MANITOBA Pulse Soybean GROWERS

pulsebeat

The Science Edition

Issue 7 • February 2023 • manitobapulse.ca

IN THIS ISSUE

YIELD & QUALITY
PEST CONTROL
MARKET DEMAND

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

We are pleased to present the seventh issue of *Pulse Beat – The Science Edition*, MPSG's annual showcase of completed research projects funded by farmer check-off dollars, bundled into neat little single-page packages.

Our farmer membership and agronomists have been asking for updated information on dry bean nitrogen management and inoculant testing, and this issue offers just that – a comprehensive package of any new results we can provide on the subject.

Dry beans are also a feature in the Pulse Canada-driven life cycle assessment on both dry beans and faba beans. This work has provided the pulse industry with a well-timed, comprehensive report on greenhouse gas emissions and input use to support the Canadian pulse industry's sustainability initiatives.

On the topic of soybeans, find summaries of projects that examined how soybean growth stages behave in Manitoba compared to other regions, and late-season mechanical weed control – including the use of a CombCut implement in-crop on volunteer canola.

To support the rejuvenated pea industry in Manitoba, we have a multitude of topics geared toward improving production. These include a look at the impact of air seeder damage, conventional and organic intercropping, on-farm foliar fungicide testing, peas grown in sequence with soybeans, canola and wheat, and root rot surveillance and variety resistance screening.

Finally, we have summaries of two market- and consumer-facing studies that demonstrate the uses of pulses for human consumption.

We always welcome thoughts from you, the farmers, on what the next research priorities should be for pulses and soybeans in Manitoba. As this issue demonstrates, you asked, we listened, and we will continue to do so to provide value from your investment.

Cassandra Tkachuk
MPSG Research Project Manager
cassandra@manitobapulse.ca

CONTENTS

YIELD & QUALITY ▸ Increasing Expectations

PEST CONTROL ▸ Improving Control

MARKET DEMAND ▸ Driving Demand

Publications Mail Agreement #40016070
RETURN UNDELIVERABLE CANADIAN ADDRESSES TO:
Manitoba Pulse & Soybean Growers
P.O. Box 1760, Carman, Manitoba R0G 0J0

Optimizing Nitrogen Rates for Pinto and Navy Beans

Dry bean yield matched maximum yield at the lowest rate of N fertilizer applied which was 35 lbs N/ac and equivalent to 60-90 lbs total N/ac as a combination of fertilizer and soil residual-N. However, the economic optimum scenario was not applying N fertilizer at all.

DRY BEANS ARE relatively poor nitrogen (N) fixers, producing less than 45% of their N requirement, on average, through biological N fixation. Currently, commercial inoculants are not easily accessed nor commonly applied. As a result, dry beans are typically fertilized like a non-legume crop. Application of N fertilizer at a rate of 70 lbs N/ac is common practice, though recommendations vary by region.

Nitrogen uptake rates in dry beans range from 3.9-4.7 lbs N required per cwt of seed, meaning a 2,000 lb/ac dry bean crop would require 78-90 lbs N/ac. This nitrogen may be derived from a combination of residual soil N, biological N fixation and N fertilizer. This experiment evaluated N fertilizer rates while a follow-up companion study has been evaluating inoculant options.

Five rates of N fertilizer (0, 35, 70, 105 and 140 lbs N/ac) were compared in Windbreaker pinto beans and T9905 navy beans at Carman and Portage la Prairie from 2017 to 2019. Nitrogen was applied as spring broadcasted urea and incorporated prior to planting dry beans. Non-inoculated dry beans were planted on 15-inch rows into tilled wheat stubble. Residual N levels among site-years ranged from 23-56 lbs N/ac (0-24" depth).

The 2017 to 2019 growing seasons were dry and warm. This lack of soil moisture may have influenced N dynamics throughout this study, reducing mineralization, inhibiting nodule development and promoting root exploration to access deep N (>24").

Nodulation was low overall, which is not surprising since beans were not inoculated, and sites did not have recent dry bean history. At flowering, dry bean nodulation was evaluated on a scale of 0-4, with 4 being >20 nodules per plant and 0 being no nodules present. Pinto beans had slightly greater nodulation than navy beans (0.6 vs. 0.4). Nodule development in this study is a result of native rhizobia populations since beans were not inoculated. As N fertilizer rate increased, dry bean nodulation score decreased.

Yield response to nitrogen rate did not vary with market class. Dry bean yield was only significantly increased over the 0 N control at the greatest rate of 140 lbs N/ac, which boosted yield by 17% (Figure 1). The yields of the other N rates were no different from the control. However, yield was maximized at the lowest rate of N applied (35 lbs N/ac), which was equivalent to 60-90 lbs of total N/ac (as a combination of N applied and soil residual N).

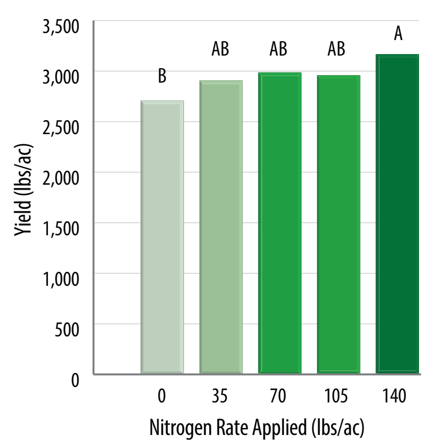
Which N rate was the most economical? Across multiple N cost and bean pricing scenarios, the return on investment was statistically similar for all rates of N application. This indicates that the economic optimum practice in these experiments was not applying N at all.

Yield from the 0 N control was exceptional, averaging 2700 lbs/ac and resulting in 83% of maximum yield. Total N uptake in the 0 N control was estimated to be 64-169 lbs N/ac. Residual soil N would have only provided 23-56 lbs N/ac, resulting in a deficit of 8-131 lbs N/ac. Soil samples were taken post-harvest and found residual N levels in the 0 N control ranging from 20-60 lbs N/ac. This post-harvest surplus indicates N requirements of dry beans were met through a combination of biological N fixation, mineralization and accessing deep nitrogen sources.

Emerging guidelines from this research suggest that full fertilization to meet N requirements may not be necessary in Manitoba and that biological N fixation is contributing to the N requirements of dry bean. In this study, non-fertilized, non-inoculated beans resulted in 83% of maximum yield. Applying the highest rate of N maximized yield but was not economical. Applying N fertilizer at a rate of 35 lbs/ac or to reach 70 lbs/ac of total N (including soil residual N) matched maximum yield without reducing nodulation.

Results from this research are being reviewed in conjunction with inoculant evaluation research and on-farm N fertility trials to revisit N management recommendations for dry beans in Manitoba. Future work will measure biological N fixation in current varieties.

Figure 1. Dry bean yield (lbs/ac) response to nitrogen rate (lbs/ac) at Carman and Portage (2017-2019) averaged across pinto and navy bean market classes.



Bars followed by different letters are statistically different at $p < 0.05$.

PRINCIPAL INVESTIGATOR Kristen P. MacMillan, University of Manitoba

MPSG INVESTMENT $77,000

CO-FUNDERS Growing Forward II

DURATION 3 years

On-Farm Evaluation of Nitrogen Rates in Dry Beans

on-farm network
PARTICIPATORY • PRECISE • PROACTIVE

Not applying nitrogen was the economical decision at four out of five on-farm trials. Dry bean nodulation was excellent in these on-farm trials even though inoculant was not applied.

AS APPLIED SMALL-PLOT research was investigating optimum nitrogen (N) rates, complementary on-farm trials were established to determine the effects of different N fertilizer rates on dry bean nodulation and yield at the field-scale.

From 2019 to 2021, MPSG's On-Farm Network conducted five trials testing a range of N fertilizer rates in non-inoculated dry bean fields. The selected fertilizer rates were specific to each farm, ranging from 0-140 lbs N/ac (Table 1). Residual soil nitrate-N levels ranged from 20-70 lbs N/ac.

