ONTARIO
Bean
GROWERS

Annual Research Report

2019-2020

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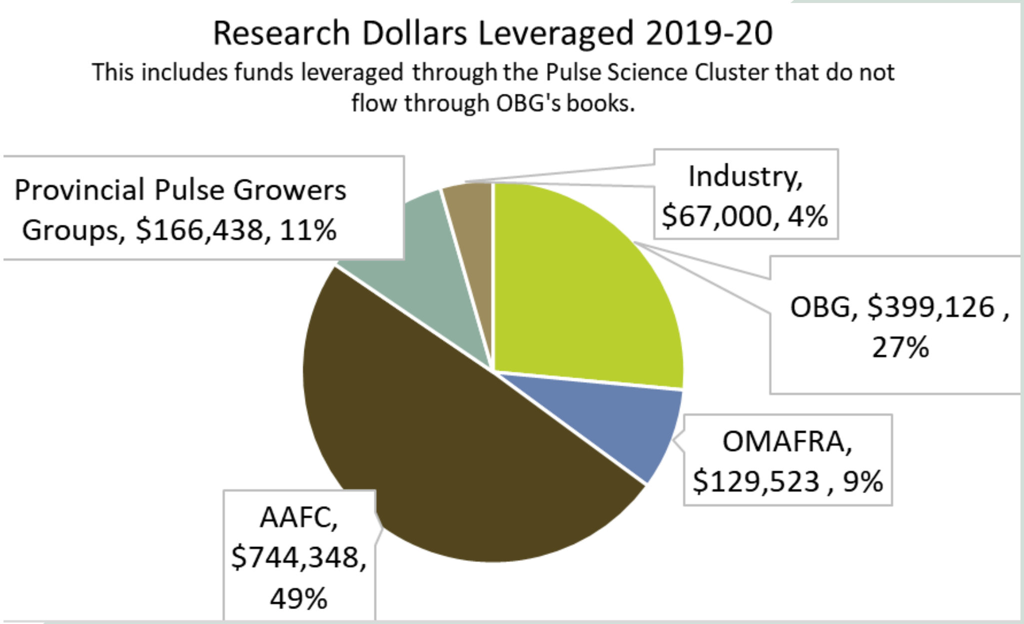
Annual Research Report

2019-20

The Ontario Bean Growers are very pleased to share with you our first stand alone annual research report. In previous years, a research report has been included as part of the annual report, but due to space limitations, we only shared the high level details of the projects that we funded.

It is our hope that the detail provided in this report will demonstrate how your check-off dollars are returning value to you.

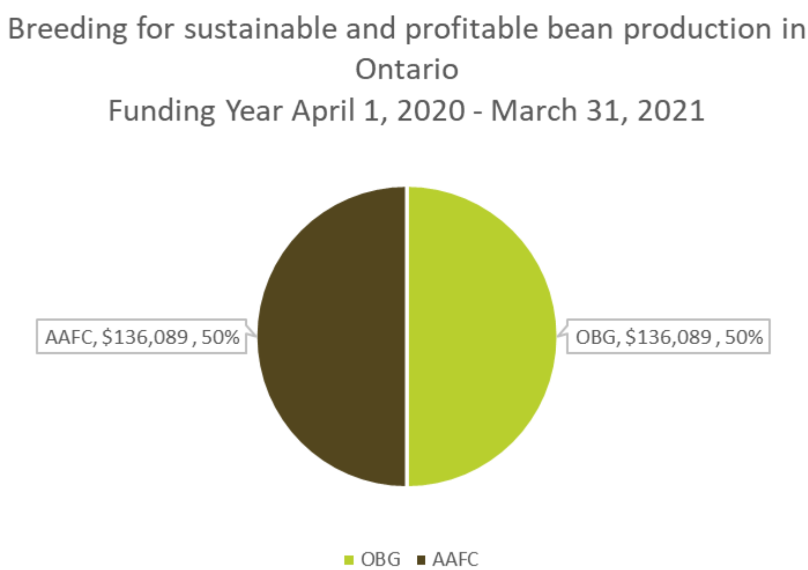
In addition to this report, which we intend to publish annually, we are excited to announce the launch of drybeanagronomy.ca. This website came about through a discussion at an Ontario Pulse Crop Committee meeting about where we should be housing all of the knowledge we have on dry bean production in Ontario. OBG's main website was our first thought, but it was decided that because of the high level of consumer traffic that is driven to ontariobeans.on.ca that perhaps a secondary site was needed for the nitty gritty details of bean production. The grower side of OBG's website will continue to be a platform to share OBG news, events, resources, and an overview of the research projects funded by growers.



Total funding to Agronomic Research Projects for 19-20
$1,506,435

Project Title: Breeding for sustainable and profitable bean production

Dr. K. Peter Pauls
University of Guelph



Year	OBG	AAFC
18-19	136,088	136,089
19-20	136,088	136,089
20-21	136,089	136,089
21-22	136,089	136,088
22-23	136,089	136,088
Total	680,443	680,443

Total Project Funding over 5 years

$1,360,886

Breeding better beans for farmers, consumers and the environment

By Lilian Schaer

Demand for bean-based ingredients and food products is growing rapidly thanks to the current trend towards plant-based proteins. There is also increasing societal pressure on agriculture regarding sustainable production practices. Helping farmers meet these demands through their crops is the responsibility of bean breeders like Prof. Peter Pauls from the University of Guelph and his team, which includes technicians Tom Smith and Lyndsay Schram, postdoctoral research associate Yarmilla Reinprecht and a number of graduate and summer students.

He is currently leading a project through the national Pulse Research cluster that focuses on learning more about the diversity of Canada's bean breeding germplasm. Specifically, that means identifying genes that control yield, disease resistance, and nitrogen fixation capacity, as well as bean quality characteristics like nutritional value, health-promoting properties and visual appeal.

"Any breeding program is a long-term exercise, which can take 10 to 15 years from cross to consumer, and every year we put new material into the pipeline," explains Pauls. "In addition to developing bean lines for that are high yielding and disease resistant, we are working to understand the genetic basis for those and other characteristics we're selecting for."

White beans account for about half of all dry or edible beans grown in Ontario; the rest are mostly large seeded coloured varieties like cranberry and kidney beans, as well as some small-seeded varieties. From the approximately 250 new crosses made every year, the hope is that two to three will make it to commercialization.

Yield is evaluated in terms of how many days it takes a crop to be harvest-ready. This is a big criterion for growers, particularly for large-seeded beans, which they expect to mature in under 100 days or about 14 weeks.

Scientists are also interested in beans with resistance to two seed-borne bean diseases, common bacterial blight and anthracnose. Both can cause significant losses for growers, so much so that currently, most seed for Ontario is actually produced in Idaho. This lets growers start with a disease-free crop, but does drive up costs by about $10 an acre or more.

With 80% of the Ontario bean crop going into canning, it's critical they perform well during processing so Pauls and his team also subject all potential varieties to canning tests in collaboration with Agriculture and Agri-Food Canada researchers in Lethbridge AB.

How beans can interact with human health is part of the research project as well. The goal, according to Pauls, is identifying compounds in the beans that have beneficial health impacts, like lowering the glycemic index of a person's diet to help control diabetes or reduce the risk of cardiovascular disease.

"How beans can relate to gut health is important and if we can find beneficial compounds, it's our hope that we can build them into the bean breeding program through biochemical and molecular markers," he says.

Another trait the team is actively looking at is nitrogen fixation, particularly in heirloom bean varieties that aren't as used to environments with high fertilizer levels as modern beans are. If plants can "fix" or produce their own nitrogen without decreasing bean production, it would result in a more environmentally sustainable crop that would also cost farmers less to grow, Pauls says.

