MANITOBA CROP ALLIANCE

The Focal Point

Winter 2022 Edition

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MESSAGE FROM THE CHAIR

***Fred Greig** – Reston, Manitoba*

Welcome back to another edition of The Focal Point. As both Chair and a member with Manitoba Crop Alliance (MCA), I am so proud of all that the organization has accomplished through research commitments in just over a year since the amalgamation. The Focal Point does an excellent job of highlighting some of the major projects funded by MCA and introducing you to the researchers and their teams that carry these projects out. MCA is currently funding 108 active research projects and has invested over 12 million dollars into these projects. We are so thrilled to once again be sharing this information with our farmer-members and others in the agriculture industry. We couldn't make this happen without the support of our members. We truly are "stronger together".

Yours Truly,

Fred Greig
MCA Chair

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THE FOCAL POINT | WINTER 2022 EDITION

Each project featured in this publication is proudly funded by Manitoba Crop Alliance

PRODUCING PREMIUM QUALITY MALT AND BARLEY IN MANITOBA

Assessment of new malting barley varieties for production and malting selection in Manitoba

Barley was once one of the major crops grown in Manitoba. Over 2 million acres were seeded to barley production in the early 1980s, but since then barley seeded acres have decreased steadily as farmers have opted to grow other crop types for a myriad of reasons, including crop rotation needs, profitability, and market signals. Manitoba recorded an all-time low in 2017 seeding 265,000 acres of barley. In 2021, just over 420,000 acres were seeded to barley (malting vs feed barley varieties acres are roughly split 50/50).

In recent years demand for Canadian malting barley has increased due to rising purchases from China and the growth of craft beer production. Approximately 90 percent of Canadian malting barley is produced in Alberta and Saskatchewan, while 4-7 percent (between 400-700,000 tonnes) is produced in Manitoba. Although malting barley can be a very profitable crop, climate and disease have often made it difficult for farmers to have their barley selected for malting use in Manitoba. In addition, delivery opportunities have historically been limited to certain regions of the province.

Another challenge in recent years has been the shift from six-row to two-row malting barley varieties. Historically Manitoba producers had a high success rate growing six-row malting barley varieties, but demand for six-row has dried up particularly since Anheuser Busch (now ABInBev) switched to two-row around 2015. Today, there are a number of new two-row malting barley varieties that have been regis-

PHOTO: CMBTC

tered in Canada in recent years with improved yield and disease resistance, but prior to now there was little data on how they perform agronomically in Manitoba, and on their quality performance, in various growing regions across the province.

The *Assessment of new malting barley varieties for production and malting selection in Manitoba* research project is intended to understand how Canada's newest malting barley varieties perform in Manitoba. Farmers will be able to use the data from these research trials to better understand the agronomic performance of these varieties in Manitoba and their performance in terms of quality, helping them make informed decisions when choosing a malting barley variety to grow. The end-users or buyers will also be able to see the quality data to support their decision to purchase malting barley from Manitoba.

In collaboration with Manitoba Crop Alliance, on-farm trials of new malting barley varieties

PHOTO: CMBTC.

TABLE 1 | MALT BARLEY VARIETY TRIAL – YEAR ONE (2020)

Location	Variety	AGRONOMY	BARLEY QUALITY					
		Yield (bu/ac)	Protein (%)	Germination Energy (%)	Water Sensitivity (%)	1000 KWT (grams)	Plump (>6/64")	RVA*
Holland	AAC Synergy	92.4	11.9	99.0	62.4	50.4	96.1	180
Holland	AAC Connect	85.3	11.6	98.8	65.4	50.6	95.5	164
Lowe Farm	AAC Synergy	84.4	11.6	96.4	78.1	51.6	97.7	14
Lowe Farm	CDC Fraser	71.1	12.2	96.4	68.6	51.0	96.8	11
Manitou	AAC Synergy	97.7	11.2	97.9	90.0	48.1	92.5	122
Manitou	AAC Connect	95.7	11.6	96.6	86.6	49.3	86.6	86
Manitou	CDC Copper	100.0	11.6	93.6	52.0	46.9	88.8	119
Wawanesa	AAC Synergy	95.1	11.5	98.6	80.9	52.4	96.6	134
Wawanesa	AAC Connect	91.6	11.3	98.3	83.4	54.3	95.0	140
Wawanesa	AAC Goldman	85.0	11.8	96.5	70.8	54.6	94.5	157
Baldur	AAC Synergy	86.7	11.8	98.9	86.1	52.5	91.8	80
Baldur	CDC Fraser	79.0	11.8	99.1	79.6	52.3	93.3	34
Baldur	CDC Copper	86.0	11.8	91.6	59.5	50.2	93.1	122
Baldur	CDC Bow	81.9	11.9	97.8	87.3	51.7	94.3	60

The first site-year (2020) showed significant differences in yields and plant stand. In 4 of the 5 sites, the check variety AAC Synergy was the top yielder with CDC Copper number 1 in the Pembina site. Most of the varieties met the standard minimum germination required by the malting industry of 95% with the exception of CDC Copper that came in slightly below 95%. In terms of malt quality, all varieties performed relatively well. AAC Connect had the highest fine extract, average of 82.7%, positive for all brewers, while CDC Bow and CDC Fraser had the highest FAN (Free Amino Nitrogen), required to feed yeast, levels, good for adjunct brewers. CDC Copper had the lowest DP (Diastatic Power), a measure of enzyme levels, and FAN, making it more suitable for all malt or craft brewers. *Rapid Visco Analysis

TABLE 2 | MALT BARLEY VARIETY TRIAL – YEAR TWO (2021)

Location	Variety	AGRONOMY	BARLEY QUALITY					
		Yield (bu/ac)	Protein (%)	Germination Energy (%)	Water Sensitivity (%)	1000 KWT (grams)	Plump (>6/64")	RVA*
Holland	AAC Synergy	95.0	12.5	97.8	97.0	50.4	97.3	201
Holland	AAC Connect	87.6	13.8	98.9	97.9	48.8	95.3	179
Westbourne	AAC Synergy	18.7	15.5	97.7	93.2	42.3	96.8	44
Westbourne	CDC Bow	14.8	16.0	94.5	68.7	41.7	97.6	34
Westbourne	CDC Copper	22.5	15.6	97.3	91.0	40.6	97.2	97
Lowe Farm	AAC Synergy	90.2	13.2	98.8	97.8	48.8	96.6	78
Lowe Farm	AAC Connect	83.2	13.5	98.8	98.8	49.5	95.3	53
Lowe Farm	CDC Churchill	92.4	13.0	98.2	98.3	45.8	96.8	76
Wawanesa	AAC Synergy	92.7	12.0	99.5	98.6	48.7	97.9	154
Wawanesa	AAC Connect	87.7	12.8	99.4	98.9	49.0	96.3	132
Wawanesa	CDC Fraser	85.3	12.1	99.5	97.6	47.2	97.7	147

Despite the challenging growing season, for the most part the quality of the barley grown in the trials in year 2 was relatively good. Just one sight, Westbourne, had protein levels that would wholly disqualify it from being selected, averaging 15.5-16%. Germination energy was generally very good, as was the percentage of plump kernels. *Rapid Visco Analysis

and check samples are grown at different locations across Manitoba over three crop years (the first crop year was 2020). Five farmers from different growing areas across Manitoba (Manitou, Holland, Wawanesa, Lowe Farm and Baldur) were involved in Research on the Farm plot trials during the first crop year.

New malting barley varieties AAC Connect, AAC Goldman, CDC Bow, CDC Fraser and CDC Copper were grown beside the control AAC Synergy. Fifty-six individual samples were collected at harvest representing the different varieties, locations and field reps to see how each performed. Agronomic data was collected from each site and composite samples were sent for Deoxynivalenol (DON) analysis. Barley quality was assessed by the Canadian Malting Barley Technical Centre (CMBTC) through malting and brewing tests in order to determine if the samples were of selectable quality for malting. Quality data was analyzed statistically to determine variety and location effects.

Despite challenges from the pandemic, five farmers were on board to participate in the first crop year. In the second crop year, five farmers participated again in the trials, four of them the same as year one. Unfortunately, one site was lost due to drought. New malting varieties AAC Connect, CDC Bow, CDC Copper, CDC Churchill and CDC Fraser were grown beside the control ACC Synergy in year two.

Overall, study results collected in the first and second crop years suggest that all the new varieties included in the trials achieved barley quality selectable for malting with a few exceptions. In 2020, 100% of the samples of AAC Connect, CDC Fraser, CDC Bow and AAC Goldman met selectable quality while 50% (4 of 8) of the samples of CDC Copper did not meet selectable quality due to either low germination or very high water sensitivity.