At flowering, nodulation was scored on a rating scale where 0 = no nodules, 1 = ≤5 nodules/plant, 2 = 6-10 nodules/plant, 3 = 11-20 nodules/plant and 4 = >20 nodules/plant. Dry beans in these trials were not inoculated, yet they had good to excellent nodulation ratings (>3.5) at all locations where ratings were collected.

Even though inoculation is not common practice for dry beans in Manitoba, native soil rhizobia populations appear to be associating effectively with dry beans. This leads us to question how much biologically fixed N is contributing to dry bean N nutrition. Similar to results from the small-plot research, as the applied N rate increased, nodulation scores decreased by 0.5-2 points in on-farm trials.

Three of the five on-farm trials did not produce a yield response to increasing N rate (Figure 1). At one trial in 2020, yield was reduced at the greatest N rate (105 lbs N/ac applied) which has been attributed to prolonged vegetative growth and delayed maturity. In these four on-farm trials, the most economical decision was to not apply additional N.

In 2021, however, there was a significant yield increase of 151 lbs/ac with 70 lbs N/ac applied compared to the 0 N control. This yield response is economical if the cost of N is less than $1.00/lb and bean prices are more than 50 cents/lb. Nitrate in the top 12" was stable over the growing season at this trial, indicating that there may have been a limited contribution of mineralized-N to dry bean N nutrition. July rainfall was 7% of normal at this location and was expected to have reduced the contribution of mineralized-N, leading to a positive yield response to fertilizer-N.

Farmers are encouraged to dig up their dry bean roots at flowering to evaluate nodulation in their fields. Identifying if nodules are present and actively fixing N (indicated by a pink/red colour inside the nodule) is the first step in making future N management decisions.

Table 1. Descriptions of the five On-Farm Network trials investigating nitrogen fertilizer rates in dry beans.

	2019		2020		2021
R.M.	Norfolk Treherne	Rhineland	Boissevain Morton	Norfolk Treherne	Norfolk Treherne
Variety	T9905	Windbreaker	CDC Blackstrap	Vibrant	Vibrant
Nitrogen rates tested (lbs N/ac)	0, 70, 140	0, 40, 70, 140	40, 70, 100	0, 35, 70, 105	0, 35, 70
Residual nitrate-N (0-24") (lbs N/ac)	20	58	n/a	34	70
Nodulation score in 0 N check strips (0-4 scale)	3.5	3.9	n/a	3.6	4.0
Yield response to fertilizer rate?	No	No	No	Yes, decrease	Yes, increase

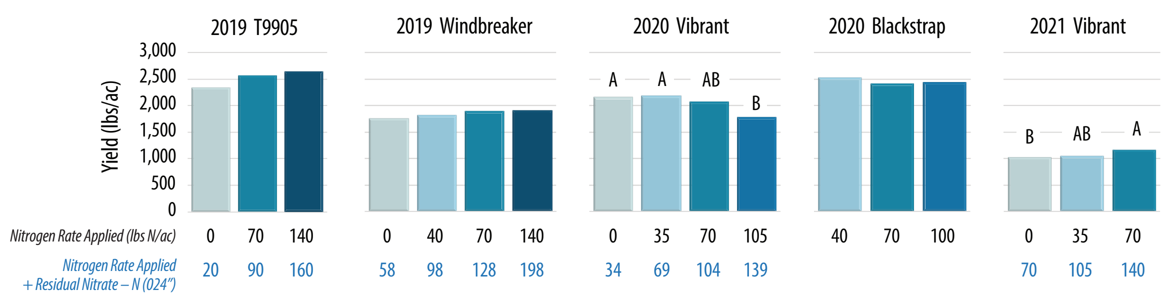


Figure 1. Dry bean yield response to nitrogen fertilizer rates at five On-Farm Network trials.

Within each on-farm trial, bars with different letters are statistically different at $p < 0.05$.

PRINCIPAL INVESTIGATOR Manitoba Pulse & Soybean Growers On-Farm Network

MPSG INVESTMENT $23,930

CO-FUNDERS Canadian Agricultural Partnership

DURATION 3 years

Evaluating Dry Bean Inoculants

The Primo GX2/N Charge inoculant significantly improved dry bean nodulation and yield at Melita in 2020 and 2021 while no difference was observed at Carman from 2019-2021. The BOS peat inoculant was no different from the non-inoculated check.

Dry bean roots with nodulation.

OBSERVATIONS OF NODULATION and lack of consistent yield response in N fertilizer studies has led to a re-evaluation of the contribution of biological N fixation to the N requirements of dry bean. Inoculation with effective rhizobia may improve N fixation and reduce N fertilizer use, however, commercial inoculants are not widely available nor commonly applied. Dry bean association with rhizobia can be highly specific and vary by both environment and variety. This apparent specificity and the overall low acreage of dry beans are limitations to inoculant development.

The objective of this research was to determine if any recently available dry bean inoculants improve nodulation and yield in pinto (Windbreaker and Vibrant), navy (T9905) and black beans (Eclipse), compared to non-inoculated, non-fertilized checks.

From 2019-2021 at Carman and Melita, inoculant products evaluated were BOS self-adhering peat inoculant and Primo GX2 granular inoculant (later re-formulated and named N Charge), both containing *Rhizobium leguminosarium* biovar *phaseoli*. Residual soil nitrate-N ranged from 12-76 lbs/ac (0-24"). At flowering, dry bean nodulation was scored on a rating scale of 0-4, where 0 = no nodules, 1 = ≤5 nodules/plant, 2 = 6-10 nodules/plant, 3 = 11-20 nodules/plant and 4 = >20 nodules/plant.

At Carman in 2019, there were no significant effects of inoculant on nodulation incidence, score nor yield for pinto and black beans. Navy beans were unharvestable due to poor establishment.

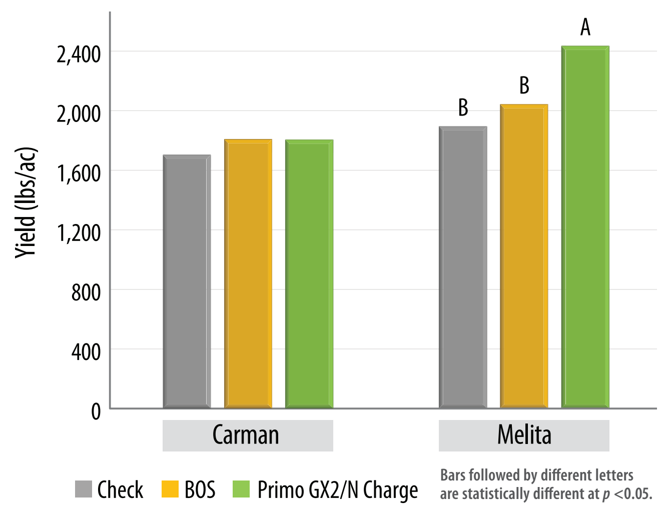
At Carman and Melita in 2020 and 2021, inoculant products had the same effect across all three bean market classes, indicating that specificity among market classes is not an issue for inoculant products. Among market classes, 77-80% of bean plants developed N-fixing nodules. On average, the granular Primo GX2/N Charge inoculant resulted in more nodulated plants than the check and was similar to the BOS product.

At Carman in 2020 and 2021, nodulation scores were relatively low (1.2 on a scale of 0-4), which may be due to the site's low soil pH (≤6.0 in 0-6" depth). At this location, nodulation score and yield were the same for all treatments.

At Melita in 2020 and 2021, however, the Primo GX2/N Charge inoculant resulted in significantly greater nodulation scores (3.2) than both the BOS inoculant (2.7) and the untreated check (1.6), which were similar to one another. This in turn resulted in a significantly greater yield for beans treated with Primo GX2/N Charge inoculant, which improved yield by 543 lbs/ac (29% more than the check).

This research is continuing to test more dry bean inoculant options for Canadian farmers as products become available. Results from this research are being reviewed in conjunction with N fertility trials to update N management recommendations for dry beans in Manitoba.

Figure 1. Pinto, navy and black bean yield (lbs/ac) response to inoculant at Carman and Melita (2020 and 2021).



