

## MINUTES

### 2005 Canola Industry Meeting

30. November 2005, Hilton Garden Inn, Saskatoon  
8:30 am – 5:00 pm

#### 1. Welcome and Chairman's remarks

The Chairperson, Dr. R.K. Downey, opened the meeting and welcomed all who came to participate in the meeting. The mailing list was circulated and Dr. Downey asked meeting participants to update the list, correct addresses if necessary and add e-mail addresses as needed. Minutes from last year's meeting were available (70 hard copies at entrance desk), they were also put on the Genome Prairie website. There were no introductions of meeting participants. The program for the Genomics Workshop to be held on December 1, 2005 was available at the front desk. Dr. Downey thanked sponsors for supporting the meeting: Ag-West Bio, Genome Prairie, Monsanto, Saskatchewan Canola Development Commission, Agriculture and Agri-Food Canada and National Research Council of Canada.

#### 2. WCC/RRC changes and Co-op Test information – Mr. Raymond Gadoua.

Mr. Gadoua reported on the WCC/RRC meeting which was held the day before on November 29, 2005, at the Hilton Garden Inn Hotel, Saskatoon. The purpose of the Co-op canola test is to generate information on the agronomic performance, disease resistance and quality of candidate cultivars for use in support of recommendation for registration. Merit scores are calculated on the basis of yield, disease resistance, and oil and protein content. Minimum performance criteria must be met, such as glucosinolate content, saturated fat content and others. A performance summary package is prepared according to established guidelines which are updated annually.

The Co-op canola test is a 2-year test with first year evaluations carried out in private tests, followed by evaluations in year 2 in the public Co-op tests.

There were 751 private tests in 2005, 727 tests of *Brassica napus* and 24 tests of *B. juncea*, 609 tests passed inspection, 108 tests were cancelled. There were no *B. rapa* tests. Seventy-five *B. napus* lines were evaluated in the public Co-op tests at 25 locations for agronomic performance. Resistance to blackleg of candidate lines was evaluated in 6 disease nurseries, there were 2 white rust assessments under controlled greenhouse conditions.

Manitoba sites had excess moisture, the test at Scott, Saskatchewan was lost due to heavy hail damage.

Questions: Dr. Downey indicated that both, excess moisture and drought, are stresses.

3. Eastern Canada canola situation – Hugh Earl

Mr. Earl titled his presentation: Cabbage Seed Pod Weevil and Brown seed which were the two main factors of concern in the 2005 canola crop.

The 2004 Ontario canola crop was about 55,000 acres, average yield was 38 bu/acre (2100 kg/ha), 10 to 20% of the acreage was winter canola. The four main growing regions were: Central Region (Lake Ontario) ~ 11,000 acres, Southern Region ~1,500 acres, Western Region (Lake Huron) ~33,000 acres and Northern Region ~9,500 acres. The Ontario canola acreage has varied from about 10,000 to 35,000 acres during the last 25 years with yields from 1,500 to 2,000 kg/ha.

High “Brown Seed” count was the major quality concern in 2005 canola. An extremely hot early summer (20 days in June over 30°C) resulted in high percentage of aborted seed. The cotyledons in these seeds are dark brown or tan in colour when crushed and are indistinguishable from bin-heated seed. They have a high free fatty acid content, limits for free fatty acid content are 0.1% for Canada #1 and 0.5% for Canada #2. There was a strong ( $r^2=0.86$ ) correlation between percent brown seed and percent free fatty acids. ADM Windsor is the only company in Ontario that crushes canola seed, they increased discounts for #2 canola and rejected many shipments. Uninsured canola was sold for \$25 to \$175/tonne. Crop insurance will pay for losses if insured.

Cabbage Seedpod Weevil was first identified in Ontario in 2001. It is now the single most damaging pest in Ontario canola, it is particularly damaging to winter canola. Matador is the only registered insecticide, there is little information on thresholds and timing of application, projects are underway to develop control recommendations.

The Ontario winter canola variety trial had 12 entries and was grown at 2 locations. At Harriston, the average yield was 3,300 kg/ha and brown seed count was 0.1%, the test received 2 applications of Matador insecticide (foliar application). At Elora, without insecticide application, the average yield was 1,700 kg/ha and average brown seed count was 2.4%. There seems to be a negative relationship between brown seed and yield.

The spring canola variety test with 18 entries was grown at 3 locations and had an average yield of 1,500 kg/ha. The tests had high brown seed counts. There was again a negative correlation between brown seed and yield.

