

CANOLA Digest

Off the drawing board

9 technologies that will change agriculture **PAGE 16**

PLUS

What dairies can teach us about data 14

Variable rate technology: An expert Q&A 27

10 Discovery Forum discoveries 32



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CANOLA digest

on the
COVER

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OFF THE DRAWING BOARD

Grain farming is still about putting seeds in the ground, giving them fertilizer, protecting them from pests and harvesting mature plants, but the tools continue to evolve. This article explores major technological advancements at early adoption or coming soon to help growers farm more efficiently, sustainably and profitably.



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The Editor's Desk

Jay Whetter

Cow bytes

Lee Moats gave me the idea for the dairy data article in this issue. Lee, who farms at Riceton, SK, and I were talking at CropConnect in Winnipeg last February and we got on the topic of data. He suggested grain producers look to the dairy industry for inspiration on how data collected and shared from each cow helps improve performance and productivity of that cow, the farm's herd and the whole Canadian dairy industry. He thinks grain producers could use the same approach to improve results from each acre.

"You should do a *Canola Digest* article on this," he said.

I like the idea of drawing inspiration from outside the canola industry, so I put it on my "to do" list. Lee's idea came up for discussion at our annual *Canola Digest* content planning meeting. On the editorial board are grower and staff representatives from SaskCanola, Alberta Canola Producers Commission and Manitoba Canola Growers Association. Errin Tollefson from SaskCanola suggested we feature Rayner Dairy on the University of Saskatchewan campus. The article took shape, and Saskatoon freelancer Kim Kennett accepted the assignment.

Collecting data on each cow is easier than on each acre, one might argue. But, with GPS, combine yield maps and field imagery synced with digital field-specific record keeping (including soil tests), growers have the performance indicators they need. Using some software, each farm can come up with an acre-by-acre profit record.

The glitch in comparing acres versus cows as "performance units" is that underperforming cows are easy to remove and replace. Growers can't sell off individual acres. But they can invest differently in each acre — putting inputs into acres that reward them with higher profits and cutting inputs to acres that never make money. If some acres are just too poor to be profitable, growers can grass them. Quarters with overall poor performance can be sold.

By sharing data with a national benchmark program the way dairy producers do, grain growers can take their standards to another level — comparing their fields and farms with regional and national averages for similar soil zones.

No one using the national benchmarks could access results from individual farms, but by sharing data, growers can get an accurate picture of the soil characteristics and farm management that went into top and bottom performing acres. I see considerable value in these benchmarks. Do you?

Tell me more

What do you think of this idea? Did any other articles in this issue inspire you? Do you, like Lee Moats, have article ideas for me? I want your input. Please take a moment to fill in the reader survey part way through this issue, or complete it online at www.survey.monkey.com/r/CanolaDigestsurvey. Use the comments boxes to share your thoughts and ideas. Thank you! ●



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Unmanned aerial vehicles are the latest whiz-bang technology to enter the ag sector, but aside from their “cool” appeal, their current limitations make them more of a complimentary tool than a replacement for satellites and manned aircraft.

By Richard Kamchen

Drones have a future in agronomy

Drone images could help crop insurance estimate unseeded acres. Photo: Farmers Edge

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Unmanned aerial vehicles (UAVs) or drones come in different shapes and sizes, costs and complexity. Some people may assume drones will become a primary source of field data collection, but Wade Barnes, president of Farmers Edge, cautions against such high expectations.

“That’s never going to happen. They’re not robust enough, they don’t have enough flight time and you can’t collect enough data,” he says, adding that far more work goes into collecting drone data versus downloading satellite images. But Barnes does see a place for drones in the future of agronomy.

Greg Adelman, owner of Crop Command Agronomy, says drone technology has a lot of potential. “Can it do everything right now that some people say it can? I don’t think so,” he says. “But it’s going to be there eventually.”

Drones are more nimble and timely

Satellites and manned aircraft easily have the advantage in scale. Adelman says a top-of-the-line fixed wing drone can fly about 1,000 acres a day, but to satisfy some among his client base, he requires a manned aircraft that can cover 20,000 acres a day. He also notes a drone requires both observer and pilot to operate, whereas only one person is needed to fly a Cessna.

What a drone provides is more surgical precision. Drones offer higher

“Can (drone technology) do everything right now that some people say it can? I don’t think so. But it’s going to be there eventually.”

—Greg Adelman

resolution images and greater nimbleness that can aid yield prediction, identify potential crop problems and examine hard-to-reach areas.

Drones, planes and satellites can each provide field maps showing normalized difference vegetation index (NDVI), which measures the chlorophyll content of the leaves and biomass. NDVI can spot subtle differences that wouldn’t be picked up by the naked eye.

“With this technology, we’ve found sometimes we can see nitrogen deficiency two weeks before it actually shows up in symptomology,” says Adelman.

Even though a drone may be closer to the ground when it takes an NDVI image, Réjean Picard, a farm production advisor with Manitoba Agriculture, urges caution about near infrared (NIR) that converts imagery to NDVI.

“That imagery may look clear when represented on a picture, but the actual differences may be greater or lesser than seen,” he says. “There is a margin of error in the information that may also translate into some error of application of inputs, for example. There is usually lots of variability in living systems.”

Picard adds that ground truthing remains a necessary component. “Imagery collected often needs to be corroborated with ground information to verify what is being ‘seen’ by the sensor,” he says.

Stitching together drone-captured imagery also takes skill, time and computing power. Chris Neeser, weed scientist with Alberta Agriculture and Forestry, researched drone utilization in scouting for weeds and diseases as part of a 2014 project. He used a drone to examine 12 fields and six crops three times during the season. Images had a resolution of five to six cm per pixel, which was good enough to identify crop rows in most situations as well as weed patches, but not individual weeds. Foliar diseases also showed up nicely on NIR, especially with a full canopy.

But Neeser says approximately 150 images are required to cover a quarter section at a resolution of five to six cm per pixel, and stitched together produced a file of about 500 megabytes. This was very time consuming to go through manually, he says.

Manual identification of potential problems is required because commercial operators do not yet offer automatic identification. “This is what might be coming down the pike in a few years’ time,” says Neeser.

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UAV REGULATIONS

Numerous rules and regulations exist for the operation of unmanned air vehicles (UAVs) and more are on the way.

For recreational purposes, UAVs weighing less than 35 kg don't need permission to fly, but operators are responsible for observing Transport Canada safety guidelines. These guidelines include the requirement to fly during daylight hours and in good weather, and keep the aircraft in visual sight. UAVs cannot be flown within nine km of an airport, higher than 90 metres from the ground or near moving vehicles.

Different rules and requirements exist for UAVs used for work or research. For UAVs that weigh two kg or less, operators don't need permission to fly if they meet the long list of safety conditions. The same is true for aircraft weighing 2.1 to 25 kg, except Transport Canada must be notified by completing an online form. UAVs weighing 25 kg and above require a Special Flight Operations Certificate (SFOC) before use.

Farmers Edge president Wade Barnes believes drones of a size useful for agriculture will face more restrictive rules. "As a result, drones will end up in the hands of people who offer more of a commercial paid-for service," he says.

Last May, Transport Canada announced it intended to introduce new regulatory requirements in 2016. For UAVs 25 kg or less, the proposed amendments would cover new flight rules, aircraft marking and registration requirements, knowledge testing, minimum age limits and pilot permits for certain UAV operators.

Transport Canada also intends to preserve the SFOC process for heavier UAVs and more complex operations, including UAVs larger than 25 kg and those operated beyond visual line-of-sight.

The department issued 1,672 SFOCs for UAVs in 2014, up from 945 in 2013 and 345 in 2012.

For more information about Transport Canada's rules, check out www.tc.gc.ca/SafetyFirst. ●

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Provincial producer organization pages	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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2. What other topics would you like to see in the magazine?

3. How do you prefer to receive information about the following topics? (Please check all that apply.)

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4. Are there any other ways you would prefer to receive information about the above topics?

5. What style of magazine writing to you prefer?

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Comments

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DRONES HAVE A FUTURE IN AGRONOMY

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Increasing the resolution is possible, but covering a quarter section at one cm per pixel creates a much larger file — 15 gigabytes — a size most consumer computers couldn't handle. Part of the objective of the project was refining the process, which is what they're working on now.

Another immediate application for drones could be crop insurance assessment. Barnes says crop insurance assessment methods remain archaic as they rely on adjusters to enter fields to make their best guess. Even incorporating satellites into their assessments is no guarantee of greater accuracy. If a satellite only provides imagery of a particular area once a week, it could miss damaging weather, and satellites cannot capture good images in overcast conditions.

Drones are "more or less on demand," Picard adds. "If weather conditions are stable, you can go up and fly the field. You can have images the next day."

Besides bringing greater certainty to measurement, drones also cut down the amount of time a farmer needs to spend with an adjuster when he could be occupied with other work, Barnes says.

Barnes also believes drones can help spread the workload of diminishing numbers of agronomists. "One of the big issues I see coming in the next 20 years is a lack of well-trained agronomic people at the field level. We're seeing it already," he says, predicting a drone might double or even quadruple the number of acres an agronomist could examine.

Specialized skill

Growers enthusiastic about drones are typically buying quadcopters, which cost a couple thousand dollars or less. These entry-level units can take pictures and video, and serve as a complementary inspection tool.

More sophisticated drones are more costly and the learning curve far steeper. Costs can range from \$15,000 to over \$100,000, depending on cameras and model, and software can range from \$5,000 to \$12,000.

"The process of collecting the information, processing it and then coming to a conclusion requires specialized knowledge," says Neeser.

Adelman says firms such as RoboFlight, the Colorado-based company he's joined forces with,



Wade Barnes, president of Farmers Edge, expects to add some type of drone program into their precision solutions offer by spring 2017.

can turn around a finished product within 24 hours for a fee of \$1 to \$4 per acre, depending on volume. "We can process 1.5 million acres per day currently and can increase our needs in a matter of a week."

Farmers Edge has partnered with DJI, the largest drone company in the world,



Greg Adelman, owner of Crop Command Agronomy, works with RoboFlight to stitch together drone images to create a full field map. RoboFlight can produce a map within 24 hours of receiving the images for a fee of \$1 to \$4 per acre.

and over the past summer conducted research and development on potential farm applications.

"Our goal is to launch or add some type of drone program within our precision solutions program by the spring of 2017," says Barnes.

As data collection devices, he says drones are part of the next revolution in agriculture. "The first big revolution in agriculture was the green revolution with Norman Borlaug and all the changes that were made around agronomy and cropping decisions. The second one was GMO. The third is going to be data and analytics in agriculture," says Barnes.

Five years from now, data collection technology will have a huge impact in agriculture.

"What's really going to help feed this world is increasing productivity and efficiency. I don't think varieties or putting more fertilizer on is going to solve it," says Barnes. ●

Richard Kamchen is a freelance agriculture writer based in Winnipeg, MB.

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These four panelists use unmanned aerial vehicles (UAVs) — or drones — and understand their capability and limitations for use in Prairie agriculture.

By Jay Whetter

Drone onward



“A drone is a tool that is really no different than my soil probe. How I collect the information, the accuracy of the information collected and what type of information is being collected will impact the ROI.”

—Kristina Polziehn

Kristina Polziehn Sturgeon County, AB

Kristina Polziehn, president of Axiom Agronomy, has two drones. She uses a DJI Phantom 2 Vision+ quadcopter with a normal camera to capture aerial images of field drainage patterns, field variability, seeding issues, weed patterns and herbicide damage patterns. ‘Copter- or rotor-style drones are limited by their flight times so tend to be better suited for small fields or research projects less than 50 acres, she says.

To create mosaic images of whole fields, she uses a RoboFlight RF70 fixed wing. It can cover 1,000 acres per day taking photos at 2.5 cm/pixel resolution. She sends these images to AgPixel to be processed into colour infrared and NDVI full-field images, which Polziehn uses to identify treatment effects in trials, field variability, weed patches and soil variability.

“I chose to purchase a RoboFlight RF70 because it is cost effective, easy to repair in field, can run a 16,000 mAmp

battery to get 55 to 60 minutes of flight time and has a large wing span (5’11”) to maneuver through 30 to 40 km/h wind gusts without compromising imagery,” she says. “It consistently produces some of the best imagery for processing with AgPixel.” With her RoboFlight, she also got training from certified pilots and MissionPlanner software that makes it “easy to design flight lines.”

When asked whether drones can provide a return on investment, Polziehn says, “A drone is a tool that is really no different than my soil probe. How I collect the information, the accuracy of the information collected and what type of information is being collected will impact the ROI.”

With imagery, she can delineate soil variability due to areas with very high sand content, and use that information to make more accurate zones for fertility management. It can also help her scout for clubroot.

“I have been looking at using the imagery for weed management, in particular for size and distribution of weeds like wild oat. If we can use the imagery to detect wild oat patches, we may be able to be more proactive in resistance management or targeting only parts of the field that require different herbicide actives.”

Brad Hanmer Govan, SK

Brad Hanmer has used drones for two crop years, and he sees so much potential in “remote sensing” for agriculture that he started a company, RoboFlight, in 2014.

When listing the uses for remote sensing, Hanmer says it can determine the need and location for precision fungicide application, be used to justify pesticide application decisions for sustainability surveys, document the extent of chemical drift damage, accurately measure unseeded acres, and check pastures for carrying capacity.

Hanmer is also testing the concept of remote sensing for on-demand fertilization. “You put down a base amount of fertilizer, then top up as remote sensing demonstrates.”



Brad Hanmer

“Drones are the sizzle. Planes are the steak. A drone can cover only 1,000 acres in a day and needs two people. A plane can cover 20,000 a day, on average.”

—Brad Hanmer

Hanmer covered 5,000 acres with a drone in 2015, but his farm is 30,000 acres. He says the technology behind all the drone talk these days is “remote sensing” and drones are just one tool to capture the data. Planes and satellites are other options.

“Drones are the sizzle. Planes are the steak,” he says. “A drone can cover only 1,000 acres in a day and needs two people. A plane can cover 20,000 a day, on average.”