Lead Researchers:

Dr. Yueshu Li

Director of Malting & Brewing Operations, CMBTC

Peter Watts

Managing Director, CMBTC

Collaborators: Dr. Ana Badea, AAFC-Brandon Research and Development Centre

ON YOUR FARM

Barley grown in trial gets malted into seasonal brew in Winnipeg

Jeff and Sheila Elder (Sheila is a delegate on the MCA Wheat & Barley Crop Committee) farm nearly 2,000 acres near Wawanesa, Manitoba and participated in the first two crop years of the trial. Although doing these types of variety trials adds a little bit of extra work during seeing and harvest, the Elder's see it as an opportunity to see how new varieties perform on their land with their methods and give them confidence to select new varieties that are suitable to their land. But something else happened last summer.

"Maker's Malt contacted me in the summer as they were looking for old crop barley to supply to a brewery who wanted to do a local brew," said Elder. "In order to malt a small batch (have no blending power) they need very high-quality malt barley. After the new crop harvest, I sent them some samples of the CDC Fraser and they liked it. They came and picked some up and malted it, and delivered it to Winnipeg to a couple of breweries. One brewery in particular (Trans Canada Brewing Co.) used it as 100 percent of their base malt in their seasonal brew they do every year called Harvest Sky."

This is the fourth year Trans Canada Brewing Co. has brewed a fall beer highlighting local ingredients. "Previous beers have used local hops, wheat or rye for different varieties and styles of beer, but they've never been able to access local malt before," explains Elder. "The fact that all of the malt in that beer came from my farm as part of this trial was pretty unique."

Another producer, Reg Marginet from Holland, Manitoba participated in the first two years of the malting barley variety trial and saw some positive results on his farm. "I have enjoyed working with MCA and their technicians. They are all down to earth people and understand when both the crops are planted and harvested, punctuality is crucial so the producer doesn't have to wait for them," says Marginet. "It's educational to see different varieties sown side by each on a field scale basis, especially in this dry year."

Yields for both varieties grown at the Marginet farm were very good in both years, a little above the average of all the trial locations, with the check AAC Synergy edging out AAC Connect. AAC Connect yielded 85.3 bushels per acre in 2020 versus the check AAC Synergy at 92.4 bushels. In 2021, the yields were 87.6 bushels and 95.0 bushels respectively.

Additional agronomic and disease data is available for farmers to review and help with choosing a malting variety to grow. Contracting and marketing opportunities will also be a critical consideration for producers.

For more information about this research and other Manitoba Crop Alliance projects, visit mbcropalliance.ca.

MCA 2020-2021 Investment: $38,358

CO-FUNDERS:
CANADIAN AGRICULTURAL PARTNERSHIP
Innovate. Grow. Prosper.

WINTER WHEAT BREEDING PROGRAM TO TARGET QUALITY FOR MILLING WHEAT CLASS

University of Manitoba winter wheat breeding program

PHOTO: UNIVERSITY OF MANITOBA WHEAT BREEDING

The winter wheat breeding program at the University of Manitoba (UM) has played an important role in developing wheat varieties in Manitoba and training students, the future work force of agriculture. Last year the Canadian Wheat Research Coalition (CWRC) alongside the Western Grains Research Foundation (WGRF) and the Saskatchewan Winter Cereals Development Commission (SWCDC) announced a five-year core breeding agreement with the UM valued at over $3.5 million to ensure the continuation of the successful Fusarium head blight (FHB) nursery program along with the winter wheat breeding program.

The FHB nursery at the UM evaluates breeding lines for their reaction to Fusarium graminearum. As one of few FHB screening nurseries in Canada, the UM program returns vital information to the network of western Canadian breeding efforts, and is the key to developing future wheat varieties with increased FHB resistance and providing this information to farmers through the provincial seed guides.

The winter wheat program at the UM has two priority areas: winter wheat breeding to develop wheat cultivars that are disease resistant and suited to the growing conditions in Manitoba, as well as germplasm and genetics development to understand the genetic basis of resistance genes and develop DNA markers for selection of economically important traits in Manitoba.

In 2020 Dr. Maneka Malalgoda joined the Department of Food and Human Nutritional Sciences at the UM with an interest in grain chemistry and processing quality.

▲ *Top: Plots are being mist irrigated to create a high moisture/humidity environment for Fusarium graminearum to infect the wheat heads. Above: The symptoms of FHB damage are bleaching of infected tissue. All of the tissue in these photos should be green based upon its age. Fusarium graminearum infection is killing the tissue prematurely. Some developing kernels abort, others are bleached and/or shrivelled, and some kernels escape infection.*

Dr. Curt McCartney joined the UM a few months later and the two connected as Dr. Malalgoda was interested in participating and testing material for the winter wheat breeding program. With the new core agreement, the UM was able to purchase grain quality testing equipment and hire a technician based in Dr. Malalgoda's lab to test the quality of the UM breeding lines. The new core agreement allowed the addition of this component as it wasn't included in the previous five-year agreement.

"This is a major step forward for us as it will allow us to develop varieties in the winter wheat milling class," says McCartney. "Because we didn't have this quality testing before, the material we were developing wasn't going to be suitable for that milling class of wheat. That meant the varieties were previously registered in the special purpose class of wheat (feed or ethanol). Once we're able to shift the breeding program in this new direction, we will be able to develop varieties that could be used for making bread, which is more appealing for farmers."

Implementing this change to develop a new class of wheat is going to take some time, but with access to

Lead Researcher:

Dr. Curt McCartney

Associate Professor, University of Manitoba

Researcher bio: In 2020 Dr. Curt McCartney joined the Department of Plant Science at the University of Manitoba as an Associate Professor in Cereal Crop Breeding and Genetics. McCartney's program will address production issues important to Manitoba farmers such as Fusarium head blight, lodging resistance, and of course grain yield.

Collaborators: Maneka Malalgoda, Assistant Professor with the Department of Food and Human Nutritional Sciences UM, Harwinder Sidhu, Research Scientist with AAFC-Lethbridge new data and more staff McCartney has high hopes for the continued success and expansion of the program. A strength of the program to this point has been its development of material that's high yielding with good disease resistance, which also remains an area of focus for McCartney.

A top priority of the program is to develop CWRW wheat cultivars that are disease resistant, semi-dwarfing, high yielding, cold hardy and suited to the higher moisture conditions of the eastern prairie provinces. "One thing I am interested in investigating is if we can find a genetic variation that will help improve winter hardiness," says McCartney. "Breeders have been struggling trying to improve winter hardiness for many years and it really hasn't increased from the variety Norstar (developed by AAFC-Lethbridge and registered in 1977). It would be nice to move beyond that."

McCartney is hopeful that with some of the new genetic information available, it's now possible to investigate new potential genetics that will be able to improve winter hardiness. "With this new knowledge, some of these crosses that we are going to explore are crosses that would never have been tried in the past," added McCartney.

McCartney is also interested in exploring new dwarfing genes for improving lodging resistance. "The genes that are currently in use are associated with FHB susceptibility. There are a number of new dwarfing genes that have been identified over the years so I would like to investigate these new genes to see if they would potentially not have this problem with FHB susceptibility," explains McCartney.

If this is the case, McCartney is hopeful this research could lead to replacing current dwarfing genes and simultaneously ramping up FHB resistance.

As part of his genetic research, McCartney is also collaborating on other Canadian wheat projects. He and collaborators at AAFC-Morden are working to sequence rust resistance genes present in Canadian spring wheat varieties. He is also collaborating with Drs. Alejandro Costamagna (UM), Tyler Wist (AAFC-Saskatoon), and Vincent Hervet (AAFC-Winnipeg) to study new types of resistance to wheat midge.

Staff recording anthesis dates in the FHB nursery

PHOTO: FIELDS TO FORKS

ON YOUR FARM

More breeding activities equals new varieties for farmers

The announcement of the new core agreement with the addition of grain quality testing is good news for farmers as it will allow researchers to develop varieties in the milling class. "The UM will now be able to develop germplasm with the grain quality characteristics of the milling class. Other breeders will be able to utilize these lines in future crosses, which will create more genetic diversity amongst our winter wheat breeding germplasm," explains McCartney. "Now that we can target the milling class, we should see a more rapid increase in yield gains for the western Canadian milling class of winter wheat. Having two healthy breeding programs will be beneficial to everyone."

Increased breeding activity translates into additional new varieties available to farmers. The UM will test spring, durum and winter wheat breeding lines going through the registration process for Western Canada. All that material gets tested for FHB resistance through the program at the UM Carman research station and by AAFC in Morden. This UM and AAFC data is the basis of the FHB resistance ratings for spring, durum, and winter wheat varieties in the provincial seed guides – a critical tool for farmers to make informed decisions on what new varieties will fit on their farms.

McCartney, Sidhu, and additional collaborators have applied for funding from the Alberta Ag Funding Consortium and the Saskatchewan Agriculture Development Fund for projects on genomic selection in the winter wheat breeding program. The intention of this project is to generate a data set from coop winter wheat as well as hard red winter wheats from neighbouring US states. Initially these lines will be tested for resistance to stripe and leaf rust, and will be expanded to FHB when they collect more seed and more agronomic and grain quality traits.

