**CAMPUS TILLAGE STUDIES, 2008**

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The campus tillage trial area is located on the NDSU campus, between the new greenhouse complex and the fenced-in NDAWN weather station area. The trial was established in 2004, and has had a strip-till, conventional till and no-till treatments on the same plots since spring 2005. From 2005 through 2007, only two crops in a sugarbeet-soybean-corn rotation could be examined each year. In fall 2007, an additional area was incorporated into the study so that all three crops could be examined.

**Soybean study, 2008.**

**Methods-**The area seeded to soybeans was in sugar beet in 2007. Individual plots were 11 feet wide (6 rows) and 25-feet long. The experimental design was a randomized complete block with 3 treatments and 12 replications. The conventional treatments received one trip across with a chisel plow in late October, 2007. Strip till plots received a fall strip till preparation using a Wil-Rich strip-tillage tool, with the knife set at 6-inches deep. In the spring, on 5/12, the conventional plots received one trip with a disc set 4-inches deep. The tillage smoothed the surface and readied it for seeding. Soil P and K levels were high (>15 ppm and >300 ppm respectively) so no fertilizer was applied. The soybean variety Peterson Farm Seed 7008RR was seeded 5/14. Seeding rate was 120,000 on the west half of the area, but a planter error resulted in a 500,000 seeding rate on the east half. The higher seeding rate area was thinned to 120,000 plants by V1 growth stage. Seeding was conducted using a 6-row, 22-inch spacing John-Deere Maximerge planter, with residue managers set to skim residue from the surface, but with minimal soil disturbance.

Roundup Max was applied to no-till and strip-till plots as a burn-down 5/12, using 10 gallon/acre water using 8001 low-drift spray tips set at 20 inch spacing at 40 psi with a bicycle sprayer. Rate of Roundup was 22 oz/acre, with 17 lb/a ammonium sulfate.

Roundup was applied to soybean three times during the growing season; 6/16, 7/1 and 8/4. The persistent rainfall hurt soybean growth and prevented vigorous competition with weed seedlings.
The rate used at each herbicide treatment was 22 oz/a Roundup with 17 lb/acre ammonium sulfate applied as detailed above.

Appearance of soybean aphid led to an application of Lorsban 4E 8/14, using a rate of 1 pt/acre applied with 10 gallon/acre water at 40 psi using a bicycle sprayer. Soybeans were harvested 9/21 using a plot combine that harvested the center 2 rows of each plot.

Data was analyzed using SAS 9.1 for Windows using the Proc Mixed repeated procedure with spatial parameters determined using GS+ 7.0 for Windows.

**Results-**Rainfall during the season was high (Figure 1). The Fargo soils remained nearly saturated in some areas of the plots all season with little relief. Yields reflect the high moisture problems in the soybean plot area.