Image capture technology continues to improve to the point where low elevation drone flight is not really an advantage, he says. “At 1,000 feet, an airplane can provide six centimetre resolution. At 3,500 feet, they can provide 25 cm resolution.” This is good enough for biomass assessment used for fungicide and fertilizer decisions.

At the end of the day, fast and accurate images from remote sensing will improve the way Hanmer and other large operators farm. “Scouting 30,000 acres is not logistically feasible on foot,” he says. “Remote imaging is a better alternative to “gut feeling” when it comes to managing input costs on 30,000 acres.”

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Brock McIntosh Carberry, MB

Brock McIntosh has been working with crop consultant Trevor Thornton using drone imagery for more precise fungicide application in his canola.

Thornton uses a senseFly eBee drone with a camera that shoots regular colour images as well as near-infrared images (NIR). These NIR images are used to create normalized difference vegetation

index (NDVI) maps of field biomass. Thornton and McIntosh take these images and ground-truth them to define the biomass threshold where it makes sense to turn the booms on or off.

Thornton loads the on-off map into the sprayer and the on-board computer takes care of the rest.

McIntosh used the drone three years ago for sclerotinia stem rot management,

continued on page 13

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DRONE ONWARD

continued from page 11

“The amount saved on fungicide that year outweighed the cost of the drone and the information it provided.”

—Brock McIntosh

a year when crop variability was higher and the spray decision was not so straightforward. “The amount saved on fungicide that year outweighed the cost of the drone and the information it provided,” McIntosh says.

The past two years the decision was more clear-cut and the drone wasn’t needed — which may be one reason growers may not want to own drones themselves. Thornton’s eBee cost him about \$40,000, including the drone, camera and the post-processing computer. “Add in the time, training and agronomic knowledge required to operate the drone and make use of the data collected, and it’s highly unlikely that a grower would make it pay off,” Thornton says.

McIntosh also uses the drone as a diagnostic tool on his potato acres. “I hire the drone to fly my potatoes about once a week, looking for irregular patterns. When we see something, we go in and verify what it is,” he says. In this case, Thornton says it would be possible to use a much cheaper quad-rotor drone with a more basic camera.

Thornton also uses his drone to assess where a nitrogen top-dress will benefit a crop. It works similar to GreenSeeker, but for drone-captured NIR images, effective algorithms are established for wheat only. “I’m not confident in the canola data at this time,” he says. While GreenSeeker makes instant rate adjustments as the applicator moves through the field, the drone information has to be processed and then put into the applicator tool computer. But the drone can produce a needs-assessment map pretty quickly, Thornton says.

Shawn Senko Guernsey, SK

Shawn Senko farms with his family near Humboldt, and he’s also a Canola Council of Canada agronomy specialist. The CCC agronomy team tested a couple of DJI Phantom 2 Vision+ quadcopter drones in 2015. The quadcopter controller has a Wi-Fi receiver that connects to a cell phone. With the free DJI app, the phone controls the camera, provides a real-time view of what the drone sees and captures the images.

“As I don’t see a large segment of growers using NDVI imagery yet, I’d say a quadcopter would fit best for most on-farm uses at this time,” Senko says. When asked about return on investment, he says, “that remains to be seen. One possibility is field scouting, but I’m cautious to recommend it at this point with my little experience doing it.”

Senko worked along with CCC summer student Amanda Wuchner, who did a lot of the flying. During the summer, Wuchner completed a 20-hour online unmanned aerial vehicle (UAV) course to provide some basic training and a level of assurance that the CCC flew safely. The CCC’s drone is within Transport Canada’s two to 25 kg weight class so the operator does not need a Special Flight Operations Certificate (SFOC) for research or commercial purposes. ●

Jay Whetter is the editor of Canola Digest. Got comments on this article? Please email him at whetterj@canolacouncil.org.

With data collected daily on each cow, Canada's dairy producers can detect disease, improve feed choices and select top-producing cows. They also share data nationally to keep pushing benchmarks of productivity. Will the dairy experience make canola producers think differently about how to manage each acre?

By Kim Kennett

What dairies can teach us about data

The Rayner Dairy Research and Training Facility at the University of Saskatchewan is a treasure trove of information for the dairy industry. The state-of-the-art facility with both parlour and robotic milking capabilities opened in October 2013 and accommodates about 100 lactating cows.

Research at the facility focuses on: dairy nutrition and feed development, animal fertility and health, animal management, technology development, and developing green technologies to improve sustainability.

Morgan Hobin, manager of the Rayner Dairy Research and Teaching Unit, explains data collection processes at the facility: Our milking systems are connected to a centralized computer, which is linked to a transponder on the collar of every cow in our barns. Our robotic milker can tell us the production based on each quarter of the udder. It will also alert us to mastitis or other infections, blood abnormalities or if the cow has kicked the cups off for any reason."

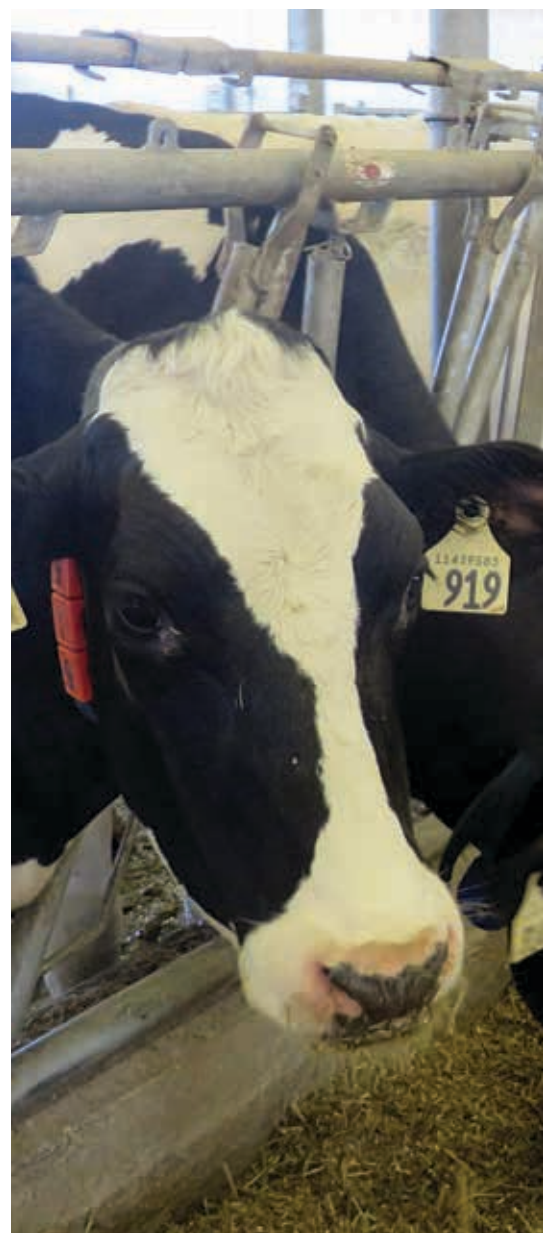
The main computer tracks milking rates, cow health and calving details. It can provide information on individual cows, specific groups (such as tie-stall

or robotic-milked cows), and can provide a snapshot of the entire herd.

Radio frequency identification (RFID) ear tags control feedings for each cow. Tags unique to each cow allow access to only one bin with rations specially formulated to meet that particular cow's needs depending on the stage of lactation or to fulfill research project requirements. Tags are registered with the Canadian Dairy Network (CDN) so if a cow is sold to another farm, a paper trail shows where that animal originated.

CDN, the national genetic evaluation centre for dairy cattle, keeps data on all dairy cows in Canada for breeding purposes. The processed data is available to Canadian dairy producers and member organizations, including breed associations, Dairy Herd Improvement (DHI) agencies, artificial insemination (AI) organizations and milk recording agencies. The Lifetime Performance Index and Pro\$, a new profit-based index from the CDN, enable producers and breeders across the country and worldwide to select bulls for AI. The extensive database traces all progeny to help reduce inbreeding.

The Rayner Dairy facility takes part in a number of non-mandatory data collection initiatives as well.



Dairies use RFID ear tags and neck transponders to track what individual cows eat, how much milk they produce and their health throughout their productive life. They can also use the data to compare the productivity and efficiency of each cow against herd and national benchmarks.



Morgan Hobin is manager of the Rayner Dairy Research and Teaching Unit. By entering data for individual cows into a national database, she gets a report that shows where Rayner cows fit into national benchmarks for productivity.



“We’re involved with the Dairy Herd Improvement Program through CanWest DHI. For each cow, we know the production, percentage of butterfat and protein of the milk,” Hobin says. “The cows are benchmarked. Every year we get a report as to where our cows fit in terms of productivity. We can set goals to improve our outputs and the quality of our milk. By being efficient, we’ll have fewer animals to milk, which will allow us to redirect staff time to other areas of the farm.”

Collecting data from each cow provides producers with the ability to manage – treat, feed, milk – cows on an individual rather than on a herd basis, which allows for optimum production from each cow.

“Individual cow data also supports a proactive rather than a reactive approach to predict or address small problems before they become larger issues affecting productivity of the animal and the producer’s bottom line,” Hobin says.

Take it to the fields

When asked how the dairy experience can be applied to the crop industry, Hobin had several suggestions.

“Record keeping can help a farmer keep track of various aspects: crop varieties planted, rotations, management practices, soil testing, spraying, fertilizer applications and yields. All of this data will provide producers with information that will be extremely helpful in improving their operations,” she says.

“A benchmarking program for the crop sector would also be useful. For instance, Brown Soil Zones in other provinces can be compared in terms of inputs and yields. This information can be interpreted by agronomists or university faculties to assist farmers in setting goals to improve management practices.”

She also encouraged the idea of sharing data and ideas among producers. “By establishing benchmarks, you will have a much better idea of effective management practices and how to become more profitable. Collaborating as an industry makes sense from efficiency and economic standpoints.”

Filippo Miglior, associated professor at the University of Guelph and chief of

research and strategic development at the Canadian Dairy Network, says the dairy industry is a success story because it’s so well organized. A lot of data is collected and shared to improve herds, management practices and milk quality. In the past 50 years, the average milk production per cow has doubled. Between 60 and 70 percent of this increase is estimated to be due to genetic improvement schemes, he says.

Miglior, along with Paul Stothard, associate professor at the University of Alberta, have recently received \$10.3 million in funding for genetic and genomic selection research to improve feed efficiency and reduce methane emissions in dairy cattle. The project will involve collection of daily feed intake data for cows and heifers for research herds at their respective universities and two large commercial farms. Data from partners in Australia, Switzerland, the United Kingdom and the United States will also be included.

“From the research, we will be able to select dairy cattle with the genetic traits needed to convert feed into increased milk production, while producing lower emissions of methane,” Miglior says.

Feed efficiency for dairy cattle can make a big difference in profitability and sustainability.

“Feed represents about 50 to 75 percent of the costs of operating a dairy farm,” Miglior says. “Development of feed-efficient cattle that produce lower methane emissions will save money on feed and will also reduce the environmental impact of the dairy industry because of fewer greenhouses gases. More feed-efficient animals also produce less waste.”

This thinking can be applied to the crop sector, he says. “If a farmer is able to grow the same amount of food with less land, it would free up land to produce other crops or for other purposes. From improving crop genetics to developing crops that are easier for animals to digest and convert into meat, any trait of interest can be targeted through collaboration and data collection.”

Kim Kennett is a freelance writer based in Saskatoon.

Grain farming is still about putting seeds in the ground, giving them fertilizer, protecting them from pests and harvesting mature plants, but the tools continue to evolve. This article explores major technological advancements at early adoption or coming soon to help growers farm more efficiently, sustainably and profitably.

By Jay Whetter

Off the drawing board

9 technologies that will change agriculture



1 Precise gene editing

Two major advancements are moving together to make for exciting times in genetics. Tools are available now that can map a genome in 14 minutes. With this, researchers can quickly compare the genomes of canola lines that perform differently under particular stresses, for example. They can then identify the genetic differences responsible for these responses and more accurately select for the desired genes.

The second major advancement is a host of new gene editing tools. CRISPR is one example, described well in a Radiolab podcast called “Antibodies

part 1: CRISPR”. As the podcast explained, CRISPR is low cost, precise and can be used on any species, making it a universal and highly effective tool.

The company Cibus has a gene-editing technique that employs a gene-repair oligonucleotide (GRON) to work within DNA's natural repair system and disrupt, add or correct target genes. Through this technique, Cibus has already brought sulfonylurea-tolerant canola to market, with 8,000 acres grown in North Dakota in 2015. The Cibus system and many others are non-transgenic, non-GMO.

New gene editing tools will bring many new traits to market, including advanced disease resistance, insect resistance and more complex traits such as cold tolerance, nitrogen use efficiency and water use efficiency. It can also change oil profiles to reduce saturated fat, for example.

