Organic Soybean and Dry Edible Bean Production Research

Natural Systems Agriculture Laboratory
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Department of Plant Science
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UNIVERSITY OF MANITOBA

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Introduction

Pulses are an important component of healthy cropping systems plus they add to the off-farm market diversity for farmers. In recent years, the market demand for organic pulse crops has grown. Canadian farmers have excellent management skills and these skills can be applied to producing high value certified organic pulses.

In response to the rising interest in organic pulse production, our research group started investigating the feasibility of growing soybeans and dry edible beans organically. The work was supported financially by the Manitoba Pulse Growers Association and the Manitoba and Canadian governments through an ARDI grant. This report summarizes 1) a 7 year project on organic soybean production in Carman, Manitoba and 2) a multi-site study on weed control in organic soybean and dry edible bean production.

Project 1. Organic soybean production under semi-commercial farming conditions

We have been conducting organic crop research since 1992, the year we started the Glenlea long-term organic crop rotation study. In 2004, we started another cropping system using much larger plots than at Glenlea. This new study, The Organic Field Crops Laboratory, and it is located at the Ian N. Morrison Research Farm near Carman, Manitoba. Each plot in this study is 2 acres in size. This allows field scale equipment to be used and yields are measured across all 2 acres using a weigh wagon.

The six-year rotation used at Carman is shown here:

1. Pea/oat green manure (grazed)
2. Spring wheat
3. Soybean
4. Barley/hairy vetch green manure (rolled)
5. Flax (direct-seeded into rolled mulch)
6. Oat (direct-seeded into mulch in some years)

Yields from this study are shown in Table 1 and results include economic performance. Average yields were 48 bu/acre for wheat, 29 bu/acre for soybean, 22 bu/acre for flax and 78 bu/acre for oat. It was interesting to observe that organic yields were quite stable across the 7 years and they did not “crash” after one or two years. Lower yields in 2011 were attributed to very difficult growing conditions

(extremely wet spring). One interesting observation was that flax yields went up when we started no-till seeding flax (which started in 2009).

The economic analysis for this rotation was conducted by agricultural economists Stephanie Fryza and Dr. Jared Carlberg. Overall, this rotation resulted in a net return of $144/acre.

Table 1. Yield of green manure (kg/ha dry matter) and grain crops (kg/ha), plus net returns for an 7 year period at the Ian N. Morrison Research Farm, Carman, Manitoba. The six year rotation is: green manure (grazed)-wheat-soybean-green manure-flax-oat and the site has been managed organically since 2002.

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Year	Pea/oat green Manure	Spring Wheat	Soybean	Barley/hairy vetch green Manure	Flax	Oat
	----------*kg/ha*----------					
2004	5397					
2005	4171	2470	2232	2729	1251	709[y]
2006	3483	4148	1558	1994	1621	2612
2007	8480	3056	2128	7902	1188	3568
2008	5800	3625	1839	7593	1189	1838
2009	6165	4070	1919	7905	2265	3831
2010	3930	3310	2157	9058	1804	2633
2011	3352	1803	1862	8921	684	3404
Average	5097	3212 (48 bu/ac)	1956 (29.1 bu/ac)	6586	1429 (22.7 bu/ac)	2981 (78 bu/ac)
Net return ($/acre)	-168 (30)[w]	215	317	-166	357	111

[w] number in brackets where green manure was grazed instead of just soil incorporated with tillage.

[y] Low oat yield in 2005 because the oat variety had poor crown rust resistance. This number not included in the overall oat yield.

Conclusions

- A well-designed rotation will allow for production of profitable yields of soybeans.

Project 2. Weed control experiments

Experiment 1. Early-season weed control in wide row and narrow row bean production

SOYBEANS

Methods

The research was conducted at Glenlea and Carman. At Glenlea this research was conducted under organic management on land that had been under organic management since the rotation was established in 1992. The Organic Field Crops Laboratory in Carman has been under organic management since 2002. Both row-cropped and solid-seeded trials were conducted at both locations.

The experimental design was a randomized complete block with four replicates. Eleven treatments were used (Table 1) and represent a variety of weed management techniques and timing of those techniques. Plot dimensions were 1.83 x 6 meters at both locations. The variety OAC Prudence was seeded using a disk drill at a rate of 470 000 plants/ha for the row-cropped trials and a rate of 800,000 plants/ha for the solid-seeded trials. The row-cropped trials were planted with a row spacing of 45 cm and the solid seeded trials were planted with a row spacing of 15 cm. Row crop cultivation was performed between the rows of the row-cropped trials as necessary throughout the growing season. See Table 2 for a schedule of field operations.

Table 1: Treatments and timing of weed control operations.

Treatment	Weed Control	Pre-Emergence	Post-Emergence
1	Control		
2	Lely	x	
3	Lely	x	x
4	Lely		x
5	Flame	x	
6	Flame	x	x
7	Flame		x
8	Rotary Hoe	x	
9	Rotary Hoe	x	x
10	Rotary Hoe		x
11	Weed Clipping		x

Table 2: Schedule of field operations.

Operation	Glenlea Row	Glenlea Solid	Carman Row	Carman Solid
Seeding	May 21	May 21	June 3	June 7
Pre-Emergence Treatment	June 8	June 8	June 9	June 15
Post-Emergence Treatment	July 12	July 12	June 23	June 26
Post-Emergence Flaming	July 22	/	July 13	/
Late Season Weed Clipping	July 28	July 28	July 28	July 28
Plant Counts	July 29	July 29	June 28	June 28
Harvest	October 5	October 5	October 4	October 6

Plots were harvested at maturity (Table 2). The Glenlea trials were harvested using a Wintersteiger plot combine. The Carman trials were harvested with a Kincaid 8XP Massey Ferguson combine. Samples were cleaned using an air blower followed by shaking through a sieve. Clean weights were measured, and yield was calculated based on area harvested. Dockage was calculated as the percentage of weed seeds and pod material cleaned out of the samples.

Results

Table 3: Plant counts, weed control rating, yield (kg/ha) and dockage (%) of all treatments in the Carman row-cropped weed control trial.

