SPRING STRIP-TILL STUDIES IN FARGO-RYAN SILTY CLAY LOAM SOILS IN A WET SPRING

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Introduction

Studies on the campus tillage plots from 2005-2008 showed that strip-till on challenging, wet, high clay middle Valley soils might be similar in profitability (2005-2007), or even higher in profitability (2008) compared with conventional tilled systems. The fall of 2008 and the 2009 growing season presented special problems. High fall 2008 rainfall resulted in a late corn harvest and sugarbeet harvest. The spring of 2009 was wet and the trial could not be seeded until 5/29, and even then seeding finished in the rain. The objective of this trial was to compare the worst possible conditions for spring strip-till with conventional till and no-till systems to determine the practicality of strip-till use in these soils.

Methods

Strip-till is normally conducted and recommended for use as a fall spring planting preparation tool in a *quasi* no-till farming system. In fall 2008, any fall tillage following October 1 was not possible. Soybean that was going to corn was harvested normally, but corn harvest was late and ears were harvested by hand and removed from the field. The stalks were broken over, similar to what might be expected with a corn-picker harvest, but not with a combine. Stalks on conventional plots were later mowed using a 3-point hitch rotary mower to a height of about 4 inches in November when the ground froze. Stalks in strip-till and no-till plots remained about 30 inches tall over winter. Sugarbeet was removed from the soil in only a 10 foot harvested row. The remaining sugarbeets were abandoned over winter.

A burn-down application of Roundup WeatherMax® mixed with 17 lb/100 gallon ammonium sulfate, and applied at a total solution rate of 10 g/acre (40 psi, 8001 low drift tips) using a bicycle applicator was applied to no-till and strip-till plots 5/4.

Soil tests to 2 ft in depth obtained in early May showed continued high P levels (>20 ppm), Zn levels exceeded 1 ppm, and nitrate-N ranged from 32-35 lb N/acre in the areas going to sugarbeet and corn. Following University of Minnesota corn N guidelines, a total goal of N fertilizer of 150 lb/acre following soybean was determined. Ammonium nitrate fertilizer at a rate of 120 lb N/acre was broadcast over the conventional corn plots 5/18, and a rate of 100 lb N/acre was broadcast over the conventional sugarbeet plots 5/18. On that same date, 60 lb N/acre as ammonium nitrate was broadcast over the no-till and strip-till corn plots, and 50 lb N/acre over the no-till and strip-till sugarbeet plots.

Conventional till corn plots were disced twice 4 inches deep 5/28. Corn, sugarbeet and soybean conventional plots were field cultivated and harrowed 3 inches deep 5/28. The tillage operations effectively buried corn residue and formed a level and friable seed bed for all crops.

All three crops were seeded 5/29. The day of seeding was the first day that it was practical to operate the strip-till unit. A Wil-Rich 6-row strip till unit was set for the shank to run about 4 inches deep. The pass was made and allowed to dry the rest of the morning before seeding. The pass made a valley about 2 inches deep in what would be the seed row, and the soil was wet and cloddy.

Corn variety Pioneer 39D85RR was seeded 1 ½ inches deep at a population of 38-40,000 pl/acre. Sugar beet variety Betaseed BTS 86 RR66 with Poncho Ultipro and 20g Tachigaren was seeded at 4.5 inch spacing (60,000 pl/acre) to stand. Soybean variety Peterson Farm Seed 7008RR was seeded at 165,000 pl/acre. All crops were sown in 22 inch rows. Plots were 25 foot long and 6 rows wide. All varieties were Roundup-Ready, so Roundup WeatherMax at 32 oz/acre with 17 lb/100 gallon mix was applied 6/12. Roundup at 22 oz/acre with 17 lb/100 gallon mix was also applied 6/26 and 7/17. On the 7/17, the Roundup was applied to all the sugar beets and soybeans, but only to the shorter corn. Roundup was finally applied to soybean only at 22 oz/acre 8/24.

