MANITOBA Pulse Soybean GROWERS

pulse beat

The Science Edition

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In this issue

Yield & Quality • Pest Control • Market Demand

Developing production tools and market demand for profitable and sustainable through local research.

This issue of *The Science Edition* arrives as most projects are heading for the home stretch before the March 2023 finale of the Canadian Agricultural Partnership (CAP). CAP is the primary means we use to stretch farmers' check-off dollars, and both federal and provincial governments fund research under CAP. Not every MPSG project is funded by CAP and in this edition's description of health-related projects, we have even reached into pre-CAP programs. However, without programs like CAP this magazine would be noticeably lighter.

While we will have many more CAP projects to report on in future volumes of *The Science Edition*, at this moment, we're working with sister organizations and governments to ensure federal and provincial government funds are available for research post-CAP. Our work is encountering challenges. The source can be traced directly to the fact that markets, governments and society, in general, continue to impose additional demands on Canada's farmers. Research traditionally offered a way for farmers to cope with changing market and agronomic demands. It still does. However, today, research is being called upon to help farm businesses cope with the extraordinary challenge of climate change. Quite simply, farmer check-offs cannot be expected to shoulder this without significant increases in government funding. Projects funded under CAP were already whittled down to the very highest priorities. Dealing with climate change will require supplementing ongoing CAP projects, not replacing them with climate-focused work. It is our earnest hope that policymakers recognize the stakes for Canada in significantly scaling up the government-farmer partnership in research.

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Soybean Seeding Depth Evaluation

Soybean yield was maximized by seed depths ranging from 0.75–1.75 inches, with 1.25 inches producing the greatest yield, on average. There was no benefit to chasing moisture and seeding soybeans deeper than 1.75 inches.

DRY CONDITIONS OVER the past few years have enticed farmers to drive soybean seed deeper than usual (>2 inches) to connect with soil moisture. The current recommendation to seed soybeans between 0.75–1.5 inches deep is based on guidelines from other regions and the range of seed depths reported by farmers and agronomists is much wider. Understanding the yield impact of soybean seed depth under Manitoba conditions became a clear priority.

The objective of this study was to identify the optimum seeding depth for soybeans in Manitoba, through evaluation of plant density, nodulation, root rot, pod height, maturity and yield.

Seeding depths ranging from 0.25–2.25 inches were tested at Arborg (clay soil) and Carman (loam soil) from 2017 to 2019 in small-plot field trials. All trials were seeded into tilled stubble, except at Arborg in 2017 which was seeded into tilled fallow. Growing conditions were drier than normal across all site-years, with cumulative May and June precipitation at 40–87% of normal. Although soil moisture was not measured, moist soil was often observed to be at 1.25 inches or deeper at the time of seeding.

Soybean seed depths of 0.5–2.25 inches resulted in maximum plant density, with plant stands ranging from 140–170,000 plants/ac, on average. Shallow seeding (0.25 inches), on the other hand, significantly reduced plant stands to 81,000 plant/ac, on average. Shallow seeded soybeans were subject to moisture fluctuations at the soil surface, which resulted in desiccation and failed germination. Deep seeded soybeans (2.25 inches) produced an acceptable plant stand but emergence was delayed, increasing risk of soil pathogens and pests,

and seedlings showed signs of stress, including hypocotyl swelling, loss of cotyledons and chlorosis.

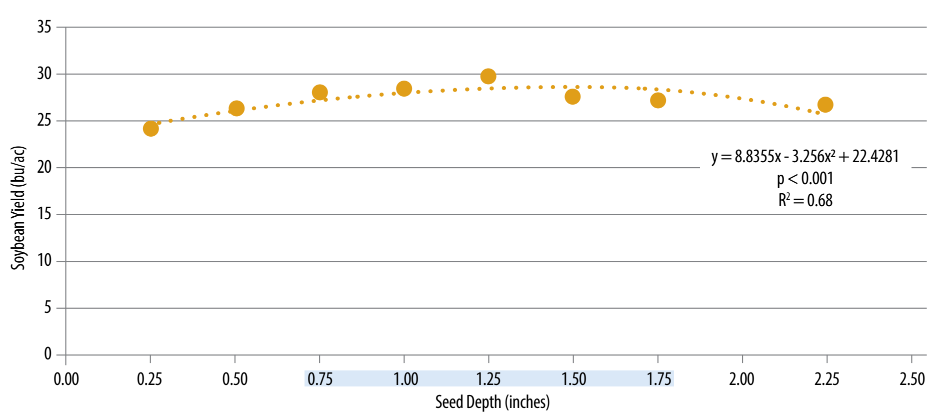
The seed depth range that maximized yield was 0.75–1.75 inches, with yield maximization at 1.25 inches (Figure 1). Shallower and deeper seeding reduced yield by 19% and 10%, respectively. Shallow seeding was more detrimental than deep seeding, likely due to dry conditions. Yield loss from non-optimal seed depth in this study was likely due to delayed emergence, reduced plant stand and reduced seedling vigour (e.g., hypocotyl swelling, chlorosis and loss of cotyledons).

To answer questions posed by farmers and agronomists, pod height, days to maturity, nodulation and root rot were all evaluated. Pod height was significantly influenced by seed depth and environment, although environment had a greater influence. Seed depths of 0.5–2.25 inches produced the highest pods (3.5–3.9 inches, on average), while shallow seeding significantly reduced pod height (3.1 inches, on average). Soybean maturity was influenced by environment but not seed depth. There was no effect of seed depth on nodulation nor root rot.

Overall, soybeans should be seeded within the optimal range of 0.75–1.75 inches, adjusting within this range depending on soil moisture, soil type, equipment and management practices.

This study provides evidence that even under dry conditions there is no benefit to chasing soil moisture beyond 1.75 inches.

Figure 1. Relationship between soybean seed depth and soybean yield based on six site-years in Manitoba (Arborg and Carman from 2017–2019). Seed depths of 0.75–1.75 inches maximized yield.



PRINCIPAL INVESTIGATOR Kristen P. MacMillan, University of Manitoba

MPSG INVESTMENT $84,000

CO-FUNDER Growing Forward 2

DURATION 3 years

Refining Soybean Seeding Window Recommendations

The window to seed soybeans in Manitoba is flexible throughout the month of May. Soybean yields did not differ among May 1–24 seeding dates, but yields were reduced by 15%, on average, when seeding was delayed until May 31–June 4.

Emerged soybean seedlings from the very early seeding window (April 28–May 6) exposed to a late spring frost.

THE TRADITIONAL RECOMMENDATION has been to plant soybeans when soil temperatures have warmed to at least 10°C, or from May 15–25 in Manitoba. However, previous Manitoba-based research found that late April to early May planting dates corresponding with soil temperatures of 6.0–10.6°C produced similar and, in one case, greater soybean yields than those seeded at the traditionally recommended time.

The purpose of the current study aimed to update soybean seeding date recommendations across a wider range of environments, using defined calendar dates. Over three years (2017–2019), experiments were established at Arborg, Carman, Dauphin and Melita. Four seeding windows were tested: *very early* (April 28–May 6), *early* (May 8–14), *normal* (May 16–24) and *late* (May 31–June 4), using the short-season variety, S007-Y4 (MG 00.5), and mid-season variety, NSC Richer (MG 00.7). Soybeans were seeded into soil temperatures as low as 0°C.

There were no differences in soybean yield when planted throughout May 1 to 24 (Figure 1). Yield was reduced by 15%, on average, when seeding was delayed until May 31 to June 4. These results indicate that the soybean seeding window is flexible during the first three weeks of May in Manitoba.

At four of 11 site-years, yield was maximized by seeding very early (April 28–May 6), but yield was significantly reduced by this very early seeding at one site-year. At five of 11 site-years, yield was maximized during the early seeding window (May 8–14).

These results highlight the risks related to seeding soybeans too early in Manitoba. Cold soil temperatures within the first 48 hours of seeding can result in chilling injury, reduced or delayed emergence and increased susceptibility to soil-borne pathogens. There is also the risk of exposure to spring frost, which can kill or injure emerged seedlings. The coldest soil temperatures occurred during the very early seeding window at Melita in 2019 (0°C), at Melita in 2017 (1.1°C) and at Arborg in 2018 (5.8°C). At those site-years, yield was reduced by 13–19% during the very early seeding window (April 28–May 6). Late killing spring frosts occurred on May 19, 2017 and June 2, 2019, that may have negatively impacted emerged seedlings and yield from the very early seeding window.

In these experiments, soybean seed protein averaged 31.9%, 13% moisture basis (range: 26.5–35.1%). The effect of seeding window on seed protein was significant overall, but this depended on the environment. At eight out of 11 site-years, protein was the same among seeding dates. Late seeding produced greater protein than during the very early or early seeding windows at two out of 11 site-years. We need to gain a greater understanding of how genetic, management and environmental factors interact and affect soybean protein and other quality factors in Manitoba before altering our farming practices to manage protein.

Based on the results of this study, seeding soybeans during the second week of May generally maximized soybean yield in Manitoba while reducing the risks associated with cold soil and late spring frost. However, the optimal time to seed soybeans can vary by region and from year to year. Each planting season, avoid seeding into soil temperatures below 8°C, ensure there is no cold rain or snow in the forecast for the first 24–48 hours after planting and aim to seed within two weeks of the last expected spring frost to establish a strong plant stand, maximize yield and minimize risk.

