TILLAGE STUDIES IN FARGO-RYAN SILTY CLAY LOAM SOILS IN THE 2010-2011 CROP YEAR

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Introduction

Conducting strip-till cultivation on heavy clay soils can be challenging, especially when corn is raised before the sugarbeet year in 22-inch rows. Previous years of work in no-till, strip-till and conventional till treatments in this study have demonstrated that the strip-till operation can be successfully accomplished in normal to drier years, but being able to fall strip-till consistently is probably not possible when the fall season is wet. In 2010, the fall was sufficiently dry to allow a fall strip-till treatment and a fall chisel-plow treatment. In addition, wet springs over the past 6 years have suggested that split application of N would be a good N management strategy. The objectives of this trial were:

i. To compare no-till, conventional till and spring strip-till treatments for yield and quality in sugarbeet and yield in corn and soybean.
ii. To determine whether application of all N early, all N at side-dress timing, or half N early and half N at side-dress timing was a superior N management method.

Methods

For the areas devoted to soybeans and sugarbeets in 2010-2011, the tillage treatments have been imposed since 2005, making this the 7th consecutive year of no-till, fall/spring strip tillage and conventional (fall/spring chisel to 8-inch depth followed by a spring field cultivator pass) treatments. For the area in corn 2010-2011, this was the 3rd consecutive year. Penetrometer measurements were taken in each sugarbeet and soybean plot each inch for 10 inches on 10/12/2011.

Soybean

Each plot was 11 feet wide (6, 22-inch rows) by 25 feet long. The experimental design was a randomized complete block with 3 treatments (conventional, no-till and strip-till) and 12 replications. The conventional till plots, which were in sugarbeets in 2009, were chisel plowed 8 inches deep on 10/19/2010. In the spring, the plots were field cultivated 3 inches deep on 6/7, the morning of seeding. Roundup Max® at 22 oz/acre with 17 lb ammonium sulfate/100 gallons mix was applied 6/6 as a burndown. Both the strip-till and no-till treatments used residue managers in front of the seed disc to move residue to the sides of the intended row. Peterson Farms Seeds 1108-RRSTS were seeded June 7, 1 ½ inch deep using a rate of 128,000 seeds/acre in 22 inch rows. Roundup Max at 22 oz/acre with ammonium sulfate was applied for post-emergence weed control on 6/21 and 7/7. Soybean stand counts were made 7/26. The middle two rows of soybeans were harvested 9/22 using a Hege plot combine. Grain was dried in a forced air oven and then measured for yield, grain moisture and test weight.

Corn

Each plot was 11 feet wide (6, 22-inch rows) by 25 feet long. The experimental design was a split plot randomized complete block design with N timing as the main effect (full N applied early and full N applied when corn was 5-6 leaf stage) and tillage as the sub-effect with 3 treatments (conventional, no-till and strip-till) and 3 replications. The conventional till plots, which were in soybean in 2010, were chisel plowed 8 inches deep on 10/19/2010. A spring soil test to 2 feet showed residual nitrate of 46 lb/acre. Soil P was 23 ppm, K was 430 ppm and Zn was 1 ppm. Therefore, only N was applied to corn. The main effect treatment applied over tillage was 150 lb N as ammonium nitrate preplant. The application was incorporated using a field cultivator within the conventional till plots, but not within the no-till or strip-till plot areas. The main effect treatment of 150 lb N/acre applied as UAN dribbled between the rows when the corn was 5-6 leaf stage was conducted on 7/7. Roundup Max® at 22 oz/acre with 17 lb ammonium sulfate/100 gallons mix was applied 6/6 as a burn-down application. Pioneer P8581R RR2 with Cruiser Extreme (85-day corn) was seeded 6/7 at a seeding rate of 34,000 seeds/acre. Stand counts were made 7/26.Roundup Max® was applied for weed control on 6/21 and 7/7. Corn was harvested by hand (rows 3 and 4)) on 10/7. Ears were dried, and then they were shelled for weight, moisture and test weight. Corn growth and yield appeared to be greatly affected by a soil salt gradient that was high on the western edge of the plots, and lower to the east. Following harvest, paired soil sample cores 6 –inches in depth were obtained from each plot.

Sugarbeet

Each plot was 11 feet wide (6, 22-inch rows) by 25 feet long. The experimental design was a split plot randomized complete block with the main effect as N timing (Full rate of N preplant/half-rate of N preplant and half-rate of N at side-dress/full rate of N at side-dress) and the sub-effect as tillage (conventional, no-till and strip-till) with 4 replications. The conventional till plots, which were in corn in 2010, were chisel plowed 8 inches deep on 10/19/2010. The conventional plots were field cultivated 6/7 to a 3 inch depth after fertilizer N application. Residual soil nitrate in the spring (4/29) was 52 lb N to 2 feet. Ammonium nitrate (34-0-0) at a rate of 48 lb N/acre was applied 6/7 to the full-N early plots and at a rate of 24 lb N/acre in the half-N early plots. Sugarbeets seed Crystal 658RR w/Poncho Beta tachigeran 45 were seeded at 63,360 seeds/acre on 6/7. The half-N side-dress (24 lb N/acre) and full-N side-dress treatments (48 lb N/acre) were applied 7/7 when the beets were about the 6-leaf stage and the side-dress N was applied as UAN dribbled between the rows. Stand counts were made 7/26 and at harvest.