"The challenge is that these things – yield, disease resistance and nitrogen fixing – are all inter-related. You have to get it all right to succeed, not just one thing," he adds. "So, you can start with plant material that you know is high yielding and then cross it with material that has the new trait you want to add."

One such example is a gene that prevents darkening of beans after harvest. Bean appearance is critically important to buyers and consumers, and since beans can be in storage for a while after harvest before they go to an end user, maintaining colour is key. Researchers screened hundreds of bean lines to find just the right trait, but since it was discovered in a very low yielding plant, the gene is now being bred into more productive bean varieties.

The bigger overarching question, though, is that of genetic diversity and the overall sustainability of the agricultural ecosystem, according to Pauls. And that's where research into some of these traits is important to help growers produce high yielding crops that support a diverse ecological community.

"This is increasingly the focus of non-farming consumers and I believe we ignore this at our peril," he says.

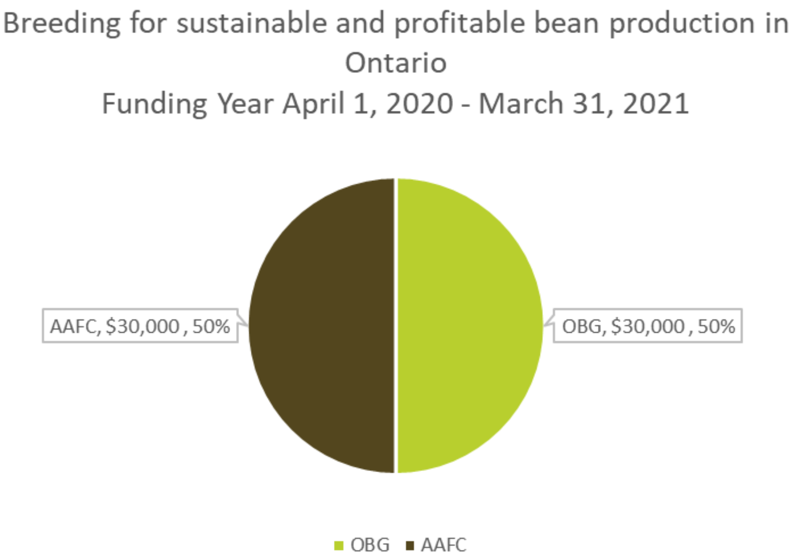
This project is part of a five-year research investment into bean research projects by Ontario Bean Growers and the Pulse Research cluster.

The cluster also includes Alberta Pulse Growers, Manitoba Pulse and Soybean Growers, Saskatchewan Pulse Growers and Pulse Canada and is supported by the Agriculture and Agri-Food Canada AgriScience Clusters Program under the Canadian Agricultural Partnership.

Project Title: Bean Breeding Germplasm Screening for Resistance to Emerging Diseases

Dr. K. Peter Pauls
University of Guelph

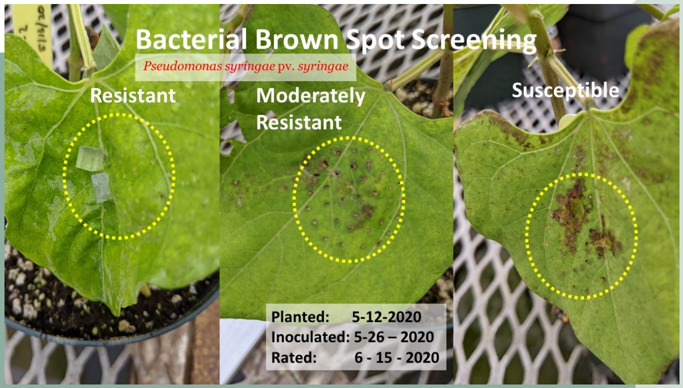
Year	OBG	AAFC
18-19	9,375	9,375
19-20	30,000	30,000
20-21	30,000	30,000
21-22	20,625	20,625
Total	90,000	90,000

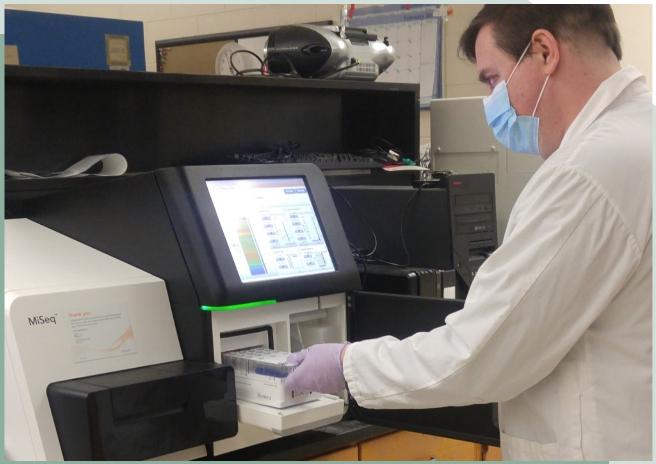


Total Project Funding over 4 years

$180,000

The goal of this project is to screen the germplasm that might be used by the Bean Breeding and Genetics program at the University of Guelph for resistance to existing and emerging diseases. The information about the disease resistance spectrum of potential materials will be used to make selections from potential parents and will allow for matching resistances in the crossing designs to maximize the diversity of disease resistance in the progeny. This project will ensure that new varieties that are developed have the appropriate spectrum of resistance genes to existing and emerging viral, bacterial and fungal pathogens, thus protecting the crop against losses to diseases and reducing the need for applications of chemical controls.





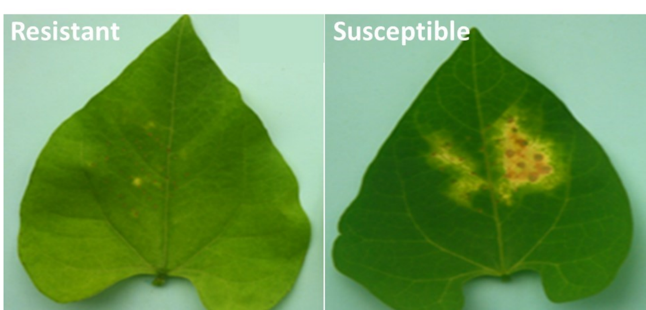
Highlights of Work to Date

An expanded set of elite material and breeding lines have been screened for bacterial brown spot. This work was carried out under greenhouse conditions with a bacterial brown spot isolate obtained from Ag Canada at Harrow. The screening has given sufficient information in selecting parental material to increase the brown spot resistance in breeding efforts.

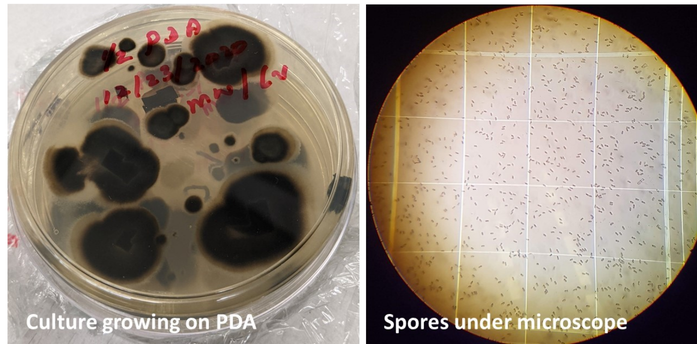
The DNA extraction of the elite breeding lines has been completed and we are looking for genetic markers that indicate the presence of disease

resistance traits such as anthracnose, common bacterial blight, bean common mosaic virus, angular leaf spot as well as seed darkening trait. A large gene pool provides a buffer against unfavourable traits. Gene sequencing data will be used to see which commercial classes of beans are genetically similar and will enable breeding crosses between cultivars that are not similar to increase diversity. A genetic marker is a DNA sequence with a known physical location on a chromosome. Using genetic markers that have been acquired the germplasm can be screened through lab-bench gel-based tests for the presence of these gene locations associated with different disease resistant traits. This characterization of the breeding germplasm for genetic similarity and disease resistance genes before making crosses will improve the efficiency of the breeding program. It allows breeders to select parents for targeted crosses that will increase the number of different versions of genes that are known to be related to the plant's response to diseases. Increasing the efficiency of a breeding program will, in theory, shorten the amount of time it takes to bring cultivars with disease resistance to market.

