EVALUATION OF COVER CROPS IN SUGARBEET PRODUCTION SYSTEMS: YEAR 2

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Introduction/Objectives

Wind storms are common in the Red River Valley and many soils in this region are prone to wind erosion; in addition to excessive soil loss due to wind erosion, there is also crop loss related to abrasion or complete removal of aboveground shoot tissues. Occasionally, fields must be re-seeded if spring wind events occur before seedlings (especially sugarbeet seedlings) are large enough to resist wind and abrasion damage. Wind erosion problems persist in this area despite conversion of many growers to less intensive tillage methods. The Red River Valley of ND and MN commonly report soil losses due to wind erosion exceeding 5 tons/acre/year (Nielsen et al. 1997). Early spring flood events can also be major sources of soil erosion in the Red River Valley.

Sugarbeet crops are negatively affected from wind storms in several respects. Damage ranges from minimal to complete and can result in a need to re-seed entire fields. Re-seeding is a particularly great economic loss when Roundup Ready sugarbeet seed are used. Cover cropping practices have become more widely adopted in ND and MN as a way to reduce damage from wind and flood events. The following criteria are some of the most important for selecting a cover crop for sugarbeet production in the Red River Valley: holds soil in place with a sufficiently developed root system, reduces wind damage to young seedlings with its aboveground biomass, is inexpensive, and can be managed and killed so that it does not compete with the crop for nutrients, water, and light. Some growers are also interested in identifying cover crops that supply N to the soil and/or that take up excess nutrients and release them later for uptake by the cash crop. Finding the right cover crop for a grower's individual needs is critical for off-setting the extra time, effort, and expense involved in the work of planting and managing the crop. **The objectives of this study were to evaluate cover crop effects on sugarbeet planted into cover crop residue. Additionally, we wished to determine which cover crop species and mixtures are most promising for incorporation into the sugarbeet cropping rotation.**

Materials and Methods

A field experiment was established in the fall of 2009 on a sandy loam soil prone to wind erosion near Amenia, ND at a grower-cooperator's sugarbeet field. The grower recognized this field as being susceptible to wind erosion and routinely planted a rye-barley cover crop mix to control wind erosion when he was growing sugarbeet in that field. Fall cover crops were planted on Sept. 14th, 2009.

Treatments were: 1) no cover crop check, 2) strip tillage check, 3)10 lb/a fall rye, 4)8 lb/a fall rye + 20 lb/a fall barley, 5)8 lb/a fall rye + 40 lb/a fall legume (arvika pea), and 6) 38 lb/a spring-seeded barley. The pea used was arvika forage pea, selected because it grows quickly in the fall to provide more growth and nitrogen-fixing capacity than other legumes during the short growth period between cover crop planting and freezing.

The study was planted into a smooth, moist, seedbed on April 19, 2010. Planting was arranged in a randomized complete block design with four replications. Individual treatment plots measured 11 feet wide and 30 feet long. In the strip tillage treatment, strips were applied in fall 2009 with a single pass into wheat residue chopped to ~7 inches high. Fertilizer was applied with the strip tillage operation in the strip tillage treatments. Tillage in all other treatments was accomplished with chisel plowing plots in fall and cultivating in spring with a field cultivator-harrow. Soil nitrogen levels were adjusted with fertilizer to approximately 130 lbs N/acre of available residual soil test plus added fertilizer N by applying 70 lb N/acre as urea. Soil phosphorus levels were measured to be 8 ppm. We applied additional P_2O_5 at planting with 3 gallons per acre of 10-34-0. Potassium fertilizer was not required. Except in the strip tillage treatment, broadcast fertilizer application was made in fall immediately before chisel plowing and fall cover crops were seeded (on Sept. 14th, 2009).

Rhizomania resistant variety Hilleshog 4012 RR was planted with a John Deere MaxEmerge II planter. Sugarbeet was placed 1.25 inches deep, and was planted to stand at a 4 ½ -inch in-row seed spacing. A 22-inch wide row spacing was used. Stand counts were taken after germination. Round up was applied three times for weed control.