PRINCIPAL INVESTIGATOR Kristen P. MacMillan, University of Manitoba

DURATION 3 years

MPSG INVESTMENT $140,000

YIELD & QUALITY

Intercropping with Yellow Peas

Pea-canola, pea-mustard and pea-oat intercrops resulted in the greatest net revenue. Pea-mustard reduced weed pressure and pea-canola had potential root disease suppression.

INTERCROPPING, OR THE pairing of two crop species in the same field, has been gaining popularity. This research aimed to identify the best companion crop partners and their seeding rates for yellow peas through two experiments in western Manitoba.

PEA MULTI-CROP STUDY

In the first study, an intercrop trial was established at Melita, Reston and Roblin (2019-2021) evaluating yellow peas intercropped with flax, oats, wheat, canola and mustard versus monocrops of each. In the intercrops, peas were seeded at a full rate while companion crop partners were seeded at a 50% rate.

The greatest pea yields resulted from the pea-mustard intercrop at Melita (32.9 bu/ac) and the pea-canola intercrop at Roblin (23.3 bu/ac) and Reston (5.9 bu/ac). Pea yields at Reston were exceptionally low due to Aphanomyces and Fusarium root rots.. Weed pressure did not differ between intercrops and monocrops in these experiments.

Total land equivalence ratio (TLER) is the relative land area under monocrops that would be required to produce yields equivalent to intercrops, accounting for the productivity of both partners in an intercrop (Table 1). For example, a TLER value of 1.18 means 18% more land would be required to achieve the same yield under a monocrop as has been achieved by the intercrop. At Melita, there was no significant difference in TLER among intercrops and monocrops. At Roblin and Reston, pea-canola resulted in the greatest TLER.

Pea-oats generally resulted in the lowest pea yields at each site, but the success of the oats more than offset the low pea yield. The pea-flax intercrop at Roblin was the only intercrop that resulted in a three-year average TLER less than 1, likely due to poor flax performance in 2021. The pea-flax intercrop often resulted in low quality peas since the high threshing speed required to properly thresh flax bolls was too high for peas, leading to damage.

Net revenues for each intercrop and monocrop were calculated by subtracting operating costs from gross revenue based on 2019 cost of production assumptions and market prices. At Melita, net revenues did not differ between intercrops and the pea monocrop. At Reston and Roblin, net revenues of pea-mustard, pea-canola and pea-oat intercrops were significantly greater than the pea monocrop.

BRASSICA SEEDING RATES WITH PEAS

In the second study, peas were intercropped with different rates of mustard, canola and camelina on land with known Aphanomyces and Fusarium root rot pressure. At Reston in 2019 and 2020, peas were intercropped with mustard or canola at three seeding rates (70:30, 50:50 or 30:70 ratios of % normal seeding rate for peas:mustard or canola). In 2021, canola was replaced with camelina.

Pea-mustard intercrops reduced weed biomass compared to monocrops, and pea-mustard consistently out-yielded peas alone. TLERs were greater than 1 for all pea-mustard seeding rates (ranging 1.6-1.8).

Pea-canola intercrops out-yielded pea monocrops in both 2019 and 2020 with TLERs of 2.0-2.4. When pea-canola intercrops were seeded at a 70:30 ratio, less Aphanomyces DNA was present in the pea roots than in the monocrop, indicating the potential for root disease suppression. Pea-camelina intercrops grown in 2021 also out-yielded pea monocrops. TLERs of the 50:50 and 30:70 pea-camelina seeding rates (1.5 and 1.4, respectively) were greater than the 70:30 ratio (1.3), suggesting an economic benefit of high camelina density in this intercrop pairing.

Due to the heavy root rot disease pressure at Reston, TLERs may be inflated. Monocrop pea yields were low due to disease. Intercrops in this situation allowed for reasonable net revenues in the field thanks to the production by the companion crop making up for the lack of pea yield.

Pea intercrops show promise in terms of yield potential, reducing weed pressure and disease mitigation. Further investigation of different partners and regions will fine-tune recommendations.

Table 1. Average total land equivalence ratio (TLER) and net revenue ($/ac) of pea intercrops grown at Melita, Reston and Roblin from 2019 to 2021.

	Melita		Roblin		Reston	
	TLER	Net Revenue	TLER	Net Revenue	TLER	Net Revenue
Pea Monocrop	1.00 a	$60 ab	1.00 b	-$147 b	1.00 d	-$263 b
Pea-Flax	1.00 a	$23 ab	0.89 b	-$177 b	1.13 cd	-$34 ab
Pea-Oat	1.10 a	$80 ab	1.25 ab	$94 a	1.63 ab	$275 a
Pea-Wheat	1.09 a	-$16 b	1.11 ab	-$19 ab	1.40 bc	$99 ab
Pea-Canola	1.18 a	$81 ab	2.03 a	$124 a	1.84 a	$221 a
Pea-Mustard	1.20 a	$91 a	1.49 ab	$111 a	1.46 bc	$316 a

Within each column, means followed by different letters are significantly different at $p < 0.05$. TLER is the relative land area under monocrops that would be required to produce yields equivalent to intercrops, when TLER is >1 the intercrops have out-yielded the monocrops.

PRINCIPAL INVESTIGATOR Scott Chalmers, Westman Agricultural Diversification Organization

CO-FUNDERS Canadian Agricultural Partnership, Western Grains Research Foundation

MPSG INVESTMENT $23,004

DURATION 3 years

Evaluating Yellow Pea Intercrops in an Organic System

While increasing seeding rates of organic intercrops reduced weed pressure, net returns were greater when peas were grown alone or with only a low seeding rate of the companion oat, barley or mustard crop.

INTERCROPPING PEAS WITH other crops offers the opportunity for organic pea producers to maximize profitability and mitigate risk. While many farmers are experimenting with intercrops, intercropping seeding rates for organic production systems have not been well established and most studies have used peas as the companion crop rather than the principal cash crop. This research aimed to evaluate different companion crop seeding rates for three pea intercrops in an organic system.

At Carman in 2019 and 2020, yellow peas were intercropped with oats, barley or oriental mustard evaluating low, medium and high seeding rates and compared with monocrop peas. In 2020, the intercrop experiments further compared an early seeding date (May 7) and a late seeding date (May 21).

Peas were seeded to a target plant population of 120 plants/m². Companion crop seeding rates were 10% (low), 25% (medium) or 50% (high) of their recommended monocrop target plant populations. For barley, these were 40, 75 and 150 plants/m², for mustard, these were 43, 87 and 131 plants/m² and for oats, target populations were 48, 80 and 160 plants/m². The trial site had been managed organically since 2004 and was tilled twice to a depth of 6 cm immediately before seeding. Intercrops were seeded together in the same row at the same depth (2-5 cm) on 6-inch row spacing.

Weed pressure in these experiments was considered above average when compared with 41 organic green manure fields across southern Manitoba and eastern Saskatchewan. Dominant weed species were green foxtail, lambsquarters, smartweed and wild buckwheat.

Compared to the monocrop peas, intercrops reduced weed biomass at maturity from 17-44% when using medium or high seeding rates (Table 1). Oat and barley intercrops were more effective at suppressing weeds than mustard. In these experiments, oats and barley emerged before peas, resulting in earlier ground cover and a size advantage over weeds. The lack of competitive impact of mustard against weeds may have been due to flea beetle pressure limiting early-season growth.

Pea yields ranged from 24.6-33.3 bu/ac, reflecting the water-limited growing conditions of 2019 and 2020 in Carman. In these experiments, intercropping with oats and mustard consistently reduced pea yields by 6-26%, while when intercropping with barley, pea yield was reduced by 15% only at the highest barley seeding rate (Table 1). Barley produced the greatest companion crop yield, but the lower economic value of the companion crops limited their return on investment. In 2020, the later seeding date resulted in lower pea yields than the early seeding date.