"The idea of this set of material is to keep testing more and more traits on it at the same time testing DNA markers that will cover the chromosomes. We'll take those DNA markers and develop genomic selection models that would predict traits in lines that we've never tested in the field," added McCartney.

Once this dataset is developed (four to five years) it will be implemented into the breeding programs. Prior to yield trials, this data will allow researchers to test around 1,000 lines from each breeding program and from those, focus on the 300 that look the best. This will make the breeding program more efficient saving time and allowing resources to be invested in other areas.

MCA 2020-2021 Investment: $66,435

CO-FUNDERS:

SPRING WHEAT

DISEASE RESISTANCE: FROM GENE DISCOVERY TO VARIETY DEVELOPMENT

New developments in strategies for wheat improvement

PHOTO-MALLORIE LEWARNE

When farmers select a variety for their operation, disease resistance is an important consideration when planning management options for the season. What is a disease resistance gene, and how is it bred into a modern variety?

Disease resistance genes are found within the host plant or crop species (wheat in this case) that would enable the plant to fight off a particular disease. The goal of genetics and pre-breeding is to identify useful genetic traits (i.e. disease resistance) from unadapted material (usually international wheat collections or wild relatives of wheat) and cross them into breeding lines so these traits can be introduced into modern varieties.

Dr. Colin Hiebert is a Research Scientist at the Morden Research and Development Centre (Morden RDC) for Agriculture and Agri-Food Canada (AAFC) who works on wheat genetics and genomics.

"There are many sources where we can find resistance genes. Wild relatives of wheat are an important source of disease resistance genes, but finding them can be challenging and time/labour intensive, so we also look at different germplasm

Manitoba Collaborators:

Dr. Brent McCallum

Plant Pathologist at the Morden RDC for AAFC.

McCallum earned his Bachelor Degree in Agriculture at the University of Manitoba (UM) before completing his Masters Degree in the Department of Plant Science at UM. Next, he earned his PhD focusing on bean rust, wheat stem rust and the genetics of rust and rust resistance at the University of Minnesota.

Dr. Colin Hiebert

Research Scientist at the Morden RDC for AAFC.

Dr. Hiebert is also an Adjunct professor, Department of Plant Science at the University of Manitoba, Chair of the Prairie Recommending Committee for Wheat, Rye and Triticale (PRCWRT), Disease Evaluation Team (DET), and board member of the European and Mediterrenean Cereal Rusts Foundation. He leads a wheat genetics research program that primarily studies disease resistance genes in wheat and durum using an array of genetics and genomics approaches.

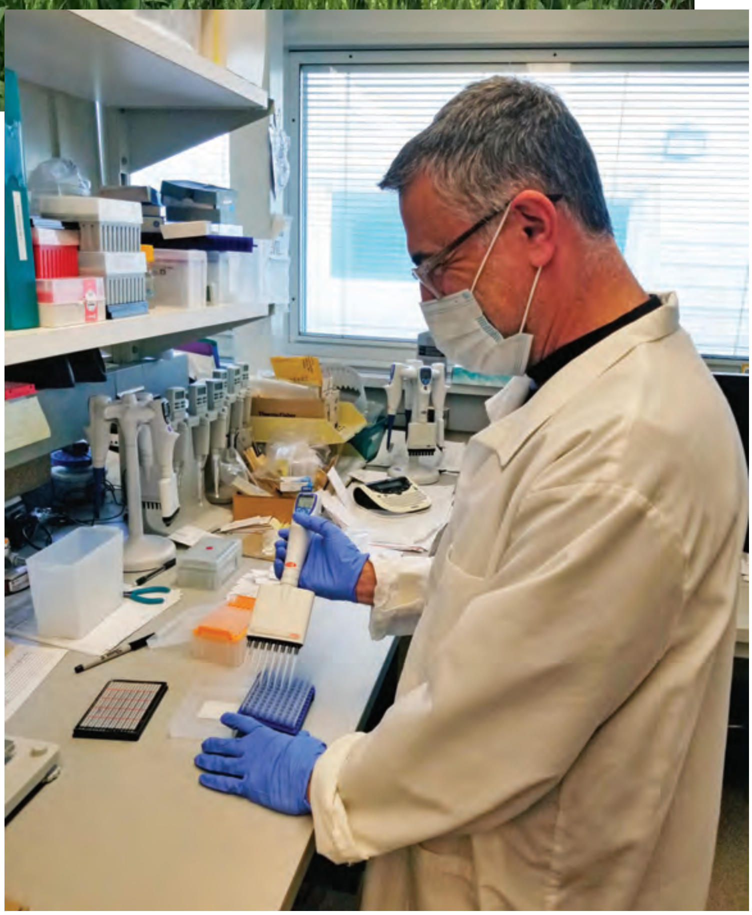

PHOTO: COLIN HIEBERT

▲ ***Technician Ghassan Mardli in the lab at Morden RDC***

collections, exotic wheat varieties and land-races for resistance to a specific disease or a set of diseases," explained Hiebert. "We search for plants that have resistance to a specific disease or set of diseases and test them with the strains of the disease we are most interested in, looking for potential sources of disease resistance."

When potential sources for resistance are found there is still no guarantee that there is something new or broadly useful, so there is a lot of testing after that. Genetic studies are performed to identify which genes are present (previously identified or new genes). Gene mapping using DNA markers is the most efficient way to determine if the gene appears to be new. Besides determining if a gene is new, DNA markers enable researchers to select specific combinations or specific genes to determine if the resistance gene is present. Selecting desired genes in this way is called marker-assisted selection (MAS) and is a powerful tool for breeding.

When a new gene is discovered for any of the rust diseases, researchers isolate the gene in a susceptible background so they can test with different strains (or races) of the targeted disease to determine how broadly effective it is. This information is critical in determining which are the best resistance genes to use in Canadian wheat breeding.

In most cases, these new resistance genes are found in germplasm that is not adapted for production in Canada. "With these unadapted backgrounds you have the whole process of trying to introduce these genes into a genetic background that breeders can use," added Hiebert. "This is one of the goals of the Canadian National Wheat Cluster and CTAG2 – Canadian Triticum Advancement through Genomic study (more on these projects follows)."

Once the resistance gene has been identified and determined to be valuable for Canadian wheat producers it must be crossed into a genetic background that is adapted to Canadian production so breeders are able to incorporate the new gene into their breeding program. Without this step, new genes tend

▲ ***Leaf rust***

▲ ***Fusarium Head Blight***

▲ ***Stem rust***

to "sit on the shelf" as breeders are hesitant to make crosses to wheat lines that have too many deficiencies in important agronomic and end-use quality traits. This process involves a lot of direct consultation with breeders and pathologists.

"From gene discovery to producing something you can hand off to a breeder takes about five years," says Hiebert. "Considering breeding timelines, developing a variety can take ten years. Best-case scenario when you're looking for a new gene and go through the whole genetics and breeding process, you likely won't see it in the field for about 15 years. Although sometimes we do get lucky and find something in Canadian wheat we didn't know about and then we can start to selectively target that gene. This was the case for stem rust resistance gene SrCad."

Because a large amount of time and resources are invested to discover resistance genes, utilizing them in combinations is the ideal way to protect that investment. "A breeder has finite resources and their two most important goals are to maximize yield and meet end-use quality parameters. We've started looking at gene combinations because a breeder cannot select five resistance genes (for example) for one disease because of the competing goals within their programs," added Hiebert.

When the same resistance genes are used repeatedly in the field, the pathogen can overcome the resistance, and the gene becomes ineffective (thus, the need to continually find new sources of resistance). In some cases, a single resistance gene does not provide enough protection, and a pyramid of multiple genes is desirable. These pyramids also make it more challenging for a pathogen to overcome the resistance.

In western Canada there are five wheat diseases which have been identified by the Disease Evaluation Team, part of the Prairie Grain Development Committee as economically important presently, or represent the greatest threat to producers. The diseases of concern are stem rust, leaf rust, stripe rust, Fusarium Head Blight (FHB), and common bunt.

FHB is a major concern for producers in Manitoba and the nature of FHB resistance is different from the rusts and common bunt. "The majority of the resistance to the rusts work by genes that recognize the fungus is invading, which triggers a defense response (usually quite strong) preventing the fungus from infecting at all, or if already infected, the plant produces antifungal compounds and kills off the cells around the fungi eliminating living tissues so the fungus cannot feed off of it. The genetics of FHB resistance is more complicated and the mechanism of resistance is less clear," explains Hiebert.

Resistance to FHB is controlled by multiple genes that work together each contributing to a reduction in disease. The resistance tends to be more dependent on the environment than resistance to the rust diseases.

