2018 Canola Discovery Forum Proceedings
Centre for Arts & Creativity, Banff, Alberta
October 22-23rd, 2018

The following document is a summary of the 1.5-day program of the 2018 Canola Discovery Forum. This is not a verbatim report of presentations, comments, and questions, and the information included does not necessarily represent the viewpoint of the Canola Council of Canada. If you have questions about the information, please contact us and refer to available presentation material.

Monday, October 22nd, 2018
1:00-1:10 PM Welcome: *Goals of Canola Discovery Forum 2018; Jim Everson and Curtis Rempel*
Jim Everson *(President, Canola Council of Canada)*
Total investment in canola research over the next 5 years is approximately $20,000,000 through partnerships with industry and the Canadian Agricultural Partnership fund through the federal government. The overarching theme of these projects is to help the Canadian canola industry on our road to 26 million metric tonnes of canola production by 2025. Some highlights of ongoing and recent canola research include: substantial efforts in **blackleg research**, addressing management concerns, helping to navigate China's concerns with Canadian canola, and the development and implementation of resistance labels and genes. In **clubroot research,** highlights include identifying sources of resistance, rapid tests for identification now offered by six commercial labs, surveillance of the disease and new pathotype detection. In **integrated pest management,** updates to economic thresholds have been made in insect pests such as lygus bugs, and identification and lifecycle analysis of natural enemies like diamondback moth have been studied. Not all canola research funding is focused on agronomy. It also includes substantial investment in **canola meal and oil** research for human and animal nutrition. Through research, canola meal has been shown to increase dairy milk production by one liter per cow per day, compared to soybean meal. The Canola Council of Canada is a full value chain organization. Canola provides $26.7 billion in economic activity to Canada annually and there is more potential to grow value.

Curtis Rempel *(Vice President, Crop Production and Innovation, Canola Council of Canada)*
Canola Discovery Forum is an avenue to bring industry and the value chain together. The vision is to foster canola innovation, through the exchange of ideas, research networks, and bringing public and private industry, academics and agronomists together. This collaboration will help us to reach our goals of an average of 52 bushels per acre by 2025. At these annual meetings, we

report on research projects already in place, share leading edge knowledge and technology transfer efforts based on the newest evidence-based research. **This year's Canola Discovery Forum will take a deep dive into canola stand establishment.** Currently we are still planting 1.5 to 2 seeds to get one plant. We will look at seeding technology, fertility, genetics, and other management techniques to improve upon this standard.

1:10-3:00 PM Panel: Canola Council of Canada agronomy messaging for 2018/2019 *(Dan Orchard, Ian Epp, Justine Cornelsen)*

Justine Cornelsen *(Agronomy Specialist, Western Manitoba, Canola Council of Canada)*
Review of 2018 growing season in Manitoba: Conditions were generally dry and extremely hot. Poor plant establishment occurred due to very dry conditions (less than 10 mm of rain in the first weeks of May), deeper planting to chase moisture, and intense flea beetle pressure. There were more re-seeded acres than the historical average due to a mix of factors: frost, drowning, wind, crusting, and flea beetles all contributed. Heat stress was a factor during flowering. It was hot, but not humid like it normally is in Manitoba. There were over 20 days above 30°C in the growing season. Overnight lows were also higher than normal. There seemed to be higher incidence of verticillium stripe (VS), potentially owing to the heat. VS disease is fairly new to Canada and more research is needed to understand the impact and how to manage it. Suspected blackleg samples sent to the Manitoba Diagnostics Lab were often actually VS, rather than blackleg. Symptoms of VS are quite similar to blackleg, with blackening in the cross section. There is also straw-like shredding which is similar in appearance to sclerotinia. Wilting and striping along one side of the stem and microsclerotia is indicative of VS, and not the other common canola diseases.
Blackleg Extension Messaging: Incidence of blackleg found in all three Prairie Provinces ranged from 10 to 13 percent. There was enough moisture in the spring to start the g disease cycle. There are now commercially available *L. maculans* race tests, which are new options for producers in management of this disease. These race tests tell us the predominant race in the field, making variety choice easier in the future. There are over 100 races in Western Canada that we are aware of. Quantitative resistance still allows some disease progression, where major gene (qualitative) resistance does not. The key extension messages for blackleg are: to manage it via lengthened rotation, scouting, use and rotation of resistant varieties, fungicide use where appropriate and learning to identify the disease.

Ian Epp *(Agronomy Specialist, Northwest Saskatchewan, Canola Council of Canada)*
Review of 2018 Growing Season in Saskatchewan*:* As of October 15th, 67% of the canola harvest was complete. The major issues in Saskatchewan this growing season were dryness early in the season, creating issues such as herbicide carryover damage in types not commonly seen (including groups 2, 4 and 14). It was an "average" year for pests of canola. As always, flea beetles were a problem, reaching threshold in many cases. In isolated cases, bertha armyworm and diamondback moths reached threshold levels. There was a frost on September 5th, which is 10 days earlier than historical averages, reaching minus seven degrees Celsius in Prince Albert. This led to very elevated green seed where the crop was still immature. There was snow on substantial canola acreage before harvest, leaving farmers questioning what to do. A lot of

surveying was done for clubroot in the province this season and growers are more actively looking for the disease. It is spreading, being found in more places and distributed widely across the province. Common annuals and winter annuals (wild mustard, stinkweed, flixweed, shepherds purse) that are not particularly hard to control, but are hosts of clubroot, need more special attention now.
The yield loss from sclerotinia stem rot (SSR) has been over five percent annually. The "wet pants test" still has value in determining whether to spray or not, but there are still so many uncertainties when it comes to the economics of a fungicide application for SSR. There is huge potential for improvement in this area to help producers make more informed decisions with this very ubiquitous disease. Levels of SSR are up across the prairies, even though it was dry.