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This diagram shows how Cibus's gene-repair oligonucleotide (GRON) works to change a gene. RTDS stands for Rapid Trait Development System. Photo: Cibus

Creating a change in the letters of DNA code using **RTDS™**

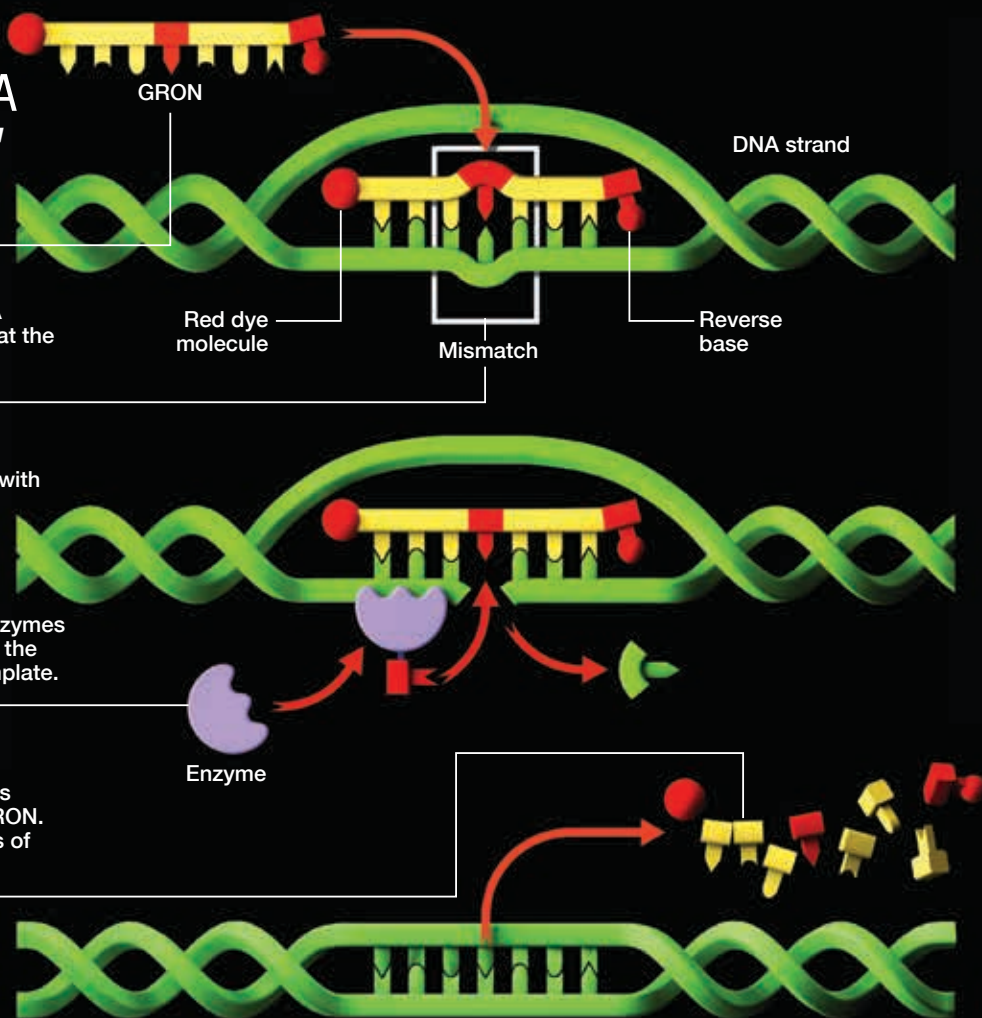
1 A Gene Repair Oligonucleotide (GRON) is paired with the plant DNA sequence. The pairing only occurs at the designed gene target region.

2 The GRON creates a mismatch with the plant DNA sequence.

3 The plant's native DNA repair enzymes recognize the mismatch and repair the plant DNA using the GRON as a template.

4 Following the repair the GRON is removed and the cell digests the GRON. This is all part of the natural process of cell division and multiplication.

5 The RTDS is complete and the targeted gene has been repaired.



2 Instant data-driven solutions

18 The following describes just one of many examples where data can start to drive practical solutions. “North America generates 20 terabytes of weather data per day,” says Tom Staples, director of Echelon with Crop Production Services, in High River, AB. With this massive amount of data and some proprietary modelling, weather forecasters can take historical weather and current weather phenomena (such as sun activity and ocean temperatures) to come up with a more accurate seasonal forecast for the growing year. This information could help with many decisions, including which variety to choose.

How a variety performs under different environmental conditions is called phenotyping. Through phenotyping, researchers can identify how a certain genetic package performs

Tom Staples, director of Echelon with Crop Production Services, in High River, AB, says data will improve seed decisions, making it possible to more accurately align varieties with a farm's particular growing conditions.



under various stresses and can use this information to discover genes responsible for these stress responses. Using accurate seasonal weather forecasts layered with locational variety performance data, phenotyping of commercial varieties, and farm location, programs can start matching ideal canola varieties to the conditions expected that year.

“Growers won’t have to spend time researching these decisions anymore,” Staples says. “The data-driven program will make it for them instantly.”

3 Robots

Daniel Lee, a robotics specialist and professor in the department of Agricultural and Biological Engineering at the University of Florida, has worked on robots to identify weeds. Robots accurately move up and down rows using GPS in combination with feelers or laser-scanning to “see” the crop rows. The more challenging step is to identify the weeds among the crop. “Weeds are identified mostly using machine vision with various techniques such as colour, shape, texture, location and plant height. The identification algorithm requires a training process,” Lee says.

He provided two examples of tools that could be mounted on robots to remove weeds. One is a mini hoe-style

Rowbot works between corn rows top-dressing fertilizer when the crop is too high for a full-size applicator. The robot allows for application when the crop needs it.

Photo: Rowbot

weeder from the University of California at Davis that mechanically removes weeds from between crop rows. The other from Blue River Technology in California can very accurately spot-spray. The current application is to thin lettuce crops, spot spraying all extra plants along a row, leaving only those spaced the right distance apart. This technology could be modified, in theory, to send out a robot to remove all canola volunteers that are not in the seed row.

Robots will do more than manage weeds. Rowbot drives between corn rows all through the season to apply nitrogen fertilizer in sync with corn needs. “A small, robotic platform opens up new ways to do field work that can maximize the needs of the plants,” says Kent Cavender-Bares, CEO of Rowbot Systems in Minneapolis. “The example with corn is that we can apply nitrogen or seed cover crops at the best time for the crop, rather than the best time for today’s machines.”

Robot research today tends to focus on high-value vegetable crops or high-acre crops like corn. As the technology moves along and is proven, uses suitable to canola and wheat will come. Concepts that could suit the Prairies include a robot that can cover the whole farm, taking and sorting soil samples using a prescribed map.

4 Smart machinery



At the touch of the autopilot activation button — marked with an “A” and a steering wheel — the brain inside a Lexion combine takes over. The button activates three systems simultaneously: auto steering, cruise pilot and Cemos Automatic. With Cemos engaged, the combine senses changing conditions and continuously adjusts separation and cleaning settings to maximize performance. Photo: Claas



With onboard computers and electrical controls for many settings, combines — for one example — are getting smarter all the time. Lexion combines have the Cemos Automatic system to sense changing conditions and continuously adjust separation and cleaning settings to maximize performance. Operators can choose from pre-programmed strategies, such as reduced harvest loss, clean sample or maximum throughput, and the machine then automatically adjusts rotor speed, rotor covers, fan speed and sieve positions on-the-fly to match the strategy.

John Deere's new Interactive Combine Adjustment is a similar concept. Operators choose a harvest priority — “minimize grain loss” is one option — and the combine adjusts fan speed, chaffer and sieve settings, and threshing clearance as needed to suit that priority. “Manual adjustment can

be made, but the combine will not give the operator a setting adjustment that will sacrifice the priority,” says Kathy Sponheim, senior product manager with John Deere's Intelligent Solutions Group (ISG). One can see how these smart combines matched with accurate autosteer and field mapping make fully autonomous combines possible today, tech-wise.

5

Autonomous field machinery

Advancement in autonomous vehicles is moving along rapidly. Google has its hands-free car going all over the place. In October, Daimler drove its Mercedes Highway Pilot transport truck in hands-free autopilot on a busy German highway. While the truck can operate fully autonomously, Daimler's engineers still stress that a driver must be present in the cabin. In time, that need will likely change as the technology becomes commonplace and people — along with government regulators and insurance companies — become more comfortable with it. Moving to farm fields is a logical extension of this technology. With the difficulty some farms have in attracting qualified combine drivers for just a few months each year, robot combines could be a big help.

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In October, Daimler drove its Mercedes Highway Pilot transport truck in hands-free autopilot on a busy German highway. Photo: Daimler





Scouting by air

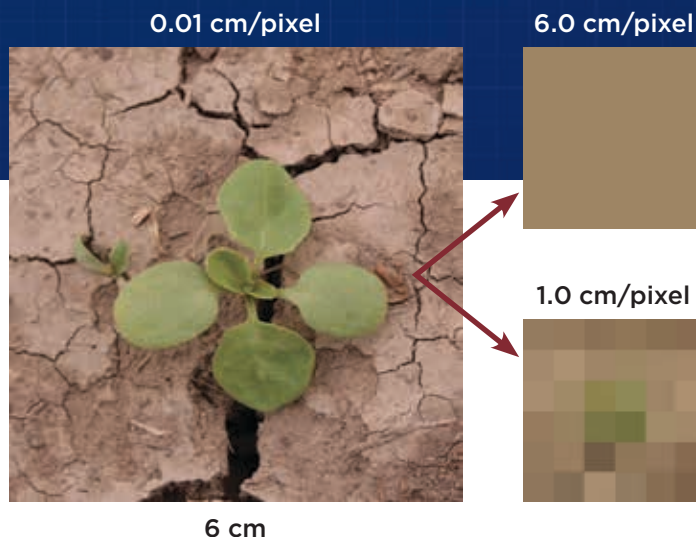
Aerial images have been with us for a while. Aerial images can currently provide NDVI to show differences in biomass, which can be ground-truthed to see if the cause is disease or fertility or frost, for example. But what about imaging for more refined crop scouting? Chris Neeser is a weed scientist with Alberta Agriculture and Forestry in Brooks, and he's researching how drones may help in weed management.

Drones, planes and satellites can take pretty clear photos, but the files are huge. A mosaic image of an entire quarter section with a ground resolution of one cm per pixel would be in the 15 gigabyte range. Images this large take a lot of time to create, they open slowly, and service providers just aren't able to handle many of them. At this time what is feasible, Neeser says, is to take photos that cover a small area (say four square metres) and repeat that across the field in a grid-like pattern. A few images could be used as benchmarks for weed development to be used for pre-seed burnoff decisions.

After crop emergence, these images could show weed growth between crop rows as an indicator of which crops need to be sprayed first. "What is not yet possible is to locate plants and identify them by species," Neeser says. "Actually it would be possible if we only had to deal with a small number of species that are easily distinguishable by leaf shape or colour. Of course reality is a lot more complex. Weeds and crops change leaf shape as they grow, leaves overlap and colour can be unreliable because of changing light." These challenges are not insurmountable, he adds. "It's mostly a matter of getting people with the right skills to work on this sort of problem."

Layering the technology: When images are good enough to map areas in a field that would benefit from a tank mix to take care of suspicious patches, it would help if sprayers could tank mix

Ground resolution at 1 cm/pixel?



The photo on the left is taken at ground level with a regular digital camera. The top right photo was taken with a drone at resolution of 6cm per pixel. Pixels have one colour, so this image completely misses the weed. The bottom right photo was taken with a drone at 1 cm per pixel resolution. At this resolution, an aerial image can indicate the presence of weeds between seed rows, which is helpful information when making weed timing decisions, but cannot identify specific weeds. Photo: Chris Neeser

on the fly to perform instant on-off of products needed only for specific weed patches. Tom Wolf, owner of AgriMetrix, described two technologies already introduced that could do this. First is the second tank and second set of plumbing and nozzles. "This option was sold for a few years in the '90s on pull-type sprayers in Western Canada," Wolf says. "The second tank was filled with the spot-spray herbicide and it was delivered with a second pump. So it was two sprayers in one, used as needed. They've all but disappeared now."

The second option is direct injection. "The sprayer tank contains only water. Several reservoirs on the sprayer hold active ingredients straight from the jug. A tiny, but very accurate pump delivers the active ingredient to the boom line, where it mixes prior to being sprayed. A second and third active can be added, limited by the number of reservoirs," Wolf says.

Raven Sidekick Pro is a direct injection option. As Raven tech support says: "If the field computer used in conjunction with the Sidekick Pro has variable rate capabilities, the application rates can be changed via a prescription map. Spot spraying can also be done."



Sensors everywhere

From smart machinery to aerial imagery to field scouting, the ubiquity of sensors will be at the core of advanced productivity and better decision-making. Sensor technology will automatically detect crop stresses such as nutrient shortages, insect pressure or disease risk so growers can make more knowledgeable and timely decisions on if, when and how to manage these stresses. Warren Bills, in digital farming business development with Bayer CropScience, lists four sensors that could improve canola management decision-making. Three of them would enhance the ability to detect specific issues from overhead using UAVs, planes and satellites.

The first of these three sky-based tools are hyper-spectral sensors that can detect thousands of colour wavelengths coming off a field. Current multi-spectral sensors typically detect four wavelengths. While the amount of data a hyper-spectral sensor can collect currently exceeds the input capabilities of commercial



Leaf wetness sensors detect the presence, duration and amount of dew in the canopy. This could be used as part of sclerotinia stem rot risk assessment to help with fungicide decisions. Photo: Decagon Devices

computers, these sensors will make it possible to identify wavelengths specific to certain crop stresses and diseases.

Second, thermal sensors — which could also be mounted on UAVs or planes — can read changes in heat patterns coming off of crops. “Stressed plants have different temperatures from healthy plants,” Bills says. “Thermal measurements can be better than leaf area or biomass indexes at detecting crops under stress.” With these first two sensors, agronomists really could use aerial imagery to diagnose disease presence and severity without the same need for ground-truthing that current sensors require.

Bills’ third sky-based sensor is ground-penetrating radar to show soil moisture levels. With flyovers in the fall and spring, growers can get soil moisture profiles for a field quickly without having to walk each field with a soil moisture probe. This is helpful for spring fertilizer decisions, to give one example.

His fourth sensor of note is a field-based leaf wetness indicator to show the presence, duration and amount of dew in the canopy. Wetness is an indicator of the sclerotinia stem rot risk and can help with fungicide decisions.

Susie Li, research scientist at Alberta Innovates – Technology Futures in Vegreville, AB is working on another helpful sensor for sclerotinia stem rot management. Her sensor can identify and count sclerotinia spores (and *L. maculans* spores, which cause blackleg). Her team is now packaging the sensor into a field-ready unit. The next step is to correlate spore counts to a threshold so growers can get an accurate “spray” alarm.