There are some resistance genes that have been identified for FHB but it is not a simple process to develop a wheat line resistant to FHB. "The most reliable method is to test extensively for FHB resistance in the field and for low mycotoxin accumulation in the harvested grain," explains Brent McCallum, Plant Pathologist at Morden RDC, AAFC. "Most wheat cultivars on the market have a very high level of rust resistance, close to immunity. However, the best resistance available to FHB is a moderate level of resistance, though steady progress has been made in breeding for resistance over the past 30 years, resulting in much lower yield losses and mycotoxin levels than were experienced with older cultivars. Genetic tools will be important in maintaining the high level of resistance to the rusts, while improving the resistance to FHB."

ON YOUR FARM

Genetic research: The foundation of highly efficient wheat varieties

Fundamentally genetic research is helping to build a toolkit to improve efficiency of selection. It allows breeders to breed wheat in a more targeted way and enables them to select traits they couldn't by simply looking at the plant. It also allows them to determine which genes may be resistant (based off of DNA testing) so field tests can be performed to validate the material. It also provides genes from unadapted backgrounds or new combinations of genes into elite wheat genetic backgrounds that a breeder can use directly into their breeding program.

There are three wheat research projects MCA has invested in to ensure wheat remains competitive for Manitoba producers and a quality product for domestic and international end users of wheat. There are multiple researchers involved in each project. We have indicated the project leads for the following projects, to see a full list of researchers please visit our website.

The first project is the *Pre-breeding and development of breeding tools to diversify disease resistance in bread wheat,* which is led by Dr. Hiebert, AAFC Research Scientist. The work is part of the Canadian National Wheat Cluster. The overall objective of this project is pre-breeding and developing germplasms that breeders can use (different combinations). Combinations of leaf rust, stem rust, and stripe rust resistance genes have been selected in elite genetic backgrounds that have good agronomic and quality traits plus reasonable tolerance to FHB. The resistance genes targeted in pre-breeding are broadly effective, provide excellent resistance to the pathogen populations present in North America, and mitigate risk from foreign strains of the fungi that cause these diseases. To facilitate pre-breeding, improved DNA markers have also been developed that are key to selecting these gene combinations. As a bonus, a novel stem rust resistance gene has also been discovered during this project and the study will be published in the near future.

The next is *CTAG2 – Canadian Triticum Advancement through genomics.* This project is lead by Curtis Pozniak, Crop Development Centre, University of Saskatchewan and Andrew Sharpe, National Research Council of Canada and activities reported in this article were led by Dr. Hiebert, Morden RDC and Dr. Curt McCartney when he was working with AAFC (now with the University of Manitoba). The overall objective of this project was to discover, develop and adapt DNA markers for three leaf rust resistance genes (Lr16, Lr32 and Lr22a) and stem rust resistance gene SrCad. "DNA markers that were highly predictive of the presence of the genes were discovered," said Hiebert. "We now have DNA markers that we have over 99 percent confidence in for selecting genes."

The third is *4-D Wheat: diversity, domestication, discovery and delivery.* The leads on this project are Curtis Pozniak, Crop Development Centre, University of Saskatchewan and Sylvie Cloutier, Ottawa Research and Development Centre, AAFC. This is an ongoing project which began in 2019 and will run until 2025. The overall goal of this study is to accelerate the future development of higher yielding, stress resistant wheat varieties for Canadian farmers by utilizing cutting edge science.

Dr. Hiebert has been studying genes that suppress (turn off) disease resistance genes as well as disease resistance genes that are suppressed when they are introduced to bread wheat. This is one avenue of research undertaken in the 4DWheat project (among many other activities). For example, two leaf rust resistance genes have been discovered that confer resistance in durum but the resistance is suppressed once the genes are in common wheat. Understanding this genetic system may provide breeders with even more tools for developing sustainably resistant wheat cultivars.

All of this research translates into supporting breeding programs and ultimately the registration of new wheat varieties that are highly efficient for Manitoba growing conditions. New varieties tend to be shorter with less lodging and better water use efficiency, have built in disease resistance meaning less reliance on synthetic fungicides and high yield potential. Pre-breeding can help speed up the breeding process so farmers can have access to these improved varieties sooner.

As results are published from these studies MCA will share them with members across our communication platforms.

For more information about this research and other Manitoba Crop Alliance projects, visit mbcropalliance.ca.

MCA INVESTMENT:

Pre-breeding $3,537 (over 5 years)

Funded in part by the Government of Canada under the Canadian Agricultural Partnership's AgriScience Program, a federal, provincial, territorial initiative.

CFCRA Canadian Field Crop Research Alliance | ARCCC Alliance de recherche sur les cultures commerciales du Canada
Alberta Wheat Commission
Saskatchewan Winter Cereals Development Commission
Sask Wheat Development Commission
WGRF Advancing Agriculture through Research
Canada

CTAG2 $150,000 (over 5 years)

Genome Canada
Manitoba Grain Innovation Hub
Saskatchewan
WGRF Advancing Agriculture through Research

4D Wheat $240,000 (over 5 years)

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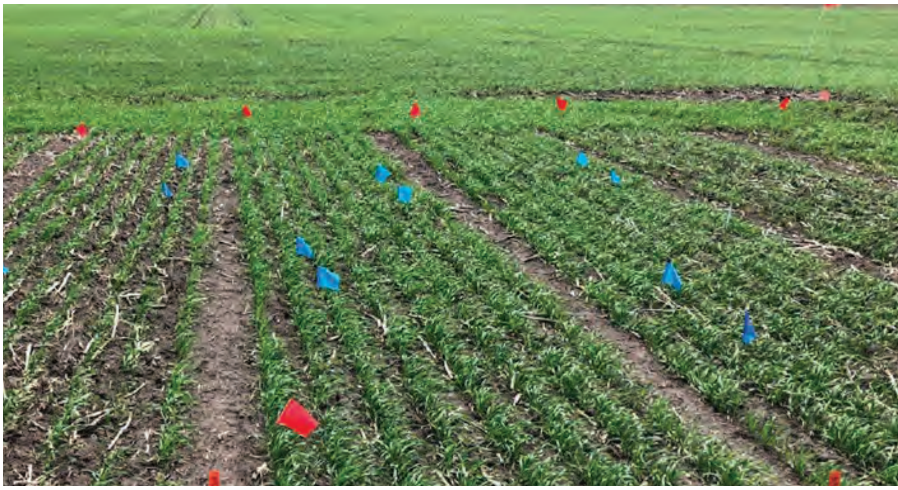
Agronomic practices to minimize lodging risk while maximizing yield and protein potential in spring wheat

Evaluating the influence of agronomic management on spring wheat yield, nitrogen use efficiency and lodging risk



PHOTOS: AMY MANGIN

Lodging not only makes cereal crops difficult to harvest, it can also dramatically reduce quality and yields. Different agronomic practices (varietal selection, nitrogen management, plant densities, and plant growth regulator (PGR) applications) can reduce lodging potential, but there is little information available on the most effective practices (or combination) to decrease lodging risk without taking resources from the developing crop.

Research from University of Manitoba (UM) PhD candidate Amy Mangin looked at the effectiveness of different agronomic practices to reduce lodging in spring wheat while maximizing yield and protein for new high yielding varieties. The objective of her research was to evaluate and better understand how high yielding spring wheat varieties respond to management practices such as nitrogen management, PGR application and seeding rate as well as their interactions and how

Lead Researcher:

Amy Mangin

University of Manitoba

Researcher bio: Amy Mangin grew up on a farm near Mariapolis, Manitoba. She received her undergraduate degree in agronomy at the University of Manitoba and her master's degree at the University of Alberta centered on herbicide resistance. After receiving her MSc she went on to work as a research agronomist in the soil fertility lab at the UM. She is currently finishing up her PhD in the Department of Plant Science at the UM and is the Research Manager at Manitoba Canola Growers Association.

Collaborators: Dr. Yvonne Lawley, Dr. Anita Brûlé-Babel, Don Flaten, University of Manitoba and Dr. Jochum Wiersma, University of Minnesota these may influence lodging risk, yield and protein in Manitoba growing conditions.

Mangin's research was conducted through two separate field experiments at Carman and Manitou during the 2018 and 2019 growing seasons. The cultivar AAC Brandon (Canadian Western Red Spring (CWRS)) was included in both experiments, with AAC Cameron (CWRS), and Proposer (Canadian Northern Hard Red (CNHR)) also included in the first experiment.

The first experiment investigated the influence of high yielding spring wheat variety, N management strategies (rate, source, and application timing), PGR applications and their interactions on spring wheat, yield components, nitrogen use efficiency and lodging risk. The second experiment investigated how plant density (low, medium, and high), N application timing, PGR applications and their interactions, affected crop canopy size and resulting nitrogen use efficiency and lodging risk.

