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Spotlight on AWC-funded Research

Alberta Wheat COMMISSION

New Chair Sets the Table for Progress on Pests

Heat Stress a Hot Topic for Scholarship Winner

A Fusarium Solution? Finding Genes that Fit

Free Asparagine Research May be Priceless for Producers

Could Hairy Glumes Spell Doom for Wheat Midge?

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ALBERTA WHEAT AND BARLEY COMMISSIONS

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Stories written by Geoff Geddes | The Word Warrior
www.thewordwarrior.com

Message from the director of research

Research is Alberta Wheat Commission's largest investment for a reason. Development of new, improved wheat genetics and best management practices will be key to helping producers adapt to changing environments, government policies and both domestic and international market demands, all while maximizing their profit.

In this edition of the Spotlight on Research, we introduce some people that we think will make a big impact on crop research in the province. Dr. Boyd Mori just joined the University of Alberta to provide his expertise in Agricultural Entomology to the research community and producers. Dr. Mori's position is supported by the Alberta crop commissions, Alberta Barley, Alberta Canola Producers Commission, Alberta Pulse Growers Commission and, of course, Alberta Wheat Commission. Dr. Mori will join two other new faculty members in the drive to increase research capacity. We will also introduce Dinithi Kumarapeli, a graduate student at the University of Alberta and the recipient of Alberta Wheat Commission's Graduate Scholarship. Dinithi is working hard to increase the resistance of wheat to abiotic heat stress. We will also present three projects within our portfolio looking at gene markers for Fusarium Head Blight, new solutions for wheat midge protection and improving the quality of wheat by reducing specific protein components.

For more information on research projects and extension opportunities, visit **www.albertawheat.com**

DR. BOYD MORI

New Chair Sets the Table for **Progress on Pests**

As the crow flies, Abbotsford to Edmonton is a short flight. For the Chair in Agricultural Entomology, however, taking the road less travelled has been longer and far more rewarding.

"I was born in Abbotsford and took two years of general science there at the University of the Fraser Valley," said Dr. Boyd Mori, assistant professor, Agricultural Life and Environmental Sciences at the University of Alberta (U of A). "I was surrounded by farming growing up, though it was more berries and daffodils, so a bit different from a cropping system on the Prairies."

He then transferred to the U of A and finished a degree in immunology and infection. At a crossroads, he drew on an interest in entomology and earned an after degree in animal biology focused on insects.

One year later, he started graduate work under Dr. Maya Evenden to combat the red clover casebearer moth, an invasive pest in the Peace region of Alberta that virtually destroyed the red clover seed industry. He helped develop a pheromone monitoring tool and tested an alternative control strategy called mating disruption.

Love is in the air

"We put so much pheromone in the field that males and females couldn't find each other to mate. This resulted in a reduction in larvae and higher yields, but it was too expensive to be practical at that time. Since then, the pheromone monitoring system we developed has been adopted in New Zealand and Oregon."

With his first foray into entomology under his belt, Mori moved to Sweden for a post-doctoral fellowship, where he focused on creating a new monitoring tool for an invasive fruit fly pest.

Returning to Canada, he signed on as a biologist, and then research scientist, with Agriculture and Agri-Food Canada (AAFC) in Saskatoon. In the latter role, he led his own research program, working on swede midge (no relation to Sweden) to find potential alternative hosts on the Prairies.

His return to the U of A came in 2019, when he accepted the assistant professor position. Mori welcomed the chance to teach and train the next generation of agronomists and researchers, and felt there was no better place to do so.

"I enjoy interaction with undergrad and grad students, and the U of A is one of the top universities in the world for research."

At the same time, he applied for a Natural Sciences and Engineering Research Council of Canada Industrial Research Chair (NSERC IRC) posting, and though the application is still pending, Mori plans to hit the ground running on a number of projects.

Those pesky Prairie pests

"The overall research theme is integrated pest management and refining those management tools on the Prairies. The project most closely aligned with wheat involves redesigning the pheromone monitoring system to use with wheat midge."