Treatment	Plant Count[1]	Weed Control Rating[2]	Yield (kg/ha)	Dockage (%)
1 - Control	48[z]	7.5	2304ab[y]	5.5[z]
2 - Pre-emergence lely	51	4	2482a	4.2
3 - Pre and post-emergence lely	53	1.75	2574a	3.0
4 - Post-emergence lely	48	5.5	2705a	3.6
5 - Pre-emergence flame	57	4.25	2711a	3.0
6 - Pre and post-emergence flame	55	3.5	1788bc	3.1
7 - Post-emergence flame	49	7	1698c	5.3
8 - Pre-emergence rotary hoe	49	4.25	2543a	4.7
9 - Pre and post-emergence rotary hoe	49	6.25	2380a	3.6
10 - Post-emergence rotary hoe	53	5.75	2609a	4.7
11 - Late season weed clipping	52	5.75	2383a	4.1

[1]Total number of soybean plants in four meters of row. Counts done prior to post-emergence flaming.
[2]Visual rating to quantify weed cover. Scale of 1 to 9, 1 is the least amount of weeds/plot, 9 is the most amount of weeds/plot.
[y]Means followed by the same letter within a column are not significantly different (P>0.05) according the Fisher's protected LSD.
[z]Means are not significantly different (P>0.05) according the Fisher's protected LSD.

Table 4: Plant counts, weed control rating, yield (kg/ha) and dockage (%) of all treatments in the Glenlea row-cropped weed control trial.

Treatment	Plant Count[1]	Yield (kg/ha)	Dockage (%)
1 - Control	60ab[y]	2038ab[y]	1.6[z]
2 - Pre-emergence lely	60ab	1930abc	1.8
3 - Pre and post-emergence lely	58 ab	1953abc	1.3
4 - Post-emergence lely	63ab	1833abc	1.5
5 - Pre-emergence flame	70a	2200a	1.8
6 - Pre and post-emergence flame	29c	602d	3.8
7 - Post-emergence flame	54bc	994d	1.6
8 - Pre-emergence rotary hoe	61ab	1932bc	1.5
9 - Pre and post-emergence rotary hoe	58	1984abc	1.8
10 - Post-emergence rotary hoe	50bc	1543c	1.8
11 - Late season weed clipping	70a	2356a	1.4

[1]Total number of soybean plants in four meters of row. Counts done after post-emergence flaming.
[y]Means followed by the same letter within a column are not significantly different (P>0.05) according the Fisher's protected LSD.
[z]Means are not significantly different (P>0.05) according the Fisher's protected LSD.

Table 5: Plant counts, weed control rating, yield (kg/ha) and dockage (%) of all treatments in the Carman solid-seeded weed control trial.

Treatment	Total Count[1]	Weed Control Rating	Yield (kg/ha)	Dockage(%)
1 - Control	20[z]	7.75	1406[z]	19[z]
2 - Pre-emergence lely	20	3	1892	10
3 - Pre and post-emergence lely	17	2.5	1895	9
4 - Post-emergence lely	19	4.75	1553	17
5 - Pre-emergence flame	19	3.25	1908	9
6 - Pre and post-emergence flame	21	4	1758	13
7 - Post-emergence flame	21	6.25	1684	18
8 - Pre-emergence rotary hoe	18	4	1825	14
9 - Pre and post-emergence rotary hoe	19	5.5	1513	14
10 - Post-emergence rotary hoe	19	6.5	1417	21
11 - Late season weed clipping	16	6.75	1619	17

[1]Total number of soybean plants in half of a square meter. Counts done prior to post-emergence flaming.
[2]Visual rating to quantify weed cover. Scale of 1 to 9, 1 is the least amount of weeds/plot, 9 is the most amount of weeds/plot.
[y]Means followed by the same letter within a column are not significantly different (P>0.05) according the Fisher's protected LSD.
[z]Means are not significantly different (P>0.05) according the Fisher's protected LSD.

Table 6: Plant counts (4 m of row), weed control rating, yield (kg/ha) and dockage (%) of all treatments in the Glenlea solid-seeded weed control trial.

Treatment	Plant Count[1]	Weed Cover Rating[2]	Yield (kg/ha)	Dockage
1 - Control	30[z]	5.5	1813bcd[y]	1.9[z]
2 - Pre-emergence lely	29	7	1544de	1.6
3 - Pre and post-emergence lely	32	6.25	1920bc	1.8
4 - Post-emergence lely	28	5.75	2053ab	1.6
5 - Pre-emergence flame	27	6.25	1668cde	2.1
6 - Pre and post-emergence flame	26	4.75	1831bc	1.6
7 - Post-emergence flame	31	5	1897bc	1.7
8 - Pre-emergence rotary hoe	31	7.5	1531e	1.8
9 - Pre and post-emergence rotary hoe	29	7.75	1874bc	1.8
10 - Post-emergence rotary hoe	30	6	2221a	1.7
11 - Late season weed clipping	31	5.75	1804bcd	1.8

[1]Total number of soybean plants in half of a square meter. Counts done after post-emergence flaming.
[2]Visual rating to quantify weed cover. Scale of 1 to 9, 1 is the least amount of weeds/plot, 9 is the most amount of weeds/plot.
[y]Means followed by the same letter within a column are not significantly different (P>0.05) according the Fisher's protected LSD.
[z]Means are not significantly different (P>0.05) according the Fisher's protected LSD.

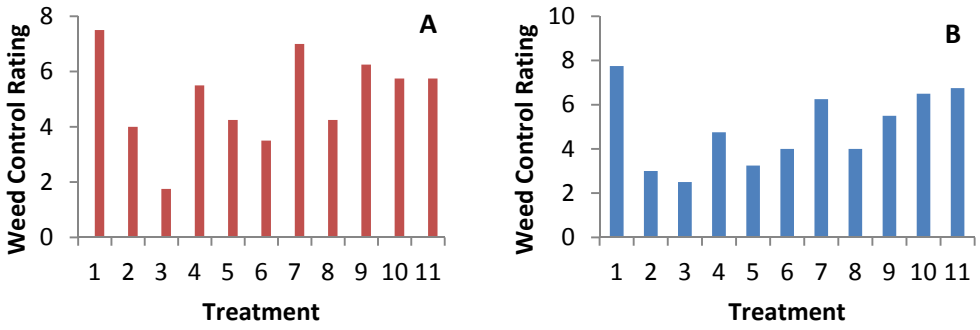

Figure 1: Average visual weed control ratings for all treatments in the Carman row-cropped (A) and Carman solid-seeded (B) weed control trial. Ratings are based on a scale of 1 to 9, where 1 represents the least amount of weeds/plot and 9 the most amount of weeds/plot.

