# Effect of Nitrogen and Harvest Date on Roundup Ready Sugarbeet Variety

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## Introduction

With the advent of Roundup Ready™ (RR) sugarbeet seed becoming available for producer use in 2008, it is certain that many growers will be planting these new varieties in coming years. Fertility and harvest date of new RR varieties may differ significantly from that of more commonly planted sugarbeet varieties. In field trials conducted in 2006 weed studies, it was observed that some RR varieties were noticeably larger than other varieties at harvest. This observation prompted questions regarding harvest date adjustments for RR sugarbeet varieties. The effect of current nitrogen (N) applications on RR varieties also needs to be evaluated. The N rates tested in this study were check (no N added), 85, 100, 130, and 155 lb N/A. The three harvest dates were September 11, September 26, and October 15, 2007. The objective of this study was to provide growers who are considering ordering RR sugarbeet seed with useful information when faced with fertility management and harvest date decisions for these new RR varieties.

## Materials and Methods

The study was located at the Prosper, NDSU Agricultural Research Station on a Bearden-Perella silt loam (coarse-silty, frigid aeric calciaquoll). The experimental design was a randomized split block in which harvest date was the main block, N level was the split-plot, and variety was the split-split plot. The study was replicated four times. A buffer area of 25 feet was left between replications for tractor traffic and to avoid spray drift. Each treatment plot was 30 feet long and consisted of six rows on 22-inch row spacings. The study was planted on May 10$^{th}$ using a 3.25 inch seed-spacing at a 1.25 inch depth into good seedbed moisture conditions and with an air temperature around 55º F and 18mph wind speeds. Plants were later thinned to a population of 180 beets per 100 ft of row. The site location was soil sampled on May 3$^{rd}$ and zones were developed based on soil test N levels. Soil test N levels were between 40 and 68 lb N/a to a depth of four feet. Two Round Up Ready sugarbeet varieties were tested, one Beta variety and one Hilleshog variety. Varieties will be referred to henceforth as VAR1 and VAR2. Two applications of Round Up were applied during the growing season for weed control and 3 fungicide applications were conducted using Eminent, Supertin/Topsin, and Headline for Cercospora control. Emergence counts were taken on June 4$^{th}$ from a single replication. Harvest stand counts were taken at all three harvest dates. The middle two rows of each treatment plot were harvested.

Harvest data was analyzed with SAS 9.1 using the GLM procedure. For convenience and timeliness of this publication, the statistical analysis of the data was conducted as if this study were a completely randomized split plot. In fact, the study was a slightly more complicated design known as a strip-split plot and the statistical analysis of significance may change slightly once the more appropriate statistical design has been employed. The data values themselves are accurate. Yield determinations were made and quality analysis was performed at American Crystal Sugar Quality Tare Lab, East Grand Forks, MN.

## Results and Discussion

As expected, recoverable sugar per acre, recoverable sugar per ton, tonnage, and percent sugar increased significantly at the later harvest dates (Table 1). Recoverable sugar increased by 36% between 09/11 and 10/15 and 15% between 09/26 and 10/15. Root tonnage increased 21% between 09/11 and 09/26 and 8% between 09/26 and 10/15. Percent sugar increased 11.6% between 09/11 and 10/15 and 7% between 09/26 and 10/15. At the earliest harvest date, the highest N rate yielded significantly greater RSA than any other treatment, but there was no difference between the recommended rate (130 lb N/a) and the higher rate for yield (tons root/a) or gross income/a. At the second harvest date, the highest N rate yielded significantly greater RSA and gross income/a for all treatments, including the current recommended rate (130 lb N/a), but showed no advantage for RST, percent sugar, gross income/ton, or sugar loss to molasses. By the third harvest date, there was no advantage observed in the 150 lb N/a N rate relative to the recommended rate (130 lb N/a).

Recoverable sugar per acre, yield, and gross dollars per acre were significantly greater when N rate was increased from the current recommended rate (130 lb N/a to 4 feet) to 150 lb N/a. Recoverable sugar per ton, percent sugar, sugar loss to molasses, and gross dollars per ton did not differ significantly regardless of what N rate was used; i.e. all N rates were statistically equivalent ($\alpha$=0.05) to the check (no N applied). Essentially, this data indicate that tonnage and all related parameters (RSA and $/a) increased significantly when N rate was increased from the recommended rate to a rate of 150 lb N/a. Sugarbeet root yields increased by about 6% when the N rate was increased from 130 lb N/a to 150 lb N/a. One factor that may have resulted in an artificial inflation of yield and quality parameters at the highest N rate is the possibility of a greater-than-normal rate of denitrification at the site of this study. The soils at the location had relatively high clay content and the rainfall during the months of May and June were 50% greater than the yearly norm for that area. The combination of these factors makes it possible that a greater than average loss of N may have occurred early in the season due to denitrification. Nitrogen loss of fertilizer N would have made all of the treatments proportionally lower than the N levels stated here, making it likely that the highest rate is somewhere between 130 lb N/a and 150 lb N/a. This suggestion is supported by the observation that the increased N rate did not result in a reduction in percent sugar, as is generally expected. Ultimately, decisions regarding N rate application and the profit margin advantage accrued by increasing the N rate above the current recommended rate will depend on the cost of N and the effect on quality parameters. It is doubtful that increasing the N rate above the current recommendation will result in a substantial profit advantage given the current price of N fertilizer. Based on this single year of data and the questions regarding the amount of N that may have denitrified, we cannot recommend increasing the N rate in Round Up Ready sugarbeet at this time. Research across more environments is needed.