Trials were seeded between April 26 and May 7 and the plant densities targeted were 150, 250 and 350 plants/m2. Nitrogen management treatments included a standard N rate of 140 lbs. N/ac as urea applied at planting, a low-rate treatment of 70 lbs. N/ac as urea applied at planting, a ESN blend (100 lbs. N/ac ESN + 40 lbs. N/ac Urea) applied at planting and a split N application that applied half (70 lbs. N/ac) the N fertilizer at planting as urea and the second half (70 lbs. N/ac) broadcast to the soil surface at the flag leaf stage as SuperU. The PGR Chlormequat chloride (Manipulator) was applied between June 5 – 14 at the beginning of stem elongation (growth stage 32).

Pre-anthesis and post-anthesis N uptake were measured and used to understand how management practices influence when the crop takes up N during the growing season. Harvest was between August 8 – 23 and grain yield, protein content and grain N yield were measured. It is important to note that both 2018 and 2019 were drier than normal growing seasons resulting in low lodging pressure. Stalk strength measurements were taken to determine lodging risk of treatments when no lodging was observed.

Variety

The varieties AAC Brandon (73 bu/ac) and Prosper (74 bu/ac) had higher yields than AAC Cameron (67 bu/ac), while Prosper had a 0.8 and 0.9% lower protein content AAC Brandon and AAC Cameron, respectively. All varieties took up the same amount of total N during the growing season, but the timing of N uptake differed amongst varieties. AAC Brandon took up a greater proportion of its total N during the post-anthesis period compared to the other varieties and as a result AAC Brandon produced a higher protein content with similar amounts of total N uptake during the growing season (Figure 1).

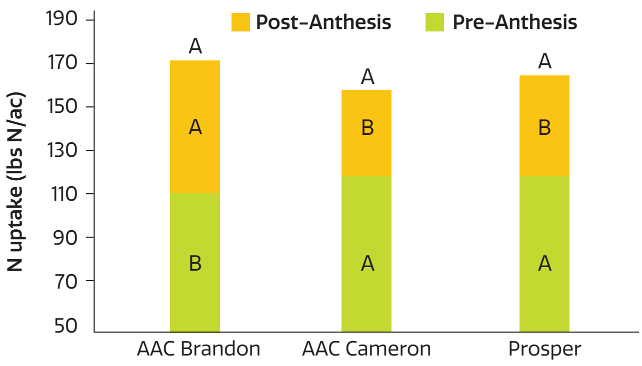


Figure 1 Pre-anthesis, post-anthesis and Total N uptake during the growing season for the varieties AAC Brandon, AAC Cameron and Prosper. Full bars indicate the total N uptake during the season, with the green portion indicating pre-anthesis uptake and yellow portion indicating post-anthesis uptake. Similar letters indicate there is no significant differences (95% confidence level) between varieties within each uptake timing.

Nitrogen Management

Grain yield was not significantly different between any of the N fertilizer treatments, indicating that 70 lbs. N/ac was sufficient for yield across this experiment. Protein content, which is more responsive at higher N levels, did show reduced protein content at low N rates and increased protein content when N was applied as a split application compared to the standard rate applied entirely at planting (Figure 2). Additionally, split N applications reduced lodging occurrence and increased stem strength compared to when N was applied entirely at planting.

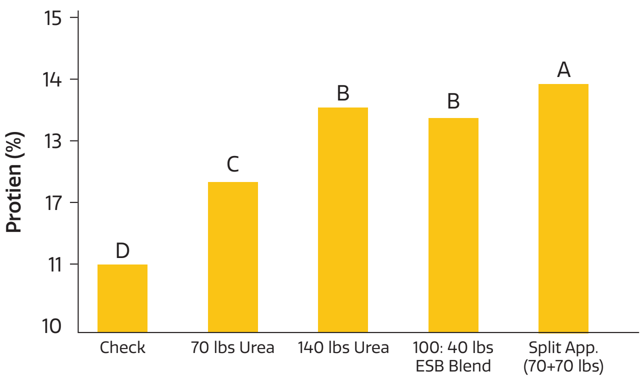


Figure 2 Nitrogen management effect on grain protein content. Similar letters indicate there are no significant differences (95% confidence level) between N treatments.

Plant Density

There were no significant differences in grain yield or protein content when plant densities increased from low (150 plants/m2) to high (350 plants/m2). However, high plant densities did have an increased lodging risk compared to the low and medium densities. Stalk strength as well are structural rooting area was increased with low plant density treatments, resulting in stems better able to resist breaking and increased anchorage of the plant to avoid root lodging as a result of rotation from the plant base (Figure 3).

Root plate pictures by plant density

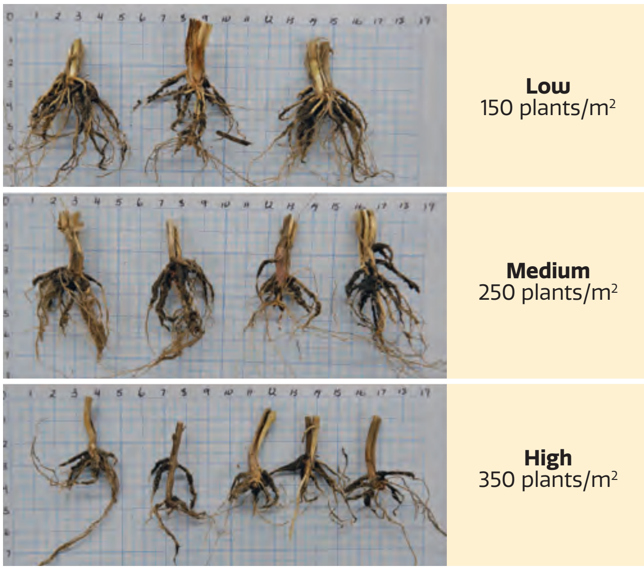


Figure 3 Structural root differences between low (150 plants/m2), medium (250 plants/m2), and high (350 plants/m2) plant densities.

PGR

The application of a PGR had a 3 bu/ac increase in grain yield and no influence on protein content of spring wheat. Additionally, PGR applications reduced lodging and increased stalk strength, but the ability of the PGR to reduce lodging in this experiment was dependent on planting density. PGR applications only reduced lodging in the high and medium plant densities as the overall levels of lodging in the low plant density was very low (Figure 4).

Lodging by plant density*PGR interaction

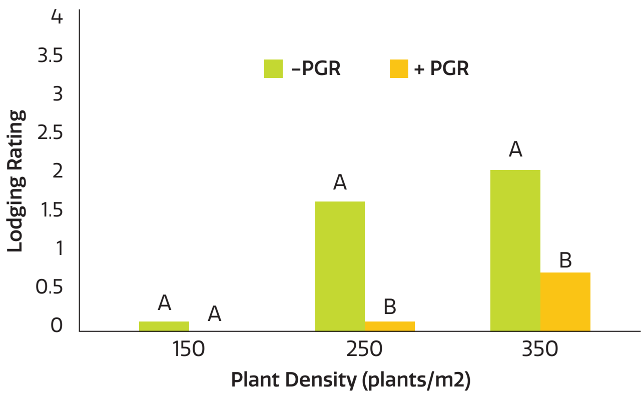


Figure 4 The effect of plant density and PGR application (Manipulator) on lodging ratings on spring wheat. Similar letters indicate there is no significant differences (95% confidence level) between PGR applications within each plant density.

ON YOUR FARM

Reduced plant densities, split N and PGR applications can reduce lodging risk in spring wheat while maintaining yield

Mangin's research found that low plant density, split N and PGR application showed the most promise to reduce lodging risk in spring wheat without reducing yield potential. Split N applications additionally had a beneficial influence of increased grain protein content. Results from this project and previous MCA funded research indicate that applying N as a split application under Manitoba conditions is a valuable tool for managing N losses, reducing lodging risk and increasing grain protein content.

When targeting high yield of spring wheat large amounts of N are required and if all N fertilizer is applied at prior to or at planting lodging risk will be high, especially when high seeding rates are used. By reducing seeding rates and lowering your plant density this research showed that you can reduce your lodging risk without sacrificing yield or protein. Additionally, the application of a plant growth regulator in season can reduce lodging risk and give a small yield increase when high-yielding growing conditions are present.

For more information about this research and other Manitoba Crop Alliance projects, visit mbcropalliance.ca.

MCA 2020-2021 Investment: $12,546

European corn borer larva
PHOTO: DR. JOCELYN SMITH

EUROPEAN CORN BORER BT RESISTANCE IN CANADA – WHAT CAN WE LEARN?

Mitigation and management of Cry1F resistance in European corn borer in Canada

European corn borer (ECB) can be a destructive insect pest to corn. ECB can contribute to quality and yield loss, and according to the Canadian Corn Pest Coalition website, one ECB per plant could reduce yield by 3-5%. ECB tunnels interrupt the physiology of the plant and create entry holes on the stalk which can lead to infection by secondary fungal pathogens that cause stalk and ear rots, and mycotoxin contamination of grain.