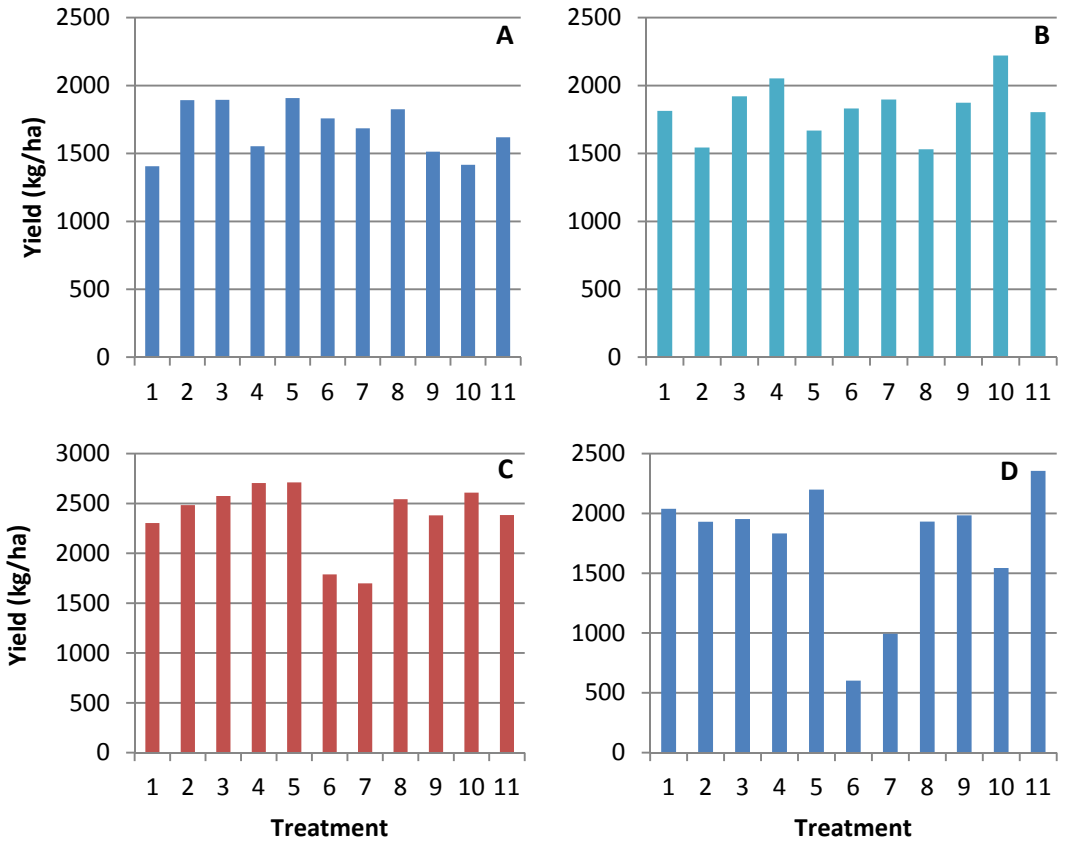

Figure 2: Average yield (kg/ha) of treatments in Carman solid-seeded (A), Glenlea solid-seeded (B), Carman row-cropped (C) and Glenlea row-cropped (D) weed control trials.

Conclusions

- With the exception of the post-emergence rotary hoe treatment in the Glenlea row-cropped trial (Table 4), plant stands were not reduced with pre or post-emergence mechanical weed control.
- Visual differences in weed cover were more noticeable in the Carman experiments where there were higher weed densities compared to the experiments at Glenlea (Figure 1). Visually, mechanical weed control and pre-emergence flaming reduced weed cover compared to control and post-emergence only treatments. This suggests that pre-emergence weed management was important.
- Significant yield differences were found in the Carman row-cropped trial and in the Glenlea row-cropped and solid-seeded trials (Tables 3-6 and Figure 2). Post-emergence flaming resulted in decreased yield the row-cropped trials (Figure 2c and 2d). Poor performance of post-emergence flaming in this research was the result of poor flamer adjustment, based on our lack of experience with the flaming process.
- There were no significant differences in percentage of dockage between treatments.
- One of the best treatments for weed control in organic soybeans was where the lely harrow was used both pre-emergence and post-emergence.

- Organic soybeans yielded an average 28.3 bu/acre under solid seeded conditions compared with 34.3 bu/acre under row cropped conditions (average across both locations). Therefore, we conclude that row-cropped organic soybeans have a higher yield potential than solid seeded organic soybeans.
- While the crop rotation effect was not tested here, it is clear that growing organic soybeans on land that has reduced weed infestation improves the outcome for organic soybean production.
- The average soybean yield across all experiments was 29.8 bu/acre. This is similar to the organic yields of soybean achieved at Carman for the period 2005 to 2012 (29 bu/acre). At the current price for organic feed soybeans ($26.00/bu), the total revenue from organic soybeans would be $774.00.

Recommendations

- Organic soybeans should be row cropped unless the weed pressure is very low
- Harrowing the soybeans twice, once pre-emergence (at the early hook stage) and once at the 1st to 2nd trifoliate leaf resulted in the best weed control and highest yield potential.

NAVY BEANS

Methods

The research was conducted at the Organic Field Crops Laboratory on the Ian N. Morrison Research Farm in Carman, Manitoba. The Organic Field Crops Laboratory in Carman has been under organic management since 2002. The experimental design was a randomized complete block with four replicates. Eleven treatments were used to represent a variety of weed management techniques and timing of those techniques. Plot dimensions were 1.83 x 6 meters.

