# STRIP TILLAGE VERSUS BROADCAST N APPLICATION FOR SUGAR BEET AND DRY BEANS

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## ABSTRACT

Strip-till placement of N was compared to broadcast N application for sugar beets and dry beans during 2006 and 2007 near Scottsbluff, NE. Effects on sugar beet stand, yield, sugar content and sucrose production and sugar loss to molasses were evaluated. For dry beans, stand and final yield effects were measured. No significant N method effects or N rate by method interactions were shown for either crop. N rate significantly increased yield of both crops. For sugar beets the optimum N rate that maximized recoverable sucrose was near 105 lbs N/acre in 2006 and 80 lbs in 2007. For dry beans, an N rate of 80 lbs N/acre maximized yields each year. The research showed the importance of testing for residual nitrate for both crops and that current UNL recommendations are adequate for high dry bean and sugar beet yields.

## INTRODUCTION

Strip-till placement of fertilizer is a fairly recent application option for sugar beet and dry bean production on the high plains. Producers may apply both nitrogen and phosphorus at one or two application depths (e.g., shallow and deeper), depending on the manufacturer's equipment design. Because of the root architecture of sugar beets, the question many producers have is whether zone placement of N might be more efficient than conventional broadcast application of N. Improved efficiency could mean less N or improved quality, however, limited data is available comparing conventional N placement versus deeper placed N. The importance of proper nitrogen nutrition in sugar beet production is well known. A lack of nitrogen results in reduced root yield while excess nitrogen causes a decrease in sucrose content and an increase in SLM (sugar loss to molasses).

Dry beans are a member of the legume family and fix atmospheric nitrogen for plant use. It is generally assumed that fertilizer nitrogen is not needed for optimal dry bean production. Dry beans, however, are extremely inefficient fixers of nitrogen and research has shown that dry bean yields can be increased by adding fertilizer nitrogen if the level of residual nitrate in the soil is low. Dry beans generally need a total of 100 to 125 pounds N per acre in addition to N they fix for high yields. N recommendations from major growing areas reflect this (Hergert and Schild, 2007; Stevens et al, 2004).

## METHODS AND MATERIALS

The objectives of this project for sugar beets were to:

1) Compare strip tillage application of N versus broadcasting to determine effects on stand, yield, sugar, SLM (sugar loss to molasses) and nitrogen use efficiency.

2) Determine the effect of application method on soil sampling recovery of residual nitrate.

For dry beans the objective was to determine effects on stand and yield.

A sprinkler-irrigated field at the PHREC Mitchell station was selected during spring 2006 for the experiment. The soil was a Tripp fine sandy loam (*Coarse-silty, mixed, superactive, mesic Aridic Haplustolls*). Soil analyses are listed in Table 1. Soils were sampled to a four foot depth (dry beans) or a six foot depth (sugar beets) in increments of 0 to 8, 8 to 24, 24 to 48, and 48 to 72 inches. Samples were analyzed for pH, organic matter, Olsen P, K, DTPA-Zn and nitrate-N.

Table 1. Soil test values for the sugar beet and dry bean sites.

| Year | pH | Organic Matter | Olsen P<br>Ppm | Nitrate-N<br>Lbs/acre |
|---|---|---|---|---|
| | Sugar Beet Soil Tests | | | |
| 2006 | 8.1 | 1.5% | 25 | 40 (4 ft) |
| 2007 | 8.1 | 1.7% | 25 | 100 (4 ft) |
| | Dr Bean Soil Tests | | | |
| 2006 | 8.1 | 1.5% | 12 | 30 (2 ft) |
| 2007 | 8.0 | 1.7% | 22 | 40 (2 ft) |

A strip-split-plot design was used to compare N application methods and N rates for both sugar beets and dry beans. N rates for sugar beets were 0, 35, 70, 105, 140, and 175 lbs in 2006. In 2007 an additional N rate (210 lbs) was added. Treatments were replicated five times.

