Western Applied Research Corporation

2008 Summary of Research Results and Events

Compiled by Sherrilyn Phelps (Saskatchewan Ministry of Agriculture)
Sept 28, 2009

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Western Applied Research Corporation

The Western Applied Research Corporation (WARC) was incorporated in 2003 and is directed by a seven member Board of Directors. The seven directors are local producers that represent both livestock and grain producers from each of the seven Agriculture Development and Diversification (ADD) districts in NW Saskatchewan.

WARC is a producer based organization that facilitates practical field research and demonstration. It also ensures the transfer of technology from research to farm level for the benefit of producers in NW Saskatchewan and the province. In addition to the field trial analysis the economic implication for the technology is evaluated.

WARC is affiliated with Agriculture and AgriFood Canada (AAFC) at Scott. The Scott Research Farm acts as the main site for research and demonstration as well as coordination of the projects. Another location accessible to WARC through AAFC at Scott is Glaslyn. In addition to Glaslyn, there are seven other sites that are accessible through the AgriARM program: Indian Head, Redvers, Canora, Rosthern, Swift Current, Prince Albert, and Melfort.

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Dan Ulrich	Minor Use Program, AAFC Scott
Arlen Kapiniak	Technician, AAFC Scott
Larry Sproule	Technician, AAFC Scott
Lorne Nielsen	Technician, AAFC Scott
Herb Schell	Technician, AAFC Scott
Steve Dueck	Technician, AAFC Scott

Scott Research Farm

The Scott Research Farm was established in 1910 by the Federal Department of Agriculture's Experimental Farm Service. In the 1970's organizational restructuring within Agriculture and Agrifood Canada Research Branch resulted in Scott Research Farm becoming a sub-station of Saskatoon Research Centre.

The farm consists of approximately 340 hectares (840 acres) of dark brown loam soil (pH ranging from 5.0-6.5). In addition to this land base there were two Project Farms operated on leased land in North Western Saskatchewan. One located near Lashburn (Black climatic zone) and the other near Loon Lake (Grey climatic zone). These project farms were closed at the end of 2006. In 2007, a new Project Farm near Glaslyn (Grey climatic zone) was started.

In the early years, there were research programs in livestock, horticulture and field crop production. Along with specialization in the agriculture industry, Research Centres also specialized. As a result, the livestock and horticulture programs have been transferred to other AAFC Research Centres. Scott Research Farm now specializes in crop production systems**.**

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Weather Report for Scott 2008

Soil Information:
Dark Brown Chernozemic (Typic Boroll)
Association: Scott
Texture: Loam Sand: 31% Silt: 42% Clay: 27%
Organic Matter: 4%
Soil pH: 6.0

Environmental Information:

	Air Temperature						
Year	April	May	June	July	Aug.	Sept.	Oct.
2008	0.6	10.6	14.6	16.7	16.8	10.9	5.2
Long-Term Mean	3.1	10.2	14.5	17.1	16.2	10.4	3.7
	Growing Degree Days						
Year	April	May	June	July	Aug.	Sept.	Oct.
2008	21	172	288	364	364	177	64
Long-Term Mean	42	171	284	377	342	171	49
	Precipitation (mm)						
Year	April	May	June	July	Aug.	Sept.	Oct.
2008	65.6	13	87.3	85.8	20.8	10	22.4
Long-Term Mean	22.5	35.7	60.7	61.4	44.0	31.2	17

Last Spring Frost: May 13 (-0.4˚C)
First Fall Frost: September 24 (-2.0˚C)

Significant Rainfall (>10mm)

April 20	33.5	July 18	37.2
April 30	11.8	July 26	18.4
June 14	26		
June 24	16.5		
June 26	26.2		

2008 Scott Field Day Summary

Sherrilyn Phelps, Saskatchewan Ministry of Agriculture and Leo Perlinger, WARC

The 2008 Scott Field Day was held on July 16th. The day had perfect weather and a great turnout of 240 attendees.

Pulse Varieties and Agronomy – Dr. Bert Vandenberg, Crop Development Centre

Some of the positive aspects of lentil development are:

- Producers have gotten better at growing lentils due to experience and better equipment
- new varieties are more resistant to lodging
- breeders are developing varieties to cater to consumer's specific preferences
- 100 g of Lentils includes:
  - 100% of your recommended daily intake of Zinc
  - 100% of your Iron
  - and 100% of your Selenium

Red lentil production is becoming more and more popular. Lentil breeding goals include high yield, customer satisfaction, and favorable elemental constituents of the lentil. A major challenge for the lentil industry is that processors do not want to use lentils in their products because there is a 4 to 1 discount for using soybeans over lentils. Lentils just cannot compete with wheat, corn, and soybeans.

Some specific lentil varieties discussed include:

- 1899T-50 - developed to mimic the lentils in India to cater to that market
- IBC-145 (for release in 2009) -medium sized red lentil with improved colour and reduced bleaching
- CDC Rosetown - standard for reduced lodging characteristics

When discussing pea varieties Dr. Vandenberg mentioned that a unique fact about peas is that we are still gaining 2% in yield every year.

Some pea facts:

- with powdery mildew resistance producers gain 10% yield over non-resistant varieties
- standability is an issue being addressed in pea breeding
- mycosphaerella blight is also an issue that has not been solved yet, but leafless varieties seem to be better
- green varieties are becoming more resistant to bleaching
- the focus is shifting more towards pea quality, as in what the pea looks like with the skin off, such as its shape and colour
- other countries such as India are importing huge amounts of peas since they can make money producing soybeans, but they are still eating peas
- pea flower can replace the desi-chickpea
- CDC Striker sets the standard for anti-bleaching properties of green peas

Dr. Vandenberg said that pea and lentil prices cannot really increase much more because if they do we will price ourselves out of the market for lower income families in India.

There was a lentil demo that showed the effects of Sencor, Solo, and Pursuit on various lentil varieties. The Clearfield lentils were obviously not affected by the Solo and Pursuit. However, Solo caused a great deal of damage to non-resistant varieties. With Pursuit there was no visual damage to low rates but often the problem is a delay in maturity that can result in yield or quality loss. With Sencor there can be a lot of damage and great yield variation and even total stand loss depending on environmental factors.

A demonstration with rolling lentils at early flowering to simulate flattening effects of hail or plow winds demonstrated the ability of different varieties to recover. Redberry is the variety of lentils that bounces back the best if flattened, it can also stand in wet weather the best without rotting away to nothing.

Insect Update – Scott Harley, Provincial Insect Specialist

With wheat midge a dry May (<20mm rain) delays midge emergence. Emergence of the male midge occurs at approx. 700 growing degree days, then females just after. The males tend to fly lower in the canopy, females will be more among the heads and actively laying eggs. Wheat becomes resistant to midge at approximately 50% flowering (or anthesis), because during anthesis there is a buildup of ferulic acid, which causes midge resistance. The variability in crops this year, due to uneven emergence has confused many producers as to when they should spray. Since it is the primary stem and first 2 tillers that account for 90% of yield, the first priority should be to protect them. The threshold is 1 midge per 8 to 10 heads. Scout in five different representative locations in the field by counting the number of midge around 100 heads.

Phosphate Fertility in Long Term Rotations (Rotation C) – Sherrilyn Phelps, SMA
Rotation C was first started in 1912 and they first started applying P fertilizer on half the plots in the 30's. The rotation is fallow → wheat → wheat, and the same half of each field has had fertilizer applied since the 30's and the other half of each field has had no fertilizer. There was an overall average yield difference of 25% between the fertilized and non-fertilized wheat crops. Since Scott has quite acidic soils, this rotation shows a much lesser P response than a more neutral or basic soil would.

Weed Management / Prairie Carnation - Eric Johnson, AAFC Scott
Eric talked about a new crop that is still being developed, called Prairie Carnation (the former weed Cow Cockle). They are looking at chemicals for weed control in Prairie Carnation and Prairie Carnation agronomy tests are also being done (such as seeding rate). The problem weeds to control in Prairie Carnation are wild mustard and wild buckwheat. It has a better emergence rate than canola at approximately 60% whereas canola is usually only 50%. The optimum plant density is 14 plants per square foot (or 12-15 lb/acre). Yields of Prairie Carnation can vary from 2500 lb/acre without fungicide to 3200 lb/acre with fungicide. Prairie Carnation does not shatter and it is easy to harvest.

Kixor (BAS 800) is a new herbicide still in its developmental stages. It can be used as a pre-seed/pre-emerge burnoff or a chem.-fallow herbicide. It is to be tank mixed with glyphosate. It gives a fast burn down with good control of roundup ready canola and wild mustard. It can be used as a pre-seed burnoff prior to cereals, peas, and lentils somewhat.

Nozzle Choices - Tom Wolf
Tom Wolf discussed new nozzle choices, calibration, and biobeds. A great nozzle is the low pressure – air induced nozzle for reduced drift and good coverage. There are 4 brands: hi-pro ultra low drift, T-jet AIXR, Air bubble jet, and Green Leaf air induction. Dr. Wolf also spoke about the new flow control nozzles to help maintain a constant droplet size as the sprayer speeds up and slows down and pressure increases and decreases. It has a spring loaded, variable sized orifice, and the only issue is that these nozzles are very pressure sensitive.
The tool for calibrating your sprayer that Tom showed was the Wilger quick calibrator, which does all the work for you. Tom also touched on biobeds, which are a mix of 1 part compost, 1 part soil, and 2 parts straw. They are for emptying out and rinsing your sprayer. It houses microbes that break down chemicals. The organic matter holds water and strips pesticides off.

Varieties for Ethanol – Dr. Curtis Pozniak
Dr. Curtis Pozniak, wheat breeder from the Crop Development Centre, has been instrumental in this project and has been responsible for the quality analysis for protein and starch as well as putting the yield data together. The project looks at measuring yield, maturity, resistance, starch content, and pentosans in all of the different varieties. The data collected to date has been used for variety recommendations and was included in the Saskatchewan Variety of Grain Crops for 2008.

The project focuses on cereal crops and varieties that have potential for supplying feedstock for the ethanol industry. For 2008 triticale, soft white wheat, Canada prairie spring wheat, and some new wheat lines will be evaluated for grain yield, protein and starch content and suitability for growing in various areas of Canada. The data from 2007 demonstrated that triticale can be very high yielding and has quite large kernels. The technology for processing triticale into ethanol is limiting right now but may be something to watch for in the future. In terms of wheat, soft white wheat was the highest yielding in 2007 with AC Andrew, Bhishaj and AC Sadash being quite comparable in terms of yield. Bhishaj has higher starch and lower protein than AC Andrew. One of the concerns with the soft white wheat is the later maturity compared to the standard hard red variety of AC Barrie.

Oilseeds for Biofuel Production
Kevin Falk spoke on different oilseeds that have potential for use in biofuel production. Brassica Carinata (or Ethiopian Mustard) is drought tolerant and similar to mustard. It's oil would be for use as only an industrial oil. The main by-product of oil production is the meal. *B. Carinata* meal with glucosinolates can be used as a bio-fumigant, and without glucosinolates can be used as a feed for in fish farming.

Another oilseed with potential for biofuel production is Camelina. The main challenge with Camelina is how extremely small the seed is. It is high in Omega-3 fatty acids, which would normally make it go rancid but it is also high in tocopherols which keep it stable.

The Canola-Barley Input Study – Sherrilyn Phelps, SMA

The canola-barley input study was designed to investigate the economic impact of individual inputs such as seeding rates, genetics, fertilizer, and herbicide. Two types of input packages were evaluated. The first involved a full input package, which consisted of the best genetics available, recommended fertilizer rates, appropriate herbicide application, and full seeding rate. The second type of input package was the empty input package which had older variety, no fertilizer, no herbicide, and lower seeding rate. There were also treatments that ranged between the two extremes. With canola, the full input package brought a $270/acre greater return than the empty input package. With barley the full input package brought a $150/acre greater return over the empty input package. These returns are after input costs. When looking at individual inputs the greatest results were with fertilizer and herbicides. Weed control was very important with both barley and canola as no weed control leads to increased weed populations in future years and dramatic reductions to the bottom line. Fertilizer was also important, particularly in the full input systems where other factors were not limiting. One input that was surprising was genetics. With canola, using higher yielding genetics (ie., hybrids) produced higher returns even after the additional seed costs. With barley, the yield potential between varieties is not as great so genetics does not play as big a role. The study showed that even with today's high chemical, seed, and fertilizer prices, these inputs are very worth while and important for maximizing profits.

Malt Barley Agronomics – Kelly Turkington AAFC Lacombe and Mark McLean

The malt barley study investigated nutrient balancing to increase the likelihood of barley to go malting. The critical thing with targeting malt is not to over fertilize with nitrogen. Not only does nitrogen increase yield, it increases protein often above the 12% range which is too high for brewers. Excess nitrogen can also have negative effects on other characteristics of the seed that affect the malting process. There can be a reduction in kernel homogeneity and an increase in betaglucan levels, which make the starch in the kernel less available and brewers get less beer produced. Dr. Turkington is just finishing a set of recommendations of how to finish malt barley, and it should be coming out this winter. In terms of disease, net blotch can affect barley. Fungicides suppress the disease but in dry climates there is not a big effect of fungicides on yields of barley in terms of net blotch. As net blotch is stubble borne the best solutions are rotation and variety selection. Fungicides can be used where necessary under heavy disease pressure.

New Crops Demonstration – Sherrilyn Phelps, SMA

We grew a number of new and specialty crops that may have potential for production in Saskatchewan. These include prairie carnation, camelina, calendula, Brassica carinata, fibre flax, heritage wheats (red fife, spelt, marquis) and various pulses.

Canola Agronomy – Doug Moisey, Canola Council of Canada.

Seeding speed can be a big factor in poor canola emergence and uneven plant stands. There is much better stand uniformity when a steady speed of between 4.5 to 5.5 mph in most cases. High fan speed can also damage the small seeds and reduce germination. Even plant stands not only make it easier for harvest but can help combat other stresses during the growing season. Club root is something to watch for in canola and rotation and sanitation are the only ways to prevent it. Make sure equipment and vehicles moving from AB are thoroughly cleaned prior to moving onto fields on your farm.

Soil Amendments – Dr. Diane Knight, University of Saskatachewan

Soil in Scott has high level of acidity (low pH) which makes the inherent soil phosphorus more available for uptake. This makes it often harder to see responses to added phosphate in trials at Scott. P is not a travelling nutrient as it does not move well within the soil. In this demo various products are being evaluated for use a P replacement strategies. Such products as rock P, wood ash, compost, alfalfa pellets, Jumpstart and Myke Pro are under evaluation for their P supplying capabilities in reponse to the high P fertilizer costs and the limitations for P sources under organic systems. The products are being evaluated at Melfort in 2008 and reports should be available next year. It is known that animal waste, such as manure, is a very good source of phosphorous.

The Scott Field Day was made possible by the support of our sponsors. A big Thanks to:

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Organic Field Day Summary

Sherrilyn Phelps, Saskatchewan Ministry of Agriculture
Leo Perlinger, Western Applied Research Corporation
Eric Johnson, Agriculture and AgriFood Canada

The 2008 Organic Field Day at Scott was held on July 24th. It was another perfect day with approximately 180 people attending. The day began at 10 a.m., lunch was a little late at about 12:30 and the afternoon tours went until 5 p.m.

Insect Update – Dr. Owen Olfert, AAFC Saskatoon

The day began with an insect update by Owen Olfert, with AAFC out of Saskatoon. There was a definite focus on wheat midge. The best solution for wheat midge damage in organic cropping systems is the development of midge resistant wheat varieties. Increasing the seeding rate to reduce the number of tillers can also help decrease midge damage because it will allow the crop to mature more evenly and earlier, which may give it a chance to beat the midge. The natural enemy of wheat midge, a parasitic wasp, can provide 30-40% control of midge, but its benefits are not shown until the year after the beneficial parasite shows up. The beneficial parasite also may not show up until the midge has already been present for a year or two. This is why conventional producers feel the need to apply chemicals. It is important to time the chemical application as to actually get the midge and eggs while they are susceptible. The chemical should not be applied too late because it will just harm the beneficial parasite population, thus allowing the midge population to increase the following year.

System Study – Seeding Rate, Row Spacing, Harrowing in Lentil and Pea Varieties

Steve Shirtliffe, University of Saskatchewan
There is an impact of seeding rates and row spacings on crop yield and weed suppression. Increasing the seeding rate resulted in better weed suppression with peas and lentils in all cases. Narrower row spacings also increased the competitiveness of the crop. Harrowing really reduced the growth of wild mustard. In peas, the more competitive varieties such as Eclipse had fewer weeds than the less competitive varieties such as Carrera. The effect of harrowing is not shown as much in more competitive varieties and higher seeding rates.

Prairie Carnation – Eric Johnson, AAFC Scott
A new crop is under development and it is called Prairie Carnation (the former weed Cow Cockle). There is interest in it for a number of reasons, including for the extraction of the saporins in the seed and for the cosmetic industry. A company called Sapornin, out of Saskatoon will be contracting acres of prairie carnation.

Agronomy of the crop is under evaluation including seeding rates, fertility, weed control, disease control, and harvest management. Prairie Carnation has a better emergence rate than canola at approximately 60% whereas canola is usually only 50%. The optimum plant density is 14 plants per square foot (or 12-15 lb/acre). This crop is appealing for production under organic systems as chemical weed control for broadleaves is very limited. The problem weeds to control in Prairie Carnation are wild mustard and wild buckwheat. The best manangement strategy is clean fields by using summerfallow or chemfallow prior to seeding Prairie Carnation. In terms of diseases, Praire Carnation is susceptible to the disease *alternaria*. Fungicide trials have shown yields from 2500 lb/acre without fungicide to 3200 lb/acre with fungicide. For harvest management, Prairie Carnation does not shatter and it is easy to harvest by either straightcutting or swathing.

Rotation "C" (Long Term Rotations) – Sherrilyn Phelps, SMA
Rotation C was originally started in 1912, but it was in the 1930's that they started to fertilize with phosphate fertilizer. The rotation includes fallow → wheat → wheat. They applied 15 lbs of P_2O_5 on half of each of the wheat fields from 1930 to 1993. From 1993 to present they have been applying P at a rate of 25 to 30 lbs/acre. In 1994 they started adding N to the wheat on stubble phase (only on the side that had always been getting P) at a rate based on the soil tests for a 30 bushel per acre target yield. As a result the wheat on stubble (receiving N and P) now yields similarly to the unfertilized fallow wheat.

The yield difference between the fertilized and unfertilized wheat seeded on fallow has been between 25 and 30%. In the last five years the average yield has been 30 bu/acre on the unfertilized side and 33 bu/acre on the fertilized wheat seeded on fallow. With $8 wheat this three bushel difference provides an increase of $24.00 revenue/acre, but with P2O5 applied at 30 lbs/acre x $1.05/lb for fertilizer = $31.50 cost/acre. Therefore $31.50 - $24.00 = a cost of $7.50/acre to fertilize in the past five years. The overall average increase in yield with fertilizing over not fertilizing since the 1930's was 6 bu/acre (6bu/acre x $8/bu = $48/acre). 48 is greater than 31.50, therefore in the long run it pays to fertilize. At current prices, 4 bu/acre yield advantage is required to pay for the fertilizer. Using current prices we evaluated the yields and breakeven scenarios over the past 18 years (since 1990). Out of 18 years of the trial at Scott, the addition of P fertilizer to fallow wheat broke even in 4 years. In 7 of the years a 2:1 return was made (>8bu advantage), with some as high as 22 bu/acre. 1 year there was no difference in yield, 3 years where there was only a small yield advantage of 1-2 bu/acre, and 3 years where there was no harvest due to hail. It is important to note that the Scott Research Farm has a very acidic soil (pH ~ 6) which means that the soil has much more ability to make the P available to the plants without any P supplementation. Results would, therefore, likely be much more substantial at a more neutral or basic site.

