Western Grains Research Foundation

RESEARCH REVIEW

$169 million+
invested in research
since 1981

WGRF Board has given producers a voice in funding agriculture research since
1981

Research conducted on over
20
crops

Message from the Chair

New directions

We're venturing in some exciting new directions at Western Grains Research Foundation (WGRF) as a result of changes to our revenue stream.

For the past four years, we have worked to ensure a seamless transition of the Western Canadian Deduction (WCD), which ended on July 31, 2017. As provincial wheat and barley commissions and associations have assumed responsibility for the WCD in their respective check-offs, this has meant a 50 percent decline in WGRF revenue.

One thing hasn't changed though – we are still the largest producer funder of crop research in Canada with $17 million invested in 2017. Research expenditures will remain close to that figure annually until 2020 using check-off reserves and our Endowment Fund.

Amidst change, another constant is WGRF's collaborative approach. We currently fund, or have committed to funding, 235 research projects on over 20 crops.

A strong focus is reinvigorating agronomic research capacity in Western Canada. To this end, WGRF is working with researchers to identify multi-crop agronomy projects that provide significant benefits to the whole farm using a systems approach.

This magazine profiles some of the great work that is being funded with producer dollars and shares our plans to transition the organization. As you read through, take note of the many advancements made possible through your support of crop research. At every turn there is continued returns from producer investment in research.

Dave Sefton
Board Chair, WGRF
Farmer, Broadview, Saskatchewan

- Farmer directed
- Research focused
- Multicrop
- Interprovincial
- Collaborative
- 35+ years experience

WGRF member organizations

Agricultural Producers Association of Saskatchewan
Alberta Barley
Alberta Federation of Agriculture
Alberta Wheat Commission
BC Grain Producers Association
Canadian Canola Growers Association
Canadian Seed Growers' Association
Keystone Agricultural Producers
Manitoba Wheat and Barley Growers Association
National Farmers Union
Prairie Oat Growers Association
Saskatchewan Barley Development Commission
Saskatchewan Flax Development Commission
Saskatchewan Wheat Development Commission
Western Barley Growers Association
Western Canadian Wheat Growers Association
Western Pulse Growers
Western Winter Cereal Producers
Agriculture and Agri-Food Canada (Class B)

Largest producer funder of crop research in Canada

$17M in 2017

Current or committed funding: **235** research projects

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Contents

Applied genomics

Wheat genome sequencing that makes sense for Canada

Not all varieties of wheat have equal breeding value to Canadian wheat researchers. Case in point: Chinese Spring. The wheat genome is big – five times bigger than the human genome – so when the genome sequence of Chinese Spring was released in 2017, it was a major breakthrough for the wheat community. But there was a hitch.

"This sequence represents approximately 95% of the wheat genome and is the most complete 'gold-standard' sequence generated to date," says Curtis Pozniak, wheat breeder and professor at the University of Saskatchewan, Crop Development Centre. "But Chinese Spring has limited breeding value to western Canadian agriculture." Not only that, he says, new analysis is finding that there are significant differences in genome structure between wheat cultivars, a variation that has yet to be fully quantified.

So while the sequencing of Chinese Spring was a great step forward overall, for Canadian wheat breeding programs to benefit, research on the wheat genome needs to dig a little deeper. Enter the Ten+ Wheat Genomes Project.

"This project was developed to produce sequence profiles of 10 diverse wheat cultivars that can be used to fully appreciate genetic differences that are important to agronomic traits, which are, in turn, important to wheat producers," says Pozniak. He adds that a major outcome of the project will be establishing a framework that wheat researchers can use to map new genome sequences more rapidly and cheaply than they can now.

For Canadian growers, that means plant breeders here will be able to identify genetic factors being targeted in western Canadian breeding material. This will ultimately lead to improved DNA marker technologies that will allow precise selection of traits, such as disease and insect resistance, and improve overall selection efficiency.

Ten+ Wheat Genome Project

Pozniak explains that the Ten+ Wheat Genome Project grew out of CTAG² (Canadian Triticum Applied Genomics), which began in 2015 and is co-funded in part by Genome Canada and WGRF.

"We believe that access to multiple genome sequences will be a critical resource for wheat breeders and scientists, and will pave the way to understand most of the genetic variation available to wheat breeders."