Though there is host plant resistance to wheat midge, it is not present in all commercial lines, meaning that many growers are still planting midge-susceptible wheat. Researchers hope to use pheromone traps and create a decision-support tool to help guide spraying decisions based on the number of wheat midge in a field and the economic threshold involved.

Mori and his colleagues will also look at natural enemies in wheat and what they eat. Are they feeding on pest species or other insects that happen to be present in the field, and what is the impact of this on pest insects?

His interest in the NSERC opportunity stems from the "best of both worlds" nature of the role.

"It involves close collaboration with industry, and I would still be able to guide my own research program. As a result, we'll be doing research that is directly relevant to industry and getting answers to questions that are top priorities for stakeholders."

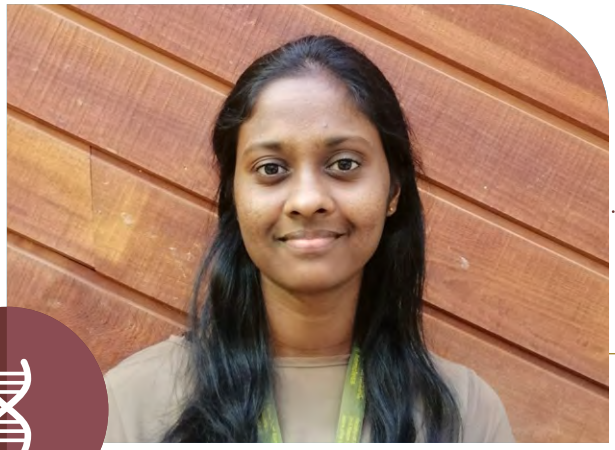
During those rare gaps in his schedule, Mori makes the most of time with his wife and two girls aged three years and nine months. As a now enshrined Prairie boy, he is an avid curler, with some ultimate Frisbee thrown in during the summer.

If the NSERC application is approved, he will assume his chair position for a five year term, with more to come after that if he has his way. In the meantime, he is grateful for the opportunity to impact growers on a daily basis.

"I'm very thankful for the support of industry and am looking forward to working with the commission on relevant research projects. Hopefully, this relationship between the university and industry bears fruit, and we can continue to move forward."

If anyone should know about bearing fruit, it's the berry-growing boy from Abbotsford.

Dr. Mori's position is being supported by Team Alberta, made by of the Alberta Wheat Commission, Alberta Barley, Alberta Canola and the Alberta Pulse Growers."



Born in Sri Lanka, Kumarapeli earned a degree in molecular biology at the University of Kelaniya, Sri Lanka."

DINITHI KUMARAPELI

Heat Stress a Hot Topic for **Scholarship Winner**

When you come from a country that can reach 35°C, working on heat stress in wheat seems only fitting. That was the case for Dinithi Kumarapeli, winner of the 2020 Alberta Wheat Commission (AWC) post-secondary scholarship.

Designed to support future researchers in agriculture-related studies throughout the province, the program includes a yearly $10,000 graduate research scholarship in Crop Science at the University of Alberta (U of A) and $1,000 undergraduate scholarships for the U of A, University of Lethbridge, Olds College, Lakeland College and Lethbridge College.

Born in Sri Lanka, Kumarapeli earned a degree in molecular biology at the University of Kelaniya, Sri Lanka. From there, she sought to extend her knowledge and pursue a long-time goal of becoming a scientist, but the opportunities for advanced research in her country were limited.

Applying herself

"I applied at other universities, and after much investigation I decided the U of A was a good fit due to the quality of education and extent of scientific research," said Kumarapeli. "I wrote to professors there and was fortunate to join Dr. Jocelyn Ozga's group in the Faculty of Agricultural, Food & Nutritional Science, where I'm currently in the second year of my MSc program."

The focus of her research is on the effects of high temperature stress on the reproductive development of wheat. In previous studies from the Ozga lab, auxin application showed promise to partially mitigate the negative effects of heat stress on wheat grain yield. Auxins are a class of plant hormones that play a critical role in plant development and adaptation to environmental conditions.

In her project, Kumarapeli is trying to further understand the effects of heat stress on wheat reproductive development and the role of auxins in ameliorating the negative effect of heat stress on grain yield.