Side-dress 28% N was streamed on the surface between the rows of corn and sugar beet on 6/26. On sugarbeet, 48 lb N/acre was applied to the no-till and strip-till plots, and 60 lb N/acre was applied to no-till and strip-till corn plots. Rainfall on 6/27 was ¾ inch and included some small hail. Stand loss estimate was about 5% for all crops, with some corn leaf shredding and holes in sugar beet leaves.

Leaf stage in soybean and leaf counts in corn and sugarbeet were recorded 6/24. Stand counts were also recorded 6/24. Leaf stage of soybean was recorded on 7/7; corn leaf stage and plant height was recorded on 7/7; sugar beet leaf count was recorded on 7/7. Two 25 foot rows of sugarbeets were harvested with a 2-row beet lifter and harvest stand count taken on 9/21. Soybeans were harvested on 9/24. It began raining heavily 10/1 and continued throughout October. Corn was harvested by hand and removed from the field during mid-October through late-November.

Results

Sugar beet

Spring strip-till formed a valley at seeding about 2 inches deep. The seed was planted into this cloddy, wet environment. Significant rain would have helped to seal the furrow better than the planting operation, but only light rain fell for about 3 weeks after seeding. In places, the furrow opened up and seed could be seen in dry soil. As a result, stands for strip-till were reduced even below no-till. Although some no-till seed was also exposed by furrow re-opening, the original seed bed was at least smooth, and not cloddy. Residue managers on the planter moved residue away from the seed furrow and was not responsible for any stand loss in no-till.

Sugar beet stand at 6/24 was higher for conventional till than no-till or strip-till. Leaf stage was higher in the June date for no-till than strip-till or conventional till, but the leaf stage of conventional till at the early July date was similar to no-till (Table 1). Leaf stage for strip-till was still behind. Observations in June showed that conventional beets were similar in leaf stage to each other, where the leaf stage of no-till and especially strip-till ranged from similar to conventional to well behind. Stands were established early for conventional, but emergence of strip-till stretched over a 3 week period. No-till emergence was intermediate of the other two tillage systems.

Harvest stand for both no-till and strip-till were less than conventional till. Stand for strip-till increased over time as plants emerged later than even the late June date indicated. There was no difference in ton yield between treatments. The net sugar was less for strip-till and sugar loss to molasses (SLM) and amino-N were higher than conventional or no-till probably because of the defoliator height chosen to remove the leaves in the plots. The height was chosen so that it removed the leaves from the conventional and no-till plots, but because the strip-till beets were about 2 inches lower because of the spring strip-till furrow some green leaf tissue remained in these beets. Beets not properly topped with green leaves remaining commonly contain less sugar, and greater impurities than beets with green removed. It is likely that if a field of beets in spring strip-till were defoliated properly, there would be no difference in sugar or impurity status compared with a conventionally tilled beet field. No-till and conventional till revenue per ton and per acre were similar, and were greater than strip-till.

Table 1. Sugar beet stand counts, leaf stages and harvest data, 2009, campus tillage plots.

Treatment	Stand count * 6/24	Leaf Stage 6/24	Leaf Stage 7/7	Harvest Stand* 9/21	Tons/ acre	Net Sugar %	SLM %	Amino N, ppm	RSA**	RST***	GRT†	GRA‡
Conventional	178	2.8	8.5	188	21.9	14.9	1.4	399	299	6534	$36.12	$788.33
Strip-till	133	2.2	6.7	160	21.6	13.9	1.5	462	278	6005	$31.34	$676.03
No-till	150	4.0	8.3	148	23.2	14.9	1.3	405	297	6887	$35.74	$827.72
LSD 5%	34	1.0	0.9	40	NS	0.5	0.05	40	12	700	$2.00	$80.00

*Stand counts in plants/100 ft of row.

