What's New With Wheat?

BATTLE RIVER IMPLEMENTS

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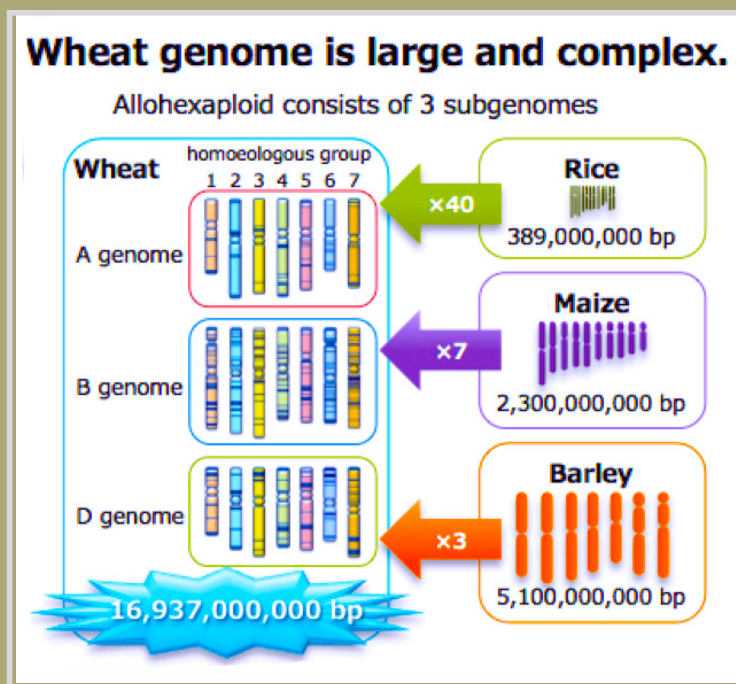
I recently attended a symposium on cereal production in Red Deer and came away very optimistic about the future of wheat breeding in Canada. There are a lot of very bright people working on some exciting projects and collaborating with breeders from all over the world to tackle issues such as cold tolerance, disease resistance, and even nitrogen fixation that can improve our varieties going forward. While there is way too much information to fit into a newsletter such as this, I thought it was worthwhile to give an overview of what is happening out there and how your check off dollars are being put to use.

First let's start with the key to the future of wheat production. That key lays in the mapping of the wheat genome, which is turning out to be a huge but attainable challenge.

The wheat genome is much larger than most of the other commercial crops we are deal with. It is several times larger than crops such as canola, soybeans, rice, barley or corn. In fact the wheat genome is 5X larger than the human genome. Complicating matters is the fact that wheat is such a diverse crop that there is great genetic diversity between varieties. Despite these challenges, geneticists are close to unravelling the mystery of what makes wheat tick. This opens the door for a lot of new techniques and efficiencies in breeding new varieties.



First and foremost on the list of things that this will allow is gene editing. Although transgenics remain an important tool for breeders, it is not necessarily the wave of the future – for reasons that are as much based in politics as they are in science.

Whereas transgenic technology introduces genes from other species (which may or may not be related to the plant they are being introduced into), gene editing is just what it sounds like – manipulating the existing genes in the plant to get that plant to express the traits you want it to. It's really just about getting to the same result we achieve through traditional plant breeding, but bypassing all the crossing of lines to isolate the trait. It saves years of time and millions of dollars. One example of what breeders are using gene editing for is a project in Spain where they have managed to "turn off" 35 out of the 45 genes responsible for the type of gluten that causes coeliac disease in one out of every hundred people worldwide. So far they have reduced the expression of the type of gluten that causes the problem by 85%, and are hopeful of bringing a variety of wheat to the market in the next few years that can safely be eaten by anybody who has gluten tolerance issues without losing the milling qualities of traditional wheat.

Another thing that understanding the genome will allow us to do is gene tagging. As breeders become familiar with the various jobs which different genes do, they can attach a molecular tag so these genes can be tracked. This allows them to do some things that haven't been available to them in the past. For example, they can now stack resistance genes in the same plant. Many diseases can be affected by a multitude of different genes, either working independently or working as a group. Say for example, that several different genes each protect a wheat plant from leaf rust independently of each other. In the past you could cross varieties that had different pathways, but you could not be sure if the next generation of wheat carried one or several of these genetic pathways – you only knew if it was resistant or not. Gene tagging allows breeder to see if multiple pathways are present in the germplasm, and if they are stable traits that will be expressed by succeeding generations of the potential variety every time.

Gene tagging also allows breeders to do "predictive" breeding. In other words they can look for specific genes

that express the trait they are trying to breed for and eliminate a lot of lines before they ever get to the field. A typical breeder will likely have 2,000 to 2,500 lines under testing in any given year. Predictive breeding means that the success rate from these lines in greatly increased because a plant breeder knows that all the lines he is evaluating in the upcoming year carry the genetic trait he is looking for before he ever puts a seed in the ground. This pre-screening step greatly increases the efficient use of limited time and resources available to the plant breeders in western Canada.

So hopefully this gives you a glimpse of what mapping the wheat genome can mean for the future of wheat farming, but I would like to end this article by giving you a peek at what kind of practical projects people are working on right now in western Canada;

1. **Fusarium Head Blight**

   Enormous resources are being poured into understanding and combating fusarium head blight – not just in Canada but worldwide. It is a very complex disease and the solution will be just as complex, involving many genes, some of which we already know do not exist in the germplasms we are currently working with. The solution on this one is still several years away.

2. **Cold tolerance of wheat**

   One of the challenges of winter wheat breeding is the cold period (vernalisation) that winter wheat needs to go through to switch from the vegetative stage to reproductive stage. To get around this, breeders cross their winter wheat lines with spring wheat so they can produce more generations per year. When they have established the traits they want in the winter wheat, they remove the spring wheat genetics from the mix. This practice tends to produce temporary lines of wheat that are very cold tolerant but act like a spring wheat. In trials, these wheats have been successfully planted and harvested over the last 3 years after being planted as early as the first week of April in the Edmonton area. Planting was based on soil temperatures rather than a calendar date and all trials included wheat being seeded into soil as low as 0 C and as high as 10 C. These lines lack a lot of the milling qualities we look for, but the potential exists to breed extremely good cold tolerance into our spring wheat in the future. Even the performance of the check, a currently registered spring wheat variety, was surprisingly stable and more studies are planned to see if some of our present varieties may be suitable for this use. Best management practices need to be established for seed treatments, seeding rate and depth, fertilizer types and placement among other things.

3. **Nitrogen fixing wheat** – This project involves transgenics. A research biologist in Lethbridge is currently working on introducing N fixing genes from legumes into triticale. The goal is to make this genetic trait a stable part of the genome in triticale. From there, it will be a relatively simple step to introduce the Nitrogen fixing trait into new wheat varieties. This project is still in the initial phase and even if it is successful, I am personally pessimistic about public acceptance of the technology.

So that is a brief look at some of what is happening in the world of wheat production and what plant breeders are doing to ensure that wheat remains a viable crop as we face new challenges in terms of market demands, diseases and even climate change over the upcoming decades.

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