Though the subject of her study was selected by her supervisor, Kumarapeli reviewed literature on the topic and was quickly intrigued.

"During my undergraduate studies in Sri Lanka, I worked on growth promoting bacteria that produce this same type of auxin, so the topic really resonated with me."

Yielding success

Kumarapeli is currently working with wheat breeding lines that vary in their resistance to heat stress with respect to grain yield, and their sensitivity to auxin-induced increases in grain yield. The knowledge gained from this study can be used to produce wheat lines that yield better under heat stress conditions during flowering.

Like her colleagues, Kumarapeli strives for relevance in research, and in that regard, the timing of this study is perfect.

"With temperatures continuing to rise, global warming is a real threat to farmers around the world; they are experiencing more extreme weather conditions and fluctuations. Wheat, like many crops, is highly sensitive to heat stress, particularly during flowering and early grain development, which can negatively affect yield. If we can identify plants that show auxin-induced increases in grain yield under heat stress conditions, they can be used to maintain yields under high temperatures."

Of course, such research is a costly proposition, prompting Kumarapeli to act quickly when her supervisor encouraged her AWC scholarship application.

"Winning this scholarship was a great feeling. I want to thank AWC as these funds have been critical to my research work."

Upon completion of her MSc degree, Kumarapeli plans to continue her studies at the PhD level and then enter the research field full-time. It may be early in her career, but if her success with heat stress and the scholarship are any indication, she may prove a hot commodity for years to come.

Winning this scholarship was a great feeling. I want to thank AWC as these funds have been critical to my research work."

DR. HARPINDER RANDHAWA

A Fusarium Solution? **Finding Genes that Fit**

As visitors, go, Fusarium Head Blight (FHB) is less welcome than the in-laws, and harder to dispatch. This dreaded wheat disease leads to significant yield loss and a drop in market value due to the production of mycotoxins that pose a risk to both animals and humans. With the rate of FHB detected in Alberta rising from 0.7 per cent of samples in 2005 to over 50 per cent in 2016, the timing is perfect for the project "Development of breeder friendly gene markers for selection of Fusarium head blight resistance in Canadian spring wheat".

"The rise in the incidence of FHB in Alberta since 2005 underlines the importance of finding new wheat lines with strong FHB resistance," said Dr. Harpinder S. Randhawa, wheat breeder with Agriculture and Agri-Food Canada (AAFC) at the Lethbridge Research and Development Centre. "Wheat production is affected by a number of stresses, and we continue to develop new cultivars with improved resistance to these stresses."

Such resistance would limit the establishment of FHB and curtail severe outbreaks in the future across Alberta and Western Canada. Unfortunately, the most popular spring wheat cultivars have only intermediate to moderate FHB resistance. As a result, farmers must rely on fungicides for disease control. That's a problem, because apart from the cost of fungicide application, factors like weather can make the practice a challenge to say the least, reducing efficacy and failing to stem the economic losses that result from FHB.

The answer to the FHB dilemma may sound simple: use more resistant wheat lines. But as breeders and producers can attest, creating those lines may take years or even decades. To speed the process and increase genetic gain over time, this project is using molecular markers, which are fragments of DNA associated with a certain location in the genome.

"Molecular markers for different traits are used routinely today in various breeding programs around the world," said Dr. Randhawa. "Since the effectiveness of markers currently available for tracking FHB resistance is limited, we are employing novel markers that can be implemented in breeding programs with greater success."

"The answer to the FHB dilemma may sound simple: use more resistant wheat lines. But as breeders and producers can attest, creating those lines may take years or even decades."

Ultimately, researchers on this study aim to develop genomic tools that facilitate effective selection of FHB resistance and speed cultivar development by accelerating the selection process. Newer cultivars with enhanced FHB resistance will offer the best strategy to mitigate the threat of FHB to wheat producers by protecting yield and grain quality. This will also make wheat production more competitive, which is critical for long-term sustainability of rural communities.

It's a solution that has been a long time coming, and can't come soon enough for breeders.

"We have been baffled by FHB for years and frustrated that while we had the resistance sources, it wasn't easy to select for FHB resistance efficiently in breeding programs. By harnessing the power of molecular markers, it's like hauling a busload of people to play, knowing that only a few will earn medals; we can get rid of the junk lines and only keep the winners."