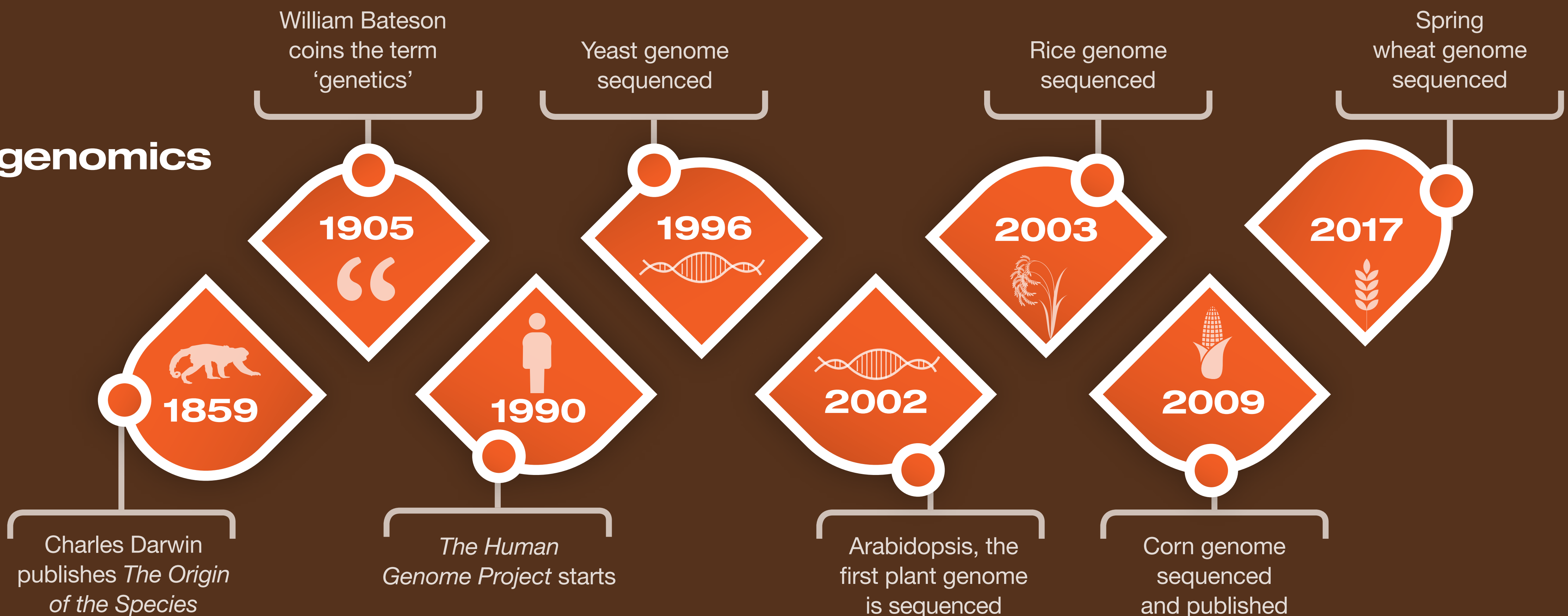
Currently, the group has generated DNA sequence profiles of two Canadian wheat cultivars, CDC Stanley and CDC Landmark, using the same approach that was used so successfully for Chinese Spring.

Already there have been some exciting discoveries. "CDC Landmark, for example, carries the genes which confer resistance to several wheat diseases and insect pests," says Pozniak. "With the new assemblies, we have quickly honed in on these important genes and detailed functional analysis is underway. Normally, this process would have taken many years. Identification of critical genes can now happen in as little as a few months."

This work constitutes Canada's contribution to the Ten+ Wheat Genome Project. DNA sequences of eight additional cultivars are being completed by consortium partners in Germany, Switzerland, the United States, Japan, Australia and China. The final result will be detailed genetic knowledge on these 10 wheat genotypes, and this information will be freely shared within the global wheat breeding community.

"We believe that access to multiple genome sequences will be a critical resource for wheat breeders and scientists, and will pave the way to understand most of the genetic variation available to wheat breeders," says Pozniak. "It will also support gene discovery, and the development of next-generation breeding tools to advance wheat breeding."

History of genomics



Field heroes

Promoting beneficial insects for pest control

"Healthy populations of insects like lady beetles, ground beetles, lacewings, damsel bugs, and many parasitoids can often keep crop feeding insects at insignificant levels. With good management decisions and the proper environment, this free biocontrol can help maximize the value of a crop."

Do you think about beneficial insects before you spray? It's a practice strongly encouraged by entomologists that's getting more attention with the help of an awareness campaign championed by WGRF.

"Healthy populations of insects like lady beetles, ground beetles, lacewings, damsel bugs, and many parasitoids can often keep crop feeding insects at insignificant levels," explains entomologist John Gavloski of Manitoba Agriculture. "With good management decisions and the proper environment, this free biocontrol can help maximize the value of a crop."

But not everyone has a good understanding of these unsung heroes and the important role they play in integrated pest management. By helping control yield-robbing pests, beneficial insects can reduce spraying, lower cost of production, save time in the field, and protect the environment.

WGRF set out to increase awareness of these benefits during the 2017 growing season. Pat Flaten, WGRF Research Program Manager, notes that the need to communicate this information was identified at a Prairie Pest Monitoring Network (PPMN) working group meeting.

"While beneficial insects play a vital pest control role in cropping systems, they haven't always been part of the discussion when making agronomic decisions. Fortunately, that conversation seems to be changing," she says. According to Flaten, producers and agronomists have been asking members of the PPMN for more information.

Not all heroes wear capes

The 'Field Heroes' awareness campaign delivered on that request. Through a variety of tactics and the tagline "Not all heroes wear capes," the campaign encouraged growers and agronomists to consider beneficial insects in crop production decision-making.

Mike Espeseth, Communications Manager for WGRF, explains that the campaign helps to showcase the significant research by federal, university and provincial entomologists in this area.

"Beneficial insect photos, scouting techniques and best management practices are available from various sources across Western Canada. We simply compiled key information and helped to raise the profile," says Espeseth. The website www.fieldheroes.ca is now a central location for information about beneficial insects.