Since intercropping both supressed weed growth and reduced pea yield, it was worth investigating this trade-off from the lens of how much pea yield was lost for the weed control benefit in an organic system. Expressed as kg of weed biomass reduced per kg of pea yield lost, the highest seeding rate of companion crops averaged 0.87 for mustard, 1.29 for oats and 2.62 for barley, meaning that the greatest amount of weed suppression for the lowest amount of pea yield reduction was with the barley intercrop. The cost of seeding companion crops may be considered the price of weed management in an organic system in this scenario. The seed cost for the highest rate of barley, oats and mustard were $11.05, $13.20 and $30.62 per acre, respectively. By comparison, research from Saskatchewan found the cost of using a rotary hoe, harrow or inter row cultivator for weed control in organic peas to be $19.10, $12.14 and $13.76 per acre, respectively. In this research, intercropping showed promise as a weed control strategy in organic systems.

Table 1. Weed biomass (kg/ha), pea yield and companion crop yield (bu/ac) of three intercrops compared to monocrop peas at Carman in 2019 and 2020.

	Pea-Barley			Pea-Oat			Pea-Mustard		
	Weed biomass	Pea Yield	Barley Yield	Weed biomass	Pea Yield	Oat Yield	Weed biomass	Pea Yield	Mustard Yield
	kg/ha	-------bu/ac -------		kg/ha	-------bu/ac -------		kg/ha	-------bu/ac -------	
Pea monocrop	1952 a	31.7 a	-	2085 a	33.3 a	-	1804 a	31.7 a	-
Low seeding rate CC	1544 ab	29.6 ab	1.5 c	1753 ab	29.4 b	4.2 c	1680 ab	29.7 b	0.3 c
Medium seeding rate CC	1261 bc	28.7 ab	2.6 b	1549 b	27.8 b	5.9 b	1472 b	29.1 b	1.0 b
High seeding rate CC	1092 c	26.8 b	6.0 a	1322 c	24.6 c	9.2 a	1498 b	26.5 c	1.5 a

Means followed by different letters within the same column are significantly different at $p < 0.05$.

PRINCIPAL INVESTIGATOR Dr. Martin Entz, University of Manitoba

MPSG INVESTMENT $21,168

CO-FUNDERS Canadian Agricultural Partnership

DURATION 2 years

YIELD & QUALITY

Predicting Soybean Growth Stages in Manitoba

Soybeans grown in Manitoba spend 42 days in vegetative development and 59 days in reproductive development, compared to Ontario where they spend 25 days and 70 days, respectively.

SOYBEANS BEGIN TO sense photoperiod (day length) as early as the unifoliate stage (VC). Manitoba represents the northern reaches of soybean production and day lengths are longer than those in other soybean growing regions. Soybean development may be delayed when grown under long day lengths (>14 hours), however, varieties vary in their sensitivity to day length.

The purpose of this research was to evaluate differences in soybean phenological development between southern Manitoba and eastern Ontario and use this information to develop an accurate model to predict critical growth stages of soybeans based on temperature, day length and soybean maturity group. A controlled environment experiment was also conducted to isolate the effect of day length on time from emergence to beginning bloom.

Ten short-season, food-type soybean varieties were planted at Ottawa (45.4°N) and Carman (49.5°N) in 2017 and 2018. Soybean growth stage was evaluated every three days. Variety maturity groups ranged from MG 000 to 1. The difference of four degrees in latitude between the Manitoba and Ontario sites translates to a day length that is 49 minutes longer in Manitoba during the summer solstice.

On average, it took soybeans in Manitoba 18 days longer to reach R1 (beginning bloom) from VE (emergence) than in Ontario (42 days vs. 24 days, respectively). Since flowering occurred earlier in Ontario, soybeans then spent 70 days in reproductive development stages in Ontario and only 59 days in Manitoba. The total time to R8 (full maturity) was the same at both sites.

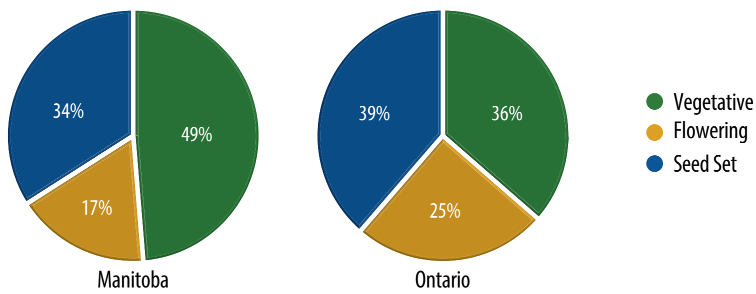
Among maturity groups, time from planting to VE, time from VE to R1 and from R1 to R5 (beginning seed) were similar. Time from R5 to R8 (seed development and maturity) increased with later maturity groups, resulting in a 20-day difference between the earliest maturity group and the latest. Later maturity groups tended to have greater yield than earlier maturity groups.

Using data collected from the field experiment, two models were developed to predict soybean phenology and developmental stages - a growth stage interval unit (GSIU) and a photothermal unit (PTU), which were then verified using data from the regional soybean variety trials. Compared to current growing degree day and crop heat unit models, both models developed in this study were more accurate at predicting soybean growth stages. The GISU model was more accurate than the PTU, but also more complex because it included more equations. This complexity could be overcome by building the model into a user-friendly app which may be used by farmers and agronomists to predict critical growth stages for pesticide application timing and predicting maturity.

In the controlled environment experiment, varieties were grown in 14-, 15-, 16- and 17-hour days at a constant 25°C temperature. The longest day length of 17 hours extended the time from emergence (VE) to R1 by two to three days compared to the shortest day length. The rate of development from VE to R1 was slower for varieties of later maturity groups. Varieties were classified into two photosensitivity groups and early maturing varieties tended to be relatively insensitive to changes in day length. Later-maturing soybean varieties were more sensitive to changes in day length, delaying time to flowering.

The models developed in this project to predict soybean development in Manitoba can be used as a foundation for developing new predictive tools, such as crop adaptation models, for farmers and agronomists in Manitoba. Results from this research are valuable to soybean breeders and plant physiologists, increasing the understanding of how soybeans behave in northern environments where the growing season is shorter and the days are longer.

Figure 1. Percentage of the total number of days soybeans spent in critical developmental stages in southern Manitoba and eastern Ontario, averaged over five site-years and 10 food-type soybean varieties.



PRINCIPAL INVESTIGATORS Dr. Yvonne Lawley, University of Manitoba and Dr. Malcolm Morrison, AAFC - Ottawa

MPSG INVESTMENT $96,400

CO-FUNDERS Western Grains Research Foundation, Agriculture and Agri-Food Canada

DURATION 2 years

YIELD & QUALITY

Minimizing Air Seeder Damage to Peas

Varying fan speed did not impact seed germination, vigour or seed coat damage. Seed moisture was the primary factor that determined seed damage.

LARGER AIR SEEDERS (>60 ft) typically require higher air velocity for adequate seed distribution and to prevent plugging. As larger seeding equipment has become more common, there was a desire to know if greater fan speeds resulted in increased damage to pea seed and how seed moisture content might impact seed damage.

The objective of this research was to determine the effects of air seeder fan speed and pea seed moisture content on pea seed quality throughout seeding.

Pea seeds at three different moisture contents (dried to 11.4%, as received at 13.6% and wet at 15.1%) were run through a stationary air drill at three different fan speeds representing low (FSL), medium (FSM) and high (FSH) speeds. Fan speeds were determined by using the manufacturer-recommended speed as the FSM (4250 rpm), then varying the speed approximately 8% lower and higher to achieve FSL (3900 rpm) and FSH (4600 rpm), respectively.

A 65-ft, 2010 Bourgault Paralink hoe drill 3310 with a 6550 cart was used. This equipment contained six secondary manifolds, each with a total of 11 openers, resulting in 66 total openers across the drill. This air drill was selected out of a list of commonly used seeding implements in Manitoba since this configuration has the potential for increased seed damage.

AAC Carver yellow pea seed was used, which has an average thousand seed weight of 240 g/1000 seeds representing an average pea seed size. The seeding rate in these trials was 222.7 lbs/ac (3.7 bu/ac), calculated to target approximately 7.4–8.4 live plants/ft^2. The fertilizer used was MES15 at a rate of 20 lbs P_2O_5/ac, resulting in 59.7 lbs/ac of product. Each treatment was run for the equivalent of 0.5 seeded acres with a targeted ground speed of 3.0 mph. Germination, vigour and seed coat damage (via soak test) were assessed before and after treatments.

