EFFECT OF ELIMINATING SPRING TILLAGE ON SUGARBEET PRODUCTION AND EMERGENCE IN STALE SEEDBEDS – YEAR 2

Laura Overstreet[1], Norman R. Cattanach[2], North Dakota State Univ. Fargo, ND

[1]Scientist; [2]Research Specialist

Introduction/Objectives

The average cost for spring tillage operations in 2008 was $8.99/a, up from $8.16/a in 2007 (American Crystal Grower Cost Survey – Red River Valley Averages). By eliminating unnecessary spring tillage, growers will save money, wear to machinery, and time. **The objective of this study is to investigate differences in stand establishment and general production potential of sugarbeet planted into stale seedbeds compared to conventional spring-tilled seedbeds.**

Stale seedbeds are seedbeds that receive primary tillage in the fall and are planted in the spring without any additional tillage. This is not a common practice in ND and MN for sugarbeet production for several reasons. In wet springs, fields are tilled lightly prior to planting in an effort to dry the soil. Some growers believe that they cannot achieve good stand counts with a stale seedbed because the soil is not fractured enough to provide adequate seed-to-soil contact to ensure germination. Another reason for a spring tillage operation is to kill early weed flushes in the field. The latter reason is less relevant now that Roundup Ready sugarbeet is available. The former reason, poor seed to soil contact in stale seedbeds, may be a legitimate concern in some areas. Just as there are potential disadvantages to stale seedbed planting, pre-plant tillage operations can have negative consequences as well. In a dry spring, moisture is lost as a result of spring tillage. Stale seedbed planting conserves soil moisture in the early spring and makes it available for seed germination and seedling emergence. Another spring tillage issue that is a considerable concern in recent years is that hard rains after a spring tillage event can create significant crusting problems on the surface of clay and clay loam, and silt loam soils. Crusting can significantly reduce sugarbeet stand establishment on these soil types. Soil type and the velocity of raindrop impact during a storm are deciding factors in determining if a soil will produce a crust that could inhibit germination and/or emergence. Another potential benefit of stale seedbed planting is that soils in fields that were not tilled in spring are less susceptible to wind erosion during wind events.

Materials and Methods

This year, 2009, was the second growing season that this study was conducted. As in 2008, the study was established at the Prosper Research Station on a Beardon Perella silt loam (coarse-silty, frigid Aeric Calciaquoll). Crop rows were oriented 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 6 replications. Soil nitrogen levels were adjusted with fertilizer to approximately 130 lbs/acre of available residual soil test plus added fertilizer N as urea. Soil test levels indicated that no P or K fertilizer was required. Three treatments were established: 1) sugarbeet planted into a fall chisel plowed/spring field cultivated seedbed (check); 2) sugarbeet planted directly into a stale or un-worked seedbed <u>without</u> residue managers (row cleaners) on the planter; and 3) sugarbeet planted into the un-worked seedbed <u>with</u> row cleaners installed on the planter.

A major difference between the study conducted in 2008 and 2009 was the level of tillage conducted in the fall prior to the growing seasons. In fall 2007, the study was prepared by chisel plowing the area two times in a manner consistent with common grower practices. The fall of 2008, however, was excessively wet. The NDAWN weather station at the study location recorded 11 inches of precipitation during the months of September and October. The historic precipitation average for the same time period is 4 inches. Fields were near saturation or flooded the entire fall season of 2008; as a result, only one light tillage pass was permitted in the fall prior to the 2009 study. In the spring, the field still had unusually high levels of wheat residue and a very uneven surface area for planting. The conventional treatment (two spring tillage operations with a cultivator/ harrow combination) was implemented on May 22, 2009, and created a smooth soil surface, incorporated most of the wheat residue, and left a seemingly well-fractured seedbed. The stale seedbed treatments, in contrast, were very uneven with obvious tire tracks, high levels of unevenly distributed wheat residue, and a poorly fractured seedbed. The stale seedbed treatments were, by all accounts, a worst case scenario for stale seedbed planting conditions. All treatments were planted on May 22, 2009, with Hillshög Syngenta variety 4022 Roundup Ready sugarbeet seeds. In the stale seedbed treatment with residue managers on the planter, the residue managers were set on an aggressive setting in an effort to fracture the seedbed and push wheat residue out of the crop row. In the conventional treatment (spring chisel plow), residue managers were not used on the planter. Seeds were placed 1.25 inches deep, and was planted to stand at a 5-inch in-row seed spacing. Row spacing was 22 inches between row centers. Harvest of the two middle rows of each six-row plot, was completed on September 30, 2009. Yield determinations were made and quality analysis performed at the American Crystal Sugar Quality Lab, East Grand Forks, MN.