Consider beneficials in crop production decisions

Provincial and federal entomologists also played an advisory role in executing the multi-media campaign that included scouting guides, social media and advertising. A series of ads ran throughout the growing season to support producers and agronomists when they were in the field making choices about crop management.

Scouting guides were created to highlight beneficial insects that prey on crop-feeding insects such as aphids, cutworms, diamondback moths and bertha armyworms. Crop guides were also developed to help producers identify what beneficial insects they should be looking for when scouting their cereals, pulses and oilseeds.

WGRF is encouraged by the uptake of the campaign in such a short time frame. "We were really pleased to see the amount of traffic on social media," says Espeseth. "Agronomists and entomologists were connecting on Twitter through our @FieldHeroes handle and sharing information and photos on what beneficials they were seeing in the field."

Producers interested in learning more should visit FieldHeroes.ca and follow FieldHeroes on Twitter for great agronomic information and timely, relevant content.

Field Heroes - Winner of the 2017 Canadian Agri-Marketing Association Award for Public Affairs/Issues Management Program

Tips to consider in your crop protection plan:

- Use a more selective insecticide that has reduced impact on beneficial insects.
- Apply insecticide at specific times of day, usually evenings, to protect beneficial insects present in the crop.
- Consider the biological control offered by beneficial insects to avoid precautionary insecticide applications.
- Use economic threshold numbers to calculate if the cost of spraying outweighs the benefit.

Herbicide resistance and you

Protecting crop tools

"There was a time when we thought herbicides were a renewable resource," says Neil Harker. "We've got to change our thinking about that."

A weed scientist with Agriculture and Agri-Food Canada (AAFC) in Lacombe, Alberta, Harker recalls the heyday of the 1980s when new herbicides with new modes of action (MoAs) were arriving thick and fast at the farm input dealership. Got a new weed problem? Here's a new solution!

Sadly, those days are gone. There hasn't been a new herbicide MoA registered for nearly 25 years, and it's unlikely one will be registered anytime soon. It means the herbicide tools Canadian growers are using now are likely to be the same ones their children will be using 20 years from now. So, Harker's question is: "Are your kids going to have any reliable herbicide options in the future?"

It's a sobering thought, and Canadian growers need only look to other geographies for a glimpse of how bad it can get. "They are hand weeding herbicide-resistant palmer amaranth in Arkansas," says Harker. "And in areas where they can ill-afford to till, like some of the sandy soils in Georgia, they're tilling to control resistant weeds." Why? Because the most effective herbicide options – all of them – are gone.

While these are particularly egregious examples of weed resistance gone bad, they shouldn't be dismissed, or chalked up to "bad farmers," because growers in these areas were just doing what growers everywhere do to control weeds, which was to use effective, easy, economical herbicide tools. Until they couldn't.

Harker believes there are ways to protect those tools for the medium to long term, but it will require real fortitude and a willingness to adjust short-term profit expectations on occasion.

More than herbicides

Canadian growers have fully taken on board the concept of herbicide group rotation as a way to slow the onset of resistance. And while that's absolutely critical and the right thing to do, Harker says that resistance management is not synonymous with herbicide rotation.

"The science is clear that the only way to prevent or delay herbicide resistance over the long term is to minimize the use of herbicides," he says. "You have to get to a point where you're willing to do something other than reach for a herbicide."

WGRF, Alberta Barley Commission, Alberta Canola Producers Commission and Saskatchewan Wheat Development Commission are currently funding a five-year herbicide resistance mitigation study led by Harker that's investigating novel integrated weed management systems.

Higher seeding rates, narrower row spacing, optimal fertilization, proper four-year rotations to break weed cycles, adding fall crops to the rotation, strategic tilling, hand roguing, even keeping roadside weeds mowed so they can't set seed are all helpful. But the mindset needs to go deeper than that, says Harker, pointing to Australia as a prime example of necessity being the mother of invention.

Farmers 'down under', with their near-continuous growing season, have been on the frontline of herbicide-resistant weed management for decades. Indeed, according to CropLife Australia, resistance to 11 distinctly different herbicide groups has been documented in weed populations there, and it's common to find weeds resistant to multiple MoAs, particularly Groups A and B (known in Canada as Groups 1 and 2).

Destroying weed seeds

Australian farmers are doing a lot of the things listed above and more, including using enclosed chaff carts to collect weed seed-laden chaff as it comes off the combine rather than put it back in the field, or directing chaff into narrow windrows for burning, or using a technique called "wiping" where specialized equipment literally wipes weeds at least 30 cm taller than the crop with a herbicide-drenched sheet to prevent seed set. One inventive producer, Ray Harrington, came up with a harvest device called the Harrington Seed Destructor, which is similar to a chaff cart but it grinds the material to powder before returning it to the field, rather than collect it for later disposal.

The point is that Australian farmers are making many agronomic, operational and equipment decisions using weed management as the motivating force. "The Australians did it because they were desperate," says Harker. "We don't feel desperate yet."

He'd like it if we didn't have to get to that point before making weed management choices that help reduce herbicide use. For example, the decision to use a higher seeding rate could be about reduced weed competition rather than about higher yield.

Capital investments, too, can fall into this thinking. He says that integrated units of the Harrington Seed Destructor – that is, units that can be built right onto the combine – will be available in a year or two. It could be as much as a $100,000 investment. Harker says it may sound like a lot, but if you spend half a million dollars on a sprayer and that's your only weed control tool, perhaps it's worth thinking about something like this as a way to expand your resistance management strategy.

