Murray Hartman's Reflections from the 2016 Canola "science-o-rama"

By Murray Hartman, Provincial Oilseed Specialist, Alberta Agriculture and Forestry

The Alberta Canola Industry Meeting / Research Update was resurrected on April 6th, 2016, under a new handle "science-o-rama". The event was hosted by the Alberta Canola Producers Commission (ACPC) and held at the
Renaissance Edmonton Airport Hotel. For the speakers and topics, I mainly targeted research projects funded by ACPC and / or ACIDF which have not been communicated widely in traditional extension events such as FarmTech and Agronomy Update. I invited speakers from the cross section of the various agriculture research providers in Alberta: Agriculture and Agri-Food Canada; Alberta Agriculture and Forestry; Alberta Innovates; universities, applied research associations and private industry. Here are my summaries of the talks given by the invited speakers.

Canola Pollination Research

Dr. Shelley Hoover, Apiculture Research Scientist, Alberta Agriculture and Forestry, Lethbridge

After briefly describing the western Canadian pollination industry, several previous studies from Quebec and internationally were mentioned where additional bee hives have increased canola yield. The limitations of previous research led her to design and conduct an Alberta research project. Using tent material that excluded wind and pollinators versus only wind at Lethbridge, she found that canola harvest index (a proxy for yield) was reduced significantly when wind was restricted. The prevalence of wind in southern Alberta means that insect pollination for commodity canola yield plays a less prominent role than in other areas.

The second aspect of her project was to assess the pollinators present in commodity canola fields at Lethbridge and Beaverlodge, with honeybee hives placed at field edge - pollinator abundance, distribution in field and relationship to yield were measured. The top 3 pollinators visiting canola flowers were honeybees, flies and hoverflies species. Honeybee visits increased with higher stocking rate and closer to hive location. Wild pollinator abundance also declined in the middle of fields. Yield data analysis is underway.

The third aspect of her project is studying the pollinator behavior in hybrid seed production fields. An MSc student from the University of Calgary (Riley Waytes) observed flower visits at 30 fields near Lethbridge in 2015 and 2016. The amount of pollen deposited on stigmas by different pollinator species, and the frequency of visits will be determined. Preliminary results show that the female leafcutter bee deposits the most pollen per visit. Information generated by this project may suggest ways to use various pollinators more efficiently.

Effects of *Piriformospora indica* on growth, yield, and stress tolerance in canola (*Brassica napus*)

Dr. Janusz Zwiazek, Professor of Plant Physiology (trees), University of Alberta

Although canola and other plants of cabbage family do not normally form mycorrhizal root associations, a recently discovered fungus *Pirifomospora indica* is able to colonize roots of brassica plants. This project involved indoor controlled environments to study the growth of inoculated canola under various stresses (low N, P, drought, flooding, low temperature or salinity). Root inoculation with P. indica increased shoot and root growth of canola seedlings and the effect was enhanced under higher N levels and by presence of organic carbon in the growth medium. Inoculation improved canola growth and yield under drought and low N or P fertility, depending on plant stage when drought occurred. Flooding, salinity and low temperature tolerances of canola were improved when inoculated. A novel protocol has been developed that makes it possible to apply fungal inoculum on a large scale.

The Use of Auxins to Enhance Canola Seed Yield Under Controlled Environment and Western Canadian Field Conditions

Dr. Jocelyn Ozga, Professor Plant Physiology, University of Alberta

The use of plant growth regulators to ameliorate the effects of abiotic stress such as heat in field crops is an active research topic. Among the classes of plant growth regulators, auxins show some promising characteristics in regulating abiotic stress effects related to plant growth and yield. This project studied the effect of auxin application on canola seed yield under heat stress and non-stress conditions. One natural auxin and one synthetic auxin were compared in the greenhouse and under field conditions (4 sites in Alberta and Saskatchewan over 2 years). Several rates of the auxins were tested at green bud stage and 1 week after green bud stage, and a heat stress treatment was included in the greenhouse study. Substantial yield increases were obtained with one of the auxins at certain concentrations under heat and non-stressed conditions in the greenhouse trials. In the field trials, auxins statistically increased yield at two site years but at different concentrations than the greenhouse study. Differences in cultivars used and maximum temperature following the hormone application in the field study likely led to varying optimal auxin analog and concentrations.