Winter Wheat Varieties / Agronomics – Gary Kruger, Western Ag Labs
The major purpose of this study was to show the resilience of the winter wheat varieties. This trial looked very poor in the fall and the spring. Emergence was very low in the fall as conditions were dry. It was debated whether to keep the trial and the decision to see what happens during

the year was made. There was no weed control but it was top dressed with 50 lbs N early spring. There were varietal differences in terms of height. As winter wheat has the ability to take advantage of early season moisture to get a jump on the weeds, the fact that no weed control was done was only evident between the plots. It is well known that one advantage of winter wheat is its competiteves with weeds. It has been suggested that fall cereals compete quite well and help control perennial weeds such as Canada Thistle. Even though the plot emergence was less than desired the crop stand in July was quite acceptable. The varieties will be harvested and reseeded this fall.

Hemp – N and P Response– Sherrilyn Phelps, SMA

The hemp N and P study was developed to understand the fertility requirements of hemp. Hemp is very responsive to N, and is similar to canola in response. The optimum levels of N required to set maximum yield were at least 100 lb/acre. Responses up to 200 lbs/acre have been noted. An interesting fact with hemp is that it is daylength sensitive. This means that no matter when it is seeded, the shortening of the days around June 21st signals the crop to initiate flowering. This means that the earlier the crop is seeded the taller the plants get because growth continues until the daylengths begin to shorten.

Soil Amendments and Phosphate Fertility – Diane Knight, U of S

The Soil Amendments Demo at Scott, which is also being conducted as a trial in other locations, was designed to examine the efficacy of a variety of natural phosphate sources for use in organic cropping systems. The soil amendments include compost, alfalfa pellets, wood ash, rock phosphate, Jumpstart (*Penicillium biliae*), and Myke Pro. They were compared to a check which had 20 kg/ha of P applied using Triple Super Phosphate. There was no significant difference apparent between any of the various treatments here at the Scott location. Other locations showed some visual differences, with the best results coming from the treatment with both rock phosphate and Jumpstart. This makes sense because the rock phosphate would provide a phosphate source while the Jumpstart would make it available for plant uptake. The demo at Scott did not show results likely due to the acidic soils present here, which have the ability to make the phosphate that is in the soil much more readily available to the plant.

Alternative Cropping Systems Study - Robert Zentner, Owen Olfert, and Julia Leeson, AAFC Swift Current and Saskatoon

The Alternative Cropping Systems Study (or ACS) is a long term study being conducted here at the Scott Research Farm that involves numerous scientists and technicians from across the province. The areas of research being conducted in the Alternative Cropping Systems study that were discussed at the organic field day last week included the economics of organic crop production, insects and arthropods, and weeds. This study includes conventional agronomic practices with both high and low input levels and organic production systems. Robert Zentner gave an in-depth presentation on the economics of organic crop production as compared to conventional systems. On average it has been shown that organic production results in a 20 to 33% yield reduction when compared to conventional production for almost all crops except alfalfa. Financially though, the premium price received for organic crops and the reduced input costs more than compensate for the reduced yields of organic crops.

Owen Olfert, with AAFC out of Saskatoon, discussed insects and arthropods in the ACS study. He noted that soil fauna such as mites and ground beetles can be used to indicate soil health. I found it interesting that the reduced input system showed the highest levels of soil fauna, followed by organic and then high inputs. This is most likely due to the increased amount of soil disturbance in organic systems and the high input systems.

Julia Leeson, also with AAFC out of Saskatoon, talked about the weed populations in the organic treatments. She pointed out that in general weed populations are not out of control, but large fluctuations from year to year are common depending on environmental conditions.

Mechanical Weed Control – Rotary hoe – Eric Johnson, AAFC Scott

The rotary hoe is an implement used for in-crop weed control in organic systems. This trial investigated how the number of passes made with the rotary hoe and the crop staging (of peas in this case) affected weed control. It appeared that the best control was achieved with two passes made at ground crack and then another two passes made at the three node stage of the peas.

Intercropping – Joanne Thiessen-Martens, OACC U of M & Chantal Stumborg, SMA
This trial looks at intercropping of fababeans and barley at different seeding rates of the two crops. Some benefits of intercropping include:

- a soil fertility benefit of growing a legume with a non-legume
- weed suppression due to increased competition
- disease and pest management – since it is harder for pests to move from crop to crop
- harvestability
    - anchor swath
    - give swath bulk

There could a challenge in harvesting the crop though, especially with two very different seed sizes (such as with a pea-canola intercrop).

Camelina Seeding Rate – Eric Johnson, AAFC Scott
Camelina is being investigated for use as an industrial oilseed, particularly in the biofuel industry. The major difficulty with growing camelina is the extremely small seed size (it has a 1000 kernel weight of only 1 gram). This trial investigates the ideal seeding rate of the crop.

Alternative Seed Treatments- Sherrilyn Phelps, SMA
This trial looks at a variety of organic seed treatments for chickpeas to prevent disease. The treatments used were RootShield, CB-QGG, and Heads Up. Crown and Apron were also used to compare results. There was not much disease present this year in any of the treatments, likely due to dry spring conditions.

Hemp Varieties – Sherrilyn Phelps (SMA)
The late maturing varieties being tested include Anka, RC 51-Jutta, RC 52-Yvonne, RC 53-Heidrun, and Alyssa. The early maturing varieties include Crag, CRS-1, CFX-1, and Finola. CRS-1 and CFX-1 are to be registered this winter with Health Canada. Finola is the earliest variety; it is short and small seeded. Sherrilyn noted that all of these varieties are dioecious, meaning that there are both male and female plants. Once the males have pollinated the females they will die down and the females will remain to produce the seed.

New Crops - Brenda Frick (OACC) and Eric Johnson (AAFC)
We grew a number of new and specialty crops that may have potential for production in Saskatchewan. These included Herbs and Spices, Green Manure Crops, Pulses, Oilseeds, and Heritage Wheats. Information about each crop is below. Some of the crops were covered during the Field Day.

<u>Forage/Green Manure Crops:</u>
<u>Alfalfa</u> – A widely-adapted and productive legume. Tap-rooted types are well suited to hay production, while creeping-rooted types are hardier and more persistent under grazing or harsh growing conditions. The market most commonly targeted by alfalfa producers is as hay. A common seeding rate for alfalfa is 8 lb/acre.

<u>Birdsfoot trefoil</u> – It is another forage species; a bloat-safe, moderately persistent, perennial legume that has moderate salinity tolerance and good tolerance to spring flooding, saturated and acid soils. It is not competitive with weeds or other forage species so clean fields are important. The recommended seeding rate for birdsfoot trefoil is 6 lbs/acre.

Black Medic – A forage species thrives in areas with full to partial sun, moist to mesic conditions, and soil containing loam, clay-loam, or gravel. It is a quite aggressive plant, but smaller in size. The normal seeding rate is 20 lb/acre. Black medic is more likely to be mix seeded with grass in a pasture than used as hay, but would still make a good green manure crop.

Alsike Clover – A short-lived perennial legume with high tolerance to spring flooding and saturated or acidic soils. It is not tolerant of drought or salinity. Alsike Clover can cause bloat in livestock. It is similar to red clover but yields are lower. A common seeding rate used is 4 lbs/acre.

Red Clover – is a short-lived, acid-tolerant perennial legume that is moderately tolerant of spring flooding and saturated soils, but intolerant of drought and salinity. It is shorter lived than alfalfa and often managed as a biennial for green manure. Red clover produces less biomass than alfalfa and is less tolerant to drought and salinity. On the plus side, red clover takes less moisture than alfalfa and because it doesn't grow as high in its first year, offers less competition as is sometime experienced with first year sweetclover. Red Clover is more tolerant of acid soils than alfalfa. It is harder to establish than sweet clover but is also less persistant. It is less competitive with crops than sweet clover which makes it more appealing for underseeding. It is not persistent as pasture, and hay is slow-drying, due to the high water content of the foliage. It can also cause bloat in livestock. The seeding rate used was 4 lbs/acre.

Sweet Clover - is a hardy, drought tolerant biennial, adapted to a wide range of soil types. It is slightly to moderately tolerant to salinity. It is intolerant of spring flooding and saturated soils. Low-coumarin varieties (such as Norgold) should be used to reduce the risk of bleeding disease in livestock. Coumarin is a phytochemical with a vanilla-like flavour; it has blood thinning properties, therefore it can be toxic at high doses for long periods. It is suggested that higher coumarin varieties are more allelopathic. Sweet clover can cause bloat. For green manure the yellow-blossomed is better adapted and grows more quickly in the spring which allows for earlier harvest/incorporation and more time for moisture recharge. Yellow is also more drought resistant than white. Yellow has finer stems and leaves making it more palatable as livestock feed and easier to incorporate as green manure. The seeding rate used for sweet clover is usually approximately 8 lbs/acre. It is commonly used for hay production. It is usually seeded with a companion crop with cereals being most common choice. Scarification of sweet clover seed should be done prior to planting to improve germination in the first year.

Oilseed Radish – Oilseed radish was originally developed for industrial oil use but more recently is used as a green manure crop in organic cropping systems. It belongs to the Brassica family and is similar to the canola and mustards that are currently grown here. The market right now is mainly for use as a cover crop but is expanding as use for forage and oil production is under evaluation. A seeding rate of 25 lbs per acre is recommended to insure a dense stand that will reduce weed competition. There is some interest now for use in carbon sequestration and nitrogen management.

Buckwheat – The starchy endosperm of buckwheat seeds are used to make flour for pancakes and bread. The seed coat is green or tan, which darkens buckwheat flour. The hull is dark brown or black, and some may be included in buckwheat flour as dark specks. This flour is commonly used for noodles especially in Japan, Korea, and Northern Italy. The groats can be used to make porridge. Another use is as green manure crop as it has a long tap root that can access nutrients from depth. A seeding rate of 36-48 lb/acre is ideal. Buckwheat requires nitrogen and phosphate fertilization, and potassium in sandy soils or under organic production. Very frost susceptible in spring and fall, early maturity, rapid growth.

Others green manure choices: (annuals)

- Chickling vetch – annual(AC Greenfix)
- Black lentil (Indian head lentil)
- Feedpea (sirius)

Research in 1990s showed AC Greenfix to produce higher dry matter than Indianhead lentils on brown and dark brown soil zones but no difference under higher moisture conditions in black and grey soils. 5-year study at Scott (Brandt) looking at chickling betch, indian head lentil, sirius feed pea and summerfallow as impact on next years wheat crop showed summerfallow and chickling vetch to have greatest impact on wheat yields. All legumes incorporated at full bloom.

Oilseeds:
Prairie Carnation – Is a specialty crop being developed from common cow cockle. The starch from the prairie carnation seed is unique because of the very small size of the starch granules. This starch may have a market in the low fat, frozen food industry as well as the cosmetic industry. The seed hulls contain saponin, which have applications in the pharmaceutical, neutraceutical and food industries. It produces 25 different saponins or detergents which have industrial uses plus potential as anti-cancer drugs and vaccines. Prairie Carnation is not an aggressive crop and does not appear to be particularly competitive. Therefore, weed control is a serious issue for production. In terms of seeding rates, current rates of 12 lbs per acre have been successful. However, higher rates of up to 20 lbs/ per acre are showing promise due to better competitiveness with weeds.

Calendula – This plant is commonly known as orange marigold. Interest in it has been aroused by government directives in Europe to eliminate the use of turpentine in paints. The oil from the seed of calendula is being investigated as a replacement for turpentine. Saskatchewan has been found to be a suitable production area. Tests in Saskatchewan show strong potential for this crop. Seeding rates should be in the range of 7 to 12 kg/ha. Nutrient requirements are under investigation. Early indications are that calendula responds well to added fertilizer.

Camelina – Camelina sativa, also known as false flax, is a novel oilseed belonging to the *Brassicacea* family. It originated in southwest and central Europe and is well adapted to the prairies. There is currently a renewed interest in its production due to its unique agronomic qualities and potential uses. Camelina reportedly grows well on marginal soils, is drought tolerant, early maturing and requires fewer inputs than other oil seed species. Camelina oil has a fatty acid oil profile with high levels of linoleic and linolenic acid which reduce cholesterol, which can provide health benefits to humans. Camelina also contains a variety of anti-oxidants including tocopherols. In terms of non-edible applications it can be used in the production of varnishes, cosmetics, soaps, colours and biofuels. The institute for Bio-based products in Montana tested nine oilseed crops including camelina, soybean, canola, mustard and flax and found that camelina outperformed all of the other crops tested, producing 7 calories of energy for every 1 calorie of energy used. The limitation with camelina for biodiesel is its cold flow properties and some quality issues. Seeding rates are approximately 10 lbs/acre. Camelina yield is approximately 600 kg/ha. It has potential for having lowest input costs and lowest environmental impact of all oilseeds. Good yields have been obtained without the addition of fertilizer, but 40-50 lbs/acre of available N may be suggested.

Brassica Carinata – Brassica carinata, commonly referred to as Ethiopian mustard, is well adapted to areas in Ethiopia with a cool, long growing season. However, preliminary agronomic evaluation in Saskatchewan suggested that B. carinata has good potential to become a new oilseed crop for western Canada. It has a relatively large seed size and contains from 26 to 40 per cent oil, about 40 per cent of which is erucic acid, which makes it unsuitable for human consumption. However, the oil can be used for industrial purposes and in biodiesel production. Research is underway to develop early maturing canola-like carinata with zero erucic acid content. Its heat and drought tolerance would allow its production in the hotter, drier areas of the province. Another advantage is its good resistance to blackleg and white rust. The recommended Carinata seeding rate is 7 lbs/acre.

Flax – Flax is growth for both its seed and its fibre. Canada is the world's largest producer and exporter of flax with annual exports valued at $150-180 million. As a result, market conditions in Canada have a significant impact on global flax prices. Virtually all of the flaxseed grown in

western Canada is destined for the export market as flax oil, flaxseed meal, and flax fiber. Saskatchewan, on average, produces four times as much as Manitoba, and has been the largest producing province since 1993-1994. Just over 1 of every 4 farms in Saskatchewan include flax as part of their rotation. Flax requires a heavy seeding rate of approximately 40 lbs/acre. Flax is responsive to nitrogen, but rarely to phosphorous or potassium; however, excess nitrogen levels cause production of coarse fibre and a crop more likely to lodge.
Fibre flax – Western Economic Diversification Canada indicates large potential within the flax processing industry, Chinese textile industry has interest in Saskatchewan long line flax fibre. Preliminary studies (ADF , Biolin Research) show potential for production of linen quality flax fibre in Sask. They have longer fibers than regular flax.

Crambe - Crambe is an oilseed crop of the *Brassicacea* family, which seed contains a high percentage of erucic acid (50 to 60%).The oil extracted from crambe seed is used as an industrial lubricant, a corrosion inhibitor, and as an ingredient in the manufacture of synthetic rubber. Crambe oil contains 8 to 9% more erucic acid than industrial rapeseed oil. Defatted crambe seed meal can be used as a protein supplement in livestock feeds. The meal contains 25 to 35% protein when the pod is included and 46 to 58% protein when the pod is removed. It has a well balanced amino acid content and has been approved by the FDA for use in beef cattle rations for up to 5% of the daily intake. Crambe is a cool season crop and can tolerate temperatures as low as 24°F. The crop requires 90 to 100 days to reach maturity

Heritage Wheats:
Red Fife – It is likely that the introduction of Red Fife started the production of spring wheat in Saskatchewan in the 1880's. Red Fife was historically a fine baking and milling wheat. The seeding rate used for Red Fife is 100-150 lb/acre. It was the most rust, smut, and frost resistant wheat variety of its time.

Spelt – Spelt is a species of wheat that has been grown since 5000 BC, and is considered to be an "ancient" wheat species. There are both spring and fall-seeded varieties but most spelt is fall-seeded. Spelt has become a major cash crop for organic farmers. Spelt can be grown in most areas where winter wheat safely survives the winter. It requires about 25-50% less nitrogen than wheat. The Organic Field Crop Handbook recommends a seeding rate of 160-180 lb/acre for spelt. A successful crop of spelt can yield 1.0 to 1.2 tonnes per acre.

Marquis – Marquis is a hybrid variety of wheat developed from a cross between early-ripening Indian wheat (Hard Red Calcutta) and Red Fife. Because of its early maturing quality, Marquis greatly extended the area where wheat may be safely grown. Its head is resistant to heavy winds and it yields flour of high quality. The seeding rate used for marquis wheat was commonly 100-150 lb/acre.

Kamut
Kamut is a close relative to wheat; however has a higher nutritional value and is better tolerated by individuals with gluten allergies. Kamut can be used in place of all the different wheats; the hard and soft varieties and also durum wheat. Kamut is only grown as an organic crop and has a fairly large market in Europe. Kamut growers typically receive around $11.00 per bushel for their kamut in contract with a processor in Saskatchewan

Pulses:
Fenugreek – Is an annual that originated in Mediterranean regions and the near east and is used for imitation maple syrup flavouring, condiments, and for synthesis of hormones. It is now grown under contract in Saskatchewan for use for treatment and management of Type 2 diabetes. The endosperm of fenugreek is comprised of a unique water-soluble galactomannan, a gum (soluble fibre) which is highly visous and form a gel in the intestine. This gel traps fat and glucose making them less likely to be absorbed. FenuLife ™ is a product developed that concentrated fenugreek extract. Emerald Seeds (Cal Kelly) specialize in production and processing of fenugreek.

Winter Peas – there are winter pea varieties that originated from Austria. They are to be seeded similar to winter wheat in the fall. Successful overwintering has occurred in Southern Alberta but there has been little success elsewhere in the prairies. The freeze thaw conditions in April cause problems in most of Western Canada. Where they have overwintered the yields have been double what the spring varieties produce so further work is being done with them.

CDC Sonata Pea – CDC Sonata is a forage pea variety. They are generally grown to produce silage. Peas are not usually used for grazing unless included with a cereal. Cereal/pea mixtures generally yield less dry matter but more protein per acre than cereals alone. It is recommended that Sonata peas are seeded at approximately 110 lbs/acre (alone or in a mix).

IH Lentils - Indianhead is a black-seeded lentil used as a green manure or plow down crop. It is seeded at 30 to 35 lb/ac (34 to 39 kg/ha) and will produce seed, if seeded early and if drought stress occurs in July and August. To use it as a green manure, it is generally planted in mid to late May to avoid seed production, and the plants are killed with 2,4-D herbicide or by cultivation when flowering begins.

Red Lentils - account for over half the world lentil trade, Saskatchewan could capture a larger share of the world market with more acres, further value-added market potential is enhanced by provincial processing plants developing red lentil splitting capabilities. ADF and AAFC studies indicate potential for successful production of early maturing red lentil varieties in the black soil zone.

Faba bean – faba bean is primarily used as livestock feed and grown primarily in Europe. The main interest in faba bean was as an on-farm, protein supplement for livestock feeding. It contains 24 – 30% protein and has been used successfully in poultry, swine, sheep, beef, and dairy production. Faba beans require cool and moist conditions for ideal growth. On average, they yield approximately 3100 lbs/acre and the seeding rate is 150 to 180 lbs/acre. The benefit with fababeans is their excellent nitrogen fixing ability. They also tolerate wet conditions. Research for the feed market strives for small seeded, early maturing, high yielding, low tannin varieties.

Soybean – Soybean is a pulse crop that has not been common in Saskatchewan in the past. It is a major part of the world vegetable oil market and now biodiesel markets. New soybean varieties and agronomics keep bringing interest and questions about potential in the area. Soybeans need a long growing season and higher heat units (2350). They are very frost sensitive and detest our cool evenings. Soybeans are important for their oil and high quality meal. Soybean meal is a crucial component in most livestock diets in the United States due to its high protein content of approximately 40%. The average yield of soybeans in Saskatchewan has been 25-35 bu/acre. The seeding rate used for soybeans varies from 50 lb/acre (for small seed) to 60 lb/acre (for large seed).