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Researchers at the University of Manitoba are using ONSET leaf wetness sensors to find out if leaf wetness in the canola canopy can be used as a predictor of sclerotinia stem rot development. Photo: Manasah Mkhabela

Setting New Standards

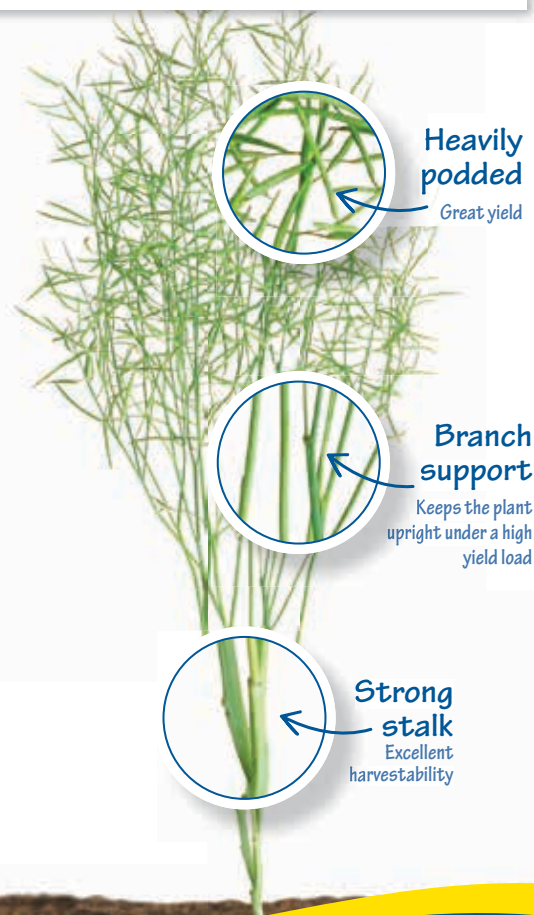
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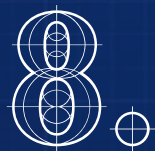
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*This is what the phosphorus filter
production unit will likely look like.
Photo: Steven Safferman*



Nano-filters to recycle phosphorus

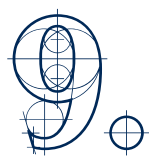
This one is perhaps more obscure, but a biggie for two reasons: phosphorus runoff feeds algae blooms that can kill lakes, and the world faces a shortage of easily accessible phosphate for fertilizer. A Massachusetts Institute of Technology (MIT) phosphorus supply and demand report claims: "At current production rates, the world's phosphate production will reach its maximum before 2040, and enter a long, slow decline. However, the world's consumption levels will continue to rise, creating an ever-widening supply-demand gap."

Steven Safferman, associate professor and researcher at Michigan State University, worked with MetaMateria Technologies in Columbus, OH, to develop and bring to market a filter of tiny (20 to 60 nm) iron oxyhydroxide fibres that capture phosphorus as liquid passes through. MetaMateria has commercial-ready filters that can work with manure treatment facilities, municipal water treatment plants, or on outflow from tile drains in fields. Captured phosphorus can be reused as fertilizer.

Richard Schorr, CEO of MetaMateria, says the cost of phosphorus fertilizer will increase dramatically without economical approaches to recover phosphorus. "The nano-modified media adsorbs over 10 times more soluble phosphorus per kilogram than other sorptive media and can be regenerated and reused multiple times, thereby lowering the cost to capture the phosphorus," Schorr says. "And because phosphorus is removed as a soluble ion, it can be precipitated in usable forms at a low cost."



MetaMateria Technologies has commercial ready nano-filters with tiny iron oxyhydroxide fibres that capture phosphorus as liquid passes through. Captured phosphorus can be reused as fertilizer. Photo: MetaMateria



Carbon fibre

This may not be a huge game-changer like other technologies, but moving away from a reliance on steel machinery parts does have advantages. Carbon fibre is lighter and stronger than steel, so it could mean less fuel burned carrying the weight of equipment through a field, less compaction, and longer life for machinery.

King Agro based in Argentina builds carbon fibre sprayer booms. Carbon fibre weighs 5.5 times less than steel, is six times stronger and doesn't corrode, King Agro claims. The company can make carbon fibre sprayer booms up to 150 feet wide that, it says, can handle field speeds of 20 mph.

"Even if the piece itself is more expensive than a regular steel boom,

the comparison is not linear since you can accomplish performances with carbon fibre that would not be possible with steel," says King Agro general manager Gerónimo Garvie. "Therefore the cost-benefit ratio is very good, and the final operational cost can be substantially lower." Besides lasting longer, the lighter weight of carbon fibre means smaller sprayers can handle larger booms, and wider booms mean fewer passes and less crop trampling per field.

Carbon fibre applications will continue to expand. BMW now uses carbon fibre parts in the frame of its i3, i8 and 7-Series cars, with more to come. Carbon fibre can improve crash safety. For example, the 7 Series' carbon-fibre door sill is meant to keep the side of the car from bowing inward in a side-impact. And as reported at extremetech.com, using a few parts made from carbon fibre instead of steel shaved 300 pounds off the car's weight.

In agriculture, lighter and stronger building material could provide many advantages. Lighter headers, for example, could take some stress off the combine's front end. "We believe carbon fibre technology has many potential applications in the ag business," Garvie says. "Cost restriction will probably be a filter, however it does seem reasonable that future machines designed on a new principle of lightweight could have a majority of parts made with composite material." ●

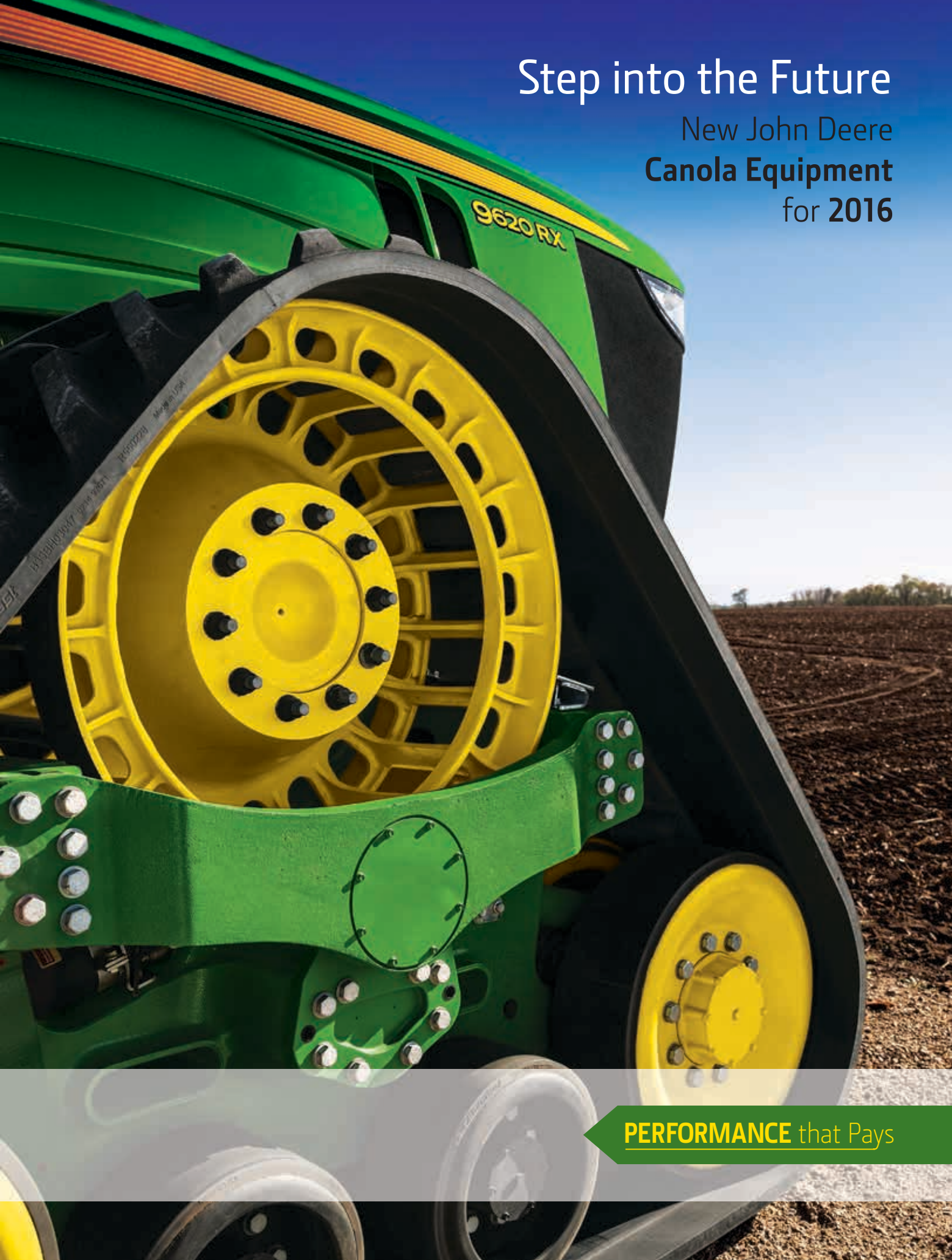
Jay Whetter is the editor of Canola Digest. Got comments on this article? Please email him at whetterj@canolacouncil.org.

John Deere will offer this King Agro carbon fibre boom as an option on its 2016 Model 4730 sprayer sold in the South American and Latin American markets. Carbon fibre is lighter and stronger than steel. Photo: John Deere



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speed changes and can deliver prescription rates based on your defined management zone. Add a boost of uptime to your efforts with two key valuable systems: Load Command™ provides speedier load times and automatic disengage once the sprayer tank is full; Direct Injection lets you change rates and products on-the-go without stopping to mix.

You've done the work to get your canola to full growth; now it's time to get the full potential out of your field. We have a couple of options to help. First, for farmers who prefer to swath, go with the new **W155 Windrower**. The W155 allows full-width use of the platform with speeds up to 12 mph (19 km/h) to cut more crop in less time. Not only does the W155 have higher horsepower than its W150 predecessor, it delivers faster acceleration without stalling. And a new integrated AutoTrac option helps to reduce any operator fatigue.

For the straight-cutters among you, you're sure to appreciate the **2016 S-Series Combines**. They feature the entirely new Dyna-Flo™ Plus cleaning system. In limited shoe conditions, your total combine capacity in canola is heightened by 13%, providing 1.5 more acres harvested per hour. Equally as important, you get a 28% reduction in tailings volume. Add to that our new Active Terrain Adjustment option ... it adjusts the settings of the Dyna-Flo Plus shoe when working slopes. So if you have rolling terrain, this is a must. Active Terrain Adjustment ensures your combine maintains ground speed and minimizes grain loss whether you're going uphill or downhill. And don't forget our 2015 offering, the tough small grains package, which provides canola growers 20% more throughput. Add it all up and what you have is the most canola-focused combine ever engineered. Enjoy.

Total Tech Solutions for your Full Canola Cycle

Having a full suite of canola equipment is about more than just the equipment you put into your field. It's also about the tools you use in the cab and in your office. Of course, we have a whole host of tech solutions to get you through the crop cycle.

It starts with the **Operations Center** within MyJohnDeere, where you have the ability to turn your information into a plan of action. Collect data quickly and easily, analyze it to make precise conclusions, and easily share it with your trusted advisors.

Maximize the value of your sprayer and seeding equipment with **Section Control**. It improves machine efficiency by reducing overlaps and skips in the field, helping you save on input costs.

By now you're familiar with **AutoTrac**, but here's a refresher: with this hands-free guidance tool, we take the pressure off manual performance and put it in the hands of our assisted steering technology. Serving as both a convenience and cost of ownership solution, AutoTrac can reduce input costs, lower fuel usage, and improve your overall operation.

Check out **Machine Sync**, our innovative machine-to-machine communication and logistics tool for increased productivity in the field. It simplifies unloading on-the-go by automating the position of the grain cart relative to the combine. And during seeding operations, coverage maps and guidance lines can be shared between tractors increasing productivity when running multiple seeders in the same field.

Then there's **Harvest Mobile**. It works directly from your iPad in your combine cab to deliver in-depth info on field performance by visualizing mapping layers such as ground speed, wet and dry yield, and average moisture. You can see exactly what's going on in your field. And it displays machine settings, like rotor speed, fan speed, and more. Harvest Mobile also enables Interactive Combine Adjustment (ICA). ICA simplifies machine controls to help the operator go from novice to know-it-all in far less time.



JOHN DEERE

Variable rate technology has been discussed for years but uptake is still low among growers. Six experts on agronomy, fertility and variable rate applications dig into some of the barriers to entry.

By Bruce Barker

Variable rate technology: An expert Q&A

Variable rate technology is more readily available than ever before. But does it pay? *Canola Digest* asked soil, agronomy and variable rate technology (VRT) experts for their opinion on four key questions.

The experts are Terry Aberhart, owner of Sure Growth Technologies at Langenburg, SK; Wade Barnes, president of Farmers Edge, Winnipeg, MB; Alan Moulin, research scientist at Agriculture and Agri-Food Canada, Brandon, MB; Jeff Schoenau, soil scientist at the University of Saskatchewan; Tom Staples, director with Echelon, part of Crop Production Services, High River, AB and Cory Willness with CropPro Crop Consulting in Naicam, SK.

Q: How can a grower make VRT pay?

Terry Aberhart: Almost all equipment less than five years old is VR ready, so the cost of additional equipment is not as large as it used to be. A properly planned VR program backed by solid agronomy will return typically at least a 3:1 return on investment.

Wade Barnes: Based on the data we've collected there is almost always a payoff in using VRT on the farm. The times when we've seen a negative return is generally correlated to not having the right field data or not targeting the correct yield potential for management

zones. VRT is only part of the value component of a farm implementing a precision agronomy program. With better data, we make better decisions including getting better results with your VRT programs. The focus should not only be on the increase in yield. Benefit also comes from decreasing inputs, and thus leading to sustainability. Farmers are now compensated for sustainable practices such as carbon offsets and the development of premiums for sustainably grown grains.