Nano Antibody Based Sensor for Plant Disease Detection

Dr. Susie (Xiujie) Li, Senior Research Scientist, Alberta Innovates Technology Futures, Vegreville

Sclerotinia is a serious disease in canola yet timely, rapid, and accurate forecasting is not currently available. One solution could be an in-field biosensor for real-time sclerotinia spore detection with specificity and accuracy. Design and testing of a miniature (nano) bio-sensor utilizing antibody-antigen system was described. As few as 5 spores could be detected and this was less than the minimum number of spores over 24 hours needed to initiate disease in a growth chamber. There was a good correlation between the number of spores and disease severity in the growth chamber. The signal from the biosensor was capable of being transmitted to an iPhone, and thus a convenient, user-friendly interface for the field could be built. The next step is to calibrate this under field conditions.

Advances in Canola Clubroot Research and Characterization of New Clubroot Strains

Dr. Sheau-Fang Hwang, Pathology Research Scientist, Alberta Agriculture and Forestry, Edmonton

The development of clubroot resistance screening for canola against the initial Alberta pathotypes was outlined. The successful introduction of clubroot resistant canola hybrids was adopted, and quickly became the primary tool used to manage clubroot in farm fields. Longer rotation breaks from canola did not generally occur as growers relied mainly on variety resistance, in spite of risks for resistance erosion. The lack of adequate rotation breaks for clubroot resistant canola (poor stewardship) led to pathogen shifts and the first cases of resistance failure in 2013.

The procedure used to identify a pathogen shift was described, and how it was confirmed that the new pathotype from 2013 was able to overcome resistance in all the commercially available varieties in western Canada. The new strain was classified as pathotype 5 in the Williams differential set, but it was obviously different because it could infect canola varieties resistant to previous pathotype 5 isolates. This indicates the weakness of various international clubroot differential sets to distinguish all clubroot strains. Current resistant canola varieties showed low disease reaction to pathotype 5x at inoculum concentrations of 5×10^3 spores/g of soil and below, and high disease with 5×10^5 or more spores/g of soil. Additional field surveys were conducted in 2014 and 2015 to look for additional fields with pathogen shifts. From 27 suspect fields in 2014, 16 were confirmed to have pathogen shifts that defeated variety resistance. These fields were located throughout the clubroot infested areas of Alberta which suggests that pathogen shifts are occurring independently. A Canadian clubroot differential set has been assembled from the various international differential sets and it is being assessed for its ability to distinguish old and new strains in Alberta. There were 9 distinct new pathotypes identified from the 2014 cases that defeated resistant varieties. The 2015 survey has confirmed another 24 fields with pathogen shifts, but the pathotyping analysis is not complete to determine how many additional new strains have occurred (preliminary analysis suggests a few, not as many as 2014). After the combined 2014 and 2015 results are analyzed, the Canadian clubroot differential set may be settled and a naming system for pathotypes suggested (to avoid vague names such as 5x, 3x, 3y, 3z etc.). The CDC North facilities (greenhouse and field) for screening canola varieties and germplasm against the new pathotype 5X was described. Research at CDC North indicates that genetic testing (PCR) can distinguish the pathotype 5 and 5X strains from other strains found in Alberta.

Rotation studies using large tubs showed that resting spore numbers and clubroot disease severity declined while canola yield increased with 2 alternate crops between canola crops compared to continuous canola. Several years of greenhouse and field trials with Vapam to fumigate infested soil before planting canola were discussed. Vapam reduced clubroot severity and improved canola growth and yield, but was deemed much too expensive for general large scale field applications. Additional work with another soil fumigant (Basamid) found better canola growth in infested soil in the greenhouse than field trials. Soil fumigation may be useful in isolated locations to mitigate clubroot hot spots, but it is expensive and requires specialized training for application.