Green Manure – choices and plowdown methods – Steve Shirtliffe, U of S

Steve Shirtliffe demonstrated a new specialized crimper-roller that has application in termination of green manure crops. The roller flattened all the crops where it was used including: oilseed radish, pea, lentil, fababean, wheat, and forage legumes. However, it did not kill the plants and within 3 weeks growth resumed.

Nitrogen fixing crops tend to be the best for use as green manure crops because they will increase the N levels in the soil. It is always a fine balance when growing green manure crops because the longer they grow the more N that will be fixed and the more residue that you can put back into the soil, but the longer they grow the more moisture they use. It is recommended to work in green manure crops or terminate them prior to July 15th. This usually puts them past maximum nitrogen fixation (for legumes) and allows moisture conservation in the fall.

Weed Tour

Sherrilyn Phelps, Saskatchewan Ministry of Agriculture and Leo Perlinger, WARC

The Weed Tour was held on July 17th as a training opportunity agronomists and researchers on new weed control technologies. Forty people attended the tour which covered topics such as new herbicides being screened, minor use pesticide registration projects, using agronomics for pest management and application technology. Also included in the tour was a Weed ID portion that allowed agronomists to test their identification skills. This event was put on in partnership with Saskatchewan Ministry of Agriculture and the University of Saskatchewan. Speakers included Eric Johnson (AAFC Scott), Dr. Steve Shirtliffe (U of S), Ken Sapsford (U of S), Dr. Julia Leeson (AAFC Saskatoon), Dan Ulrich (AAFC Scott), Dr. Tom Wolf (AAFC Saskatoon), Dr Hugh Beckie (AAFC Saskatoon) and Clark Brenzil (Sask. Agric.)

Thanks to **Bayer CropScience** for sponsoring the lunch.

Glaslyn Field Tour

Sherrilyn Phelps, Saskatchewan Ministry of Agriculture and Leo Perlinger, WARC

On July 22nd a Field Tour at Glaslyn was organized by AgriTeam Services. Approximatley 45 producers and agronomists were in attendance. The tour included the AAFC offstation site at Glaslyn where varieties, insect management, weed management and disease management were discussed.

Thanks to **AgriTeam Services** from Glaslyn for organizing such a successful tour.

Crop Opportunity and Scott Research Update

Sherrilyn Phelps, Crop Specialist, Saskatchewan Ministry of Agriculture

On Feb 28, 2008 the Crop Opportunity and Scott Research Update was held at the Gold Ridge Convention Centre in North Battleford. In attendance were approximately 250 producers, industry representative, and agrologists.

Dr. Jeff Schoenau from the University of Saskatchewan started the event and talked about getting the most out of your fertilizer dollars. Dr. Schoenau talked about various aspects of chemical fertilizers and then discussed alternative forms of fertilizer such as alfalfa pellets, compost, and manure. He left the crowd thinking about the value of manure and how it could be incorporated into crop production systems.

Other topics included:
Ken Sapsford, University of Saskatchewan, discussed the results of their large perennial weed control trial. Focusing mainly on Canada Thistle the trial shows that there is no quick fix and that control is best achieved over time with a variety of strategies. *Eric Johnson*, AAFC Scott, also talked about new chemistries for weed control and how to control tough weeds. *Elwin Hermanson*, Canadian Grain Commission, discussed what KVD means and how the removal of it affects the development of new varieties. *Stu Brandt*, AAFC Scott, talked about understanding the value of inputs in canola.
Sherrilyn Phelps, Saskatchewan Agriculture, discussed the new wheat midge resistant wheat varieties and how the resistance mechanism works. *Faye Dokken*, Saskatchean Agriculture, gave a disease update and focused mainly on clubroot, ergot, FHB and seedling diseases. *Dale*

Risula, Saskatchewan Agriculture, discussed what was new with pulse varieties. The day ended with a market outlook presentation by *Larry Weber* from Weber Commodities.

Thanks to the sponsors of the event:

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Royal Bank Financial

Agronomy of *Camelina sativa*

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Introduction

Oilseed crops are a valuable commodity for Canadian agriculture and demand for oil is increasing. The international oilseed market is dominated by soybean, canola, and sunflower; however, diversification of oilseed crops into non-traditional areas may be needed to meet growing demand. *Camelina sativa*, a crucifer oilseed (also recognized as camelina, false flax, and gold of pleasure) is of interest for the purpose of expanding the oilseed production area in western Canada. Camelina was grown as an agricultural crop in European countries and Russia up to the 1950's. The search for new sources of essential fatty acids, particularly omega-3 fatty acids, has led to a renewed interest in this crop. Camelina possesses valuable agronomic attributes that make it attractive as an alternative oilseed crop such as low seed cost, lower water requirements, and resistance to a number of insect and disease pests. On the other hand, weed control is challenging since there are no registered herbicides for this crop.

Few agronomic evaluations of camelina have been conducted in western Canada. Therefore basic agronomic studies must be conducted to provide growers with production recommendations.

The objective of this project was to determine the optimum seeding rate and plant density of two camelina cultivars at five locations in western Canada. A second objective was to screen the tolerance of camelina to a range of grassy and broadleaf herbicides and response to nitrogen fertilizer.

Optimum Seeding Rates and Plant Densities for *Camelina sativa*

Objective

To determine the optimum seeding rate and plant density in *Camelina sativa*.

Methods and Materials

Studies were designed as a RCBD factorial with cultivar (CS0005 and CS0006) and planting density (12, 25, 50, 100, 200, 400, 800, and 1600 seeds m^{-2}) as main factors. Each treatment was replicated 4 times. The sites were the Scott Research Farm (2007, 2008), Beaverlodge Research Farm (2007, 2008), Melfort Research Farm (2007, 2008), Semi-Arid Prairie Agriculture Research Center at Swift Current (2007), the South East Research Farm at Redvers, SK. (2007), and the Ryan Mercer Farm at Lethbridge, AB (2008; study conducted by the University of Alberta).

The studies were seeded on summerfallow due to lack of broadleaf weed control options. Weed control was achieved at some locations with a spring application of trifluralin or ethafluralin (not registered); however, most of the weed control was achieved through hand weeding. Actual seeding densities were based on viable seeds and thousand kernel weights. Germination of both cultivars was >95% and 99% in 2007 and 2008, respectively. Actual seeding rates for the various seeding densities are shown in Table 1.

Table 1: Corresponding seeding rates (in kg ha^{-1} or lb $acre^{-1}$) to planting densities per m^{-2} for *Camelina sativa.*

Seeds m^{-2}	kg ha^{-1}	lb $acre^{-1}$
12	0.2	0.15
25	0.3	0.3
50	0.7	0.6
100	1.3	1.2
200	2.8	2.5
400	5.5	4.9
800	11	9.8
1600	22.2	19.6

Data collection that will be discussed in this report included: plant emergence (plants m^{-2}), lodging, days to flowering, days to maturity, plant moisture content (indication of maturity), seeds/pod, seed yield, thousand kernel-weight, and number of plants m^{-2} post-harvest. Data was analyzed across sites with PROC Mixed and for the most part, combined data is presented. Site-year and site-year by treatment interactions were considered a random effect.

Results

Results from the analysis of variance (Table 2) indicate that cultivar had a marginal effect on plant emergence, lodging, and thousand kernel weight (significant at $p < 0.10$). Cultivar had a significant effect on days to flowering and seeds/pod. Planting density had a significant effect on all variables measured with the exceptions of seeds/pod and thousand kernel weights. The only cultivar by rate interaction occurred with moisture content which was significant at $p < 0.10$.

Table 2: Analysis of variance results for camelina planting density study across 9 sites in Alberta and Saskatchewan. 2007-08.

Source	Plant emergence	Lodging	Days to Flowering	Days to Maturity	Moisture Content (%)	Seeds per pod	Plant Height	Seed Yield	1000-kw
Cultivar	0.09	0.08	0.04	0.35	0.98	<0.0001	0.89	0.32	0.09
Rate	<0.001	<0.0001	0.01	<0.0001	0.03	0.22	0.01	<0.001	0.2
Cultivar X rate	0.54	0.39	0.87	0.84	0.09	0.61	0.76	0.41	0.85

Plant Emergence

When averaged over locations and densities, 42% of the planted seeds emerged (Table 3). This varied from a low of 12% at Melfort in 2008 to a high of 67% at Swift Current in 2007. The percent emergence was higher at lower planting densities and declined as planting density increased (Table 4).

Table 3: Overall percent emergence of camelina seed at sites in Alberta and Saskatchewan. 2007-08.

Site	Year	Percent Emergence
Beaverlodge	2008	51%
	2007	58%
Melfort	2008	12%
	2007	29%
Scott	2008	44%
	2007	27%
Lethbridge	2008	47%
Redvers	2007	41%
Swift Current	2007	67%
MEAN		**42%**

Table 4: Percent emergence of camelina seed at different planting densities. Mean of nine site-years. 2007-08.

Seeds m^{-2}	Emerged Plants m^{-2}	Percent Emergence
12	7	59%
25	12	50%
50	22	43%
100	43	43%
200	79	39%
400	147	37%
800	277	35%
1600	444	28%

Lodging

Lodging was evaluated visually using a scale of 1-4 with 1 being erect and 4 being flat on the ground. The cultivar CS0006 had a slightly higher lodging rating of 1.6 compared to 1.4 for CS0005. Lodging ratings declined as planting density increased; however, there was a slight increase at the highest density (Fig. 1)

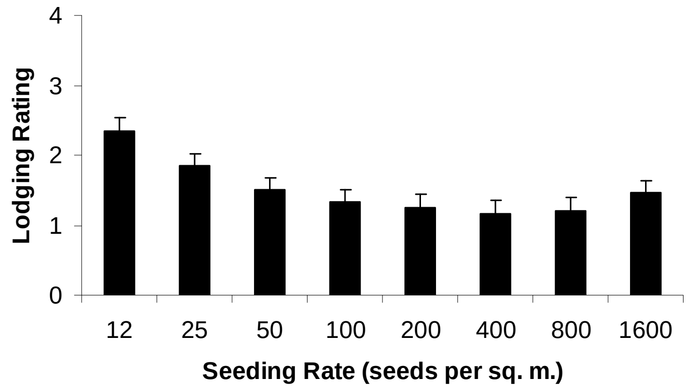

Fig. 1: Lodging ratings for camelina plants at a range of seeding rates. Lodging rating evaluated visually using a scale of 1-4: 1 = erect; 4 = flat on the ground. Error bars are the standard error of the mean.

Days to Flowering

Mean days to flowering for CS0006 was 46 days, 1 day earlier than CS0005. Seeding rates of > 200 seeds m^{-2} generally reduced days to flowering by 1 day, compared to seeding rates of 12 to 100 seeds m^{-2} (data not shown),

Days to Maturity

Both cultivars matured in 92 days when averaged across all planting densities; however, higher seeding densities reduced the days to maturity by as much as 7 days (Figure 2).

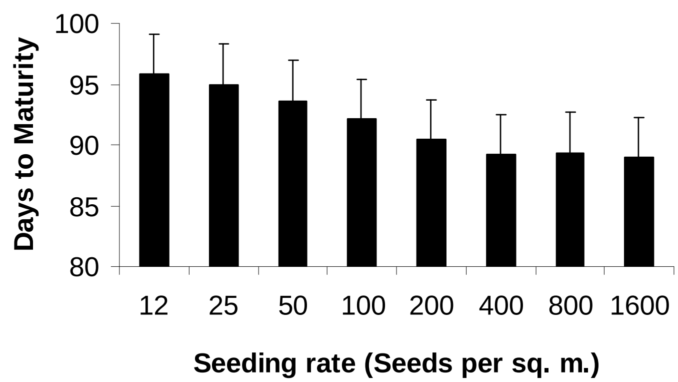

Fig. 2: Effect of camelina seeding rates on days to maturity. Error bars are the standard error of the mean.

Plant Moisture

At maturity, plants from two 0.25 m^{-2} quadrats in each plot were clipped, weighed and then oven-dried. The plants were re-weighed after drying and moisture content was calculated. This provided a subjective evaluation of plant maturity. Trends were similar to days to maturity (Fig. 3) validating that higher seeding rates hastened plant maturity.

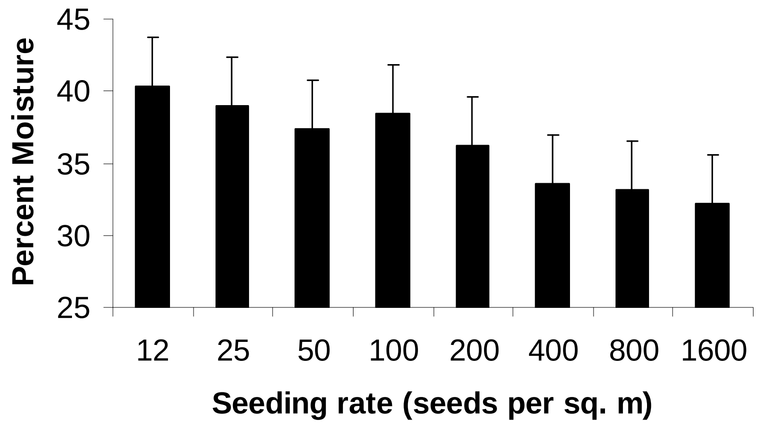

Fig. 3: Effect of camelina seeding rates on plant moisture content. Error bars are the standard error of the mean.

<u>Seeds per pod</u>

Although statistically significant, the cultivar CS0006 had 1 seed per pod more than CS0005; therefore, it is of limited biological significance. The mean number of seeds per pod for CS0006 was 9 (data not shown).

<u>Post-harvest plant density</u>

Plant counts were taken following harvest to provide an indication of plant mortality during the growing season. Statistical analysis was not performed on plant mortality for this report but it appears that seeding rate had little effect (Figure 4).

<u>Plant Height</u>

Plant height increased as seeding rate increased from 12 to 400 seeds m^{-2} then declined at rates higher than 400 seeds m^{-2} (Figure 5).

<u>Seed Yield</u>

Seed yield was regressed against seeding rate and plant emergence using non-linear regression. An asymptotic Michaelis-Menten model was used to fit the data. Seed yield increased dramatically as seed rate density increased and levelled off at about 450 to 500 seeds m^{-2} (Figure 6). Correspondingly, yields increased until plant emergence numbers reached about 125 to 200 plants m^{-2} (Figure 7); therefore, low densities could not fully compensate by producing more pods. Yields declined by greater than 10% when plant densities dropped below 70 plants m^{-2}.

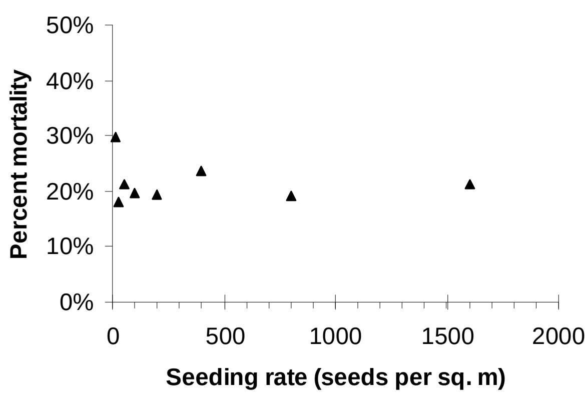

Fig. 4: Effect of camelina seeding rates on percent plant mortality during the growing season. Plant mortality was based on plant counts taken post-harvest compared to plant counts taken 3 weeks after emergence.

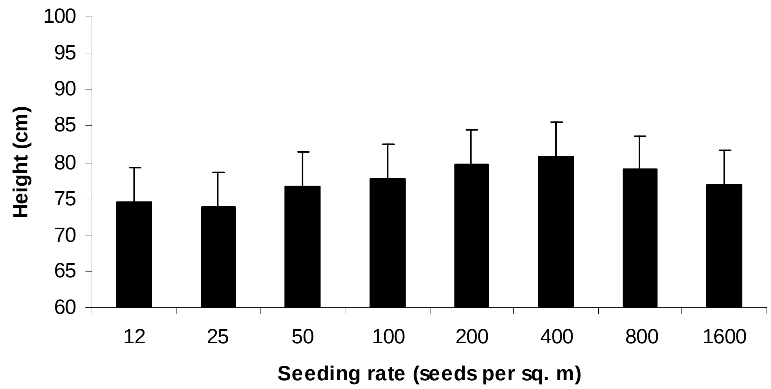

Fig. 5: Effect of camelina seeding rates on plant height (cm). Error bars are the standard error of the mean.

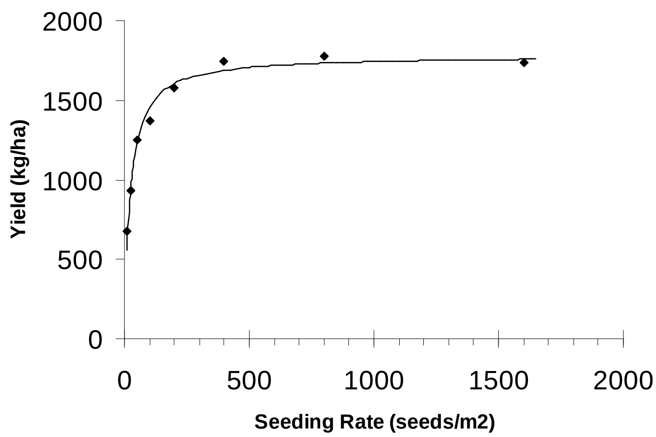

Figure 6: Relationship between planting density (viable seeds m^{-2}) and camelina seed yield. Mean of nine sites in Alberta and Saskatchewan. 2007-08.

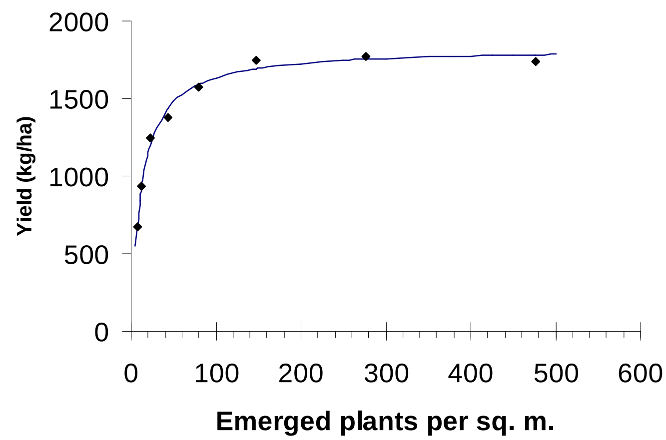

Figure 7: Relationship between camelina plant emergence (seeds m^{-2}) and seed yield. Mean of nine sites in Alberta and Saskatchewan. 2007-08.

Seeding at a rate of 500 seeds m^{-2} (about 6.0 kg ha^{-1} or 5.3 lb $acre^{-1}$) would result in 210 plants per m^{-2} if emergence is 42% (average emergence in this study) but only 60 plants per m^{-2} if emergence is 12% (lowest emergence in this study). This seeding rate is satisfactory if emergence is greater than 25% (to achieve minimum of 125 plants m^{-2}). Growers should be aware that these plant population studies were conducted under weed-free conditions. Camelina has limited broadleaf weed control options; therefore, a higher plant density may be warranted under weedy conditions. Based on the results from this study, a minimum seeding rate of 500 seeds m^{-2} (6.0 kg ha^{-1} using a thousand kernel weight of 1.2 grams) is recommended.

Thousand kernel weight

The mean thousand kernel weights for CS0005 and CS0006 were 1.20 and 1.18 grams, respectively. Seeding rate had no effect on thousand kernel weight (Table 1).

Herbicide Screening

At Scott, camelina was screened for tolerance to Command (clomazone), Frontier (dimethanamid), and Prowl (pendimethalin) herbicides. Unacceptable levels of injury were recorded for both Command and Frontier. Injury ratings from Prowl application were acceptable. Prowl is similar to trifluralin or ethafluralin in its weed spectrum. Prowl may have difficulty being registered due to the current moratorium on new registrations for dinitroaniline herbicides.