Keith Gabert *(Agronomy Specialist, Central Alberta South, Canola Council of Canada)*
Review of 2018 Growing Season in Alberta: 2018 was another dry year (in many areas of the province), after what was also a particularly dry year in 2017 in southern Alberta. This dryness contributed to stand establishment issues, also intensified by flea beetle pressure, and typical rates of seed placed fertilizer that were too high for the dry conditions. Dryness contributed to very low weed pressure early on and likely to clubroot symptoms not being as prevalent.
Clubroot: There have been over 100 new cases of clubroot in commercial fields in Alberta every year. We are not on top of this disease and its spread. The number of spores and its movement in the soil makes this disease a major challenge. Early detection is most important. Everyone on the farm needs to be looking at canola roots by digging up plants. One million clubroot spores can cause a 50% yield reduction. We are only one cycle away from a disaster at spore levels like this. Soil samples to assess spore levels in the field are a good tool, but they do not replace good scouting.
Key Messages for Clubroot: Prevention is key! Extend crop rotation out of canola for at least two years, deploy resistant varieties early (there are 28 resistant cultivars on the market), scout aggressively, control weeds and volunteer canola, practice direct seeding and reduced tillage, utilize patch management in highly infected areas (initial treatment area should be twice the size of the apparent infection area), monitor equipment movement between fields, and keep scouting even with resistant varieties deployed (150 fields have overcome clubroot resistant varieties).

Panel Question and Answer Period:
1) How early is too early to seed?
    a. Research shows that the probability of success and the likelihood to reach yield potential increases with early seeding. Still have to evaluate soil temperature and all other agronomic factors into decision of when to start seeding.
2) Clubroot
    a. Liming in fields. If pH is 5.2, can you lime enough to get it to 7.2, and how much would it take?
        i. Could be four to six tonnes of lime but would need to see a soil test that included a liming recommendation. The quantity of lime will be influenced by soil texture, organic matter and buffering capacity. Currently liming infrastructure is not great here, but this is a normal practice across the world.

b. What is the impact of lime on clubroot?
    i. Lime can help limit clubroot but it is not a silver bullet, just one tool. Current research appears to indicate that increasing soil pH up to 7.2 or 7.5 can limit gall formation. This reduction in galling may also be due to levels of free calcium in soil but further research is required. Capital investment is required for application and opportunities for application with variable rate technology. Product is very pricey if far away from source. Expect liming to be standard practice here in 10-15 years.
c. Is liming the solution? Our soils are above 7.2 to 7.5 already. Is clubroot present in fields with higher pH?
    i. Results are variable. Lime application has reduced gall size by half in some studies. Maybe more ideal for patch management or field entrance options. Fields in Southern Alberta with higher pH still have prevalence. Initial results: lime had moderate impact on low spore load fields.
d. Do we have understanding on pH in terms of pathogen? Some pathotypes may be able to tolerate higher pH levels.
    i. Not aware of anyone looking at pH variability. Soils at same pH can differ in the amount of clubroot they can suppress. Something in the soil aside from pH that confers suppressive ability. Need far better understanding here.
e. Are lamb's quarters a host for clubroot?
    i. No, more or less specific to the Brassica family.
f. In non-clubroot areas, when do you use resistant varieties?
    i. As soon as possible. To prevent spore buildup, use as soon as you feel any risk. Resistance will be standard soon like blackleg. Not a fix for tight rotation or lack of scouting.
g. Should you assume you have clubroot?
    i. Yes, take proper precautions. Assuming you don't have it is something of the past.
h. Short rotations are accelerating the prevalence of clubroot. Longer rotations are the answer but are not economical… how do we get there? We need to strive for two break crops between canola crops.
    i. Tight rotations can build spore loads quickly. Growers need profitable cropping alternatives to canola.

3) Sclerotinia: is the petal test the answer?
    a. Petal test options are another tool to assist with decision making, but they also come with limitations. Environmental conditions such as moisture still have the largest impact on disease development.
4) Comment from audience: seeing early season flea beetle damage connection with blackleg incidence in the field.
5) Verticillium Stripe (VS). Are there infection differences between varieties? Are some varieties already resistant?
    a. Yes, there are varietal differences. More research is needed. Need to ensure we aren't overestimating blackleg occurrence by mistaking VS for blackleg due to similar symptoms. (We may currently be mistaking VS for blackleg overestimating blackleg.)

6) Are there any seed treatment replacements for neonicotinoids?
    a. Life science companies are working on replacements. Seed treatment does not make canola bulletproof. Neonicotinoids are a great tool but we need to manage risks around their use. Don't know when we will have replacements where we'll be without the neonicotinoids. Flea beetles are patchy and it is difficult to predict when you'll have an issue.
7) Will there be herbicide carryover again this year?
    a. So much plays into this, so carryover is very difficult to predict on a broad scale, but given dryness, could have more issues next year. Herbicide rotation and crop rotation very specific from field to field. Awareness will be higher this year. Good record keeping and herbicide rotation are important.
8) Green seed. Current data? Do we need updated research? Is it happening more and more?
    a. Comment: Can't assume old data is irrelevant. Seed physiology hasn't changed. What has changed significantly is plant genetics, growth habit and plant stands.
9) Smoke from BC forest fires… concern for maturity? Do we look at varieties in terms of smoke occurrence?
    a. Potential effect of smoke on photosynthetic gas exchange of canola? Predicting smoke is not possible. Reduces radiation efficiency of plant. Studied around the world. One or two times a lifetime occurrence. Trade off, early seed and spring frost damage risk or later seeding with fall frost and shorter maturity time. Smoke has been shown to increase germination in some parts of the world.