Common Bacterial Blight



Anthracnose caused by *Colletotrichum lindemuthianum*

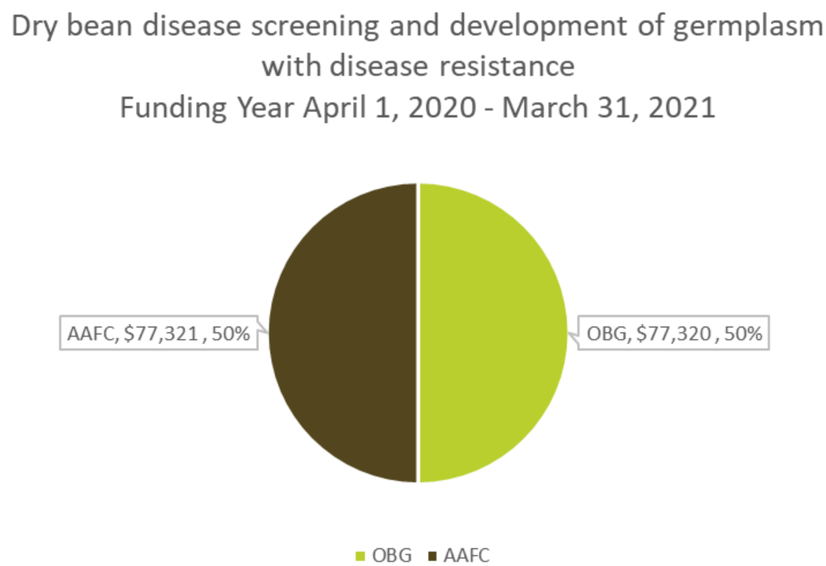


Two new anthracnose races (race 105 and 109) that have been reported to be present in Ontario bean growing areas have been acquired for this project. These races will be used for screening the differential set and our germplasm collection. The results would help in identifying additional entries that possess genes that are different from other resistant genes that confer resistance to race 73 which is the predominant race in the region. This would enable the research team to introgress additional resistance genes in the background of genes such as Co-4 in parental germplasm that would enhance the durability of anthracnose resistance.

This project is funded in part through the Canadian Agricultural Partnership (the Partnership), a federal-provincial-territorial initiative.

Project Title: Dry bean disease screening and development of germplasm with disease resistance

Dr. Jamie Larsen
Agriculture and Agri-Food Canada



Year	OBG	AAFC
18-19	62,751	62,751
19-20	75,836	75,835
20-21	77,320	77,321
21-22	78,855	78,855
22-22	81,435	81,435
Total	376,197	376,197

Total Project Funding over 5 years

$752,394

In search of blight resistant dry bean varieties

By Lilian Schaer

Blight resistant dry bean varieties would solve various problems for Ontario farmers, from higher yields to better quality beans. There's even the potential to bring seed production back to Ontario, which would reduce costs for growers.

Identifying and developing those resistant varieties is the task of bean breeder Jamie Larsen, a research scientist at the Agriculture and Agri-Food Canada (AAFC) Research Centre in Harrow, Ontario, who is heading up a project doing just that as part of the national Pulse Research Cluster.

"Dry beans are susceptible to a lot of diseases, especially seed-borne diseases and some have major impacts affecting how they are grown in Ontario and their cost of production," Larsen explains.

That means Ontario dry bean growers have to get seed grown in Idaho in order to have a clean seed source with a greater chance of giving the plants a disease-free start. Common bacterial blight, bacterial brown spot and halo blight are the most common disease culprits in Ontario dry bean varieties.

"Quality is really important - beans have to look perfect for market or you can't sell them," Larsen says.

Larsen and his team have collected leaves from infected Ontario dry bean plants to determine what blight challenges are present in the province, and is using those findings to screen bean breeding lines from the AAFC Research Centre in Harrow as well as the University of Guelph for their resistance to those various diseases. The goal is to get resistant varieties registered in Ontario.

In order to continue testing outside of the field season, the researchers have retrofitted existing growth room facilities so they can work indoors and differentiate the bacterial pathogens that cause bacterial blight diseases.

They have also set up disease testing nurseries – common bacterial blight likes warmer temperatures so those trials are in Harrow, whereas bacterial brown spot and halo blight favour slightly cooler temperatures so they are located with AAFC's Research Centre in London..

"We were noticing that some lines that were supposed to be resistant to common bacterial blight had symptoms of the disease, so we did Ontario surveys and looked at what bacterial pathogens were present," he says. "We found a lot of bacterial brown spot and we haven't been breeding for this so far."

White beans that have been bred for common bacterial blight resistance are also showing resistance for bacterial brown spot, but less so for halo blight, initial results show. The same is true for small seeded coloured beans – black, pinto and red beans – but the resistance level is lower as less breeding work has been done on these varieties do date.

"What this means is that if we can continue to select for resistance to either common bacterial blight or bacterial brown spot, we should be able to get it all together – it simplifies things a bit," Larsen notes.

The case is less clear for large seeded beans, which

includes dark red, light red and white kidney beans and cranberry beans. According to Larsen, there is no correlation at all between disease resistance, which means the research team will have to approach each disease individually with those bean varieties.

Screening will continue annually for the remaining years of the project to validate the findings. Larsen will also focus on understanding resistance by crossing susceptible parents with resistant parents and using molecular mapping to understand where in the bean genome those traits are.

"The bean has been sequenced so we can drill down to the gene. Testing is time-consuming and expensive and needs expertise, so we're hopeful we will be able to use molecular markers," he says.

By the end of the project, Larsen hopes to have a good handle on what lines are resistant to common bacterial blight and bacterial brown spot, as well as some information around halo blight, which is more prevalent in western Canada than in Ontario. Resulting germplasm will be shared with dry bean breeders across Canada.

All large seeded bean seed currently comes from Idaho, whereas some small seeded coloured bean seed is available locally. Larsen's ultimate, if lofty, goal is to bring dry bean seed production back to Ontario for every market class, a move that could reduce seed costs by approximately $10 to $15 per acre.

Owen Wally, a research scientist in field crop pathology at AAFC, is working with Larsen on the project, as is Frédéric Marsolais, a research scientist at the AAFC Research Centre in London. Larsen also collaborates with Prof. Peter Pauls at University of Guelph.

This project is part of a five-year research investment into bean research projects by Ontario Bean Growers and the Pulse Research Cluster.