Alan Moulin: I do not have any economic data to confirm the returns on variable rate management apart from a study published in 1997 which showed a return of approximately \$10/ha (Beckie et al. 1997) for a plot-scale study. Economic data from our Canola Council of Canada project will be analyzed once all the 2014 to 2016 data for the current variable management study are available.

Jeff Schoenau: Limit the number of management zones per field to a reasonable number. Also, delineating zones that provide large contrast in soil conditions and productivity potential will provide greater likelihood of the varied input giving a significant response.

Tom Staples: Due to crop, soil and weather conditions in Western Canada, the largest “bang for the buck” in varying inputs comes from variable rate nitrogen (N). The core philosophy of variable rate N is limiting the amount

“Due to crop, soil and weather conditions in Western Canada, the largest “bang for the buck” in varying inputs comes from variable rate nitrogen.”

—Tom Staples

to what matches the crop's demand in areas of poor productivity (dry, saline or other) and increasing the amount of available N in areas where good growing conditions enable the crop to positively respond. Over 10 years and across thousands of variable rate acres in all kinds of soils and weather conditions, CPS and Echelon have demonstrated that variable rate N generates a five percent or greater increase in yield while using the same amount of nitrogen fertilizer that the grower would have used in a flat rate scenario.

Cory Willness: To measure the value of VR, the key to getting a good return will mostly be related to the price of the service, accuracy of the zone maps, annual soil sampling and sound fertilizer recommendations. If the zones represent the field and the zone soil testing is done properly on every field every year, if you have a high level of confidence in your agronomist, and if the annual fees are fair, VR will pay off. If those four things don't line up, you are unlikely to get a return.

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Jeff Schoenau, soil scientist at the University of Saskatchewan, says weather variability is a challenge in creating a VR prescription. "Weather is a wild card that can cause the relationship between input application and crop response in management zones to vary greatly from year to year, sometimes completely reversed," he says.

Q: What data is most important in order to put together a variable rate program?

Cory Willness: The most important data to develop proper zone maps for VR is a soil, water and topography map. This can only be accomplished with a high-grade elevation map and soil sensors (typically electrical conductivity but perhaps others). This type of map will separate the field into common sense zones that typify the soil types and water related properties. A solid soil, water and topography map layer should form the basis of soil sampling programs and recommendations as fertilizer response varies across the field predominantly by these three factors. Yield maps and biomass images from satellites, plane or drones are very useful in developing yield goals, but they don't provide a base layer for fertility or moisture. Soil fertility and soil sampling start with the word "soil" for an obvious reason.

Tom Staples: At its core, the goal of any variable rate program is to predeter-

mine the response curve of the crop and the probability of achieving that response. Echelon has determined that the most consistent, affordable and scalable methods are those that incorporate actual measurements of yield potential (such as multiple years of multi-spectral imagery and/or yield data) in combination with as many other layers of information as are economically available. The layer that is most critical is the grower's own knowledge of the field.

Jeff Schoenau: Soil properties like organic matter, conductivity, texture, pH, depth to carbonates, nutrient content and supply, and topographic position are all shown to correlate with yield and productivity in various studies. However, not all properties are strongly correlated or correlated to the same extent in all studies. The strength of the relationship can vary from field to field, area to area, with crop type and management history. As well, the history of crop parameters — yield and protein — can help delineate meaningful management zones, as can remote sensed information like aerial photos and normalized difference vegetation index (NDVI) imagery. Collection and assemblage of a number of past years' data to analyze trends is especially useful.

Alan Moulin: In my opinion the predictor of yield is an analysis of several years of yield data. Preliminary analyses

of current CCC data show that, on average, yield response to fertilizer increases with N input, and from low to average and high yielding zones. However there is considerable variability between sites, and there are several fields where this relationship is not significant. Furthermore these results are for one year (2014) of a three-year study (2014-16).

Wade Barnes: The right data is the most important, which means all the data. We believe that having a consistent data strategy, which is scalable and realistic to implement, is important. We believe soil, yield, applied inputs, weather, machinery and variety are all important, but the most important element to developing decision tools in agriculture is having field centric information.

Terry Aberhart: The basis of any good VR program is creating good zones that are relevant to the variability of the soils in that area combined with strong agronomic advice. The right basis for creating zones or approaches may differ across different growing regions or areas.

Q: Which is better: Variable rate fertilizer based on past productivity/field features or based on real-time in-crop needs (eg. Greenseeker)?

Jeff Schoenau: Both these approaches have been shown to be effective. A real challenge in developing effective prescriptions is sorting out and predicting the production potential in each of the zones for the upcoming season. We often have a rather large range of "normal" here on the Prairies. Weather is a wild card that can cause the relationship between input application and crop response in management zones to vary greatly from year to year, sometimes completely reversed.

Alan Moulin: Real-time application of fertilizer using a reflectance sensor has shown a benefit. Research at Indian Head, SK indicated that sensor-based N management [using Greenseeker – editor]

performed well compared to the conventional practice of banding N fertilizer at seeding. However soil moisture at the time of application can affect fertilizer application results based on sensor measurements. Consequently there is considerable variability associated with this technology.

Cory Willness: The majority of farmers in Western Canada are willing to go all-in and apply all their fertilizer needs near seeding to grow high-yielding crops. With short season crops that have relatively low fertility requirements, such as barley, there is limited time and value to start top-dressing with another equipment pass. With long season crops that are heavy fertilizer users in a more stable environment (such as corn under irrigation), top-dressing and in-crop sensors can provide value.

Tom Staples: Depending on the application, the majority of in-season fertilizer in Western Canada has been shown to be inefficient and often logistically impossible. This is due to many agronomic and logistical reasons, including the shortness of our growing season and the narrow window of growth stages of some crops where a yield response can be generated by mid-season applications of nutrient. However, in-crop real-time sensors do show promise for collection of another “layer of data” that could be used for generating a variable rate prescription in successive years.

Terry Aberhart: It really depends on what you are trying to manage. Past productivity approaches mainly are best for pre-plant application and long-term planning. Real-time in-crop approaches are best for managing in-season variability. In-crop approaches can be very effective for things like VR fungicide.

Wade Barnes: We have had more success in developing strategies using historical and in-season data to create pre-applied prescriptions. In the future, real time prescriptions may become a better option, but the prescriptions will need to take into account all the field centric data (including historical) in the algorithm rather just a sensor reading.



Cory Willness, who runs CropPro Crop Consulting in Naicam, SK, says VR will pay off if the zones represent the field, if the zone soil testing is done properly on every field every year, if you have a high level of confidence in your agronomist, and if the annual fees are fair.

Q: VRT is not just about N fertilizer. When it comes to canola, what VRT practice is most likely to provide a return on investment?

Terry Aberhart: VR fungicide has, in canola, been a big success as well.

Wade Barnes: In the data we've collected, N has had the largest return on investment. We believe that the proper use of data will pay as large a dividend, rather than a focus on strictly VRT. Using data that comes from developing a precision ag program can help farmers pick the right variety for each field or choose the exact timing of a fungicide application with the correct product. When you add VRT alongside decision tools derived from field centric data, which is generally created from VRT, you can create tremendous value for the farmer.

Alan Moulin: The highest input cost for small grain and oilseed crops is nitrogen fertilizer (Beckie et al. 1997), so I anticipate that variable management of N would provide the most return on investment.

Tom Staples: Variable rate seed has less potential for canola, and in fact can be a risky endeavour. The ROI on VR

canola seed is just not that high. In the work we have done with VR fungicide, the canola isn't as responsive to changing rates of the active ingredient. There is some opportunity to “shutting off the nozzle” in areas with little or no crop establishment, thereby saving some input costs in small areas of the field. However, the potential ROI is small.

Cory Willness: The answer is “it depends”. In depressions that have light salinity or flooding, VR seed can pay off by increasing seed rates and improving plant stands. But if the salinity is too high or the depression floods, all the canola will die anyway. VR fungicide, perhaps as simple as on or off, also can make sense if 80 percent of the field has a heavy canola crop and 20 percent of it is flooded out and dead. But under average conditions, we often can't even get the decision right about when it pays to spray fungicide on canola, so this is a much bigger profitability issue than varying fungicide rates. If the decision to add VR to other inputs has multiple question marks, and involves extra costs and extra work for the farmer, then maybe let the neighbours try it first. ●

Bruce Barker is a freelance writer specializing in agriculture production.

This article, the third in a series on agonizing agronomy decisions, looks at the question of whether to reseed a poor-looking canola crop.

By Taryn Dickson

To reseed or not?

30 **A**t the end of the growing season it's easy to look back at the choices you made and either pat yourself on the back or wish you'd done something differently. This past season many growers had these reflective thoughts in relation to their reseeding choice.

For some growers it worked out well to reseed. Some did well by sticking with their original stand. Others didn't get the results they hoped for with either strategy. The reseeding decision will always be a bit of a gamble, but by considering all the factors and focusing on higher-probability practices, you can give yourself the greatest possibility of success.

Justine Cornelsen, Canola Council of Canada (CCC) agronomy specialist and stand establishment lead within the agronomy team, relies on research from hundreds of trials across Western Canada to support her advice to growers.

"If you still have about five plants per square foot after flea beetle, cutworm and seedling disease pressure, it is still

possible to achieve 100 percent yield — provided the stand is uniform," she confirms.

In fact, data show plants can produce 65 to 90 percent of their yield potential at just three plants per square foot, depending on conditions. A recent three-year study out of the Western Applied Research Corporation (WARC) in Scott, SK determined that canola could achieve 90 percent of its maximum yield with a plant density of just 18 plants per square metre (approximately 1.7 per square foot).

Conversely, the WARC study also reported a yield and economic benefit from reseeding in May or early June when plant stands were 20 plants per square metre (around two per square foot) or less. However, the concluding comments from this study cautioned that if conditions didn't allow for it, reseeding was not recommended.

When growers are close to that minimum threshold, Cornelsen reminds them

they have more to consider than just going after a slightly higher stand count.

"If you reseed, you're going to be playing catch-up all year," she said, considering some of the drawbacks of this option, including the five-day delay (on average) that was reported in WARC's reseeding trials.

Reseeding can tighten up an already limited growing season; present a dilemma for final seed quality (often increasing the distinctly green seed content); and add costs for fuel, time and machinery usage, in addition to potential compaction. Loss of soil moisture can also occur, and growers face extra seed costs (in many cases). There is also the predicament of how to fertilize the new crop, since estimating nutrients remaining from the initial planting can be daunting.

"On the other hand, if you stick it out with a lower stand count, you'll have to keep a closer eye on that field," Cornelsen says. "You'll have to monitor it more frequently than other fields and give it priority on the timing of insect and weed control to give it the best chance at success."

Canola is a resilient and adaptive crop, so low plant stands often lead to increased branching and podding (which may present challenges for even maturity) and a thicker stalk, which could be tougher on equipment. Fewer plants can also mean increased weed pressure or increased vulnerability to the impact of environmental stresses, such as flea beetles, cutworm or seedling disease.

One alternative is to reseed only the portion of the field most affected by frost, drought or flood. However this can be tricky and will increase the variability within the field. Another option is to seed a *Brassica rapa* variety, which generally requires fewer days to mature, although recent research found no increase in overall yield with this.

If reseeding, it should be done as early as possible, as long as soil temperature and moisture are favourable. Some yield benefit has been determined when reseeding was completed in May or early June, but not in mid-June.

In 2015, reseeding turned out to be quite successful for Manitobans who

"If you reseed, you're going to be playing catch-up all year. ... On the other hand, if you stick it out with a lower stand count, you'll have to keep a closer eye on that field."

—Justine Cornelsen

were able to reseed early enough into warm, moist soil and then experienced a conveniently long fall. In addition, insurance and seed company compensation options tipped the economics in favour of this decision.

How to assess a stand

The first step to making the correct reseeding decision is to properly assess your stand. Walk the field in an “X” or a “W” pattern (not just at the field’s edge) with your sampling hula hoop (or alternative method for sampling) and count the number of plants per square foot in 25 or more locations, making sure to check the high and low spots.

If your average count is one to two plants per square foot, it could still be fine to leave — depending on the evenness of the stand, latitude of your field and calendar date. For instance, it may be favourable to reseed a variable field with 1.5 plants per square foot early in the spring, but it is much less favourable for an uneven stand in mid-June.

Of course, the stand count should only include plants that are alive and healthy with an active growing point — which was crucial to check for many growers who dealt with spring frosts in 2015.

“To properly assess the damage, plants should be assessed three to four days after a frost event,” Cornelsen says. “Look at the growing point on top of the plant for fresh green growth to indicate that the plant is still alive.”

Other spring pressures can be overcome by using slightly higher seeding rates, optimizing seed placement (often by simply reducing seeding speed) and keeping volunteer canola to a minimum.

So, while some success stories from localized regions in the Prairies in 2015 may make reseeding sound appealing, in many cases it is often still better to hold off and make the most of the stand you have. Or check with your local CCC agronomist if you aren’t sure! ●

Taryn Dickson is resource manager for the Canola Council of Canada’s crop production and innovation department.



What plant count would you have estimated for a field that looked like this? Would you have guessed that there are 2.2 (top), 5.2 (centre) and 8.6 (bottom) plants per square foot? Even thin stands can end up producing respectable yields, especially with additional monitoring.

The Canola Council of Canada hosted the Canola Discovery Forum in Canmore, AB, in October 2015. Here are a few forum discoveries to think about as you make plans for 2016 and beyond.

By Jay Whetter

10 Discovery Forum discoveries

The annual Canola Discovery Forum digs into scientific discovery, research needs and new practical applications to improve production, profitability and sustainability of canola. The forum is an opportunity to “discuss new ideas for what should be done and could be done,” says Alberta Canola Producers Commission director Daryl Tuck.

Here are 10 highlights:

1. More plants mean less variability

Canola at lower plant populations can branch out and produce just as many pods as canola at higher plant populations. Stands with low plant counts can also yield as high as dense stands. But the wide range of yield variability that results from lower populations is often overlooked in this comparison.