3:15- 5:00 PM Panel: Innovation in agronomy tools in a changing regulatory landscape
Moderator: Gregory Sekulic (Canola Council of Canada)
Panelists: Chris Anderson (Bayer Canada), Peter Brander (PMRA), Christy Morrissey (University of Saskatchewan), Sarah Mukherjee (Crop Protection Association)

Chris Anderson *(Global Canola/OSR Technology Lead, Bayer Canada)*
What have we achieved already in the canola industry? Canola is the most profitable crop farmers have ever had on their farm. It has changed livelihoods of producers in Western Canada. It has been a game changing technology for their kids, bringing them back to the farm. Further innovation is needed, and innovation in the face of uncertainty is not new. There are four factors for innovation: scientific success, consumer value, regulatory success, and public acceptance. Anything that reduces one of these four factors reduces the success or likelihood of innovation.
The phases of development of new products in agricultural biotechnology take longer (10+ years) than that of cancer drugs and longer than the 787 Dream Liner jet. In other spaces, innovation happens faster. It is very hard to have the foresight to know what customers are going to need in 10-15 years. For example, in 2000, we didn't even know clubroot was a problem, and now we are assuming everyone in the Prairies has it. This is not to say we do not need a robust regulatory system; we cannot have successful innovation without it. We want predictable, science-based rules. In order to achieve public acceptance, we need to shape agriculture for the benefit of farmers, consumers and the planet.

Peter Brander *(Chief Registrar and Director General Pest Management Regulatory Agency, Health Canada)*
The Pest Management Regulatory Agency (PMRA) of Health Canada has the mandate of protecting human health, the environment and ensuring that the pest management tool in question has value. In determining value, the PMRA does not conduct a cost-benefit analysis. If there is reasonable certainty from scientific evaluation that no harm to human health, future generations or the environment will result from exposure to or use of a pest control product, and that the product has value, its registration for use in Canada can be approved. The PMRA does not sway from this legislation. Risk and value must be acceptable, and sustainable development must be supported. It is the responsibility of the pesticide manufacturers to provide the necessary data and information in support of the registration of their products. The PMRA conducts its scientific review based on the data and information provided by the registrant, in addition to literature found in the public domain. Every submission is entered into one of five defined categories. Data evaluation includes product chemistry evaluation, value assessment, human health evaluation and environmental assessment. The public is consulted for all proposed major registration decisions. There is periodic re-evaluation of chemicals already in the market place to ensure continued acceptability. These re-evaluations are initiated based on time elapsing from initial registration and also when an OECD (Organisation for Economic Co-operation and Development) member country prohibits the use of an active for health or environmental reasons. Currently, the PMRA is undergoing a review of its re-evaluation process and looking internationally at other countries' systems and processes. Global joint reviews are a cooperative effort by two or more regulatory authorities globally to review pest management products. No global joint reviews currently exist internationally and there is large potential here to re-engage.

Christy Morrissey *(Associate Professor, University of Saskatchewan)*
We do not see large monocrop systems in nature, and these types of cropping systems are likely facing a lot of risk because of their simplicity. They have a huge reliance on synthetic chemicals, neonicotinoids in particular. There is 215,000 kg of pesticides applied each year in the Prairies, which is leading to contamination of wetlands, having a negative effect on aquatic insects and birds. Birds are an indicator species of overall environmental health. Pesticides affect bird's ability to migrate in the right direction and put on fat. Pesticides, though, are not the main problem. There are socioeconomic challenges facing producers. Farmers need to make a living and are dealing with climate extremes, like local droughts, and increases in disease, weeds, and insect issues. We are seeing a degradation in soil and both surface and ground water, a loss of biodiversity, which are all indicators of a systems-level problem and there is not one answer. The Agriculture Sustainability Triangle consists of food security, economic sustainability, and environmental health at its three corners. People see these three things in the triangle as a trade-off between one another. Identifying and recognizing ecosystem services is a possible solution to create a win-win-win between these three pillars. The 'diversity-stability' hypothesis states that increased diversity increases ecosystem function. **Solution 1**: protect and enhance existing landscape features, like wetlands. Wetlands with vegetation buffers have lower neonicotinoid concentrations. Wetlands maintain biodiversity. Wetlands are a major and important source of habitat, as emphasized by the flight path of birds

in canola fields. Replacing marginal land with diverse perennials could actually increase yield, with no net loss of profits. **Solution 2:** Promoting great on-field diversity. This can be achieved by planting perennials inter-mixed with crop. 10% integrated strips work the best, with no net loss of yield. **Solution 3:** Integrate novel ecological technologies into traditional cropping, like inter-cropping or cover crops (ex. canola/ pea inter-cropping system). Results have found that the combined yields of the inter-crop are higher than the yield of the monocrop.
A systems level approach is needed to manage diversity. Canadian Prairie Agroecosystem Resilience Network (CPARN) uses an integrated system approach and encourages participatory science, which involves both scientists and non-scientists working together, in real time or near real time to conduct original research often with the goal to affect social change.

Sarah Mukherjee *(Chief Executive, Crop Protection Association)*
The presentation began with an overview of the implications of "Brexit" on agriculture and agriculture policy, as well as the broader political and social implications. Currently, there is an anti-globalization movement, growth of nationalist parties in Europe, increase in protectionism, and a lot of anti-science and anti-expert sentiment in the population (noting that they are six generations separated from the farm while Canada is closer to three or four). Crop protection companies cannot appear to be defensive, unengaged or unwilling to listen. We must engage with people to make agriculture relevant to everyone and be willing to listen to their concerns. Most of the agricultural conversation currently is happening with government and regulators, not the people/the consumers. An example of the "BeeConnected" tool was given, where industry associations worked together for the benefit of both parties involved. The future of agriculture is bright if we continue to work together!