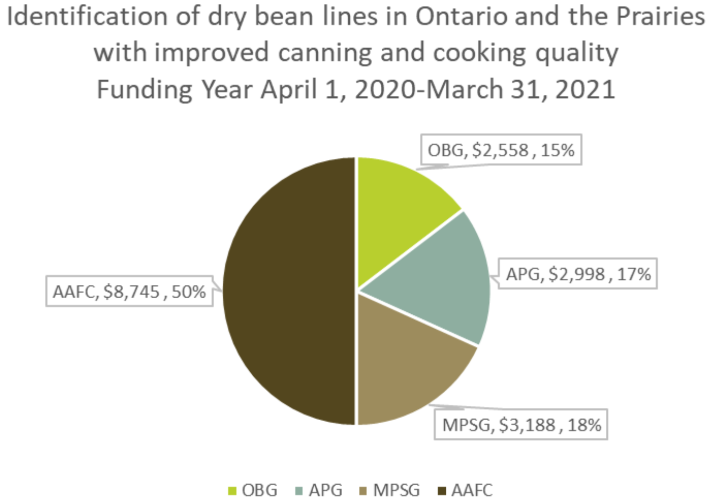
The cluster also includes Alberta Pulse Growers, Manitoba Pulse and Soybean Growers, Saskatchewan Pulse Growers and Pulse Canada and is supported by the Agriculture and Agri-Food Canada AgriScience Clusters Program under the Canadian Agricultural Partnership.

SPOTLIGHT ON: Speed Breeding at AAFC-Harrow

Since Dr. Jamie Larsen and his team at Agriculture and Agri-Food Canada- Harrow took over the dry bean breeding program, they have put significant effort into improving the speed at which varieties are released to Ontario bean growers. Part of this was designing and installing an automated “speed breeding” system in the winter of 2020 which uses LED lights and hydroponics to cut off 2-3 years from the usual 8-9 years that it takes to get a new bean variety registered. A large portion of certified seed production for Ontario is completed in Idaho. This leads to significantly increased cost of production to farmers. The long term goal of Larsen’s program is to bring all dry bean seed production back to Ontario, by the time he retires, through development of high yielding and disease resistant varieties. This speed breeding system, which is the only one like it in the world, is a key step in that direction.

Project Title: Identification of dry bean lines in Ontario and the Prairies with improved canning and cooking quality

Dr. Parthiba Balasubramanian
Agriculture and Agri-Food Canada



Year	OBG	MPSG	APG	AAFC
18-19	2,559	3,188	2,997	8,745
19-20	2,559	3,187	2,997	8,744
20-21	2,558	3,188	2,998	8,745
21-22	2,559	3,189	2,997	8,744
22-22	2,559	3,188	2,997	8,744
Total	12,794	15,942	14,986	43,722

Total Project Funding over 5 years

$87,444

This project is one that is not usually reported on at grower meetings, but it is of great importance to Ontario's dry bean industry. The results of the canning and cooking quality work feed into the decisions made by Ontario's Pulse Crop Committee, an organization comprised of representatives of the industry. OBG's representatives are Mike Donnelly -Vanderloo and Jennifer Mitchell.

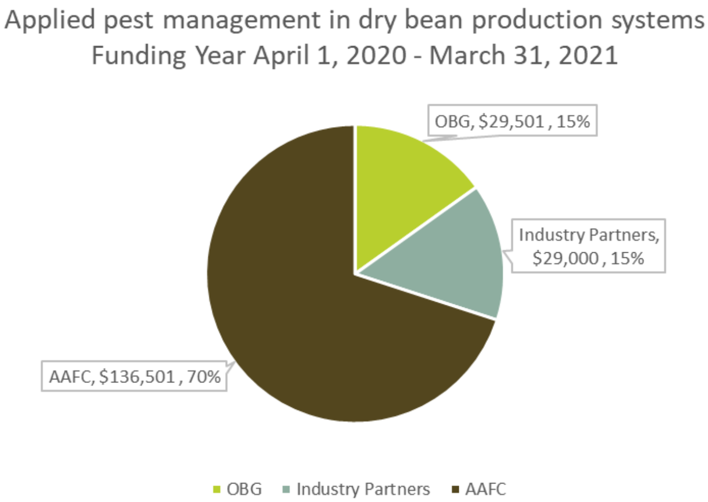
Each year, up to seven dry bean Cooperative Registration Trials are grown in Canada. They include three trials in Ontario (Navy, Coloured Major and Coloured Minor), two trials (Wide Row and Narrow Row) in Manitoba, and one trial each in Saskatchewan and Alberta. Each trial has three to six locations with three or four replications per location. Dry bean lines from the 2019 Registration Trials of Ontario, Saskatchewan and Alberta were assessed for canning and cooking quality traits at the Bean Pilot Plant at AAFC-Lethbridge. Also, experimental dry bean lines in the 2019 Advanced Yield Trial of Ontario were assessed for canning and canning quality traits in March 2020.

Dry bean seeds of check cultivars and experimental lines in the 2019 Ontario Registration Trials were evaluated for canning and cooking quality attributes at the Bean Pilot Plant, AAFC-Lethbridge. 75 dry bean lines including 21 navy, 10 cranberry, 6 dark red kidney, 6 light red kidney, 3 white kidney, 13 black, 3 red and 13 pinto bean lines grown at three locations were assessed for canning and cooking quality traits. Data summary and recommendations on acceptability of dry bean lines for cooking and canning quality traits were provided to the breeders and to the Ontario Pulse Crop Committee (OPCC). At the Annual Meeting of the OPCC in February 2020, 4 navy bean, 1 light red kidney, and 1 white kidney from the University of Guelph breeding program were put forward for registration. The newly registered varieties were put out for licensing in the fall of 2020. License proposals were received from 3 companies related to two of the navy bean varieties, and one proposal was received to test two varieties.

For the 2019 Ontario Advanced Yield Trial, ninety-five (32 navy, 15 black, 10 pinto, 3 light red kidney, 9 dark red kidney, 2 white kidney, 13 cranberry and 11 other types) dry bean lines were processed in cans, but at the time this report was received from AAFC, they had not been assessed for canning and cooking quality traits due to COVID-19 restrictions.

Project Title: Applied pest management in dry bean production systems.

Chris Gillard
University of Guelph, Ridgetown Campus



Year	OBG	AAFC	Industry
18-19	29,500	136,501	29,500
19-20	29,500	136,501	29,500
20-21	29,501	136,501	29,500
21-22	29,500	136,500	29,500
22-22	29,501	136,500	29,500
Total	147,502	409,501	145,000

Total Project Funding over 5 years

$975,005

Getting the best bang for your pest management buck

By Lilian Schaer

The battle against insect and pest diseases is a never-ending one for dry bean growers. Chemical controls are a key management tool, but they can be costly. It can be hard for growers to access independent advice on both economic return and product performance in order to make decisions on the best treatment approaches to use on their farms.

Enter Chris Gillard, Associate Professor in dry bean agronomy and pest management at the University of Guelph's Ridgetown Campus.

His research program focuses on identifying, evaluating and determining the effectiveness and economic response of new pest management tools in order to provide growers with unbiased, arms-length product reviews.

"This program is unique in Canada; it's the only one in the country doing public sector dry bean research from an applied, grower point of view. Pest management products are a key part of the management of any pest and farmers are consistently asking for feedback on how products compare to each other," Gillard says.


Irrigation system to promote disease

Under the national Pulse Research Cluster, Gillard is leading a study that is evaluating the efficacy and economic returns of various new tools against soybean cyst nematode, potato leafhopper, anthracnose, white mold, common bacterial blight and

root rot, which contribute to the development of a stronger pest management strategy.

Part of Gillard's work involves developing long-term data sets on product efficacy and economic returns so that growers can have as much information available as possible on performance before they decide whether or not to use a product.

"You can't just take a one or two year snap shot to get an accurate picture of performance and growers want to know what the likelihood for success is before they decide if they should use a particular product or not," he says.