Nitrogen Response

Preliminary results from 2008 indicate that camelina is quite responsive to nitrogen (data not shown) and the nitrogen requirement to achieve maximum yield are similar to other *Brassica* oilseeds.

Executive Summary

- Mean percent emergence of camelina seed over nine site-years was 42%;
- Higher plant densities hastened camelina maturity by as much as 7 days;
- Optimum camelina plant densities varied between 125 and 200 plants m^{-2}; which would correspond to a seeding rate of 500 seeds m^{-2} or higher;
- Nitrogen requirements of camelina and *B. carinata* appear to be similar to other *Brassica* species.
- Herbicide screening trials were unable to identify any potential broadleaf herbicides in either crop.

Future

There is sufficient data on the camelina seeding rate trial to provide growers with recommendations. Therefore, it will not be repeated in 2008. Unless potential candidates can be identified, there will be no further screening of herbicides in camelina as pretty well every broadleaf herbicide that is available has been evaluated.

Acknowledgements

The funding support of the Prairie-Wide Canola Agronomy Research Agreement and the Saskatchewan Ministry of Agriculture Development Fund is greatly appreciated.

Optimum Seeding Rates and Plant Densities for *Brassica carinata*

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Objective

To determine the optimum seeding rate and plant density in *Brassica carinata*.

Methods and Materials

Studies were designed as a RCBD factorial with cultivar (070768EM and 070760EM) and planting density (12, 25, 50, 100, 200, 400, 800, and 1600 seeds m^{-2}) as main factors. Each treatment was replicated 4 times. The sites were the Scott Research Farm, Glaslyn Project Farm, Beaverlodge Research Farm and the University of Saskatchewan.

The studies were seeded on summerfallow due to lack of broadleaf weed control options. Weed control was achieved at some locations with a spring application of trifluralin or ethafluralin (not registered); however, most of the weed control was achieved through hand weeding. Actual seeding densities were based on viable seeds and thousand kernel weights. Germination percentages of the cultivars were 93 and 80% for 070768EM and 070760EM, respectively.

Results and Discussion

The results from the ANOVA indicate that there was a cultivar, rate and cultivar by rate interaction for plant emergence and lodging (Table 1). None of the factors had an effect on days to flowering but seeding rate had a significant effect on days to maturity and seed yield.

Table 1: ANOVA for *Brassica carinata* seeding rate trial

Source	Plant emergence	Lodging	Days to Flowering	Days to Maturity	Seed Yield
Cultivar	0.04	0.04	0.12	0.14	0.2
Rate	<0.0001	0.001	0.51	0.0003	<0.0001
Cultivar X rate	<0.0001	0.06	0.44	0.50	0.19

Plant emergence

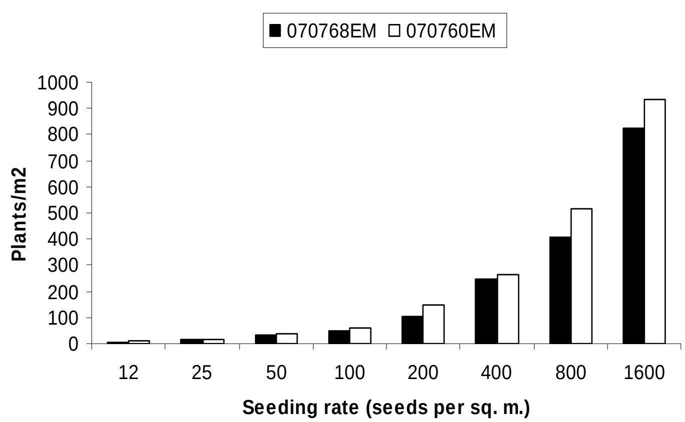
When averaged over locations, cultivars and densities, 64% of the planted seeds emerged (Table 2). The percent emergence was higher at lower planting densities and declined as planting density increased (Table 2). Emergence percentages for individual sites were 84%, 55%, 65%, and 54% for Beaverlodge, Glaslyn, Scott, and Saskatoon, respectively (data not shown).

There was a cultivar by rate interaction for plant emergence (Table 1). Cultivar 070760EM had overall higher emergence than 070768EM with the interaction indicating increased emergence at higher seeding rates (Fig. 1). The reason for the higher emergence for the one cultivar is not understood at this time. It has slightly larger seed (TKW of 4.7 vs. 4.6); however, its germination was lower. It could be the germination test underestimated the emergence potential of 070760EM resulting in a higher number of viable seeds being planted for that cultivar.

Table 2: Percent emergence of *Brassica carinata* seed at different planting densities. Mean of four sites. 2007-08.

Seed Rates (seeds m^{-2})	Emerged Plants (m^{-2})	Percent Emergence
12	9	78%
25	17	69%
50	34	68%
100	55	55%
200	127	64%
400	257	64%
800	459	57%
1600	877	55%
MEAN		**64%**

Figure 1: Interaction of cultivar and seeding rate on plant emergence of *Brassica carinata.* Mean of 4 sites. 2008.



Lodging

Lodging was evaluated visually using a scale of 1-4 with 1 being erect and 4 being flat on the ground. The cultivar 070760EM had a higher lodging rating of 2.5 compared to 1.6 for 070768EM. Lodging ratings declined as planting density increased to 100 seeds per m^{-2}; but increased at rates above 100 seeds per m^{-2} (Fig. 2). The cultivar X seeding rate interaction indicates a higher degree of lodging for 070760EM at the higher seeding rates; with only slight differences at the lower seeding rates (Fig.2).

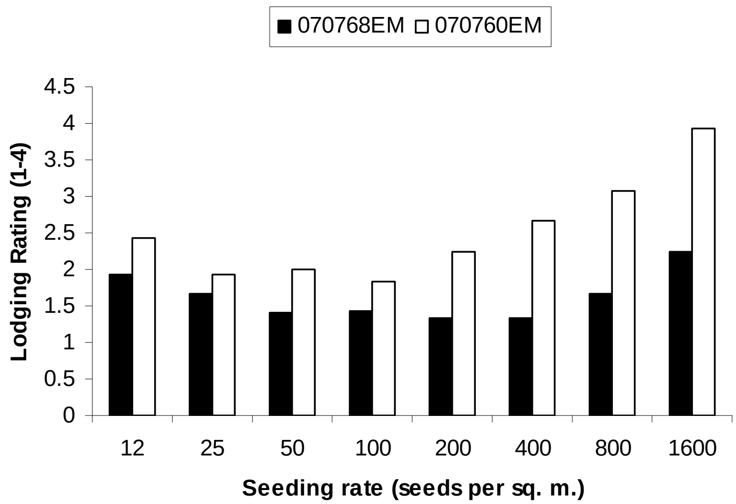


Figure 2: Effect of cultivar and seeding rate on lodging ratings in *Brassica carinata.* Mean of 4 sites. 2008

Days to Flowering

When averaged across sites, both cultivars began flowering 47 days after seeding (data not shown). Seeding rate had no effect on days to flowering.

Days to Maturity

Increased seeding rates hastened maturity by up to 4 days (Fig. 3). Days to maturity decreased as seeding rates increased from 12 to 400 seeds m^{-2} with higher rates having littlel effect (Fig. 3).

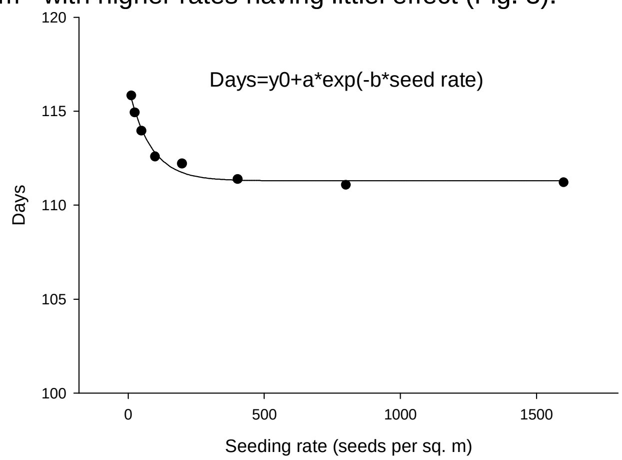
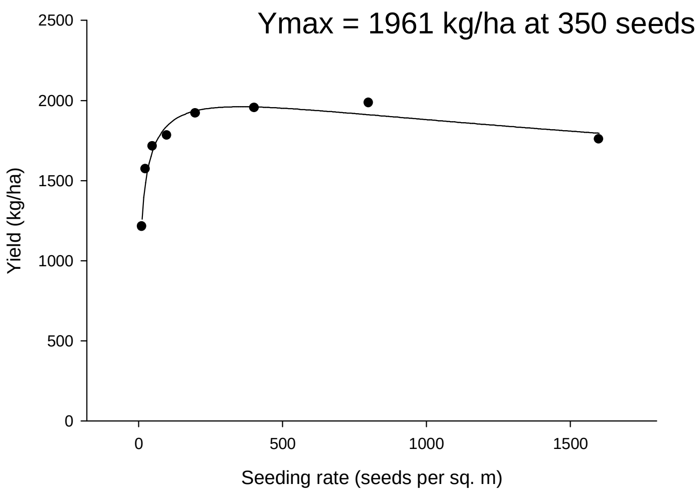


Figure 3: Relationship between seeding rate and days to maturity for *Brassica carinata.* Mean of 4 sites. 2008.

Seed Yield

When averaged across sites, a maximum seed yield of approximately 1960 kg ha^{-1} (35 bus/acre) was achieved at seeding rates of 350 seeds m^{-2} (Fig. 4) and 200 plants m^{-2} (Fig. 5). Yields declined at seeding rates above 500 seeds m^{-2}. A seeding rate of 350 seeds m^{-2} would equate to about 15 kg ha^{-1} or 13 lbs $acre^{-1}$.



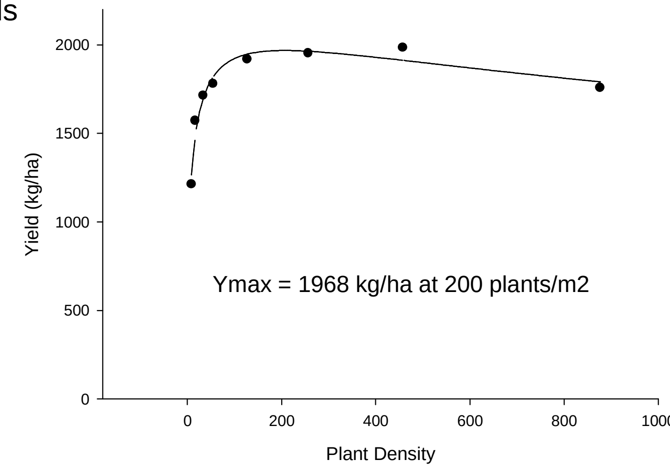


Figure 4: Effect of seeding rate on yield of *Brassica carinata.* Mean of four sites. 2008.

Figure 5: Effect of plant density (plants m^{-2}) on yield of *Brassica carinata.* Mean of four sites. 2008.

Future

The *Brassica carinata* seeding rate trial will be repeated in 2008. A phosphorus response trial will be initiated at 2 locations in 2008. Herbicide screening in *Brassica carinata* will be conducted at Scott in 2008.

Acknowledgements

The funding support of the Prairie-Wide Canola Agronomy Research Agreement and the Saskatchewan Ministry of Agriculture Development Fund is greatly appreciated.

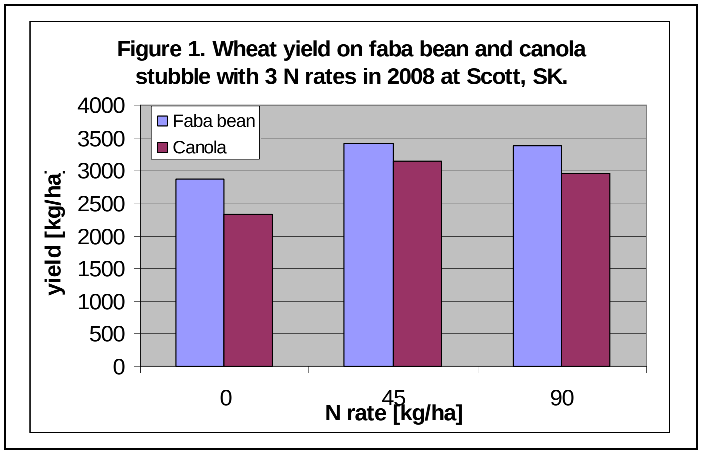
Faba Bean: A partial solution to high cost fertilizer N?

Stewart Brandt, AAFC Scott Research Farm

Faba bean is a small acreage N fixing legume crop that is grown in western Canada. It is reasonably well adapted to the region although it is late maturing and requires adequate moisture to be productive. What makes this crop interesting is that it can fix more nitrogen than it requires for seed production. What this means is that it increases the supply of N for subsequent crops rather than depleting soil N.

In 2007, we initiated a small filed experiment to assess whether faba bean grown as a grain crop would fix enough additional N to meet a significant proportion of the N needs of a succeeding wheat crop. To do this we grew a faba bean crop and canola in 2007 and planted HRS wheat on both stubbles in 2008. We applied either, 0, 45 or 90 kg/ha [0,40 and 80 lb/ac]of N on sub plots on both stubbles. We also added extra plots so we could follow the faba bean-wheat and canola-wheat sequences over several cycles to measure cumulative effects.

Results from 2008 are very encouraging. The effect of preceding stubble type was statistically significant. With no fertilizer N, wheat on faba bean yielded 550 kg/ha [8.2 bu] more than wheat on canola stubble (Figure 1). Even when fertilizer N was added (45 and 90 kg/ha N) the wheat yield on faba bean stubble exceeded wheat yield on canola by 260 and 420 kg/ha [3.9 and 6.2 bu/ac], respectively. This suggests that faba bean did meet some of the N requirements of this wheat crop AND that there are other benefits associated with growing wheat after faba bean compared with canola. There was no evidence of differences in weeds or diseases between the 2 stubble types, suggesting that some soil related factor was in play. Other studies do indicate that other pulses like pea and lentil extract less moisture from the soil than canola, and it may be worth examining moisture extraction characteristics of faba bean to determine if this is a factor.



Growers should be cautioned that this is just a single year of data at one site. It is not known how broadly and reliably the results can be applied. To address this issue we plan to repeat the study at Scott over several years, and based on how promising the results are we will look at how they could be validated more broadly.

Fababean – Barley Intercrop

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Introduction

Fababeans are of interest to many growers in the higher rainfall areas as a crop to enhance nitrogen fixation. One of the limitations to fababeans is their long season and preference for straight cutting. Under adverse fall weather, such as snow, standing fababean crops can go down and are very difficult to straight cut. Developing methods to enhance the harvesting would be of benefit to growers.

Objectives:

To evaluate the impact of intercropping fababeans with barley and characteristics that affect the intercrop such as seeding rate and variety competitiveness.

To evaluate the potential of swathing fababeans and whether intercropping can enhance the swath and keep it off the ground.

Methods:

Fababeans (cv. Goria) were seeded on May 14th and then on May 20th (approximately one week later) barley was cross seeded into the fababeans. Two varieties of barley (cv. Copeland and cv. Bold) were chosen to see if there is an impact of variety on the intercrop with fababeans. Copeland is a 2-row normal height malt barley variety with medium maturity. Bold is a 2-row feed variety that is semidwarf in height and has late maturity. Seeding rates for fababeans were 240 lbs/acre. Two seeding rates of barley targeted 1/4 and ½ recommended rates and were 24 and 49 lbs/acre for CDC Copeland and 42 and 84 lbs/acre fore CDC Bold, respectively.

Data collected includes emergence counts, dry matter weights, plant population at harvest, grain yield, 1000 kernel weights, height of swath off the ground, and depth of swath.

Results:

Plant Stand:

There was even emergence throughout the plots. Barley seeded at ¼ and ½ recommended rates had averages of 55 and 99 plants per square metre, respectively. Even though there were more plants in the ½ rate of barley, the dry weights showed no difference between the two rates. Mean stem counts after harvest were 62 and 87 stems per metre square for the low and high rate, respectively. Comparing the emergence and after harvest stem counts shows the lower rate of barley gained in stem counts (tillered) while the higher rate of barley actually lost plants per square meter.

Fababean emergence averaged 42 plants per square meter across all treatments with no significant differences. After harvest stem counts were significantly affected by intercropping with barley. Plots with fababeans alone averaged 45 plants per square metre, while the barley intercrop plots averaged 30 plants per square metre.

Biomass:
Fababean biomass at late flowering was dramatically affected by intercropping. All intercropped treatments, irrespective of seeding rates, dramatically reduced fababean biomass by 75 to 80%.

Grain Yield:
In terms of grain yield, barley yields were not affected by seeding rate. Fababean yield was significantly higher where there was no barley intercrop. Within the intercropped treatments there was no effect of barley variety so the variety data was combined. There was an effect of barley seeding rate as the ¼ seeding rate produced higher fababean yields than the ½ seeding rate (Table 1). There was also a significant impact of harvest management in that the straight cut treatments had slightly higher fababean yields than in the swathed treatments.

When crop prices are taken into account, barley intercropped with fababean produced similar returns as fababeans alone. However, cleaning costs and differences in harvesting costs were not included.

Table 1. Barley and fababean grain yields and value per acre as affected by intercropping, barley seeding rate, and harvest management. Data from 2008 at Scott Research Farm.

		Barley		**Fababean**		**total**
Crop/Intercrop	**Harvest Method**	**kg/ha**	**$/acre**	**kg/ha**	**$/acre**	**$/acre**
Fababean only	Swath	0	0	3429	$305.21	$305.21
Fababean only	Straight cut	0	0	3439	$306.05	$306.05
1/4 rate barley	Swath	4017	$235.36	794	$70.67	$306.03
1/4 rate barley	Straight cut	4723	$276.70	843	$75.05	$351.75
1/2 rate barley	Swath	4431	$259.62	403	$35.82	$295.44

* Used barley price of $3.16 per bushel from 2009 Crop Planning Guide - Dark Brown Soil Zone, Saskatchewan Ministry of Agriculture
** Used fababean price of 11 cents per pound as obtained from Roy Legumex as average price for last year ($6.60per bushel)

Effect of Intercrop on Swath:
The fababeans alone had the thickest swath (Table 2). As the fababean plants are quite dense this is not suprising. However, the addition of barley to the fababeans did result in lifting the swath off the ground. The taller variety (CDC Copeland) increased the height of the swath off the ground in comparison to the shorter CDC Bold variety. This may be the result of cutting the crop slightly higher as there was taller stubble left on the CDC Copeland treatments when compared to the CDC Bold treatments. Figure 1 shows the height difference of the barley varieties. CDC Bold is a semidwarf and the fababeans are clearly visible above the canopy. CDC Copeland is taller and it is harder to see the fababeans.

Table 2. Swath measurements as influenced by intercropping and barley variety. Data from 2008 at Scott Research Farm.

	height off ground	**depth of swath**	**stubble height**
	(cm)	**(cm)**	**(cm)**
Fababean only	--	17.3	18.3
CDC Bold	11.45	13.2	20.8
CDC Copeland	15.95	12.6	23.55

(a) (b)

Figure 1. Fababean barley intercrop with two varieties of barley at the ¼ seeding rate. a) CDC Bold semi dwarf barley, b) CDC Copeland normal height barley

Conclusions:
The delayed seeding of barley worked well and the crop stand was very good. During late podding stage the fababeans were dramatically affected by the disease chocolate spot which resulted in early dieback of the plants. Despite the disease the fababean plots yielded 57 bushels per acre. Intercropping fababeans with barley dramatically reduces fababean yields and may be better suited to higher moisture areas. However, intercropping provided a better swath by lifting it off the ground which may result in better quality fababeans.

Future work:
This study will be repeated in 2009. Future work with fababeans should look at intercropping at greatly reduced rates of other crops or crops that are less competitive than barley.