Panel Question and Answer Period:
1) What can we do to have a unified message moving forward?
    a. In 2012, London nearly ran out of water. In response, we got all relevant parties together and developed four messages for public. This worked. Park what you disagree on and focus on what you do agree on.
2) No global joint reviews. What was it like historically? Why less?
    a. Exact number of joint reviews up to ten. Europe has not been engaged, hazard vs risk-based approach. Has been some head way for collaboration. The UK are potential partners, Australia has fallen off but willing to re-engage in process.
3) Urban landscaping and biodiversity?
    a. Value of saving wetlands vs what's in the city. Prairie landscapes or city, this can apply everywhere. The Idea of not being pushed in urban areas is due to the large scope of the task.
4) Rural landscape… producers face size of equipment and expansion. Will the future be for smaller units that are self-driving that can maneuver better and obtain same amount of yield on a smaller land mass?
    a. Moving to smaller equipment, adding on-field management practices, etc. Not impossible - just need to plant the idea in the producer's head. Shift into precision agriculture, acre or sub acre field.
5) RNA technology. Regulatory framework? Consumer acceptance?

a. Anderson: Regulatory perspective, work within agency but going to be the same as always. How to ensure acceptance? We default to science, which doesn't apply to general population. Need impactful meaningful message. Collaboration required.
b. Mukherjee: No GMO's in UK. Consumers don't see the benefit.

Tuesday, October 23rd, 2018

Stand Establishment Workshop

Introduction *(Autumn Barnes, Agronomy Specialist Southern Alberta, Canola Council of Canada)*
The Canola Council's strategic plan focusses on sustainable, reliable supply, differentiated value, and stable and open trade. Agronomy fits into the pillar of 'reliable supply,' and in that area we recognized specific areas where more yield can be captured with improved management and innovation. In stand establishment, we feel there is potential to capture an additional three bushels per acre in moving towards an average yield of 52 bushels per acre by 2025. Canola yield and stand density have not been strongly correlated and it is difficult to put an economic value on the agronomic challenges of lower densities, like poorer weed competition and uneven and delayed maturity. The Canola Council's message in recent years was to target seven to ten living plants per square foot but new meta-analysis shows with new hybrids that may not be necessary (or cost-effective). Regardless of what the plant density goal is, we encourage selecting a seeding rate to achieve that density, not a standard pounds per acre measurement across all seed weights. Vary target plant stands based on risk factors. www.canolacalculator.ca has tools to help identify risks, determine target plant densities, and calculate seeding rates. This tool automatically reverts to six plants per square foot if the producer doesn't enter a number, and this is a good starting point. Across Western Canada, producers are still averaging 50-60% emergence of their seeded canola. The message of "slow down and shallow up" has existed for a long time. While it is still valid, to improve we need more than that. In 2017, 60% of fields in southern Alberta had less than four plants per square foot. Not only is stand density important, but uniformity is likely as, or, more important.

8:10-8:50 AM: Herbicide stewardship and managing low plant densities *(Rob Gulden, Professor of Weed Ecology and Management, University of Manitoba)*
The importance of herbicides in several crops was highlighted (ex. 80% yield loss in corn with no herbicides). There are approximately 500 herbicide resistant cases and we are losing modes of action (MOA) in a number of weed species, with many species having resistance to multiple MOA. In 2002, 32% of fields had resistant weeds, in 2008 that number grew to 48%, and in 2016 up to 68% of fields had resistant weeds in them. The top 10 herbicide resistant weed management practices were given in presentation, including things like MOA rotation, herbicide mixtures, and crop diversity. Spatial arrangement is important for weed management and we need row spacing and target density data for canola with regards to 'critical period of weed control' (CPWC). As soybeans move to narrower rows, producers can eliminate one in-crop herbicide application. Increasing target density (in soybean) does not have impact on CPWC, but lower densities force producers to spray. Stand density surveys in canola showed a regional effect with a range of 24-140 plants per square meter. There were year and environmental effects on these densities, while the producer effect was also highly significant.

Seeding rate did not play a role, whereas depth, speed and other practices unique to individual producers may have. There is a need to achieve a balance between densities and yield. Ideally, we could turn canola into a "k-selected" offspring, rather than "r-select," which has small offspring, lower resources per offspring, and low potential to reach reproduction. At low densities, uniformity is hard to establish, with more herbicide needed. Canola plays a role in farm-wide weed strategy and uniform stands are essential for herbicide stewardship. There are many unanswered questions, but we can look at other crops. Good agronomic decisions are key to persevering good technology.

Question and Answer Period:

1) Weed surveys and lower plant densities and "producer effect." Are they not using as much fertilizer, not timing herbicides properly?
    a. Some of the data is available, but we are still working through the analysis. Therefore no comment at this time.
2) Comment: Do we have the pricing structure of seed wrong? Charging per kilogram. Farmers are seeding less due to cost of seed. Something going on in industry; economics and biology diverging, not coming together. Example: US herbicide resistance with corn, systems not priced to be sustainable. Seed rate did not play a role but that doesn't mean there isn't pressure for lower densities, right at the turn of the curve. In AUS they have seven percent OP seed farm saved seed to battle the weeds. Then use the herbicide tolerant varieties when weeds are uncontrollable.
3) Kochia control in saline soils, how do you get canola to grow well there?
    a. Charles Geddes is doing research on this. Kochia is much better adapted to saline soils than canola. Breeders can select for saline tolerance. Work in Swift Current shows that hybrids have better saline tolerance on par with barley.

8:50-9:20 AM: Reducing toxicity of seed-placed phosphorous in canola *(Patrick Mooleki, Research Scientist, Agriculture and Agri-Food Canada)*

The current guidelines for seed-placed fertilizers were developed on 6-12 inch row spacing with one inch opener spread. Patrick Mooleki's work is addressing different combinations of opener spacing and row spacing, with representative seed bed utilization (SBU) percentages. It is investigating safe seed row phosphorous rates on 9 and 12 inch row spacing combined with one, two, and four inch openers and 20, 35, 50, 65 lbs./ac of P_2O_5. Other agronomic practices remained similar to producers' conditions. Plant density was measured 14, 21 and 28 days after seeding and at harvest. Preliminary results showed an increase in mortality with increasing P rates and decreasing SBU, with no impact on yield.

Question and Answer Period:

1) Was there an unfertilized control?
    a. No, but will add in in next year.

