Soybean Tillage Systems to Manage Corn Residues

Purpose:

No-till planting is a common practice for soybean growers in Ontario. Over the past decade corn residue has become increasingly difficult to deal with in the production of no-till soybeans. As corn yields have increased over time, so has the amount of residue produced by the corn plant. Within the last few years new tillage technology, referred to as 'vertical tillage,' has been introduced to the Ontario marketplace to help manage corn residue.

This project will assess if minimal tillage can help to increase yields for no-till soybeans, or whether more tillage in necessary to increase soybean yields. Residue removal may also be part of the solution so this strategy will also be investigated.

Methods:

Tillage trial information has been collected from the SMART soybean project (2008-2010) as well as 2 other spring tillage specific trials which were run in 2010. An additional 10 field scale trials were set up in the fall of 2010 to assess fall vertical tillage. These trials were conducted as field scale trials, which were typically 20 feet x 1000 feet per treatment with replications. Two small plots assessing 30 different tillage / residue scenarios were set up in the fall of 2010. Trials were planted with a 15" Kearney vacuum planter. Plots were weighed at harvest time using a calibrated weigh wagon.

Figure 1. Salford RTS running in corn stalks. Coulters are on 7 inch spacing run at about 3 inches deep.

Results:

The 2010 growing season was exceptional. With the high temperatures and timely rains, yields were very high. There was no significant insect or disease pressure. 2010 was not a particularly good year to show the advantages of using some tillage because the spring was not overly wet or cold so the beans got off to a good start.

In Table 1 the effects of tillage in the SMART project from 2008 to 2010 are shown. Over the course of these 3 growing seasons pre-tillage showed very little impact on yields. The average yield gain over the 3 years of this trial was only 0.5 bushel per acre. This is not enough of an increase to warrant the use of tillage when the costs of time, diesel and equipment maintenance are factored in. It should be noted that none of these trials were planted early in the growing season and the soil types were silt loam or clay loam.

Table 1: Summary of Yield Results from SMART project

Location	Year	No-till		No-till + Fertilizer* + Pretillage	
		Rep 1	Rep 2	Rep 1	Rep 2
Middlesex	2010	59.4	56.1	58.3	59.0
Chatham	2010	51.7	45.9	51.4	47.4
Elgin	2010	62.0	59.9	59.3	60.0
Norfolk	2010	56.7	55.2	58.4	57.5
Brant	2010	55.1	54.3	57.0	54.9
Elgin	2010	54.8	59.4	60.1	56.4
Elgin	2009	54.6	51.0	54.6	52.0
Elgin	2009	52.4	55.2	53.9	56.3
Huron	2009	44.0	45.2	44.0	46.1
Brant	2009	47.9	mv	49.3	50.4
Perth	2009	51.6	51.6	54.2	53.3
Middlesex	2009	44.7	47.8	44.2	47.2
Middlesex	2009	46.2	46.6	46.5	48.5
Middlesex	2008	49.1	50.4	mv	52.6
Middlesex	2008	49.2	48.0	49.7	50.9
Huron	2008	53.5	56.9	57.1	58.3
Perth	2008	49.9	mv	54.2	mv
Brant	2008	69.7	65.6	69.9	59.4
Elgin	2008	62.6	60.1	56.4	58.0
Elgin	2008	57.1	54.8	52.2	55.4
Elgin	2008	48.5	46.6	46.6	51.3
Average Yield (bu/ac)		53.3		53.8	
Yield Advantage (bu/ac)				**0.5**	

*Fertilizer = 40lbs/ac of P and 70lbs/ac K actual. Pre-tillage = RTS run 2 times.
mv = missing value

As a result of the low yield gains over the course of this project, a variety of other tillage practices and residue removal trials were initiated in 2010. These trials were set up to consider a few different issues, including a closer look at the problem of corn residue.

In Table 2 the results from 2 tillage trials in 2010 are shown. One trial was run near Lucan; the other was run near Bornholm. In these trials a combination of Salford RTS and Salford RT99 were used to do the tillage strips. Each treatment was replicated 3 times, and the strips were 20' wide, running the length of the field (over 1000').

Figure 2. A Salford RT 99 is an RTS with a gang of discs at the front of the unit allowing for more aggressive tillage than a regular RTS.

Table 2: Results for Tillage Trials for Managing Corn Residue in 2010

Treatment Name	Average Yield (bu/ac)	Yield Advantage (bu/ac)
No-till	55.3	-
RTS 1x	57.7	2.4
RTS 2x	56.4	1.1
RT 99 1x	56.6	1.3
RT 99 2x	58.6	3.3
1X = 1 time, 2X = 2 times		

Response to tillage proved to have more positive impacts at these locations. One of the reasons may be that these trials were planted relatively early. The RT99 had the greatest impact on yields, but it is also disturbed the soil and buried corn stalks more than the RTS. These results show that there is promise for using minimal tillage units to increase yields but it may take more tillage than one pass vertical tillage.

At the Lucan location stalks were also removed followed by no-till planting. (Results not shown) Where stalks were removed, which was done by using a hay rake to clear off 20' wide strips the length of the field, the yield gain was over 7 bu/ac. This huge response to corn residue removal has triggered more intensive trials with stalk removal.

Summary:

1) Spring time one pass minimal tillage provided no yield benefit on lighter soil types from 2008-2010. A small yield gain was found when planting early.
2) More intensive spring time tillage (RT 99) provided more yield than the RTS.
3) When removing corn residue and using regular no-till practices there was a 7 bu/ac increase at one site in 2010. More site years will be necessary to investigate this response.

Next Steps:

The focus of this project will be around managing corn residues and combining that with the different types of tillage, including some conventional methods. Two trials have been set up for the 2011 season with 10 different tillage types, and 3 rates of corn stalk removal. Another set of trials will focus on the timing of the tillage, with tillage being done in the fall, spring, and a combination of both, on varying soil types. The following tillage systems were set up in the fall of 2010. Each had three levels of corn residue tested.

Table 3. Continuing Research Treatments for Soybean Production

1	No-till (no stalk chop)	6	Fall 1X and Spring 1X RTS + Stalk Chop
2	Spring RTS 2X (no stalk chop)	7	Fall Disc + Spring Cultivate
3	Fall RTS 2X (no stalk chop)	8	Fall Disc + Fall Cultivate (Stale Seedbed)
4	Fall 1X and Spring 1X RTS (no stalk chop)	9	Fall Disc Ripper + Spring Cultivate
5	No-till + Stalk Chop	10	Fall Moldboard Plow + Spring Cultivate

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