Gillard's data shows which products provide the greatest consistency in performance and return to the grower over time. Comparing it to a batting average in baseball, he adds that a product that has consistently better performance has a greater likelihood of giving a grower a good return the next time they use it.

"The main information is whether or not the grower was able to make money with their crop while using a specific product," he explains. "That's a key aspect to this project."

Another component of Gillard's cluster-funded project is looking at new pests and developing recommendations for growers. This includes things like if and when they should spray (pest thresholds) and what products they should use, how they should scout for pest presence and the best timing of spray applications. Two recent additions to Gillard's roster are western bean cutworm and soybean cyst nematode.

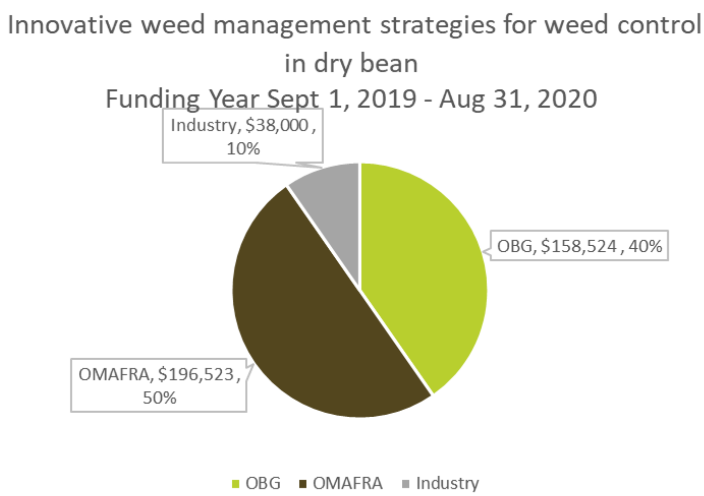
Gillard predicts that soybean cyst nematode in particular will be a major dry bean pest in Ontario in the future – due in part that so little is known about it and there are very few tools in Ontario for managing it in dry beans. It was only formally discovered in a commercial dry bean crop in 2018, whereas it was first isolated in soybeans over 40 years ago.

Plant breeding may be the primary tool to manage

Click here to view the Edible Bean Agronomy and Pet Management Research Results on the Ridgetown College website.

Project Title: Innovative weed management strategies for weed control in dry bean

Peter Sikkema
University of Guelph, Ridgetown Campus



Year	OBG	OMAFRA	Industry
18-19	47,967	60633	12,667
19-20	110,557	196,523	25,333
Total	158,524	183,857	38,000

Total Project Funding over 5 years

$393,047

Pre-plant and Pre-emergence use of 2,4-D ester in Dry Bean

By Todd Cowan
Huron Research Station/U. of G.
Field crop weed management

Introduction

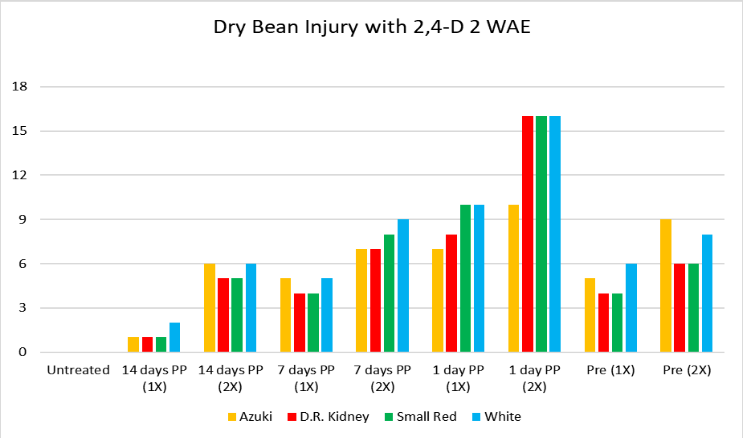
Historically growers in Ontario have used conventional tillage practices in the production of dry beans. Adoption of reduced-, strip- and no-tillage practices, has been increasing in the province. With improved equipment technology some dry bean growers have been working towards transitioning into these reduced tillage systems. Strip-till has shown promise as a nice compromise between conventional tillage and no-till. Dry bean growers can benefit from the tillage within the strip creating favourable conditions for planting and delivery of fertilizer right in the root zone. The benefits from reduced tillage such as improved soil health and protection from soil erosion can be realized from a strip-till system.

Background

With the adoption of reduced tillage practices some challenges have developed. Glyphosate-resistant Canada fleabane has spread rapidly throughout much of Ontario, including many of the dry bean growing regions of the province. Glyphosate-resistant Canada fleabane is adapted to reduced tillage. A lot of research has been conducted on herbicide options for the control of this weed in soybean. Saflufenacil (Eragon), metribuzin (Sencor) and 2,4-D ester have proven to be effective options. Preliminary experiments found that there is potential for the use of 2,4-D ester in dry bean production. Further work was required to determine sensitivity of dry bean market classes to 2,4-D ester and to determine the ideal application timing.

Evaluations

Between 2016 and 2018, six dry bean tolerance trials were conducted to evaluate 2,4-D applied preplant and pre-emergence across four dry bean types (azuki, dark red kidney, small red, and white). Trials were established in a strip-till system using fall established strips with no strip freshening in the spring. 2,4-D ester was applied at 320 ml/ac (1X) and 640 ml/ac (2X) at 14, 7, and 1 day pre-plant and pre-emergence (3 days after seeding). The 1X rate used reflects the current registered use pattern for pre-plant application in soybean. 2,4-D ester is not currently registered for use in dry bean. Trials were



evaluated for visible crop injury, stand count, biomass, height, maturity and yield. Trials were maintained weed-free throughout the growing season.

Results

The application of 2,4-D ester caused visible crop injury across all bean types at all application timings when evaluated 1, 2, 4 and 8 weeks after emergence (WAE). As the pre-plant application interval decreased the level of injury increased. The highest bean injury occurred when 2,4-D was applied at the 2X rate 1 day prior to seeding. Visible bean injury was greater at the early evaluation timings, but injury was transient with low levels of injury 8 WAE. The 1 day pre-plant application resulted in a decrease in plant stand and plant height at the 2X rate. Plant biomass was reduced with the 7 and 1 day pre-plant applications. Crop maturity and yield were not negatively affected by the application of 2,4-D ester at any of the application timings across all bean types. Azuki beans were the most tolerant to the pre-plant applications of 2,4-D. Figure 1 demonstrates the impact of 2,4-D application timing on injury of four market classes of dry beans.

Figure 1. Dry bean injury at 2 weeks after emergence from application of 2,4-D applied at various timings.

Conclusions

The results from this study found that at the proper application timing 2,4-D ester can be used safely in dry bean for the control of glyphosate-resistant Canada fleabane. Recommended timing is 14 days pre-plant at the current soybean label rate of 320 ml/ac. Currently, 2,4-D ester is not registered for pre-plant or pre-emergence application in dry bean. It would be our hope that a registration could be achieved through the User Requested Minor Use Label Expansion Program.

Permit and grass herbicide tankmix partner comparison in White Bean

By Todd Cowan
Huron Research Station/U. of G.
Field crop weed management

Introduction

Weed control in dry beans can be a daunting task. Management decisions should be based on knowledge of weed pressure and weed species on a field specific basis. There is no one size fits all scenario with weed control in dry beans. The size of farm operations means there is a diverse mix of past crop/weed management practices, a broad range of environments and soil types. This can lead to differing weed species and populations to be aware of when preparing weed control strategies. An understanding of this information will help growers select the correct herbicide program for each individual field. A soil applied herbicide program is a great foundation for managing weeds in dry beans. The aim of this article is to assist you in selecting the right program for each field on your farm.