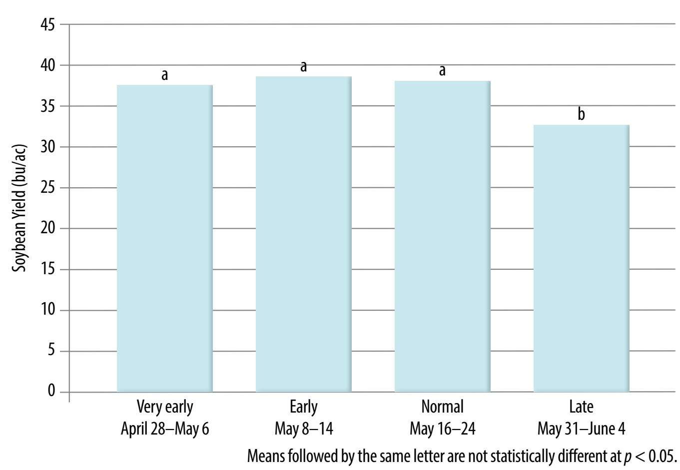


Figure 1. Soybean yield by seeding window among Arborg, Carman, Dauphin and Melita environments from 2017–2019.

PRINCIPAL INVESTIGATOR Kristen P. MacMillan, University of Manitoba

MPSG INVESTMENT $169,400

CO-FUNDER Growing Forward 2

DURATION 3 years

YIELD & QUALITY

Preceding Crop and Residue Management Effects on Dry Beans

Pinto beans can be grown successfully following a range of crops (wheat, corn, canola or dry beans) and under direct seed conditions in Manitoba with no penalties to plant stand nor yield.

CROP SEQUENCE WITHIN a rotation can influence yield through various agronomic factors, such as nutrient cycling, residue, soil moisture and pest pressure. Farmers in Manitoba seed dry beans most commonly following wheat > corn > canola > dry beans and oats.

According to MASC data from 2011 to 2020, 23% of navy bean acres were planted into spring wheat stubble, 29% into canola stubble, 10% into navy bean stubble and 15% into corn stubble, and relative navy bean yield produced by those previous crop types was 111%, 89%, 91% and 111%, respectively. There is currently no research data available for Manitoba on the effect of preceding crop and residue management on dry bean yield and productivity. The objective of these experiments was to determine the effect of preceding crop type and residue management on dry bean production.

From 2017 to 2020, experiments were established at Carman and Portage la Prairie on land that had not seen dry beans in at least five years. Windbreaker pinto beans were planted into four crop residues (wheat, canola, corn and pinto beans) that had been split into tilled and direct seed treatments.

Preceding crop did not affect pinto bean yield in these experiments, with bean yield ranging from 2908–3041 lbs/ac among preceding crop type, suggesting that there is flexibility in where to place dry beans in a crop rotation. In two out of six site-years, at Carman in 2018 and 2019, direct-seeded pintos yielded 10–17% greater than those seeded into tilled stubble (Figure 1). Pinto beans at Carman may have benefitted from some moisture conservation associated with direct seeding as the soil texture at that site is lighter.

Overall, pinto beans seeded into tilled residue resulted in a slightly higher plant population (74,000 plants/ac) than direct-seeded beans (70,000 plants/ac). Pinto beans seeded into canola stubble (76,000 plants/ac) resulted in a higher plant population than corn stubble (68,000 plants/ac) overall, but the trend was not consistent among environments. All plant populations were near the target plant stand of 70,000 plants/ac. An important finding is that bean plant stands following corn were similar in both direct seed and tilled treatments since corn residue management can be challenging. Seeding equipment varied by environment, but all sites used double- or single-disc openers and seeding took place between the preceding corn rows to avoid root balls. Minimal hair pinning occurred in corn stubble but was sometimes a problem where wheat residue was not standing or well distributed.

Crop residue and tillage treatments influenced grassy weed control. Grass weed density was lower when beans followed corn (13 plants/ft^2) compared to beans following wheat (47 plants/ft^2). In all preceding crop types, grass weed density was lower in direct seeded pintos (24 plants/ft^2) compared to pinto beans seeded into tilled residue (43 plants/ft^2). In fields where grassy weeds are a problem, especially herbicide-resistant populations, consideration of where pinto beans occur in rotation and how residue is managed can help reduce weed competition and selection pressure.

Root rot severity was the greatest in pinto beans following pinto beans and lowest in beans following corn. Environment accounted for the greatest range in root rot severity. Fields with a long history of bean production or fields prone to wetness are likely to see more significant effects of root rot. It is possible that the dry growing season conditions (39–69% normal precipitation) and lack of dry bean field history resulted in lower disease levels. White mould was not a yield-limiting factor in these experiments.

Throughout this study, dry conditions were favourable for yield and highlighted the resilience of pinto beans to direct seed conditions when residue management and seeding equipment facilitate good crop establishment.

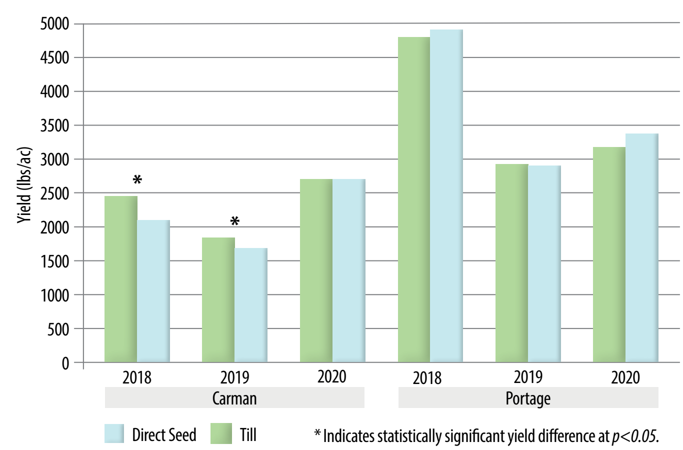


Figure 1. Average pinto bean yield (lbs/ac) by tillage system at Carman and Portage la Prairie, MB from 2018–2020 (n=48).

PRINCIPAL INVESTIGATOR Kristen P. MacMillan, University of Manitoba

MPSG INVESTMENT $121,800

CO-FUNDER Growing Forward 2

DURATION 4 years

YIELD & QUALITY

Investigating Protein Discounts of Manitoba Soybeans

Protein has not been an explicitly stated discount item for Manitoba soybeans, but rather an unnamed part of the basis of the *Chicago Mercantile Exchange* futures price. These discounts are $0.10–0.20 per bushel for protein levels that are 1.5–2.0% below the Ontario or Quebec standard for the crop year.

SOYBEAN PROCESSORS MUST blend lower protein soybeans from Manitoba (38%, dry matter basis (d.b.), on average) with higher protein soybeans from Ontario or Quebec to achieve 47.5% d.b. protein meal for animal feed. Processors provide guarantees for their soymeal products and pay claims to buyers if their guarantees are not met. Blending can introduce costs stemming from inefficiency during processing and inconsistency in product quality, which ultimately leads to discounts on low protein soybeans (<40% d.b.).

It has become a priority to understand the protein discount to support continued soybean production in Manitoba, mitigate the risk of shipment rejection if protein standards are not met (minimum of 32% d.b.) and alleviate the direct impact of discounts on the local cash price of soybeans.

The objectives of this study were to:

1. determine what makes up the discounted value of Manitoba soybeans,
2. examine the discounted value from a processor perspective and
3. assess the value of research (e.g., varietal development or management practices) to help narrow the quality gap.

A literature search was conducted to find current information pertaining to the soybean protein discount, including scientific journals, extension publications, industry publications and articles in the popular farm press. A series of consultations were also conducted with soybean producers, buyers and processors.

There are several discounts commonly applied to soybeans by buyers. These include test weight, moisture, foreign material, damage and splits. However, protein has been an unnamed part of the basis of the *Chicago Mercantile Exchange* futures price and has not been explicitly stated as a discount item. These discounts have been set relative to the protein levels of soybeans in the marketplace at a given time due to variability in protein among regions and years.

Discounts for lower protein Manitoba soybeans are approximately $0.10–0.20 per bushel for soybean protein levels that are 1.5–2.0% below the Ontario or Quebec standard for the crop year. This price discount is about 1–2% off the 40% d.b. protein soybean price. Discounts of $6 per tonne have been reported for soybeans with under 33% d.b. protein in Manitoba and discounts of $9 per tonne have been reported in Manitoba for soybeans with under 32.4% d.b. protein. Soybeans falling under 32% d.b. protein can face rejection.

With longer histories of soybean production, Ontario and Quebec have had time to hone their skills in both production and marketing. There has been a lack of soybean protein data available to Manitoba farmers, which is something MPSG is working to alleviate through various research studies examining genetic and environmental influences, such as the project summarized on the next page.

As soybean production continues in Manitoba, we will continue to gain experience that will lend itself to an improved soybean export product and/or increased local processing capability. Currently, there is only one soybean processor in Manitoba. The low protein level of the soymeal they process is offset with other protein additives prescribed by livestock nutritionists who formulate rations for dairy, chicken and hogs.

What is the value of closing the gap between 38% and 40% protein soybeans? If we project 1.3 million soybean acres produced annually in Manitoba at a yield of 40 bu/ac, this gives us 52 million bushels of soybeans. If the price differential between 38% and 40% protein soybeans is $0.20/bu, then the value of closing the 2% protein gap can be valued at $10.4 million/year to producers.

Our future directions are to work toward closing the gap by increasing soybean protein levels over the long term and explore the various ways we can process our existing low protein soybeans locally while supplementing with alternative protein sources.