To help farmers with this decision, WGRF is funding a three-year study led by Breanne Tidemann, research scientist with AAFC, to evaluate the efficacy of the Harrington Seed Destructor on weeds in Alberta and to determine if efficacy varies by cropping system and management choices.

Reduce use today to ensure tools are available tomorrow

The reality is that herbicide-resistant weeds are becoming more widespread, abundant and, worse, more complex. There are wild oat populations on the Prairies now with five-way resistance – only very old Group 3 products work on them now. The hard truth is that the only way to reduce selection pressure is to reduce herbicide use and start to include alternate weed control measures as part of an overall weed management plan.

Research will play a key role in helping farmers form these plans. Pat Flaten, Research Program Manager with WGRF, says that the organization is supportive of this type of research because it is relevant to numerous crops and tools. "These concerns go beyond herbicide resistance. How do we protect our investments in other valuable crop protection tools?" She points to variety development as an example. "The industry has built disease and insect resistance into seed. How are we going to preserve those tools as well?"

Harker admits it's a major mind shift for Canadian producers – a recognition that in order to protect herbicide tools, we need to use them less, and that using them less will, in some years, come at a cost to productivity and profit.

Harker admits it's a major mind shift for Canadian producers – a recognition that in order to protect herbicide tools, we need to use them less, and that using them less will, in some years, come at a cost to productivity and profit.

The Harrington Seed Destructor is a harvest device that pulverizes weed seeds, which could play a role in mitigating herbicide resistance.

Top 10

Herbicide-resistant weed management practices

Agriculture and Agri-Food Canada research scientists Hugh Beckie and Neil Harker have reflected on more than 30 years of collaborative research, extension activities and farming experience to compile their top 10 herbicide-resistant weed management (HRWM) practices.

10 Keep accurate records

Maintain a database that chronicles your agronomic practices, particularly those that vary from field to field and year to year. Records should include cultural, mechanical, and herbicidal weed management variables. Keeping accurate records will help you make informed crop management decisions, especially pesticide choices, for each field.

9 Practice strategic tillage

Use tillage only if, where and when deemed necessary to manage herbicide-resistant (HR) weeds. The risk of weeds developing resistance to herbicides is shown to be highest in no-tillage, owing to greater herbicide use and weed seed bank turnover rate. In some regions, tillage is an essential method for managing some glyphosate-resistant weeds.

8 Customize weed management by field

Weed management programs are not one size fits all – they should be customized on a field-by-field basis as weed populations are not uniform across your land. Even within a typical field they are not generally consistent. Survey your weed populations before herbicide application. It is also possible to detect and manage weeds in real time using sprayers equipped with sensors.

7 Use weed sanitation practices

Equipment sanitation practices reduce both immigration of weed seeds and spores into a field and HR gene (seed or pollen) dispersal across a field. Reducing weed seed load into the soil can be achieved directly by harvest weed seed control practices, which include chaff carts, direct-harvest crop residue baling, narrow-windrow burning and seed pulverization.

6 Rotate in-crop wheat and non-wheat herbicides

Many HR grassy weed populations (e.g., wild oats) are able to tolerate herbicides using the same mechanism as wheat. Therefore, it is important to rotate in-crop wheat and non-wheat herbicides to delay or manage this type of resistance. Avoiding continuous cereal crop rotations and including non-selective herbicides such as glyphosate or glufosinate in HR crops will help to achieve this objective.

5 Rotate herbicide groups

Rotate herbicides based on their group (site of action). The group number is identified on the front of each herbicide product. Where possible, across and within growing seasons, rotate the use of one herbicide group with other herbicide group(s) that control the same weeds in a field.

4 Use herbicide mixtures

Herbicide mixtures, or tank mixes, can be effective in delaying resistance. They are most successful when herbicide mixtures that combine different sites of action meet the criteria of 1) similar efficacy, 2) similar soil residual activity, and 3) different propensities for selecting for resistance in the target species. For example, mixtures of Group 2 and 4 herbicides having overlapping control of some key broadleaf weeds have been shown to delay or manage resistance.

3 Scout fields before and after herbicide applications

Scout your fields before in-crop herbicide application to determine what weeds are present, their distribution and abundance in order to customize an effective weed management plan. Additionally, scouting post-herbicide application will inform you of how successful you have been in controlling the targeted weeds. Unmanned aerial vehicles have good potential for weed surveillance and monitoring. Whether using spreadsheet or mapping software, scouting data are important parameters to record annually.

2 Focus on crops and practices that promote competitiveness

Employ crops and practices that can aggressively compete with weeds. Some traits include rapid emergence (the 'first up wins') and ground cover, rapid and extensive canopy closure, and plant height. Crop competitiveness is optimized by good agronomic practices such as precision fertilizer placement near or at time of seeding, optimum seed placement and seedbed conditions, and high crop seeding rate. Adopt the 'First up wins' approach?