Background

Pursuit and Permit are the only soil applied broadleaf herbicide options available to Ontario dry bean growers. Treflan, Prowl H2O, Dual II Magnum, Frontier Max and Eptam are currently available soil applied grass herbicides for use in dry beans. Each product provides differing levels of broadleaf weed control. Understanding this can make selecting a product to complement your broadleaf herbicide easier.

Evaluations

Four weed control trials were conducted between 2017and 2019 at the Huron Research Station and

Ridgetown Campus to evaluate five soil applied grass herbicides (Treflan, Prowl H2O, Dual II Magnum, Frontier Max and Eptam) alone or in combination with Permit applied preplant incorporated. Evaluations included crop injury, weed control eight weeks after emergence, weed density and biomass and white bean yield.

Results

Tankmixes of all five grass herbicides in combination with Permit provided good to excellent weed control of all species evaluated. Improvements in control with the tankmixes were not always significantly different but a trend to improved control was noted. This article will discuss the differences between the herbicide alone treatments. This will make identifying a tankmix partner clearer for individual field circumstances.

Velvetleaf

Eptam provided good control (82%) of velvetleaf 8 WAE while the remaining grass herbicides did not provide any control. Permit provided excellent control (98%) of velvetleaf when applied alone.

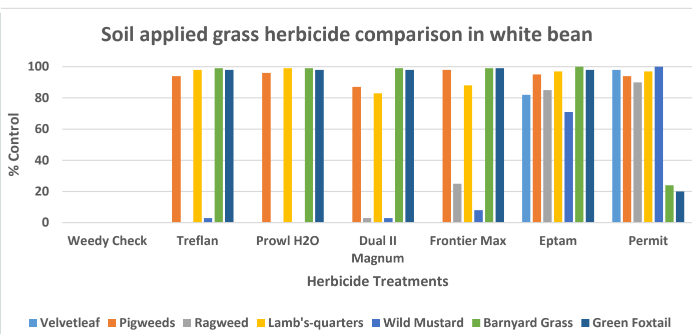


Figure 1. Weed control 8 weeks after emergence with soil applied herbicides in white bean.

Pigweeds (green & redroot)

Treflan, Prowl H2O, Frontier Max, Eptam and Permit provided excellent control (94-98%) of pigweed species evaluated 8 WAE. Dual II Magnum provided good control (87%). Control of pigweeds increased to 99 to 100% when Permit was tankmixed with any of the grass herbicide options evaluated.

Common Ragweed

Eptam provided good control (85%), Frontier Max provided poor control (25%) while the remaining grass herbicides provide no control of common ragweed 8 WAE. Permit provided excellent control (90%) of common ragweed. Control of common ragweed was improved when Permit was tankmixed with Treflan (93%), Frontier Max (94%) and Eptam (98%).

Lamb's-quarters

Treflan, Prowl H2O, Eptam and Permit alone provided excellent control (97-99%) and Dual II Magnum and Frontier Max provided good control (83-88%) of lamb's-quarters. All tankmix treatments provided 99 to 100% control of lamb's-quarters.

Wild Mustard

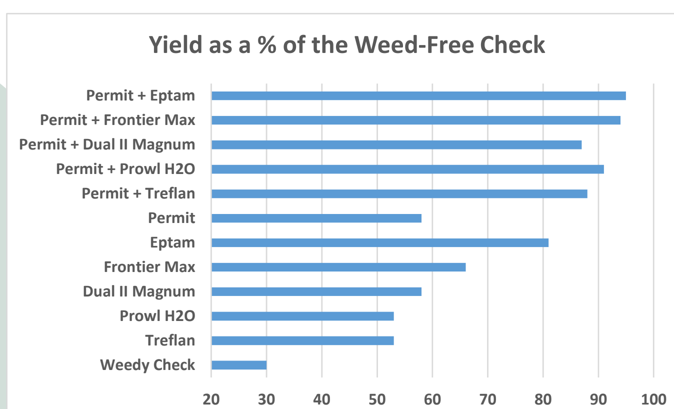
Permit alone provided excellent control (100%) of wild mustard, Eptam provided fair control (71%) while the remaining grass herbicides did not control wild mustard. There was no improvement in wild mustard control with any of the tankmixes.

Barnyard Grass and Green Foxtail

Permit provided poor control (20-24%) of barnyard grass and green foxtail. All of the grass herbicides evaluated provided greater than 98% control of barnyard grass and green foxtail. The tankmixes with Permit provided similar control to the grass herbicides applied alone.

Yield of White Bean

White bean yield reflected the level of weed control provided by each herbicide or herbicide tankmix. Yields were maximized with tankmix combinations of Permit plus either Frontier Max or Eptam.



Conclusions

Eptam followed by Frontier Max provided the highest broadleaf weed control of all the grass herbicides evaluated. Permit provided excellent control of the broadleaf weeds evaluated and poor control of the grass species. Growers can improve their annual broadleaf and grass weed control by strategically selecting the right tankmix partner. Knowledge of the herbicide options available and the weed species composition in each field is very important to maximize weed control and profitability.

Volunteer azuki bean control with Permit herbicide applied post-emergence

By Todd Cowan
Huron Research Station/U. of G.
Field crop weed management

Introduction

Azuki beans have been grown in Ontario for over two decades with an estimated 20,000 acres being grown in 2020. Acreage has continued to climb as the profitability of growing azuki beans is very attractive to growers. A better understanding of agronomic practices to produce azuki beans has spurred on growth in this niche market.

Azuki bean production does not come without its challenges. One of the biggest challenges facing producers is the ability of azuki beans, lost in the harvesting process, to remain viable in the soil for many years after. This poses a problem in subsequent crops. Volunteer azuki beans compete with following crops for resources and can negatively impact yield. If left uncontrolled, these volunteer azuki beans will produce seed that will return to the soil seedbank. Of concern is the possible contamination of crops such as IP soybean and dry common beans. Separating volunteer azuki beans from the crop can be quite costly to the producer as well as the processor. Volunteer azuki beans have proven difficult to control in IP soybean and dry common bean.

Evaluations

In 2015, trials were initiated at the Huron Research Station to study volunteer azuki bean control at different application timings in white beans using Permit herbicide. Permit was selected because of its crop safety in white beans and because previous tolerance trials demonstrated that azuki beans were susceptible to postemergence applications of Permit. Azuki bean seed was broadcast over the entire trial area and worked in the day of white bean planting. Initial trials evaluated Permit at 19 g/ac across three application timings: preemergence, early postemergence(V1) and late post-emergence (V3). In 2017 further studies were initiated to evaluate Permit at three postemergence application timings; applications were made at V1-V3 (early), V3-V4 (mid) and V4-V9 (late) stage of volunteer azuki bean at three rates (14 g/ac, 19 g/ac and 27 g/ac) to determine what timing and rate would be most beneficial. Evaluations included control ratings, volunteer azuki bean density and biomass assessments, percent contamination of white bean crop with volunteer azuki bean and yield.

Results

Initial studies demonstrated that Permit applied preemergence provided little to no control of volunteer azuki bean with no significant reduction in density, biomass or percent contamination. Postemergence applications provided poor to fair control of volunteer azuki beans with no reduction in plant density. There was a reduction in percent contamination and an increase in yield with the early postemergence application.

The second set of trials which evaluated three application timings and three rates found that control at 8 weeks after application was poor with no significant reduction of volunteer azuki bean density. In general, volunteer azuki biomass was reduced at all three rates across all three timings. Of interest is the reduction in percent contamination when Permit was applied at the V1-V3 stage and the V4-V9 stage timing of application at 19 and 27 g/ac.

