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BETTER DISEASE PROTECTION COULD UNLOCK YIELD POTENTIAL

by KIERAN BRETT

Supported by ACIDF Ltd., research is finding new ways to protect Alberta feed grains from an ever-shifting lineup of damaging diseases.

Anyone who doubts that plant disease is a serious issue in Alberta crop production should have tagged along with Chris Solick this past summer. Owner of Elite Ag Services, affiliated with the AgriTrend Agrology network, Solick was struck by the impact of disease on his clients' Central Alberta cereal crops.

“Disease is always somewhat of a factor,” says Solick, “but in 2008, with all the moisture in this area, there was a huge impact. I was seeing disease on wheat plants in the two-leaf stage. Later on you walk the same fields, and 50% of the wheat area is dead tissue.”

MANAGEMENT OPTIONS LIMITED

To Solick's way of thinking, a cereal plant is like a factory. The purpose of the factory is to produce grain. When the factory is compromised by disease, you've reduced the plant's ability to capture energy and turn it into grain.

How can a producer keep the factory strong? Solick's advice to clients stresses multiple avenues of disease defence. One is to observe recommended crop rotations to avoid the disease buildup that a barley-barley-barley rotation would cause. Another is to consider a timely fungicide application. Still, in Solick's view, a little help at the molecular level wouldn't hurt either.

“If you look at canola, a lot of the different disease issues have been overcome with disease resistant varieties,” he says. “Years ago blackleg was a problem, and now the focus is on sclerotinia and clubroot. If we had wheat and barley varieties that had better resistance to leaf diseases, that would be a fantastic tool to have.”

WANTED: A RESEARCH FOCUS ON CEREAL DISEASE

Craig Shaw, a fourth-generation farmer near Lacombe and member of the ACIDF Board, believes that Alberta needs higher yields to compete with other feed grains like U.S. corn.

“Today, compared to 10 years ago, we think we're making strides on barley yields,” says Shaw. “But to be competitive, we need more. Barley needs to produce 90 to 100 bushels per acre as a steady average. The trouble is, once you get up in that yield range, you tend to get lodging.”

Recommended agronomic strategies, such as avoiding continuous cereal crops within a rotation and using a fungicide for disease control, have generally worked well for Shaw. Still, he believes an attitude of *good enough* has governed industry thinking about cereal crops for too long. Rather than making do with what we have, he'd sooner see industry begin to address the ultimate potential of cereal crops, because the upside is there.

When the U.S. corn industry talks confidently about increasing average yields to 250 or 300 bushels per acre over the coming years, to Shaw, that's a signal the Canadian feed grains industry needs to get its skates on.

“It makes it tough to compete in terms of feed grains when the competition is continually making big strides,” he says. “For example, there's always room for improvement in cereal varieties. We need to be actively trying to make progress to stay competitive.”

RESEARCH 2009

Because plant diseases are always changing, it takes focused ongoing research investment for farmers to maintain the upper hand. Meet some of the scientists who are making it happen and the issues behind their work.

Suppose the country's plant breeders and plant pathologists took a five-year sabbatical. How much disease impact would Alberta's cereal grain producers actually see? After all, farmers have plenty of varieties to choose from, available fungicides work well and careful crop rotation would help keep disease in check.

Not so fast. As Ron DePauw explains, researchers can never rest because plant disease never stands still.

“We are dealing with biological organisms that are able to mutate to overcome the resistance genes we are using,” says DePauw, Swift Current, Sask.-based wheat breeder with Agriculture and Agri-Food Canada (AAFC). Over the years, DePauw and colleagues have developed and registered many new varieties of hard red spring, durum, Canada Prairie Spring, general purpose and white wheat.

He explains that the goal of AAFC's breeding program is to reduce the business risk faced by producers and processors, while ensuring consumers enjoy a safe and nutritious food supply. Along with 'abiotic' stresses associated with climatic issues (frost, heat and drought), the program focuses on 'biotic' stresses such as diseases and insects.

RUSTS ON THE MARCH

DePauw's to-do list for 2009 shows just how dynamic the cereal disease landscape is, and how pressing some of its challenges are.

From an Alberta perspective, stripe rust has emerged as a disease causing significant losses. The issue is that new races of stripe rust can reproduce at much warmer temperatures than before. While previous races could not reproduce at temperatures higher than 12°C, these new arrivals keep rolling up to 18°C. As DePauw explains, the implications of this change are worrisome.