Results and Discussion

Review of previous years' results: At Prosper in 2008, soils remained dry for more than three weeks after planting; the stale seedbed treatments displayed faster and more even seedling emergence than the spring tillage treatment, presumably due to reduced moisture evaporation from stale seedbed treatments. The use of residue managers on planters in combination with stale seedbed planting provided an additional benefit to early-season seedling emergence, as well. On May 19th, 2 weeks after planting, the stale seedbed treatment planted without residue managers displayed about the same seedling emergence rate as the spring tillage treatment (117 plants/100 ft vs. 112 plants/100 ft). The stale seedbed treatment with residue managers resulted in 27% greater seedling emergence than the spring tillage treatment. By May 23rd, there were 172 (stale seedbed without res. managers) and 176 (stale seedbed with res. managers) seedlings emerged per 100 feet of row compared to 150 seedlings per 100 feet of row in the spring tillage treatment. Stand counts at harvest indicate that there was little difference in final stand between treatments, but counts were still slightly higher in the stale seedbed treatments. There were no significant differences among treatments for any of the tonnage or quality parameters measured.

Results of current year: Considering the poor seedbeds created in spring 2009, the stale seedbed treatments produced remarkably good results. Stale seedbed planting (with or without using residue managers on the planter) gave statistically equal values for sugarbeet root yield and sugar content compared to the spring tillage treatment (Table 1). Root yield was very good for all treatments. Net sugar in the stale seedbed treatments was equal to or higher than net sugar determined for the spring tillage treatment. There were no significant differences between treatments for gross return per ton or gross return per acre. In terms of early season sugarbeet seedling emergence, stand counts taken June 16th, 25 days after planting, showed lower stand counts in stale seedbed treatments, but the values were not statistically significant (Table 2). By harvest, there were statistically fewer sugarbeet per 100 ft. of row for stale seedbed treatments. Stand count values taken at harvest were 9% and 12% lower than spring tilled seedbeds for stale seedbed without residue managers and stale seedbed with residue managers, respectively. Despite fewer sugarbeets, the root yield per acre and gross revenue per ton were no different between stale seedbeds and spring tilled seedbeds.

Conclusions

These data suggest that stale seedbed planting should be considered by growers, since even a very poor stale seedbed did not result in any significant reductions in root yield, sugar content, or revenue compared to conventional spring tillage. It should be noted that this study was conducted on only one soil type, a silt loam; stale seedbed planting on other soil textures is likely to produce different results from those observed here. There is an expected net increase in per acre revenue from stale seedbed planting as a result of savings in diesel fuel. The intangible benefits of more time and greater flexibility in spring as a result of eliminating two unnecessary passes across each acre are an additional incentive for growers to consider testing stale seedbed planting on a small part of a field in coming years.

Acknowledgement

Funding for this project was provided by the Sugarbeet Research and Education Board of Minnesota and North Dakota.

Table 1. Sugarbeet yield and quality parameters resulting from stale seedbed planting. ‘Conventional’ indicates standard spring tillage practice accomplished with a cultivator with a rolling crumbler bar; ‘Stale – no res. mngrs’ indicates that sugarbeet seed was planted into a stale seedbed employing a planter without residue managers; ‘Stale – w/ res. mngrs” indicates that sugarbeet seed were planted into a stale seedbed using a planter equipped with residue managers. LSD values indicate the least significant statistical difference between treatments (P<0.05). If LSD is recorded as *NS*, then no treatment differences were significant.

Tillage Treatment	**Root Yield (Tons/a)**	**Gross Sugar (%)**	**SLM (%)**	**Net Sugar (%)**	**RSA* (lb/a)**	**RST** (lb/ton)**	**GRT† ($/ton)**	**GRA‡ ($/acre)**
CONVENTIONAL	38.7	14.6	1.4050	13.2	10186	263.2	26.60	1029.50
STALE – NO RES. MNGRS	38.3	14.6	1.3850	13.2	10140	264.6	26.90	1032.70
STALE – W/ RES. MNGRS	37.4	14.9	1.4167	13.5	10084	270.0	28.40	1056.20
LSD	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

* Recoverable Sugar per Acre; ** Recoverable Sugar per Ton; †Gross Return per Ton; ‡Gross Return per Acre

Table 2. Sugarbeet emergence on June 16 and at harvest in three seedbed preparation treatments. Treatments are described in Table 1, above.

Date	**Treatment**	**Plants (100 ft^{-1})**
June 16, 2009	Conventional	184
	Stale – No Res. Mngrs	171
	Stale – w/ Res. Mngrs.	176
LSD		**NS**
Sept. 30th (Harvest)	Conventional	154
	Stale – No Res. Mngrs	140
	Stale – w/ Res. Mngrs.	136
LSD		**6.7**