Crop Sequence Effect in Sugarbeet, Soybean, Corn, and Wheat Rotations

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Introduction

In recent years, sugarbeet growers increasingly report planting sugarbeet after soybean or corn. Some growers and researchers have observed differences in fertility, weed management, and final yield measurements for sugarbeet following corn or wheat compared to sugarbeet following soybean. In 2007, some farmers reported poor stands and lower yield for sugarbeet planted after corn. Farmers and researchers have expressed interest in the effect of crop sequence on sugarbeet and associated crop yield and quality. Corn and soybean acreage is increasing in ND and MN each year, and some economists predict a dramatic growth of corn production with the onset of the ethanol industry in the Midwestern United States. In 2007, corn acreage increased by 47% from 2006. If this trend continues, it is certain that growers will be incorporating corn into their sugarbeet rotation with increasing regularity.

One concern involving crop sequence is the level of residual N remaining after the preceding crop and how it may affect the current year's beet sugar production. Disease issues and pesticide carry-over, weed management, crop-related phytotoxicity (allelopathic interactions), and water and nutrient use are all factors that should be considered when making cropping rotation decisions. The objective of this study is to evaluate the effect of corn and soybean as preceding crops on yield and sugar quality in a sugarbeet cropping system.

Materials and Methods

This study was established in spring 2006 at the Prosper research station to examine the rotation sequence effect of corn, soybean, and wheat on sugarbeet yield and quality. The previous year, 2005, the study area had been used for wheat production. Corn and soybean are crops that have not traditionally preceded sugarbeet in the Red River Valley. Wheat is a treatment included as a standard of comparison since it has been more commonly used as a crop preceding sugarbeet in this area.

The study is designed as a completely randomized block experiment and replicated four times. The experiment consists of six combinations of the four crops:
1) wheat/corn/soybean/sugarbeet
2) wheat/corn/sugarbeet/soybean
3) wheat/soybean/corn/sugarbeet
4) wheat/soybean/sugarbeet/corn
5) wheat/sugarbeet/soybean/corn
6) wheat/sugarbeet/corn/soybean

Treatment plots are separated by an eleven foot buffer to minimize risk of drift damage from neighboring treatments. Plots are 30 feet long and six rows wide and all crops are seeded using a 22-inch row spacing. Weed control, disease management, and other cultural needs are assessed individually for each crop and managed according to NDSU Extension guidelines. Periodic vigor and stand ratings are made throughout the season to evaluate potential allelopathic, weed, disease, or chemical effects resulting from management of previous crop.

In 2006, the study was initially established so that each of the four replications was individually planted to one of the four crops. Each sequential year, additional crops will be introduced and randomly placed in the replications to allow for determination of the effect of the preceding crop and also allow for each crop to be planted in each of the four growing seasons. Since 2006 was the first year of the study, there was no effect of a preceding crop (wheat was the preceding crop for all treatment plots). The 2007 growing season was the first year that data could be determined for a preceding crop. The study was planted on May 2nd with sugarbeet variety Beta 1305R, soybean variety Roughrider (165,000 seeds/a), corn variety Pioneer stacked (39D85-NM08, 32,000 seeds/a), and wheat variety Alsen (80 lbs/a). Sugarbeet was planted at three-inch row spacing and later hand thinned to 5.5 inch to

insure optimal stand. Emergence ratings were evaluated on May 22 and June 4th. Soybean, corn, and sugarbeet were harvested on September 14th, October 2nd, and September 26th, respectively

Results and Discussion

When averaged across all treatments, soybean yield was 49 bu/a with 6.4% moisture content. Corn yield averaged across all treatments was 172 bu/a with 9.7% moisture content. Wheat yield averaged across all treatments was 48 bu/a with 7.5% moisture content. No significant differences in moisture content of soybean, wheat, or corn were determined regardless of preceding crop.

In 2007, data analysis revealed that the following sugarbeet parameters did not change as a result of the preceding crop in this study: beets per 100 ft of row, net sugar, recoverable sugar per ton, gross profit per ton, and gross profit per acre (Table 2). Recoverable sugar per acre was greater for beet following corn or beans than for beet following wheat (Table 2). Sugarbeet tonnage was also lower for beet following wheat (Table 1). This may have been due to greater weed pressure in a corner of the field where these plots were located. We will continue to investigate the relationship between beet yield and wheat versus corn and soybean in the next two years of this study.

Soybean yields were greatest when soybean was grown after corn (Table 1). Soybean planted after corn resulted in a 17.19 bu/a yield advantage compared to yields after sugarbeet and 7.5 bu/a advantage compared to yields after wheat. No significant differences were observed for corn yields as a result of the preceding crop. Emergence counts for corn in early June revealed no differences in emergence as a result of the preceding crop. Corn yield after beets was lower than corn after soybean or wheat. There were no significant differences for wheat yield as a result of the preceding crop. All wheat yield values were very similar.

Conclusions

The reduction in sugarbeet yields following wheat was unexpected, since wheat is a common crop preceding sugarbeet in rotation systems. This is the second year of a four-year study, so this trend will continue to be analyzed in following years. The sugarbeet following wheat plots were placed close to one another in a corner of the field that had higher weed pressure, so perhaps the increased competition for moisture and nutrients was more of a factor for the reduced sugarbeet production values than the treatment effects themselves. Soybean and corn as preceding crops for sugarbeet did not result in any remarkable differences for sugarbeet tonnage or sugar quality parameters. Sugarbeet following beans had the greatest emergence counts on two dates (May 22nd and June 4th) while corn and wheat as preceding crops gave similar emergence counts for corn and wheat. Sugarbeet after corn resulted in the highest (although non-significant) sugarbeet yield and recoverable sugar per acre. If corn consistently proves to be a good preceding crop for sugarbeet, this may be good news for growers considering incorporating corn into their sugarbeet rotation.

Table 1. Yields of crops following other crops in rotation sequence. Because there were significant differences among yield values for all crops, LSD values were determined by individually analyzing each crop, treating the preceding crop as the treatment effect.

Crop	Preceding Crop	Average Yield	Standard Deviation
Soybean	Beet	40.19 bu/a a	6.09
Soybean	Corn	57.38 bu/a b	1.99
Soybean	Wheat	49.85 bu/a ab	4.6
Corn	Beet	155 bu/a a	12.15
Corn	Soybean	187 bu/a a	25.3
Corn	Wheat	174 bu/a a	48.5
Wheat	Beet	49.18 bu/a a	3.78
Wheat	Soybean	48.82 bu/a a	6.56
Wheat	Corn	44.73 bu/a a	1.1
Beet	Soybean	32.1 ton/a a	0.19
Beet	Corn	33.4 ton/a a	1.08
Beet	Wheat	30.2 ton/a b	0.12

Table 2. Sugarbeet sugar and quality parameters. Values are means averaged across reps. Net sugar (% sucrose); RSA = Recoverable Sugar per Acre (lb/a); RST = Recoverable Sugar per Ton (lb/ton); Beet/100' = # beets per 100 feet of row; Gross Ton = Gross profit ($/Ton beet); Gross Acre = Gross Profit ($/acre). Letters following values represent statistical differences determined by lsd.

Treatment	Net Sugar	RSA	RST	Beet/100'	Gross Ton	Gross Acre
Beet after Soybean	15.3 a	9818.7 a	305.6 a	175 a	34.40 a	1103.90 a
Beet After Corn	15.2 a	10,123.5 a	303.3 a	181 a	33.80 a	1129.10 a
Beet After Wheat	15.3 a	9225.1 b	305.9 a	162 a	34.40 a	1038.20 a