Improving Yield of Second Year Soybeans

(St Clair Region SCIA Regional Partner Grant)

(Final Report)

Purpose:

The purpose of this project was to determine the value of a rye or winter wheat cover crop in fields where soybeans follow soybeans. Many growers find themselves in a situation where for cropping, economic or other reasons they plant soybeans in a field two or more years in a row. This results in yield loss and can increase pest and disease pressure in the field.

The rye or wheat was planted immediately following soybean harvest and killed off in the spring prior to planting soybeans. The hope is to get enough growth to provide some benefits to the soil and increase the yield of the succeeding soybean crop. There is research from Pennsylvania indicating that cover crops can improve soybean yields in these situations. When rye was broadcast into a standing soybean crop at time of first leaf drop in this three year study, the yield of soybeans was increased by 7.5 bu/ac (20%). The intent of the project was not to replace a good crop rotation for soybean production but to provide a tool for growers who find themselves growing multiple years of soybeans.

Methods:

The project sites were established in the St Clair Region Soil and Crop Improvement Association area (Essex, Kent and Lambton). Fields were selected which had one or more years of soybeans previously and were going into soybeans. Immediately following soybean harvest the winter wheat and rye cover crop was drilled in or broadcast and worked in at a rate of 60 lbs/ac. Main project sites had both cover crops and secondary sites had a minimum of one cover crop. Each site had at least two replications. The cover crop was left to grow over winter and was killed prior to soybean planting.

At cover crop establishment soil samples were taken to determine fertility, organic matter content and soybean cyst nematode levels. GPS coordinates of the cover crop treatments were taken so flags could be put back late in the season for harvest. Cover crop growth was monitored and height measurements taken shortly before they were killed off. Soybean growth and yield measurements were taken for the treatments.

Results:

The first project year 2006/2007 (fall ’06 to soybean harvest ’07) was the startup year for the project. The soybean crop was late maturing and the fall became very wet so plots were only planted in Essex County. One main and two secondary sites were planted in the first week of November. The main site had a corn residue strip in it and two reps of the rye and wheat cover crops. One secondary side had both wheat and rye and the other had just rye. The main plot was on a sandy loam soil and growth was slow but uniform in the fall. By the beginning of May the rye had reached a height of 31cm (12”) leaf extended and the winter wheat was 26cm (10”) tall. Cover crop growth was slow on the two secondary sites due to late planting and clay soils. By early May growth was uneven and generally poor. Fertility, organic matter and soybean cyst nematode

(SCN) samples were taken and analyzed. The three sites had adequate fertility and organic matter averaged about 3.5%. The main site SCN samples were generally in the low to moderate risk range. The two secondary sites had no SCN present. One of the secondary sites was not harvested by the cooperator. See table 1 for the soybean yield results.

Table 1. 2007 Soybean Yield Results (bu/ac)

Plot	Check	Rye	Winter Wheat	Following Grain Corn
Main - Kingsville	34.1	46.6	48.5	52.0
Secondary – Amherstburg*	48.1	48.9	---	---

* Site had poor cover crop growth.

In the second year of the project 2007/2008 the fall was more favourable for the establishment of cover crops after soybean harvest. Plots were planted in all three counties, three main plots and three secondary plots. Two of the main plots had a corn residue strip again and one of the main plots had manure applied as an extra treatment. All the plots were on clay or clay loam soils. The plots were soil sampled in the fall of 2007 and the fertility levels were moderate to high. The organic matter levels ranged from 3 to 4.5%. One of the main plots had significant levels of soybean cyst nematode; the other plots had no SCN. The cover crop growth was good going into the winter. Height measurements of the cover crops were taken between May 4th and May 9th, 2008, see table 2. The measurement was taken from the ground to the extended leaf tip. The average height for the rye was 30cm and 25cm for the winter wheat. The yield data can be found in table 3.

Table 2. Cover Crop Growth May 2008 (cm)

Cover Crop	Comber*	Amherstburg	Kingsville	Wallaceburg	Florence	Merlin
Rye	42 (27)	26	39	25	34	NA
Winter wheat	NA	22	27	NA	25	25

Table 3. 2008 Soybean Yields (bu/ac)

Cover Crop	Comber*	Amherstburg	Kingsville	Florence*	Merlin*	Average Yield*	
Check	36	32.0	35.2	22.1	36.8	34.4	33.6
Rye	35	30.8	34.4	19.5	NA	33.4	
Winter wheat	NA	30.6	37.0	20.6	32.9		33.8
After corn	NA	NA	55.2	27.9	NA		

*Notes: The Comber site cover crop had to be replanted so growth was less. The number in brackets in table 2 is the height of the replant. The Florence site experienced reduced rainfall and significant weed pressure. The rye planted at the Merlin site had very poor emergence so the plot was moved to a part of the field where winter wheat was going to be killed out due to winterkill but only had one rep. The average yield is for the Comber, Amherstburg and Kingsville sites.

The fall of the final year of the project (2008/2009) was about average for time of harvest of the soybeans and cover crop planting was completed just a little later than last year. Early growth conditions were good but winter set in mid November and stopped growth earlier than in 2007. Three main plots and two secondary plots were established. Soil tests revealed very good fertility and an average organic matter level of 4%. The spring was very favourable for cover crop growth. The height measurements can be found in table 4. Yield data for 2009 is in table 5.