Bt corn technology was developed to control ECB and has been highly effective since its commercialization in 1996. Until 2018, there had not been any field-evolved cases of ECB resistance in North America until it was found in

PHOTO: MCA

Nova Scotia. In the early years of Bt corn technology, Bt hybrids only expressed one Bt protein against ECB but as time went on, more Bt proteins were developed and corn hybrids expressing more than one protein against the same pest (pyramid) were brought to market as a resistance management strategy. The risk of resistance developing to multiple proteins at the same time is significantly lower than to a single protein.

Because ECB was controlled so successfully for the last 25 years using Bt corn, it became less of a priority for research, pest management, and resistance monitoring. The reaction to the discovery of resistance in Nova Scotia has been supported by many stakeholders across the Canadian corn industry. A research project titled: Mitigation and management of Cry1F resistance in European corn borer in Canada began in 2020 with researchers from the University of Guelph and members of the Canadian Corn Pest Coalition. The researchers are stepping back to look at the general biology of ECB in Canada and learning from the situation in Nova Scotia in order to discover and promote best management practices that are applicable in areas like Manitoba where growing conditions are similar to Nova Scotia.

Master's student Emily Glasgow joined the team in 2020 and has validated a molecular method for determining the pheromone race of ECB. The two pheromone races of ECB differ in their geographic distribution and the host crops they prefer; Z-race primarily infest

▲ ***Mating moths.*** PHOTO: DR. JOCELYN SMITH

Lead Researchers:

Dr. Jocelyn Smith

Research Scientist, University of Guelph Ridgetown Campus

Dr. Rebecca Hallett

Professor and Associate Dean, University of Guelph

Researcher bios: Jocelyn Smith is a Research Scientist in Field Crop Pest Management at the University of Guelph Ridgetown Campus. Smith earned her Bachelor of Science and Masters Degrees at the University of Guelph and focused her PhD research on western bean cutworm in corn. Smith lives near Sarnia, Ontario and is involved in her multi-generation family farm cropping corn, soybeans, wheat and sugar beets.

Rebecca Hallett is Associate Dean of Research & Graduate Studies, Ontario Agricultural College, and a Professor in the School of Environmental Sciences, at the University of Guelph. Dr. Hallett's research interests include the ecology of invasive alien insect species, the chemical ecology of insect-host plant interactions, impacts of climate change on agricultural pests, and the development of integrated pest management programs for insect pests of vegetable and field crops. A major goal of her research is the development of pest management programs that help to reduce pesticide risk and that conserve natural enemies

Collaborators:

Emily Glasgow
M.Sc. Candidate

Dr. Yasmine Farhan
Research Associate

▲ ***ECB stalk boring.*** PHOTO: DR. JOCELYN SMITH

corn while E-race utilize many other crops for their development such as peppers, apples, wheat, or hemp. If Cry1F resistance is not limited to one race, this could have implications for management of the resistant populations. Glasgow has tested multiple ECB populations that were collected before and during the project to date. Preliminary results indicate that the Nova Scotia Cry1F resistant populations are primarily Z race, but additional testing of ECB collected from other crops is still needed to confirm that the resistant populations are truly limited to corn.

Glasgow is also looking at the heritability of Cry1F resistance and if there are fitness costs associated with resistance compared to Cry1F susceptible populations, such as lower reproductive rates or different developmental timing. These results will also be used to inform management of Cry1F resistant populations.

A second master's student will join the project in the spring of 2022 who will study historical ECB monitoring and phenology data to determine whether existing developmental models are appropriate or need to be updated for ECB monitoring in Canada. The student will also pursue testing different pheromone races of ECB and their host range.

The research team is also testing multiple ECB populations across Canadian corn growing regions to determine their susceptibility to Cry1F and the other Bt proteins currently in the market. Once populations are collected from the field they are tested in the lab, but sentinel plots are also being planted with collaborators in Ontario, Quebec and in the Maritimes to monitor for ECB injury in different Bt traits. Lastly, the team is investigating molecular markers for Cry1F resistance which could lead to a faster way to confirm resistance. "Ultimately, this project aims to develop a more robust and efficient way to monitor for resistance in the future," added Dr. Smith.

PHOTO: MCA

Refuge-in-a-bag (RIB) corn is a combination of non-traited corn (which serves as a refuge) and Bt insect-protected corn premixed in one bag. The refuges provide areas for insects to develop without exposure to Bt toxins (helps slow the development of resistance).

PHOTO: GETTY IMAGES

ON YOUR FARM

Current resistance management recommendation remains the same: multiple modes of action and scouting

The current recommendation for growers is to follow general resistance management guidelines – use multiple modes of action. "It is critical that hybrids expressing a single Bt protein are removed from the marketplace and that growers have access to pyramid hybrids for major corn pests in their regions. Since the resistance discovery in Nova Scotia, the industry has acted on this" says Dr. Smith. Growers also need to ensure that they are following the refuge requirements specified for the hybrid they are growing.

Growers are encouraged to scout their fields in season to ensure the Bt proteins are working and that there isn't any unexpected insect injury to Bt hybrids. "If growers do come across anything, they should contact their seed provider, agronomist, crop advisor, or extension personnel in their region so that they can investigate," explains Dr. Smith. "These people can test to see if the protein is being expressed in the plants as expected, and if they rule out that the plants are expressing the correct protein but there is insect damage, then we would probably make a collection of the insects and do further testing."

Growers can contact members of Canadian Corn Pest Coalition for questions, scouting tips and to learn more about proper stewardship of corn pest management technologies (www.cornpest.ca).

For more information about this research and other MCA projects, visit mbcropalliance.ca.

MCA 2020-2021 Investment: $10,000

CO-FUNDERS:

PIONEER. BAYER syngenta. Grain Farmers of Ontario Atlantic Grains Council Manitoba Agriculture Ministry of Agriculture, Food & Rural Affairs perennia ideas • innovation • success

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SUNFLOWER

Trials underway to determine optimal plant populations for sunflowers in Manitoba

Sunflower plant population study

Sunflowers are a good rotational crop. They are hardy with drought tolerance, and with the challenges of the 2021 growing season, sunflowers reported good yields and maintained high pricing, making them a good rotation option for farmers.

For a row crop like sunflowers, planting accuracy is very important as it sets the crop up for a productive season in order to achieve a high-quality seed and return on investment. Sunflowers are able to adjust to various plant populations by adjusting the head/seed size, which can ultimately affect yield and seed quality. The trick is to find the 'sweet spot'.

Oilseed varieties are often planted at a higher population than confectionary types. According to Manitoba Agriculture, oilseed sunflower populations range from 20,000 – 22,000 plants per acre (0.6 plants per ft2) and confectionary sunflower populations should not exceed 18,000 plants per acre (0.4 plant per ft2) to ensure large seed size. Farmers often have questions around plant populations with both confectionary and oilseed varieties.

As part of the Research on the Farm Trial Program, eight farmers from across Manitoba participated in on farm trials to examine and determine the

Lead Researcher:

Daryl Rex

Research Trial Specialist
Manitoba Crop Alliance

Researcher bio:
Daryl joined the Sunflower Association in the spring of 2018. Prior to that, he was conducting small plot research trials for a major seed company for close to 30 years in western Canada. Daryl was raised on a Manitoba Century family farm in the Pembina Valley and has a Bachelors of Science in Agriculture from the University of Manitoba.

best sunflower plant populations in Manitoba growing conditions. 2021 was the first crop season the project was conducted. It is important to note it was a very dry season across the province that did affect emergence.

The objective of the sunflower plant population study is to quantify the agronomic and economical impacts of reducing and increasing normal planting rate in sunflowers in Manitoba. Eight farmers from Manitoba participated: six farmers from the rural municipality of De Salaberry, Brokenhead, Stuartburn, Ritchot, Thompson and St. Andrews participated in the oilseed sunflower study, and two farmers from Emerson-Franklin and North Norfolk participated in the confection sunflower study.

"The sunflower plant population study is based off of real-life conditions on each farmers farm," says Daryl Rex, Research Trial Specialist at MCA. "Through the trials we are mainly looking at the yield affects based on the farmer's normal plant populations, plus and minus 10%."

"Rainfall was below average throughout the growing season across most of Manitoba, so its not a surprise we didn't see a significant difference in yields across more of the trials this year," says Rex. "In some trials we did see a significant difference in plant stand between the three planting rates."

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TABLE 1 | OILSEED SUNFLOWER SINGLE SITE ANALYSIS

Rural Municipality	Seed Rate (Check) seeds/ac	Plant Stand @ V2			Yield			CV%	P-Value	Statistically Significant @ 95%
		Low Seed Rate	Check Seed Rate seeds/ac	High Seed Rate	Low Seed Rate	Check Seed Rate lbs/ac	High Seed Rate			
De Salaberry	22,000	18,000^{A}	23,250^{B}	25,000^{C}	2,170	1,910	2,143	14.04	0.4333	No
Brokenhead	23,000	21,250	23,250	23,500	3,293	3,305	3,305	1.75	0.9463	No
Stuartburn	25,000	17,500^{A}	19,750^{B}	19,250^{AB}	2,516^{B}	2,870^{A}	2,812^{A}	4.53	0.0141	Yes
Ritchot	25,000	24,500^{A}	26,000^{A}	29,500^{B}	2,058	1,981	1.995	5.29	0.5854	No
Thompson	22,000	19,500	20,750	21,750	1,498	1,613	1,571	7.16	0.3958	No
St. Andrews	23,000	22,250	24,500	25,500	1,191	1,220	1,222	6.57	0.8378	No

One site year of oilseed sunflowers showed a significant yield difference between the three planting rates in the first crop year (2021).