PRINCIPAL INVESTIGATOR Dr. Charles Grant, University of Manitoba

MPSG INVESTMENT $24,650

DURATION 2 years

Soybean Protein and the Impact of Genotype and Environment on Quality

Crude protein levels were comparatively lower (40.4%, dry matter basis; 35.2%, 13% moisture basis) from soybeans grown in northern environments, but these soybeans contained greater concentrations of critical amino acids indicating that crude protein alone may undervalue the nutritional value of Manitoba-grown soybeans.

SOYBEANS GROWN IN western Canada have lower crude protein values than those grown in eastern Canada and the southern U.S., limiting opportunities for future development of the soy processing sector. Protein plays an important role in determining the value of the crop as it relates to the feed value of meal for livestock. However, feed formulation strategies have evolved away from a primary focus on crude protein content to a focus on digestible amino acid content.

Essential amino acids (EAA) must be provided in the diet. Diets with high crude protein that are limited or deficient in one or more EAA cannot support livestock growth and production targets. Thus, a more accurate reflection of soybean nutritional quality is the concentration of EAA that are primarily limited in livestock feeds — specifically, lysine, cysteine, threonine, methionine and tryptophan. The sum of these EAA is the critical amino acid value (CAAV). The higher the CAAV, the better the feeding value.

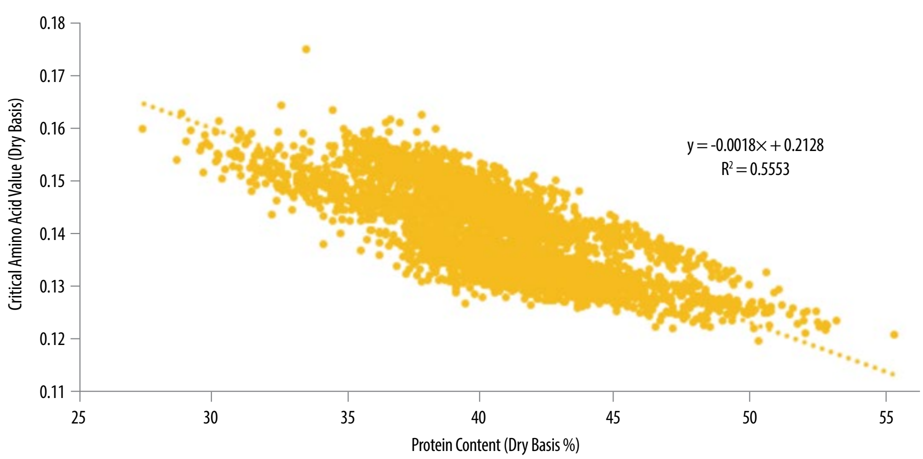
Protein and amino acid profiles are influenced by variety (genotype), environment and the interaction between the two. This research evaluated these effects on soybean protein and amino acid concentrations. Approximately 4,700 whole soybean samples were supplied from 13 different variety trial locations across Manitoba in 2018 and 2019. Near-infrared (NIR) spectroscopy was used as a non-destructive, simple and fast method of assessing protein and amino acid contents.

On average, crude protein levels (% dry matter basis) were 39.1% (range: 27.3–50.5%) and 42.2% (range: 34.1–55.3%) in 2018 and 2019, respectively. There were significant effects of genotype, environment and genotype × environment interactions on soybean crude protein and amino acid content. Among those factors, genotype was responsible for most of the variation for all traits. Protein and amino acids responded differently to various environments, but what made environments favourable for soybean protein and amino acid accumulation was unclear. Statistical analysis identified varieties where protein and amino acid contents persisted across growing environments and cropping years.

There was a negative correlation between crude protein and the CAAV (Figure 1), providing evidence that the nutritional value of soybeans may not be best represented by crude protein levels. Thus, in soybeans with high crude protein content, less of the protein consists of critical amino acids, suggesting that after a certain stage, the increased protein in soybean grain is mainly composed of other amino acids. These results are consistent with data from the northern plains of the U.S. and provide evidence that crude protein alone may not be the best predictor of the overall nutritional value of soybean meal derived from crops produced in northern latitudes.

The next step of this research is underway, characterizing the nutritional profile and feeding value of Manitoba-grown soybean meal and oil for use in diets of layer, pullet and broiler chickens, and swine.

Figure 1. Relationship between critical amino acid values (the sum of lysine, cysteine, threonine, methionine and tryptophan amino acid content divided by crude protein %) and crude protein (dry basis %) in soybeans in Manitoba in 2018 and 2019, combined.



PRINCIPAL INVESTIGATOR Dr. James House, University of Manitoba

MPSG INVESTMENT $48,875

CO-FUNDER Canadian Agricultural Partnership

DURATION 2 years

On-Farm Evaluation of Soybean Row Spacing

Soybean yield responded to row spacing at five site-years in 2019 and 2020, or 31% of the time overall (2019–2021). Yield was increased by 1.9 bu/ac with narrower row spacings, on average.

on-farm network
PARTICIPATORY • PRECISE • PROACTIVE

ACCORDING TO PREVIOUS Manitoba small-plot research on soybean row spacing, narrow rows (9–10 inches) outyielded wide rows (27–30 inches) 86% of the time. When comparing narrow (8–12 inches) vs. intermediate rows (16–24 inches) in this same study, narrow rows increased yield only 15% of the time. To test this at the field scale, MPSG's On-Farm Network (OFN) began investigating row spacing with interested farmers in 2019, conducting trials using each farmer's existing equipment.

Sixteen soybean row spacing trials have been conducted through the OFN from 2019–2021, comparing narrow vs. intermediate row widths (7.5 vs. 15 or 10 vs. 20 inches) and intermediate vs. wide rows (15 vs. 30 inches). In addition to yield, canopy closure ratings were taken in 2020 and 2021 to assess how efficiently soybeans captured sunlight and shaded out late-emerging weeds at different row widths.

In the on-farm trials, soybean yield responded to row spacing at five of 16 site-years (31%) — at two of seven sites in 2019 and three of five sites in 2020 (Figure 1). Yield was increased by an average of 1.9 bu/ac among significant site-years. Broken down by row spacing comparisons, narrow rows (7.5–10 inches) outyielded intermediate rows (15–20 inches) 43% of the time (3/7 site-years) and intermediate (15-inch) outyielded wide rows (30-inch) 20% of the time (2/9 site-years). At significant sites, narrow rows increased yield by 1.8 bu/ac over intermediate and intermediate rows raised yield by 2.1 bu/ac over wide rows.

In 2021, plants were smaller overall due to drought conditions, resulting in poor canopy closure. Rows remained open at R5 (<85% canopy closure) for all row spacings except for 7.5-inch rows. In 2020, canopy closure at R1 decreased as row width increased, where 30-inch rows had 11% less ground coverage than 15-inch rows. As the season progressed, the canopy continued to close until full closure was reached at R5 for all row spacings.

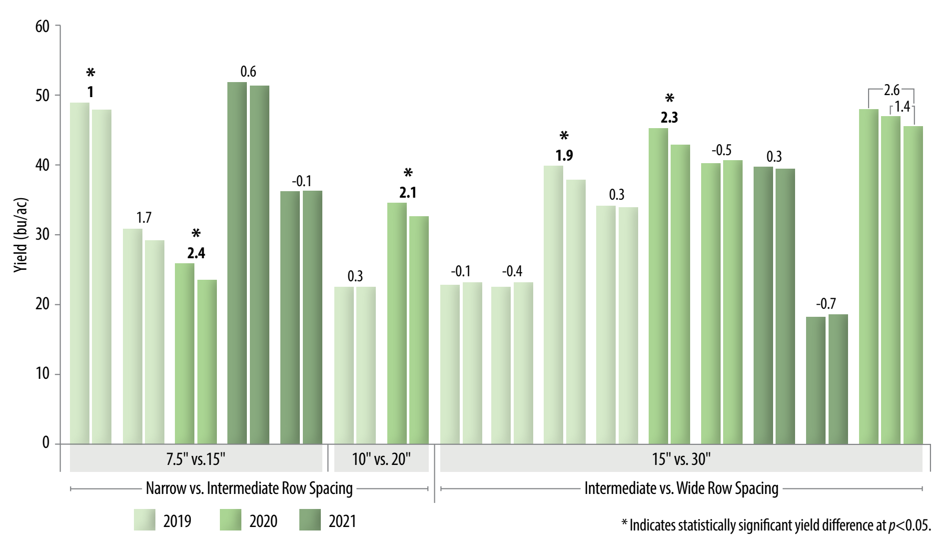
Narrow row spacing is one tool that helps create a more competitive plant stand against weeds. At one on-farm trial in 2020, late-season weed pressure was significant enough to quantify the impact of row spacing on weeds. At that site, weed pressure was greater in 15 than 7.5-inch rows (average of 9 vs. 5 weeds/0.5m²), respectively). This narrow spacing had a 2.4 bu/ac yield advantage.

In years with adequate moisture and greater yield potential (2019–2020), soybean yield has benefitted from narrower row spacings roughly 42% of the time. When combined with 2021 data, including drought-stricken sites, yield responded to row spacing roughly one-third of the time. Narrow row spacing has been said to provide moisture conservation benefits in dry years due to increased shading of the soil surface and a more even distribution of plants throughout the field. On-farm trial sites in 2021 did not see an advantage to narrower rows. This may be due to the strong influence of moisture limitations ahead of and during the growing season, which may have minimized the impact of other agronomic factors.