Table 4. Cover Crop Growth May 2009 (cm)

Cover Crop	Comber*	Amherstburg	Kingsville	Chatham*	Florence	Average
Rye	43	42	50	21	38	43
Winter wheat	NA	33	24	NA	27	28

*Notes: Rye measurements were taken two to three weeks earlier than the other locations and are not included in the average.

Table 5. 2009 Soybean Yields (bu/ac)

Cover Crop	Comber	Amherstburg	Kingsville	Chatham	Florence	Average Yield*	
Check	61.9	46.1	54.0	55.7	38.6	51.3	46.2
Rye	63.4	46.0	57.0	55.9	37.6	52.0	
Winter wheat	NA	41.3	48.0	NA	39.6		43.0

*Notes: The average yield for the cover crop is compared with the sites that had that cover crop.

Summary:

Interest in the use of cover crops is growing in Ontario and in much of the United States. The benefits include trapping nutrients, protecting the soil from wind and water erosion, improving soil structure and organic matter, managing soil moisture and many more. Some of the challenges associated with cover crops include establishment, management of the cover crop and insect and disease interactions. Establishing the cover crop was one of the challenges experienced in this project. The first year the soybean harvest was late and the fall was wet making it difficult to find suitable conditions to drill in the cover crop. Fortunately, the rest of the fall did allow for reasonable growth. The third year harvest was a little earlier and the cover crop was planted in better time but winter set in mid November reducing the growth going into the winter. One solution to getting more growth would be to broadcast the cover crop into standing soybeans. This can work well if done at the start of leaf drop and moisture conditions are adequate. This could be done with an airplane or a high boy if there are tram lines. Seeding rates would have to be increased for broadcast as well. All but one of the plots was planted with a no-till drill and the other was broadcast and worked in. Both methods worked will.

The concern about management of the cover crop, especially rye, by many of the co-operators turned out to be not much of an issue. The rye was easily controlled with glyphosate in the first half of May. Planting into the dead or dying cover crop was no problem and there were no problems with slugs.

The benefits of planting a rye or winter wheat cover crop are many. Overall the yield boost to the second year of soybeans was not as great as anticipated. Of the six sites with rye where there were no plot issues, rye gave a yield advantage at two sites and was within a bushel of the check in the rest. Five sites with wheat and no issues saw two

with a yield improvement and the other three with a slight to nine bushel per acre yield reduction. The average of those sites gave a 2 bu/ac yield advantage to rye and no yield difference to the wheat. The plots with corn strips in them to show the rotation effect yielded 25% to over 50% higher than the check reinforcing the importance of crop rotation for high soybean yields. The highest yield response to the cover crops came in year one on a sandy loam soil. It was a dry year so moisture conservation from the cover crop residue may have contributed to the yield increase.

Bill Deen, University of Guelph, also received funding from the OMAFRA Ontario Great Lakes Program to conduct research on cover crops between soybean crops. At Elora in 2009, no-till soybean yield was increased by 5 bu/ac following a drill established fall cover crop when compared to continuous soybeans with no cover. When spring tandem disk tillage occurred prior to soybean planting, the impact of cover crop establishment was reduced.

Soybean cyst nematode (SCN) infestations of fields were identified in each of the sites. Most of the sites had none to moderate infestations. There is research that indicates that some cover crops including rye can reduce SCN populations. In the third year of the project a secondary site with a rye cover crop and sandy loam soils had very high levels of SCN. Benchmark soil samples were taken and analyzed for SCN cysts and eggs in the fall of 2008. This sampling was repeated in the fall of 2009. Half of the field had been in corn in 2008 so part of it was included in the benchmark sampling. The SCN levels in the corn were about a third of the levels of the other half of the field that was in soybeans in 2008. The rye strips were planted in the fall of 2008 where the soybeans had been. In the spring of 2009 the entire field was planted into a SCN resistant variety. The SCN sampling from the fall of 2009 showed a 30% reduction in cysts where corn was the previous crop, a 65% reduction in cysts for the rye strips and a 50% reduction for the check strips. These results show that crop rotation is still the best way to manage SCN populations. They also show that SCN varieties can help to reduce SCN populations. Finally and an important part of this project is that a rye cover crop in combination with a SCN resistant variety can further reduce SCN populations. Soybean cyst populations were reduced by 50% following rye in research conducted by Agriculture and Agri-Food Canada.

Another benefit of a rye cover crop is weed suppression. In one of the plots in year two there were some weed escapes. Although weed counts were not done there were visibly less weeds where the rye strips had been. Research has shown that rye can provide some weed suppression.

From an economic point of view the yield benefits don’t translate into much at 2 bu/ac for rye and zero for winter wheat. The cost of seeding the cover crop is about $3.00 per bushel for the rye and about $5.00 per bushel of winter wheat. The custom rate from the OMAFRA publication (2006) is $21.00/ac for a no-till drill. The glyphosate application to kill the cover crop might not have to be charged to the cover crop if a burndown is normally used. The cost will have to be weighed off against the benefits discussed in this summary.

There may be benefits to the soil as the living crop may help, stimulate soil life, improve soil structure or provide a small contribution to soil organic matter levels but those benefits are difficult to measure in the short time a cover crop is in the ground. These

cover crops can definitely help protect the soil from water and wind erosion as soybean residue is often not enough to protect the soil.

Next Steps:

The project is complete. Some statistical analysis may be done and the results will be compared to the project conducted by Bill Deen, University of Guelph. Bill received funding from the OMAFRA Ontario Great Lakes Program to establish research plots at several locations to study cover crop benefits to soybeans.

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