Research on the management of cabbage seedpod weevil and swede midge is conducted at the University of Guelph, OMAF and AAFC with support from grower associations, the Canola Council and private industry. Factors studied are: planting date, foliar insecticide application, and seed treatment. There was no effect of planting date, but weekly foliar insecticide applications were effective in preventing yield losses and reducing brown seed. Different foliar insecticide treatments had no effect on brown seed. There were significant effects of foliar spray on yield and brown seed reduction in all varieties tested, except for yellow mustard. Foliar sprays

significantly reduced percent damaged pods. Tests were also conducted on farmers' fields.

In summary: yield losses to insects can be very substantial, two applications of Matador are recommended, all varieties are susceptible, there is a clear benefit from foliar applications over seed treatment and percent brown seed increases as yield decreases.

4. Report from Plant Biosafety Office – Wendy Shearer

The Plant Biosafety Office (PBO) is responsible for regulating the importation and environmental release of plants with novel traits (PNT's). A new variety is subject to regulation when it contains traits novel to that species in Canada, or the trait is present at a level outside the range observed for that trait in cultivated varieties of that species in Canada.

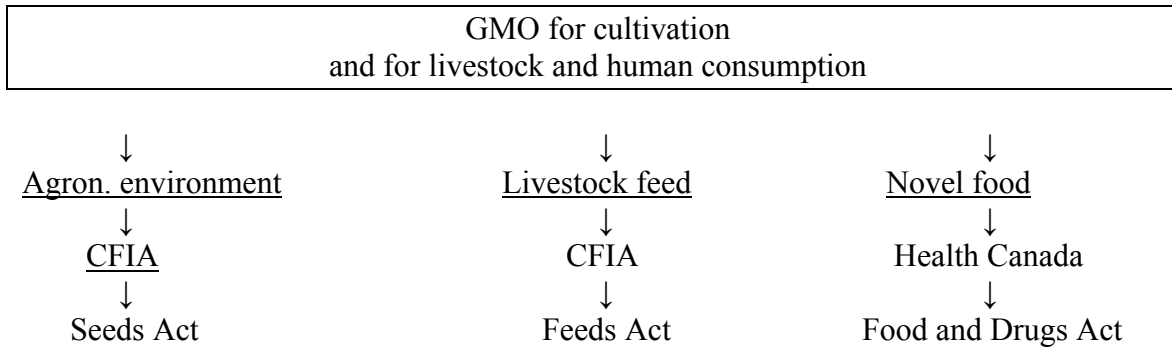
There are international standards for the assessment of environmental risks for PNT's, as well as import controls and other regulations. International activities include: the Cartagena Protocol on Biosafety, International Plant Protection Convention (IPPC), North American Plant Protection Organization (NAPPO), North American Biotechnology Initiative (NABI) and Bilateral Regulatory Protocol Agreements with different countries. There are various import and "capacity building" activities under development. The 2004 Auditor General Report stated that there was insufficient awareness among importers regarding import requirements for PNT's.

The Environmental Risk Assessment (ERA) consists of the confined field trial program followed by unconfined release authorizations, policy development and research. There were 90 applications for confined field trials in 2005, and 208 field trials were authorized (12 *B. juncea* and 122 *B. napus*). 47 PNT's received unconfined environmental release authorizations. Five PNT's were approved in 2005 and 14 submissions for unconfined release are currently under review. A guidance document on the use of "novelty" as a regulatory trigger is under development.

Regulatory guidelines for the environmental release of PNT's for plant molecular farming are currently being developed. There is a need for harmonization among biotechnology working groups in the OECD.

5. Changes in regulations and trade issues – JoAnne Buth, Canola Council of Canada  
JoAnne Buth titled her presentation: Canola GMO's, pesticides and trade.

## Regulatory Reviews for GMO's



### GM Events in canola

Monsanto: RR, GT73

Bayer CropScience: 5 events related to Liberty Link/Invigor and Bromoxynil herbicide tolerance.

In Japan: environmental approval under review.

China: safety certificates expire in 2007.

Mexico: new regulations for food only.

South Korea: all events approved, except Bromoxynil.

Pakistan: no regulatory system.

The EU has a 9-year moratorium on GM canola, progress is slow. Canola oil can be exported to the EU for biodiesel. Soybean and corn GMO's are less of a problem than canola, because of the many different events in canola. There is also the danger of outcrossing to other canola and the volunteer problem. Several GM events are no longer commercial and varieties have been de-registered, included are: oxy 235 and the Liberty Link/Invigor events MS1RF1, MS1RF2, Topas 19/2 and T45. Producers should not grow unregistered varieties that might contain events not approved in export markets.