Surprisingly, varying fan speed did not significantly affect seed germination, vigour or seed coat damage. Seed moisture was the primary factor determining seed damage (Table 1).

Seed moisture content had the most significant impact on germination, vigour and seed coat damage (percentage of damaged, wrinkled and smooth seed coats). Pea seed that had been dried to moisture contents below the recommended level (to 11.4% seed moisture) had significantly lower germination and vigour (more than 10% decrease) compared to the "as-received" seed (13.6% seed moisture) and the wet seed (15.1% seed moisture). Reduced germination and vigour will negatively affect plant stand and plant establishment, reducing crop yield potential. These results reflect similar findings from previous PAMI research on air seeder distribution and seed damage to wheat, canola and soybeans, where drier soybean seed (8% seed moisture) resulted in poorer germination than 13% soybean seed moisture.

Ensuring seed moisture content is at the recommended level is imperative for good seed germination, vigour and seed coat quality. These results indicate that initial moisture content, before running the seed through the drill, is an important factor for maintaining seed quality and establishing a successful crop.

To obtain the desired moisture content, it is recommended to pay close attention to proper storage and to monitor pea seed moisture by moving the grain during storage, as necessary. However, some factors influencing seed moisture are not within our control. Though differences in fan speed did not affect the seed quality, manufacturer-recommended speeds are suggested to maintain productive performance to reduce the risk of plugging at low fan speeds and improve the potential for more accurate seed distribution at recommended speeds versus high speeds. Understanding the impact of seed moisture on germination and vigour translates to more accurate seeding rates and thus successful plant stands.

Table 1. Germination, vigour and seed coat damage (assessed via soak test) of field pea seed at three different moisture contents after being run through the air seeder.

Moisture content	Germination (%)	Vigour (%)	Soak Test (%)		
			Damaged	Wrinkled	Smooth
Dry (11.4%)	75.3 b	69.8 b	13.9 a	8.2 b	77.9 a
As received (13.6%)	87.0 a	82.4 a	9.33 a	11.0 b	79.7 a
Wet (15.1%)	86.2 a	80.8 a	10.2 a	48.0 a	41.8 b

Within each column, means followed by different letters are significantly different at $p < 0.05$.

PRINCIPAL INVESTIGATOR Charley Sprenger, Prairie Agricultural Machinery Institute

MPSG INVESTMENT $30,000

DURATION 1 year

Crop Sequence of Peas, Soybeans, Canola and Wheat

Preceding crop has had minimal effects on crop yield and quality to-date in the establishment phase of this rotation study. However, rotation effects often emerge slowly over time.

PEA ACRES HAVE been increasing in Manitoba and questions have arisen over how they fit in rotation with soybeans, the third most dominant crop of the province, next to canola and wheat. Soybeans and peas are primarily grown following spring wheat (27% and 30% of acres, respectively) and canola (22% and 35%, respectively).

Over three years (2019-2021), a crop sequence experiment was established north of Brandon investigating five rotation sequences with peas, soybeans, canola and wheat. The sequences evaluated were canola-wheat-pea, canola-wheat-soybean, soybean-canola-wheat-pea, soybean-wheat-canola-pea and pea-canola-pea-wheat. This experiment forms the basis for a longer-term crop rotation study that will be conducted through to the 2026 growing season for a total of eight years.

Crop yields were good to excellent in 2020 and 2021. Preceding crops had minimal effects on crop yield and quality in 2020 and 2021.

In 2020, average days to emergence ranged from 7-15 days depending on the crop. In most cases, preceding crop had no effect on plant stand. The exception was in peas, where plant stands were lower following canola versus wheat, on average.

In 2021, average days to emergence ranged from 13-14 days for canola, peas and wheat. Preceding crop history (i.e., the crop combination grown in 2019 and 2020) had no effect on yield, except in the case of field peas (Figure 1). Pea yields were greater following canola-wheat in rotation than pea-wheat, with other treatment yields intermediate. It is unclear at this time whether this trend will continue in the longer-term. Current guidelines recommend a minimum of four years between pea crops in the absence of Aphanomyces root rot.

Preceding crops had minimal effects on grain quality except in the case of soybeans. Seed weight was greater where soybeans followed peas, including canola-pea or wheat-pea preceding crop histories vs. canola-wheat. However, protein was 1.7% higher in soybeans that followed wheat-pea rather than canola-pea, with the inverse trend evident for percent oil.

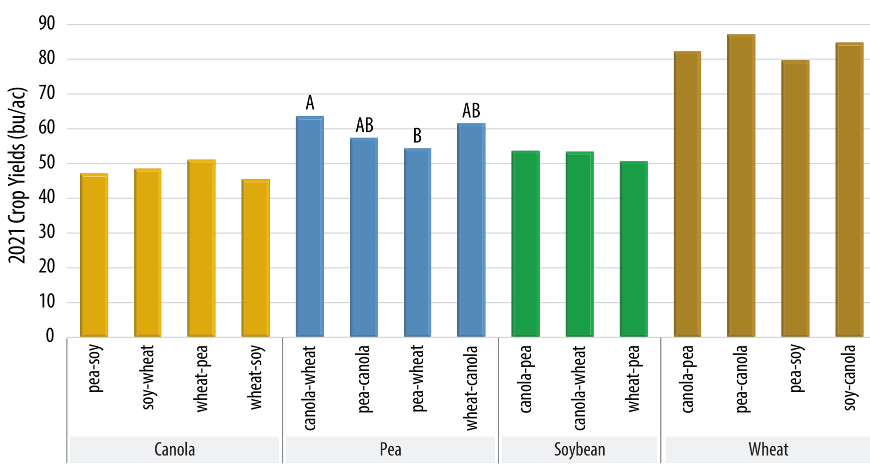
In 2019, root rot disease was present in all pea plots and ranged in severity from 2.6-3.8, based on a scale of 0 (no disease) to 9 (death of plant). Similarly, root rot was observed in all soybean plots with disease severity ranging from 3.6-4.9. In 2020, root rot severity in pea plots ranged from 3.1-5.4 and root rot severity in soybean plots ranged from 2.3-3.2. In 2021, severity in pea plots ranged from 2.5-4.1 and in soybeans ranged from 2.8-5.2.

To confirm the visual disease assessment, 10 symptomatic roots were collected from each plot for fungal isolation and identification of Fusarium species. In 2019, *Fusarium avenaceum*, the most common Fusarium species that infects peas, was frequently isolated from the pea plots. In contrast, *F. avenaceum* was not commonly found in the soybean plots. The predominant Fusarium species isolated from pea and soybean plots was *F. oxysporum*.

Crop sequence did not have a significant effect on root rot disease in peas and soybeans, nor on root nodulation. The year-to-year differences in root rot severities were due to varying moisture conditions.

At the conclusion of this study in 2021, not all crop sequences had completed a full cycle. While results so far indicate limited effects of preceding crop, this is not surprising since effects of rotations often emerge slowly over time with changes in the plant-soil system. The differences observed to date may not reflect the long-term trends that develop as rotations evolve and mature. This establishment phase has been important as it forms the foundation for a longer-term rotation study. Another five years of these crop sequences are planned to continue this study, allowing for two full cycles of each rotation to provide a more reliable assessment of the longer-term performance of the various rotations.

Figure 1. Yields (bu/ac) of canola, peas, soybeans and wheat in 2021 following two years of crop sequences.



Within crop, means followed by different letters are significantly different at $p < 0.05$.

PRINCIPAL INVESTIGATOR Dr. Ramona Mohr, Agriculture and Agri-Food Canada - Brandon

MPSG INVESTMENT $82,800

CO-FUNDERS Canadian Agricultural Partnership, Ag Action Manitoba Program

DURATION 3 years

Pea Root Rot: Surveillance and Evaluating Variety Resistance

Fusarium avenaceum was found to be the most aggressive *Fusarium* species infecting pea fields, among nine different species identified. Partial resistance to root rot was observed in a few commercial field pea varieties.