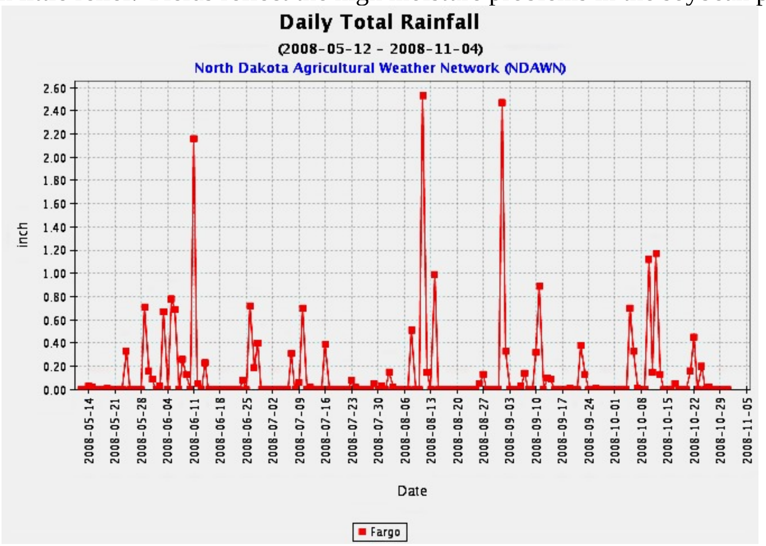


**Figure 1. Fargo rainfall from date of seeding to corn/sugarbeet harvest 10/27.**

**Table 1. Soybean yield and test weight due to tillage treatment.**

| Treatment | Yield, bu/acre | Test weight, lb/bushel |
|---|---|---|
| Conventional | 21.6 | 55.3 |
| Strip-Till | 26.5 | 55.5 |
| No-Till | 27.7 | 55.7 |
| LSD 5% | 3.0 | NS |

Strip-till and No-till were equally superior to conventional till by about 5 bu/acre. This difference is likely due to higher aggregate stability in the strip-till and no-till plots that shed excess water better and maintained larger soil pores that enabled better oxygen utilization by soybeans in those plots compared to those in the conventional plots. Strip-till and no-till plots were noticeably firmer during the season. Figure 2 shows that after harvest no-till and strip-till soil was denser near the surface, but tended to be less dense at deeper depths compared with conventional tillage. Many of these differences were significant (Table 2).

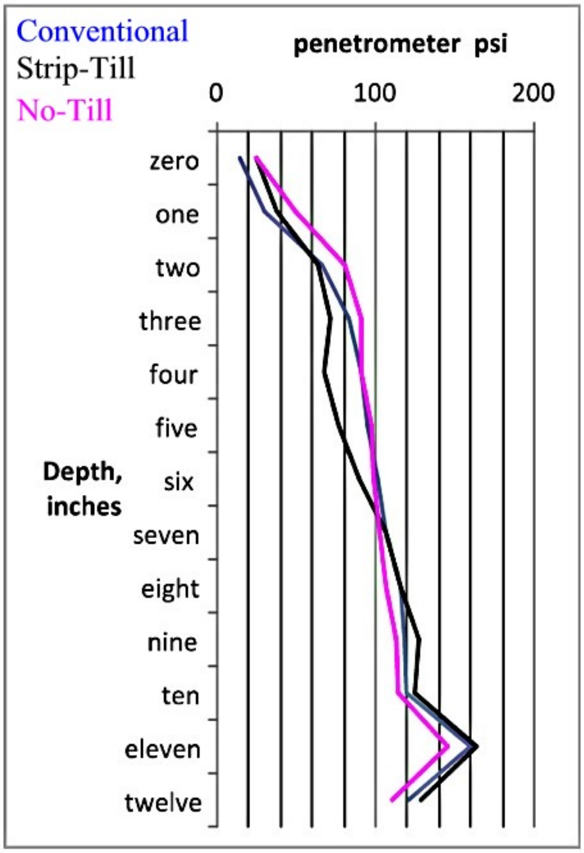


**Figure 2. Penetrometer resistance (lb/sq inch) from soil surface penetration (zero) to 12-inches in depth after soybean in conventional, strip-till and no-till plot areas.**

**Table 2. Penetrometer resistance of soil under conventional, no-till and strip-till plots.**
*Indicates significance in at least the 5% probability level.

| Depth, inches | Tillage Treatment | | | F | LSD 5% |
|---|---|---|---|---|---|
| | Conventional | Strip-Till | No-Till | | |
| 0 | 15 | 25 | 25 | 2.92* | 8 |
| 1 | 30 | 38 | 49 | 3.99* | 13 |
| 2 | 66 | 63 | 80 | 9.00* | 8 |
| 3 | 83 | 72 | 91 | 10.4* | 8 |
| 4 | 91 | 68 | 91 | 14.3* | 12 |
| 5 | 95 | 76 | 97 | 10.6* | 12 |
| 6 | 101 | 89 | 99 | 4.25* | 8 |
| 7 | 107 | 107 | 103 | 0.71 | NS |
| 8 | 115 | 116 | 107 | 1.8 | NS |
| 9 | 118 | 127 | 113 | 3.93* | 11 |
| 10 | 119 | 119 | 114 | 2.46* | 10 |
| 11 | 160 | 163 | 135 | 2.31* | 16 |
| 12 | 121 | 128 | 111 | 4.06* | 13 |