9:20-9:50 AM: Early season insects and canola stand establishment *(Ted Labun, Seedcare Technical Lead, Syngenta)*

Canola is a resilient crop. Flea beetles and cutworms are significant pests. What impact does stand density have on the pests, and vice versa? Results from studies Syngenta conducted from 1999-2018 were highlighted. Seed size and seeding rates have really increased over that time, while plant stand density has decreased. Today we have both striped and crucifer species of flea beetle while in 1999, we had only crucifer flea beetles and only cotyledon feeding. In 1999, there was very minimal crop residue, while now we have much more in often a direct-seed situation. Crucifer flea beetles start feeding at over 15°C. In an example, treated versus untreated sections (neonicotinoid treated seed versus bare seed) of the field showed markedly more damage with bare seed (75% damage). Flea beetle stem feeding is relatively new, with very minimal stem feeding seen before. This stem feeding is likely driven by weather; when it's windy and cold they feed more on stem. Seed treatments do protect against stem feeding, as observed with untreated seed and major stem feeding damage. An example was given of a field with one to two seedlings per square foot with a lot of flea beetles in field. The grower cooperator left strips unsprayed through this field and the unsprayed yielded 30 bu/ac, while the sprayed yielded 50 bu/ac. The 25% defoliation action threshold is still a very good start. Cutworms can be very patchy in a field. Seed applied insecticides kill only cutworms, which is much better than foliar application. Devastation from cutworms can happen so quickly.

Question and Answer Period:

1) How much of this information has been shared with growers? Some growers aren't convinced about seed treatment.
    a. This is the first time this information is being shared.
2) Can you give us an overview of Syngenta's engagement in PMRA reviews and what's in the pipeline?
    a. Can't address PMRA question. All companies looking into new technology. Some new things coming. Long time to commercialization, 10+ years.
3) What are we supposed to look for in seed treatments, concerns around application rates and coverage in coating seeds?
    a. Seed companies do a very good job of application. Follow up on quality. Loading analysis. Canola hardest crop to treat, small seeded crop. Can be sure the bag of seed you're buying is treated properly and of good quality.
4) Cutworm control. How long is seed treatment going to last?
    a. Usually three weeks of control. Today, cotyledon stage can be 14-21 days, longer in the ground more susceptible to attack. In terms on length of control, hard to answer, many factors play a role.
5) Can't buy any canola seed without seed treatment on. Any land/areas where the treatments are more challenged to succeed compared to others?
    a. Depends more on spraying. More important factor on weather and seeding depth. Problems show up where the weather is.

10:20-11:45AM: Panel: Seeding Technology *(Curtis de Gooijer, Kris Cherewyk, Brian Deleye-standing in for Yancy Wright)*

Curtis de Gooijer *(Corporate Agronomist, Bourgault Industries)*

How do we increase canola emergence? The pillars within seed emergence include seed germination and vigour, seeding equipment, fertilizer placement and environmental factors. What kind of damage is happening to the seed as it travels from the seed tank into the ground? Bourgault studied this and found that vigour and germination didn't get statistically lower. With induced blockages, germination was still okay, but vigour decreased. Seed drill stepping, where the third row is the first opener to go through the ground and it throws dirt on top of first row, can have a major impact on emergence. Fertilizer placement at seeding and types of fertilizer being used can also have a major impact on emergence and yield of canola. How can we put more phosphorous down in a one-pass system? Trials were conducted using 0P, 55P mid-row band (MRB), 100P in seed row (SR), 55P MRB, 25P SR, and a spilt (15 SR, 40 MRB) ($P=P_2O_5$). The treatment with 100 lbs. SR and the spilt treatment had the same yield, but 100P SR had lower plants per square foot. The target seeding rate was 10 seeds per square foot, and the high rate of 100P SR treatment had 35% emergence. The drone pictures showed major differences in maturity, with the lower plant stand having much longer maturity. The triple shoot opener set up saw the highest emergence rates of over 70%. In this situation, the seed is separated by two inches, with nitrogen (N) and phosphorous (P) separate. In subsequent trials, the phosphorous in the seed row was increased to 200 lbs. This high rate did not kill (all of) the seed and had the highest numerical yield. If farmers only have 50% emergence, then half of their seed is left in the field. It was suggested that we can improve management by developing specific agronomic guidelines/best management practices for specific plant densities.

Kris Cherewky *(Field Support Representative, Vaderstad Industries)*
Objective of Vaderstad is to build the best plant possible. Factors within a producer's control are the speed of implement, nutrients, soil health, agronomic management practices, and type of equipment. "Give the seed what it needs to succeed." Seedhawk advantages of accurate seeding depth. A planter has the advantage of "space" and uniformity. Overcrowding creates a "weed" situation where plants are in competition with each other. Lower plant stands allow for a better plant, with more branching, larger roots, better airflow through canopy. There are potential benefits of more even maturity and better disease defense.

Brian Deleye *(Territory Sales and Finance Manager, John Deere)*
Canola yield components were investigated through a meta-analysis initiated by John Deere. This looked at pods per area, seeds per pod, and seed weight. As plant densities increase, the number of pods per canola plant decreases. Lower plant densities have higher survivability. The same seeding depths have different levels of survivability, while deeper seeding depths took longer to flower. They also noted goals of improving seed uniformity, as well as increasing survivability. Seed row residue management is a very important benefit, with a 12% yield increase in a three centimeter residue-free zone around the seed row. Soil type has a significant influence on establishing a seed shelf during seeding, with sandy soil making it difficult. Heavy soil types tend to favour disk type openers. It was also noted that John Deere now has a small grains team in North America.