Plots were seeded using a disk drill to the variety Envoy at a row spacing of 45 cm. A seeding rate of 420,000 plants/ha was used. Plots were seeded on June 7 and re-seeded on June 30 due to excessive moisture. Replicate 1 was not reseeded, but kept for a weed control demonstration. The treatments used in this experiment (Table 7) were adjusted due to excess moisture and the resulting inability to perform pre-emergence weed control. Row crop cultivation was performed between the rows of the row-cropped trials as necessary throughout the growing season. See Table 8 for a schedule of field operations.

Table 7: Treatments and timing of weed control operations. The numbers indicate the number of passes performed during mechanical weed control.

Treatment	Weed Control	Post-Emergence	2nd Post-Emergence
1	Control		
2	Lely	1	
3	Lely	2	
4	Lely	2	2
5	Lely		2
6	Flame		x
7	Rotary Hoe	1	
8	Rotary Hoe	2	
9	Rotary Hoe	2	2
10	Rotary Hoe		2
11	Weed Clipping		x

Table 8: Schedule of field operations.

Operation	
Seeding	June 7
Pre-Emergence Treatment	June 15
Re-seeding	June 30
Post-Emergence Treatment	July 13
2nd Post-Emergence Treatment	July 20
Post-Emergence Flaming	July 28
Late Season Weed Clipping	July 28
Plant Counts	July 22
Harvest	October 6

Plots were harvested at maturity (Table 8) with a Kincaid 8XP Massey Ferguson combine. Replicate 4 was harvested, but harvested samples were not included in the analysis due to unevenness in the plots caused by excessive moisture. Samples were cleaned using an air blower followed by shaking through a sieve. Clean weights were measured, and yield was calculated based on area harvested. Dockage was calculated as the percentage of weed seeds and pod material cleaned out of the samples.

Results

Table 9: Plant counts, weed control rating, yield and dockage of all treatments in replicate 2 and 3 of navy bean weed control trial.

Treatment	Plant Count[1]	Weed Control[2]	Yield (kg/ha)	Dockage (%)
1- control	38	6	1481	20
2 - post-emerg Lely x1	52	5	1455	25
3 - post-emerg Lely x2	46	3	1544	13
4 - post-emerg Lely x2 then x2	38	3	1345	12
5 - post-emerg Lely x2 later	43	6	1024	31
6 - post-emerg flame	43	5	1301	15
7 - post-emerg rotary x1	52	6	1539	22
8 - post-emerg rotary x2	46	6	1762	14
9 - post emerg rotary x2 then x2	52	5	1403	19
10 - rotary hoe x2 later	50	3	1549	17
11 - late season weed clipping	38	7	1579	27

[1]Total number of soybean plants in four meters of row. Counts done prior to post-emergence flaming.
[2]Visual rating to quantify weed cover. Scale of 1 to 9, 1 is the least amount of weeds/plot, 9 is the most amount of weeds/plot.

Conclusions

- Due to weather conditions results were only obtained from replicates two and three, and therefore should only be considered as preliminary results for the first year of the study
- Statistical analysis was not performed due to a lack of replicates
- The rotary hoe appeared to be less damaging to bean stands than the lely harrow.
- The highest yield occurred where the beans were rotatory hoed twice post-emergence.

Experiment 2. Effect of late-season weed topping in bean production

A late-season weed topping treatment was included in all early-season weed control experiments. Late-season weed topping was conducted throughout the growing season when weed height exceeded the height of the soybeans or navy beans. See experiment 1 for results on the weed topping treatment.

Conclusions Weed topping with a swather was effective at increasing soybean yield and reducing weed seed return to the soil.

Experiment 3: Cover crops for weed suppression in organic bean production

Methods

Cover crop experiments were conducted at the Ian N. Morrison research farm at Carman in 2009-2010, with separate trials for soybeans and navy beans. Experiments were laid out in a split-plot design with four replications, with cover crop as the main plot and cover crop termination approach as the subplot. For each trial, five different cover crops (fall rye, winter wheat, oats, barley, oilseed radish) and a control treatment were established in fall 2009. High densities of volunteer spring wheat in fall 2009 and spring 2010 masked the effect of the oat, barley and oilseed radish cover crops; thus these treatments were abandoned. A summary of major field operations for the two trials is displayed in Table 1.

Soybean Trial

In mid-May 2010, fall rye, winter wheat and control plots in the soybean trial were split into two cover crop termination treatments (till and no-till). In the "till" treatment, cover crops and weeds were soil incorporated with a rotovator prior to seeding; in the "no-till" treatment, soybeans and navy beans were direct-seeded into the standing cover crop. The fall rye and winter wheat cover crops in the no-till treatment were terminated by mowing above the growing soybeans in mid-June. In the no-till control plot, weeds were flamed when soybeans were just beginning to emerge. Measurements in this trial included soil moisture at soybean seeding, cover crop biomass at pulse seeding, weed ratings (scale of 1 to 5), crop yield (harvested with a plot combine) and post-harvest soil surface residue.

Navy Bean Trial

The navy bean trial was established following the same methods as the soybean trial; however, this trial drowned out in late May. The entire trial was rotovated and three replicates were reseeded in late June to assess any lingering effect of the cover crops after incorporation. Measurements in this trial included soil moisture at initial navy bean seeding, weed ratings (scale of 1 to 5), crop and weed biomass, and crop yield. Yield samples were cut by hand and later threshed.

Table 1. Summary of field operations for soybean and navy bean cover crop trials

Date	Soybean Trial	Navy Bean Trial
Sept. 14, 2009	Seeded cover crops	Seeded cover crops
May 26, 2010	Rotovated "tilled" treatments	Rotovated "tilled" treatments
	Seeded soybeans	Seeded navy beans
May 27, 2010	Measured soil moisture	Measured soil moisture
June 7, 2010	Flamed no-till control plots	Flamed no-till control plots
June 16, 2010	Mowed fall rye and winter wheat in no-till plots	Mowed fall rye and winter wheat in no-till plots
June 24, 2010		Tilled all plots and reseeded 3 replicates
Sept. 28, 2010		Hand harvested navy beans
Oct. 4, 2010	Harvested soybeans with plot combine	
Oct. 13, 2010	Collected soil surface residue samples	

Results

Soil Moisture

Soil moisture use by a cover crop can affect the performance of a pulse crop when soil moisture becomes limiting; therefore, available soil moisture at time of pulse seeding (May 26) was measured.

