3-4	221	1145	1450	939
Crystal 999	3-4	1247	949	714	970

¹. Harvest date 1 = Sept. 10; 2 = Sept. 23; 3 = Oct. 6; 4 = Oct.20.

Table 7. Gain in gross return (\$/A) between harvest dates at the various N rates

Variety	Harvest Dates ¹	N Rates			
		66 %	100 %	133%	0
Beta 4811	1-2	260	200	93	184
	1-3	377	236	223	279
	1-4	413	438	401	417
Crystal 999	1-2	201	179	160	180
	1-3	315	361	388	355
	1-4	489	515	479	494
VDH46177	1-2	190	179	195	188
	1-3	292	303	288	294
	1-4	512	525	526	521
Beta 4811	2-3	117	36	130	94
	2-4	153	238	308	233
Crystal 999	2-3	114	182	228	175
	2-4	288	336	317	314
VDH46177	2-3	102	124	93	106
	2-4	322	346	331	333
Beta 4811	3-4	36	202	178	139
Crystal 999	3-4	174	154	89	139
VDH46177	3-4	220	222	238	227

¹. Harvest date 1 = Sept. 10; 2 = Sept. 23; 3 = Oct. 6.; 4=Oct. 20.