1 Ensure crop diversity is the foundation of your HRWM plan

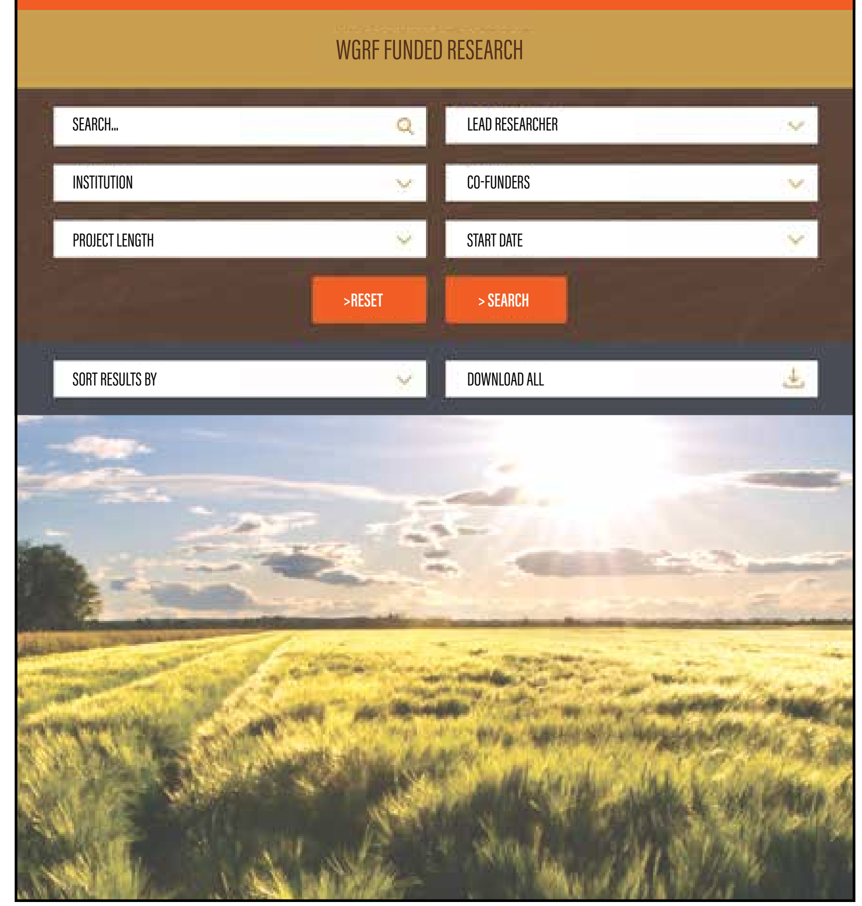
The core of an effective HRWM plan is crop diversity. Include weed-competitive species and those with varied growth cycles and maturities in your crop plan – a mix of dicots and monocots, winter and spring planted, cool and warm season or annuals and perennials. While this approach ensures herbicide diversity, it also helps to provide different seeding and harvesting dates, and selection pressures on weed communities.

This story is adapted from: "Our top 10 herbicide-resistant week management practices" by Hugh Beckie and Neil Harker in Pest Management Science 2017.

New online search tool

More than 400 WGRF-funded research projects are now listed at westerngrains.com in a user-friendly, searchable format. Search by researcher, institution, keyword or co-funder to find out more details of what projects we have funded in the past and present.

This search tool was part of the WGRF website revamp in March 2017. We are working to continually improve the project listing section to keep producers and stakeholders updated on our research commitments.



Crop scouting with UAVs

Evaluating the on-farm potential of drone technology

PROJECT CONTRIBUTORS
Alberta Alfalfa Seed Commission
Alberta Canola Producers Commission
Alberta Crop Industry Development Fund
Alberta Pulse
Alberta Wheat Commission
Potato Growers of Alberta
Western Grains Research Foundation

Do unmanned aerial vehicles (UAVs) have a practical application on the farm? That's what Chris Neeser set out to determine in a two-year study that evaluated the use of drones for scouting weeds and disease.

Neeser, who works with Alberta Agriculture and Forestry's Crop Diversification Centre, got underway with the research in 2014 with funding from WGRF and six other organizations.

"The offering at the time was NDVI maps, or normalized difference vegetation index maps, and what they could show happening in fields," he says. At its simplest, NDVI maps show whether a target area contains green vegetation. Marketing hype suggests that UAVs can generate these maps quickly and easily, allowing growers to get a bird's eye view of their fields to identify areas that need attention and take quick action.

What Neeser and his team found, however, was a more complicated process. The UAV's ability to stay on course, the flight control system, camera quality and capability, and, finally, the software and technical ability to process collected imagery and collate it into some kind of readable, high-resolution image within a reasonable timeframe were all factors in the efficacy and usefulness of using a UAV to scout for weeds and disease.

The research team used both fixed-wing and multi-rotor UAVs, and they captured images three times during the season in six crops (two fields each of barley, canola, field peas, seed alfalfa, potatoes and spring wheat). The first flights, conducted in late May and early June, were focused on weed scouting, while the second two flights (late July and again from mid-August to early September) assessed the ability to spot crop disease with UAVs.

Early weed scouting

"As far as weeds go, the problem is a lack of image resolution," says Neeser. "We don't have enough resolution to detect small weeds at those early, critical stages."

It's not necessarily a more efficient way to scout for disease, he says, but it does offer growers a better chance of finding problem areas that warrant further investigation.

He explains that NDVI maps are essentially a collection of pixels; the ability to identify which pixels are crop and which are weeds is a challenge.

