STRIP TILLAGE IN SUGARBEET ROTATIONS – YEAR 3

Laura F. Overstreet[1], Norman R. Cattanach[2] and David Franzen[1]

[1]Scientist; [2]Research Specialist – North Dakota State Univ.

Introduction/Objectives

Because many sugarbeet growers are also soybean, corn, and wheat growers, we include these other commonly grown crops to determine their productivity potential in strip tilled and conventionally chisel plowed cropping rotations. Sugarbeet is a crop that would benefit from wind protection offered by strip tillage systems in ND and MN. Reduced tillage operations also result in fuel savings for strip tillage systems, which is appealing to many growers. Autosteer technology and Roundup Ready sugarbeet seed have made strip tillage more manageable for growers new to strip tillage. However, there are potential disadvantages to strip tillage. One of the most negative scenarios for strip tillage occurred this past fall. The wet fall of 2008 prevented fall strip tillage in poorly drained, high clay soils in the Red River Valley of ND and MN. In the Red River Valley, it is believed that strip tillage should be conducted in the fall rather than the spring because the high clay soils will freeze and thaw during the winter and early spring, thus reducing clods and creating a more friable seedbed at planting time. Fall tillage is more favorable from a time and workload management perspective as well since early sugarbeet planting is a priority and fall strip tillage assures that the sugarbeet field is ready to plant in the spring as soon as soil conditions are suitable. The poor fall conditions in 2008 provided an opportunity to investigate the yield potential of sugarbeet, corn, and soybean in strip-till systems when strips must be established in the spring. By making strips in the spring of 2009, we tested the assumption that spring strip tillage will reduce stand and yield potential for sugarbeet, soybean, and corn. **The objective of this study was to evaluate three regionally-important crops (sugarbeet, corn, and soybean) through a full crop rotation using strip-tillage and chisel plow systems. 2009 was the third year of this study.**

Materials and Methods

This study is replicated at two locations: The Prosper research station and a grower-cooperator's farm near Glyndon, MN. Both sites are relatively well-drained and are located on regionally representative soil types with no history of major disease issues. The study was designed as a randomized complete split plot with two whole plot treatment factors: strip-tillage vs. conventional chisel plow tillage. Split plot treatment factors are each of the four crops used in the rotation. The rotation sequence for this study is wheat/sugarbeet/soybean/corn. According to the design of this study, each crop is present in each year of the study. We were not able to make strips in the fall of 2008, as is the recommended practice, because of a wet fall. The seedbed created in the spring was visually poor for both chisel plowed and strip tilled treatments, but was relatively worse for strip tillage. Fertilizer was applied with the strip tiller in the strip till treatments on May 19, 2009 at Glyndon and on May 20 at Prosper using urea and triple super phosphate at both locations. Fertilizer was broadcast applied between the first and second chisel plowing operations in the conventional tillage treatment on May 19, 2009 at Glyndon and on May 20 at Prosper. Fertilizer application rates were the same for both tillage treatments. The strip tilled and chisel plowed treatments were seeded with all crops on May 20 at Glyndon and on May 22 at Prosper. Three gallon/a of 10-34-0 was applied as a starter fertilizer at planting for corn, soybean, and sugarbeet. Sugarbeet variety Crystal 658RR, corn variety Pioneer Hybrid 39D85RR, and soybean variety Peterson 1002RR were seeded in this study. The wheat variety Alsen was used as a crop preceding sugarbeet. All row crops were seeded to stand and planted with 22 inches between row centers. Sugarbeet were seeded at 4-9/16 inches in-row; the rate was increased slightly above recommended populations due to the poor seedbed. The target corn population was 33,500 plants per acre and the target soybean population was at 163,500 plants per acre. Wheat was drilled at 100 lb of grain per acre. Sugarbeet and corn emergence counts were taken early in the growing season at both sites

Wheat was harvested the week of August 24th, 2009. Soybean was harvested on September 25th at both locations and corn was harvested on October 27th at both locations. Sugarbeet was harvested on September 29th at Glyndon and October 12th at Prosper.

Results

Review of previous years' results: Despite wet conditions in early spring 2007, sugarbeet root yield and sugar content did not differ between tillage treatments; root yield averaged 29.6 ton a^{-1} for strip tillage treatments and 30.0 ton a^{-1} for chisel plow and net sugar averaged 14.5% for both treatments. In 2007, soybean yield differed between locations but not treatments; strip tillage yields averaged 49 and 30 bu a^{-1} from ND and MN and chisel plow averaged 52 and 32 bu a^{-1} from ND and MN. Corn yields were not significantly different between tillage treatments and were 148 and 162 bu a^{-1} for strip tillage and chisel plow. In 2008, sugarbeet root yield and recoverable sugar content did not differ between tillage treatments; average root yield was 27.4 and 29.0 ton a^{-1} for strip tillage and chisel plow; sugar content averaged 14.4% for strip till and 14.7% for chisel plow. In 2008, soybean yield did not significantly differ between tillage treatments at one location and was significantly greater for strip tillage compared to plow at the other location; yields ranged from 36 to 56 bu a^{-1}. In 2008, corn yield was significantly greater with strip tillage relative to chisel plow at both locations; yields ranged from 163 to 231 bu a^{-1}.