Soil moisture content was significantly lower in plots containing a winter cereal cover crop than in the control in the navy bean trial (Fig. 1). The same trend was observed in the soybean trial but was not statistically significant (Fig. 1). Less available soil water can be helpful in pulse production, especially dry edible beans which are very sensitive to excess soil water.

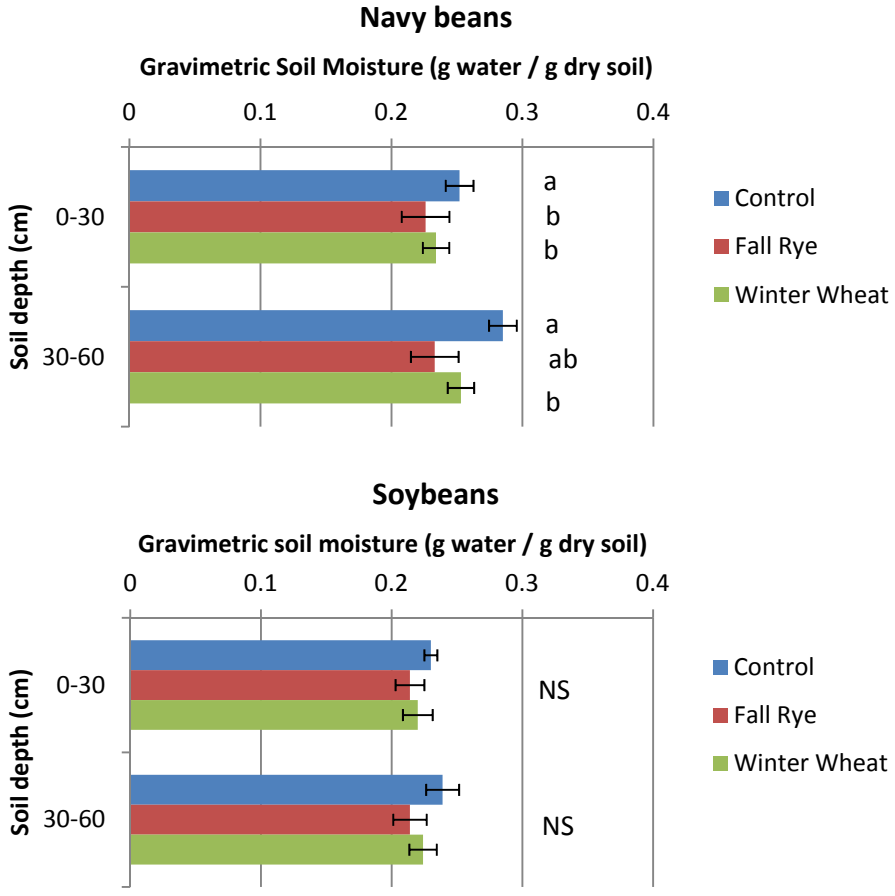

Figure 1. Gravimetric soil moisture content in navy bean and soybean trials as affected by the presence of a fall rye or winter wheat cover crop, May 26. Error bars represent ± the standard error of the mean. Bars followed by the same lower case letter are not significantly different according to Fisher's Protected LSD test (p>0.05). NS = not significant.

Cover Crop – Weed Dynamics

Ratings on the presence of weeds and the growing cover crop were conducted in August to assess the level of weed suppression by the cover crop and the success of the cover crop termination.

In both the soybean and navy bean trials, weed ratings were lower in plots where the cover crop was terminated by mowing above the growing pulse crop (no-till), indicating that the cover crop provided some weed suppression (Fig. 2). Fall rye and winter wheat appeared to provide more weed suppression than the control. It is interesting that these effects were still observed in August in the navy bean trial, even though all treatments in this trial had been tilled prior to reseeding in June.

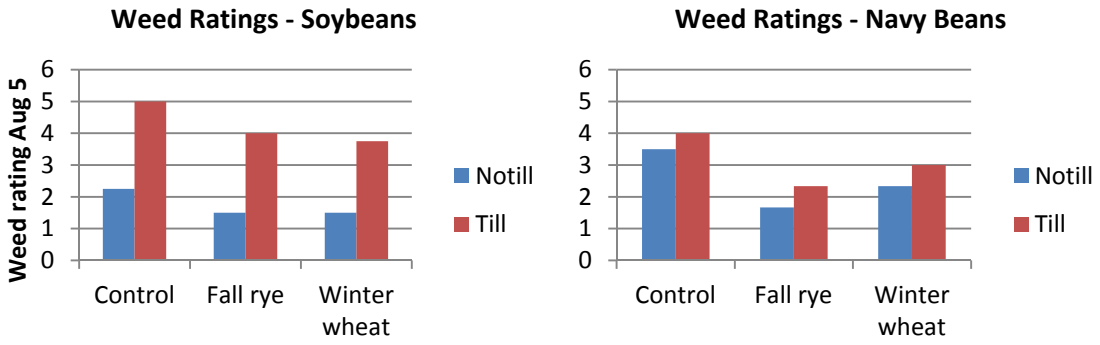

Figure 2. Visual ratings for the presence of weeds in soybean and navy bean trials in August 2010. Ratings were on a scale of 1 to 5, where 1 was the least amount of weeds and 5 was the greatest amount of weeds.

Ratings on the presence of the cover crop were much higher where the cover crop was terminated by mowing (no-till) than where the cover was tilled before seeding (till) (Fig. 3), indicating that mowing did not effectively kill the cover crop. Termination by mowing was more successful for fall rye than for winter wheat, since the winter wheat had not yet flowered at time of mowing and thus continued to grow. High cover crop ratings in the no-till control treatment were due to volunteer wheat.

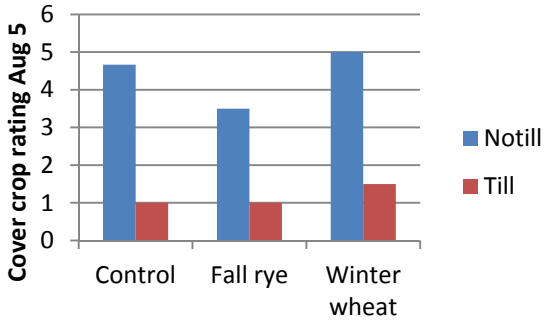

Figure 3. Visual ratings for the continued growth of the cover crop in soybeans in August 2010. Ratings were on a scale of 1 to 5, where 1 was the least amount of cover crop and 5 was the greatest amount of cover crop.