N rates for dry beans were 0, 40, 80, and 120 lbs per acre and were replicated six times. The strip-till implement was manufactured by Schlagel Manufacturing of Torrington, WY (http://www.schlagel.net/Till-N-Plant.htm.).

To avoid confounding tillage or ripping effects with N application method, all plots were strip tilled. The strip-till N treatments for sugar beets were applied one or two days before planting (late April or early May) using UAN (32-0-0). The shanks were set to a depth of 11 inches and two injection points were at 4 inches and 10 inches below the soil surface with half of the N being applied at each depth. The broadcast N treatments received 35 lbs N/acre before planting (except the check) with remaining N applied June 27 as urea (46-0-0) followed by a light irrigation.

For dry beans, strip-till N treatments were also applied one or two days before planting (early June) using UAN (32-0-0). Shank depth was 11 inches with N injection points at 4 inches and 10 inches below the soil surface with half of the N being applied at each depth. The broadcast N treatments were applied in late June as urea (46-0-0) followed by a light irrigation.

Dry beans were harvested in late September each year and sugar beets were harvested in late October each year.

## RESULTS AND DISCUSSION

**Sugar Beets**

Nitrogen rates for sugar beets were set so the highest rate would be sufficiently high to provide excess N to determine effects on SLM. With the planting and replanting delays, inclusion of the lower rates turned out to be important as we fully expected a much lower yield level (nearer 20 tons per acre) due to the late replanting. Seedling counts a week after planting (2006 and 2007) showed stands as low as 30,000 to 40,000 plants per acre (seeding rate 56,000/a). Plant stands two weeks after replanting ranged from 48,000 to 51,000 plants per acre each year and there were no N rate or method treatment effects (data not shown).

A condensed analysis of variance (SAS PROC MIXED) is shown in Table 2. The only significant treatment effect both years was N rate.

Table 2. Analysis of variance for strip-till N versus broadcast N for sugar beets.

| Factor | Tons/acre | | % Sugar | | SLM | | #Sucrose/acre | |
|---|---|---|---|---|---|---|---|---|
| | 2006 | 2007 | 2006 | 2007 | 2006 | 2007 | 2006 | 2007 |
| | ---------- Pr > F---------- | | | | | | | |
| N Method | 0.91 | 0.14 | 0.82 | 0.65 | 0.23 | 0.65 | 0.99 | 0.13 |
| N Rate | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.02 | 0.04 | 0.01 |
| N*Method | 0.61 | 0.06 | 0.29 | 0.68 | 0.80 | 0.56 | 0.54 | 0.15 |

Tables 3 and 4 show parameter averages as affected by N application method and N rate. As noted from Table 2, application method had no significant effect on any parameter measured. There was a tendency for tare (data not shown) and SLM to be somewhat lower with strip-till applied N versus broadcast both years.

Table 3. Yield averages for N method effects on sugar beets.

| N Method | Tons/acre | | % Sugar | | % SLM | | Lbs Sucrose/acre | |
|---|---|---|---|---|---|---|---|---|
| | 2006 | 2007 | 2006 | 2007 | 2006 | 2007 | 2006 | 2007 |
| Broadcast | 25.9 | 24.1 | 17.5 | 15.3 | 1.39 | 1.55 | 9050 | 7350 |
| Strip Till | 25.8 | 25.3 | 17.5 | 15.3 | 1.35 | 1.51 | 9050 | 7755 |

Table 4. Yield averages for N rate effects on sugar beets.

| N Rate | Tons/acre | | % Sugar | | % SLM | | Lbs Sucrose/acre | |
|---|---|---|---|---|---|---|---|---|
| Lbs/acre | 2006 | 2007 | 2006 | 2007 | 2006 | 2007 | 2006 | 2007 |
| 0 | 22.7 | 22.8 | 18.2 | 16.1 | 1.21 | 1.40 | 8265 | 7310 |
| 35 | 24.7 | 24.9 | 17.6 | 15.9 | 1.32 | 1.51 | 8700 | 7985 |
| 70 | 26.2 | 25.9 | 17.8 | 15.3 | 1.35 | 1.52 | 9335 | 7920 |
| 105 | 27.4 | 25.0 | 17.2 | 15.0 | 1.42 | 1.60 | 9425 | 7500 |
| 140 | 26.6 | 24.6 | 17.3 | 15.0 | 1.47 | 1.56 | 9240 | 7380 |
| 175 | 27.4 | 24.6 | 16.9 | 15.3 | 1.48 | 1.55 | 9320 | 7540 |
| 210 | -- | 25.0 | -- | 14.5 | -- | 1.64 | -- | 7240 |