Breeding for clubroot resistant Brassica napus canola cultivar carrying multiple resistance genes

Dr. Habibur Rahman, Professor Plant Breeding, University of Alberta

The University of Alberta (U of A) program to search for clubroot resistance in the six closely related Brassica species was described. A total of 275 accessions of six Brassica species were evaluated. Resistance was found more frequently in turnip (B. rapa var. rapifera) and black mustard (B. nigra). Limited resistance was found in B. napus (mainly in rutabaga types) and B. oleracea, and no resistance was detected in B. juncea and B. carinata.

Dr. Rahman then described the breeding and development of multi-genic clubroot resistant hybrid canola in partnership with Crop Production Services. The CR gene 1 involved a major gene with good resistance to pathotype 3, and markers were developed to assist with breeding. The CR gene 1 was used by CPS to create a Rf line (male parent) for hybrid seed production. The introgression of CR gene 2 was more difficult since the parent source was not canola quality oilseed type. After breeding to improve agronomic and seed quality traits and developing markers, the CR gene 2 was used by CPS to create a CMS line (female parent) for hybrid seed production. These two lines with different clubroot resistance has produced the first hybrid variety (PV 580 GC) with true multi-genic resistance. Tub tests at the U of A shows good resistance against the new pathotype 5x. Breeding of improved CR cultivars carrying resistance to multiple pathotypes will continue and several improved hybrids are in the pipeline.

Blackleg pathogen variation & developing a "tub test"

Ralph Lange, Program Leader, Alberta Innovates Technology Futures, Vegreville

An interesting analogy of increasing technology in warfare was used to illustrate the host-pathogen evolution in resistance and disease. A brief history of blackleg and pathogen genetic diversity on the prairies was given. The Australian system of resistance grouping was outlined, and how the current project was conducted to test if such a tub system could work in western Canada. In the first round of tub testing with residues from 12 fields, about 5 different resistance groups could be identified. The strategy for management of blackleg genes using resistance group ratings would be to put resistance genes into fields where they will be effective and avoid repeatedly exposing the same effective genes to the resident pathogen population (thus increasing risk of adaptation). Quantitative resistance or adult plant resistance is a complicating factor for blackleg disease severity. There appears to be 2 main groups of blackleg genetic populations in Alberta. Growers should not rely solely on resistant cultivars even if resistance groupings can be established in western Canada – other tools such as crop rotation, fungicides, sanitation, etc. need to be used to reduce inoculum.

Geospatial Data Tools for Evaluating On-farm Yield Response to Crop Inputs

Dr. Dan Heaney, Vice President Global Agronomy, Farmers Edge

Geospatial yield data has the potential to allow growers to assess impact of management decisions, but few have the capability or time to clean and properly analyze the data. The main objectives of this study were: to research and improve technologies to clean and analyze yield data; create a tool set to evaluate

yield responses to crop inputs, management practices and field conditions; apply these tools in cooperation with producers to manage on farm research trials; and identify further requirements. Yield data from combine monitors have numerous limitations: calibration issues; multiple machines; speed or flow changes; partial passes and lags between header movement and data logging. Seven different methods were compared for cleaning yield data using two years of yield data from 10 cooperating producers. The best method involved filtering for: start and end pass delays; max and min velocities; max and min yields; minimum swath; and local standard deviation of yield from a 20 meter radius. About 6-20% of yield data is pruned. Several field examples were given for illustrating the differences between gross and cleaned yield maps.

Six methods and field layouts for comparing effects of treatments in large scale trials with yield monitors were compared using fields with variable rate fertilizer and fungicide / growth regulator treatments. The best method was analysis of the yield data in a long check strip vs the yield data in equal sized treatment strips on each adjacent side of the check strip. Several field examples were illustrated. Based on this project and his experience, his advice for on-farm trials were:

1. Keep it simple: 1-3 treatments including check
2. Long and narrow configurations
3. Assess variability prior to placement using satellite imagery, yield maps previous years, soil maps/tests
4. Build treatments and/or checks into controllers
5. Calibrate equipment
6. Use in-season imagery for initial assessment
7. Harvest along treatment axis (same day, same combine)
8. Replicate by repeating strips within a field, repeating different fields or data sharing

Night Spraying and Seeding Between the Rows

Ken Coles, General Manager, Farming Smarter, Lethbridge

Data from several trials comparing time or day / night on efficacy of pre-seed and in-crop herbicides was presented. Pre-seed and in crop herbicides had most consistent results with day time applications although grass herbicide efficacy often improved with night time application. Broadleaf weed control was most sensitive to environmental conditions. Glyphosate and Liberty efficacies were more affected by environmental conditions than herbicides used in wheat. Various weather factors such as temperature, wind, humidity, sunlight, dew and inversions were described for their possible impact on the trial results. Less extensive trials with fungicides have not shown a clear advantage for day vs night spraying.