ROOT ROT IS a major constraint on field pea production in western Canada. Past annual surveys of fields in Manitoba have shown that several pathogens are responsible for root rot in peas. These include *Fusarium solani*, F. *avenaceum* and *Rhizoctonia solani*, among others. Infection by these root pathogens can reduce seedling emergence, root growth and nodulation resulting in less nitrogen fixation and lower yields.

As pathogen populations evolve, continued monitoring of pea fields is critical to evaluate the incidence and severity of root diseases. Planting resistant varieties could also provide a means for reducing the negative impact of these root pathogens on plant growth and yield. However, at the onset of this study, little information existed on the root rot reactions of pea varieties.

Two complementary studies were conducted. The first involved annual pea disease surveys from 2013-2017, where 40 fields in Manitoba were evaluated for incidence and severity of root rot and symptomatic pea roots were used for molecular diagnostic testing. Root disease severity was rated on a scale of 0 (no disease) to 9 (death of the plant). The second study evaluated 60 pea varieties for their reactions to *R. solani*, *F. solani* and *F. avenaceum*, compared to the partially resistant line, Carman, and the susceptible cultivar, AC Reward. Field trials were conducted at Morden and Brandon.

In the first study, average root rot severity (3.3) was greater in 2013-2017 compared to the previous five-year period and Fusarium root rot was detected in virtually all fields assessed each year. Nine different Fusarium species were identified infecting pea roots according to in-depth root disease analysis from three fields in 2015. *F. avenaceum* was found to be the most aggressive species among them. In the five-year period that followed this study (2018-2022), average root rot severity (3.4) was slightly higher and Fusarium root rot was detected in all surveyed fields.

Advancements were made in the area of molecular diagnostics, which is a method that provides rapid and precise results. New molecular detection techniques for pea root rot pathogens were developed, including the identification of new primers for qPCR methods on *F. avenaceum* and *F. acuminatum*, and optimization of primers for the root pathogen, *Aphanomyces euteiches*.

In the second study, a few varieties consistently demonstrated partial resistance to at least one of the root rot pathogens similar to that of the partially resistant check, Carman (Table 1). Most varieties consistently had low emergence counts following infection with *R. solani* and high root rot severity ratings following infection with all three pathogens (Table 1). At both locations, inoculation with *R. solani* caused the greatest reduction in the number of emerged plants even though four times as many seeds had been planted in comparison to the experiments that were inoculated with *F. avenaceum* or *F. solani*. A few cultivars consistently displayed partial root rot resistance to at least one of the root rot pathogens similar to that of the partially resistant check, Carman.

These results have helped us stay up-to-date on pea root rot pathogens in Manitoba, they have identified the need for more research to enhance root rot resistance in high-yielding pea varieties and they have helped make important strides in molecular diagnostics.

Since the conclusion of this research, Aphanomyces root rot, which commonly appears alongside Fusarium root rot, has become widespread across western Canada. Initiatives are underway to stay ahead of this aggressive pest before it becomes a bigger problem.

Table 1. Results of pea root rot resistance experiments at Morden and Brandon (2013-2017). Seedling emergence and root rot ratings for a subset of eight commercial field pea varieties tested (of 60 total) against all three root pathogens, compared to the means of the partially resistant control, Carman.

Variety	*Rhizoctonia solani*		*Fusarium avenaceum*		*Fusarium solani*	
	Emergence (%)	Disease Severity (0-9)	Emergence (%)	Disease Severity (0-9)	Emergence (%)	Disease Severity (0-9)
Morden						
CDC Dakota	**35**	5.7	**67**	5.0	**62**	5.2
40-10	**28**	5.6	**67**	5.1	**62**	**5.1**
Delta	20	5.6	**51**	**4.8**	47	**4.7**
Abarth	**26**	5.9	**54**	5.4	49	5.4
Toledo	15	5.6	44	**4.8**	34	5.2
AC Reward	23	5.8	**52**	5.3	**50**	5.4
Carman	**32**	**4.8**	**64**	**4.1**	**63**	**4.4**
Brandon						
CDC April	14	**3.6**	**61**	**2.8**	**63**	**3.6**
CDC Mosaic	20	**4.4**	**65**	**3.4**	**69**	**3.8**
CDC Rocket	**24**	**4.3**	**60**	**3.2**	**64**	**3.4**
AC Reward	20	**4.5**	**64**	**3.6**	**67**	4.2
Carman	**29**	**4.0**	**66**	**2.8**	**68**	**3.1**

Bold = similar to the mean of the partially resistant check, Carman, based on least significant differences (LSD) at 5%.
Disease severity scale = 0 (no disease) to 9 (death of plant).

PRINCIPAL INVESTIGATORS Dr. Bob Conner, Dr. Debra McLaren, Dr. Maria Antonia Henriquez and Dr. Yong Min Kim, Agriculture and Agri-Food Canada and Dr. Sheau-Fang Hwang, University of Alberta

MPSG INVESTMENT $45,000 (Study 1), $40,000 (Study 2)

DURATION 5 years

On-Farm Evaluation of Fungicide in Field Peas

A single application of fungicide at early flower significantly increased pea yields 28% of the time. A second application of fungicide improved pea yield over a single application 44% of the time.

MYCOSPHAERELLA (ASCOCHYTA) BLIGHT is the most common foliar disease in peas in Manitoba, infecting the majority of pea crops each year. Peas are the single host crop of this disease, and it is the main target of foliar fungicide applications.

The On-Farm Network (OFN) began investigating pea yield response to fungicide applications in 2017. Over the past six growing seasons, there have been a total of 44 trials across the province evaluating pea fungicide using randomized and replicated strip trials in farmers' fields. Of those trials, 25 have investigated a single application vs. none, 16 have compared a single vs. double application, two compared a single vs. double vs. none and one trial has compared double vs. no application.

Product choices (e.g., Delaro, Dyax, Cotegra, Priaxor, Headline, Miravis Neo, Zolera) were at the discretion of the farmer and were applied according to label recommendations at early flower (R1 to R2). If a second application was tested, it was applied 10 to 14 days after the first.

Among the 25 trials comparing a single application of fungicide at early flower vs. untreated strips, there have been seven statistically significant yield responses. A single fungicide application increased pea yield 28% of the time over no application. Yield increases ranged from 1.4-12.5 bu/ac (average: 4.6 bu/ac). Assuming a product cost of $21.25 and a pea sell price of $10/bu, five of the seven significant trials were economical, providing a return on investment of $1.75-$104.08/ac (average: $36.05/ac).

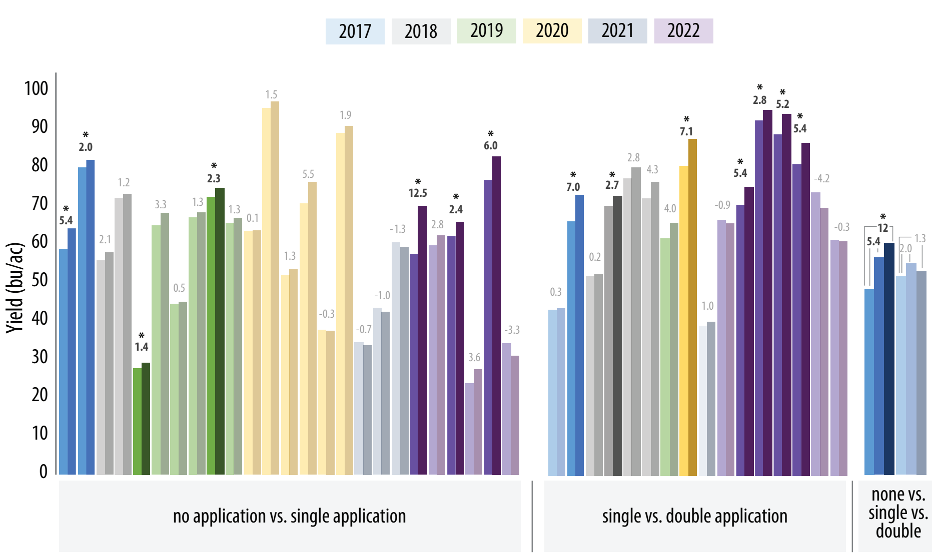
During the dry years of 2019, 2020 and 2021, it was more common to ask if a fungicide application was necessary at all due to the dry growing conditions. In those years, risk of disease development was low, leading to fewer instances where foliar fungicides paid.