These results prompted further analysis of the data to determine the ideal Permit rate and application timing to minimize crop contamination with volunteer azuki bean. It was clear that Permit would not necessarily provide control of volunteer azuki bean but it may delay azuki bean development and seed production enough to reduce contamination in white bean.

White bean contamination with azuki bean varied with Permit application timing and rate. Permit applied at 14 g/ac reduced azuki bean contamination in white bean by an average of 42%, however the range was from 7 to 98%. The reduction in azuki bean contamination increased to 75% when the rate of Permit was increased to 19 g/ha, the range in contamination was 6 to 98%; the best application timing was at the V1-V3 stage. Increasing the rate of Permit to 27 g/ha resulted in a 70% reduction in contamination with a narrower range of 34 to 98%; the best application timing was the V1 to V3 stage.

The chart below summarizes the impact of Permit on azuki bean contamination in white bean as influenced by rate and application timing. The data indicates that Permit should be applied at 19 to 27 g/ac targeting the V1 to V3 stage of volunteer azuki bean. In the event that application cannot be made during the V1 to V3 stage growers will want to consider using the 27 g/ac rate at the V4 to V9 stage of azuki bean as their next best option.

	% Contamination				
Rate	**Untreated**	**V1-V3**	**V3-V4**	**V4-V9**	**Average across Timing by Rate**
Permit - 14 g/ac	**31**	**19**	**18**	**18**	**18**
Permit - 19 g/ac	**31**	**8**	**13**	**14**	**11**
Permit - 27 g/ac	**31**	**9**	**15**	**10**	**12**
Avg. across Rates X Timing	**31**	**12**	**15**	**14**	

Figure 1. Rate and timing of appli*cation of Permit herbicide to minimize volunteer azuki bean contamination in white bean.*

Left: Untreated Control Right: Late Postemergence

Conclusions

Permit applied postemergence does not provide consistent control of volunteer azuki beans in white beans. However, growers can use Permit strategically to reduce volunteer azuki bean contamination in their crop sample and to reduce volunteer azuki bean seed return to the soil seedbank.

Growers should target applications at the V1 to V3 stage of volunteer azuki beans at rates of 19 to 27 g/ac. Where application has been delayed beyond V3 it is recommended that growers consider targeting the V4 to V9 stage of azuki bean at 27 g/ac. Permit has excellent crop tolerance in white bean at all rates evaluated in these studies.

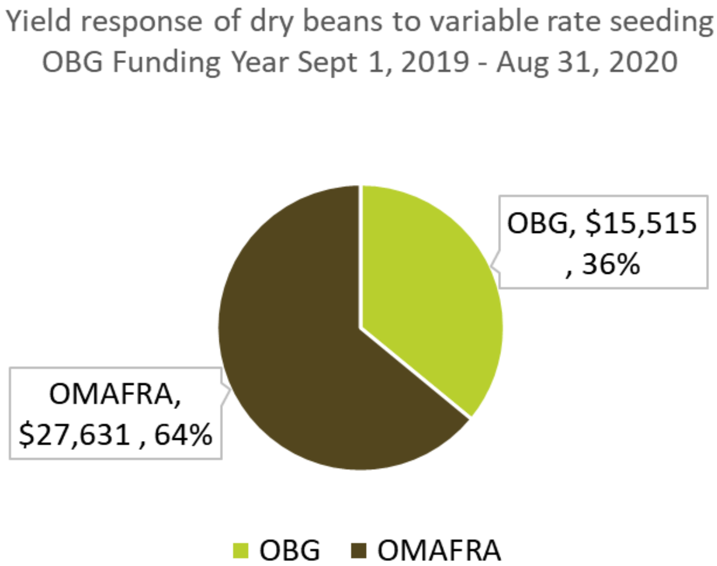
For further information please contact Peter Sikkema (psikkema@uoguelph.ca) or Todd Cowan (tcowan@uoguelph.ca)

Click here to view the Weed Control Research Results on the Ridgetown College website.

Variable Rate Seeding Project

Project Title: **Variable Rate Seeding of White and Cranberry Beans**

Meghan Moran, Canola and Dry Bean Specialist
OMAFRA



Year	OBG	OMAFRA
17-18	7,728	
18-19	235	30,307
19-20	15,515	27,631
20-21	2,400	5,600
Total	25,878	63,538

Total Project Funding over 5 years

$975,005

Thanks to six Ontario dry bean producers located in Perth and Oxford Counties, a large seeding rate trial was conducted over 3 years on approximately 900 acres of cranberry beans, 600 acres of white beans and 200 acres of black beans. The objectives of the project were to:

- Demonstrate the use of a new yield monitor for coloured bean combines, and
- Evaluate the opportunity to adjust seeding rates to reduce economic risk and risk of white mould

Using Premier Equipment's Enhanced Learning Blocks, and significant support from Greg Kitching, four different seeding rates were planted in randomized, replicated plots (Table 1). Each seeding rate was replicated 15 times per field, and each plot was approximately half an acre in size. Before building the seeding rate prescriptions, each field was divided into 3 different yield zones (high yielding, average yielding, below average yielding) based on historical yield and input from the producer, and the replicated plots were divided across the three yield zones (Figure 1).

Table 1. Seeding rates used for white and cranberry beans

White Beans seeds/ac	Cranberry Beans seeds/ac
44000	40,000
77000	52,500
110000	68,000
120000	82,500

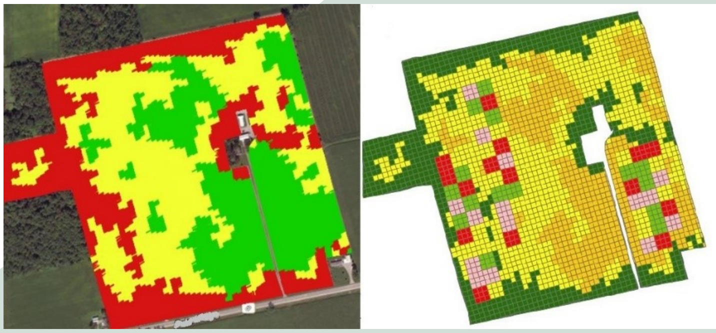


Figure 1. Yield zones (left) created using historical yield data, and the dry bean seeding rate prescription (right) with a total of 60 seeding rate plots placed in high, average and below average yield zones. In the area of the fields outside of the research plots, producers chose their own variable seeding rates.

Plots were seeded by the producers using their variable rate planters and yield data was collected from their combines. New load cell yield monitors, designed by Greentronics in Elmira, were installed on the Pickett Twin Master combines of the two cranberry bean cooperators. With just a few exceptions, all crop inputs other than seed were blanket applied to the project fields. SoilOptix was used to measure over 20 different soil parameters on each field, aerial imagery was collected at first flower, and plant populations were counted by hand on a subset of plots. All fields were planted on 30” rows (two fields were twin rows on 30” centers) and producers grew the varieties that best suited their farms. The original intention was to collect data on 900 acres of white beans but one cooperator switched to black beans which was determined to be an acceptable comparison. Also, a planter error ruled out one field of white beans.

Low population plots visible early in season

At this time statistical analysis has been conducted by Ken Janovicek, University of Guelph, for yield data collected in 2018 and 2019 from 5 fields (~500 acres) of white beans and 1 field (~100 acres) of black beans. Analysis of these 6 fields is described below.