“Instead of being killed off by the summer heat, these races of stripe rust can continue to reproduce and cause damage,” he says. “It shows that these pathogens, which previously came out of the Pacific Northwest, have adapted to our climatic conditions and now can come into Western Canada from the Great Central Plains of the U.S. as well as the Pacific Northwest.”

Still, stripe rust might not be the biggest issue on DePauw's desk these days. A strain of stem rust -- known as UG99 and its variants because of its origins in Uganda -- shows virulence on Sr24 and Sr31, two widely deployed stem rust resistance genes. Associated with yield reductions of up to 100% on susceptible varieties, UG99 has the potential to create a sort of doomsday scenario for global wheat production if left unchecked.

“Most of our varieties are susceptible,” says DePauw, “so we're getting quite anxious to build in resistance to UG99 before it gets to Canada.”

Just in case breeders and pathologists are finding it too easy to sleep at night, there are other challenges as well. A new strain of leaf rust, for example, has shown itself able to brush aside the resistance gene Lr16 that's in many current cereal varieties. Despite considerable progress, long-time problem fusarium continues to make its presence felt.

With many disease threats present today, and others on the horizon, grain growers in Alberta can be thankful that DePauw and other plant and disease scientists are hard at work building a genetic line of defence.

Building a future with peas

Diseases like aschochyta blight and downy mildew can make peas a tough crop to grow. Use of better control tools and a change of producer mindset would be helpful.

On the face of it, field pea ought to be a more important crop in Alberta than it is today. It fits nicely in a crop rotation, reduces the farmer's nitrogen bill the following year and is a proven component of feed rations for hogs and poultry. So what's the problem?

According to Ken Lopetinsky, recently retired ARD pulse research agronomist and now an industry consultant, it's simple. Some farmers just don't like to grow the crop. In fact, many have never even tried it.

“There are three kinds of field pea growers in Alberta,” says Lopetinsky. “The first group will only grow peas if the price is high that year. The second group likes peas in the rotation for agronomic reasons and tends to grow lots of it. They know how peas benefit the next crop. The third group doesn't grow a lot of field pea, but they keep it in part of the rotation in most years.”

One reason for producers' reluctance to plant field pea more consistently is that it can be comparatively tricky to grow. While many producers are familiar with diseases of cereals or canola, pea diseases like seed decay, root rot, ascochyta blight and downy mildew cause many to throw up their hands in frustration.

“Some growers have problems because of disease pressure in the field,” says Lopetinsky. “But sometimes, growers haven't used all the tools that are available. When some growers have lodged crops, they see it as a problem with the variety itself, not as a disease issue that needs to be properly managed.”

In Lopetinsky's view, an agronomic education effort is needed, emphasizing the use of clean seed, proper fertility and an overall disease management program including proper field scouting. Further down the track, greater availability of disease-resistant pea varieties may take some of the stress and uncertainty out of pea production. The question here is whether genetic resistance is even possible.

The international connection

With funding from ACIDF, researchers are tapping international research networks to stay a step ahead of globe-trotting cereal crop diseases.

Alberta might be known as Wild Rose Country, but with all due respect to the wild rose, no plant represents the province as well as barley. This crop is not only the foundation for a successful and

dynamic livestock industry, it also makes possible a range of foods we consume and export all the time.

With barley so quintessentially Albertan, then, it might be surprising to know that several other countries play major roles in the ongoing development of the barley we grow.

In fact, sustainable crop improvement would be next to impossible without extensive international cooperation. Two of the key players in this effort are CIMMYT (International Centre for the Improvement of Maize and Wheat) in Mexico and ICARDA (International Centre for Agricultural Research in the Dry Areas) in Syria.

“This is an extremely valuable way to go,” explains Jim Helm, Lacombe-based plant breeder with Alberta Agriculture and Rural Development, who's developed 33 barley and triticale varieties with resistance to diseases like scald, rusts and fusarium. “Almost all the really good resistance we have came out of germ plasm from ICARDA.”

No substitute for fresh genetic material

Diseases pressures change over time, making crop varieties that have been resistant to a disease become gradually more susceptible to it. Helm notes that re-establishing resistance requires the introduction or one or more new genes.