Hemp Response to Nitrogen and Phosphorus - Preliminary Report

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Introduction
The increasing consumer demand for hempseed and hempseed oil products has been dramatically increasing in North America. As hemp can be grown under license in Canada, but not in the United States, there is a huge potential for Canada to become the leader in production and processing of hemp in North America. The key to growing hemp successfully is good establishment and fertility.

Objectives
The objective of this study was to establish nitrogen (N) and phosphorus (P) response curves for industrial grain hemp in order to provide recommendations for the industry to enable them to optimize yields and quality.

Materials ns Methods
Two hemp cultivars (Finola and Crag) were treated with a range of N and P (applied as P_20_5) rates to determine a fertility response curve for two hemp cultivars (Crag and Finola), at two locations in Saskatchewan (Scott and Melfort, AAFC Research Farms), in three years (2006, 2007 and 2008). The N rates were 0, 50, 75, 100, 150 and 200 kg N /ha and the P rates were 0, 20, 40, 60 and 80 kg P_20_5/ha. As the N rate varied, the P rate was maintained at 80 kg P_20_5/ha. Similarly, as the P rate varied, the N rate was maintained at 200 kg N/ha. The untreated control received no fertilizer. The trial was a split-plot design with 4 replications. Cultivar was the main plot and fertilizer rate was the sub-plot.

Results
Hemp responded well to applied N fertilizer. Finola was slightly more responsive to N than Crag, as seed yield increased with increasing N rates (Figure 1). This appears to be an indication of the higher yield potential of the Finola variety. Both varieties maximized seed yield at applications near 150 kg N/ha, where yield was 56% and 97% higher than those obtained at the 0 kg/ha N control, for Crag and Finola, respectively.

The response of hemp seed yield to additional P in these trials was minimal (Figure 2). The highest rate of P (80 kg P_20_5/ha) only improved seed yield by 8% and 15% over the no fertilizer control, for Crag and Finola, respectively.

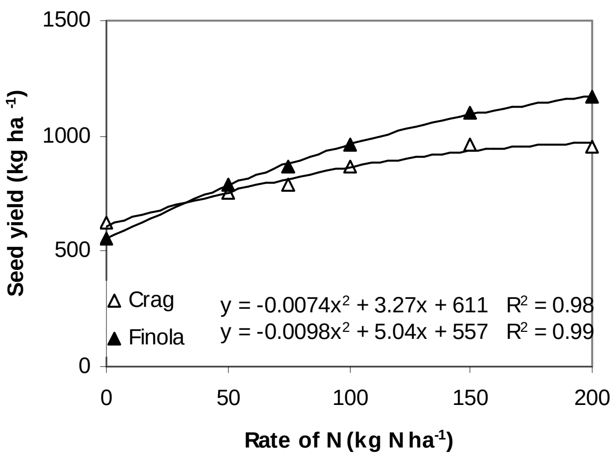

Figure 1. Response of two hemp varieties to N rates (0, 50, 75, 100, 150 and 200 kg N ha^{-1}), averaged over three years (2006, 2007 and 2008) and two locations (Scott and Melfort).

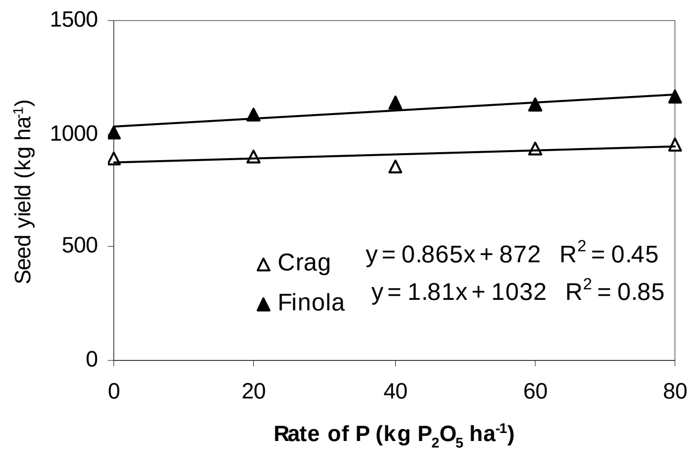

Figure 2. Response of two hemp varieties to P rates (0, 20, 40, 60, and 80 kg P_2O_5 ha^{-1}), averaged over three years (2006, 2007 and 2008) and two locations (Scott and Melfort).

Conclusions
1. Hemp responded well to additional nitrogen, with yield being maximized at around 150 kg N/ha.
2. Hemp showed minimal yield response to added phosphate fertilizer.

Hybrid Poplar Underseeded to Forages

Sherrilyn Phelps and Shannon Chant, Leo Perlinger
Saskatchewan Ministry of Agriculture: North Battleford and Swift Current
Western Applied Research Corporation: Scott

The increasing value of woodlots coupled with payments for carbon sequestration are encouraging producers to consider planting acres of woodlots. However, the current methods of planting trees involve tillage and keeping bare ground to control weeds which goes against carbon sequestration. In 2006 we started looking at establishment in no-till versus tilled land and had good success. For 2007 and 2008 the objective was to evaluate the effect of underseeding the trees to legume forages. The legume forages may provide increased carbon sequestration, nitrogen fixation to aid tree fertility, and competition to weeds.

The poplar seedling were originally planted in 2005 in 6 rows. The East 3 rows were planted into rototilled land, and the West 3 rows were direct seeded into standing stubble. The weed control on the rototilled land was accomplished by further rototilling whereas the direct seeded land was controlled with glyphosate. In 2006 hybrid poplar seedlings were underseeded to alsike clover, birdsfoot trefoil and black medic. The plantation consisted of 6 rows of poplars with 31 poplars per row. There were 2 rows for each forage that were underseeded (one in rotolled poplars and one in direct seeded poplars). Seeding of the forages consisted of 1 m of the intended forage on each side of the intended tree row.

In 2007 the forages were mowed 3x during the summer at full bloom stages. Weeds were controlled by hand removal (weed wiper) in areas not mowed such as near poplars. Black medic did not establish and was therefore left as bare ground. Herbicides were used to control the weeds in these rows.

Table 1 summarizes the growth of the trees from 2006 to 2007. There was just under 1 metre of growth in the trees with the tilled side doing better than the direct planted.

Table 1. Summary of the hybrid poplar seedlings

		tilled			direct planted		
Number of trees		Alsike clover	birdsfoot trefoil	black medic	Alsike clover	birdsfoot trefoil	black medic
	2006	21	21	24	20	20	26
	2007	21	20	23	21	22	25
Height (cm)							
	2006	38.1	39.8	31.6	34.9	38.0	34.5
	2007	136.7	134.8	124.9	124.9	113.8	122.8
growth (2007 - 2006)		**98.6**	**95.0**	**93.3**	**90.1**	**75.8**	**88.3**
st dev							
	2006	9.0	11.6	11.1	10.3	9.0	9.5
	2007	34.7	31.2	35.5	26.7	31.2	37.2

In terms of the effect of the forages initial results indicated that where the alsike clover was planted the trees are growing more. However, in late 2008 it was determined that the forages were reducing the growth of the trees (Figure 1) and the forages were terminated. Mulch of oat straw was applied in late August as a means to reduce weed pressure and to improve soil moisture retention.

Figure 1. Hybrid poplar row with no forages on left, poplar row with forage on right. Picture taken fall of 2008 after mulch applied to tree rows.

Willow Demonstration

Sherrilyn Phelps and Shannon Chant
Saskatchewan Ministry of Agriculture: North Battleford and Swift Current

On June 4 and 5th in 2007willow plugs were planted at Scott, SK. With 150 plugs in 2 rows. The objective of this demonstration was to evaluate the growth of willows over 3 years when the biomass will be harvested.

The rows were 2.5 feet apart and the willows were 2 feet apart. Site preparation consisted of glyphosate application followed to rotilling a strip 300 feet long.

The rows were hand weeded, however were fairly clean throughout the year. Growth of the willows occurred quickly with visually no losses. No heights or counts were taken in 2007. In 2008 we will measure the height of 20 plants in early May prior to growth and then remeasure in October once growth ceases.

The Role of Inputs in a Canola-Barley Rotation;
Results of a 4 year study.

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SUMMARY
We examined the impact of inputs of improved cultivars, seed rate, fertilizer [full or half rates], herbicides [full or half rates] applied to the same plots over a 4 year period in a canola-barley sequence at 4 locations in Alberta and 2 locations in Saskatchewan. Results to date indicate that canola was much more responsive to almost all inputs tested than was barley. This suggests that canola would be a very poor candidate crop for input cuts compared with barley. Fertilizer and herbicide effects were not always evident in the first year of the study, but did tend to increase over time. This was expected as soil nutrient supplies became depleted and weed pressure increased where these inputs were reduced or eliminated. Cultivar effects with canola occurred quite consistently each year, but for barley effects were not as evident. Seed rate effects did not always appear and there was no evidence to suggest that their impact changed over time.

INTRODUCTION
Crop production in Western Canada relies heavily on the use of inputs. They include land, machinery, buildings, interest and labor as well as pesticides, fertilizer and seed. The latter three garner the most attention because their costs have risen much more rapidly that grain prices. From 1992 to 2002, crop values increased by 11%, but pesticide, fertilizer and seed costs rose by 28-65% (Statistics Canada, 2004). For this reason, farmers often question whether they can reduce these inputs without incurring yield losses that exceed cost savings.

With this in mind, a group of AAFC agronomists designed an experiment to examine the role of inputs in our cropping systems. It was unreasonable to look at all possible input combinations with all crops. We decided that we would try to determine if inputs had the same impact in an input system that targeted high yield as in an input package that targeted low yield [the full and empty input concept]. It was also important to examine if input impacts differed for different crops, or if inputs would have cumulative effects over time. We also felt it was important to determine if the importance of various inputs varied across soil and climatic zones, and ensure that results could be broadly applied. The objectives of the study were: To determine if some crops were better candidates for input cuts than others: To determiner which inputs to target if cuts are made: Assess whether use of one input affects responses to others: To generate a preliminary understanding of potential cumulative effects of input cuts over time.

STUDY DESCRIPTION
Studies were designed as a split plot factorial with canola and barley as main plots and inputs as factors in sub plots. The same input strategy was applied to each plot for a period of 4 years to evaluate cumulative effects in a canola-barley or barley-canola rotation. Wild oat and wild buckwheat at 100 seeds m^{-2} were seeded into all plots, in year one only. Crops were direct seeded, and treatments were as described in Table 1. For a full description of how the treatments were applied and the studies managed at each site year, refer to Appendix A1 to A4.

The full canola input package consisted of 5020 hybrid canola sown at 6.4 lb/ac, fertilized so that available soil plus fertilizer N, P, K, S were sufficient for target yields of 30-45 bu/ac depending on location based on a "Crop Nutrient Use Calculator" from the Canadian Fertilizer Institute. [The calculator can be accessed at http://www.agric.gov.ab.ca/app19/calc/crop/nutrientuse.jsp]*] Liberty at 1.35 L/ac

The empty canola package consists of LBD 2393LL OP canola [74P00 LL in 2007and 84S00 LL in 2008] sown at 3.2 lb/ac; no fertilizer; no herbicide. The 50% fertilizer rate targeted 50% yields, while the 50% herbicide rate was 0.68 l/ac of Liberty.

The full barley input package consisted of AC Metcalfe barley seeded at 2.6 bu/ac; fertilized so that available soil plus fertilizer N, and P were sufficient for target yields of 50-80 bu/ac depending on location, and Achieve [0.2L/ac] plus Buctril M [0.4 L/ac]. The empty barley input package consisted of; Harrington barley seeded 1.3 bu/ac, no fertilizer, no herbicide. The 50% fertilizer rate targeted 50% yields, while the 50% herbicide rate was half the full rate.

Table 1. Treatment descriptions for canola and barley in the input study.

1) Full package	2) Empty package
3) Full package minus genetics	4) Empty package plus genetics
5) Full package minus seed	6) Empty package plus seed
7) Full package minus 50% fertilizer	8) Empty package plus 50% fertilizer
9) Full package minus 100% fertilizer	10) Empty package plus 100% fertilizer
11) Full package minus 50% herbicide	12) Empty package plus 50% herbicide
13) Full package minus 100% herbicide	14) Empty package plus 100% herbicide

Table 2. Canola and barley input costs [$/ac] with several inputs added to a full input package or removed from an 'empty' input package during 2005 to 2008.

Treatment	Canola				
	2005	**2006**	**2007**	**2008**	**4 yr mean**
FULL Inputs	110	117	113	120	115
Full – genetics	90	97	93	105	96
Full – 50% seed	89	96	92	99	94
Full – 50% fert	69	97	75	77	80
Full – 100% fert	54	54	54	54	54
Full – 50% herb	100	107	103	110	105
Full – 100% herb	84	91	87	95	89
EMPTY Inputs	0	0	0	0	0
Empty + genetics	7	7	7	7	7
Empty + 50% seed	14	14	14	14	14
Empty + 50% fert	15	43	20	23	25
Empty + 100% fert	55	63	59	66	61
Empty + 50% herb	15	15	15	15	15
Empty + 100% herb	26	26	26	26	26
	Barley				
FULL Inputs	110	117	113	82	106
Full – genetics	90	97	93	66	87
Full – 50% seed	89	96	92	74	88
Full – 50% fert	69	97	75	54	74
Full – 100% fert	54	54	54	36	50
Full – 50% herb	100	107	103	70	95
Full – 100% herb	84	91	87	53	79
EMPTY Inputs	0	0	0	0	0
Empty + genetics	7	7	7	1	6
Empty + 50% seed	14	14	14	6	12
Empty + 50% fert	15	43	20	16	24
Empty + 100% fert	55	63	59	46	56
Empty + 50% herb	15	15	15	17	16
Empty + 100% herb	27	27	27	29	28

Studies were initiated in 2005 at Lacombe, Beaverlodge and Fort Vermilion in AB, and Scott and Melfort SK, and in 2006 at Lethbridge AB. At Fort Vermilion, only canola was grown in 2005, but both crops were included at this location in 2006. Hail caused extensive damage at Scott in 2006, and flooding of canola at Lacombe in 2007, so data for these site years was not included. The study was not conducted at Fort Vermilion in 2008.

Studies were evaluated for effects on plant densities, weed density and biomass, residual soil nutrients, grain yield, crop quality factors and economic contribution margins. Contribution margins were calculated by multiplying the effect of each input on yield by $8/bu for canola or $3.50/bu for barley, and subtracting the additional cost of using that input (Table 2).

It is not feasible to present and discuss all data, so much of the discussion is based on averages across all sites for each year. Readers are cautioned that there was considerable variability across site years, meaning that results would apply generally, but that in individual cases responses could be quite different from what is reported here.

RESULTS

Plant Density; Table 3

1. Plant densities shortly after emergence generally reflected the rate of seeding for both canola and barley.

2. Switching from the higher yielding hybrid canola cultivar to the lower yielding one resulted in reduced plant density during 2007 and 2008. Cultivar had no effect on plant density of barley.

3. Reducing seeding rate by 50% resulted in a less than 50% reduction in plant density indicating that percent emergence was generally higher at low seed rates than high seed rates reflecting greater interplant competition at higher seed rates.

4. Canola plant densities sometimes declined where herbicides were removed from full inputs and increased where full herbicides were added to empty inputs.

5. Removing all fertilizer from full inputs significantly increased canola density at some location years, possibly due to inadequate separation of seed from fertilizer.

6. Canola plant densities declined over the growing season (Tables 3 and 4).

7. Plant densities after harvest were also affected by seed rate, but likely also reflected effects of weed competition where herbicides were either omitted or added. Removing all herbicides with full inputs reduced post harvest plant density from 94 to 72 plants per m^2 when averaged across all locations, while adding full herbicides back into the empty input package increased densities from 46 to 61 plants.

8. If we need 30 plants per m2 at harvest to avoid having inadequate plants for near optimum yield, densities were below that threshold in 10 of 22 cases with empty inputs. Restoring full seeding rate with empty inputs decreased that to 8 cases. However, adding half or full herbicides to empty inputs reduced the number of cases where densities declined below 30 plants to 3 and 1 case respectively. With full inputs densities were above this threshold in almost all cases, except where the seed rate was cut in half or all herbicide was removed, and in those cases the threshold was not exceeded in 3 of 22 cases for both.

Table 3. Influence of adding or removing inputs on canola and barley plant densities [plants m^{-2}] shortly after emergence during 2005 to 2008.

Treatment	Canola				
	2005	**2006**	**2007**	**2008**	**4 yr mean**
FULL Inputs	168	168	91	97	110
Full – genetics	176	176	76	73	96
Full – 50% seed	103	103	58	56	67
Full – 50% fert	186	186	88	96	114
Full – 100% fert	159	159	90	110	114
Full – 50% herb	183	183	87	91	111
Full – 100% herb	156	156	83	82	102
EMPTY Inputs	111	111	51	40	63
Empty + genetics	102	102	65	51	69
Empty + 50% seed	186	186	86	72	104
Empty + 50% fert	108	108	52	37	61
Empty + 100% fert	112	112	42	34	58
Empty + 50% herb	103	103	51	39	61
Empty + 100% herb	104	104	51	52	66
LSD P=0.05	**33**	**15**	**10**	**11**	

Table 3 continued	Barley				
FULL Inputs	192	198	167	211	192
Full – genetics	207	174	185	220	197
Full – 50% seed	135	106	108	157	127
Full – 50% fert	208	193	170	201	193
Full – 100% fert	196	186	170	213	191
Full – 50% herb	194	196	166	230	197
Full – 100% herb	198	190	157	203	187
EMPTY Inputs	130	118	112	126	122
Empty + genetics	124	118	94	134	118
Empty + 50% seed	183	173	166	218	185
Empty + 50% fert	127	120	109	134	123
Empty + 100% fert	127	119	107	134	122
Empty + 50% herb	130	100	113	133	119
Empty + 100% herb	118	100	102	125	111
LSD P=0.05	**35**	**19**	**12**	**18**	

Table 4. Post harvest canola plant density [plants m^{-2}] with several inputs either added to a full input package or removed from an 'empty' input package during 2005 to 2008.

Treatment	Canola				
	2005	**2006**	**2007**	**2008**	**4 yr mean**
FULL Inputs	138	75	77	84	94
Full – genetics	132	65	72	65	84
Full – 50% seed	83	47	54	49	58
Full – 50% fert	146	78	78	80	96
Full – 100% fert	135	84	83	91	98
Full – 50% herb	140	69	80	79	92
Full – 100% herb	120	68	49	50	72
EMPTY Inputs	97	43	23	21	46
Empty + genetics	83	49	33	24	47
Empty + 50% seed	142	59	42	27	68
Empty + 50% fert	98	39	29	20	47
Empty + 100% fert	85	41	23	21	43
Empty + 50% herb	98	52	46	33	57
Empty + 100% herb	95	58	48	43	61
LSD P=0.05	**12.5**	**7.6**	**6.7**	**7.6**	

Weed Density and Weed Biomass; Table 5 and Table 6.

1. Weed densities before treatment in 2005 were generally unaffected by input treatments because weeds were sown prior to the crop. However in 2006, treatments where herbicides were eliminated in 2005 had higher weed densities reflecting weed seeds generated the previous year, and this trend was amplified in 2007 and 2008

2. Overall weed densities and weed biomass increased with each additional year, except in barley in 2008 which showed a decline compared with 2007.

3. Use of herbicides at either the 50% or full rate reduced weed biomass at some locations in 2005, most locations in 2006, and all but Melfort [full inputs canola only] in 2007, and all locations in 2008.

4. Differences in weed densities and biomass between the 50% and 100% rates of herbicide started to appear in 2007 and become more apparent in 2008.

5. With barley, weed biomass increased somewhat with no herbicide in 2005, but increased much more with no herbicide in 2006, and again in 2007

6. The difference in weed biomass between herbicide treated and untreated treatments increased with each successive year with both crops.