"We need to see weeds when they're tiny and that just doesn't show up," says Neeser. Still, he sees potential for this technology to develop weed density maps.

"Bottom line, we have the parts to build a system that would do this," he says. "But how useful is a weed density map just now? At this point, not so much because we don't have sprayers that can use those maps."

Scouting for disease

On the disease scouting side, Neeser sees more immediate application. "With crop diseases, we have enough resolution to see it's there, but it can't tell us what the disease is."

Crop disease tends to create patches that are highly visible in the canopy from a height. Neeser thinks farmers could use those images to guide boots-on-the-ground physical inspections and treatment. One symptom of clubroot in canola, for example, is a thin canopy. Flying a drone over a known clubroot field could reveal patches where none were noticed by other means.

"The imagery would allow you to see small spots, gaps in the crop canopy, some of them small enough that you wouldn't necessarily see them by walking the field," Neeser explains. "You wouldn't know what the disease was, or even if it is disease, from the images, but you'd know where to look and where to test in the field."

It's not necessarily a more efficient way to scout for disease, he says, but it does offer growers a better chance of finding problem areas that warrant further investigation. "It's a totally new approach to managing disease in specific areas."

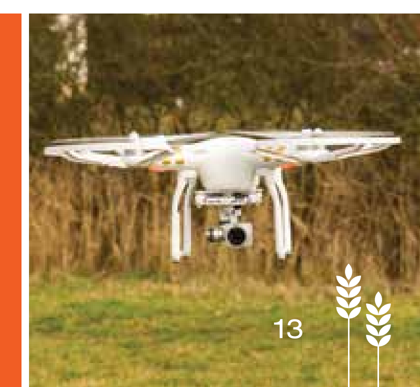
Are UAVs worth the cost?

Given its current limitations, is UAV technology worth the expense? Well, yes and no.

Neeser is the first to admit that UAVs, including all the software and image-making support it requires, is constantly evolving and getting cheaper. Even so, the cost and the extra layer of technical expertise they add is mostly being borne by independent crop advisors who, he says, increasingly see adding UAVs to their arsenal as a necessary cost of doing business and staying competitive.

But it will be a while before it replaces the other high-tech crop surveillance tool. Satellite imagery is much better and faster than it once was and is far less expensive to use. "No way can a drone compete with a satellite on cost," he says.

Having said that, UAVs are in their infancy when it comes to farm work, and Neeser is keen to see what the future holds. "Right now, UAVs are a great ad hoc crop inspection tool."



Winter wheat and FHB: a brave new world

Breeding for improved disease resistance

Anjan Neupane doesn't see a world free of fusarium head blight (FHB), but he does see one where we take control of it.

A PhD candidate at the University of Manitoba (U of M), Neupane is the most recent graduate student to receive the WGRF Endowment Fund Graduate Scholarship (which provides $100,000 annually toward graduate scholarships at the universities of Manitoba, Alberta and Saskatchewan on a rotating basis).

His project, *Winter wheat breeding for improved disease resistance, quality and agronomic traits* is aimed squarely at finding genetic sources of disease resistance in winter wheat, then generating molecular markers that breeders can use in their programs to more quickly develop disease resistant varieties. Supervised by professors Dr. Anita Brûlé-Babel at the U of M and Dr. Lily Tamburic-Ilincic at the University of Guelph, the research is not just for FHB, but leaf and stem rusts as well.

Disease resistance and crop performance

Neupane also wants to figure out if there is a relationship between breeding for disease resistance, yield and end-use quality. In other words, does achieving disease resistance through plant breeding come with any tradeoffs in terms of crop performance?

To do both of these things, Neupane is combining field, greenhouse and lab work.

"I have two double haploid populations of winter wheat, the Triumph/25R51 cross and the Superior/D8006W cross," he says, explaining that double haploid technology speeds up the breeding cycle. "Between these two, I have 110 double haploid lines in each population that I am phenotyping in the field."

Phenotyping in the field

A plant's phenotype is, in essence, the physical expression of its genetics. For example, all wheat plants have genes that affect leaf development. Breeders wanting to create new varieties with a huge flag leaf will look for that physical characteristic in the lines they are testing and keep those lines in their breeding program.

Neupane is doing his phenotyping work at the U of M's FHB nurseries in Winnipeg and Carman, plus a third nursery in Ridgetown, Ontario, which gives him data for three field sites in one year. Here, his winter wheat lines are inoculated with disease then evaluated for physical characteristics including plant height, yield, maturity, protein content, as well as their in-field reaction to disease, FDK and DON levels – to mention but a handful of the characteristics he is recording.

"I'll then analyze the DNA of each line in the lab using the latest marker technology, such as SSR and SNP*," says Neupane. He is looking for associations between what's in the DNA (genotypic data) and what he documented in the field (phenotypic data). In other words, finding the genetic markers that relate to a physical plant trait.

"I'm about halfway through the project now," he says. "I'm currently working on the phenotyping, and it's going well – so far we're seeing good variation among the lines."

Taking control of FHB

The lab work is still to come, and Neupane is optimistic about finding genetic markers for FHB and rust resistance that breeders can eventually use in their programs. He acknowledges it's a way out yet, but it's possible and that's the key.

"Winter wheat is facing a major problem with these disease pressures. We might not get rid of them, but we can take control of them."

