Meet a Researcher – Dr. Belay Ayele

March 31, 2019

Due to increased availability of wheat genome information over the past year, it has become easier for researchers to pin-point where the genetic controls for traits of economic importance are in the complex wheat genome. Although this technology has little to do with the typical day-to-day activities of a farmer, it has everything to do with unlocking a world of opportunity for the future of wheat in Canada.

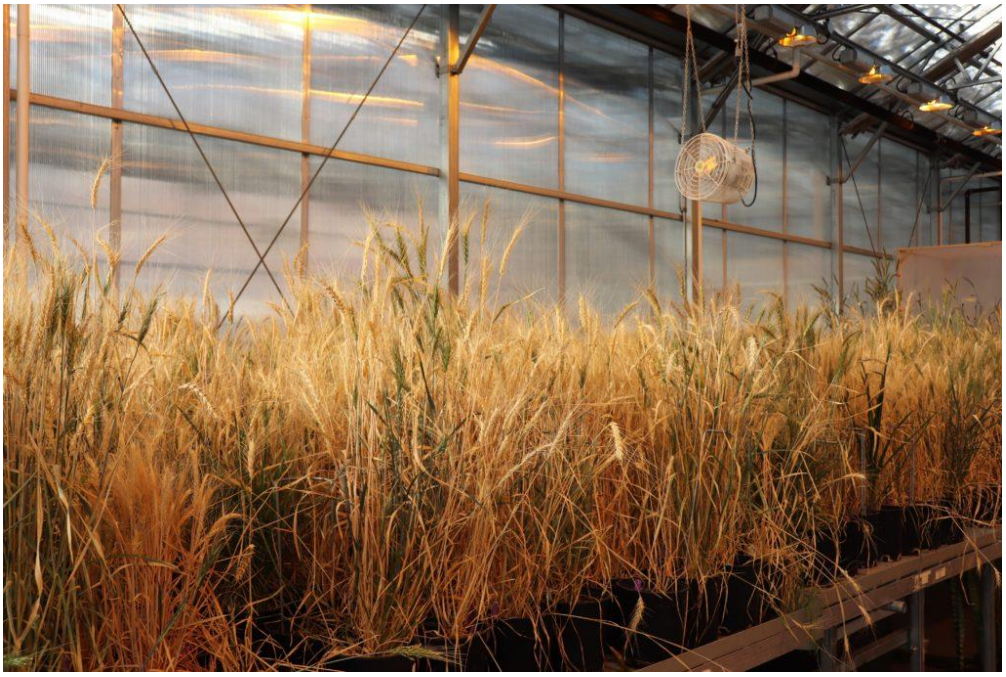
Dr. Belay Ayele in his laboratory at the University of Manitoba. (Photo: Kate Rodger, MWBGA)

Meet Dr. Belay Ayele, Associate Professor in the Department of Plant Science at the University of Manitoba. Dr. Ayele lives and breathes plant hormones, which are also known commonly as plant growth regulators (PGRs) by crop producers and related industries. While completing his master's degree at Wageningen Agricultural University in the Netherlands, he became interested in focusing his studies on the biology of seed germination and dormancy, two traits that are critical in controlling pre-harvest sprouting, which refers to the germination of seeds prior to harvest, in cereal crops. Pre-harvest sprouting is one of the most important problems in the production of wheat and barley, two major cereal crops of Canada, as it downgrades the quality of the grains, thereby causing financial loss to the producers.

While completing his PhD in at the University of Alberta, Edmonton, Alberta, Dr. Ayele studied one of the plant hormones, gibberellin (GA) and its production pathway, the GA Metabolic Pathway, intensively.

*“*GA is involved in regulating crop growth and development from seed to seed” explained Dr. Ayele as he discussed what drew him to studying these hormones, “I wanted to understand how these compounds are produced and degraded in plants because it is involved in regulating a wide range of traits of agronomic importance in crop plants. Therefore, for someone who is passionate about making a difference in the breeding world, this seemed to be the perfect path for Belay to take. To study more about this plant hormone, Belay went to RIKEN Plant Science Center in Japan for his postdoctoral research, as most of the discoveries about GA come from the research labs of Japanese scientists at RIKEN.
“There wasn’t a lot of information on the variation in wheat plant hormones when I first started school. Wheat is a major crop in Canada and the world,” Ayele mentioned, as he explained his decision to focus on wheat during his PhD, “If I work on a major crop I know I can make a difference.”