Panel Question and Answer Period:
1) Regarding P responses. Did you control for the N amount going on with P?

    a. Did not adjust for N, 140 lbs. of N total.
2) Lower plant stands producing optimal yields. Would you be comfortable recommending these stand targets to your producers?
    a. We'll get there, but changing the ideology of the producer is difficult. More information available so they can make their own decisions. Lower rates have yielded better results. Managing expectations. Farmer seeded into straw field, risk is increased. If lowering seeding rates, then need to be better at other factors (herbicide used, rotations, fertility, etc.). Look at fertilizer placement and other factors. Get producers to slow down will help with emergence challenges.
3) Follow up soil test for the P test? Economic analysis? 100$/acre spent on P in your trials.
    a. Have done economics, not published yet. Grow different crop on top of trials from last year. Marked out strips and harvested strips cross ways, want to see how next year's crop responded to the P Results will be online (Bourgault).
4) Did you soil test for residual P? What was the calcium concentration? Calcium can mobilize the P.
    a. Yes. It was eight ppm P. Did not test for calcium.
5) How are you putting your fertilizer down for Vaderstad planter?
    a. Twenty pounds per acre ($P_2 0_5$) right in with the seed in liquid form. Fertilizer packages varied but all banded before the planter went in.
6) Did banding before wreck the seed bed?
    a. No, didn't leave the field clumpy.
7) How many locations, how robust are the geographies being tested?
    a. Phosphorous testing was around St. Brieux (Bourgault). Maybe can make more customized recommendations. Need more locations of testing to increase the confidence of the results.
8) Improvement in soil quality indicators. How compatible are the new planters in direct seeding into standing stubble? Is more tillage needed?
    a. Challenges here, but warming up of the soil is key. Getting the stubble removed. Depends on farmers' situations.
9) Comment: What you see when seeding rate decreases, the variability increases. In this scenario, in years when conditions are not as good, there will be yield reductions. Higher seeding rates are insurance for these years. Canola is plastic and it's good to have it compete with itself a bit. A lot of research being done this.
10) Canola in singulation planting. How low is too low?
    a. Six seeds per square foot, produced the best yield potential and survivability but under good conditions. Under bad conditions can't say.
11) What have you seen for distance between seeds within the row?
    a. Ideal distance is 1.5" per plant.
12) Would it make sense to aim for separation and set seed row wider to modify for plant per square foot?
    a. More research needed, in-row spacing more important than the row spacing itself. Should be measuring the distance between plants and look at standard deviation.

11:45 – NOON: InVigor Rate: Target plant population for InVigor canola *(Jared Veness, Technical Development Manager, BASF)*
Farmers haven't paid much attention to the thousand seed weight (TSW) of their canola lots in the past. InVigor has conducted large scale replicated trials over four years with 21 site years of data, investigating factors like seed size, plant density and seeding depth. The trial design is fifteen times larger than that of breeding plots to minimize edge effects. Two to 20 seeds per square foot were planted. Plant establishment was consistent across hybrids tested, but not linear. There was 50-70% emergence in these trials. With warm, black soils, 80% emergence is possible. The more seeds in the ground and emerged plants, the more prone the plants are to lodging. There is an associated yield penalty with higher lodging. It was found that we are losing plants per square foot with higher seeding rates, through self-thinning (essentially, canola is a weed in very dense populations). This is a balance, as denser stands mature faster, and weeds take advantage of gaps in canopy with low densities. The end goal (for InVigor Rate varieties) is hybrid-specific recommendations. Five to seven plants per square foot is the recommendation for canola stand density right now for InVigor hybrids. Moving forward, there will be four ranges of seed bags, divided by TSW ranges. Neil Harker's work showed lower seed vigor with smaller seed size so BASF will not be selling seed that is at the low end of the TSW range.
Question and Answer Period:
1) Plot size?
    a. It was 20 feet by 150 feet.
2) Seeding speed?
    a. Varied. Don't know off hand.
3) Will seed production be managed differently for larger seed size?
    a. Looking at more consistency in seed size from production standpoint.
4) Model for seed growers? For them to aim for certain seed size?
    a. Unsure on this side of things.

1:00-2:00 PM: Elevator pitches and feedback panel: Tools that will improve canola stand establishment
Feedback panel: *Leeann Minogue (Grainews editor, FBC publishing), Murray Hartman (Provincial Oilseed Extension Specialist, Alberta Agriculture and Forestry), Curtis Rempel (Vice President- Crop Production & Innovation, Canola Council of Canada)*

Brent Nicol, Early Season Scouting *(Digital Farming Specialist, xarvio-BASF)*
Pitching "Xarvio scouting", a scouting application. It includes weed identification, disease recognition, and leaf damage. The user takes a picture of the weed they want to identify and the application identifies it and gives a percent confidence in the given answer. The application has a map function (GPS) and it can be shared with others. This is a global tool which learns by Artificial Intelligence, constantly growing and improving the more it is used. There are 18,000 photos of 27 different weeds in fields on the application right now. It is free of charge to use.
Feedback:
1) Is this based on facial recognition or page of look-a-likes?
    a. Based on recognition, it gives % accuracy.
2) Region settings?

    a. Yes, specific for area.
3) Can this get to a point where a grower can input weed spectrum and then design herbicide management plan?
    a. Yes, working with another collaborator.
4) Disease or insect damage on cotyledons possible to identify, but what about stem feeding?
    a. Not yet.
5) How confidential is the data?
    a. It stays within their system, housed by them.
    b. No promotion of data.
6) How good is identification at cotyledon stage?
    a. 60% of images taken in Canada were at cotyledon stage, new images being uploaded to train the program.
7) Rare weeds on farm that we cannot identify- how can the app identify it?
    a. Multiple pics are taken.