Breeding resistance to the in-laws, however, is still a distant goal.

About Dr. Harpinder Randhawa

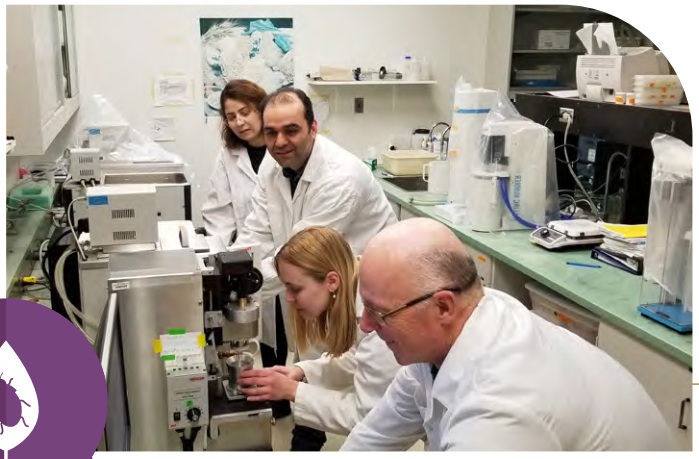
Dr. Randhawa is a spring wheat breeder working at Agriculture and Agri-Food Canada. His passion for wheat breeding developed during his childhood as he worked alongside his parents on the family farm in Punjab. He obtained his B.Sc Agriculture (Hons) in 1990 and M.Sc with a specialization in Plant Breeding in 1993 from Punjab Agricultural University, Ludhiana. He joined the PhD program at the University of Saskatchewan, Saskatoon, in 1998 where he conducted genetic and molecular studies of loose smut resistance in durum wheat.

Since 2007, Dr. Randhawa has been working as a spring wheat breeder with Agriculture and Agri-Food Canada at the Lethbridge Research Centre, Alberta. His prime focus of research is to develop spring wheat cultivars that are high yielding with excellent end use quality and resistance to various biotic and abiotic stresses in western Canada. He has developed nine high yielding spring wheat cultivars for general production in western Canada.

His other research interests include the identification of new sources of disease resistance in wheat, genetic mapping, doubled haploid production, and new breeding tools. He has published over 65 research articles in the international journals, supervises many undergraduate and graduate students and post-doctoral fellows and attended over 35 national and international conferences.

Did you know?

- *FHB has a wide host range that includes all small grain cereal crops (wheat, barley, oat, rye, triticale), corn and many wild and tame grass species.*
- *The disease was first described in England in 1884, where it was called wheat scab.*
- *Fusarium graminearum is only one of many species of Fusarium, but it is considered the most important one in Canada.*
- *FHB has occurred in eastern Canada for many years, yet it was first identified in the Prairies in 1923 and in Alberta in 1989.*
- *Losses due to FHB in Canada have ranged from $50 million to $300 million annually since the early 1990s.*



From right to left, Martin Scanlon (PI) works with project personnel Susane Trevisan, Ali Salimi and Somayeh Khorami to set up an instrumented dough mixer.

DR. MARTIN SCANLON

Free Asparagine Research May be Priceless for Producers

The best things in life might be free, but free asparagine can make life miserable for the wheat industry. As the free asparagine found in wheat flour is the main precursor for acrylamide in bread and cookies, it was also the basis for wheat research, all of which begs some critical questions: What is free asparagine? What is acrylamide? Why do we care? For answers to these queries and more, look no further than the project "Mitigating Free Asparagine".

Acrylamide is a chemical that naturally forms in certain heat-treated, starchy foods like bread and french fries, and has been linked to cancer in lab animals. As the forerunner of acrylamide, free asparagine (one amino acid building block of gluten proteins) is the main target of this study. With the EU pushing its wheat importers to reduce acrylamide levels in their products, researchers are trying to determine the effects of variety and nutrient availability on the acrylamide-forming potential of Canadian wheat.

Additionally, scientists will investigate whether addressing this food safety focus will have unintended consequences on breadmaking quality.