## Corn

**Methods-** The area grown to corn in 2008 was in sweet corn in 2007. The first differential tillage was conducted in the fall 2007/spring 2008. The experimental design was a randomized complete block with 3 treatments (conventional, strip-till and no-till) and 6 replications. Individual plots were 25 feet long and 11 feet (6 X 22 inch rows) wide. Conventional tillage was conducted on the same dates and in the same manner as detailed in the soybean methods, except that the plots were disced twice on 5/12 on the corn stubble instead of the once in the plots going to soybean. The fall soil test nitrate to 2 ft indicated 36 lb nitrate-N/acre. In the conventional plots, 160 lb N/acre was applied as urea before spring discing 5/12. In addition, soil tests indicated zinc levels at 0.3 ppm, so 10 lb/a zinc sulfate (36% zinc) was broadcast over all plots 5/1. For strip-till, strip-tillage was conducted 10/30/07, and 50 lb N/acre as urea was applied at that time. On 5/12, Roundup Max at 22 oz/acre with 17 lb/acre ammonium sulfate was broadcast sprayed over no-till and strip-till plots using a bicycle applicator with 8001 low-drift nozzles at 40 psi at a total volume rate of 10 gal/acre water.

Plots were seeded 5/14/08 using Pioneer 39D85, Hx1 RR2, corn borer resistant variety at a seeding population of 32,000 pl/acre. The planter was a John Deere Maximerge 22-inch planter with residue managers set to sweep away residue, but to allow only minimal disturbance of soil. The seed was planted between an inch and a half and two inches deep into a moist seedbed.

Nitrogen was applied to no-till corn as a dribble side-dress application on 6/11 when the corn was about 5-leaf stage. 160 lb N/a was applied to the no-till plots (53 gallon/acre) using 28-0-0. Supplemental N was also applied to strip-till plots on 6/11 with a total of 110 lb N/acre (37 gallon/acre) using 28-0-0. The application was conducted using a bicycle sprayer with nozzles set every 20 inches using a streambar set with the rows instead of across them. The middle 4 rows of each plot were fertilized. Roundup was again sprayed at 22 oz/acre with 17 lb/acre ammonium sulfate 6/16 and again on 7/1.

Plots were hand-harvested between 10/24 and 10/27 by collecting row 3 of the 6-row plots. A quantity of corn was hand-shelled immediately after harvest each day and moisture and test weight was obtained. The corn from the hand-shelling was deposited back into the harvest bag and the bag was dried at 40 degrees C for several days to prepare for mechanical shelling.

**Results-**

Date of tasseling was observed as 7/28 for the strip-till plots and 7/30 for the conventional and no-till plots. Strip-till plots appeared more vigorous from emergence to harvest and were easily identified without the use of a plot plan during the growing season. Early season growth stage (Table 3) was lower in conventional and no-till compared with strip-till on 6/18. Strip-till yield was 24 bu/acre greater than conventional till. There were no moisture differences at harvest, but it was raining during the hand harvest, and that high humidity through those days might have influenced the results. Test weight was not affected by treatment.

**Table 3. Effect of tillage treatment on growth stage, yield, moisture and test weight of corn.**

| Treatment | Growth stage 6/18 | Yield, bu/acre | Moisture, % | Test weight, lb/bu |
|---|---|---|---|---|
| Conventional | 2.8 | 84 | 23.4 | 51.9 |
| Strip-Till | 4.3 | 108 | 22.9 | 52.1 |
| No-Till | 3.3 | 96 | 23.4 | 51.2 |
| F | 11.3 | 2.12 | 0.24 | 0.66 |
| LSD 5% | 0.8 | 23 | NS | NS |