Crop Yield

Soybean yield was affected significantly by an interaction between cover crop species (control, fall rye, winter wheat) and cover crop termination (till, no-till) (Fig. 4). Where fall rye was the cover crop, termination approach did not affect crop yield, while in winter wheat, yield was much lower in the no-till treatment than the tilled treatment. Again, this was due to poor termination of the winter wheat cover crop as discussed above. Navy bean yield was not affected by cover crop or by termination approach.

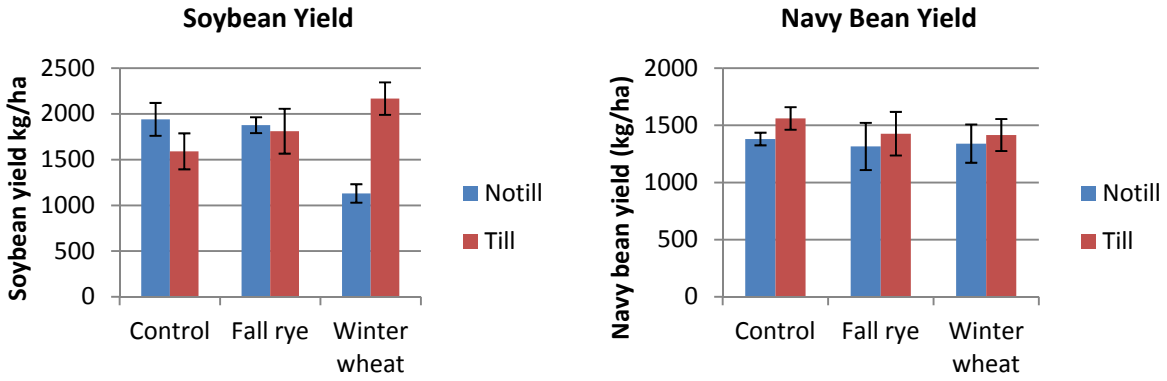

Figure 4. Soybean and navy bean yield as affected by cover crop type and termination approach. Error bars represent ± the standard error of the mean.

Soil Surface Residue

One of the benefits attributed to cover crops is physical protection from soil erosion. Therefore, post-harvest soil surface residue was measured in the soybean trial to determine whether the cover crop effect was present at the end of the growing season.

The presence of a cover crop significantly increased soil surface residue compared to the control, but only in the no-till treatments, where the cover crop was terminated by mowing above the growing beans.

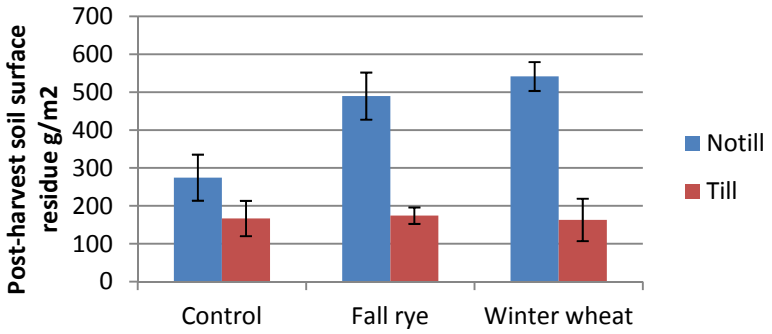

Figure 5. Soil surface residue measured after soybean harvest. Error bars represent ± the standard error of the mean.

Conclusions

- A winter cereal cover crop reduced soil moisture content prior to seeding pulse crops. In years when moisture becomes limiting, this moisture depletion may affect pulse yield. In years of excess moisture, this moisture depleting feature of cover crops may help pulses, especially for edible beans.
- Winter cereal cover crops suppressed weeds when they were allowed to continue to grow after bean seeding.
- Mowing did not provide complete termination of the winter cereal cover crops, especially winter wheat, which was mowed prior to flowering. Fall rye was successfully controlled by mowing.
- Soybean and navy bean yields were not affected by cover crop type or termination, except in the case of a poorly terminated winter wheat cover crop, which reduced soybean yield.
- Cover crops that were terminated without tillage resulted in more soil surface residue after soybean harvest.
- Post harvest ground cover, which is important for erosion control after bean harvest, was significantly higher when the cover crop was mowed and beans direct seeded into the cover crop residue.

Experiment 4. Variety differences under organic management

A) Soybean variety trials

Methods

The research was conducted at the Glenlea Long-Term Organic Field Laboratory in Glenlea, Manitoba and at the Organic Field Crops Laboratory on the Ian N. Morrison Research Farm in Carman, Manitoba. At the Glenlea site, this research was conducted under organic management on land that has been under organic management since the rotation was established in 1992. The Organic Field Crops Laboratory in Carman has been under organic management since 2002. Due to excess moisture the soybean variety trials at Glenlea did not establish successfully, and are therefore not included in this report. A row-cropped and solid-seeded variety trial was located in Carman. Initially, ten cultivars were included in this variety trial, but due to excess moisture the variety trial was re-seeded in Carman and a lack of available seed for all varieties reduced the amount of treatments included in the row-cropped variety trial to nine and the solid-seeded variety trial to seven.

The experimental design was a randomized complete block with four replicates. The cultivars included in this study (Table 1) were chosen due to their relevance to Manitoba Producers and because they were non-GMO types (a requirement of the organic certification system). Plot dimensions were 1.83 x 6 meters. Plots were seeded on May 26 then re-seeded June 14 using a disk drill at a rate of 470 000 plants/ha with the exception of the cultivars AC QGC10N and AC QGC12N which were seeded at a rate of 600 000 plants/ha. The row-cropped trials were planted with a row spacing of 45 cm and the solid seeded trial was planted with a row spacing of 15 cm. Row crop cultivation was performed between the rows of the row-cropped trials as necessary throughout the growing season.

Table 1: Variety, type and zone of soybeans included in this study.

