Genetics as risk management:

Crop traits & variety differences key to puzzle

By Gord Leathers

Every seed that hits the ground is made up of three important parts — the embryo, the starchy endosperm that feeds it and the seed coat that holds it all together.

Laced through every cell in the embryo are the genes, half from each parent, and within the genes lie the essence of the next generation of field beans, barley or whatever else that seed may be.

"This will program everything from disease resistance to yield to maturity," says Dr. Jeannie Gilbert of the Cereal Research Centre in Winnipeg. "It's all stored in the genes."

A gene is comprised of four different bases bolted together in different ways along a twisted strand of DNA. It instructs individual cells to make or use a particular protein.

All by itself it's a simple thing, however, put several million genes together and let them engage in a tug-of-war for dominance and things get a lot more complicated. You now have an organism with countless different traits which either enhance or undermine its survival.

In farming terms that means next year's crop has to endure what nature throws at it and still fill the hoppers with plump seeds. And this must be done with a rack of genes that don't come from around here.

Wheat and barley are from the Middle East, soybeans are from China and even the sunflower, whose ancestors sprang from the North American Great Plains, calls Kansas and Missouri home.

Still, the genes that made the ancestral plants flourish in their ancient breeding grounds are the first mechanism by which they cope here.

Genetics can determine everything about a crop from seed size and type — as with these different varieties of soybeans — to end uses and days to maturity. Producers need to take genetic variability into account when selecting varieties to plant

"The varieties that make it mature within our northern agro-ecosystem, otherwise they wouldn't be here," explains Daryl Domitruk, with the Manitoba Department of Agriculture. "To make it through, and on the market, its genetics are adapted to the area."

That area extends from the Canada/U.S. border north to The Pas and is roughly divided into different climatic zones. Oddly enough, it's elevation more than latitude that influences the length of the growing season.

"Our shorter growing seasons are surrounding Riding Mountain National Park," Domitruk says, and this is certainly illustrated on the growing degree day map where Wasagaming sits in a cool, blue circle. The other extreme is a "banana belt" in the Morden/Carman/Altona area where farmers enjoy the warmest area for crop growing in the province.

However, in the North American context, the ecological differences between eastern and western Manitoba are not as significant as the greater differences between Portage la Prairie and South Dakota.

"There we're talking the difference between the cool-season cereal-growing regions of the Canadian Prairies and the United States corn belt where there is a significant difference in climate," Domitruk says. "Whereas the differences between Portage and Dauphin are much smaller."

This northerly climate doesn't seem to bother the major field crops such as wheat, barley, canola and flax.

Their ancestors moved to higher latitudes because of the seed trade from the Middle East into Europe and Asia. The

genetically suitable variants produced good crops in their adopted homelands and their descendants moved into Europe and eventually the Americas. Since then, the breeding programs have become more elaborate, especially in the last 50 years.

"One of the major advancing areas that we've had in agriculture has been genetics," Domitruk says. "Our ability to produce things is better because we know so much more."

There is nothing new about genetic manipulation within crop species — that's been the focus of breeding since its inception. Farmers selected seed that grew best in their own regions and produced the best plants that lost the least to pests and disease. This has been a constant, long-term game.

"You're basically putting a selection pressure on a pest and it's responding," Domitruk says. "There are new races of rust that appear, just through natural processes and advancements in genetics have made the necessity to keep ahead of the pathogens easier."

Other crops, such as soybeans and sunflowers are on the northern extension of their geographic range so, because of their metabolism, growing them becomes risky.

"Maturity is probably the No. 1 factor," says Rob Park, oilseed specialist and sunflower grower. "If you're going to grow a variety that matures in 129 days and there's no chance of that happening, then there's no point even starting."

For sunflowers, the critical element is the length of the growing season, particularly with confection varieties. They do well and are widely grown in the Dakotas and Minnesota. The northern ecological boundary for sunflowers appears to be the Trans Canada Highway although there are some growers as far north as Minnedosa.

"There's a lot of times we see that border being pushed quite a bit so growers have to be very careful that they're growing a variety that will mature and finish and yield in this area," Park says. "There's not a lot of lines that are bred specifically for this region because we're on the very outskirts of the sunflower region."

Soybeans are also critical for a slightly different reason. While the length of the growing season is important, what's really crucial for soybean is the amount of heat the plant can collect during its lifespan.

It's the heat that drives the plant's metabolism so its growth, its seed weight and seed quality are at their most productive under a warmer temperature regime than you'll find over most of the province.

"If you look at all soybean varieties, with all the genetic diversity, we're only selecting from a small percentage of the germplasm," according to Bruce Brolley with the Manitoba Department of Agriculture. "This is because we're looking at the most northern growing area in the world."

Breeding new varieties of plants is one of the driving forces behind agriculture and the last decade has seen an explosion of breeding programs in the labs of the government and the private sector.

Consequently there's been an explosion in the number of new varieties growing in the fields of the Manitoba farmer.

Some breeds are more resistant to pests and disease, some breeds are designed for specific crop rotations and others are able to produce products for new markets.

For instance, the last 10 years has seen a demand for euricic acid in industrial lubricants so new strains of canola are producing it in the fields of Manitoba.

As a result of these new breeds, farmers are faced with a bewildering range of choices among breeds and brands and that's not likely to become any simpler any time soon. How is a farmer to know what will work in the home region?

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"The whole issue of adaptation has been taken care of by embedding it within in the variety registration system, the variety evaluation system and other programs such as crop insurance," Domitruk says. "Farmers are guaranteed that the material they have is inherently adapted to the Canadian Prairies."

The Manitoba Crop Variety Evaluation Team (MCVET) makes sure they are by testing different breeds of plants in 19 sites across the province. The different varieties are evaluated and yields are compared to those of previous years and other breeds.

This gives the farmer a good idea as to how well the seeds suit the geography and how well they'll fit into an agronomic package. While emphasis on variety selection is warranted, it shouldn't be at the expense of other agronomic practices.

"It's really not a stand-alone decision," Domitruk says. "If you're going to select something with particularly high yield potential, you'd better support that yield potential with good agronomy."