Two fungicide applications, Eminent and Headline, were applied for Cercospora leaf spot control. Harvest of the middle two rows of each six row plot, was completed on September 22, 2010. 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: The 2009 growing season was a challenging one. Fall 2008 was unusually wet and, although we were able to plant the fall cover crop treatments, the seedbed was wetter than optimal at all three of the locations at which the study was replicated. Due to the wet fall conditions, we were also prevented from applying strips with the strip tiller in the fall, causing strip tillage to be a spring operation, which is not a recommended practice in the Red River Valley. The spring 2009 season was also wetter than usual and brought substantial flooding to many areas of the Red River Valley. The site locations for this study remained wet until mid-May, delaying planting of spring-seeded cover crops and all sugarbeet until late May. No major wind storms occurred at the research location in 2009, so there was minimal representation of the benefit of cover crops for wind protection. Consistently, the best cover crops in 2009 were spring-seeded barley, fall-seeded rye+barley, and fall-seeded rye+pea. Because strip tillage was conducted in late spring 2009 and produced a poor seed bed relative to other treatments, the strip tillage treatment produced significantly lower final stand, tonnage, and/or sugar content than other treatments. At two of the three locations, the conventional treatment (no cover crop) performed roughly as well or better than the best of the cover crop treatments in the absence of water limitations and significant wind events.

Results of current year: In contrast to 2009, 2010 was a very favorable growing season allowing early planting and providing good heat unit accumulation and sufficient moisture. It was also a year in which sugarbeet produced better with cover crops or strip tillage than without, as indicated by the conventional tillage treatment being the lowest producer of root tonnage and recoverable sugar per acre (RSA). The best treatment tested in this study this year was not a cover crop treatment; it was the strip tillage treatment which provided significantly greater root yield, RSA, and gross return per acre (GRA) relative to the conventional (no cover crop) treatment and most cover crop treatments. Among cover crop treatments, fall rye+barley resulted in greatest sugarbeet root yield and RSA. Fall rye+pea performed moderately well in 2010, as did spring-seeded barley.

Comments

One trend observed consistently at all four location years is that the fall rye cover crop results in slightly lower sugarbeet root yield compared to the no-cover crop check. Rye is well known as an allelopathic species, capable of producing root and shoot exudates that can interact antagonistically with other plant species nearby. In 2009, it was also observed that spring oats performed poorly at both locations at which it was tested. For fall cover crops, fall rye+barley and fall rye+pea mixtures appear to be better choices than fall rye alone. Spring barley is also a good spring-seeding option for cover crops, but will not produce the same biomass accumulation for wind protection as a fall-seeded crop. Spring-seeded oats did not perform as well as other cover crops tested. Strip tillage is another wind protection option and performed exceedingly well in 2010 despite a poor year in 2009, which resulted from establishing strips in spring rather than fall. Fall strip tillage is obviously a better tillage option that spring strip tillage in this region because it creates a much better seedbed, resulting in better germination, emergence, and plant stand.

Acknowledgement

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References

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Table 1. 2010 Data, Amenia, ND. Main effect of cover crops and strip tillage on sugarbeet yield and quality compared to conventional chisel plow tillage; LSD values indicate the least significant statistical difference between treatments. LSD of *na* indicates that no differences were statistically significant at P<0.05.

Treatment	Root Yield (Tons/a)	Sugar (%)	SLM[*] (%)	Net Sugar (%)	RSA[†] (lb/a)	RST[‡] (lb/ton)	Beets/ 100ft	Gross Ton[§] ($/ton)	Gross Acre[¶] ($/acre)
Conventional	32.98	15.4950	1.1849	14.3101	9421.22	286.20	172.1	49.44	1625.31
Strip Tillage	39.73	15.6875	1.3436	14.3439	11391.71	286.88	157.1	49.64	1970.50
Fall Rye	30.87	15.6275	1.1849	14.4426	8910.68	288.85	160.8	50.24	1548.80
Fall Rye + Barley	36.00	15.6225	1.2666	14.3559	10332.71	287.12	171.3	49.72	1788.72
Fall Rye + Pea	34.42	15.6575	1.2788	14.3787	9891.58	287.57	189.6	49.85	1713.75
Spring Barley	34.07	15.4075	1.2131	14.1944	9688.39	283.89	175.8	48.75	1665.69
LSD (P<0.05)	**3.14**	**na**	**0.1038**	**na**	**840.48**	**na**	**18.3**	**na**	**163.44**

[*] %SLM = Sucrose Loss to Molasses, a measure of impurity content
[†] RSA = Recoverable Sucrose per Acre
[‡] RST = Recoverable Sucrose per Ton
[§] GrossTon = Gross Revenue per Ton
[¶] GrossAcre = Gross Revenue per Acre