7. In 6 of 16 cases, adding the hybrid canola cultivar back into empty inputs decreased weed biomass. Also in 6 cases, increasing the seed rate with empty inputs decreased weed biomass in canola. With barley, genetics had no effect but doubling seed rate with empty inputs did reduce weed biomass in 5 of 15 cases.
8. In the absence of herbicides, weeds became a serious problem at Scott in 2005, at Lacombe in 2006, and most other locations by 2007.
9. Adding fertilizer in the absence of herbicides frequently increased weed biomass suggesting that weeds may have benefited at least as much as the crop from improved supply of nutrients.

Table 5. Influence of adding or removing inputs on weed densities [plants m^{-2}] prior to herbicide application on canola and barley during 2005 to 2008.

Treatment	Canola				
	2005	**2006**	**2007**	**2008**	**4 yr mean**
FULL Inputs	73	115	30	61	70
Full – genetics	65	127	27	66	71
Full – 50% seed	73	127	23	142	91
Full – 50% fert	90	117	31	92	83
Full – 100% fert	68	116	22	91	74
Full – 50% herb	69	154	43	166	108
Full – 100% herb	76	293	309	445	281
EMPTY Inputs	93	297	361	477	307
Empty + genetics	72	280	363	411	282
Empty + 50% seed	73	281	275	451	270
Empty + 50% fert	87	330	377	539	333
Empty + 100% fert	85	310	516	579	372
Empty + 50% herb	73	186	87	254	150
Empty + 100% herb	67	134	36	180	104
LSD P=0.05	**30**	**65**	**71**	**73**	
	Barley				
FULL Inputs	99	259	163	60	145
Full – genetics	77	267	194	57	149
Full – 50% seed	73	260	195	42	143
Full – 50% fert	86	223	135	52	124
Full – 100% fert	73	224	137	45	120
Full – 50% herb	75	210	161	69	129
Full – 100% herb	81	233	368	324	252
EMPTY Inputs	94	254	612	398	340
Empty + genetics	91	280	516	306	298
Empty + 50% seed	82	264	462	317	281
Empty + 50% fert	98	247	636	376	339
Empty + 100% fert	79	278	558	367	321
Empty + 50% herb	68	221	443	192	231
Empty + 100% herb	89	275	286	86	184
LSD P=0.05	**41**	**75**	**180**	**67**	

Table 6. Influence of adding or removing inputs on weed biomass [Kg ha^{-1}] in canola and barley during 2005 to 2008.

Treatment	Canola				
	2005	**2006**	**2007**	**2008**	**4 yr mean**
FULL Inputs	65	15	9	118	52
Full – genetics	29	31	16	133	52
Full – 50% seed	123	34	7	115	70
Full – 50% fert	90	9	24	159	71
Full – 100% fert	49	32	10	247	85
Full – 50% herb	30	45	95	451	155
Full – 100% herb	1338	1580	3634	3129	2420
EMPTY Inputs	2496	2494	3379	3416	2946
Empty + genetics	1855	1857	3124	3156	2498
Empty + 50% seed	1862	2148	2858	3306	2543
Empty + 50% fert	2420	2972	4052	4015	3365
Empty + 100% fert	2558	3009	4780	4041	3597
Empty + 50% herb	304	311	375	1894	721
Empty + 100% herb	105	118	48	327	150
LSD P=0.05	**175**	**431**	**379**	**538**	
	Barley				
FULL Inputs	10	24	103	82	55
Full – genetics	10	20	65	56	38
Full – 50% seed	25	71	259	108	116
Full – 50% fert	14	46	73	72	51
Full – 100% fert	20	14	123	106	66
Full – 50% herb	31	41	304	106	121
Full – 100% herb	88	981	3079	2865	1753
EMPTY Inputs	108	1400	2635	2798	1735
Empty + genetics	149	1405	2880	2201	1659
Empty + 50% seed	70	934	2397	1978	1345
Empty + 50% fert	132	1522	3136	2878	1917
Empty + 100% fert	158	1718	4220	3445	2385
Empty + 50% herb	46	268	531	213	265
Empty + 100% herb	27	59	294	158	135
LSD P=0.05	**50**	**301**	**424**	**295**	

Barley leaf Diseases. Table 7.
1. Where AC Metcalfe was grown, net blotch was significantly lower than where Harrington was grown, independent of what other inputs were used. Inputs did not affect disease severity With AC Metcalfe. The trend was similar with other leaf spots, but severity on Harrington was not always higher, possibly because overall disease levels were too low to detect differences.
2. Where Harrington was grown, net blotch was most severe with full inputs. Full fertilizer with empty inputs increased severity of net blotch on Harrington in some cases compared with empty inputs without fertilizer. Increasing the seed rate of Harrington with empty inputs also tended to increase net blotch severity compared with empty alone in 2005.

Table 7. Influence of adding or removing inputs on severity [% leaf area affected] of net blotch and other leaf spots of barley during 2005 to 2007.

Treatment	**Net blotch**		
	2005	**2006**	**2007**
FULL Inputs	5.72	1.99	2.14
Full – genetics	21.50	12.44	13.70
Full – 50% seed	5.87	1.55	1.26
Full – 50% fert	4.76	0.41	1.76
Full – 100% fert	4.33	0.82	1.29
Full – 50% herb	4.84	1.61	2.16
Full – 100% herb	4.69	1.71	1.26
EMPTY Inputs	12.57	5.16	4.82
Empty + genetics	4.08	1.22	0.73
Empty + 50% seed	18.3	6.50	6.41
Empty + 50% fert	14.89	6.19	6.80
Empty + 100% fert	14.14	9.52	9.29
Empty + 50% herb	13.18	5.63	5.52
Empty + 100% herb	11.63	5.04	6.20
LSD P=0.05	**3.0**	**1.8**	**2.4**
	Other leaf spots		
FULL Inputs	5.95	3.00	4.92
Full – genetics	11.08	3.99	5.06
Full – 50% seed	4.65	2.66	3.12
Full – 50% fert	5.48	2.63	5.28
Full – 100% fert	6.21	2.4	5.41
Full – 50% herb	5.41	3.05	4.03
Full – 100% herb	6.36	3.73	6.08
EMPTY Inputs	10.44	4.46	6.75
Empty + genetics	5.62	2.69	4.65
Empty + 50% seed	12.09	4.27	7.80
Empty + 50% fert	10.19	4.09	6.72
Empty + 100% fert	10.92	4.36	7.39
Empty + 50% herb	9.44	3.62	5.91
Empty + 100% herb	8.92	3.47	5.19
LSD P=0.05	**2.4**	**0.6**	**2.3**

Grain Yield and Contribution Margin; Table 8 and Table 9. [See also Appendix B8 and B9].
1. Full inputs increased canola yield significantly in 20 of 21 cases compared with empty inputs, by an average 31bu/ac over all location years. Full inputs increased barley yield significantly in all 20 cases, averaging 42 bu/ac more over all location years. Differences between full vs empty inputs got larger with each successive year, mostly reflecting increasing weed pressure and declining nutrient supplies from soil. The contribution margin for full inputs was $111/ac for canola and $36/ac for barley compared with empty inputs.

2. With full inputs, the higher yielding canola cultivar increased canola yield significantly in 12 of 21 cases, and decreased yield significantly in one case. Barley yield increased significantly in 6 cases and decreased significantly in 3 of 20 cases where the higher yielding cultivar was used. Over all comparisons, canola yield increased by 7 bu/ac on average, and barley by 5 bu/ac improving contribution margin for canola by $36/ac and decreasing contribution margin for barley by $-4/ac for the higher yielding cultivars of canola and barley respectively.

Table 8. Influence of adding or removing inputs on canola and barley yield [bu/ac] during 2005 to 2007.

Treatment	Canola				
	2005	**2006**	**2007**	**2008**	**4 yr mean**
FULL Inputs	53	48	36	43	45
Full – genetics	46	41	33	34	38
Full – 50% seed	54	39	32	42	42
Full – 50% fert	49	46	32	32	40
Full – 100% fert	41	35	26	25	32
Full – 50% herb	55	46	35	41	44
Full – 100% herb	47	38	16	12	28
EMPTY Inputs	25	21	6	2	14
Empty + genetics	29	26	9	3	17
Empty + 50% seed	26	25	7	2	15
Empty + 50% fert	27	26	6	5	16
Empty + 100% fert	32	27	7	4	18
Empty + 50% herb	35	27	20	11	23
Empty + 100% herb	34	30	22	18	26
LSD P=0.05	**6.3**	**5.6**	**2.5**	**3.3**	
	Barley				
FULL Inputs	70	86	77	73	77
Full – genetics	65	85	68	70	72
Full – 50% seed	73	85	68	74	75
Full – 50% fert	60	81	69	68	69
Full – 100% fert	49	73	59	63	61
Full – 50% herb	67	87	73	74	75
Full – 100% herb	60	72	38	36	51
EMPTY Inputs	46	50	24	19	35
Empty + genetics	44	50	24	27	36
Empty + 50% seed	45	56	28	29	40
Empty + 50% fert	52	57	26	25	40
Empty + 100% fert	59	62	24	26	43
Empty + 50% herb	52	67	44	57	55
Empty + 100% herb	52	68	48	59	57
LSD P=0.05	**7.1**	**7.2**	**4.1**	**4.7**	

3. With empty inputs, the higher yielding cultivar increased canola yield significantly in 4 of 21 cases, while increasing barley yield in 2 and decreasing barley yield significantly in one of 20 cases. Over all comparisons, canola yield increased by 3 and barley by 1 bu/ac. The contribution margin for the higher yielding cultivar was $18/ac for canola and $4/ac for barley.

4. With full inputs, the full seed rate compared with the 50% rate did not affect canola yield in 2005 or 2008, but increased it significantly in 4 of 5 cases in 2006, while decreasing yield significantly in 2 of 6 cases in 2007. With barley, yield was increased significantly in 5 and decreased significantly in 2 of 20 cases. Over all comparisons canola and barley yield was increased by an average of 3 and 2 bu/ac respectively, and economic returns [contribution margin] decreased by $6/ac for canola and increased by $4/ac for barley.

5. Increasing seed rate with empty inputs increased canola yield significantly in 2 cases, while increasing barley yield significantly in 6 cases, and decreasing it significantly in another. Over all comparisons both canola and barley yields were increased by 3 bu/ac, which decreased economic returns by $-1/ac for canola and in creased it by $9/ac for barley.
6. Adding half or all fertilizer compared with no fertilizer with full inputs increased canola yield significantly in 14 and 16 cases respectively, by an average of 8 and 13 bu/ac over all comparisons. Barley yield was increased significantly in 9 and 12 cases respectively by an average of 8 and 16 bu/ac where half and full rates of fertilizer were used compared with no fertilizer. Half rates of fertilizer increased economic returns by $32/ac for canola and $4/ac for barley over no fertilizer. Full rates increased returns by $15/ac for canola, but decreased net returns by $17/ac for barley.
7. Adding half or all fertilizer back with empty inputs increased canola yield significantly in 3 and 5 cases respectively by an average of 2 and 4 bu/ac. Barley yield was increased significantly in 6 and 8 cases respectively by an average of 5 and 8 bu/ac. The economic impact of half rate fertilizer was a **decrease** of $5/ac for both canola and barley compared with no fertilizer. The full fertilizer rate **decreased** economic returns by $55/ac for canola and $42/ac for barley compared with no fertilizer.
8. Adding half or all herbicide with full inputs increased canola yield significantly in 16 and 17 cases respectively, by an average of 16 and 17 bu/ac. Barley yield was increased significantly in 7 and 15 cases respectively by an average of 26 and 29 bu/ac. The half rate of herbicide increased economic returns by $114/ac for canola and $65/ac for barley compared with no herbicide. Full rates of herbicide resulted in increased economic returns of $111/ac and $57/ac for canola and barley.
9. Adding half or all herbicide back with empty inputs increased canola yield significantly in 12 and 15 cases respectively by an average of 9 and 12 bu/ac. Barley yield was increased significantly in 15 and 16 cases respectively by an average of 20 and 22 bu/ac. Full and half rate herbicide increased canola economic returns by $62 and $78/ac, and barley by $53 and $47/ac compared with no herbicide.
10. A closer look at the data reveals that we are still achieving unexpectedly high yields from **FULL** inputs with no fertilizer, even after 4 years. Canola yield has declined each year, likely reflecting depletion of soil nutrients. But barley yield may reflect climatic conditions as well as depletion of soil nutrients because barley yield with this treatment was lowest in 2005, highest in 2006 and intermediate in 2007 and 2008. To support these yields would require approximately 65 to over 100 kg/ha of N, but soil test N was typically less than 30 kg/ha. This suggests that the soil is supplying far more than conventional soil testing suggests. This likely reflects improvements in the nutrient supplying capacity of the soil due to elimination of fallow, and tillage as well as introduction of N fixing pulses into rotations. It also suggests that there is considerable potential to reduce fertilizer N on well managed soils if we can accurately predict how much the soil is supplying.

Table 9. Influence of adding or removing inputs on canola and barley contribution margin [$/ac] during 2005 to 2007.

Treatment	Canola				
	2005	**2006**	**2007**	**2008**	**4 yr mean**
FULL Inputs	83	75	98	186	111
Full – genetics	41	31	94	134	75
Full – 50% seed	113	24	128	203	117
Full – 50% fert	108	114	133	156	128
Full – 100% fert	73	57	120	134	96
Full – 50% herb	106	58	110	183	114
Full – 100% herb	65	19	-49	-35	0
EMPTY Inputs	0	0	0	0	0
Empty + genetics	29	26	20	1	19
Empty + 50% seed	-3	12	-2	-12	-1
Empty + 50% fert	-10	14	-21	-3	-5
Empty + 100% fert	-28	-39	-83	-70	-55
Empty + 50% herb	63	31	97	57	62
Empty + 100% herb	50	44	111	105	78
LSD P=0.05	**44**	**52**	**34**	**60**	**48**

Table 9 continued	Barley				
FULL Inputs	-20	13	73	77	36
Full – genetics	-19	32	61	84	40
Full – 50% seed	0	21	52	88	40
Full – 50% fert	-10	43	89	104	57
Full – 100% fert	-26	43	83	111	53
Full – 50% herb	-19	35	69	90	44
Full – 100% herb	-25	-6	-30	-21	-21
EMPTY Inputs	0	0	0	0	0
Empty + genetics	-7	-2	-2	25	4
Empty + 50% seed	-8	12	7	26	9
Empty + 50% fert	-1	0	-17	-3	-5
Empty + 100% fert	-20	-32	-69	-47	-42
Empty + 50% herb	6	41	52	113	53
Empty + 100% herb	-5	30	55	108	47
LSD P=0.05	**26**	**31**	**26**	**53**	**34**

Crop Quality

Crop quality data on seed weight, green seed [canola only], protein, oil content [canola only] as well as data for barley on volume weight, % plump and % thin seed have not been completed for all years to date. Interpretation of results will have to await completion of these analyses. Results to date do suggest a fairly consistent cultivar effect for some quality parameters, while fertility and weed control effects sometimes differed depending on the input level used. Seed rate also affected quality in some cases.

Soil Sampling and Analysis for Microbiological Properties

Only fertilizer and herbicide input treatments were sampled for microbiological properties. Soil samples were collected at flowering stage of canola growth and flag-leaf stage of barley growth. Plants were excavated from four random 0.5-m lengths of row from each plot. Loose soil was shaken off the roots, and the soil that adhered strongly to the roots was carefully brushed and kept as rhizosphere soil. Non-rhizosphere (bulk) soil (0-7.5 cm depth) was sampled from the middle of two adjacent crop rows near each of the four locations per plot. The four bulk or rhizosphere samples from each plot were bulked, sieved through a 2-mm sieve and stored at 4 ºC until required for analysis.

Soil microbial biomass C (MBC) was measured using the substrate-induced respiration (SIR) method, in which 300 mg of glucose was dissolved in 4.5 mL of water and added to 50 g air-dry soil. The soil was incubated in 1-L jars for 3 h at 22 ºC, and the amount of CO_2 that accumulated in the head space was measured by gas chromatography.

The functional diversity of soil bacteria was evaluated by the Biolog™ method, which tests the ability of a microbial community to utilize different C substrates contained in a microplate. The procedure was adapted by colorimetrically standardizing inoculum densities in all (1 g) soil samples to about 10^3 cells mL^{-1}. Aliquots of 150 µL of the soil suspension were added to Biolog Ecoplates™ microplates containing 31 substrates and a water control. The plates were incubated at 28 ºC without shaking. Optical densities in the wells were read with an enzyme-linked immunosorbent assay (ELISA) plate reader (at 590 nm) after 48 h of incubation. The optical density readings were corrected for the water controls in subsequent analyses. Negative readings after the correction were adjusted to zero.

On the basis of the patterns of utilization of the substrates by the bacteria in the soil suspensions, diversity was evaluated by calculating Shannon-Weaver diversity index (H') as follows: H' = -Spi (ln pi) where pi = Ratio of activity (i.e., optical density reading) on the ith substrate to the sum of activities on all substrates. S is the number of different substrates (out of 31) used by the bacterial community. Results were analysed as a factorial combination of the percentage of input type (herbicide or fertilizer) and input rate (plus or minus 0, 50 and 100%).

Results and Discussion

Only results from canola plots are reported here. At Beaverlodge, adding herbicide to a canola empty package increased microbial biomass in canola rhizosphere relative to adding fertilizer (Table 10). However, subtracting herbicide from a full package resulted in greater bacterial diversity in canola rhizosphere than subtracting fertilizer (Table 11). These effects were not significant in 2007.

There were quadratic responses of microbial biomass and bacterial diversity with decreasing fertilizer or herbicide inputs in canola rhizosphere of a full package at Beaverlodge (Table 11). Thus, while microbial biomass decreased with decreasing inputs between -0 and -50%, but increased between -50 and -100%, the reverse occurred for bacterial diversity, i.e., increased between -0 and -50% and increased between -50% and -100%. In bulk soil, bacterial diversity decreased linearly with decreasing fertilizer or herbicide inputs at Beaverlodge (Table 11). Subtracting inputs from a full package had no effects on soil microbiological properties in 2007.

At Lacombe, there was a significant interaction in microbial biomass in canola rhizosphere between increasing herbicide and increasing fertilizer inputs to an empty package (Table 12). Increasing herbicide inputs increased microbial biomass linearly, but increasing fertilizer inputs resulted in a quadratic response of an initial increase followed by a decrease in microbial biomass (Fig. 1). A quadratic response of bacterial diversity was also observed with increasing fertilizer or herbicide inputs to an empty package at Lacombe, i.e., an initial decline followed by a slight recovery (Table 12). This quadratic response is similar to what was observed for both inputs in canola rhizosphere at Beaverlodge in 2007.

Interpretation of these results is difficult because significant effects are different from year to year. It may become clearer when results from 2008 are also analysed.

Table 10. Effects of adding inputs to a canola empty package on soil microbial biomass C (MBC) and bacterial diversity (Shannon index, H') at Beaverlodge in 2008.

	Rhizosphere	
Treatment	MBC (mg kg^{-1} soil)	H'
Input (n = 12)		
+Fertilizer	429b	2.12
+Herbicide	627a	2.20
SEM (15 df)	51	0.13ns
Input percentage (n = 8)		
+0	625	2.06
+50	516	1.98
+100	444	2.45
SEM (15 df)	63ns	0.16ns
Linear contrast	n.a.	n.a.
Quadratic contrast	n.a.	n.a.
Input x Input percentage	ns	Ns

Table 11. Effects of subtracting inputs to a canola full package on soil microbial biomass C (MBC) and bacterial diversity (Shannon index, H') at Beaverlodge in 2008.

	Rhizosphere		Bulk soil	
Treatment	MBC (mg kg^{-1} soil)	H'	MBC (mg kg^{-1} soil)	H'
Input (n = 12)				
-Fertilizer	438	2.34b	977	2.16
-Herbicide	367	2.56a	1052	2.13
SEM (15 df)	41ns	0.06	82	0.10
Input percentage (n = 8)				
-0	493	2.34	974	2.37
-50	297	2.61	931	2.16
-100	416	2.40	1138	1.91
SEM (15 df)	51	0.07	101ns	0.12
Linear contrast	ns	ns	n.a.	*
Quadratic contrast	*	*	n.a.	ns
Input x Input percentage	ns	ns	ns	ns

Table 12. Effects of adding inputs to a canola empty package on soil microbial biomass C (MBC) and bacterial diversity (Shannon index, H') at Lacombe in 2008.