There were significant differences in recoverable sugar per acre, yield, and gross profit per acre as a result of the RR variety tested (Table 3). One variety ranked better than the other in most cases, although not all differences were significant. Percent sugar content was the same between varieties. Variety 2 had a slower emergence rate and produced reduced stand counts relative to Variety 1. When emergence counts were performed on June 4th, Variety 2 displayed population counts of about one-half that of Variety 1. At the early harvest date, Variety 1 yielded greater RSA and root yield than Variety 2, but there were no differences between varieties for RST, percent sugar, sugar loss to molasses, or income calculations. At the second harvest date, Variety 1 yielded better RSA, root yield, and gross income/a. At the last harvest date, Variety 1 produced more beneficial values for all parameters measured except sugar loss to molasses, which was statistically equivalent to Variety 2.

It should be noted that both RR varieties tested were still being developed to meet approval standards at the time that this study was conducted, and both companies have continued to develop varieties with more favorable germination and emergence measurements compared to the varieties that were used in this study. This data was produced simply as a test to determine the extent of variability between different varieties and their responses to N. Variety tests will be conducted and data provided by coded variety trials for variety selection purposes.

| Parameter | Harvest Date 1 (Sept. 11) | Harvest Date 2 (Sept. 26) | Harvest Date 3 (Oct. 15) |
|---|---|---|---|
| RSA | 7220.9 a | 8498.4 b | 9805.3 c |
| RST | 292.8 a | 306.6 b | 327.9 c |
| Yield | 24.6 a | 27.7 b | 29.9 c |
| % Sugar | 15.8 a | 16.5 b | 17.7 c |
| SLM | 1.19 a | 1.21 a | 1.27 b |
| $/t | 31.2 a | 34.4 b | 39.4 c |
| $/a | 768.40 a | 953.41 b | 1177.09 c |

Table 1. Harvest date effect on sugarbeet yield and quality. Values are means averaged across reps, variety, and N rate. RSA = Recoverable Sugar per Acre (lb/a); RST = Recoverable Sugar per Ton (lb/ton); Yield = root yield (ton/a); sugar (%); SLM = sugar loss to molasses (%); $/t = gross $/ton; $/a = gross $/acre. Letters following values represent statistical differences determined by lsd. All statistical analysis is measured within the given parameter between harvest dates (across the rows, not down the columns).

| Parameter | Check | 80 lb N/a | 100 lb N/a | 130 lb N/a | 150 lb N/a |
|---|---|---|---|---|---|
| RSA | 7693.1 a | 8248.8 b | 8418.5 b | 8834.4 c | 9436.1 d |
| RST | 309.6 a | 309.8 a | 308.2 a | 308.9 a | 309.3 a |
| Yield | 24.7 a | 26.5 b | 27.1 b | 28.5 c | 30.2 d |
| % Sugar | 16.7 a | 16.7 a | 16.6 a | 16.7 a | 16.7 a |
| SLM | 1.23 a | 1.21 a | 1.22 a | 1.22 a | 1.22 a |
| $/t | 35.07 a | 35.14 a | 34.76 a | 34.91 a | 35.00 a |
| $/a | 876.17 a | 939.18 b | 955.50 bc | 1001.22 c | 1059.43 d |

Table 2. Nitrogen rate effect on sugarbeet yield and quality. Unless noted, all values are averaged over reps, variety and harvest date. RSA = Recoverable Sugar per Acre (lb/a); RST = Recoverable Sugar per Ton (lb/ton); Yield = root yield (ton/a); sugar (%); SLM = sugar loss to molasses (%); $/t = gross $/ton; $/a = gross $/acre. Letters following values represent statistical differences determined by lsd. All statistical analysis is measured within the given parameter between N rates (across the rows, not down the columns ).

| Parameter | Variety 1 | Variety 2 |
|---|---|---|
| RSA | 8971.9 a | 8044.5 b |
| RST | 310.6 a | 307.7 a |
| Yield | 28.8 a | 26.0 b |
| % Sugar | 16.7 a | 16.6 a |
| SLM | 1.23 a | 1.21 a |
| $/t | 35.31 a | 34.64 a |
| $/a | 1023.41 a | 909.19 b |

Table 3. Variety effect on sugarbeet yield and quality. Unless noted, all values are averaged over reps, N rate, and harvest date. RSA = Recoverable Sugar per Acre (lb/a); RST = Recoverable Sugar per Ton (lb/ton); Yield = root yield (ton/a); sugar (%); SLM = sugar loss to molasses (%); $/t = gross $/ton; $/a = gross $/acre. Letters following values represent statistical differences determined by lsd. All statistical analysis is measured within the given parameter between varieties (across the rows, not down the columns).

**Conclusions**

There was a significant advantage found by delaying harvest date until mid-October for both varieties. One variety was clearly better yielding in most cases, demonstrating that there are differences between varieties for the new RR sugarbeet varieties becoming available in 2008. The higher than average precipitation levels in the early spring of 2007 may have resulted in high rates of denitrification, which would confound the data by artificially decreasing the effective N rate for this study. This data does not provide enough evidence to recommend a higher N rate for RR varieties, particularly when the varieties are harvested later in the season. Further research will elucidate the need for increased N rates in Round Up Ready sugarbeet varieties.