Compared to the previous small-plot work, on-farm results have shown a greater likelihood of response (43%) for soybeans grown on narrow vs. intermediate rows. This research has validated that narrow rows can deliver soybean yield benefits at the field scale and more often than expected.

The OFN will continue to investigate row spacing with interested farmers to further build this dataset and gain a better understanding of soybean row spacing dynamics across a range of environments.

Figure 1. Soybean yield response (bu/ac) to row spacing at sites across Manitoba from 2019 to 2021.



PRINCIPAL INVESTIGATOR Manitoba Pulse & Soybean Growers – On-Farm Network

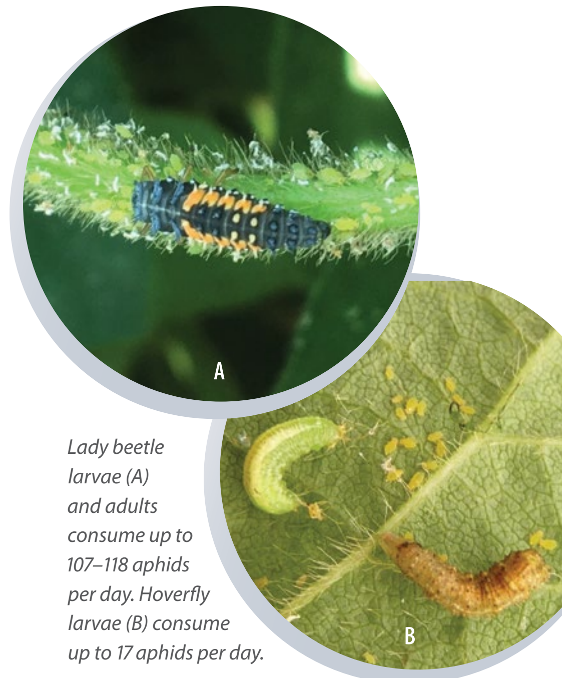
MPSG INVESTMENT $42,630

CO-FUNDER Canadian Agricultural Partnership

DURATION 3 years

Suppression of Soybean Aphids by Natural Enemies

When aphid migration is low, natural enemies can suppress aphid populations. During infrequent outbreak years, greater immigration levels overwhelm natural enemies and aphid populations escape their control.



Lady beetle larvae (A) and adults consume up to 107–118 aphids per day. Hoverfly larvae (B) consume up to 17 aphids per day.

SOYBEAN APHIDS ARE a sporadic invasive pest that arrive each year in July via southern winds. Widespread outbreak levels occurred in 2006, 2008, 2011 and 2017. During low soybean aphid years, natural enemies including lady beetles, green and brown lacewings, minute pirate bugs, damsel bugs, hoverflies and parasitoids have provided sufficient control. The outbreak in 2017 allowed researchers to compare aphid suppression by natural enemies between outbreak and non-outbreak years.

In 2017 and 2018, 12 and 11 field experiments, respectively, were established in southern Manitoba. Aphid colonies were established on soybean plants that were either open to natural enemies or isolated from them via screens. On fields edges, Malaise traps (Figure 1) were set up to monitor the movement of natural enemies from adjacent habitats (either canola, wheat, alfalfa or wooded areas).

Seven of the 12 fields in 2017 had aphid populations above the economic threshold of 250 aphids per plant. In contrast, 2018 was the opposite, with very few aphids occurring at all.

Aphids escaped control by natural enemies in 2017 due to high levels of aphid immigration into the field. Significant aphid suppression occurred in only one of the 12 fields, on a field where aphid immigration was low. In 2018, aphid migration was low and natural enemies were able to suppress all experimental aphid colonies.

During the outbreak year, massive immigration of winged aphids overwhelmed natural enemies and aphid populations escaped control. When aphid migration was low, which is the typical situation in Manitoba, natural enemies were able to suppress them.

Natural enemies can significantly reduce aphid populations, but it may be economical to consider an insecticide treatment in outbreak years. To determine if control is economical, consider using the Aphid Advisor app, which calculates a dynamic action threshold based on aphid and natural enemy counts, soybean growth stage and air temperature.

As aphid populations grew week-to-week in 2017, so did populations of hoverflies, lady beetle larvae and adults, minute pirate bugs, damsel bugs, green and brown lacewings and aphid mummies from parasitoids.

Hoverflies (syrphids) made up the highest proportion of predators and increased six-fold in response to the aphid outbreak. Lady beetle larvae and adults (coccinellids) were the second most common and increased four-fold.

Hoverflies and green lacewings moved between soybeans and canola more than between soybeans and other habitats, likely since canola provided pollen as an additional food source. Lady beetles moved from all nearby habitats into soybeans and stayed to feed on aphids. Overall, natural enemies moved among soybeans, wheat, canola, alfalfa and wooded areas, suggesting they are all contributors of natural enemies.

Determining the best combination of natural habitats and crops that maximize natural enemy populations is the next step to achieving sustainable pest control. ◗

Figure 1. Bi-directional Malaise trap between soybeans and adjacent habitats to monitor the movement of natural enemies between crops.

Photo: Crystal Almdal

PRINCIPAL INVESTIGATOR Dr. Alejandro Costamagna, University of Manitoba

MPSG INVESTMENT $107,838

CO-FUNDER Western Grains Research Foundation

DURATION 4 years

Improved Wireworm Monitoring in Manitoba

Suspected wireworm presence was confirmed in >90% of surveyed fields in southern Manitoba. *Hypnodius bicolor* was the most prevalent among seven different species detected. Only 28% of fields were at the economic threshold of one wireworm per trap.

WIREWORMS ARE THE larval stages of click beetles and have become a major pest of crops on the Canadian Prairies due to a lack of effective control methods. These larvae feed on seed and below-ground plant tissues during the early stages of plant growth. Since they are difficult to scout for, it has been unclear how much of a pest they can be in soybeans and other crops.

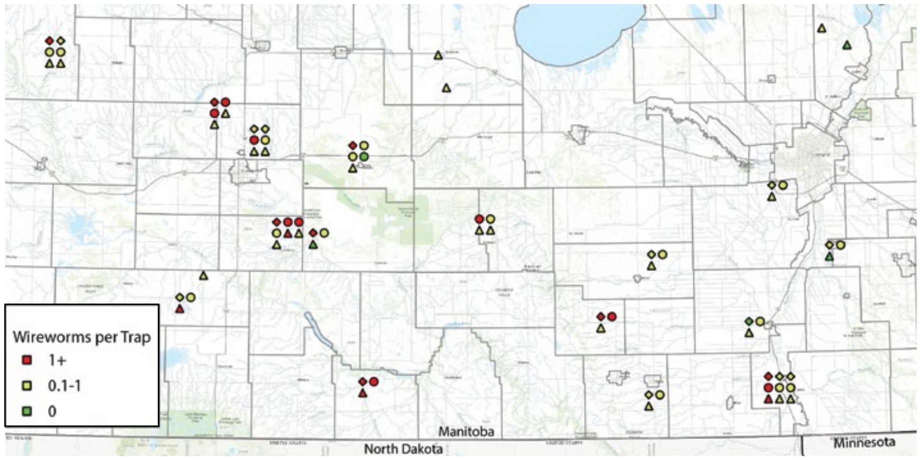
Encouraging responsible use of soybean seed treatments for wireworm control has been a priority at MPSG. The goal is for farmers to utilize seed treatment on a prescribed basis from knowledge of pest pressure in each field. A greater understanding of wireworm distribution and species composition will help farmers make more informed and economical seed treatment decisions.

Objectives of this study were to:

1. test multiple bait trapping tools and techniques for sampling wireworms,
2. examine the wireworm species composition in Manitoba using DNA barcoding to catalogue the species and
3. determine the damage inflicted on soybean plants by different wireworm species and larval stages.

Fields throughout southern Manitoba that had suspected wireworm presence (19, 26 and 30 fields in 2018, 2019 and 2020, respectively) were surveyed three times (spring, summer, fall) using 16 bait traps per field. Bait traps consisted of wheat seed and vermiculite placed 4.5 inches underground in four transects (the preferred method, optimized prior to surveillance). After two weeks, wireworm extraction and species identification took place. In two fields with high infestations, 125 traps were placed in 25 transects biweekly from late April to October to monitor changes in species over time.

Figure 1. Wireworms collected per trap in 2018 (diamond), 2019 (circle) and 2020 (triangle). The nominal economic threshold is one wireworm per trap.



Wireworms were present in most of the sampled fields (>90%) and more abundant in the spring. However, only 28% of fields had more than one wireworm per trap, which is considered the nominal economic threshold. At least seven known species were identified. *Hypnodius bicolor* was the most common species found in spring (93% of wireworms present), but the species composition changed drastically in some fields throughout the season. *Limonius californicus* and *H. abbreviatus* became more abundant from May to July, shifting back to *H. bicolor* in August.

The relationship between field conditions and wireworm bait trap catch was assessed. Soil moisture was significantly correlated with wireworm populations, where on average, every 1% increase in moisture has the potential to reduce wireworm abundance by 15%. Warmer soil temperatures (>6°C) resulted in more wireworms. Soil texture was only borderline significant, but wireworm densities were 13x higher in fine loamy soil than clay soil. Tillage and crop type did not have significant associations with wireworm abundance.

According to laboratory analysis under controlled conditions, it was determined that wireworms were strongly associated with soybean crop damage. *Limonius californicus* was found to cause considerably more damage to plants than both *Hypnodius* species. Crops grown in sand/silt soil were more susceptible to damage than in clay soil and air temperatures >20°C resulted in the most wireworm damage.