	Rhizosphere	
Treatment	MBC (mg kg^{-1} soil)	H'
Input (n = 12)		
+Fertilizer	687	2.61
+Herbicide	640	2.57
SEM (15 df)	24ns	0.04ns
Input percentage (n = 8)		
+0	573	2.71
+50	735	2.49
+100	682	2.58
SEM (15 df)	29	0.04
Linear contrast	*	*
Quadratic contrast	**	**
Input x Input percentage	* (Fig. 1)	ns

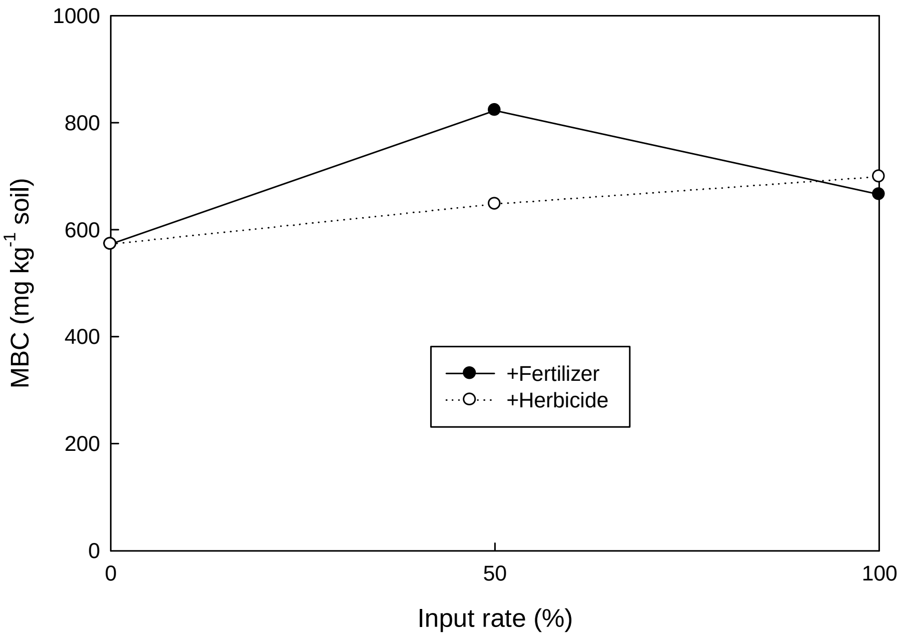

Fig. 1. Interaction between fertilizer and herbicide addition to a canola on soil microbial biomass C (MBC) at Lacombe in 2008.

Future Work

The 4 year canola-barley input study has field work complete. The next step is to see how long it will take to get the empty input packages and those with weed and fertility issues back into production. The next phase is a recovery project and will begin in 2009.

2008 Fall Tillage Trial

Sherrilyn Phelps[1], Stu Brandt[2], Eric Johnson[2], and Arlen Kapiniak[2]
[1]Saskatchewan Ministry of Agriculture
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Objectives and Background:
This project was set up to look at the effects of fall tillage on temperature and soil nitrogen. It is well documented that tilled soils warm up quicker in the spring and encourage better germination. With the movement to direct seeding fall tillage has gone to the wayside. However, harrowing is still common and is often done in the fall under these systems. Producers who use the fall harrowing feel that they are getting better germination in the spring. It is possible that there may also be an increase in soil temperatures and N mineralization as a result of fall harrowing. Before we can evaluate the impact of different tillage systems we need to have methods to detect difference if they are present. The objective of this study was to determine if we could detect differences between no till and extreme tillage using Western Ag Labs soil probes and temperature probes.

Materials and Methods
Small plots measuring 1 m x 5 m with 4 replicates per treatment were situated on wheat stubble. The treatments consisted of tilled versus no till in the fall. In late October the tilled plots were rototilled in one pass to a depth of 4 inches. Digital soil temperature probes were inserted to a depth of 2.5 inches on May 6th and removed July 17th. Two PRS probe pairs per plot were inserted on May 6th. The first set was removed after 24 hrs to give initial soil N measurements. At 2 weeks after initial insertion the second set was removed and replaced with a fresh pair of probes. Exchange of probes occurred every 2 weeks until the last probes were removed 56 days after the initial insertions. Probes that were removed from plots were thoroughly cleaned and sent to Western Ag Labs for analsysis. Western Ag Labs provided us with measurements for nitrogen (NO3, NH4 and total N).

Results and Conclusions:

Initial soil N levels show that there was a slight increase in N availability in the tilled plot compared to the no till plots on May 6th however the amount was not statistically significant. With continued measurements of soil nitrogen over time there was no detectable differences between the tilled and no-tilled plots as the curves were almost identical (Figure 1).

On the other hand, average daily temperatures were different between the tilled and no-till plots. The tilled plots were consistently higher in daily average temperatures with the overall average being 1 degree Celcius higher than the no-till plots (Figure 3).

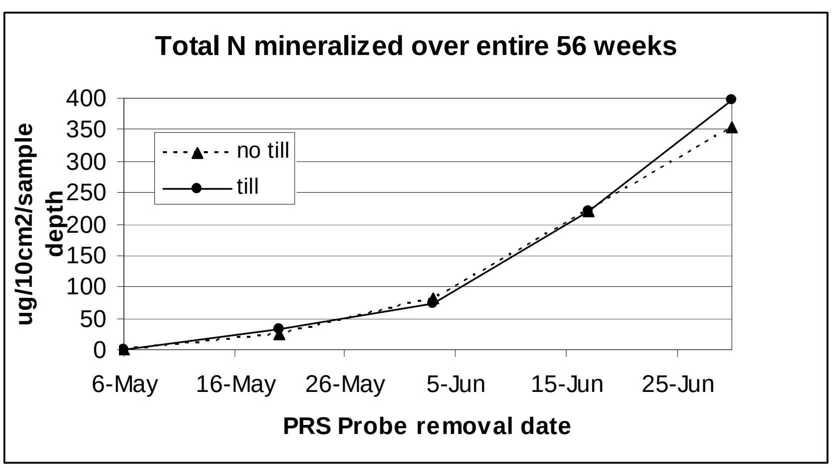

Figure 1. Amount of N (NO3 + NH4) mineralized over the 56 weeks of the experiment.

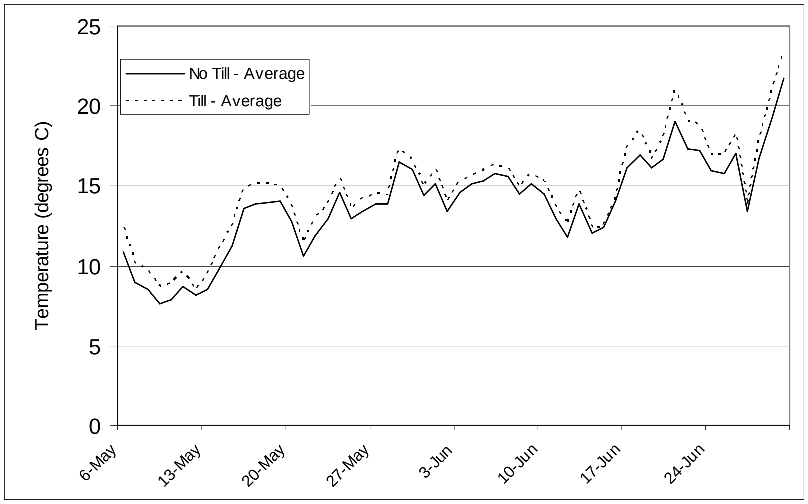

Figure 3. Effect of tillage on daily average temperatures.

Conclusion

In conclusion this trial confirmed previous research that there is an effect of tillage on soil temperature and that this soil temperature difference remains in effect well into the growing season. In terms of soil nitrogen, there was an indication that there was slightly higher nitrogen levels at the start of the growing season but our sampling methods were not able to show significant differences. In reality, even small differences in nutrient levels at the time when plants are small and can only access a small area of the soil can have large impacts on emergence and seedling health. Our methods were not able to detect differences in nitrogen due to high variability. More replications and better moisture conditions may reduce the variability and could be considered for further work.

2008 Western Canadian Ethanol Feedstock Trial

Interim Report – July 8, 2009

Phelps, S.M. [1], B. Beres[2], E. Johnson[2], C. Pozniak, S[3]. Chant[1]
[1] Saskatchewan Ministry of Agriculture; [2] Agriculture and AgriFood Canada; [3] Crop Development Centre - University of Saskatchewan

Introduction

As the interest in cereal grains for use as feedstock for ethanol production has been increasing since 2005, a project to evaluate the production of such grains was initiated. The project started in 2006 in Saskatchewan and the in 2007 it expanded to Western Canada and in 2008 the project expanded further to include 25 sites across Canada. For the results presented in this report the focus is on Western Canada sites and varieties that are currently registered in Canada. Cereals evaluated include triticale, Soft White Spring (CWSWS) wheat, Canada Eastern General Purpose (CWGP) wheat, Canada Prairie Spring (CPS) wheat, and Canada Western Red Spring (CWRS) wheat. Varieties of each class are listed in table 1.

Methods

Small plots were seeded in randomized complete block design at appropriate seeding dates for spring wheat 25 locations across Canada. Locations for this reports consist of 15 sites in 3 provinces: Saskatchewan (Canora, Glaslyn, Outlook , Melfort, Redvers, Regina Scott, Swift Current), Manitoba (Arborg, Melita, Roblin, Rosebank), Alberta (Killam, Lethbridge – dryland & irrigated)

Plots were maintained using appropriate pest management strategies including herbicides, fungicides and insecticides as needed. Fertility involved targeting high yields so nitrogen levels were set at 100 lbs total between soil and fertilizer N. Other nutrients were per soil test recommendations.

Plots were harvested using straight cut small plot combines and sub samples sent for further analysis

Data collection included days to heading,maturity, height at maturity, lodging and disease ratings, grain yield, test weights, kernel weight and crop biomass (straw yield). Protein concentration and starch content were analyzed by Dr. Curtis Pozniak with Crop Development Centre at the Univeristy of Saskatchwan.

Results

Grain yield results (Table 1) show very high yields ranging from 66 bu/acre to 84 bu/acre. Two irrigation sites are included in the data, which increased the yield performance but rankings weresimilar to rainfed sites. The dryland sites produced approximately 10 bu acre^{-1} less than the averages shown in Table 1 with the range going from 53 to 70 bu acre^{-1}. At the two irrigated sites, the yields were impressive and ranged from 117 to 148 bu acre^{-1}. The only difference in ranking between the irrigated and dryland sites was with AC Barrie and Unity. They performed better under irrigation than Superb and were also better than the CPS varieties.

Over all the locations the highest yielding were the soft white spring wheats (CWSWS) with AC Sadash the highest yielding variety over the 15 sites but not statistically different from Hoffman, AC Andrew, and Pronghorn.

Overall, the yield rankings were CWSWS > triticale>CPS=CWRS varieties. Within the CWSWS class, AC Sadash and AC Andrew out-yielded Bhishaj. There was no difference in yield with the triticale varieties as they all performed similarly. AC Vista was once again the top yielding CPS variety and Superb out yielded AC Barrie. Unity yielded in the middle between Superb and AC Barrie.

Table 1. Grain yield from 2008 Western Canadian Ethanol Feestock Trial. Data reported in kg ha^{-1}, bu ac^{-1} and % of AC Barrie.

		Grain Yield			
Variety	**Class**	**kg ha^{-1}**	**bu ac^{-1}**	**%**	*****
AC Sadash	SWS	5613	84	128%	a
Hoffman	CEGP	5459	82	124%	a
AC Andrew	SWS	5456	82	124%	a
Pronghorn	Triticale	5368	81	122%	ab
Bhishaj	SWS	5176	78	118%	b
Tyndal	Triticale	5050	76	115%	bc
AC Ultima	Triticale	5047	76	115%	bc
AC Vista	CPS	4826	72	110%	cd
Superb	HWRS	4665	70	106%	de
AC Crystal	CPS	4558	68	104%	ef
Unity	HWRS	4555	68	104%	ef
5700PR	CPS	4525	68	103%	ef
AC Barrie	HWRS	4386	66	100%	f
LSD ($p<0.05$)		*265*	*4*	*6%*	
CV		*13.67%*			

* varieties sharing the same letter are not statistically different

Other data collected is shown in Table 2. There was a difference in days to maturity as triticale was later than most other cereals. Triticale was also more prone to ergot. In terms of lodging the Eastern feed variety was more prone to lodging. Kernel weight varied by variety and class as a reflection of contrasting seed size; the triticale varieties and Hoffman had the largest kernel weights and the CWSWS wheat had the lowest kernel weights.

Straw yield and height at maturity are related. The taller varieties tended to produce the most straw.

Table 2. Days to maturity, thousand kernel weight, height and maturity, straw yield, and ergot and lodging rating results. Lodging and ergot ratings based on 1 to 5 scale where 1 is good, 5 is poor. Number of sites that collected the data are indicated at the bottom of the table

Variety	Class	Maturity days	Lodging rating	Ergot rating	KWT $G\ 1000^{-1}$	Height cm	straw $kg\,ha^{-1}$
AC Ultima	Triticale	106	1.58	2.03	44	99	6372
Pronghorn	Triticale	108	1.51	1.82	43	107	6529
Tyndal	Triticale	108	1.28	1.76	44	104	6257
AC Andrew	SWS	105	1.30	1.24	37	85	5813
AC Sadash	SWS	105	1.37	1.11	35	87	5820
Bhishaj	SWS	104	1.53	1.03	35	86	5474
AC Barrie	HWRS	106	1.37	1.24	36	92	5300
Superb	HWRS	108	1.21	1.18	40	86	5095
Unity	HWRS	102	1.63	1.16	34	94	5430
5700PR	CPS	105	1.19	1.11	38	78	5164
AC Crystal	CPS	104	1.35	1.03	39	81	4924
AC Vista	CPS	103	1.74	1.00	40	84	5071
Hoffman	CEGP	105	1.81	1.00	45	101	6420
# sites		*9*	*13*	*11*	*13*	*15*	*8*
LSD (p<0.05)		*2*	*0.24*	*0.18*	*0.73*	*1.55*	*325*
CV		*1.61*	*38*	*30.78*	*4.36*	*4.23*	*10.30*

Analysis of the grain for percent protein, starch and pentosans was performed by Dr. Curtis Pozniak at the University of Saskatchewan (Table 3). Data shows that AC Sadash had the lowest protein and highest starch over all other varieties. The other SWS wheats of AC Andrew and Bhishaj were similar to AC Sadash with AC Andrew having lower starch than AC Sadash. Comparing the crop classes, SWS and triticale had the lowest protein and highest starch compared to other crop types followed by CPS and HWRS.

Table 3. Percent protein, starch, and pentosan content of the 2008 samples analyzed by Dr. Curtis Pozniak, University of Saskatchewan

Variety	Class	Protein (%)	Starch (%)	Pentosans (%)
AC Sadash	SWS	11.8	60.92	5.84
Pronghorn	Triticale	12.1	58.64	5.47
Bhishaj	SWS	12.3	59.61	5.61
AC Andrew	SWS	12.3	58.8	5.66
AC Ultima	Triticale	12.5	58.64	5.97
Tyndal	Triticale	13.4	56.73	6.31
Hoffman	CEGP	13.5	58.22	5.93
AC Crystal	CPS	13.7	58.32	5.42
5700PR	CPS	14.2	57.72	5.88
AC Vista	CPS	14.2	57.4	6.26
Unity	HWRS	15.5	57.98	5.72
Superb	HWRS	15.7	56.3	5.75
AC Barrie	HWRS	16.2	57.04	5.44
LSD (p<0.05)		*0.6*	*1.32*	*0.19*

Summary of Conclusions:

1. SWS are the highest yielding class of wheat in this project with the lowest protein and highest starch content making it very appealing for use as a feedstock for ethanol production. Grain yield rankings were SWS>triticale>CPS=HWRS.

2. In terms of individual varieties, AC Sadash (SWS) produced the highest overall grain yield, lowest protein, and highest starch. AC Andew was comparable to AC Sadash in yield and protein content but slightly lower in starch. Bhishaj was lower yielding but had protein and starch content similar to AC Sadash.
3. Triticale performed well in terms of yield, seed weight, protein and starch content making it also attractive for use in ethanol industry. However the maturity was 2 to 4 days later than SWS and it was the tallest cereal which may hinder production in some areas.
4. CPS wheat was comparable to HWRS in terms of grain yield but did have lower protein and higher starch making it more attractive for ethanol production.
5. Superb was the highest yielding HWRS and AC Barrie was the lowest.Unity was one of the earliest varieties but had the lowest kernel weight. It was also the tallest wheat variety for Western Canada
6. Hoffman is an Eastern feed variety that produces high yields but is not registered for use in Western Canada

Acknowledgement:
Thank you to the sites and site managers that were involved in this project: Terry Hogg with Canada-Saskatchewan Irrigation Diversification Centre (CSIDC) at Outlook, Alvin Eyolfson with Battle River Research Group for the site at Killam, AB; Clair Langlois with BC Grain Producers Association for the sites at Dawson Creek and Fort St. John BC (data not included); Garth Johnstone with South East Research Farm at Redvers, SK; Kim Stonehouse with East Central Research Foundation at Canora, SK; Brian Nybo with Wheatland Conservation Area Inc at Swift Current, SK; Cecil Vera with AAFC at Melfort; Ron DePauw with AAFC for site at Regina; Jeff Kostiuk and Keith Watson with MAFRI and PCDF for site at Roblin, MB; Scott Day and Scott Chalmers with MAFRI/WADO for site at Melita, MB; Paula Halabicki with MAFRI for site at Arborg, MB; Tyler Huck with AgriPro/Syngenta for site at Rosebank, MB; Brian Beres and Ryan Dyck with AAFC Lethbridge; Steve Dueck and Arlen Kapiniak with AAFC at Scott for the sites at Glaslyn and Scott, SK, respectively.

Pre-emergence tillage in organic peas with a precision shallow cultivation tool (PSCT)

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[1] Agriculture and Agri-Food Canada, Scott, SK, Canada; [2]Saskatchewan Agriculture and Food, Scott, SK.

Objective
This project was a proof of concept. It was intended to evaluate shallow tillage shovels mounted on a heavy harrow as a pre-emergence tillage tool in organic systems. The project would determine whether the precision shallow cultivation tool (PSCT) performed at an adequate level to warrant further longer-term replicated studies.

Materials and methods
Two non-replicated strip trials at Scott were used to evaluate pre-emergence tillage in organic peas – one on stubble, and the other on conventionally tilled fallow. In 2007, the stubble site had been seeded to tame oats which were cut and baled off prior to maturity. The field was harrowed in the fall of 2007, and then again in the spring of 2008. The fallow site was worked four or five times throughout the summer of 2007, and then spring tooth harrowed at a shallow depth in fall of 2007, and then again in the spring of 2008.

In the spring of 2008, just prior to seeding, wild mustard and wild oat seeds were hand broadcast across all plots. On May 20th, CDC Golden yellow peas were seeded at approximately 45 degree angles to the plot at a rate of 200 kg/ha using a hoe drill with 9 inch spacing at a depth of 3 cm. Granular field pea inoculant was applied with seed at a rate of 5 kg/ha.