** RSA = recoverable sugar per acre

*** RST = recoverable sugar per ton

† GRT = gross revenue per ton

‡ GTA = gross revenue per acre

Corn

Corn was seeded into the wet cloddy seed furrow environment similar to that for sugar beet. Corn emergence for conventional tillage was relatively uniform, while emergence in strip-till and no-till plots ranged over a 3 week period (Table 2). Leaf stage for no-till and conventional till was more advanced than strip-till at 6/24 and 7/7 . No-till corn was shorter than conventional till on average, and strip-till was much shorter than either no-till or conventional till corn at 7/7. On 8/3, tassel emergence was much greater for conventional and no-till than for strip-till. At harvest, there were no differences in yield between any treatment, but test weight for strip-till was about 1 lb/bu less than conventional or no-till. The difference in test weight might have been an indicator of higher harvest moisture for strip-till or later maturity, although those factors could not be measured with our hand harvest.

Table 2. Corn stands, leaf stages, corn height, tassel emergence, test weight and Yield due to treatment, campus tillage plots, 2009.

Treatment	Stand Count 6/24	Leaf Stage 6/24	Leaf Stage 7/7	Corn Height inches	Tassels Emerged % 8/3	Test Weight lb/bu	Yield bu/acre
Conventional	187	5.0	7.6	18.8	40.8	55.1	156
Strip-till	182	4.0	6.2	12.4	7.9	54.1	146
No-till	185	4.5	7.1	16.2	35.4	55.7	149
LSD 5%	4	0.6	0.7	1.2	15	0.5	NS

Soybean

Early stand was impacted by furrow re-opening for both strip-till and no-till compared with the conventional seed bed. Leaf stage at the late June date was lower for strip-till than conventional till or no-till, but by 7/7, leaf stage of all treatments was similar. This was the first year that soybean yield for strip-till was less than conventional till. The reason for this yield decrease is again cultural due to the valley formed during the spring strip-till operation. Because of the valley, late planting and cool conditions through June, the soybeans started to flower very soon after 7/1. This resulted in the first nodes of beans very close to the soil surface. In conventional and no-till plots, these low beans were mostly recovered at harvest. However, nearly all of the first nodes of beans were not harvested in the strip-till plots. A conservative estimate for the bushels in the first node would be about 5 bushels, which would make all treatments very similar in yield.

Table 3. Soybean stand, leaf stage and yield due to treatments, campus tillage plots, 2009.

Treatment	Stand Count 6/24	Leaf Stage 6/24	Leaf Stage 7/7	Yield bu/acre
Conventional	250	0.83	2.4	24.2
Strip-till	226	0.50	2.4	18.1
No-till	222	0.69	2.5	20.1
LSD 5%	20	0.16	NS	5

Summary-

Sugarbeet yield was similar for all treatments despite lower stands with spring strip till conditions. The furrow conditions because of the 2 inch deep valley formed during the spring strip till operation resulted in relatively higher defoliation height for this treatment compared with the others and a corresponding increase in impurities and lower recoverable sugar and economic return. Corn emergence was also affected by poor seeding conditions in the spring strip till, but yields were not affected. Lower test weight suggested later maturity and higher moisture in the spring strip till due to uneven emergence and late tasseling date. Soybean stand was reduced by both no-till and strip-till. Leaf stage for strip-till was initially behind conventional till, but caught up to conventional till by 7/7. Soybean yield was reduced probably because of the inability of the combine to reach the lowest node of pods sheltered in the 2 inch deep valley produced by the spring strip-till operation.

From this season, a normal strip-till operation using a shank-style tool is not a good method of preparing a seed bed. A spring strip-till unit should have consist of a coulter, residue manager, and some light tillage tool that works only the top inch or two of soil, but no deeper. This would form a level, drier surface seed bed that would be more resistant to furrow re-opening, but would perhaps be superior to no-till and similar to conventional till by having a darker, roughed-up surface. This coming spring looks like conditions will be similar to 2009, so we will test the theory above.