TABLE 2 | CONFECTION SUNFLOWER SINGLE SITE ANALYSIS

Rural Municipality	Seed Rate (Check) seeds/ac	Plant Stand @ V2			Yield			CV%	P-Value	Statistically Significant @ 95%
		Low Seed Rate	Check Seed Rate seeds/ac	High Seed Rate	Low Seed Rate	Check Seed Rate lbs/ac	High Seed Rate			
Emerson-Franklin	18,000	14,000^{A}	16,500^{B}	18,000^{B}	3,156	2,912	3,039	7.09	0.6089	No
North Norfolk	23,000	10,500^{A}	11,000^{AB}	15,500^{B}	2,768^{B}	2,796^{B}	3,058^{A}	4.66	0.0405	Yes

One site year of confectionary sunflowers showed a significant yield difference between the three planting rates in the first crop year (2021). Note the actual plant stands were at the V2 stage versus the targeted check seeding rate was at planting.

TABLE 3 | ECONOMIC ANALYSIS

Seed Rate (Check) seeds /ac	Seed Cost/Acre			Yield			Net Profit/Acre (Seed Costs)			CV %	P-Value	Statistically Significant @ 95%
	Low Seed Rate	Check Seed Rate	High Seed Rate	Low Seed Rate	Check Seed Rate	High Seed Rate	Low Seed Rate	Check Seed Rate	High Seed Rate			
	$/ac			lbs/ac			$/ac					
25,000	$43.45	$49.37	$55.30	2,516	2,870	2,812	$1,063.59	**$1,213.43**	$1,181.98	4.53	0.0141	**Yes**

For the oilseed site that showed a significant difference in yield, the net profit was calculated based off of market price to show the economic impact.

Indicates statistical difference at 95% confidence interval

Median Seed Cost of $395/bag

Sunflower Price (Nov. 2021) – $0.44/lb

ON YOUR FARM

Two or three years of data will provide recommendations on optimal plant populations across the province

Drew Baker, a farmer from Beausejour, Manitoba, and his family have been growing sunflowers for over 40 years on their farm, and participated in the sunflower plant population trials in 2021. "We've never played around with sunflower plant populations before," said Baker. "Last year there was a lack of water, all our crops were the same – they needed rain. I think we would have seen a difference in yields and plant stands if we had had more precipitation."

Baker chooses to participate in on Research on the Farm trials because it gives him access to data that is valuable to his operation. "We don't have the background to do statistical analysis. To have people equipped to do that come out and help us run the trials is so easy, and gives us confidence in the results."

PHOTO: MCA

Participating in Research on the Farm trials like the sunflower plant population study gives farmers an advantage. "It's a great program to us. We get access to data that is valuable to our farm that we can compare to what's going on across the province because there are other guys doing the same trials," says Baker. "We've got data we probably wouldn't have gotten otherwise, which has influenced how we make decisions on our farm – whether its fungicide timing or plant populations, we're adjusting how we do things based on what were seeing in these trials."

The sunflower plant population study will be conducted on farms across Manitoba for three growing seasons with the results reviewed annually. "After three years of the study we should be able to give farmers recommendations on optimal plant populations based on current varieties, agronomic practices, and environmental conditions across Manitoba," explains Rex. "We will have a larger dataset from multiple fields across a number of farms with different soil types, cropping history and management styles."

"Conducting trials over multiple years is important to learn the effects of climate on planting populations," said Morgan Cott, Agronomy Extension Specialist, Special Crops at MCA. "We know in a drought there is little benefit from increasing populations, so now we want to learn what the yield and economic improvement might be under high-moisture/precipitation years and "perfect" years."

After three years of data the results will show what each farmer found was their best plant population based on real-life management practices. This data compiled from trials across Manitoba should help answer farmers' questions around plant populations for their local growing conditions.

Sign up now to conduct a trial on your farm using your practices in 2022, or wait until early 2023 for an update on this study.

For more information about these research projects and other MCA projects, visit mbcropalliance.ca.

MCA 2020-2021 Investment: $29,000

MEET A RESEARCHER

Bunyamin Tar'an

Chickpea and Flax Research Program Chair at University of Saskatchewan

Updated vision for Canada's only public flax breeding program

Where did you work before the University of Saskatchewan?

After I graduated from the University of Guelph (U of G) I moved to Saskatoon, Saskatchewan and began working on pulse crops and later specializing in chickpea breeding and genetics at the Crop Development Centre (CDC). I stayed in this position for nearly 15 years until 2020 when the previous flax breeder left and the position became vacant. I became the interim flax breeder from July 1, 2020 until March, 2021, and from April, 2021 I officially became the flax and chickpea breeder combining the two programs.

What got you interested in this area of work?

In agriculture everything starts with the seed. In my job we begin by breeding genetic material to grow that seed into crops which grow to produce food or fibre, for example. I am very fascinated with the seed and how we can improve its genetic material, especially now with all the technology that is available to us in genetics and genomics. Its rewarding to make the connection from genetics in the beginning all the way into the field to help farmers and consumers.

Researcher Bio:

Bunyamin Tar'an is the SK Ministry of Agriculture Strategic Research Program Chair in Chickpea and Flax Breeding and Genetics at the University of Saskatchewan (U of S) Crop Development Center (CDC). Tar'an grew up in South Sumatra, Indonesia and moved to Canada in 1992 to pursue his post-secondary education. He earned both his M.Sc. and Ph.D. from the University of Guelph (U of G) in Ontario specializing in plant breeding and genetics. Tar'an now lives in Saskatoon, Saskatchewan.

Tell us a bit about what you're working on at the CDC.

The flax breeding program at the U of S is the only remaining public flax breeding program in Canada. My vision for the program is focused on how we can improve flax yields to make it more economically competitive with other crops for farmers. Farmers need good, competitive materials for their rotations. They need the agronomy for flax to be successfully grown in fields and get the yield they need for a return on their investment. We also have to look into where the end products will go – the food market? Industrial for oil? And what about the consumer who will use the end product? All of these things will be addressed and considered.

The overall objective of the breeding program is to develop high yielding flax cultivars with improved agronomic and seed quality characteristics acceptable to both domestic and export markets. Agronomically speaking, flax is well known as a difficult crop to harvest. We're looking at how we can improve crop characteristics associated with ease of harvest and straw management (reducing plant height and lowering fibre content with no yield penalty). Besides maintaining yield and disease, these agronomic characteristics and the challenges they pose for farmers are top of mind for variety development within the program.

Traditionally flax started in Manitoba and the province remains an important area for flax production. Before we release a variety, we have co-op trials to look at the adaptation throughout the prairies. Over the years we have had on average three locations in Manitoba for the yield trials to ensure they are performing in Manitoba conditions. We also work closely with the Agriculture and Agri-Food Canada Morden Research and Development Centre. The Fusarium disease nursery is well established and we like to continue to screen the materials in order to have good resistance to this disease. We feel collaborations like this are crucial to the success of the program.

The new generation of flax cultivars with significant improvement in yield potential included CDC Rowland released in 2018 and CDC Kernen in 2020. We continue to push on the yield ability and will potentially release a new variety with good performance across the prairies in 2022.

What can you say about the value of farmers providing funding and support to your organization?

Farmer support is always a priority. There are three pillars of support that we need to operate the program – farmers, government (federal of provincial) and industry. Farmer support is a critical part of what we do, as we open two-way communication with farmers. They provide funding and we learn from them what their needs are, what their problems are, and we aim to give back varieties that address these needs and problems.

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PHOTO: MCA

How does that farmer funding and support directly benefit farmers?

Through new varieties. Farmers support our research, and we release varieties with improved yields and improved agronomic performance. That's the direct benefit from the flax breeding program. The funding allows us to give back improved seed, which is on of the reasons why I got into this line of work in the first place.

The flax breeding program at the U of S is the only remaining flax breeding program in Canada. We are very thankful of the support we receive from farmers which enables us to continue to work together to keep the program alive.

How do you spend your time outside of work?

I like gardening, working with plants and trying different things. I enjoy pets and animals, and being in nature walking and hiking.

What gets you excited about the work you do?

Because I see the whole process, starting from the genetic material/makeup (DNA) all the way to how the plants perform in the field, I understand the process along the way. This is really exciting to me. And in the end the satisfaction from farmers who grow the varieties, its rewarding to see happy customers and farmers.