This project has provided a greater understanding of wireworm dynamics in Manitoba. When it comes to management, we aim to develop recommendations for actions based on the full risk profile of the pest. Future directions from this research are to refine economic thresholds for wireworm species present in Manitoba and to monitor how the populations and the threat to soybeans evolve over time.

PRINCIPAL INVESTIGATORS Dr. Bryan Cassone, Brandon University

MPSG INVESTMENT $44,053

CO-FUNDERS Canadian Agricultural Partnership, Western Grains Research Foundation

DURATION 3 years

Soyagen: Improving Yield and Disease Resistance in Short-Season Soybeans

Several advancements were made in the area of soybean genomics. Two examples include the development of the first soybean haplotype map, which serves as a worldwide resource for plant breeders, and a precise PCR test for Phytophthora root rot and soybean cyst nematode diagnostics.

THREE IMPORTANT CHALLENGES exist when developing high-yielding soybean varieties suited to Canadian conditions:

1. varieties must mature and produce seed in record time,
2. they need to be resistant to pests and diseases and
3. impediments to further adoption of soybeans across western Canada must be identified and addressed.

Genomics, or exploration of the genetic code of soybeans, allows us to identify DNA markers that control aspects of plant growth like maturity and resistance to pests. Breeders can then use these markers to improve varieties rapidly and easily. A team of scientists from six research institutions across Canada was assembled to investigate soybean genomics, economics, and social impacts to maximize soybean industry growth.

This study involved five main activities:

1. development of cost-effective, high-throughput genotyping tools,
2. improved selection tools to achieve high yields of short-season soybeans,
3. improved diagnostics for the presence and type of Phytophthora root rot (PRR) and soybean cyst nematode (SCN),
4. improved selection tools for varietal resistance to PRR and Sclerotinia and
5. identification of needs to maximize the innovation potential of the soybean industry.

Technological advancements made in Activity 1 will assist breeders with choosing the most promising soybean lines to cross together, alleviating costs and challenges. For example, the first haplotype map for soybeans was constructed using whole-genome sequence data, now serving as a worldwide resource for applied genomics and breeding.

In Activity 2, two tools were developed to help breeders improve varieties and assess traits that cannot be distinguished visually:

1. DNA markers that provide immediate, relevant information on key genes controlling maturity and
2. a statistical model that accurately predicts how complex traits (e.g., yield) of a soybean line will perform in the field based on a plant's genetic makeup.

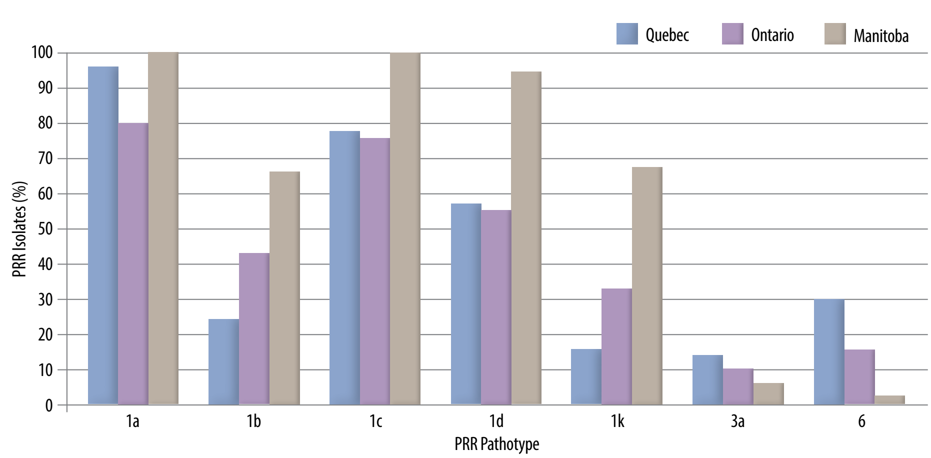
In Activity 3, the genetic makeup of various PRR pathotypes and SCN was characterized and enabled development of PCR tests to identify the presence of PRR and SCN. This precise diagnostic tool will help stakeholders reduce yield loss from these pathogens.

The PCR test from Activity 3 was used to evaluate the presence and distribution of PRR pathotypes in Activity 4 from samples collected across Canada (Figure 1). This characterization serves as a reference tool for breeders to track the evolution and status of PRR.

In Activity 5, farmers, extension specialists and agronomists identified soybean production knowledge gaps and barriers to adoption. Containerized transportation systems, processor demands on quality and grower investments in plant breeding were also assessed. Results have shown, for example, that the availability of higher-yielding, short-season soybean varieties could increase adoption across western Canada and that protein and oil contribute equally to the value of the soybean crop.

Economic benefits of this research have the potential to reach $278 million annually, based on soybean yield potential increases, improved resistance against diseases and other pests, and reduction in pesticide use.

Figure 1. Percentage of Phytophthora root rot (PRR) isolates carrying a given pathotype from 295 isolates sampled from QC, ON and MB fields (2018–2019).



PRINCIPAL INVESTIGATORS Dr. François Belzile and Dr. Richard Bélanger, Université Laval | MPSG INVESTMENT $160,000

CO-FUNDERS Genome Canada, Agriculture and Agri-Food Canada, CÉROM, Genome Quebec, Canadian Field Crop Research Alliance, EMBRAPA-Soja, Saskatchewan Pulse Growers, Semences Prograin, Syngenta, Sevita Genetics, Coop Fédérée, Grain Farmers of Ontario, Université Laval, University of Guelph, Réseau Avertissement Phytosanitaire | DURATION 5 years

Dry Bean Root Rot: Variety Resistance and Molecular Diagnostics

Fusarium cuneirostrum was identified for the first time in Canada as part of the dry bean root rot complex. Dry bean varieties were identified with partial resistance to root rot, which will help with the development of resistant varieties in the future.

ROOT ROT DISEASES are considered a serious threat to dry bean production. Past surveys have shown that bean root rot is caused by a complex of pathogens, including as many as seven fungal species. The most prevalent species in Manitoba have been *Rhizoctonia solani* and *Fusarium solani*, but other *Fusarium* species require further investigation. The first step of root rot investigation is identifying the species involved and monitoring their changing populations over time. Refinement of molecular diagnostics will make rapid, specific and sensitive detection possible.

When it comes to root rot control, resistance is not a common trait of most dry bean varieties in Manitoba, but a few have previously shown partial resistance to several *Fusarium* species and *R. solani*. This research aimed to provide new information for the future adaptation of root rot resistance in bean varieties.

Two complementary studies were conducted. The first involved annual dry bean disease surveys from 2013–2017, in which 30 bean plants were collected from each of 40 fields in Manitoba to be rated visually for root rot severity and 15 plants were further evaluated in the lab. Symptomatic bean roots were used for molecular diagnostic testing. The second study evaluated 36 dry bean varieties for their reactions to four different root pathogens, including three different *Fusarium* species and *R. solani*. Field trials were conducted at Morden. The inoculum of a specific root rot pathogen was added to the seed of each variety just before planting.

In the first study, average root rot severity was greater in 2013–2017 compared to the previous five-year period. Fusarium root rot was detected in all bean fields that were sampled. According to in-depth root pathogen identification, up to 12 different *Fusarium* species were identified.

Table 1. Seedling emergence and root rot ratings for a subset of 10 commercial dry bean varieties tested (of 36 total) against root pathogens, compared to the mean of control varieties in the root rot resistance experiments.

Variety	Market Class	Emergence (%)	Disease Severity Rating (0–9)
Windbreaker	Pinto	57	<u>5.2</u>
CDC Pintium	Pinto	54	5.1
Etna	Cranberry	56	**3.4**
Beryl	Great Northern	58	5.1
CDC Jet	Black	**62**	**4.7**
AC Redbond	Small Red	**64**	5.1
Early Rose	Pink	**72**	<u>5.3</u>
Pink Panther	Light Red Kidney	**65**	5.1
T9903	Navy	<u>52</u>	4.9
Arikara Yellow	Yellow	**70**	4.8
Mean of Control Varieties		57	4.9
LSD (n = 40,1080; 443 df)		5	0.25

Bold = better than the mean of all the controls based on least significant differences (LSD) at 5%; underlined = worse.

Fusarium cuneirostrum was identified as a causal agent of root rot in dry beans for the first time in Canada. A set of *Fusarium* species were screened for pathogenicity on the variety, Envoy. Of the species tested, *F. cuneirostrum* was the most aggressive, followed by two isolates of *F. avenaceum*. Other *Fusarium* species were less aggressive, but they could still impact dry bean productivity as part of the root rot complex due to their abundance.

In the second study, several varieties with partial resistance to seedling blight were identified by their high rates of seedling emergence, including CDC Jet and Pink Panther (Table 1), among others not listed.

Most varieties consistently had high root rot severity ratings, but a few showed partial resistance to root rot, as indicated by their low root rot ratings in Table 1. The partially resistant check, Etna, showed resistance to all of the pathogens at both locations. Another cranberry bean, Cran 09, and another black bean, Black Violet, were also partially resistant to root rot (data not shown). Root rot resistance rarely occurs in large-seeded market classes, so its detection in the cranberry bean varieties was an important finding.

Rhizoctonia solani inoculation resulted in the lowest seedling emergence (60%, on average) compared to other pathogens (67% for the *Fusarium* species). Root rot severity was greatest in plots inoculated with *Fusarium* species (4.8, on a scale of 0–9) and *R. solani* (4.4).

These results have since informed dry bean breeders of suitable root rot resistant parents for crossing programs. They have helped make important strides in molecular diagnostics, including new detection techniques for root pathogens for faster and more precise management decisions in the future.