Neil Harker, research scientist with Agriculture and Agri-Food Canada (AAFC) in Lacombe, AB, demonstrated that stands of five and 10 plants per square foot can both reach full yield potential. But the yield range with five plants is actually 78 to 100 percent of full potential while the yield range with 10 plants is 92 to 100 percent of full potential.

More plants buffer against plant loss from flea beetles and frost, for example, and a uniform stand of 10 plants will mean the crop is at a tighter range of staging than the bigger, branchier plants

with lower populations. This can mean earlier maturity, more uniform staging for harvest timing, and lower harvest losses. Earlier maturity also reduces the likelihood that canola yield will be affected by heat stress during flowering and podding.

Knowing your plant stand and comparing that to yield results, harvest timing and all-season management is an important step in setting a true profit-driven seeding rate. But as Owen Kinch, SeedMaster field research manager, said at Canola Discovery Forum: “Very, very, very few people actually know what they have for canola plant populations.”

2. Seeding canola at a uniform depth is more challenging than we realize

The common recommendation is to seed canola at a consistent depth of ½” to 1”. But as Lacombe, AB canola grower Craig Shaw noted at Canola Discovery Forum, the best a precision tool could achieve is 1” variation from shallowest to deepest seed placement, and 1½” is more common. That means a typical seeding operation will put some seed at ½” depth, some at 2” and the rest at all points in between. “We are asking a lot of our seeding equipment,” Shaw said.

A level drill with well-maintained openers and tires is just part of the picture. Fan speed also influences seed

“Very, very, very few people actually know what they have for canola plant populations.”

—Owen Kinch

depth. Airflow is inconsistent from row to row, and the increased airflow required to carry fertilizer often means excessive and unpredictable seed bounce in the row. For improved canola seed placement, we may see a move to metering at the opener, which could improve seed placement down the row and provide consistent airflow in the last stage of seed drop.

3. Are we moving backwards in our application of nitrogen?

Mario Tenuta, soil ecologist with the University of Manitoba, asked this question in his presentation. Research in the 1970s and '80s showed that banding nitrogen (N) helps reduce losses and improves crop uptake. But with time constraints to seed larger acreages and seeding equipment not keeping up with increased N application rates, more growers are applying broadcast fertilizer, Tenuta said. By moving from banding to broadcast, growers are losing value from their N.

Ross McKenzie, crop nutrition consultant who recently retired after 38 years with Alberta Agriculture in

Lethbridge, said the best growers can hope for is 70 percent efficiency — as in 70 percent of applied N is actually taken up by the plant. This would be for N side-banded or mid-row banded into the root zone at the time of seeding. His second choice is banding in a separate pass from seeding. In late fall, a grower can band urea or ESN or a combination of both depending on potential for N loss.

Broadcast application at seeding has 40 to 50 percent efficiency if the fertilizer is not incorporated or is poorly incorporated. Dribble banding in-crop is 20 to 30 percent efficient “if you’re lucky and get a timely rain after application,” McKenzie says.

Foliar, which McKenzie calls “the biggest joke in town,” has five percent efficiency in terms of uptake through leaves.

McKenzie’s number one concern is that “very little work” is being done to create up-to-date N fertilizer response information as canola yield potential increases with improved genetics and agronomic management. “We need to be able to fine-tune application at high rates,” he said.

4. Growers hear mixed messages about how best to approach variable rate fertilization

This may be part of the reason why adoption is so low. Is vegetation index mapping the key? Or elevation? Electrical conductivity? Yield? Brian Chorney, Manitoba Canola Growers Association director, said in his introductory address, “I talk to three different consultants and get three different points of view on what approach to use. We need a well-researched approach.”

Terry Aberhart, grower from Langenberg, SK, agri-coach and owner of Sure Growth Technologies, shared his approach. He uses soil electrical conductivity (EC) maps as well as



Crop nutrition consultant Ross McKenzie says the greatest nitrogen efficiency comes when fertilizer is side-banded or mid-row banded into the root zone at the time of seeding.

PowerZone maps, which combine up to 30 years of satellite images to create zones for variable rate fertilizer. Using only one year of satellite images can lead to inconsistent results. When building historical maps for variable rate, vegetative index is not reliable, Aberhart said, because more biomass does not always mean more yield. In low areas that tend to produce a lot of biomass, his experience is that fertilizer in those soils is not limiting and that applying less fertilizer can actually increase yields and improve the bottom line for those acres. (For a more in-depth discussion of variable rate fertilizer, see Bruce Barker’s full article on page 27.)

5. Genetic resistance to clubroot will not last long under intense canola rotation

Evidence of this is already found around Edmonton where high clubroot pressure and tight canola rotations have led to a rather quick shift in the clubroot population to overcome current sources of resistance. Ralph Lange, plant pathologist with Alberta Innovates — Technology Futures in Vegreville, explained why at Canola Discovery Forum. Clubroot is an “obligate” pathogen, he said, which means it needs a susceptible host to survive. This puts it under “high selection pressure to adapt.” As host resistance improves — through breeding efforts in the case of canola — the pathogen must adapt



Terry Aberhart from Langenberg, SK, says in low areas that tend to produce a lot of biomass, fertilizer is not limiting and that applying less fertilizer can actually increase yields and improve the bottom line for those acres.

quickly or survive somehow (as resting spores, for example). If not, the population dies. Clubroot can adapt quickly, Lange said, because it produces many billions of spores per gall and it can recombine its genes readily to quickly create strains that attack resistant varieties. These many billions of spores mean there are more opportunities for advantageous mutations and genetic shuffling, which increases the chances of a population shifting to overcome genetic resistance.

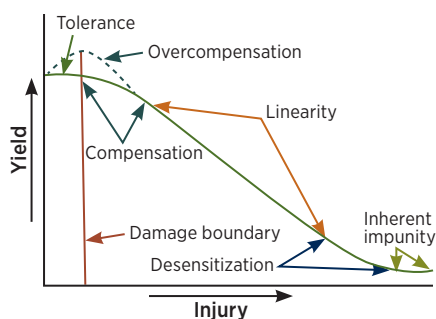
6. The relation between yield loss and crop injury due to insect feeding is not linear

Yield loss does not increase in step with crop injury. Rather, low levels of insect feeding can actually stimulate the plant to increase yield as a compensation response, said Hector Carcamo, entomology researcher with Agriculture and Agri-Food Canada in Lethbridge. Carcamo also defined two important terms to keep in mind when considering insect management. *Economic injury level* is the break-even point at which the value of the crop damaged by the pest equals the cost of the control action to prevent it. However, the *economic or action threshold* is usually set a little lower to prevent the insect pest from reaching the point of economic injury level. Ideally thresholds should take into account natural enemies, Carcamo said, which would make the action thresholds higher, but this information is rarely available.

Very little work is being done to create up-to-date N fertilizer response information as canola yield potential increases with improved genetics and agronomic management. “We need to be able to fine-tune application at high rates.”

—Ross McKenzie

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Hector Carcamo used this graph, developed by Hunt et al. from the University of Nebraska, to show that yield loss and insect feeding are not linear at low and high levels. At low levels of insect feeding, plants actually overcompensate and can produce higher yield.

7. Swathing a few days later can make a large contribution to yield

Camile Baillargeon, canola grower from North Battleford, SK, said that in 2015, his canola showed a 4 to 5 bu./ac. increase in yield when swathed at 80 percent seed colour change (SCC) on the main stem compared to swathing at 50 percent SCC. The difference has not been that large in past years, he said, but in 2015, the stand was thinned due to frost and flea beetles. Fewer plants meant more branching, and only 20 to 30 percent of the yield was on the main stem. Swathing when the main stem had almost complete SCC gave side branches more time to fill in.

James Humphris, oilseed crops manager with Bayer CropScience, said eliminating all swathing done before 40 percent SCC on the main stem could single-handedly achieve the Canola Council of Canada's goal of gaining a 2 bu./ac. yield increase by 2025 through improved harvest management. A combination of later swathing and straight combining could work on many farms.

Kevin Serfas sees that potential, but he and his family, who run a large farm in southern Alberta, still swath all their canola. "We have a three-month harvest window in southern Alberta and swathing allows us to use it," he said. By swathing canola, he can harvest about 10 days earlier than everyone else.

"Currently I have one combine per 3,500 acres. If straight combining, I'd need a combine for every 2,500 acres." He hasn't totally ruled out straight combining as long as it maintains his harvest window and his combine-to-acres ratio. "Strides in plant breeding will be key to adoption of straight combining," he said, referring to pod shatter tolerance as an example.

8. Well-worn myths about combine function may lead to higher harvest losses

Nathan Gregg, project manager with the Prairie Agricultural Machinery Institute (PAMI), shot down three common myths in his presentation at Canola Discovery Forum.

- **Myth 1: Keeping the combine running full will reduce loss.** Wrong. In theory, this may improve grain on grain threshing, however Gregg said years of combine testing have shown that as feed rate increases, free grain and unthreshed losses increase.
- **Myth 2: Settings for canola will be fine for the entire day and season.** Wrong. Check in the morning, afternoon and evening as well as crop to crop to see how time of day influences losses. Weeds, crop curing, crop uniformity and even variety can influence losses based on fixed settings.
- **Myth 3: Loss monitors show what is thrown over.** Wrong. Loss monitors can tell if losses are going up or down, but determining the amount of loss means "you have to get dirty," Gregg said. Using a drop pan to check for losses coming out the back of the combine is dirty but important work.

Once you get to know the combine's breaking point for losses based on load, how losses change based on conditions and what the loss monitor is really saying, growers may not have to measure losses as often, Gregg said.

"There really is a lot of upside to the vegetable oil market. The ceiling is well beyond the canola industry's 52 by 25 targets."

—Peter Entz

9. If we grow more canola, we can sell it

"There really is a lot of upside to the vegetable oil market," said Peter Entz, assistant vice president for Richardson International. "The ceiling is well beyond the canola industry's 52 by 25 targets," he said, referring to the goal of 52 bu./ac. average yield by 2025. Entz divided the canola oil market into four sections: food oil, high-oleic low-linolenic specialty oil, biodiesel and non-GMO. "If one of these markets takes off, farmers and the industry can run with it," he said. Entz's comments merged well with SaskCanola director Bernie McClean's comment that the "yield potential of canola is staggering." On his farm near Medstead, McClean aims for "maximum economic yield," which strikes a balance between genetic yield potential and practical use of input dollars.

10. To convert knowledge into action, share it in a way that resonates

Desmond Ballance, senior project manager with LifeLearn, explained that to get a message across — be it the benefits of genetic research, modern farming or agronomic recommendations — keep it simple. Use "bite sized chunks" of information to convert knowledge into action, she said. As a guideline, divide the message into three components: problem, research and application. When reviewing presentations, for example, ask: Is it relevant? Is it visual? Is it effective? To get complex or controversial ideas across, find one sentence that explains it, she said. Unless more detail is requested, share that sentence and stop there.

To listen to a podcast on Canola Discovery Forum highlights, go to www.canolawatch.org and search for the article, "Podcast: Canola Discovery Forum review." While at the site, consider signing up to receive the timely, research-based and free canola agronomy newsletter. ●

Jay Whetter is the editor of Canola Digest. He wants your comments on this article and on what "should be done and could be done" in canola research. Email him at whetterj@canolacouncil.org.

The Trans-Pacific Partnership agreement will open new markets for value-added products by eliminating canola oil tariffs into Japan and Vietnam and establishing clear rules for low-level presence of seed with biotech traits.

By Maxim Legault-Mayrand

TPP to eliminate tariffs, increase exports

Canada and 11 other Pacific Rim countries came to an agreement on the Trans-Pacific Partnership in Atlanta, GA, in October. Ratification and implementation processes of the trade deal are underway, with possible implementation in 2017 or 2018.

The signatories are Canada, the U.S., Mexico, Chile, Peru, Japan, Singapore, Brunei, Malaysia, Vietnam, Australia and New Zealand.

“Three of those countries are already major markets for Canadian canola. The TPP should increase trade security with those countries and expand export opportunities,” says Patti Miller, president of the Canola Council of Canada (CCC). “Eliminating tariffs will see exports shift increasingly to value-added products, while maintaining the overall volume of canola that is exported.”

For the canola industry, this shift towards canola value-added products is expected to allow for more domestic delivery options for growers, allow more processing of value-added products such as oil and meal, and contribute to Canada’s competitive access to international markets.

More specifically, Japan, which currently has a higher tariff on canola oil than it does on canola seed, will phase out its oil tariff over five years, keeping canola on a level playing field with other oils. Once fully implemented, the agreement will also put Canadian canola oil in line with Australian canola oil, which currently has preferential treatment going into Japan based on an earlier agreement.

“Canada currently exports around two million tonnes of canola seed per year to Japan and a small amount of oil,” Miller says. “This agreement should mean an opportunity to sell more oil to Japan, which will increase the value of our exports and bring benefits to the whole canola value chain. This increased value will flow through communities across the country.”

Vietnam will phase out crude canola oil tariffs over four years and refined oil tariffs over five years. Its canola seed and meal tariffs will be eliminated immediately upon ratification.

The canola industry estimates that when tariffs are fully eliminated in Japan and Vietnam over five years, exports of canola oil and meal could increase by up to \$780 million per year.

Biotech rules

The TPP text also contains commitments around transparency and cooperation for each country’s science-based approval processes.

In an era when the amount of biotech traits being commercialized is increasing,

attaining approvals in every country at the same time is a challenge. The potential for a low-level presence (LLP) of an authorized trait to appear in a shipment to a country where it is not approved – as happened with Triffid flax in the EU – is growing. The agreement establishes more clear and consistent rules regarding the low-level presence of these traits in shipments. Knowing that LLP rules will be applied consistently and fairly will help to make trade more stable and reduce the risk of costly disputes.

The TPP does not require a signatory country to adopt or modify its laws, regulations and policies for the control of products of modern biotechnology within its territory.