What is the best piece of advice you've received?

Enjoy what you are doing, and do your best. When I enjoy and try my best even if I fail, I never regret it.

WHOLE FARM RESEARCH

Research approach focuses on multi-crop issues and opportunities in Manitoba

When MCA came together on August 1, 2020 the committees and board members began to embrace the opportunity to fund research on issues and opportunities that were cross commodity in nature. They formed the MCA Whole Farm Research Committee with the objective to lead and develop a research program that allows for a whole-farm, cross commodity approach to research. "Finding benefits based on a variety of crops will make the farm more profitable, efficient and environmentally sustainable," says Boris Michaleski, farmer and Chair, Whole Farm Research Committee. "Doing research following scientific protocols and accurate data collection on a replicated basis will give Manitoba farmers unbiased, accurate information they can apply on their farms."

Whole Farm Research is not crop-specific and leads to innovative solutions for the benefit of Manitoba farmers now and into the future. The research is primarily done in Manitoba to be representative of our soils and climatic conditions, and projects can be tailored to issues that are relevant to Manitoba farmers.

The Whole Farm Research Committee was formed with two farmers from each of our crop committees (Corn, Flax, Wheat & Barley and Sunflowers) and includes Boris Michaleski (Chair) from Ashville, Sheila Elder from Wawanesa, Hubert Preun from St. Andrews, Warren McCutcheon from Carman, Edgar Scheurer from Dugald, Sally Parsonage from Baldur, Eric Fridfinnson from Arborg, and Andrew Harris from Winnipeg.

The committee began by looking through the portfolio of projects that were previously approved by our individual organizations and already in progress. Many of these projects showed that we had all taken the opportunity to co-fund with other commodity groups in the areas of weeds, soil, water and rotational opportunities, all issues or opportunities that affect more than one crop. This inventory exercise identified that MCA was already funding 35 projects in progress in these

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topics. Among these are the Integrated Crop Agronomy Cluster projects co funded with Western Grains Research Foundation, several prairie commodity associations and Agriculture and Agri-Food Canada (AAFC) through the AgriScience Research Clusters Program.

In one active project, Dr. Matthew Bakker, associate professor in the Department of Microbiology at the University of Manitoba (UM) and his students investigate species interactions (microbe-microbe, microbe-plant, microbe-insect) that impact the sustainability and productivity of cropping systems. "Soils harbor astonishing microbial diversity, and those microbes perform vital functions that support productivity. One of the functions we're most interested in is the control of plant pathogens by other members of the soil microbiome," says Dr. Bakker.

In another project funded with other commodity associations through the Integrated Crop Agronomy Cluster, Dr. Charles Geddes weed scientist with AAFC in Lethbridge is studying the management of glyphosate-resistant kochia in western Canadian cropping systems. Dr. Rob Gulden, professor at UM in Weed Ecology and Management is lead of the Manitoba part of this study in a corn-canola-spring wheat-soybean rotation. This research uses a multi-experimental approach to determine how growers can adapt cropping systems to increase competition with weeds and mitigate the selection for, and/or manage existing populations of glyphosate resistant kochia.

"Within the rotation we are looking at a couple of agronomic treatments in each crop: narrower and wider row spacing (varies by crop) and a normal seeding rate with

PHOTO: KIM BROWN-LIVINGSTON, MANITOBA AGRICULTURE AND RESOURCE DEVELOPMENT

▲ ***Glyphosate resistant kochia.***

PHOTO: MATTHEW BAKKER, UNIVERSITY OF MANITOBA

▲ ***Newdale, Manitoba's provincial soil.***

a higher seed rate," explains Dr. Gulden. "What we are trying to learn is how these alternate agronomic treatments, both of which are supposed to make the crop more competitive, work with respect to reducing kochia biomass and kochia seed return. We also have a graduate student looking at glyphosate resistance levels at the molecular level in Manitoba."

Next, the committee took some time to identify what they saw as emerging issues and opportunities in the whole farm area. They developed some General Principles and Research Priorities for Whole Farm research, which are outlined below.

General Principles:

MCA Whole Farm Research projects are:

- Innovative and forward-thinking.
- Designed to answer farmers questions or resolve issues.
- Solution-oriented with actionable outcomes and an emphasis on end goals that farmers can implement in their operations.
- A pathway to assess and integrate new/next technology into Manitoba cropping systems.
- Another channel to communicate and collaborate with other organizations in Manitoba and across Canada.
- An opportunity to enhance communication channels with consumers and the public.

Research Priorities:

› Crop Rotation Innovation

- Economic analyses for Manitoba rotation choices.
- Understand rotations designed for increased yield poten tial (costs and benefits).
- Pest control approaches including herbicide and fungicide rotations.
- Water use efficiency and water use balance.
- Nutrient use efficiency and stewardship.
- Harvest management.

› Soil Health: Organic Matter

- Herbicide and fungicide effects on soil biology.
- Carbon sequestration.

› Cover Crop and Intercropping

- Options designed for Manitoba growing conditions.

› Pest Management: Weeds, Diseases and Insects

- Optimize current tools and minimize resistance pressure.
- Next generation control options.
- Integration of digital tools.

› Water

- Extremes of moisture managing drought and flood
- Irrigation and drainage innovation

From that came a decision to inaugurate our first ever call for proposals. In April 2021 MCA issued a call out to researchers for letters of intent for Whole Farm Research projects to begin in 2022. The Whole Farm Committee chose seven proposals for full application. We shared those proposals with Manitoba Canola Growers Association and Manitoba Pulse & Soybean Growers for their consideration. MCA coordinated information sharing with staff from each organization as we considered which projects we would be interested in funding and if there were opportunities to co-fund any of the projects.

Of the seven proposals submitted, three have been selected by the committee and contracts are underway to leverage our farmer member dollars. Funding announcements will be made through our various communication channels once contracts are signed.

Of course, MCA will still be looking at commodity specific issues but on top of that we want to continue to reach out and work with partners in this area seeking solutions that deliver sustainable, profitable, production choices for Manitoba farmers.

Respectfully submitted,
Lori-Ann Kaminski
Research Program Manager – Cereal Crops

TABLE 1: MCA's whole farm research program investments.

MCA Whole Farm Research by Priority	Number of projects	Total of MCA funding contribution over lifetime of projects ($)	Total funding contribution of all funding partners ($)
Crop Rotation Innovation	11	434,027	11,326,968
Soil Health: Organic Matter	4	298,977	880,208
Cover Crop and Intercropping	1	15,000	1,519,722
Pest Management: Weeds, Diseases, and Insects	7	247,451	4,108,150
Water	10	88,434	1,884,232
Other	2	509,548	908,402
Total	**35**	**$1,593,437**	**$20,627,732**

RESEARCH PROGRAM FACTS

MANITOBA CROP ALLIANCE

Active research projects: 108

67 Barley or Wheat Projects

3 Corn Projects

2 Flax Projects

1 Sunflower Project

35 Whole Farm Projects

Lifetime value of 108 current projects

$120,570,987

Total MCA contribution

$12,928,911

MCA's leveraging rate in 2020-2021:

For every $1 grower dollar → MCA leveraged to $11

Manitoba Corn Committee Trials

7 Grain Corn & **3 Silage Corn** sites in 2021. Providing farmer members third-party, replicated performance data

Research on the Farm

MCA's Research on the Farm had a total of **56** trials in 2021

4 wheat projects | **2** barley projects
1 corn project | **1** sunflower project

SR&ED Credit 2020-2021

(August 1, 2020 to July 31, 2021)

33.44%

MCA currently works with

50+

active partners to co-fund research

MCA total investment in research and production in our 2020-2021 fiscal year totaled

$5,416,190

For the fiscal year 2021-2022 MCA has budgeted

$3,235,086 million

on behalf of **farmer members** for research and production. We strive to meet our goal to allocate

65% of our annual budget towards research and production.

Sunflower Variety Performance Trials

4 sites providing farmers third-party, replicated performance data

PHOTO: ASSINIBOINE COMMUNITY COLLEGE

Recent commitments to enhance future of agriculture in our province

Manitoba Crop Alliance is proud to support the future of agriculture in Manitoba through investments like these:

MCA has contributed $500,000 to the University of Manitoba (UM) towards the building of the **Prairie Crops & Soil Research Facility** (PCSRF). The PCSRF will further strengthen the UM's already well-recognized agronomy and crop production teaching and research programs. The facility will increase the capacity for crop research and allow scientists to better integrate soils, crop, entomology and livestock research to make crop production in Manitoba more sustainable.

MCA has committed $100,000 to the Collaboration Zone within Assiniboine Community College's **Prairie Innovation Centre for Sustainable Agriculture**. The Prairie Innovation Centre is the college's next step as a national leader in agricultural training, and will aim to meet the growing labour demands in this important sector. The Collaboration Zone is an integral piece of the Centre, where education and industry connection will meet.

MANITOBA CROP ALLIANCE

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