Among the 16 trials comparing two fungicide applications to a single pass, there have been seven statistically significant yield responses. Two fungicide applications increased pea yield 44% of the time, improving yield by 5.1 bu/ac, on average (range: 2.7-7.1 bu/ac). Considering the same economic assumptions as above, all seven of those yield responses were economical, providing an average return on investment of $29.70/ac (range: $5.75-$50.15/ac).

Disease ratings began in foliar fungicide trials in 2019 to further explain yield responses. Of the significant trials from 2019 to 2022, Mycosphaerella blight severity was often reduced by fungicide. In most responsive trials with large yield differences, there was also commonly a reduction in white mould incidence in single vs. none or single vs. double application trials.

To determine if a fungicide application is likely to be beneficial, consult MPSG's *Fungicide Decision Worksheet for Managing Mycosphaerella Blight in Field Peas.*

For more information and results on each of the OFN pea fungicide trials, visit manitobapulse.ca/on-farm-research-reports.



Numbers above bars indicate yield differences between treatments. *Statistically significant yield difference at $p < 0.05$.

Figure 1. Yield difference (indicated by the value above the paired bars) between peas with no application of fungicide vs. a single application, and peas with a single application of fungicide vs. a double application, from individual On-Farm Network trials from 2017-2022.

PRINCIPAL INVESTIGATOR Manitoba Pulse & Soybean Growers On-Farm Network

MPSG INVESTMENT $317,416

CO-FUNDER Canadian Agricultural Partnership

DURATION 6 years, ongoing

Evaluating the CombCut as a Tool to Manage Late-Season Weeds in Soybeans

A cutting implement like the CombCut or a swather may be used to cut above the soybean crop canopy multiple times during the growing season or when volunteer canola is at >75% flower to reduce weed seed production while maintaining soybean yield.

MANAGING LATE-SEASON WEED escapes like volunteer canola and other herbicide-resistant weeds is important to reduce dockage and weed seed return, which can pose a challenge for future crops both as volunteer weeds and as hosts of soil-borne canola diseases. Mechanical weed control tools play an important role in integrated weed management strategies and may be effective at managing late-season weeds before they set seed.

The CombCut is one such tool that is typically used to cut rigid-stemmed weeds below the crop canopy while flexible leaves of a crop like cereals pass through unharmed. As soybeans are less flexible, this research proposed to evaluate the utility of the CombCut to remove the seed-producing parts of weed escapes by cutting near the top of the soybean crop.

Two experiments were established in Carman in 2019 to investigate the optimal timing, frequency and height of cutting when using the CombCut in soybeans to manage volunteer canola. Glyphosate-tolerant soybeans were seeded with glyphosate-tolerant canola at a rate of 40 plants/m^2 to simulate the presence of volunteer canola in a soybean crop.

The first experiment evaluated frequency of cutting using the CombCut, comparing 1) a no cut control, 2) one pass when weeds grew above the canopy on July 8, 3) two passes, including one on July 8 and again on July 15 when weeds regrew and 4) three passes on July 8, 15 and 24. Three passes of the CombCut over the soybean canopy in July reduced canola seed return, significantly reduced canola seed as dockage in the harvested sample and did not negatively impact soybean yield (Figure 1). One- and two pass-treatments were no different from the control.

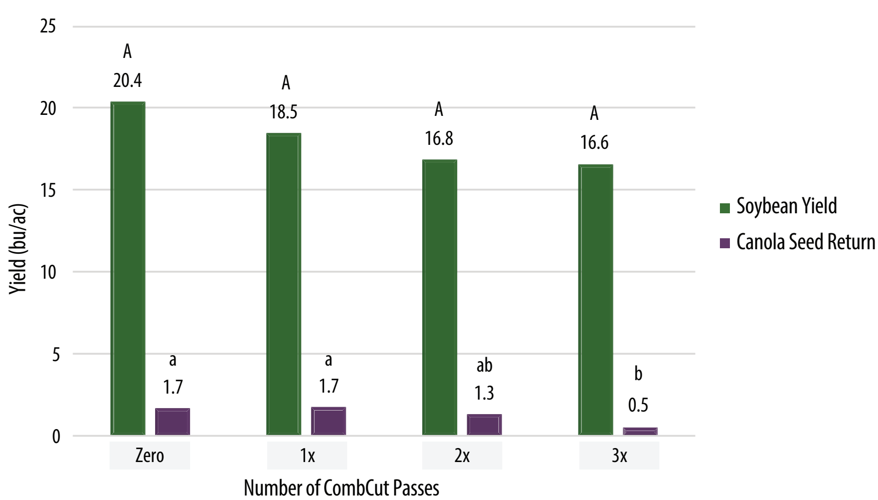
The second experiment evaluated cutting timings based on the amount of canola flowering (25%, 50%, 75% and greater than 75%) and cutting height (5-10 cm above the soybean canopy and 10-15 cm within the canopy).

Cutting when the canola was >75% flower resulted in the lowest canola seed return (29 lbs/ac), but this was not significantly different than the other timings (39-57 lbs/ac). Cutting at 25% canola flower resulted in the greatest amount of canola seed return (57 lbs/ac) since the canola regrew and set seed.

The cutting height of the CombCut, either above or within the soybean crop canopy, had a significant effect on canola seed return and soybean yield. Placing the CombCut 10-15 cm within the soybean crop canopy reduced volunteer canola seed production compared to cutting above the canopy, but it also reduced soybean yield due to cutting damage to the crop.

Using the CombCut above the crop canopy had no negative effects on soybean yield. Multiple passes were necessary to manage volunteer canola and worked best if timed when canola was at >75% flower. In cases where volunteer canola pressure is high or where patches of herbicide-resistant weeds exist, cutting just above the soybean crop canopy with a CombCut or swather may be an effective strategy to reduce weed seed production.

Figure 1. The effect of CombCut cutting frequency on soybean yield and volunteer canola seed return yield.



Different letters above bars within each crop indicate significant differences ($p < 0.05$) between treatments.

PRINCIPAL INVESTIGATORS Dr. Martin Entz and Katherine Stanley, University of Manitoba

MPSG INVESTMENT $27,140

CO-FUNDER Canadian Agricultural Partnership

DURATION 1 year

Life Cycle Assessment of Canadian Dry Bean and Faba Bean Production

Fertilizer was the biggest contributor (74-80%) to climate change impacts of navy, pinto and red kidney beans, whereas both fertilizer (48%) and fuel for field operations (37%) contributed the most for faba beans.

THERE IS A growing desire to better understand the environmental impacts associated with the production of pulses destined for the food industry. A life cycle assessment (LCA) is the systems-level approach used to quantify these impacts, including emissions (e.g., greenhouse gases, pollutants) and inputs (e.g., fuel, fertilizer, water) required to produce pulses across their entire life cycle, or value chain.

An LCA offers insight into the sustainability of a product, which can inform policy and management decisions, such as improved crop management and reduced input use. While LCAs have already been conducted for Canadian peas and lentils, comparable assessments have not been reported for dry beans and faba beans.

From 2020 to 2021, Pulse Canada worked with the University of British Columbia to: 1) develop regionalized life cycle inventories (LCIs) for Canadian dry beans and faba beans and 2) provide a comprehensive report to support the Canadian pulse industry's initiatives around the sustainability of pulses. An LCI is a high-quality, regionalized dataset that is representative of Canadian production conditions and made available publicly for stakeholders, like food companies, to utilize.

LCI data were collected from navy, pinto, red kidney and faba bean farmers in Alberta, Manitoba, Saskatchewan and Ontario via survey. Farmers were asked about practices including soil preparation, seeding, fertilizer application, pest management and pesticide applications, harvesting and crop drying. The environmental impact categories assessed in this study included climate change, mineral resource use, fossil and nuclear energy use, terrestrial acidification, freshwater eutrophication and ecotoxicity, and others.