Four years of trials with winter wheat and canola attempted to answer the question: is inter-row seeding worth the time, energy, technology investment? Canola plant density was statistically less only when seeding directly on the stubble row of the preceding crop. Canola yield was not consistently affected by inter-row vs normal and on-row seeding, but the Pillar Lasers disc hoe-openers yielded statistically more than the Stealth Paired row hoe-openers.

Lastly, results from hail simulation trials were shown that are underway to determine if yield loss from hail at different stages in modern hybrid canola differs from loss charts developed many years ago.

Monosem Precision Planter Trial and Mitigating Short Rotation Yield Loss Study

Dr. Neil Harker, Research Scientist Weed Ecology and Crop Management, Agriculture and Agri-Food Canada, Lacombe

Interest in precision planters for seeding canola has increased, and a study was initiated several years ago to compare the emergence and yield of a Monosem precision planter to the Conserva Pak used at the Lacombe Research Station. The replicated trial compared these two seeders at 12 and 24 inch row spacings, and six seeding rates. 2015 plots were lost after the severe summer hailstorm. Based on the limited data so far, yield tended to be slightly higher with the Conserva Pak (1 year – 2014). Canola plant mortality was slightly lower with the Monosem, particularly during a dry spring (2015), and the Monosem tended to result in earlier flowering and maturity, less green seed and greater kernel weights. With both seeders, 24 inch rows increased plant mortality, delayed maturity, reduced yields and increased green seed levels.

The second topic discussed was impact of short rotation canola on pests and yield. Results from several trials were presented. In 2008, direct-seeded, all phases rotation experiments were established at 5 AAFC locations on the Canadian prairies to compare continuous canola (0 years break) to canola rotated with wheat (1 year break) or barley and peas (2 years break). Blackleg disease incidence and root maggot damage decreased with longer rotation breaks, while yield increased. In another experiment at 5 western Canadian sites, canola cultivars from different companies and herbicide tolerant systems were rotated in various intervals or mixtures to assess if genetic rotation can mitigate risks such as blackleg disease. Blackleg incidence was not affected by mixtures or rotation patterns of different varieties in short rotation, and only decreased with 1 or more years of break out of canola. Yield increased only with 2 years rotation break away from canola. A trial was initiated in 2014 on the plots of previous experiment with continuous canola for 6 years, to investigate whether continuous canola yield loss can be mitigated by increasing fertilizer rates, tillage, fungicides, seeding rates and removing chaff. Preliminary results from 2014 / 15 shows that sometimes 150% NPKS fertilizer improves continuous canola yield and further analyses will be conducted after more site-years of data are available.

Canola Research Hub

Barb Chabih, Program Coordinator, Canola Council of Canada

The abundance of various canola research projects and programs in Canada helps this industry to keep up with challenges and innovation, but keeping track of all this research is difficult. Fortunately, the Canola Research Hub, launched at the beginning of 2015, provides the industry with a convenient online resource for sharing and comparing this growing body of research findings. This database started with the results of all 30 studies under the Canola/Flax Agri-Science Cluster of Growing Forward 1. The Hub's content is being updated to include results of projects under GROWING FORWARD 2, Canola Agronomic Research Program (CARP), and Ultimate Canola Challenge (UCC). The Research Hub can be accessed directly at the link http://www.canolaresearch.ca or through the Canola Council of Canada website under the Research drop down menu. Barb guided the audience through an on-line tour of the Canola Research Hub, showing its functionality, menus, and examples of reports. A brief video tour is also available at http://research.canolacouncil.org/research-hub-video.