Variety	Type[1]	Manitoba Variety Zones[2]
AC QGC10N	Natto	Short season
AC QGC12N	Natto	Short season
Tundra	Normal	Short season
OAC Prudence	Normal	Mid season
OAC07-03C*	Medium	Mid season
OAC06-03*	/	Mid season
AC QGC16T	High	Long season
OT05-18	High	Long season
OAC Erin	Normal	Long season

[1]Whole seed protein of normal type soybeans is around 40%, medium types around 42.5% and high protein types around 45% (Seed Manitoba 2010 and 2011).
[2]Soybean varieties are organized into 3 maturity zones, short, mid and long season areas (Seed Manitoba 2010 and 2011).
*Included in the row-cropped variety trial only.

Average plant height was measured at plant maturity. Visual weed ratings were performed for weed cover throughout the growing season. At maturity plots were harvested with a plot combine. Samples were weighed prior to cleaning to get an indication of dockage in each sample, which was mainly comprised of weed seeds. Samples were cleaned using an air blower followed by shaking

through a sieve. Clean weights were measured and yield was calculated based on area harvested. Dockage was calculated as the percentage of weed seeds and pod material cleaned out of the samples.

Results

Table 2: Average plant height, weed cover, yield and dockage for the row-cropped variety trial at Carman.

Variety	Height (cm)	Weed Cover[1]	Yield (kg/ha)	Dockage (%)
AC QGC10N	93	5.25	1906	7
AC QGC12N	84	4.75	1963	6
Tundra	92	3	2123	4
OAC Prudence	85	4.5	1788	8
OAC07-03C	87	3.75	2134	5
OAC06-03	93	3.75	1927	5
AC QGC16T	76	7.25	815	26
OT05-18	101	1.5	2516	4
OAC Erin	81	4.75	1711	10

[1]Visual rating to quantify weed cover. Scale of 1 to 9, 1 is the least amount of weeds/plot, 9 is the most amount of weeds/plot.

Table 3: Average plant height, weed cover, yield and dockage for the solid-seeded variety trial at Carman.

Variety	Height (cm)	Weed Cover[1]	Yield (kg/ha)	Dockage (%)
AC QGC10N	90	9	869	21
AC QGC12N	81	8	979	20
Tundra	88	6	1479	9
OAC Prudence	92	6	1061	15
AC QGC16T	79	8	517	34
OT05-18	95	3	1820	5
OAC Erin	84	7	840	23

[1]Visual rating to quantify weed cover. Scale of 1 to 9, 1 is the least amount of weeds/plot, 9 is the most amount of weeds/plot.

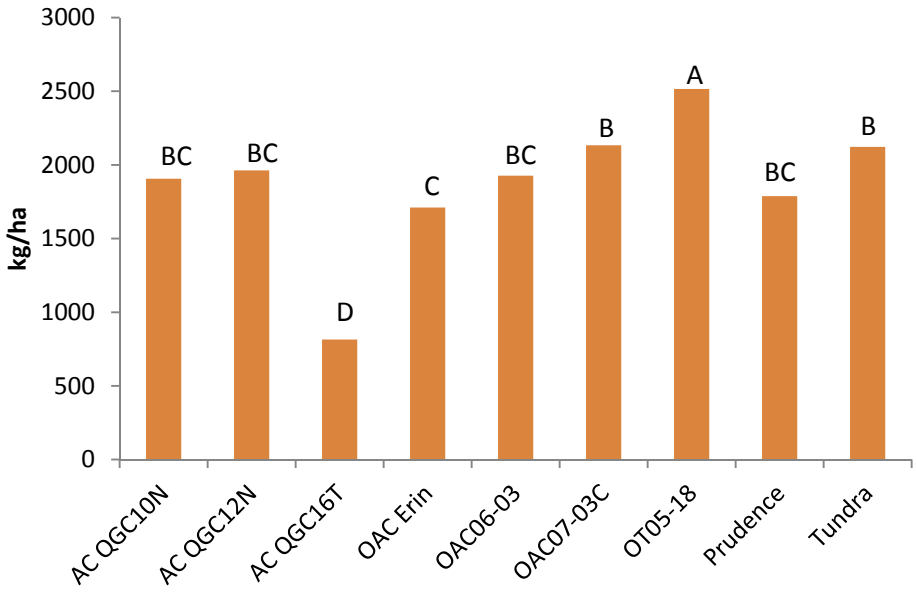

Figure 1: Yield (kg/ha) for all soybean varieties in the row-cropped variety trial. Mean bars with the same letter are not significantly different (P>0.05) according to Fisher's protected LSD.

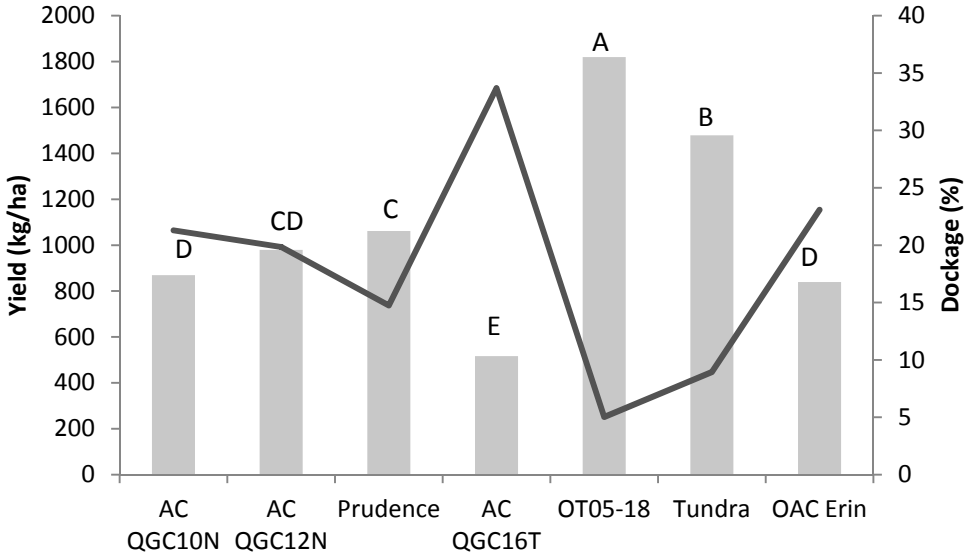

Figure 2: Yield (kg/ha) and dockage (%) for all soybean varieties in the solid-seeded variety trial. Statistical analysis letters correspond to yield. Mean bars with the same letter are not significantly different (P>0.05) according to Fisher's protected LSD.