The way he sees it, growers are already doing some level of phenotyping when they select which varieties of winter wheat they'll grow based on past performance. His work is taking that one step further – by finding genetic markers for improved disease resistance and quality traits, breeders can develop varieties growers want faster and more robustly.

"It's really important to have this research funding at the university level because as plant breeders and geneticists, we have to think into the future," says Neupane. "I appreciate the Western Grains Research Foundation for providing this scholarship to pursue my PhD study. It's a valuable investment in a future scientist and I am pleased to contribute back to growers in Western Canada."

* SSR: Microsatellite polymorphism, or simple sequence repeat;
SNP: Single nucleotide polymorphism.

Peas that can handle the heat

New insights into pea plant genetics

As climate change is causing temperatures to increase globally, heat stress is becoming a significant limiting factor for pea cultivation. Heat stress can lead to fewer flowers, fewer pods, and ultimately, lower yields.

"We wanted to find new varieties that have robust and consistent yields in a warming world," says Rosalind Bueckert, a plant scientist at the University of Saskatchewan. She led a recent study funded by WGRF that demonstrated pea plants with specific traits may be more resistant to heat stress. Bueckert and her colleagues, Tom Warkentin and Shaoming Huang, are the first to uncover the location of genes that affect heat resistance.

Resilient plants have more pods and a longer flowering period

While tolerance to heat stress in peas seems to be dependent on quite a few traits, the study identified two that are most important – higher pod numbers and longer flowering duration.

The research shows that varieties of pea that have more pods to begin with will have higher yields after a heat-stress event. Similarly, "if a pea variety flowers for a longer time, it has more opportunities to have a higher yield, even under heat stress," says Bueckert. That's because the plant has more time to recover from extreme weather events during flowering. But a flowering period that is too long can lead to other problems. "You need the right balance of the vegetative and reproductive phases," she says.

To determine which traits are important for heat resistance in peas, Bueckert's team crossed two commonly used varieties of pea – CDC Centennial and CDC Sage.

"By crossing two different varieties of pea, you may be able to breed offspring with traits beyond those of either parent," says Bueckert who evaluated more than 100 new pea lines derived from this cross. For example, some of the offspring were more heat resistant than either CDC Sage or CDC Centennial. The researchers cultivated these new lines of pea for two growing seasons in Saskatchewan.

One batch was seeded mid-May – a typical time for pea cultivation. A second batch was started in early June. The late-seeded plants flowered later in the season when temperatures were higher. This allowed the researchers to test for pea lines that grew better and had higher yields in warmer weather.

Gene mapping for better variety selection

"Identifying traits that make pea plants more resistant to heat stress is one piece of the puzzle," says Bueckert. The other piece is better understanding the genetics of these traits.

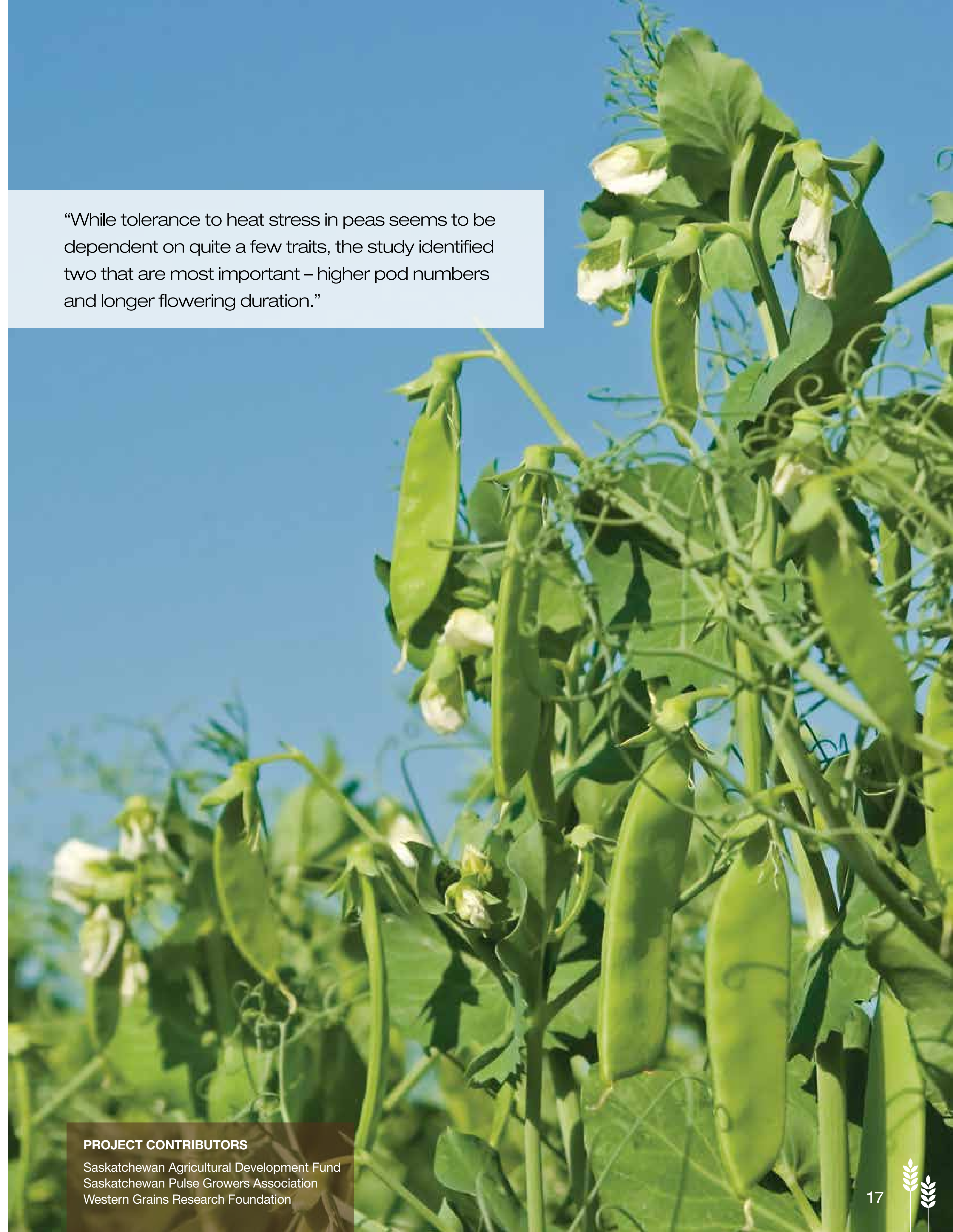
Traditionally, researchers used visible traits, such as pod number, to select crop varieties that grow well in specific environments. However, mapping out the pertinent genetic information helps focus the work. Researchers can identify specific genetic locations for a trait within the pea's genetic map. From there, researchers can more reliably select crop varieties.