Countries such as Canada, the U.S., Australia, Mexico and Vietnam that have approved biotech crops also have an onus “to increase communications among and between the Parties regarding new authorizations of plants and plant products of modern biotechnology so as to improve global information exchange,” as the text reads.

This exchange will be one job for a new working group on products of modern biotechnology, which will operate under the TPP’s Committee on Agricultural Trade.

Sanitary and phytosanitary

The TPP affirms the rights and obligations in the World Trade Organization (WTO) agreement to protect trading countries from sanitary and phytosanitary (SPS) non-tariff trade barriers. Canada’s canola exporters have faced SPS issues over the past few years, such as the potential risk of salmonella in canola meal sent to the U.S.

The new agreement establishes a committee where SPS issues can be discussed by experts to facilitate trade, enhance cooperation and resolve issues at an early stage. “For one thing, it specifies timelines for resolving issues — which was a request of agricultural stakeholders,” Miller says.

In the years ahead, Canada’s new Parliament will be responsible for the ratification and implementation process. ●

Maxim Legault-Mayrand is market access manager with the Canola Council of Canada. He is based in Ottawa.

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*Canola yield data collected from large-scale, grower managed Proving Ground™ trials across Western Canada as of October 30, 2015 as part of the 2015 DuPont Pioneer Yield Challenge. Product responses are variable and subject to any number of environmental, disease and pest pressures. Individual results may vary. Multi-year and multi-location data is a better predictor of future performance. Refer to www.pioneer.com/yield or contact a Pioneer Hi-Bred sales representative for the latest and complete listing of traits and scores for each Pioneer® brand product. Genuity® and Roundup Ready® are registered trademarks of Monsanto Technology LLC. Pioneer® brand products are provided subject to the terms and conditions of purchase which are part of the labeling and purchase documents.

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The Canadian Canola Growers Association has made a significant investment to spur innovation in agricultural policy research.

By Cheryl Mayer



Peter Slade (left) is the first CCGA Agricultural Policy Chair, a new position at the University of Saskatchewan. He talks with CCGA president Brett Halstead.

Advancing ag policy research

Often we associate innovation in the agriculture sector with advances in crop production, like new seed varieties and new equipment technologies. These are very tangible areas where new ideas are necessary to help farmers remain competitive by reducing costs and increasing productivity. Another, less obvious area where innovation is critical to the success of farmers is public policy. Agricultural policies must continuously adapt to new and emerging issues in order to help farmers respond to a changing business environment. Just like innovation in crop production, innovation in policy development requires investment in research.

“Agriculture policy development is a cornerstone of the work we do at CCGA,” says Brett Halstead, president of the Canadian Canola Growers Association (CCGA). “We believe for Canada to be

a world leader in agriculture, we must invest in new ideas that can drive innovation in this field.”

To help achieve this, CCGA has partnered with the University of Saskatchewan to establish the CCGA Agricultural Policy Chair. Under the partnership, CCGA contributed a one-time \$5 million endowment to the University’s Department of Bioresource Policy, Business and Economics.

“We’re excited about this opportunity and foresee that the research coming from this new chair will strengthen agriculture policy research, leading to new ideas and ultimately enhancing farm profitability,” says Halstead.

The policy chair was formally established in the fall of 2014, and since then the University has hired Peter Slade, a PhD graduate from the University of Guelph, originally from Newfoundland. “I am very excited to research policy areas that have real impact for farmers,” says Slade. “The grain marketing environment in Western Canada has changed significantly during the last few years, impacting many areas of agriculture policy and creating opportunities for new ideas to be brought forward.”

“Agriculture policy development is a cornerstone of the work we do at CCGA. We believe for Canada to be a world leader in agriculture, we must invest in new ideas that can drive innovation in this field.”

—Brett Halstead

While still working on the details of his research projects for the coming year, Slade has identified three areas on which he would like to focus his efforts:

1. Grain handling and transportation. He will look into issues such as the organization of grain handlers and how their market power affects farmers, as well as capacity constraints in the transportation of grain.

2. New technologies. What impact does new technology such as big data and precision agriculture have on farmers? Does the policy environment supporting these new technologies allow farmers to fully realize their benefits?

3. Business risk management. How can programs be modified to increase farmer participation and help farmers better manage risk?

Beyond contributing to the advancement of agricultural policy development, CCGA’s partnership with the University will also build capacity for future policy development. “Not only are we investing in the future of our farms, but we’re also investing in the future of our people,” says Halstead. “This contribution will build future leaders in agriculture policy by providing an innovative training ground at an institution reputable in policy research.”

Agricultural policies have a direct impact on farm profitability. Investing in research is necessary to ensure these policies help enhance profitability, rather than hinder it. ●

Cheryl Mayer is director of policy development with the Canadian Canola Growers Association.

ABreport



EVENTS DESIGNED TO MAKE YOU MORE PROFITABLE

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FEBRUARY 17 or 18, 2016

canoLAB

canoLAB is an hands-on, interactive day of diagnostics and discussion covering key agronomic topics with a slate of top-notch instructors. The event is co-hosted by the Alberta Canola Producers and the Canola Council of Canada.

Topics include harvest losses, disease diagnostics, fertility, genetics, insect damage assessments and much more. Attendees are divided into small groups, so attendance is limited to ensure maximum instructor interaction.

Choose Wednesday, February 17 or Thursday, February 18. Register now at www.albertacanola.com/events

FEBRUARY 23-24, 2016

Leading Edge — Farm Management Series

The Leading Edge Farm Management Conference will be held on February 23 and 24, 2016 in Red Deer.

For 2016, Leading Edge will be a two-day event with more time dig deeper into farm business management issues and more time to interact with the Leading Farm Management advisers speaking at the event. This year's confirmed speakers include:

- **Glen Hodgson**
Conference Board of Canada
- **Merle Good**
Farm Business Consultant
- **Dean Gallimore**
Chartered Accountant
- **Rob Strilchuk**
Certified Management Accountant

The two days will feature a number of sessions to help farm managers with managing and developing:

- business structures
(for both incorporated and non-incorporated farms)
- tax planning and succession strategies
- liability and risk management
- farm financial health indicators
- plus an evening banquet and all speaker panel to answer a broad range of questions ●

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 ALBERTA
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PRODUCERS COMMISSION

Alberta Canola Producers Commission AGM — January 26 at FarmTech

Even if you are not a registered FarmTech attendee, you can still attend our AGM held Tuesday, January 26 at the FarmTech Conference.

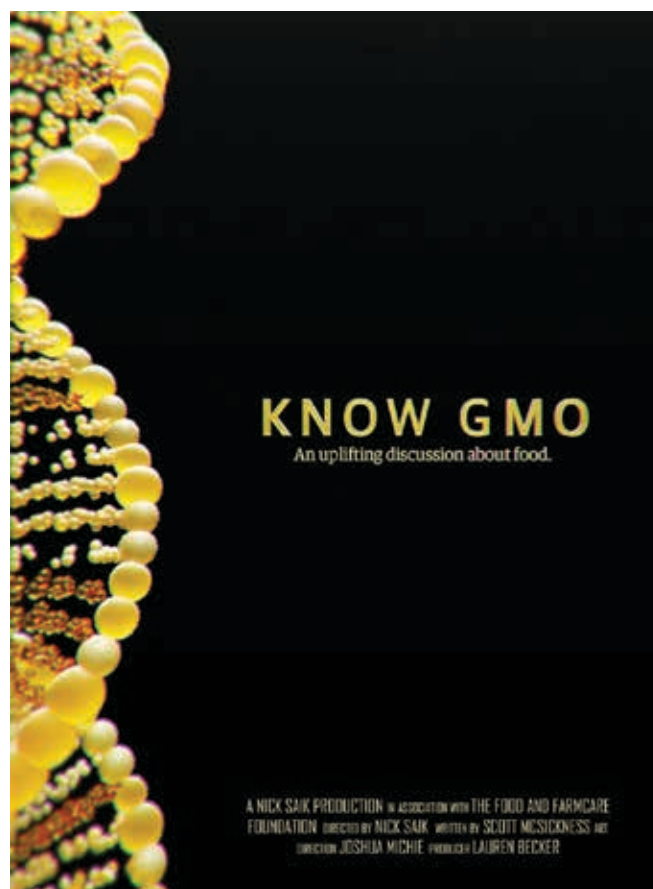
Visit the events page on our website — www.albertacanola.com/events — for registration and location information. ●



FarmTech™



ACPC Connects is your window into the activities of the ACPC as we work both locally and globally to make Alberta canola producers more profitable. Written by farmers just like you who represent you on our board of directors, these posts show you exactly how we are working for you and the canola industry as a whole.



SUPPORT FOR KNOW GMO

Alberta Canola Producers Commission has supported the making of the Know GMO film project. This documentary will demystify and explain GMOs to our consumer audiences. Sharing credible, practical and scientific information about how biotechnology is shaping the future of agriculture and food production, this film will give consumers a compelling firsthand look at the people, the ethics and the science behind the myths and mystery of our food.

For more information on the project, please visit www.knowgmothemovie.com ●



LICENSE TO FARM

The agriculture and food industry has come under scrutiny by consumer groups because of questions about farm practices and product choices of producers. Social media gives anyone with an opinion the opportunity to spread misinformation about how food is produced and many people growing up in urban settings have no connection to the farm.

SaskCanola is releasing *License to Farm* in January, to encourage producers to speak up about their way of life and why they make the choices they do. This short documentary highlights the facts behind common misconceptions about agriculture production in Canada. The goal of this project is to inspire producers to participate in more conversations about food, build trust with their urban neighbours, and protect their social license to farm.

The public premiere of *License to Farm* will be held at the Crop Production Show in Saskatoon. To find out more details about the making of the documentary and to watch the trailer, please visit www.licensetofarm.com



Research Tax Credit

Scientific Research and Experimental Development (SR&ED) is a federal government program designed to encourage research and development through tax-based incentives. SaskCanola invests a significant amount of the producer levy contributions in research to manage new challenges farmers face in their fields. As a result of the research investment, SaskCanola is able to participate in this program and the benefits are passed along to the producers. These tax credits can be claimed by filing form T2038(IND) for individuals or T2SCH31 for corporations.

In addition, farm corporations may claim a portion of their levy contributions as a qualifying expenditure towards the Saskatchewan Research and Development Tax Credit by filing form T2SCH403.

More information is available at www.saskcanola.com

Blackleg Resistance Strategy

Supporting research to help growers manage blackleg in the field

By Donna Fleury, P.Ag.

Disease resistant varieties and extended canola rotations are good practices for managing blackleg disease. However, researchers continue to receive reports of higher levels of disease and damage including fields with resistant cultivars/lines and are also seeing changes in the pathogen *Leptosphaeria maculans* that causes blackleg in canola. Several projects are underway to learn why.

Gary Peng, a research scientist with Agriculture and Agri-Food Canada (AAFC) in Saskatoon, SK is co-leading a five-year project initiated in 2013 to study a blackleg resistance strategy in relation to management practices in the field. This collaborative project with Dr. Dilantha Fernando, University of Manitoba and Ralph Lange, Alberta Innovates, is intended to monitor a large number of farms in each province to understand different management practices and the impact on the blackleg pathogen and resistance in canola.

"In Saskatchewan, we selected several fields with differing rotations in three main regions including the Battleford, Yorkton, and Weyburn areas. We are trying to understand how the disease level and pathogen populations

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canoLAB**

TCU Place
Saskatoon, SK

FEBRUARY 25, 2016
**Top Notch
Farming**

Kerry Vickar Centre
Melfort, SK







MARCH 9, 2016
**WARC Crop Opportunity &
Scott Research Update**

Dekker Centre
North Battleford, SK

Pathogen populations consist of dozens of races and differ greatly from field to field. Early infection, as shown here, could indicate a resistance breakdown for those genetics on that field.

Blackleg field rating scale

**Score blackleg for each
clipped tap root using the
following scale**

0		No diseased tissue visible in the cross section.
1		Diseased tissue occupies 25% or less of cross section.
2		Diseased tissue occupies 26-50% of cross section.
3		Diseased tissue occupies 51-75% of cross section.
4		Diseased tissue occupies 75% or more of cross section.
5		Diseased tissue occupies 100% of cross section with significant constriction of affected tissues; tissues dry and brittle; plant dead.

change over time under different rotations and other management practices,” says Peng.

The researchers collected some data on shorter rotations, but for the longer rotation fields, the next crop won't be planted until 2016 and that part of the study is ongoing. “Although we have some preliminary observations, the complexity of the study and various components is proving to be challenging,” says Peng.

Preliminary observations are showing that different disease levels in the fields do not seem to be closely related to either the pathogen race profile or the resistance gene profile. There doesn't appear to be any immediate link between the variation in disease levels and specific management practices. Peng has been trying to determine if the non-race specific resistance in varieties is adequate, how it works, and what kind of environmental conditions will influence resistance performance.

“So far, all of the R-rated varieties tested, even without a major R gene involved, carry a good quantitative resistance background to the pathogen relative to Westar,” says Peng.

“With blackleg, early infection is important, particularly in cotyledons. In the R-rated varieties, there was less chance of pathogen development into the petiole before the cotyledon dropped off, which also helps prevent further development of cotyledon infection into the stem where infection is critical to plant damage,” Peng continues.

The researchers also compared R varieties and Westar plants for infection development in the stem, and found

that the R varieties have substantially stronger stem resistance.

The question still remains: why are some R varieties experiencing higher levels of disease? Is it related to environmental or other factors? “We expect that damage by hail or insects may facilitate higher levels of disease, or factors such as weather or other environmental conditions, but we need more information to confirm that and figure out ways to mitigate the risks,” says Peng.

He continues, “In fields with higher risk conditions, a fungicide application may provide some disease reduction, but translating that into a yield increase is a tricky process. Extended rotations will reduce the pathogen level, because lower pathogen numbers are definitely less of a risk factor for blackleg.”

Growers can be proactive in monitoring blackleg and assessing the risk by taking a few minutes during harvest to assess their fields. “If growers are seeing more than 10 percent disease incidence, there is likely sufficient inoculum around and it's time to think about changes in the management strategy,” says Peng. “If the disease incidence is staying below five percent, then it is probably still a good sign of cultivar resistance and a healthy crop.”