Conclusions

- Preliminary results show that some varieties may be better suited to organic growing conditions than others

- OT05-18 yielded significantly higher than all other varieties in both the solid-seeded and row-cropped trial.
- AC QGC16T had a significantly lower yield than all other varieties in both the solid-seeded and row-cropped trial.
- These trials demonstrated that row-cropping soybeans under weeding conditions can result in greater weed control. The row-cropped and solid-seeded trials were located directly beside each other and had approximately the same level of weed growth across trials. Row-crop cultivation in the row-cropped trial resulted in decreased weed levels and greater yields. The average yield in the row-cropped trial was 1876 kg/ha, while the average solid-seeded yield was 1081 kg/ha.

B) Dry bean variety trials

Methods

The research was conducted at the Organic Field Crops Laboratory on the Ian N. Morrison Research Farm in Carman, Manitoba. The Organic Field Crops Laboratory in Carman has been under organic management since 2002. The experimental design was a randomized compete block with four replicates. The four bean types and eight cultivars originally included in this study (Table 4) were chosen in consultation with MAFRI pulse specialists in order to include representative varieties from all major bean classes. Due to wet spring conditions the bean trial was re-seeded and due to a lack of available seed the Kidney Bean variety was not able to be included in the variety trial.

Plot dimensions were 1.83 x 6 meters and the beans were seeded with a row spacing of 45 cm. Plots were seeded using a disk drill with seeding rates chosen to reflect bean growth habit and organic growing conditions (Table 4). Plots were seeded on May 26 then re-seeded on June 14. Granular inoculant was applied with the seed at a rate of 27g/plot, about twice the recommended inoculation rate. Row crop cultivation was performed as necessary throughout the growing season.

Table 4: Variety, bean type and seeding rate of all treatments included in this study.

Variety	Type	Seeding Rate (pl/ha)
Envoy	Navy	420,000
Morden 003	Navy	420,000
Cargo	Navy	420,000
Maverick	Pinto	350,000
Mariah	Pinto	350,000
Pintium	Pinto	350,000
Jet Black	Black	420,000
Pink Panther	Kidney	350,000

Average plant height was measured at plant maturity. A harvestability rating was also performed at maturity in order to get an indication of how close the pods are to the ground. At maturity plots were harvested with a Kincaid plot combine. Samples were weighed prior to cleaning to get an indication of dockage in each sample. Samples were cleaned using an air blower followed by shaking through a sieve. Clean weights were measured and yield was calculated based on area harvested. Dockage was calculated as the percentage of weed seeds and pod material cleaned out of the samples.

Results

Table 5: Average plant height, harvestability, dockage and yield of all treatments.

Variety	Type	Avg. Plant Height (cm)	Harvestability[1]	Dockage (%)	Yield (kg/ha)
Envoy	Navy	39	1.5	18	1357
Morden 003	Navy	41	2.25	10	1964
Cargo	Navy	41	1.75	17	1585
Maverick	Pinto	41	1.25	6	3013
Mariah	Pinto	46	2	7	2314
Pintium	Pinto	38	2	12	1634
Jet Black	Black	55	2.25	11	2206

[1]visual rating to quantify the distance from pods to the ground, 1= poor, 2=medium, 3=good

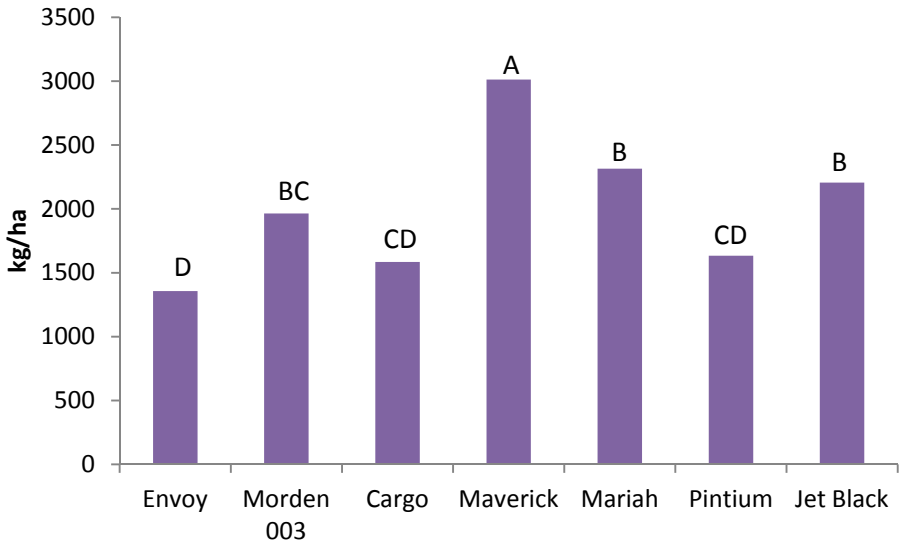

Figure 3: Yield (kg/ha) of all varieties in the dry bean variety trial. Mean bars with the same letter are not significantly different (P>0.05) according to Fisher's protected LSD.

Conclusions

- Preliminary results show that some varieties may be better suited to organic growing conditions than others.
- Of the navy bean varieties included in this study, Morden 003 yielded significantly higher than Envoy, but not greater than Cargo.
- Maverick yielded significantly greater than the other two pinto bean varieties included in this study, Mariah and Pintium.

Extension Activities

- Crop Diagnostic School, July 6-16, 2010 – 280 participants
- Organic Field Tours, July 19, 2010 – approx. 50 participants in two tours
- Organic Field Tours, July 2011 – approx.. 80 participants
- Organic Field Tour, July 2012 – approx.. 160 participants

References

Seed Manitoba. 2010. Variety selection and growers source guide. [Online] Available: http://www.seedmb.ca [Accessed January 7, 2010].
Seed Manitoba. 2011. Variety selection and growers source guide. [Online] Available: http://www.seedmb.ca [Accessed December 21, 2010].

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