"The more work we can do with genetic locations and molecular techniques, the more efficient we will be," says Bueckert.

The researchers are also examining other traits that can contribute to heat resistance in peas. For example, "semi-leafless varieties of pea are better at dealing with heat stress than leafy varieties," says Bueckert.

Future research will aim to identify more of these traits, and further the understanding of the genetic basis of heat resistance in peas.

This story is adapted from: American Society of Agronomy. "Genetic map reveals heat tolerance traits in peas." ScienceDaily.



"While tolerance to heat stress in peas seems to be dependent on quite a few traits, the study identified two that are most important – higher pod numbers and longer flowering duration."

PROJECT CONTRIBUTORS

Saskatchewan Agricultural Development Fund
Saskatchewan Pulse Growers Association
Western Grains Research Foundation

Leader in cropping system research

WGRF transitions to cross-cutting issues

Garth Patterson
Executive Director, WGRF

It's an exciting time at WGRF as the organization is in full transition toward leadership in funding cropping systems research. It's a role that seems to be a natural fit.

"When we looked at our strengths and our uniqueness, being western Canadian, multi-crop, farmer-focused and an independent charity, we can play a leadership role in funding research on cross-cutting issues affecting western Canadian cropping systems," says Garth Patterson, Executive Director.

"Agronomy research capacity is one," says Patterson. "There's also research issues that cut across all crops such as nutrient management, herbicide-resistant weeds, changing weed populations, pest monitoring and management, and genomics tools, and crop adaptation to climate change.

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Patterson and his team have been busy sharing WGRF's four-year transition plan with member organizations and funding partners. Central to the plan is a focus on cropping systems research for all crops, particularly for the major crops like wheat, barley, canola, pea, and lentil. Crops like corn, soybean, fababean, sunflower, mustard, canaryseed, oat, flax, and winter cereals will still be supported by research funding because of the role they can play in improving the diversity and sustainability of cropping systems.

Variety development to 2020

Although the provincial commissions and associations are now responsible for the wheat and barley check-off dollars, Patterson forecasts that variety development will be supported until at least 2020.

"We are continuing to work with the commissions/associations to invest our remaining wheat and barley funds into research," he says. "We experienced a 50 percent decline in revenue with the Western Canadian Deduction transfer in August 2017, but we still expect to invest $17 million annually for the next three years from check-off reserves and the Endowment Fund."

Another area of focus for WGRF is knowledge transfer. This direction is no surprise as strong communications is a key leadership trait. Stay tuned for new research findings and insights that you can apply to your farm business.

Transition plan highlights:

- Cropping system research funding for all crops
- Crop specific research funding for intermediate crops: corn, soybean, fababean, sunflower, mustard, canaryseed, oats, flax, winter cereals
- Continued wheat and barley variety development funding
- Enhanced reporting of research
- Extension/technology transfer
- Interaction with key influencers
- Targeted involvement in research policy

Western Grains Research Foundation

Crop production systems research

WGRF aims to fill a current gap in the area of crop production system research.

Cropping Systems

Agronomic challenges faced by western Canadian farmers cut across multiple crops – everything from soil health and crop rotation to herbicide resistance and climate change mitigation.

Producer Benefit

WGRF makes funding decisions that are mindful of the economic interests of producers

Whole-farm approach

WGRF works with researchers to identify multi-crop agronomy projects that provide significant benefits to the whole farm using a systems approach.

Resiliency

WGRF is focused on research that will support producers with resilient cropping systems in order to adapt to climate change.

Sustainability

WGRF funded research will help producers mitigate climate change – such as agronomic practices to reduce greenhouse gases and increase carbon sinks.

DID YOU KNOW:

Some ground beetles can consume more than **8 cutworms per day**

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