With the ever growing role of genetics in agriculture, the project also plans to investigate the Canadian wheat gene pool, including the parents of existing genetic populations, to find biologically significant genetic variation that controls asparagine formation. If they find that variation, they will grow a minimum of two genetic populations at up to three locations in 2020 to evaluate asparagine content in these populations.

"This is critical work for the industry," said Dr. Martin Scanlon, Dean, Faculty of Agricultural & Food Sciences at the University of Manitoba. "'Given the current focus on acrylamide, the EU could potentially give importers an ultimatum: 'Tell us the free asparagine potential of the wheat varieties you are importing, or we will close the border'. That would amount to a non-tariff barrier to the sale of Canadian wheat to the EU, so it's vital that we can cite projects like this to show our efforts at mitigating the production of free asparagine in wheat."

Knowledge gained through this research will be applied by end-users of Canadian wheat across the globe, including Warburtons – the UK's largest baking company - as part of their IP (Identity Preserved) wheat program in Canada. Over the last two decades, the program has involved 2300 farmers and the purchase of 4,000,000 MTs of Canadian wheat.

The stakes are high, but Dr. Scanlon is heartened to see all parties collaborating to find solutions.

"It's encouraging that we have such a large consortium working on this that involves the entire value chain," said Dr. Scanlon. "Bread bakers like Warburtons are teaming up with commodity growers and seed growers, and with scientists at AAFC [Agriculture and Agri-Food Canada] and CIGI [Canadian International Grains Institute], to address a potential food safety risk as defined by the European Food Safety Authority."

There is also a key training component to the study, as it includes two students and three research associates who augment a strong, multi-disciplinary team of agronomists, wheat breeders and food scientists.

Research is all about asking questions and finding answers, and on both counts, "Mitigating Free Asparagine" is well on its way.

About Dr. Martin Scanlon

Martin Scanlon is Dean of the Faculty of Agricultural and Food Sciences at the University of Manitoba in Winnipeg, Canada. He obtained BSc (Hons) and PhD degrees in Food Science at the University of Leeds in England. After postdoctoral fellowships at the Canadian Grain Commission and the University of Manitoba in Winnipeg, he returned to England to become Head of the Milling Section at the Flour Milling & Baking Research Association in Chorleywood.

Since joining the faculty at the University of Manitoba in December 1991, he has researched the properties of plant food materials, and how those properties change during processing. A research study leave was spent working for Pillsbury in the Department of Mechanical Engineering at Imperial College in London, England.

He is the author or co-author of over 240 publications, including two patents and 125 refereed journal papers. Dr. Scanlon has served on national grant review panels and conducted reviews of programs in Canada and internationally. He currently serves on the Advisory Board for the province of Manitoba's Food Development Centre, and was elected to the Board of Directors for the international organization - Cereals and Grain Association.

Did you **know?**

- *Asparagine is a naturally occurring amino acid with two nitrogen atoms (most have one). Gluten proteins contain a lot of asparagine to provide a rich source of nitrogen for the germinating wheat grain.*
- *According to Canadian Grain Commission figures, the United Kingdom is consistently Western Europe's biggest importer of Canadian wheat. In 2017-18, the UK imported 334,900 metric tonnes, almost double the total imported by the rest of Western Europe.*
- *The National Association of British and Irish Millers (NABIM) regards Canadian wheat as good for bread-making because of "excellent characteristics and gluten strength which work well in a blend with UK wheats."*
- *Reductions in sulfur deposition from the atmosphere and slower sulfur mineralization in no-till soils has led to sulfur deficiency in wheat in some regions of Kansas. Symptoms are most noticeable during rapid growth or during stem elongation, where yellow and stunted plants are observable in patches of the field.*

When I first became a research scientist, I was active on Twitter as a way to connect with growers and agronomists,"

DR. TYLER WIST

Could Hairy Glumes Spell Doom for Wheat Midge?

They may sound like a punk rock band, but hairy glumes could soon be music to the ears of growers fighting wheat midge. Though small in stature, wheat midge is a huge threat to crops, with yield losses sometimes mounting to over 50 per cent in Alberta's wheat fields. It is little wonder, then, that researchers are targeting this pesky pest in projects like "Alternatives to Sm1: hairy glumes, awns, and egg antibiosis for managing wheat midge".