By the end of the project, researchers hope to be able to demonstrate some good practices that may help reduce the risk of blackleg resistance breakdown across the Prairies. ●

MBreport



Innovation in Oil

By Sandi Knight

Three Manitoba canola growers are bottling and marketing canola oil with flavour characteristics unique to their own farms. As grapes produce different flavour subtleties in wine based on their “terroir” — a French word that covers soil, topography and climate — so does canola from different regions produce slightly different oil.

The Manitoba Canola Growers Association (MCGA) and the Manitoba Agri-Health Research Network (MAHRN) are studying virgin, cold-pressed canola oil, meal and co-products from processing as part of a Canadian Climate Advantage Diet (CCAD) project funded by Growing Forward II. The three-year \$396,000 project is looking at how the interaction between plant genetics and local growing conditions impacts the nutritional profile, flavour characteristics and end-use qualities of Manitoba-grown canola. MCGA has contributed \$10,000 to the project with a goal of adding value and finding innovative uses for Manitoba-grown and processed canola. The venture addresses the keen interest consumers have in local food, terroir and virgin cold-pressed oils.

The three farmers involved to date are: Brian Chorney of East Selkirk, Jack Froese of Winkler and Larry Bohdanovich of Grandview. They all grow the same variety but, surprisingly, the look, taste and even nutritional profile of each oil is different. The East Selkirk Vintage has a higher iron

content. The Grandview oil has a higher vitamin A number, is the strongest in flavour and has the deepest gold colour. Variations also exist in the percentage of crude oil extracted (33.9 to 39.5 percent) and clarified oil recovered from the crude (68.1 to 69.5 percent). East Selkirk has the highest rates. (Note that cold pressing cannot extract as much oil from the seed, resulting in a high-oil meal.)

These unique, cold-pressed oils were test marketed at both the retail and food service level with highly favourable results. They are being embraced for salad oils, drizzles and a Canadian-grown alternative to extra-virgin olive oil.

The 2015 Vintages, prominently labeled with each growing area, will be available in early 2016 at five Winnipeg Red River Co-ops as well as the Winkler Co-op. These new virgin canola oils are also part of the Buy Manitoba Program. Such distinctive specialty oils demand a premium and sell at up to 20 times the price of conventional canola oil.

The long-term goal of this project is to develop on-farm enterprises and small and medium sized business product lines. “It’s always exciting to see innovation in agriculture and Manitoba canola growers are definitely excited about growing future prospects for canola in Manitoba,” says Ellen Pruden, education and promotions manager with MCGA. ●



Winkler 2014

Grandview 2014

East Selkirk 2014

*Manitoba Virgin Canola Oil, 2014
Unique colour, flavour nutritional qualities
based on growing location. Replace imported
Extra Virgin Olive Oil with a Manitoba
original.*

DEFINITIONS

Terroir (ter-war)

A term most often associated with grapes and wine, this is the special set of characteristics expressed in agricultural products when the geography, geology and climate of a location interacts with plant genetics. As a result of this project, we now know terroir exists in Manitoba-grown canola.

Cold-pressed oils

Obtained by mechanically pressing and grinding the seed at a slow speed. Cooling methods are in place to ensure the temperature does not exceed 60°C during this process.



CropConnect Conference

MCGA Annual General Meeting

Where: CropConnect **Date:** February 11
Time: Breakfast served at 7:00 am,
AGM starts at 7:30 am **Pre-register at:**
www.cropconnectconference.ca
Registration is free.

February 10 & 11, 2016

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- A tradeshow with access to crop specific information • 2 intense days with over 30 educational speakers
- Keynote Speaker: **Michael Boehlje**, Economist, Center for Food and Agriculture Business, Purdue University
- Keynote Speaker: **Charlie Arnot**, CEO, Centre for Food Integrity
- Keynote Speaker: **Donald Cooper**, former owner, Cooper Canada
- Banquet Speaker: **Dave Hemstad**, 3 time Canadian Comedy Award nominee

For more information on the event or to register visit
cropconnectconference.ca



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¹AgCelence benefits refer to products that contain the active ingredient pyraclostrobin. ²All comparisons are to untreated unless otherwise stated.

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These delicious recipes from CanolaInfo can also be found in the Canadian Diabetes Association's 2016 Healthy Living Calendar and on CanolaInfo.org

By Nancy Hughes for CanolaInfo

MUESLI MUFFINS

WITH ALMONDS & CRANBERRIES



Whole grains, cranberries and almonds jack up the nutrient power in these muffins compared to common, cake-like ones. To round out breakfast, pair a muffin with some nuts and a piece of fruit for additional protein, energy and nutrients. Canola oil provides a moist, tender texture, plus adds vitamins E and K.

Ingredients

1 cup	(250 mL)	canola cooking spray
¾ cup	(150 mL)	all-purpose flour with fibre
¼ cup	(60 mL)	granulated sugar
1½ tsp	(7 mL)	ground flaxseed
¾ tsp	(4 mL)	ground cinnamon
½ tsp	(2 mL)	baking soda
½ cup	(75 mL)	salt
1½ cups	(375 mL)	sliced almonds
½ cup	(125 mL)	quick-cooking or old-fashioned oats
1 cup	(250 mL)	dried cranberries
¾ cup	(75 mL)	non-fat Greek yogurt
one 4 oz	(114 mL)	canola oil
1		jar pear purée baby food
1½ tsp	(7 mL)	large egg
		almond extract

Nutritional analysis per serving

Calories.....	240	Carbohydrates.....	34 g
Total Fat.....	9 g	Fibre.....	3 g
Saturated Fat.....	1 g	Protein.....	6 g
Cholesterol.....	15 mg	Sodium.....	115 mg

Instructions

1. Preheat oven to 350 °F (180 °C). Lightly spray a 12-cup, non-stick muffin pan with cooking spray or use paper muffin liners.
2. In a large bowl, whisk together flour, sugar, flaxseed, cinnamon, baking soda and salt.
3. In a small bowl, combine almonds, ¼ cup (60 mL) oats and ¼ cup (60 mL) cranberries and set aside. Stir remaining oats and cranberries into flour mixture until well blended.
4. In a medium bowl, whisk together yogurt, canola oil, pear purée, egg and almond extract. Stir yogurt mixture into flour mixture until just blended. Do not overmix.
5. Spoon equal amounts of batter into muffin cups. Sprinkle evenly with reserved almond mixture. Bake 18 to 20 minutes. Cool in pan 5 minutes. Remove from pan; serve warm or let cool to room temperature.

Yield: 8 servings

Serving size: one muffin

continued on page 46

PULLED PORK

WITH SMOKED PAPRIKA LIME OIL



Bring the flavours of Mexico into your kitchen. This easy-to-make dish of tender pork over warmed tortillas is topped with a citrus oil of smoked paprika, lime and garlic and finished with a sprinkling of pungent cilantro. Canola oil does double duty here: its high heat tolerance is perfect for browning the pork and its neutral taste lets the flavours of other ingredients shine.

Ingredients – Pulled Pork

1 lb.	(500 g)	pork tenderloin
1½ tsp	(7 mL)	ground cumin
¼ tsp	(1 mL)	salt
¼ tsp	(1 mL)	ground black pepper
2 tsp	(10 mL)	canola oil
1 medium		red onion, cut into 12 wedges
1 medium		jalapeno, seeded and minced
½ cup	(125 mL)	water

Ingredients – Smoked Paprika Lime Sauce

1 tbsp	(15 mL)	canola oil
2 tbsp	(30 mL)	fresh lime juice
1 medium		garlic clove, minced
1 tsp	(5 mL)	smoked paprika
¼ tsp	(1 mL)	salt
¼ tsp	(1 mL)	ground black pepper
8		soft corn tortillas
4 cups	(1 L)	shredded lettuce
1 medium		jalapeno, seeded and minced
¼ cup	(60 mL)	chopped fresh cilantro
1 medium		lime, cut into 8 wedges

Nutritional analysis per serving

Calories.....	300	Carbohydrates.....	27 g
Total Fat.....	10 g	Fibre.....	4 g
Saturated Fat.....	1 g	Protein.....	26 g
Cholesterol.....	75 mg	Sodium.....	360 mg

Instructions

1. Sprinkle pork with cumin, salt and pepper. In skillet, heat 2 tsp (10 mL) canola oil over medium-high heat. Brown pork for 2 minutes, turn and cook other side for 2 minutes.
2. In slow cooker, add onion, jalapeno and water. Add pork and cook 3½ hours on high setting or 7 hours on low setting or until pork is fork tender.
3. Meanwhile, in small bowl, whisk together all ingredients for Smoked Paprika Lime Sauce. Set aside.
4. Transfer pork to cutting board, leaving onion mixture in slow cooker. Let pork stand 3 minutes. Shred meat using two forks and stir back into onion mixture.
5. Warm tortillas according to package directions. Top with equal amounts of shredded lettuce and pulled pork. Stir paprika mixture and spoon evenly over tortillas and top with cilantro. Serve with lime wedges.

Yield: 4 servings (3 cups/750 mL) pulled pork and ¼ cup (60 mL) sauce

Serving size: 2 tortillas and ¾ cup (175 mL) pulled pork and 1 Tbsp (15 mL) sauce

.S.A.N.

49th Annual

Convention



20



16

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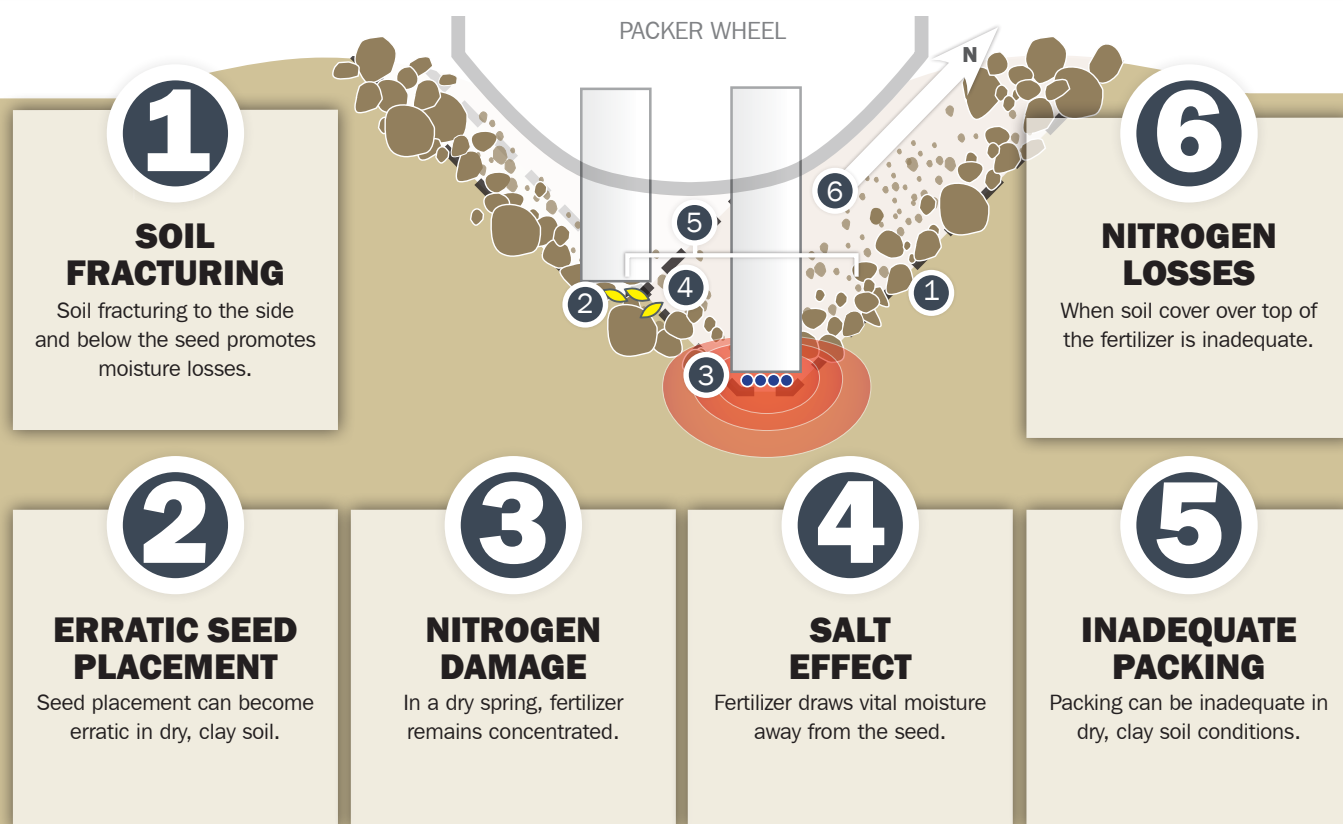


canolacouncil
OF CANADA

6 HAZARDS OF SIDE-BANDING IN DRY CONDITIONS.

The current long range weather forecast by World Weather® is for a spring El Nino effect in the winter of 2016. Spring could be the driest that we have experienced in more than a decade; the El Nino is being termed the "Godzilla" of El Nino's by the National Oceanic and Atmospheric Association (NOAA).

An extended period of dry weather in the spring can have a profound effect on germination and potentially also on yield, even in relatively wet years. In dry conditions, side-banders have 5 potential emergence reducing hazards. In addition, new research shows a 6th hazard, the loss of ammonia when the soil cover over top of the fertilizer is inadequate.



Only the Bourgault Mid Row Bander® system provides optimal seed to fertilizer placement in all conditions maximizing your earning potential even in the dry years.

Check out: www.bourgault.com under "News" to read about the resolved legal dispute between AAFC and Bourgault Industries Ltd. on the results of a three year agricultural research study conducted by AAFC which compared the effect of N fertilizer management, including side-banded and mid-row banded placement, on crop production, which addressed some of these issues.



PURSuing PERFECTION