This study was not intended to evaluate or endorse any dry bean variety for its suitability in Canada. AAFC expressly disclaims any implied warranty of merchantability, non-infringement or fitness for a particular purpose concerning the research findings.

PRINCIPAL INVESTIGATORS Dr. Bob Conner, Dr. Debra McLaren, Dr. Maria Antonia Henriquez, Dr. Yong Min Kim, Dr. Kenneth McRae and Dr. Anfu Hou, Agriculture and Agri-Food Canada

MPSG INVESTMENT $45,000 (Study 1), $60,000 (Study 2)

DURATION 5 years

Lygus Bugs in Dry Beans and Soybeans

Lygus bug nymphs caused more yield and quality loss than adults, and the greatest quality losses were incurred from damage at the seed development, filling and maturity stages. Navy beans exhibited more seed pitting damage than pinto beans.

Pitting from lygus injury at the seed filling stage.

Photo: T. Nagalingam

LYGUS BUGS ARE a pest of several crops in Manitoba. The term lygus bug refers to any member of plant bug in the genus *Lygus*. Adults and nymphs feed on flower buds, seeds and pods using piercing mouthparts that extract plant sap. Lygus feeding on dry bean seeds results in sunken perforated areas, negatively impacting quality.

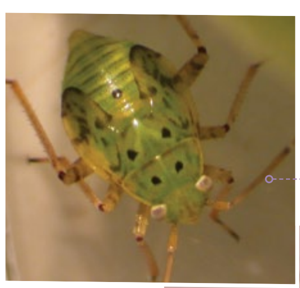
Economic loss due to lygus bugs in dry beans does not occur in most years in Manitoba. However, quality may suffer when lygus bug numbers are extremely high in a given region. Observations of lygus bugs feeding on dry beans in Manitoba in 2007 prompted concerns about their effects on yield quality and quantity. Little is known about the species composition or seasonal patterns of lygus bug occurrence on dry beans in Manitoba. This research aimed to address that.

Seventeen navy bean, 10 pinto bean and nine soybean fields were surveyed for lygus bugs from 2008–2010. At the centre and margins of these 36 fields, sweep net and tap tray samples were taken weekly and species were identified. Additionally, in the laboratory and field cages, researchers investigated the effects of feeding by tarnished plant bug (*Lygus lineolaris*) adults and fifth instar nymphs on different development stages of navy beans to characterize short-term effects of feeding and long-term effects on yield.

Of the adult plant bugs captured, 78–95% were tarnished plant bugs (*L. lineolaris*), less than 10% were alfalfa plant bugs (*Adelphcoris lineolatus*) and other species made up the remainder (*L. elisus, L borealis*). Species composition varied among years but not among crops. *Lygus lineolaris* reproduced in dry beans and soybeans and completed a single generation.

In dry beans, lygus bug adults were first collected in late July during the late vegetative and early pod set stages, and females laid eggs in the crop. Nymphs hatched, developed and were most abundant at the seed development and seed filling stages. At seed maturity, late instar nymphs and adults were present. This indicates that the first generation of reproductive adults immigrated to the crop and the second generation developed in-crop.

Lygus lineolaris reproduced in soybean crops, but nymphs had poorer survival than in dry beans. In late August and early September, adult numbers peaked in dry beans and soybeans partly due to immigration of adult lygus bugs from earlier maturing crops. Dry beans and soybeans appeared to be a host for transient alfalfa plant bugs. There were no effects on yield quality or quantity associated with the numbers of plant bugs seen in these field surveys. Seed pitting was found on navy beans but was negligible on pinto beans.



Lygus bug fifth instar nymph, about 4 mm (1/6 inch) long.

Lygus bug adult, about 5 mm (1/5 inch) long.

Photos: T. Nagalingam

In laboratory and field cages, *L. lineolaris* nymphs were found to be more damaging than adults. Feeding damage also varied by plant development stage. At flowering to pod initiation, buds, flowers or pods were aborted. Pod loss sometimes reduced yield, but seed quality was unharmed.

The late-season stages were most at risk from lygus bug damage. Feeding during seed development and filling resulted in shrivelled seeds and pods, consequently reducing seed weight. At seed maturity, feeding caused direct seed injury, resulting in pitted seed coats. There was no loss in yield quantity when feeding occurred at seed maturity, but seed pitting reduced yield quality. Although all growth stages were vulnerable to lygus, the late-season stages were most at risk since displaced lygus from harvested crops moved into maturing dry beans and caused quality loss.

Lygus bug population numbers were not high enough during the years of this research for an economic threshold to be developed. A suggested nominal threshold was proposed of 10 lygus adults/m² at the beginning pod (R2) to mid-bloom (R3) when conditions are not favourable for the plants but are favourable for lygus bugs (e.g., hot and dry). This is based on the 2009 field cage experiment that found that 1 adult/m² reduced yield by 0.6 g/m², or roughly 5.4 lbs/ac.

PRINCIPAL INVESTIGATOR Dr. Neil Holliday, University of Manitoba

MPSG INVESTMENT $50,300

CO-FUNDERS University of Manitoba Graduate Fellowship; Agri-Food Research and Development Initiative

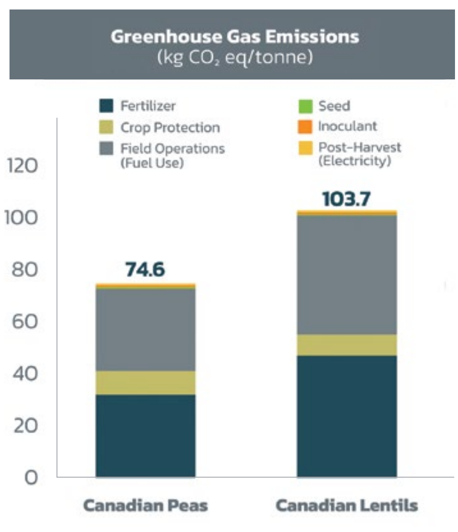
DURATION 3 years

MARKET DEMAND

Life Cycle Assessment of Canadian Prairie Pea and Lentil Production

Peas and lentils grown on the Canadian prairies have low environmental footprints compared to other crops. Fuel and fertilizer were identified as hotspots for emissions and resource use.

ALTHOUGH CONSUMER DEMAND for sustainable, wholesome ingredients continues to rise, the food industry is facing scrutiny over the validity and transparency of sustainability claims. This offers the Canadian pulse industry an opportunity to showcase the low environmental footprint of Canadian pulses and to develop strong datasets aligned with the needs of companies looking to make these claims. Over the last two years, Pulse Canada worked with the University of British Columbia on a life cycle assessment of Canadian peas and lentils to gain a deeper insight to the carbon footprint of the crops and offer extensive data for the food companies to leverage.



Life cycle assessment (LCA) is a widely recognized methodology for quantifying resource inputs (i.e., energy, fuel, water) and emission outputs (i.e., greenhouse gases, air pollutants) throughout a crop's life cycle to assess their overall environmental impact.

The project had two outcomes:

1. Develop thorough and regionalized life cycle inventories (LCIs) for peas and lentils.
2. Develop a comprehensive report to support the Canadian pulse industry's initiatives around the sustainability of Canadian pulses.

The cradle-to-farm gate life cycle environmental impacts of pea and lentil production were assessed using aggregated field-level data supplied by Canadian pulse farmers at the ecozone, provincial and prairie scales. Survey data was collected from 287 lentil farmers and 269 pea farmers across the prairies. These surveys captured information on the crop's full production, including seed, fertilizer and pesticide inputs, fuel use, grain drying, yields and field operations. Practices like no-till were accounted for to measure soil carbon sequestration, and a credit was applied to the pulse crop due to the nitrogen benefit provided to crops in rotation.

The results of the LCA confirm that Canadian peas and lentils have very low environmental footprints compared to other crops and sources of plant-based ingredients. Fuel and fertilizer were identified as hotspots for potential reductions in emissions and resource use, therefore adopting best management practices may enable farmers to further reduce impacts. A focus on fuel use efficiency is particularly relevant given the global and national conversation on carbon and climate change.

Furthermore, this study provides additional evidence that peas and lentils lower the negative environmental impacts of Canadian cropping systems and growing pulses contributes to reducing the climate impacts of Canadian agriculture.

While more work can be done to reduce the impact of fuel use on production, conducting this life cycle assessment improves the marketability of peas and lentils by identifying the low-environmental impacts of production. Lastly, due to their impact on cropping systems, this study provides additional evidence that growing pulses contributes to reducing the climate impacts of Canadian agriculture as a whole.

To view the full LCA report, visit pulsecanada.com/sustainability.

PRINCIPAL INVESTIGATOR Dr. Nathan Pelletier, University of British Columbia

TOTAL INVESTMENT $87,300

CO-FUNDERS Pulse Canada, Agriculture and Agri-Food Canada

DURATION 2 years

MARKET DEMAND

Dairy-Like Ice Cream and Cheese Created from Soybeans

Soybean ice cream and cheeses were successfully created with flavour additions to overcome the "beany" taste.


Soybean Ice Cream

Soybean Cream Cheese

SOY MILK AS an alternative to cow's milk is well established, but how well do high-protein soybeans function in ice cream and cheese products? This research made strides in creating plant-based "dairy" products.

Whole soybean seed, high-oil and low-oil press cakes were tested. Press cakes had greater protein content than whole soybeans, which led to a better texture in both the cheese and ice cream-like products.