Among the critical times in a farmer’s year are seeding and harvest. During seeding, farmers make sure that they have high quality seeds to ensure fast and uniform germination, and seedling establishment. The seeds need to be planted at an optimal time and in favourable environmental conditions so that they germinate and emerge from the soil with vigor. However, conditions such as excess moisture occurs during spring, either before or after planting, for many Manitoba crop producers, causing a delay in planting or affecting the stand establishment or growth of the crop. The occurrence of undesirable weather such as cool and moist summer conditions after crop maturity are the other sources of problems in wheat and barley production, since such weather conditions cause pre-harvest sprouting of the grains. After harvesting, grains are subjected to quality evaluation. Lower quality grains such as those affected by pre-harvest sprouting are brought to a feed mill to be sold at lower price into the feed market for livestock, while the high quality grains are sold into the international market to be made into food that will be consumed by humans all over the world. In general, during both critical times, the environmental conditions that crop is subjected to play a very important role in determining grain yield and quality.



Wheat plants are grown in a greenhouse attached to Ayele's laboratory as a part of his research. (Photo: Kate Rodger, MWBGA)

In his research lab, Belay has growth facilities that allow his research team to control the environmental conditions that a plant is subjected to, making it entirely possible to control the growth conditions, ensuring the crop grows to its full genetic potential – unfortunately, not something that farmers are able to do. Dr. Ayele's research, partially funded by the Manitoba Wheat and Barley Growers Association (MWBGA), is about finding the right combination of genes that will allow breeders to develop a wheat and barley varieties that can tackle abiotic (weather related) stress factors such as preharvest sprouting of grains and the extremes of soil moisture; problems constantly challenging Manitoba wheat and barley growers. Research on excess moisture in crop agriculture is considered a 'gap area' in Canada by many.

To help ensure that a wheat plant does well, "we need to have a balance between dormancy and sprouting," Ayele explains, "the two hormones responsible for controlling this are GA and abscisic acid (ABA)". If a seed has too much GA, the seed will germinate very easily, often resulting in a near-mature wheat plant that has seeds sprouting while it's still standing. The other extreme is that a seed with too much ABA will not germinate for a long time, if at all.

"We have to look at both sides."

When developing new wheat varieties, finding the 'happy medium' between these two hormones is crucial. Breeders seek out varieties like this, which possess intermediate level of dormancy, as they are the best option for farmers and can help produce grains that can readily germinate after harvest but not before harvest so that the farmer does not need to worry about the occurrence of field sprouting.

Through his work, Dr. Ayele has been able to associate plant hormone changes with certain genes related to ABA and GA on the wheat genome. Newly expanded genomics technologies will enable breeders to screen new varieties being bred to see which ones have these desirable traits.

This machine, called a Triple Quad LC/MS, measures hormone levels in seed tissues for Ayele's research. (Photo: Kate Rodger, MWBGA)

"The wheat genome is very complex," Dr. Ayele went on to explain just how complicated wheat is, "it has three genomes and each gene has six copies." Having the technology available to tap into the wheat genome information makes it easier to generate tools that can aid the breeders to develop new varieties that can withstand different environmental stress conditions.

Ayele also does research with the GAs and ABA hormones in barley which is, according to him, "even more tricky" to find a balance than in wheat. Farmers want barley to sprout quickly and evenly in the spring during seeding, maltsters want the same quick, even sprouting in the malt house, but neither want the barley sprouting while the crop is standing in the fall or the harvested seeds are in storage. Finding this balance requires researchers to be extra picky with the selection of genes in barley.

Dr. Ayele's research is intended to provide breeders with the tools they need to develop new varieties needed for wheat and barley so that the two crops can remain competitive within domestic Canadian markets, as well as in international markets. The Manitoba Wheat and Barley Growers Association is proud to be a major funder of this project, alongside the Western Grains Research Foundation, Natural Sciences and Engineering Research Council of Canada, Canadian Foundation for Innovation, and two Growing Forward 2 programs (the National Wheat Improvement Program and the Manitoba Grain Innovation Hub).

As posted on Manitoba Wheat and Barley Growers Association Website