Because there was not a significant method effect, N rate effects were averaged across methods. N rate increased yield up to a N rate of 110 pounds per acre. Sugar content showed

the usual decline with increasing N rate, but sucrose amount was maximized near the 105 lb N rate. Increasing N rate significantly increased SLM and decreased sugar content.

This experiment confirms much of our past N rate research on sugar beets: increasing N rate increases tonnage up to a point, but with declining sugar content and increasing SLM, maximum recoverable sugar occurs at optimum N. In this work, we began the project with the expectation of producing near 26 ton beets or higher but with replanting, those expectations dimmed. The current University of Nebraska N algorithm would have recommended 140 lb N/acre in 2006 and 60 lbs N/acre in 2007 for 26 ton beets. The University of Nebraska algorithm for sugar beet N recommendations is:

***N Rate (lbs/a) = 9*expected yield {T/ac} - 30*%OM - nitrate-N in 6 feet* - other credits**.

In 2006, beet yield was maximized near 27 tons per acre and near 26 tons in 2007. The N response curves showed 105 to 115 pounds of N per acre maximized tonnage and recoverable sugar in 2006 and 60 to 80 pounds of N in 2007. The effects for 2006 match 'classic' effects of N rate on different sugar beet parameters (Figure 1). The research shows that the UNL algorithm, although considered conservative, is still an excellent guide to N application for sugar beets.

**Dry Beans**

Nitrogen rates for dry beans were selected to be high enough to maximize yield. Plant stands two weeks after planting showed no treatment effects (data not shown). The current UNL N recommendation for dry beans (Hergert and Schild, 2007) based on the soil tests in Table 1 would have been 80 pound N in 2006 and 60 pounds in 2007. The condensed analysis of variance (SAS PROC MIXED) for dry beans is shown in Table 5. The only significant treatment effect both years was N rate. Application method and the N by method interaction were not significant (Table 6).

Table 5. Analysis of variance for strip-till N versus broadcast N for dry beans.

| Factor | 2006 | 2007 |
|---|---|---|
| | ----------Pr>F---------- | |
| N Method | 0.21 | 0.71 |
| N Rate | 0.01 | 0.01 |
| Rate*Method | 0.74 | 0.87 |

Table 6. Yield averages for N method effects on dry beans.

| N Method | CWT/acre | |
|---|---|---|
| | 2006 | 2007 |
| Broadcast | 34.1 | 31.8 |
| Strip Till | 34.9 | 32.1 |

Because there was not a significant N method effect (Table 5), N rate effects were averaged across methods (Table 7).

Table 7. Yield averages for N rate effects on dry beans.

| N Rate | CWT/acre | |
|---|---|---|
| Lbs/acre | 2006 | 2007 |
| 0 | 32.0 | 29.9 |
| 40 | 33.9 | 30.6 |
| 80 | 36.0 | 33.8 |
| 120 | 36.2 | 33.5 |

The N rate for maximum yield (80 lbs/acre) is very close to what the current UNL recommendations would have been for this field and shows that current guidelines are capable of providing adequate N for high yielding dry beans. The yields from this experiment are 30-50% higher than county average dry bean yields in the Nebraska panhandle. There was not a significant difference in N application methods which is not unexpected for a mobile nutrient like N. Doing a good job of soil sampling to estimate residual nitrate in the top 30 inches and applying adequate N is important to maintain profitable dry bean production.

## REFERENCES

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Figure 1. 2006 N rate effects on sugar beet yield parameters at Scottsbluff, NE