Sugarbeets were harvested 10/3 using a 2-row harvester. Beets were weighed and tare bags containing about 18 beets were sent to the East Grand Forks Quality Laboratory for quality measurements. At harvest, the soil was very dry and hard. Clods the size of sugarbeets was common. These were picked out of the weighed piles at the end of each plot, bagged and weighed, with the weights subtracted from the harvest weight for a true harvest weight of sugarbeets recorded in the results.

Results

Soybean

There were no differences in mid-season stand (7/26) or yield with tillage treatment.

Table I. Soybean yield and final stand with tillage treatment, 2010.

Treatment	7/26 stand (pl/25'row)	Yield, bu/acre
Conventional	129	39.6
Strip-till	123	41.0
No-till	124	38.5
LSD 5%	NS	NS

Corn

Corn yield with treatments were overwhelmed by a soil salinity gradient. Without regard for soil salt, Table 2 describes the effect of N timing and tillage.

Table 2. Corn final stand, test weight and yield due to tillage treatment, 2010.

Treatment	Treatment	7/26 stand Pl/acre	Yield, bu/acre	Test Weight, lb/bu
Ntiming	Early	33,200	83	54.7
	Late	34,900	59	54.7
Tillage	Conventional	32,800	69	54.2
	Strip Till	35,000	80	54.3
	No-till	34,200	65	54.9
Sig		Ntiming sig	Ntiming sig	None

There was a significant relationship between corn yield and soil salt Figure 1.

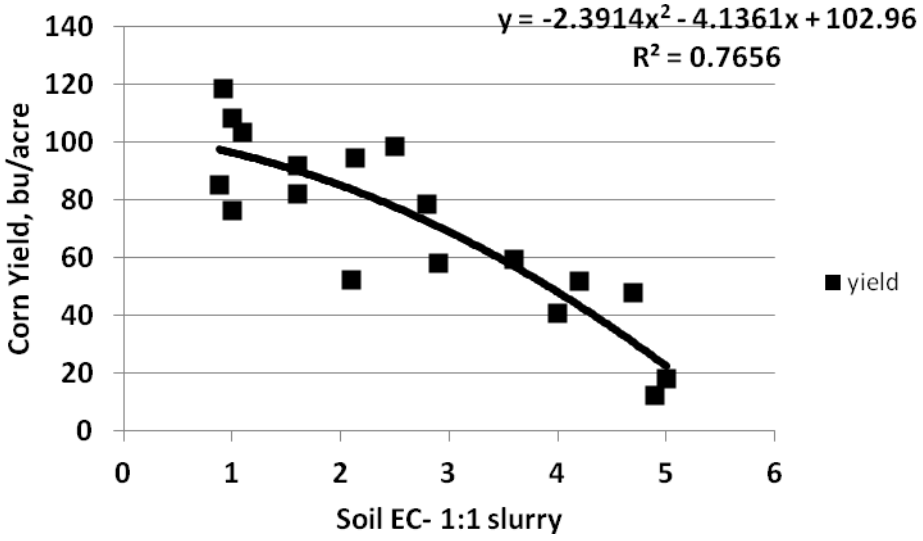

Figure 1. Relationship of Corn Yield to Soil EC, campus tillage plots, 2011.

Sugarbeet

Sugarbeet yields were decreased greatly from normal due to the continual wetness in May and June. The split application of N, with half applied early and half applied late increased beet yield by 30-40% and recoverable sugar per acre by about the same amount. Tillage was not a factor that influenced yield and quality this year.

Treatment	Yield, tons/a	Sugar %	SLM %	Stand 7/26 Pl/100 ft.	Harvest Stand Pl/100 ft.	Recoverable Sugar/ton	Recoverable Sugar/acre
Ntiming 1	6.53	17.5	1.07	230	232	329	2148
2	10.15	17.3	1.08	232	250	325	3323
3	7.10	17.2	1.05	232	228	323	2295
Tillage 1	6.89	17.3	1.06	228	242	326	2264
2	8.25	17.2	1.09	230	228	323	2647
3	8.63	17.5	1.05	238	242	330	2647
FNtiming	4.52 *	.74NS	0.3 NS	0.01 NS	0.63 NS	0.62 NS	5.06 *
Ftillage	0.8 NS	.74 NS	2.17 NS	0.72 NS	2.17 NS	0.88 NS	0.35 NS

Penetrometer readings-

The soil was very dry in the surface foot when the penetrometer was used after harvest of sugarbeet and soybean. There were no differences due to treatment at any depth in the sugarbeet plots. The very surface soil and 1-inch depth had a significantly lower density in strip-till soybean plots than conventional or no-till plots. All other depths were similar in density readings.

Summary-

In the 7th year of this long-term tillage experiment, there were no differences in yield of corn , soybean or sugarbeet yield/recoverable sugar per acre with no-till or strip-till treatments compared to the conventional treatment. N timing in corn favored a preplant N application over a total side-dress application. This was probably due to the continually wet conditions up to about the 10 leaf corn stage. The corn was deficient in N too long under the total sidedress treatment to fully recover after application. There were not enough corn plots in the research trial space for a third treatment of half early and half late. Measurement of soil EC in the surface 6 inches in the corn plot showed a good relationship between soil EC and yield, with corn yields reduced about 80% in plots with EC from 4-5 mmhos/cm. In sugarbeet, the half-early half-sidedress treatment was greatly superior to the total preplant and total sidedress treatments for yield and recoverable sugar per acre. This study will be continued in 2012, with corn being grown after soybean and sugarbeets after corn.