Results of current year: Considering the poor seedbeds created in spring 2009, corn and soybean yields for strip tillage were remarkably competitive for strip tillage compared to conventional chisel plowing. Corn yields did not significantly differ as a result of the tillage system or study location (Table 1), but yields were 19 bu/a and 26 bu/a greater in strip tillage than in conventional tillage at Prosper and Glyndon, respectively. Corn grain moisture at harvest was significantly greater at Prosper compared to Glyndon, but there were no significant grain moisture differences as a result of tillage treatment (Table 1). Soybean yields were significantly less at Glyndon compared to Prosper, but there was no difference in soybean yield as a result of the tillage system used (Table 1). Soybean yields in strip tillage treatments were about 8 bu/a lower than chisel plowed treatments at Prosper and 6 bu/a higher than chisel plowed treatments at Glyndon. Reduced soybean iron chlorosis symptoms were observed in strip tilled plots compared to conventionally tilled plots. This was the second year that such observations have been made.

Sugarbeet yields did not differ as a result of tillage system used, and both tillage systems produced high root yields (Table 2). However, there was significantly less sucrose content in sugarbeet roots produced with strip tillage compared to conventional tillage. There was also significantly greater sucrose loss to molasses at one location for strip tillage compared to conventional tillage. The reduced sucrose content in sugarbeet produced with strip tillage did not result in significantly less recoverable sucrose per acre, but did result in significantly reduced recoverable sugar per ton for strip tillage compared to conventional tillage. Reduced sucrose content and increased loss to molasses in strip-tillage systems probably resulted from three main factors: (1) significantly reduced sugarbeet stand in strip-tilled plots, (2) poor defoliation of strip-tilled beets at harvest and (3) the nitrogen application rate may need to be reduced for strip-tillage systems. Reduced final sugarbeet stand in strip-tilled plots was probably due to seeding beets into a poor seedbed in the spring. When strips were created in the spring, the seedbed was visibly wet and left large clods that probably reduced sugarbeet germination and emergence. Poorer defoliation of beets at harvesting was partly the result of uneven sugarbeet plant stand, which was also the result of a poor seedbed at planting. Regarding nitrogen fertilizer rate, considering the well-established relationship between excess soil nitrogen and increased loss to sugar as molasses, it is possible that the banded N in the strip tillage plot has been applied in excess of requirements for this system. Reducing the N rate in strip tillage may therefore result in reduced impurities in sugarbeet root and increased percent sucrose. If it is possible to reduce N rates for sugarbeet produced with strip tillage, there is an obvious savings to the grower in fertilizer expense. There is also a distinctly positive environmental impact associated with reducing N and P levels that accumulate and impair the quality of surface and ground waters. We plan to conduct a study in 2010 to examine the effect of reducing nitrogen and phosphorus fertilizer rates in strip tillage systems.

Conclusions

This project has shown that strip-tillage can produce sugarbeet, soybean, and corn yields that are statistically equal or greater to yields obtained using conventional tillage. We determined that even when strips could not be established in the fall, corn and soybean yields did not decline as a result of spring strip tillage compared to spring chisel plowing for seedbed preparation. We determined that sugarbeet stand did decline as a result of spring strip tillage, but that it did not affect final root yield. The reduced sugar and greater loss to molasses observed in 2009 in strip tillage systems has also been observed in 2007 and 2008, and therefore may indicate that the recommended nitrogen application rate for conventional tillage is too high for strip tillage systems.

SUMMARY STATISTICS OF MULTI-CROP STRIP-TILLAGE STUDY, 2009 DATA (YEAR 3)

Table 1. Strip-tilled and Conventionally-tilled Soybean Yields at 2 locations. 2009 Growing Season. Least significant difference (LSD) values provided for P<0.05; NS signifies no significant differences.

	Average Yield SOYBEAN (bu/a)	Average Yield CORN (bu/a)	Average grain moisture of corn (%)
Prosper – Strip Till	39.66	203	37.28
Prosper - Conventional	47.74	184	38.23
Glyndon – Strip Till	30.19	194	32.24
Glyndon - Conventional	24.19	168	32.43
LSD (P<0.05)	8.61	NS	3.56

Table 2. Strip-tilled and Conventionally-tilled Sugarbeet Yields at 2 locations. 2009 Growing Season. Least significant difference (LSD) values provided for P<0.05; NS signifies no significant differences.

	Root Yield (Tons/a)	Gross Sugar (%)	%SLM (%)	Net Sugar (%)	RSA (lb/a)	RST (lb/ton)	Stand Beets/100ft
Prosper – Strip Till	32.2	13.9	1.1775	12.7	8184	255	187
Prosper - Conventional	32.0	15.0	1.0875	13.9	8877	277	211
Glyndon – Strip Till	35.5	14.0	1.2300	12.8	9067	255	128
Glyndon - Conventional	35.5	15.6	1.0600	14.5	10297	290	200
LSD (P<0.05)	NS	0.60	0.1417	0.67	1687	13	24