In the coming months the 2020 yield results and all cranberry bean results will be added to the analysis and regression curves developed for yield and profitability response to as-applied seeding rate. This data should be valuable to all dry bean producers using blanket seeding rates, variable rate seeding, or for estimating the yield potential of thin stands in re-plant scenarios. SoilOptix data will also be analyzed with a focus on evaluating what soil parameters drive differences between yield zones, and which parameters most impact yield response to seeding rate. Premier Equipment are providing support with data analysis and further support from statisticians will be pursued to fully utilize the dataset.

White/Black Bean Results (2018-2019)

Each project field was divided into 3 zones based on historical yield, however statistical analysis of yield response shows that most fields only have 2 zones. In 5 of the 6 fields, yield data from 2 of the 3 zones was statistically the same. In one field, all zones performed the same. It should be noted that fields used for the project were generally quite flat and although some variability could be noted visually, other farms and regions of the province are much more variable.

Analysis of yield response to seeding rate shows there was only a significant response to seeding rate on 3 of the 6 fields. That means that for half of the fields the seeding rate had no impact on yield, even though seeding rates ranged from 40% of a typical seeding rate up to 110% of typical. Similarly, the profitability (profit = yield x price of beans – standard cost of production) did not change significantly across seeding rates for these 3 fields. Profit was the same in the low and high seeding rate plots.

Two of the fields in which yield response to seeding rate was not significant were strip-tilled and seeded in twin rows on 30” centers. It may be the case that the slightly narrower row spacing played a role in the lack of yield response to seeding rate. It should be noted, however, that these fields had the driest conditions of the 6 and did not have earlier canopy closure. Plants in these fields were generally shorter in stature than the others, and in some areas the canopy never fully closed over the rows. There was no white mould observed in either of these fields.

The data shown in Table 2 is from one field of Apex white beans grown in West Perth in 2018. In this field, yields in the zones that were labelled “highest yielding zone” and “average yielding zone” were statistically the same. Yields in the zone labelled “lowest yielding zone” were statistically lower than yields in the rest of the field.

While yield ranges differ from one farm to the next, the data in Table 2 is representative of the 3 fields where yield and profitability had a significant response to seeding rate. In the historically better yielding areas of the field, all seeding rates of 77,000 seeds/ac and higher had the same yield and profitability. In the lowest yielding part of the field, seeding at 77,000 seeds/ac produced a lower yield, but because seed costs are lower the profitability was the same as at higher seeding rates. Based on this data, it may be concluded that:

- there was no advantage to increasing seeding rates above 110,000 seed/ac in any parts of the field
- blanket rate of 110,000 seeds/ac would be a profitable practice
- profitable variable rate seeding prescription could include seeding rates ranging from 77,000 seeds/ac to 110,000 seeds/ac, with lower seeding rates in the high yielding areas of the field.

Table 2. Yield and profitability response to seeding rate in a 2018 field of Apex white beans.

	Seed Rate (seeds/ac)	Yield (lbs/ac)	Profit ($/ac)
High Yield Zone	44000	2436 b	521 a
	77000	2500 ab	527 a
	110000	2560 a	531 a
	120000	2568 a	529 a
Avg. Yield Zone	44000	2309 b	473 b
	77000	2543 a	543 a
	110000	2569 a	535 a
	120000	2578 a	532 a
Below Avg. Yield Zone	44000	2223 c	440 b
	77000	2397 b	487 a
	110000	2490 a	504 a
	120000	2498 a	502 a

Note: Within a yield zone, yields followed by the same letter are statistically the same, and profits followed by the same letter are statistically the same. Profit= averageyield x price of beans – standard cost of production, where the standard cost of production includes the actual cost of the seed in the year of the study.

Across the 6 fields the effect of treatment by zone was not significant, meaning the response to seeding rate is the same in all zones. Although there is a significant yield difference between zones in most fields, they respond to seeding rates in the same way. For example, yield may be higher in one zone than another, but altering the seeding rate has the same relative response in both zones. This will be further evaluated with regression analysis.

Visual Observations on Maturity, Weeds and White Mould

The following observations are not based strictly on data, but on notes and photos collected through extensive scouting of the plots over the 3 years.

At lower populations, individual bean plants branch more and produce more pods. More branching may translate to a longer flowering period and more days to maturity. Larger plants laden with pods tended to result in more lodging. Maturity differences between plots with the highest and lowest seeding rates were observed in some white beans fields but was not observed to the same extent in cranberry bean fields. In September of 2019, Nautica grown in North Perth had dark green leaves in plots seeded at 44,000 seeds/ac but plants were senescing and had yellow leaves in plots seeded at 120,000 seeds/ac - this was the most extreme example of maturity differences. In a less extreme example, plots seeded with T9905 at 120,000 seeds/ac were dropping leaves in September 2020, while the 44,000 seeds/ac plots still had some green leaves. In most fields, and at white bean seeding rates of 77,000 – 110,000 seeds/ac, differences in maturity were minimal.

Nautica white beans on Sept 8th at 120,000 seeds/ac on the left, and 44,000 seeds/ac on the right.

Cranberry fields were scuffled between the rows and generally had fewer weeds. In two white bean fields more weeds could be observed in the plots seeded at 44, 0000 seeds/ac compared to higher seeding rates in some of the replicated plots, but not all. Typically, when fields were weedy it was not observed to be related to the seeding rates. Fields planted on 15” rows should have canopy closure over the rows earlier in the season, so it could be hypothesized that seeding rate would have less of an impact on weed density on narrower rows that it did in this project.

Example of higher weed pressure in low population plots.

Average percent canopy closure of white beans at first flower was 49% in plots seeded at 44,000 seeds/ac and 64% in plots seeded at 110,000 seeds/ac (2018 data only). For cranberry beans, percent canopy closure at first flower ranged widely from approximately 17-60% at the lowest seeding rate and from approximately 20 -85% at all other seeding rates (2018 data only).

The standard fungicide practice for fields was two applications to target mould and anthracnose, although a few fields had a third pass. One producer applied their second fungicide pass with a variable rate prescription based on an aerial NVDI map, turning off the fungicide in thin areas of the field. This could have impacted observations of white mould for two fields.

Level of white mould infection was either high across the whole field, sporadic in the field, or not present. In one of the 18 fields under study the level of white mould infection in the plots was directly related to the plant population; level of mould infection increased with increasing population. That occurred in a field of cranberry beans where mould set in late in the flowering period. Lush growth does increase risk of mould, but amount of early season rainfall and vegetative growth had a bigger impact on amount of mould than the population of plants. The greatest amount of white mould was observed in white bean fields that have historically received a lot of manure and had beans nearly waist high; high mould levels were observed across the majority of the field. There was no mould observed in the fields that were strip-tilled and planted on twin rows, which also received the lowest amount of spring rainfall, resulting in short plants.

Reports will be developed and shared as the 2020 data is collected and analysed. Anecdotally, lowering seeding rate in cranberry bean fields had a greater positive impact on profitability than what was observed in white bean fields. I look forward to analysing and sharing this data. If you have questions about the project or its results, please contact Meghan Moran (Meghan.moran@ontario.ca, 519-546-1725).

Thank you so much to the farmer cooperators on the project, Greg Kitching of Premier Equipment, Nicole Rabe and Dan Bihari from OMAFRA, and Ontario Bean Growers.

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A One Stop Shop for Ontario Dry Bean Agronomy

The Dry Bean Agronomy website outlines agronomic management practices for dry bean production in Ontario and brings together expertise and research results from extension specialists and academic researchers. The site was developed in cooperation with and will be managed by Meghan Moran, Canola and Edible Bean Specialist, OMAFRA.

Ontario Pulse Crop Committee

The Ontario Pulse Crop Committee co-ordinates the variety registration and variety performance trials for dry beans in Ontario.

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