**Sugar Beets**

**Methods-** The area seeded to sugar beet was in field corn in 2007. The experimental design was a randomized complete block with 3 treatments (conventional, strip-till, and no-till) and 12 replications. The conventional till plots were chisel plowed on 10/30/07, followed by two discings. Strip-tillage was conducted 10/30, and 50 lb N/acre as urea was applied to the strip-till plots at a depth of 6-inches. In the spring, Roundup Max was applied at 22 oz/acre with 17 lb ammonium sulfate/100 gallon solution, using a bicycle sprayer with 8001 low-drift nozzles at 20 inch spacings at 40 psi and 10 gal/acre water on 5/12. With a soil test of 36 lb nitrate-N to 2-feet depth, 70 lb N as urea was broadcast applied to conventional plots 5/12 and disced once to incorporate. Sugarbeets were seeded to variety Crystal 434 with Allegiance and Thivan T45 seed treatment. Seed-spacing was 4 9/16 inches apart. Micro-rate herbicide that consisted of- Progress 11.6 oz/acre, Upbeet 1/8 oz/acre, Stinger 1.3 oz/acre, Select Max 3 oz/acre and MSO 5.8 oz/acre, was applied 6/11, 6/24 and 7/1. Weed control was hindered by wet soil conditions and inadequate canopy development in some areas of the plot. However, most weeds were controlled except for venice mallow. Sugar beets were hand-harvested from 10 foot of row 3 or 4 on 10/27. Extremely wet conditions prevented mechanical harvest. All beets harvested were cleaned as much as practical and placed into tare bags and sent to the East Grand Forks Quality Laboratory for analysis.

**Results-**Use of strip-till resulted in more vigorous early season growth (Table 4) than no-till or conventional tillage. The strip-till plots were easily identified throughout the season, compared with the no-till and conventional till plots. At harvest, strip-till and no-till resulted in higher sugar content, higher ton yield and higher recoverable sugar per acre than the conventional plots. Strip-till tonnage yield and recoverable sugar per acre were greater than no-till. Recoverable sugar per ton was greatest in no-till. No-till had the lowest harvest stand. No-till had the greatest Gross $ return per ton, but strip-till grossed more $/acre than either conventional or no-till. Strip-till exceeded conventional profit by $500/acre.

**Table 4. Sugar beet growth and harvest parameters as affected by tillage treatment.**

| Treatment | 6/18 Leaf emergence | Sugar % | Harvest Stand, beets/100ft | Ton Yield | RST | RSA | Gross $ ton | Gross $ acre |
|---|---|---|---|---|---|---|---|---|
| Conventional | 2.5 | 17.2 | 195 | 14.4 | 322 | 4637 | $41.62 | $599 |
| Strip-Till | 4 | 17.7 | 177 | 25.5 | 328 | 8364 | $43.11 | $1099 |
| No-Till | 2.2 | 17.8 | 134 | 19.0 | 332 | 6308 | $44.10 | $838 |
| F | 28.3 | 6.36 | 7.28 | 11.8 | 4.02 | 12.5 | 4.02 | 11.8 |
| LSD 5% | 0.5 | 0.3 | 30 | 6.0 | 8 | 1500 | $1.98 | $250 |

**Summary-**The campus tillage study has been in these tillage treatments for over four years. The soil in the tillage plots has started to change during the last two seasons. This was the first year that all three crops showed differences due to tillage. The very wet soil conditions during the season likely contributed to excessively wet conditions in the conventional till. More water probably soaked into these plots than the others due to lower density at the surface layers, and the strip-till plots and no-till plots showed generally less dense subsoil, probably from better residual soil aggregation. Conventional till systems destroy established larger pores and in these fine-textured soils it results in very small pore sizes that can become saturated with water. The no-till and strip-till plots showed evidence of larger pore sizes that helps with both drainage and air-drying and the strip-till in particular showed less moisture stress than conventional. No-till suffered early from the cold soil conditions. Even with residue managers, significant residue remained near the seed row. The strip-till was bare in the spring above the seed and that would have enabled the soil around the seed and young plants to warm faster than no-till. The combination of warmer soil temperatures and drier soil were probably the reasons for the success of strip-till in this study.

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