Suresh Desai, RNAi Technology *(Greenlight Biosciences)*
Pitching RNAi technology. Greenlight Biosciences has a proprietary scalable process to produce low cost RNAi. The product is a sprayable double-stranded RNA for control of agricultural pests in a highly specific manner. RNAi is a natural process when an RNA molecule inhibits the gene expression by interfering with the message. This is a new mode of action (there is currently no topical RNAi product on the market) with low toxicity, that is biodegradable, highly specific and pollinator friendly. In their process, yeast is used to make the RNA product. It is produced at a low cost (<$1/g) at an industrial scale. Currently testing on flea beetles and it is working.
Feedback:
1) What is the shelf-life?
    a. We are working on it. It stays in glass bottle protected from sunlight until spray time.
2) What's the specificity?
    a. Highly specific.
3) We have two major species of flea beetles in the Prairies. Do you need two RNAi formulas?
    a. They do have a high similarity between the two and can target one or both.
4) Killing things quickly with RNA... how to pitch this to consumers?
    a. Slower than insecticide. Need to be cautious about messaging.
5) Specificity and non-impact, could you just apply in the overwinter habitat?
    a. Thinking about it. Spray later in the season and get reduced emergence in next year.
6) Regulatory pathway? Natural product? Rhizobacteria?
    a. Working on EPA, recognizes RNA as a biopesticide. Initial discussions.

Tyler Billay, High-speed Planting *(Horsch LLC)*
Pitching high-speed planting. Horsch is headquartered in Germany and the planter in question, Maestro, is built and designed in North America. Seeing four plants per square foot average on Prairies, but why do we plant ten? To compensate for seed handling damage, overlap, and curve compensation. The goal should be to plant one seed and get one plant to grow, mastering the growth of one plant and multiplying that 200,000 times. Singulation technology is not new, it just needs to adapt to canola. The Maestro can plant canola perfectly at seven to

nine miles per hour. Attention to detail is the difference between successful and unsuccessful farmers. Beans and corn are coming to western Canada; why not add canola to the singular planting platform?

Feedback:

1) One seeding outfit? Can we plant all crops this way?
    a. Planter is best tool for certain crops (beans, corn) but not cereals. Specify machine to the crop.
2) Don't know why 40% of canola is not emerging. It is hard to correct equipment when you don't know the problem to start with. More complex problem than just the equipment.
    a. At least allows you to control one variable.
3) Wanted to see plots of singulation versus normal planting. Do you have this information to show producers?
    a. Yes, refer farmers to their neighbors. Lots of machines in western Canada. These are 160-acre comparisons of singulation and solid seeding.
4) How many acres per foot of machine do you recommend, and what is the cost?
    a. The recommendation: 40 acres per hour @ 8 MPH with 40-foot machine. Ex. 5000-6000 acres in western Canada costing $400,000.
5) A comment was made that although testimonials are often shared, they aren't the best type of data on which to base decisions. .

Gregor Sekulic, Conservation tillage *(Agronomy Specialist, Peace Region, Canola Council of Canada)*

In Canada, 85% of acres are on some sort of conservation tillage regime. Why are some producers still hesitant to adopt these methods? People would potentially rather see a clean row of canola on black soil that is not being stressed, versus the same plant stand on residue. This provides canola moisture at the surface for germination and that residue does not need to be cleared. If one is going to do tillage, then slow down and don't do high-speed disking, as tillage erosion is partly a function of speed. This practice spreads clubroot and causes major tillage erosion, which will only contribute to the removal of soil from the surface which has happened over the last 100 years.

Feedback:

1. Tillage erosion on flat land? Why should I slow down?
    a. Maybe this message doesn't apply to you but there are other soil health concerns with tillage than just erosion.
2. How do you sell negatives of tillage to the urban public?
    a. Trying to mimic a natural system, but tillage doesn't happen in a natural system.
3. Do you think strip till would be a good fit for conservation purposes?
    a. Which is the lesser evil? Row crop, narrow rows….

2:00-2:40 PM: Challenges and solutions from other small-seeded crop *(Kevin Walsh, Customer Recommendations and Stewardship, Seminis Vegetable Seeds)*

Seminis is the vegetable division of Bayer CropScience (formerly Monsanto), which provides growers with 26 different crop species in different countries and different environments. The challenges in this space currently are a growing population, changing climate, changing

economies and diet, and limited farmland. Seminis supplies 90% of the seeds to organic farmers even though they are "labeled as" a genetically modified company. Labor in the horticultural industry is so expensive, so there is a shift towards automation. An example was shown of plant tape and automated greenhouses. The plant tape concept has potential benefits for small seeded field crops like canola. Building partnerships is important to Seminis for continued innovation. For example, they are currently working with drones and precision irrigation opportunities.

Question and Answer Period:

1) Brassicas used as a fumigant for other crops?
    a. Not addressed.
2) How is the carbon footprint changing?
    a. Vegetables can be grown more locally. Solar options and efficiency to reduce energy costs are being worked on. Changing consumers' messages.
3) Farmers get frustrated with the multitude of apps available. How do you navigate applications brought forward to your company?
    a. Group validates the capabilities. Tools only as good as the data that feeds them. Working with breeding company to identify one trait but as you increase the data input, algorithms can identify more things, and things you wouldn't notice (that can be detected using AI). Long term this can help but short-term is annoying. Growers want one tool on phone only, so connect all of them.
4) Water usage and footprint?
    a. Depends on country. Water is a big issue. Saudi Arabia stopped the export of crops that have water in them. Some crops will just disappear because of too much water consumption (i.e. celery). Using black water or sanitization water causes plant other problems.

3:00-3:30 PM: What role do varietal differences play in secondary dormancy? *(Sabine Gruber, Professor of Crop Science, University of Hohenheim)*

Fifteen years of secondary dormancy research information was presented**. (**Primary dormancy and secondary dormancy in the same seed, as related to seed bank canola/OSR.) Can we select for low-dormancy varieties? Dormant seeds can become volunteers later on. Soil environment affects dormancy potential. Dry and dark is more conducive to dormancy induction. Dormancy potential varies by variety. Dormant seeds can survive in the soil for up to 10 years**.** Volunteers can outcross and contaminate current canola crop**.** Dormancy induction in the lab is standardized to compare different seed lots. Result is percentage dormancy potential. Large range of dormancy found (2-95%) and it is never down to zero percent. Lab tested varieties were then tested in the field, enclosed in a bag. Heritability of dormancy is 0.82. Five QTLs identified that explain 42% of phenotypic variability. Location, genotype and the interaction is very significant. Identify low dormancy plants and use for future breeding. Immediate stubble tillage had higher volunteers than no tillage**.** Natural destruction of seeds will happen in the seed bank**.** High dormancy variety had larger soil seed bank compared to low or medium dormancy. Immediate tillage leads to large seed banks**.** Seed bank can be reduced by aging**.** Ideal scenario is low dormancy potential variety, with little harvest loss, delayed tillage, and long crop rotation. Environmental conditions are not controllable, but you can try to control

dormancy culturally. Unfortunately, the farmer does not know what the dormancy potential of seed they have is. Breeders have not been interested in this topic. One German breeder is testing varieties to make recommendations for farmers.