At present, the options for addressing wheat midge include insecticides and use of a wheat variety carrying the *Sm*1 gene. It sounds like an effective strategy, so what could possibly go wrong?

"If the midge develops virulence (ie. can grow on midge resistant wheat) and we lose the *Sm*1 gene, we could see losses of up to $300 million/year for Canadian wheat crops," said Dr. Tyler Wist, research scientist, Field Crop Entomology, Agriculture and Agri-Food Canada (AAFC). "That gene prevents much of the yield losses due to wheat midge, so if it's no longer effective, it leaves a huge void."

Since the failure of *Sm*1 is more a matter of "when" than "if", this project aims to fill that void through development of spring wheat lines carrying the "hairy glume" (HG) trait, an awned trait (awn is an unusual floral expansion not seen in other major cereal crops, but a characteristic feature of barley and wheat spikes) and the Sm1 trait. This multi-pronged approach could be a solid alternative to relying strictly on *Sm*1 in combating wheat midge.

In a sign of the times, the inspiration for this research came from a place where many great ideas are born today: social media.

"When I first became a research scientist, I was active on Twitter as a way to connect with growers and agronomists," said Dr. Wist. "One day I received an email from Rob Graf of AAFC Lethbridge with pictures of wheat heads covered in trichomes [tiny hairs that can be seen emerging from the surfaces of leaves and other epidermal surfaces of plants]."

Most wheat today has few or no trichomes, but the picture sent from Lethbridge was of a turn of the century wheat line that was extremely hairy. The image was accompanied by two pivotal questions: What do you think this 100 year-old wheat might do against wheat midge? Could these hairy glumes stop that infernal insect pest from getting to the surface of the plant and probing for surface chemicals?

"The dilemma with the HG trait was whether we could get it into spring wheat that would be commercially viable on the prairies, something that had never been

studied before. Pierre Hucl with the Crop Development Centre also had a hairy-glumed wheat to test. Now that we had two plants to work with, I thought we could design an experiment to test this theory and hopefully develop a wheat variety with especially hairy glumes that works on the Canadian prairies."

As a second line of attack against wheat midge, Dr. Wist and his colleagues are exploring something called egg antibiosis, discovered by Curt McCartney of AAFC Morden, a trait currently existing in one breeder line of winter wheat that is not commercially available. Antibiosis means that wheat midge eggs fail to hatch on wheat, so when the plant detects their presence, it promptly kills them.

Though hairy glumes are not a complete barrier, it appears wheat midge is less attracted to plants with this quality (and who wouldn't be?).

"If growers have wheat midge laying fewer eggs on their plants, the chances of virulent midge developing are decreased, and there will be less damage to seeds and kernels as a result."

About Dr. Tyler Wist

Dr. Wist spent his early years of study in Saskatoon and started working with pest insects through the City of Saskatoon's Pest Management Department. There he delved into mosquito identification, population monitoring and larval control, as well as learning about insect stressors of the urban forest.

After that, he studied crop pollination by insects for an MSc degree at the University of Saskatchewan. With the aid of an NSERC (Natural Sciences and Engineering Research Council of Canada) scholarship and an Alberta Innovates scholarship, he studied insect chemical ecology in hosts, volatile attraction of pest insects and parasitism of lepidopterous insects at the University of Alberta.

As an NSERC postdoctoral researcher with AAFC, Dr. Wist then turned his attention to aphids and the insects that eat them in cereal crops, leafhopper vectors of aster yellows disease and flea beetle damage in canola. He eventually expanded into a research scientist position with AAFC Saskatoon, taking on the wheat midge work in Western Canada.

Did you **know?**

- *The full common name of the wheat midge is the Orange Wheat Blossom Midge. This insect is orange colored throughout its life, including the egg stage.*
- *The single gene that makes wheat tolerant to wheat midge is called the Sm1 gene. It is named by taking the genus and species name from its scientific name Sitodiplosis mosellana, and the "1" means that it is the first resistance gene and, at the moment, the only gene.*

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