COMPARING NARROW AND STANDARD ROW WIDTH STRIP TILLAGE TO CONVENTIONAL TILLAGE

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Introduction/Objectives

For sugarbeet growers considering strip tillage on 22-inch row spacing, there are a many different types of strip tillage machines with different configurations and designs to consider for use in their farming practices. To qualify for participation in some NRCS conservation programs, it is required that less than one-third of the soil surface be disturbed. To meet this qualification, a producer growing sugarbeet with 22-inch row spacing must disturb less than about 7 inches of soil when creating strips. **The objective of this study was to evaluate effectiveness of modified row cleaners to create tillage strips narrower than 7 inches for use in sugarbeet production in strip tillage compared to strip till machines which create wider strips (10-12 inches)**. Additionally, a conventional chisel plow tillage treatment was included for comparison. It should be pointed out that even if the strip tilled area meets the one-third disturbance criteria, growers may still be disqualified from some NRCS conservation programs due to soil disturbance necessitated during harvesting operations. A grower considering applying for conservation credits should discuss the program criteria with an NRCS employee, including tillage and harvesting requirements, before committing to the program.

Materials and Methods

A row width strip till vs. conventional tillage field experiment was established on a Beardon Perella silt loam (coarse-silty, frigid Aeric Calciaquoll) at a research site near Prosper, ND. In late October 2007, tillage strips were made at the Prosper Research Station into standing wheat stubble. Soil nitrogen levels were adjusted to approximately 130 lbs N/acre of available N by applying 85 lb N/acre as UAN (28%) at planting using a fertiplacer shoe to apply UAN in a shallow furrow above the seedbed. The study was seeded on May 7, 2008 with non-Roundup Ready sugarbeet variety Crystal R434 planted at a 5-inch in-row spacing and 1.25-inch depth.

The trial was planted into the strips going in a north-south direction. Individual treatment plots measured 11 feet wide and 30 feet long. Planting was arranged in a randomized complete block design with 4 replications. Individual Three treatments were evaluated in this trial.

- Ultra-narrow rows (6-8 inches wide) – Modified Yetter row cleaners
- Conventional strip tillage (9-12 inches wide) – WilRich strip-tiller with conventional Dawn row cleaners
- Conventional tillage with fall chisel plow and spring field cultivator

Rhizomania resistant variety, Crystal 434R, regular pellet was planted at 4 mph on May 07, 2008 with a John Deere MaxEmerge II planter. Sugarbeet was placed 1.25 inches deep, and was planted to stand at a 5-inch in-row seed spacing. A 22-inch wide row spacing was used. Counter insecticide was surface band applied at 10.9 lbs/A, and incorporated with a drag chain at planting. Stand counts were taken after germination. Four post emergence micro-rate herbicides, two cultivations and hand labor was used as needed for weed control. Three fungicide applications, Eminent, Supertin/Topsin and Headline were applied for Cercospora leaf spot control.

Harvest of the two middle rows of each six row plot, was completed on October 02/2008. Yield determinations were made and quality analysis performed at the American Crystal Sugar Quality Lab, East Grand Forks, MN.

Results and Discussion

For the purposes of this discussion, the more common strip tillage treatment with wider strips will be referred to as “strip till” and the modified strip till with narrower strips will be referred to as “narrow strip till.” Conventional chisel plow will be referred to as the “conventional” treatment. Statistical significance for yield and other agronomic parameters in field research studies has been determined by a p-value of 0.10.