Preparing a frozen soybean dessert began with making soy milk by extracting protein from the press cakes and adding sugar, vanilla and a pinch of salt to an automatic ice cream maker. The first batch resulted in icy products that layered when frozen, so a 1% sodium alginate stabilizer was added to develop a creamier texture resembling ice cream. Adding vanilla, chocolate or strawberry flavouring masked any beany soybean flavour.

To create cheese, tofu was made from the extracted soy milk, and oil, pectin, gums and salt were added to create a cream cheese-like product. The additions of herb, lemon or cucumber flavours hid the beany taste. Producing a hard cheese-like soy product was trickier and required adding agar flakes and starch to achieve the desired texture. The beany taste was also apparent, so flavouring would be desired.

PRINCIPAL INVESTIGATOR Dr. Sue Arntfield, University of Manitoba

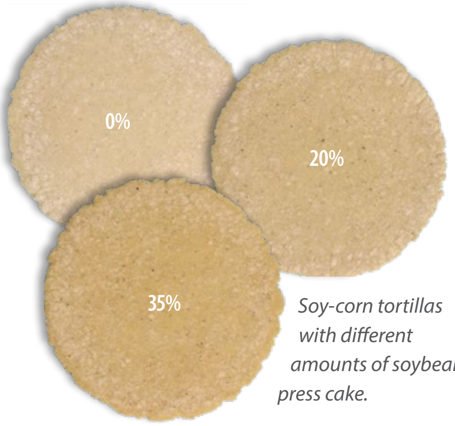
MPSG INVESTMENT $10,000

DURATION 1 year

MARKET DEMAND

Soybean-Corn Tortillas

Adding soybeans to corn tortillas resulted in a slightly darker, softer tortilla.



Soy-corn tortillas with different amounts of soybean press cake.

TRADITIONALLY, TORTILLAS ARE made from wheat or corn flour. Soybean press cakes are made from soybean meal by-products of oil processing. They are high in nutrients including protein, fibre, residual oil and micronutrients. Adding soybean press cake has the potential to improve the nutritional value of tortillas.

Corn flour, salt, xanthan gum, water and different amounts of soybean press cake (0–35%) were used to create tortillas. The gum was necessary since the press cake was not as sticky as corn flour.

Tortillas made with soybeans added were yellower and redder than traditional corn tortillas, but visually, this difference was small. Adding soybeans resulted in a softer tortilla that was easier to break.

Nutritionally, soybeans contain more trypsin inhibitors than corn. Trypsin inhibitors reduce the availability of trypsin, which is an enzyme necessary for protein digestion. Adding soybeans increased the level of trypsin inhibitor activity, which could be problematic, especially for anyone on a diet with limited protein intake. The cooking methods used in this study were not able to deactivate these inhibitors since they are relatively heat stable. Subjecting soybean press cakes to more severe heat treatments prior to incorporation may reduce the level of trypsin inhibitor activity and improve protein digestion.

PRINCIPAL INVESTIGATOR Dr. Sue Arntfield, University of Manitoba

MPSG INVESTMENT $32,000

DURATION 2 years

MARKET DEMAND

The Impact of Dry Bean Compounds on Cardiovascular Function

Red kidney beans improved cardiovascular function by lowering tension of the blood vessel wall. Twenty-one compounds were absorbed into the blood of those who ate a mixed bean diet, of which some are expected to be responsible for these health benefits.

PREVIOUS RESEARCH PROVED that consuming a half-cup of mixed pulses every day could improve blood flow to the legs of those with peripheral artery disease in only eight weeks. It was proposed that specific compounds absorbed from pulses are responsible for these benefits.

The objective of this research was to learn about these bean compounds and see if beans can positively affect blood vessel function immediately after consumption. In one experiment, blood vessel function was measured after healthy individuals ate four types of beans separately (navy, red kidney, black, pinto). A second experiment involved blood metabolomic analyses of individuals with peripheral artery disease who ate a mixture of all four bean types, compared to a rice control, for eight weeks.

The first experiment showed that eating red kidney beans produced the specific benefit of vasodilation or lowered tension of the blood vessel wall. This allows for improved blood flow, which over the long term will help protect against cardiovascular disease, including peripheral artery disease that affects the legs.

According to the second experiment, including beans in the diet changed the metabolic profile of the blood, which likely explains the health benefits derived from beans. It was also revealed that 21 compounds (of the 1,781 total found in beans) were detected in the blood of individuals who ate the mixed bean diet, some of which are expected to be responsible for the health benefits ascribed to beans.

PRINCIPAL INVESTIGATOR Dr. Peter Zahradka, St. Boniface Hospital Albrechtsen Research Centre

MPSG INVESTMENT $40,000

DURATION 2 years

MARKET DEMAND

Black and Navy Bean Effects on Blood Vessel Function

Black beans improved the elasticity of blood vessels in hypertensive rats. However, this health benefit was lost when black beans were removed from the diet for more than two weeks.

PREVIOUS RESEARCH HAS shown that consumption of dry beans leads to cardiovascular benefits, but it has been unclear which bean types contribute to this improvement. This study was designed to determine which bean type (black or navy) had the greatest potential for improving blood vessel function.

The impact of different diets containing beans was tested on hypertensive rats with elevated blood pressure and less elastic (stiff) arteries, compared to the healthy control rats. Diets of black beans, navy beans or no beans (control diet) were consumed for eight weeks. All animals were then placed on the control diet for another four weeks to see if the measured parameters returned to normal.

Blood vessel thickness, a major structural feature that is increased by high blood pressure, was reduced by the black bean diet. This means black bean consumption blocks structural changes to the blood vessels caused by high blood pressure. Navy beans may have had some effect on blood vessels, but they were not as potent as black beans.

The hypertensive rats that ate black beans daily for eight weeks also had greater blood vessel elasticity and this was maintained for two weeks after the beans were removed from the diet. But this protective effect was lost after four weeks without beans in the diet. This indicates that black beans are more potent, but their beneficial effects are eventually lost if they are not eaten regularly.

PRINCIPAL INVESTIGATOR Dr. Peter Zahradka, St. Boniface Hospital Albrechtsen Research Centre

MPSG INVESTMENT $10,000

CO-FUNDERS Agri-Food Research and Development Initiative

DURATION 2 years

2022 Funding Approved for Research[†]

OUR GOAL IS to have the list of projects below reflect the breadth of ideas and information pulse and soybean growers are eager to embrace. The list demonstrates that MPSG's research programs remain focused on four broad areas we think are important to members. Most topics within each area are drawn from first-hand observations of crops and soils recorded by farmers, agronomists and researchers. However, in the search for answers, we've learned it is necessary to reach into realms we can't observe first-hand. As a result, the list contains projects in areas such as soil microbiology and plant genomics that probe nature at a scale we cannot comprehend without the use of modern scientific tools. We used to refer to projects using such tools as "upstream" to distinguish them from research with more immediate and practical results. Nowadays, we recognize such a distinction is unfair. Every question we seek to solve through research affects the improvement of farm practices.

Moreover, we've also learned that most projects, no matter how practical, do not stand on their own. Results always need to be interpreted in the context of a particular farm application. So, we've complemented research investments with knowledgeable MPSG extension professionals who provide that critical interpretive service through mediums like this magazine. Also, we supplement our own efforts with interpretive partnerships across the industry spectrum. In that regard, the list contains projects that were developed in the context of maximizing members' success in fulfilling yellow pea contracts with Roquette.

RESEARCHER	PROJECT	START	END	MPSG FUNDING	TOTAL VALUE
IMPROVE YIELD AND QUALITY					
MPSG – MCVET	Evaluating Yield, Disease Resistance and Protein in Pulse and Soybean Varieties	1990	ongoing	cost recovery	cost recovery
AAFC – Mohr	Management Practices to Optimize Establishment and Early-Season Growth of Soybeans	2017	2022	$73,462	$144,022
IHARF				$35,280	
CMCDC				$35,280	
U of M – Lawley	Cover Crop Strategies for Dry Beans and Soybeans in Manitoba	2017	2022	$195,444	$195,444
AAFC – Mohr	Sustainable Soybean Cropping Systems for Western Manitoba	2017	2022	$98,325	$196,651
U of M – MacMillan	Optimizing Nitrogen Rates for Dry Bean Production	2017	ongoing	In 2016, MPSG committed $400,000 per year for five years to support applied research at the U of M. Under this program an Agronomist-in-Residence conducts research, extension and student training. Projects are reviewed annually to ensure they align with farmer priorities.	
U of M – MacMillan	Novel Pulse Cropping Systems	2017	ongoing		
U of M – MacMillan	Pea Crop Rotation Length and Sequence	2020	2023		
U of M – Lawley	Optimizing the Frequency of Soybeans in Manitoba Crop Rotations	2018	2023	$129,519	$496,588
U of M – Ayele	Mitigating Soybean Harvest Losses by Enhancing Podding Height	2018	2022	$82,411	$164,822
AAFC – Hou	Dry Bean Breeding for Early Maturity and Pest Resistance	2018	2023	$728,188	$1,456,376
AAFC – Bing	Pea Breeding for Yield, Pest Resistance and Flavour	2018	2023	$98,630	$2,776,828
AAFC – Han				$43,155	
AAFC – Cober	Short-Season Food-Type Soybean Breeding	2018	2023	$186,930	$2,368,188
AAFC – Cober	Meeting the Soybean Protein Meal Standard in Western Canada	2018	2023	$131,699	$658,500
U of G – Rajcan	Breeding for Organic Soybean Production	2018	2023	$20,000	$157,143
MPSG – On-Farm Network	Soybean Response to Seeding Rate	2012	ongoing	OFN	OFN
MPSG – On-Farm Network	Evaluation of Single vs. Double vs. No Inoculation Strategies for Soybeans	2013	ongoing	OFN	OFN
MPSG – On-Farm Network	Soybean Response to Biological Stimulants	2019	ongoing	OFN	OFN
MPSG – On-Farm Network	Soybean Response to Row Spacing	2019	ongoing	OFN	OFN