Question and Answer Period:

1) Late tillage? Weeks or months?
    a. Weeks work in central Europe. Mice eat the seeds. Slight rainfall or wet conditions the seeds start to germinate but cannot finish and dry out and die.
2) No till?
    a. Found more surviving seeds, cracks in the soil seeds can go deeper.
3) Comment from the audience: Trying to get companies to test dormancy for years. Easy to modify because of the variation in the population. If different canola quality types are going to be grown (high oleic, etc.) there is going to be contamination. Problem with volunteers in pulses, get reasonable control with herbicides but nice if we don't have that problem. Breeders need to take responsibility to reduce the dormancy of the seed.
4) Does the dormancy trait persist in the purchased seed? Possible tie to emergence issues?
    a. Yes, high germinability from breeder but when seeded the emergence is very poor due to dry soil and causes seed to be induced into dormancy and leading to uneven emergence.
5) QTL's identified… how stable will they be in spring canola?
    a. Not a breeder; cannot say. Tried a small selection experiment in GH with spring oilseed rape and it was possible to reduce dormancy. Many genes are involved.

3:30-4:00PM: The value of wild species in canola production *(Paul Galpern, Associate Professor, University of Calgary)*

Where the wild things are? In the spaces between our field, like wetlands, pivot corners, shelterbelts, forest patches, fence rows, road margins, pasture land, 'low' spots, poplar bluffs, and stream margins. Here, we find habitat for other beneficial species, which provide various ecosystem services (pollination services, pest control, water retention and purification). Landscape scale, beneficial insects, and off-field habitat might contribute to yield of our cash crops. Beneficial insect surveillance conducted since 2015 with 332 sites in or near canola fields found 150,000 arthropods. The collection point changed the organism collections, while similar insect populations are found in crop and near crops. Investigating whether the complexity of a field impacts the diversity and the number of insects, and found that the type of patches does not matter, but the layout does in a negative relationship. Complexity is key. Are wetlands a point-source for beneficials? If we leave them in the field, are they providing a reservoir for beneficial insects? The further away from grassland we go, the number of bees and species diversity trapped decreased, while the collections stay the same in perennial grasslands. What about field margins? In some cases, field sizes are too large for insects to go through them. Does flower visitation influence yield? Tented canola had slightly lower yield compared to open tent yields. As you move from the middle of an average field in a municipality, the amount of landscape variability (non-crop) you encounter is hugely variable. "Uncultivated stuff" in fields has a positive effect on yield compared to fewer uncultivated bits in the field. Regions with more complex fields have higher marginally canola yields. That means there is potential here to fix field diversity, by adding uncultivated areas and maintaining what is there, and increase

yields. The next steps are to look at this using precision yield data. Which types of features contribute more to yield? How does variety interact with pollination services?

Question and Answer Period:

1) More bee species in cereals than canola?
    a. Not significantly different
2) Comment: Putting netting over canola. Past research with *B. rapa* cages with and without bees found yields were all the same. Cage without bees had fewer seeds per pod but plants had more pods because they continued to flower. Be careful with assumptions…
3) Data on insecticide use by district?
    a. Don't have it but would be useful to add as a covariate.

4:00-4:30 PM: What have we learned and what's next? *Murray Hartman (Oilseed Extension Specialist, Alberta Agriculture and Forestry) and Curtis Rempel (Vice President of Crop Production & Innovation, Canola Council of Canada)*

Introduction: Ward Toma *(General Manager Alberta Canola)*

The Canola Agronomic Research Program (CARP) is administered by the Canola Council of Canada, but it is fully funded by farmers. In Alberta, this program is used to research agronomy and cultural issues that cannot be patented. Alberta Canola's main goal is to find better ways to grow canola and control pests. Currently, there is $4,000,000 in active research projects.

Murray Hartman:

Keep Canadian agriculture competitive! Messages have to resonate to the public and rigorous regulation is very important. There is value to the unfarmed land that is normally thought of as 'waste-land'. There is a lack of data on low plant densities. How many herbicide applications are needed? What is the critical period of weed control? The PMRA has a health, environment and value component in reviews, but has no cost benefit analysis? BASF's plant population recommendation is five to seven plants per square foot. It is amazing for a seed company to be promoting lower seed sales. Lookout, robotics is coming in our lifetime. What value we are getting economically from off-field areas, and is there a societal benefit we can be promoting? We have to look at the economics of all practices. Stand density is a very complicated problem. We can't predict what will happen in the season and there are so many other variables at play. What should the plant density recommendation in canola be? Maybe four to eight plants per square foot, but drive more to economics. What is happening to 40% of canola that does not emerge? How many practices should be reassessed under lower plant populations? Potentially we can fine-tune agronomics for specific densities and conditions? Data, to knowledge, to wisdom, then to recommendation to the farmers.

Closing Remarks: Curtis Rempel

Thank you to Murray Hartman for his service and wisdom over the years and good luck in your retirement next year. Thank you to 2018 Canola Discovery Forum participants, organizing committee, and speakers. Thank you to the provincial grower organizations and industry for funding the research and thank you to the researchers who conduct the research. Without this, we would not have the innovation that is needed to keep advancing canola production.