Table 1 displays sugarbeet yield and sugar quality values for each tillage treatment. Interestingly, the conventional chisel plow treatment performed significantly worse than either of the strip tillage treatments. Sugarbeet yield was greatest for the strip till treatment, producing 27.3 tons/a; the narrow strip till treatment produced 26.4 tons/a. The strip till and narrow strip till treatments produced 31% and 27% greater root yield than the conventional chisel plow treatment. The narrow strip till treatment yielded significantly greater gross sugar content than either of the other two treatments. The strip till treatment resulted in significantly greater impurities relative to the other treatments, measured as sugar loss to molasses (SLM). As a result of the high SLM value, the strip till treatment produced significantly less net sugar than the other two treatments. It is likely that the greater molasses content of beets from the strip till treatment is related to nitrogen (N) immobilization early in the growing season with subsequent release of nitrogen later in the growing season. The release of N from soil and crop residues is tightly regulated by residue management, fertilization practices, and climate. Despite slightly better yields in the strip tillage treatment, recoverable sugar per acre was greatest in the narrow strip till treatment and least in the conventional treatment. Likewise, recoverable sugar per ton was greatest in the narrow row treatment and least in the conventional treatment. Sugarbeet stand at harvest did not differ statistically among treatments. Sugarbeet seedling emergence, however, revealed that the strip tillage treatments were more favorable for seedling emergence (Table 2). Early season emergence counts determined that strip tillage treatments were almost four times greater than counts taken in the conventionally tilled plots. No rainfall events occurred for almost three weeks after sugarbeet planting, resulting in a dry seedbed in the conventional treatment, which retarded seed germination and emergence. The strip tilled plots contained greater soil moisture than the conventionally tilled plots, and thus provided a better environment for seed germination and emergence. Observations in mid-June indicated that sugarbeets were generally larger and more vigorous in strip tillage treatments where wheat residue was more upright, as opposed to lying flat. The narrow-row treatments were most likely to have residue standing upright because the residue managers disturbed less of the inter-row area, thus leaving the wheat residue vertical rather than rolling it down.

In conclusion, this study demonstrates that sugarbeet production in strip tillage systems can outperform conventional tillage systems in some situations. In 2008, the lack of rainfall for almost three weeks after sugarbeet planting resulted in an unfavorable seedbed environment in conventionally tilled fields. The greater soil moisture content in strip tilled fields provided a strong advantage for seed germination and seedling emergence, giving sugarbeet plants in strip tilled treatments an early season advantage that resulted in greater root yield at the end of the growing season. The higher level of sugarbeet impurities in the strip tilled treatment cannot be fully explained, but did not detract from the statistically greater recoverable sugar observed in that treatment relative to the conventionally tilled treatment.

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Table 1. Sugarbeet yield and quality parameters resulting from conventional and ultra-narrow row widths in strip tillage and conventional full-width tillage. ‘Conventional’ indicates standard tillage practices accomplished with a fall chisel plow and spring cultivations with a rolling crumbler bar. ‘Narrow’ indicates that the strips were made using a strip tiller with modified row cleaners that resulted in a strip of very narrow width, about 6 inches wide. ‘Strip till’ indicates that strips were made with a strip tiller using conventional row cleaners, resulting in a strip that was 8-10 inches wide. LSD values indicate the least significant statistical difference between treatments (P<0.10). If LSD is recorded as *NS*, then no treatment differences were significant.

Tillage Treatment	**Root Yield (Tons/a)**	**Gross Sugar (%)**	**SLMº (%)**	**Net Sugar (%)**	**RSA* (lb/a)**	**RST** (lb/ton)**	**Stand (Beets/100ft)**	**GRT† ($/Ton)**	**GRA‡ ($/a)**
CONVENTIONAL	20.8	15.5	1.16	14.3	5932	286	180	35.50	733.91
NARROW	26.4	15.9	1.11	14.8	7848	297	187	38.01	1006.61
STRIP TILL	27.3	15.3	1.31	14.0	7607	279	186	33.74	918.19
LSD	3.45	0.1912	0.1241	0.2765	950	5.5280	NS	1.35	115.34

ºSugar Loss to Molasses; * Recoverable Sugar per Acre; ** Recoverable Sugar per Ton; † Gross Return per Ton; ‡ Gross Return per Acre

Table 2. Sugarbeet emergence during early , mid, and late season in three seedbed preparation treatments. Treatments are described in Table 1, above.

Tillage Treatment	**Stand Count (plants $100ft^{-1}$) 05/19/08**	**Stand Count (plants $100ft^{-1}$) 05/23/08**	**Stand Count (plants $100ft^{-1}$) 06/20/08**
CONVENTIONAL	7.08	22.92	216.67
NARROW	27.08	43.33	199.17
STRIP TILL	26.67	34.58	224.58
LSD	9.82	18.63	24.85