“Some diseases, like loose smut, can be prevented by changing even a single gene in the host plant,” says Helm. “But with other diseases, such as scald or net blotch, a single- gene approach won't do the same. In these cases, more than one gene, or a pyramid of genes, might be required.”

Organizations like CIMMYT and ICARDA are valuable repositories of genetic material for the world's cereal crops. When a breeder like Helm needs new material to solve a new disease problem, these Centres can often provide it.

Alberta's international connection is entering a new phase with the start of a five-year, $5 million research project for barley and triticale. Funded by ACIDF and led by Helm, the project will work with CIMMYT for the triticale component and ICARDA for the barley.

Says Helm: “Over the years, organizations like CIMMYT and ICARDA have been great assets to our research on behalf of Alberta cereal crop producers.”

A system-wide approach to yield enhancement

This plant pathologist outlines how science and agronomy can work together to push feed grain yields higher.

Plant scientists have become expert at introducing genes that give plants a trait that producers, processors or consumers want: think herbicide resistance in canola.

Now suppose a barley disease like scald is a problem. In this case, why not find a resistance gene and plunk it into all the best barley varieties? This would allow for the higher yields that producers, buyers and marketers all say they want.

Fair enough, but as plant pathologist Kelly Turkington of Agriculture and Agri-Food Canada in Lacombe points out, reducing disease and boosting yields isn't solely achieved through the introduction of disease resistance.

“In many cases the whole cropping system has also resulted in a reduction in yield,” says Turkington. “Often when diseases, weeds or insects are problems, it's because the cropping system is not set up to effectively manage these issues.”

He cites the example of producers who grow barley for feed. In many cases, because of on-farm feed requirements or other market factors, rotations might be tight or producers might be growing continuous barley. When growers plant the same crop year after year, especially when it's the same variety too, it places a significant selection pressure on disease pathogens in the population. This enables them to adapt to the resistance genes in the varieties being grown.

What would Mother Nature do?

While a sound crop rotation makes sense, and a fungicide application can be a good investment, Turkington wants growers to think about their cropping system in even broader terms. Research at Lacombe and elsewhere in Western Canada has shown that using an integrated crop management approach to crop production enhances crop health and competitiveness. For example, they have found that rotating particular barley varieties can reduce disease pressure even when barley is being grown continuously.

“The goal is to add diversity in relation to crop and pest management back into the cropping system,” says Turkington. “We can use Mother Nature to mitigate diseases, weeds and insects. By improving crop health through integrated crop management, you make the crop more competitive with weeds and better able to withstand disease and insect attacks.”

Ultimately, introducing disease resistance into new feed grain varieties will continue to be an important strategy. Turkington stresses that this work will have the greatest long-term value when accompanied by a better understanding of the pathogens that cause disease, while using this knowledge as part of an integrated crop management program.

“If a resistant variety is overused, it ends up being bad for the farmer and also bad for the breeder,” he says. “Under these conditions, pathogens can adapt to the resistance being used, limiting its usefulness for both breeders and farmers. But if you put that resistant variety into the right cropping system and manage the source of resistance, you're going to prolong the usefulness of that variety.”

DISEASE PROTECTION AND YIELD ENHANCEMENT A TEAM EFFORT

ACIDF recognizes and thanks the following organizations for their expertise and dedication to reducing the impact of disease on the long-term production of Alberta farmers.

Agriculture and Agri-Food Canada
Agri-Trend Agrology Ltd in
Alberta Agriculture and Food Council
Alberta Agriculture and Rural Development
Alberta Agricultural Research Institute
Alberta Barley Commission
Alberta Pulse Growers Commission
Canada Grain Commission
CIMMYT (feed grain germplasm development based in Mexico)
Crop Life of Canada and its members
Farm Crop Input Suppliers and Dealers
Feed Grain Growers
ICARDA (feed grain germplasm development based in Syria)
Reduced Tillage Linkages
Saskatchewan Agriculture and Food
Seed Cleaning Plants
Seed Growers
University of Alberta
University of Manitoba
University of Saskatchewan

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This is the third in the series of articles that look in depth at specific solutions to feed competitiveness and will outline investments being made by private industry, farmers, research organizations, government and funding agencies in present and future feed grains research and development. Printed copies are available upon request or visit our website www.acidf.ca for others issues.