A total of 181 responses were used to compile the LCI. Of these, 65 responses were on navy beans (36%), 31 (17%) on pinto beans, 34 (19%) on red kidney beans and 51 (28%) on faba beans. Across all four bean types, 14% of the responses were from SK, 27% from MB, 36% from ON and 22% from AB.

At the national scale, faba beans had lower environmental impacts across all categories than the three types of dry beans. This is due to the ability of faba beans to acquire up to 90% of their nitrogen (N) needs through biological N fixation and leave behind an N-credit for subsequent crops. Whereas in dry beans that have a comparatively lower capability of fixing N (<45%), there has traditionally been a greater reliance on fertilizer to supply the crop with N. Among the dry bean types in this study, pinto beans had the lowest environmental impacts across most categories. In part, this is due to greater pinto bean yields with similar inputs to other bean types.

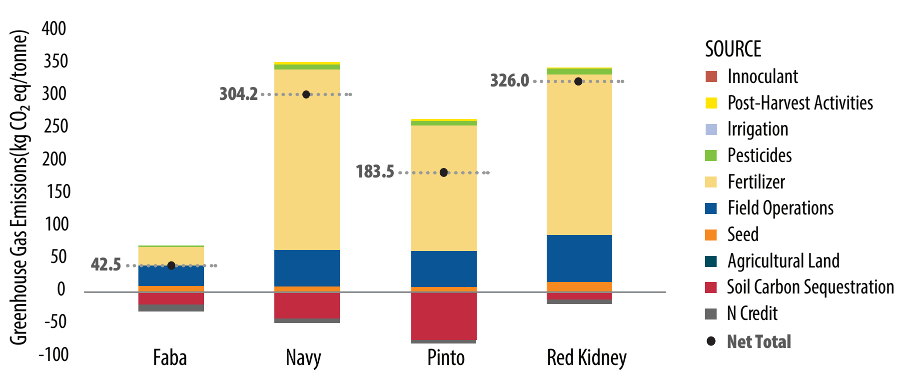
While there were some variations between crops and regions, fuel and fertilizer were identified as hotspots for potential reductions in emissions and input use. At the national level, fertilizer contributed most (74-80%) to climate change impacts in dry bean crops. In faba beans, fertilizers (48%) and fuel for field operations (37%) were the biggest contributors.

Soil carbon sequestration was responsible for climate change reductions of 25% and 3% in pinto and red kidney beans, respectively. N fixation produced a 13% reduction in faba beans. The impacts of N fixation were considerably lower (2%) in dry beans due to lower N fixation and higher levels of fertilizer use.

Adopting the most recent best management practices on N management in dry beans is one way to reduce the effects on climate change. Recent fertilizer and inoculant research findings (pg. 2-4) further discuss N management practices and suggest fertilizer reductions and biological N fixation improvements are possible for dry beans.

For more information on the LCA in pulses and their impact on the industry, visit pulsecanada.com/sustainability.

Figure 1. Greenhouse gas emissions resulting from faba, navy, pinto and red kidney bean crops across Canada.



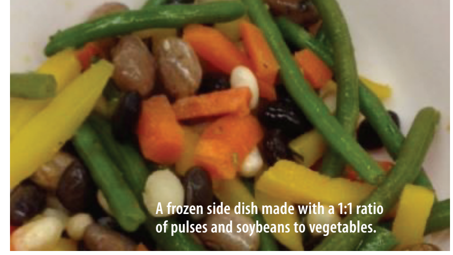
PRINCIPAL INVESTIGATOR Dr. Nathan Pelletier, University of British Columbia

DURATION 2 years

TOTAL INVESTMENT $124,500 (75% AAFC; 25% Pulse Canada)

MARKET DEMAND

Developing Frozen, Microwaveable Side Dishes with Pulses and Soybeans


A frozen side dish made with a 1:1 ratio of pulses and soybeans to vegetables.

Processing techniques were developed to include dry beans and soybeans in individual quick-frozen applications and two frozen, microwaveable side dishes were successfully developed with an equal proportion of beans to vegetables.

CONSUMERS LOOK FOR quick foods that are healthy and flavourful. Currently, many frozen and microwaveable meal options only contain small proportions of pulses.

The objective of this research was to produce two gluten-free frozen, microwavable side dishes with a 1:1 ratio of pulses and soybeans to vegetables. From 2011 to 2013, optimal processing procedures were investigated to include pulses and soybeans in frozen microwavable products while maintaining end quality and reducing oligosaccharides, which influence flatulence. Conventional soybeans and pinto, navy, black, kidney and cranberry beans were evaluated.

It is more common for soybeans to be highly processed into products like soy milk instead of minimally processed individual quick frozen (IQF) applications that utilize the whole bean. IQF requires hydration, cooking, freezing and packaging.

In this research, an IQF process was developed for beans that maintained quality, texture, appearance and flavour, and reduced oligosaccharides. No processing aids were used which increases market opportunity with a "cleaner" label. This process can be adapted and utilized by the industry.

Two prototypes of frozen, microwaveable side dishes combining pulses, soybeans and vegetables were developed. When taste-tested, these dishes were flavourful and well-liked. There is potential to increase the proportion of dry beans and soybeans within IQF dishes to position these crops more favourably in the processed food industry.

PRINCIPAL INVESTIGATOR Janice Meseyton, Food Development Centre

MPSG INVESTMENT $14,900

DURATION 2 years

MARKET DEMAND

Developing a Soybean Saskatoon Berry Smoothie

A soy-saskatoon berry smoothie was made with Manitoba ingredients that had a smooth texture and a good balance of sweetness, acidity and fruity flavour.

SMOOTHIES ARE TYPICALLY made with fruit and dairy ingredients. Non-dairy smoothies are desirable for those that are lactose intolerant, vegan or those seeking plant-based ingredients. These can be made with soybeans as a dairy replacement while maintaining a rich nutritional profile. Manitoba-grown soybeans and saskatoon berries were used to create a locally sourced, non-dairy smoothie prototype.

Yogurt culture was used in the process of soymilk fermentation to reduce the beany flavour of soy and anti-nutritional factors to increase digestibility. This work confirmed that regular yogurt culture in combination with other lactic acid bacteria could be used to ferment soymilk into a semi-solid curd without whey separation occurring.

The smoothie was created by blending soy yogurt made from defatted soymilk with juices (saskatoon, sour cherry and black currant), gums, white grape juice concentrate and vitamin mineral premix. The end product was low in saturated fat, high in iron, very high in calcium and a source of fibre.

Ten panelists evaluated the smoothie on sweetness, acidity level, flavour balance, creaminess and overall acceptability on a 0-4 scale at the Food Development Centre. The soy-saskatoon berry smoothie was described by panelists as having a smooth texture with a good balance of sweetness, acidity level and fruity flavour.

Nutrition Facts
Valeur nutritive
Serving Size 1 cup (250ml)
Portion 1 tasse (250ml)

Amount / Teneur	% Daily Value / % valeur quotidienne
Calories / Calories 170	
Fat / Lipides 1.5 g	2 %
Saturated / saturés 0.5 g + Trans / trans 0 g	3 %
Cholesterol / Cholestérol 0 mg	
Sodium / Sodium 30 mg	1 %
Carbohydrate / Glucides 33 g	11 %
Fibre / Fibres 33 g	12 %
Sugars / Sucres 21 g	
Protein / Protéines 8 g	
Vitamin A / Vitamine A	0 %
Vitamin C / Vitamine C	0 %
Calcium / Calcium	40 %
Iron / Fer	20 %

Ingredients Listing: soymilk, saskatoon berry juice, water, grape juice concentrate, sour cherry juice, inulin, vitamins and minerals (vitamin A, vitamin D2, vitamin B2, calcium lactate, zinc gluconate, maltodextrin), dairy blend (pectin, maltodextrin, guar gum, xantham gum), black currant juice, natural flavour, culture.

PRINCIPAL INVESTIGATOR Meeling Nivet, Food Development Centre

MPSG INVESTMENT $23,000

DURATION 2 years

MANITOBA
Pulse Soybean
GROWERS

T 204.745.6488
www.manitobapulse.ca

YouTube