continued ➤

RESEARCHER	PROJECT	START	END	MPSG FUNDING	TOTAL VALUE
Improve Yield and Quality continued					
MPSG – On-Farm Network	Evaluation of Inoculation Strategies for Peas	2019	ongoing	OFN	OFN
MPSG – On-Farm Network	Evaluation of Inoculation Strategies for Dry Beans	2019	ongoing	OFN	OFN
MPSG – On-Farm Network	Dry Bean Response to Nitrogen Fertility	2019	ongoing	OFN	OFN
MPSG – On-Farm Network	Pea Response to Seeding Rate	2021	ongoing	OFN	OFN
WADO	Intercropping Practices for Yellow Peas	2019	2022	$23,004	$69,012
AAFC – Mohr	Economic and Environmental Value of Peas and Soybeans in Rotation	2019	2022	$82,800	$160,560
U of M – Stasolla	Genetics to Overcome Drought and Salinity Effects in Soybeans	2019	2022	$139,725	$270,945
U of M – House	Soybean Protein Testing in the Regional Variety Trials	2022	ongoing	$56,595	$56,595
U of M – Oresnik	A Superior Rhizobium Strain for N-Fixation in Dry Beans	2019	2022	$188,830	$366,166
MPSG/MCA/MCGA	Tools and Techniques to Manage Extreme Moisture	2019	2022	$120,000	$823,000
U of M – House	Evaluating the Feeding Value of Western Canadian Soybeans for Layers, Pullets, Broilers and Swine	2020	2023	$239,760	$479,520
U of M – Oresnik	Effect of the Frequency of Soybeans in Rotation on Rhizobium and Soil Microbial Community	2020	2023	$110,486	$214,247
Roquette	Variety Adaptation Trial for Higher Protein Peas	2020	2022	$0	$17,064
Roquette	On-Farm Assessment of Precision Phosphorus Management for Crop Dry-Down	2020	2022	$0	$17,280
Roquette	Better Understanding of Return on Investment of Intercropping Combinations	2020	2022	$0	$18,507
Roquette	Pea Protein Survey/Investigation in the Swan River Region	2020	2020	$0	$5,076
Roquette	Development of Organic Extension Fact Sheets	2020	2022	$0	$3,072
AAFC – Mohr	Optimizing Nitrogen and Phosphorus Management for Dry Beans in Southwestern Manitoba	2021	2023	$93,150	$186,300
PAMI	Pea Seed Mortality Due to Air Seeder Damage	2021	2022	$31,050	$62,100
Morden Community Economic Development Corporation	Validating Opportunities and Building Local Capacity for Digital Agriculture	2021	2023	$32,000	$202,000
U of W – Bidinosti	Development and Evaluation of a Fully-Automated Data Rover for Rapid Data Collection of Stress Tolerance in Soybeans	2022	2023	$24,300	$48,600
U of M – Gulden	Rotational Effects and Optimized Plant Spatial Arrangement for Wheat Production in Manitoba	2017	2022	$82,800	$349,140
AAFC – Mohr	New Crop Rotation Economics	2018	2023	$35,000	$1,300,000
U of L – Leroy	Economics of Diverse Crop Rotations	2018	2023	$15,000	$351,000
REDUCE THE COST OF PEST CONTROL					
MPSG – On-Farm Network	Field Pea Response to Foliar Fungicide	2017	ongoing	OFN	OFN
MPSG – On-Farm Network	Dry Bean Response to Foliar Fungicide	2017	ongoing	OFN	OFN
MPSG – On-Farm Network	Soybean Response to Foliar Fungicide	2018	ongoing	OFN	OFN
MPSG – On-Farm Network	Faba Bean Response to Foliar Fungicide	2020	ongoing	OFN	OFN
AAFC – McLaren U of A	Management of Root Rot in Peas in Manitoba	2018	2023	$0 $45,404	$88,305
AAFC – Vankosky	Prairie Insect Survey	2018	2023	$20,000	$571,000
AAFC – Leeson	Prairie Weed Survey	2018	2023	$25,000	$753,100
AAFC – Leeson	Prairie Herbicide-Resistant Weed Survey	2018	2023	$3,000	$88,000
AAFC – Geddes	The Next Generation of Prairie Herbicide-Resistant Weed Surveys	2020	2023	$48,445	$96,890
AAFC – Turkington	Prairie Disease Monitoring Network	2018	2023	$45,000	$1,360,000

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RESEARCHER	PROJECT	START	END	MPSG FUNDING	TOTAL VALUE
Reduce the Cost of Pest Control continued					
AAFC – Geddes	Glyphosate-Resistant Kochia – Rotation, Seeding Rates and Row Spacings	2018	2023	$15,000	$1,282,000
PAMI – Landry	Spray Drift Reduction with High-Clearance Sprayers	2018	2023	$30,000	$424,000
AAFC – Chatterton	Optimizing Disease Management Strategies for White Mould and Bacterial Blights of Dry Beans	2018	2023	$61,951	$616,904
AAFC – Chatterton	Pea Root Rot – Resistance Genes, Crop Rotation and Intercropping	2018	2023	$30,679	$1,636,818
U of S – Shirtliffe				$18,426	
U of M – Tenuta	Root Lesion Nematode Survey	2018	2023	$20,639	$853,813
AAFC – Chatterton				$4,975	
AAFC – McLaren	Strategies for Effective Management of Phytophthora and the Root Rot Complex of Soybeans	2018	2023	$75,506	$887,919
LU – Bélanger	Root Diseases – Genetic Screening Methods	2018	2023	$44,657	$652,776
U of M – Daayf	Defining Pathogen-Related Soil Quality Targets for Annual Legumes to Pursue Through Crop Rotation	2019	2022	$88,172	$253,782
AAFC – Geddes	Integrated Weed Management to Mitigate Glyphosate-Resistant Weeds	2019	2022	$110,940	$309,984
Roquette	Developing the Capacity to Detect and Quantify Aphanomyces Oospores and Disease Severity in Manitoba	2020	2022	$0	$36,936
Roquette	Efficacy and Return on Investment of Foliar Fungicide in Yellow Peas	2020	2022	$0	$64,800
Roquette	Volunteer Soybean Control in Yellow Pea Production	2020	2022	$0	$22,200
Roquette	Satellite Imagery – Assisted Sampling for Aphanomyces	2020	2021	$0	$34,496
AAFC – Geddes	Manipulating Weed Seed Production Through Phenology-Based Weed Control	2021	2022	$11,556	$46,224
ACC – Singh	Developing a Weather-Based Fungicide Application Decision Support Tool for Managing White Mould in Dry Beans	2021	2023	$41,850	$83,700
GROW MARKET DEMAND					
U of G – Duncan	Cholesterol-Lowering Properties of Dry Beans	2018	2023	$136,431	$757,680
AAFC – Ramdath				$47,196	
U of S – Nickerson	Pulse Ingredient Processing for Improved Flour Quality	2018	2023	$103,802	$2,866,150
AAFC – Hou				$12,571	
AAFC – Balasubramanium	Dry Bean Cooking Quality	2018	2023	$15,942	$87,444
IMPROVE SOIL QUALITY					
U of M – Lawley	Cover Crops – Establishment Windows, Soil Health and Yield	2018	2023	$40,000	$1,519,772
MPSG – On-Farm Network	Tillage Management for Dry Beans	2020	ongoing	OFN	OFN
AAFC – Crittenden	Understanding How Soil Health Affects Corn and Soybean Yield and Quality	2020	2023	$60,350	$241,400
New Era Ag	Using Wood Ash as a Soil Amendment to Control Clubroot – Effect on Peas and Soybeans in Northwestern Manitoba	2020	2023	$7,500	$153,540
Agri-Earth Consulting, PBS Water Engineering	Beneficial Practices for Soil and Water Quality, Excess Water and Drought Resiliency in Southwestern Manitoba	2020	2023	$33,729	$391,200
PAMI	The Effect of Low Ground Pressure Traffic Systems on Soil Compaction in Heavy Clay Soils Affected by Extreme Moisture Conditions	2021	2023	$21,000	$137,500
U of M – Bakker	Integrating Microbiology into Assessments of Soil Health in Manitoba	2021	2022	$37,827	$151,308
PAMI	Analysis of the Carbon Intensity of Legume Crop Production and their Potential for the Future Low Carbon Economy	2022	2022	$16,200	$32,400

† At time of printing.

AAFC – Agriculture and Agri-Food Canada
CMCDC – Canada-Manitoba Crop Diversification Centre
IHARF – Indian Head Agricultural Research Foundation
LU – Laval University
MCGA – Manitoba Canola Growers Association
MCVET – Manitoba Crop Variety Evaluation Trials
MPSG – Manitoba Pulse & Soybean Growers
MCA – Manitoba Crop Alliance
OFN – On-Farm Network
PAMI – Prairie Agriculture Machinery Institute
U of A – University of Alberta
U of G – University of Guelph
U of L – University of Lethbridge
U of M – University of Manitoba
U of S – University of Saskatchewan
WADO – Westman Agricultural Diversification Organization

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