The following treatments were applied across the plots at a 45 degree angle to the seed rows at a speed of approximately 6.4 km/hr:
Treatment # 1 – untreated
Treatment #2 – single pass with PSCT 6 days after seeding prior to crop emergence
Treatment #3 – two passes with PSCT 6 days after seeding
Treatment #4 – single pass with PSCT and single pass with rotary hoe 6 days after seeding.
Treatment #5 – two passes with rotary hoe 6 days after seeding
Treatment #6 – single pass with PSCT 9 days after seeding at ground crack stage
Treatment #7 – single pass with PSCT 13 days after seeding with peas at 3 node stage

The strips were swathed in four 8 meter by 5 meter samples on August 19th, and combined on September 8th. The samples were cleaned using number 22 top screen and number 8 round bottom screen on a clipper cleaner and then through a spiral seed separator to determine yield and percent dockage.

Both trials were assessed for plant emergence counts 5 days after the last treatment, a visual stand reduction estimate 10 days after last treatment, visual control of weeds 10 and 76 days after last treatment, field pea yield, and % dockage.

Results and discussion
Since the trials were not replicated, the data collected could not be subjected to a statistical analysis; however, the trends do provide some insight into the performance of the implement.

Tables 1 and 2 summarize the data for the fallow and stubble trial, respectively.

June 10th plant counts noted that numbers indicated some variability, particularly on fallow. It was noted that plant development was quite variable. Multiple passes and later passes had a higher number of plants just emerging at time of counting, indicating initial injury. This was noted on both stubble and fallow, although reductions in plant stand were more noticeable on the fallow. Cultivation at the 3-node stage of the crop resulted in a reduction in plant stand, particularly on fallow. Visual stand reduction estimates validated the count data.

The weeds established much better on fallow than on stubble. Weed control ratings indicated that the later the cultivation, the higher the level of weed control for both wild oat and wild mustard on fallow, and wild oat on stubble. Wild mustard control generally declined with later tillage on stubble, indicating better control with earlier treatments. Double passes were only marginally better than the single pass; and the PSCT was more efficacious in controlling weeds than the min-till rotary hoe.

All treatments improved field pea yield with the exception of cultivation at the 3-node stage on fallow. % dockage also declined with all the pre-emergence tillage treatments, particularly on fallow.

Table 1 – Fallow Trial

Character Rated	Peas	Peas	W. Mustard	W. Oats	W. Mustard	W. Oats	Peas	Peas
Rating Date	08-06-10	08-06-20	08-06-20	08-06-20	08-08-20	08-08-20	08-09-08	08-09-08
Rating Data Type	Emergence	STDRED	Control	Control	Control	Control	Yield	Dockage
Rating Unit	#/m2	%	%	%	%	%	g/m2	%
Trt-Eval Interval	15 DA-A	25 DA-A	25 DA-A	25 DA-A	86 DA-A	86 DA-A	105 DA-A	105 DA-A
No. Treatment	1	2	3	4	5	6	7	8
1 Untreated	85	0	0	0	0	0	156	41
2 Single Pass Pre-e Till 5 das	79	4.5	56.25	32.5	17.5	17.5	249	18
3 Double Pass Pre-e Till 5 das	62	9	45	25	27.5	30	224	25
4 Single Pass Pre-e Till 5 das Single Pass Rotary Hoe	75	1	22.5	7.5	27.5	15	225	23
5 Double Pass Rotary Hoe 5 das	71	1.5	20	12.5	40	30	210	26
6 Single Pass Pre-e Till Peas in Ground Crack Stage	81	14.5	73.75	22.5	35	42.5	222	19
7 Single Pass Pre-e Till 3 Node Stage	52	57.5	87.5	78.75	30	30	155	26
LSD (P=.05)	17.7	8.295	36.506	30.31	20.108	16.522	80.5	15.1
Standard Deviation	12	5.64	24.821	20.608	13.671	11.233	54.8	10.3
CV	16.77	44.86	56.97	80.7	53.92	47.66	26.62	40.27
Grand Mean	71.86	12.57	43.57	25.54	25.36	23.57	205.71	25.56
Bartlett's X2	11.958	11.124	7.458	12.56	6.999	7.012	2.014	1.825
P(Bartlett's X2)	0.063	0.049*	0.189	0.028*	0.221	0.22	0.918	0.935
Treatment F	3.83	52.704	6.386	6.337	3.72	6.066	1.747	2.241
Treatment Prob(F)	0.0098	0.0001	0.0006	0.0006	0.0112	0.0008	0.1595	0.0792

Table 2 Stubble Trial

Character Rated	Peas	Peas	W. Mustard	W. Oats	W. Mustard	W. Oats	Peas	Peas
Rating Date	08-06-10	08-06-20	08-06-20	08-06-20	08-08-20	08-08-20	08-09-08	08-09-08
Rating Data Type	Emergence	STDRED	Control	Control	Control	Control	Yield	Dockage
Rating Unit	#/m2	%	%	%	%	%	g/m2	%
Trt-Eval Interval	15 DA-A	25 DA-A	25 DA-A	25 DA-A	86 DA-A	86 DA-A	105 DA-A	105 DA-A
No. Treatment	1	2	3	4	5	6	7	8
1 Untreated	79	0	0	0	0	0	319	14
2 Single Pass Pre-e Till 5 das	77	0	40	25	50	27.5	378	14
3 Double Pass Pre-e Till 5 das	92	0	41.25	42.5	45	25	374	14
4 Single Pass Pre-e Till 5 das Single Pass Rotary Hoe	79	0	41.25	12.5	27.5	22.5	353	16
5 Double Pass Rotary Hoe 5 das	81	2.5	56	22.5	30	7.5	346	13
6 Single Pass Pre-e Till Peas in Ground Crack Stage	77	4.5	82.5	35	62.5	20	385	7
7 Single Pass Pre-e Till 3 Node Stage	70	21.25	83	65	0	37.5	373	11
LSD (P=.05)	16.7	5.339	48.899	41.754	11.347	12.838	139	19.9
Standard Deviation	11.3	3.63	33.247	28.389	7.715	8.729	94.5	13.5
CV	14.36	89.95	67.65	98.14	25.12	43.64	26.18	106.53
Grand Mean	78.93	4.04	49.14	28.93	30.71	20	361.16	12.69
Bartlett's X2	3.772	0.173	7.838	2.081	1.894	11.522	8.556	5.351
P(Bartlett's X2)	0.708	0.917	0.165	0.838	0.755	0.021*	0.2	0.5
Treatment F	1.308	18.416	2.973	2.222	39.02	8.313	0.24	0.178
Treatment Prob(F)	0.2967	0.0001	0.0292	0.0814	0.0001	0.0001	0.9579	0.9799

Conclusions

The PSCT provided efficacious weed control in 2008 to warrant further replicated studies. Future funding will be applied for to conduct replicated studies on timing of pre-emergence weed control and efficacy of pre- and post-emergence tillage using a combination of PSCT and a min-till rotary hoe.

Herbicides for Control of Canada Fleabane (*Conyza Canadensis* L. Cronq.) in Western Canada.

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[1]Department of Plant Sciences, University of Saskatchewan, [2]Agriculture and AgriFood Canada and [3]Monsanto Canada Inc.

Background

There are now 15 species of weeds around the world that have known resistance to glyphosate (Heap, I.International Survey of Herbicide Resistant Weeds.Online). However there are no known glyphosate resistant weed biotypes in Canada at this time and most of the species that have shown resistance to glyphosate are not present in western Canada. The one species that is present here and that has developed glyphosate resistance in 5 countries (USA, Brazil, China, Spain and Czech Republic) is Canada fleabane (*Conyza canadensis*). This trial was established to evaluate herbicide options available to producers for control of Canada fleabane in western Canada.

Materials and Methods

Five site years of data have been generated in Saskatchewan (2006 at Meota, 2007 & 2008 at North Battleford and Saskatoon). Canada fleabane was the dominant weed at all sites. Applications were made in the spring when the majority of the Canada fleabane was less than 5 cm. tall. Visual ratings were recorded at 7 to 10, 16-29 and >35 days after application. There was no crop seeded in the trials and the trials were terminated after the final rating.

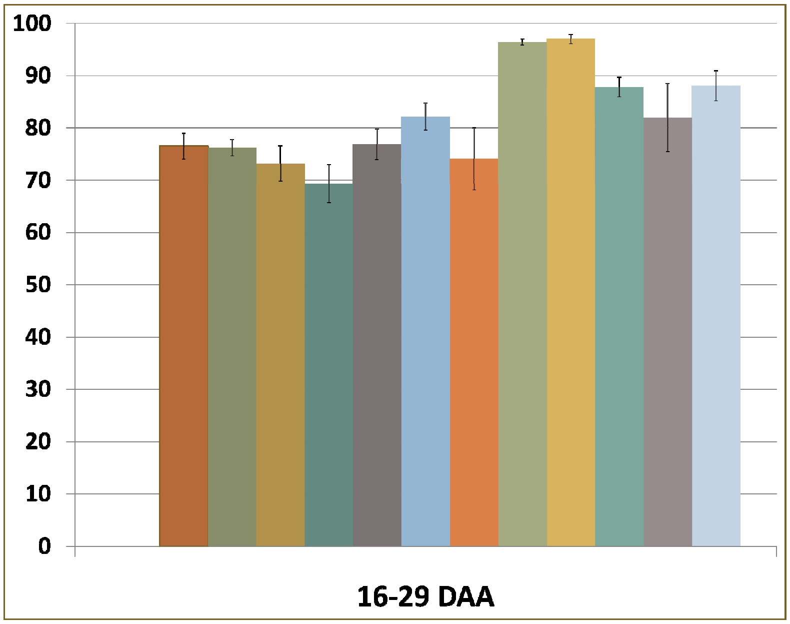
<u>Treatment list</u>

1. dicamba@140 gai/ha
2. 2,4-D LV ester @ 560 gai/ha
3. 2,4-D LV ester @ 700 gai/ha
4. clopyralid@ 75 gai/ha
5. clopyralid@ 100 gai/ha
6. clopyralid@ 150 gai/ha
7. amitrol@ 1000 gai/ha
8. florasulam@ 5 gai/ha + merge @ 0.5% v/v
9. pyrasulfotole+ bromoxynil@ 202 gai/ha
10. BAS 800 @ 18 gai/ha + merge @ 1.0% v/v (2 site-years of data only)

Results & Conclusions

At 16 –28 DAA, all treatments controlled Canada fleabane greater than 70%. Greater than 80% control was achieved with clopyralid@150 gai/ha, florasulam@ 5 gai/ha, pyrasulfotole+ bromoxynil@ 202 gai/ha and BAS 800 @ 18 gai/ha. Greater than 90% control was achieved with amitrol@ 1000 gai/ha and glyphosate @ 675 gai/ha indicating that these populations of Canada fleabane were not resistant to glyphosate.

By the final rating data, regrowth was occurring in a few of the treatments. Greater than 70% control was achieved with dicamba@ 140 gai/ha and clopyralid@ 75 and 100 gai/ha. Greater than 90% control was achieved with clopyralid@ 150 gai/ha, amitrol@ 1000 gai/ha and glyphosate @675 gai/ha.



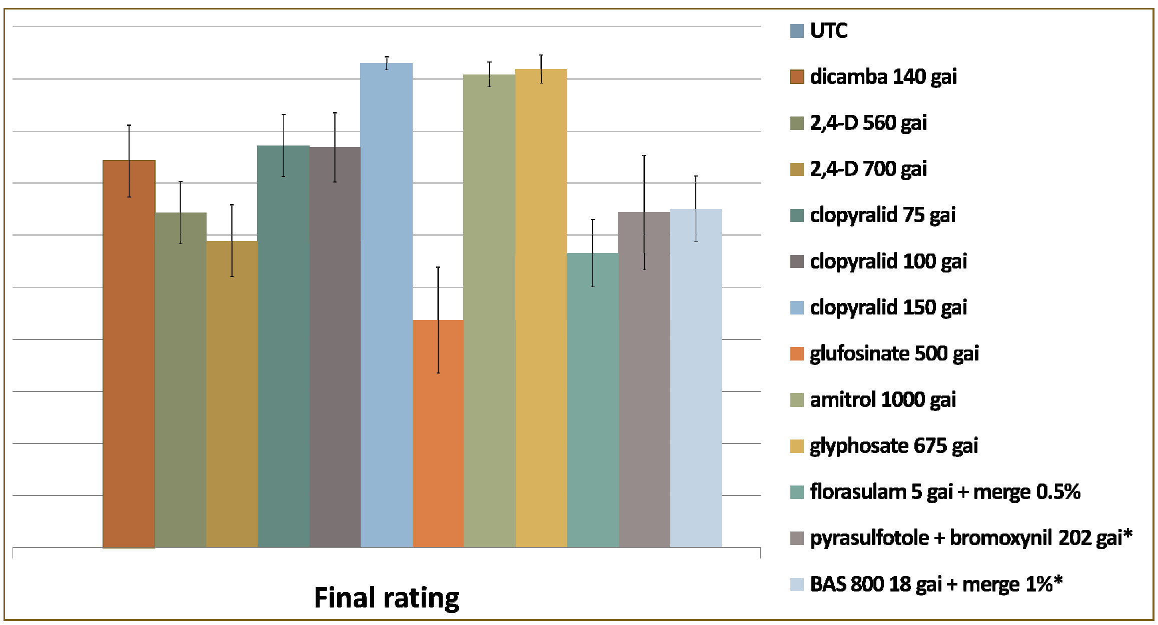


Figure 1: % Canada fleabane control – visual ratings
*only 2 site years of data

There are alternative herbicides that will suppress and/or control Canada fleabane if glyphosate resistant biotypes appear in Western Canada. Future work should be considered to evaluate all of these products with crop competition and in-crop herbicides.

2008 Pesticide Minor Use Program

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The federal Minor Use Pesticide program is designed to assist in the registration of pesticides, be they herbicides, fungicides or insecticides, where returns on investment are insufficient for a private chemical company to conduct the work. Projects typically involve small acreage crops (minor crops) but can also involve a major crop where a minor pest is an issue. Projects are producer driven through a priority setting process in which all stakeholders including producers, chemical representatives, provincial and federal representatives participate. With an emphasis on pursuing the registration of effective low risk chemistries the ultimate goal is to provide Canadian producers with safe effective tools to control pests and remain competitive on the world stage.

AAFC Scott is one of 10 federal minor use pesticide research sites in Canada. Since 2003, 215 minor use field trials have been conducted on crops such as grasses for forage and hay production, legumes, herb and spices, oil seeds, vegetables and small fruits. Pesticide registrations require supporting field research data that shows the intended crop will tolerate the pesticide, that the target pest is controlled, and that the end product is safe for human consumption.

In 2008 34 minor use field trials were conducted with 17 focused on evaluating crop tolerance, 14 trials evaluating the level of pest control in addition to crop tolerance and 3 residue trials for the purposes of characterizing pesticide residue levels in the end product. The table below summarizes by row various crop-pesticide evaluations from 2008 field trials at AAFC Scott. Crop tolerance is designated as either acceptable as indicated by a * or as unacceptable in which case a description of the type of injury is provided. Where pest control evaluations were required to support a registration the target pest is identified followed by either a '*' for acceptable pest control or an 'unacceptable' pest control designation. Insufficient pest pressure for the purposes of evaluating pest control does occasionally occur.

While challenges remaining for finding solutions to Canada thistle control in alfalfa and broadleaf weed control in hemp results from 2008 revealed a number of positive findings. Several potential broadleaf weed control products for use in Timothy and perennial ryegrass grown for seed production were identified. Weed control evaluations in dry beans have provided strong support for the registration of a mix of active ingredients from Basagran and Solo for effective control of broadleaf and grassy weeds on select bean types. In regards to insect pest control Alverde provided encouraging results for the control of lygus and alfalfa plant bug in alfalfa when grown for seed production. Although gymnosporagium levels in Saskatoon berries were insufficient in 2008 previous work with the product Switch in 2007 revealed successful suppression of entomosporium. Pest control in potential crops such as cumin and prairie carnation will continue in an effort to provide the necessary tools for the successful production of these crops.

Crop (application growth stage)	**Product**	**Crop Tolerance** * =acceptable	**Pest**	**Acceptable Pest Control ***
Timothy for seed (Seedling)	Frontline XL	*		
Borage (early flower)	Proline 480 SC	*		
Oriental Mustard (early flower)	Proline 480 SC	*		
Perennial Ryegrass for seed (fall 3-4 leaf)	Pre-Pass Express SG + glyphosate	* (seed yield 2009)		
Perennial Ryegrass for seed (fall or spring 3-4 leaf)	MCPA Amine, Spectrum, Frontline, Buctril M, Prestige, Infinity	*		
Perennial Ryegrass for seed (fall or spring 3-4 leaf)	Simplicity	Plant loss/stunting		

Perennial Ryegrass for seed (flag leaf)	Tilt 250E	*		
Hemp:Crag and Finola (3 leaf)	Muster Toss-N-Go (1/4X rate) Lontrel (1X rate)	Stunting, and delayed maturity Plant deformation/delayed maturity		
Hemp: Crag and Finola (pre plant)	Kixor (BAS800)	Plant loss		
Bean: Black,Pink,Pinto,Red (2-4 trifoliate)	Solo+merge	delayed maturity		
Dry Bean: Black, Pinto, Red	Solo+Basagran Forte+28-0-0	*		
Dry bean: Pink, (4th trifoliate)	Solo+Basagran Forte+28-0-0	Stunting/reduced yield		
Cumin (early flower)	Quadris	*	blossom blight (Fusarium root & alternaria)	insufficient pressure (plant loss/variable control)
Saskatoon berry (silver tip, petal drop, green fruit)	Switch	*	Gymnosporangium	insufficient pressure
Hybrid Poplar (pre-plant+8 wk post plant)	Flumioxazin 51% WDG (SureGuard)	* (soil and weed applied)	RR canola, cow cockle, shepard's purse, wild oats, hempnettle, narrow-leaf hawksbeard, spiny sow thistle	*
Prairie Carnation (2-4 leaf)	Centurion	*	Wild oats	*
Alfalfa for seed (3app,5-7 day interval, bud)	Alverde	*	Lygus/alfalfa plant bug	*
Birdsfoot Trefoil	Odyssey	*	Labelled weeds	*
Milk Thistle (30-40% loose flowers)	RU weathermax, Aim		Crop dry down	unacceptable
	Liberty		Crop dry down	*
Potato	Chateau Frontier Chateau/Prism Prism Aim		Cleaver	unacceptable * * * *
Alfalfa (flower buds visible)	Solo+Basagran Solo+Pardner Infinity	* * stunting/chlorosis	Canada Thistle	unacceptable unacceptable unacceptable

Alternative Seed Treatment Trial

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Kabuli chickpeas were chosen to test efficacy of alternative seed treatments as they are very susceptible to seedling diseases. Seeds of kabuli were treated with the following seed treatments and then planted at two seeding dates of May (early and mid-May). Seed treatments included RootShield® , CB-QGG, Heads-up, Crown, Apron, and Crown plus Apron.

RootShield® is a biological fungicide registered for suppression of root diseases in greenhouse crops. The active ingredient is a beneficial microbe, *Trichoderma harzianum* strain T-22. Rootshield actively grows onto the plant roots as they develop and protects roots against *Pythium, Rhizoctonia, and Fusarium.* It is

CB-QGG is a liquid, natural seed treatment formulated with various macro and micro nutrients as well as other organic type constituents and microorganisms. It is produced by EcoChem out of Hanna, Alberta.

Headsup is a plant protectant product produced in Kamsack, SK. The biological seed treatment is derived from *Chenopodium quino* and is a preplant seed treatment for the prevention of fungal and bacterial diseases of plants.

Crown and Apron are fungicides registered for use as seed treatments to control seed rots and damping off caused by various species. Crown is effective against *Botrytis, Fusarium* and *Rhizoctonia* species*.* Apron is effective against *Pythium, Fusarium and Rhizoctonia* species.

Results
Results did indicate improved plant counts with all seed treatments in the early-May seeding date, however the numbers were not statistically different (Data not shown). With the mid-May seeding date there were no difference between treatments. As the soil was dry in May and June it was not the best conditions for evaluating effects of seed treatments. More work needs to be done under higher disease pressure.

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