Canola Council is working on a market access policy to obtain approval for events in export countries, on "zero" tolerance (absence) of adventitious presence and the development of non-food canola markets.

To ensure access to export markets in the future: a new GM canola (*B. napus*, *B. rapa*, *B. juncea*) will not be commercialized in Canada until necessary approvals are obtained in Canada, US, Japan, Mexico, China, EU (?) and South Korea. There will be no closed loop option, status will be reviewed annually and markets added as regulatory systems develop.

Adventitious presence is the "unintentional, unavoidable presence of GMO material." There is a zero tolerance for unapproved events. Reasonable global tolerances must be established, and Canada must become a leader on this.

Japan will have a new food safety law in 2006. There will be increased testing of pesticide residues in canola – focus is on glyphosate and malathion. It is important that growers do not use unregistered pesticides and follow label instructions (i.e. preharvest intervals). Canola shipments to Japan have been found to contain 0.06 to 2.0 ppm malathion, used for control of insects in storage bins, based on 10 years of CGC monitoring. The maximum residue level for malathion is 0.1 ppm in Canada and 0.5 ppm in Japan. The use of lindane is illegal, it is not registered for use in canola in the US. Growers need to be educated.

6. Canola breeding  
Breeding for shattering resistance – Van Ripley

This is a collaborative research project between AAFC, Saskatchewan Canola Development Commission and Saskatchewan Mustard Development Commission.

Significant yield losses can occur in canola due to shattering, yield losses of 2 to 8 bu/acre have been estimated under commercial growing conditions. Costs associated with swathing are estimated at \$5 to \$10 per acre. Time of swathing is critical and could have significant impact on seed quality and increased green seed counts.

Field and indoor screening methods for pod shatter are being developed, potential variation for pod shatter resistance between *B. napus* canola varieties are studied and pod shatter resistance in *B. juncea* and *B. carinata* is evaluated. AAFC *B. napus* breeding material is heavily based on interspecific crosses, eg. the yellow seed material was derived from crosses with *B. juncea* and *B. carinata* which are shatter resistant. The material has never been evaluated for pod shatter.

Indoor screening testing method utilizes a random impact test (steel ball bearings in a shaker) and rupture energy (pendulum machine). Results from indoor tests will be compared with field data.

Field pod shatter resistance testing utilizes different harvest methods for yield assessment: swathed at proper maturity, direct combining at full maturity (added in 2005) and straight combining one month after maturity. Plot yields were compared with visual estimations of % pod shatter and pod drop. Seed quality: oil, protein, chlorophyll and glucosinolates were also determined. A significant correlation was found between plant height and pod shatter, while all correlations with other plant morphological traits were non-significant.

Yellow-seeded lines of *B. napus* had less shatter losses than black seeded varieties and lines in 2004 and 2005. There was a meaningful and useful correlation between observed yield losses in yield tests with visual scores of the number of shattered pods. *Brassica juncea* had lowest shattering losses. Seed chlorophyll content was highest in seed from swathed plots.

Seven lines (2 *B. juncea* and 5 *B. napus*) were selected for indoor screening based on field results. Pendulum machine results were correlated with pod length. There was also a correlation of field ratings with rupture energy index values per mm pod length. It takes more energy to rupture pods of yellow-seeded lines.

In the future, more work will be done on the pod shatter resistant species *B. juncea* and *B. carinata*. Four pod shatter susceptible *B. juncea* and two pod shatter susceptible *B. carinata* lines have been identified. Mapping populations will be produced in both species derived from crosses between pod shatter resistant and susceptible material to investigate mechanism of pod shatter. We might encounter interactions of pod shatter reaction with maturity. Bulk segregant analysis will be used for marker discovery.

#### Questions:

- 1) Shattering resistance in *B. napus* is not necessarily related to seed colour, it is most likely the result of introgression of genes from *B. juncea* used as a parent in the development of the yellow seed *B. napus* material.
- 2) The moisture content of pods is considered in assessing shatter resistance.
- 3) Shatter resistance of individual pods is estimated when using the pendulum machine to measure shatter resistance.

#### University of Alberta breeding program – Habibur Rahman

The University of Alberta has a long history in canola breeding. Dr. Zenon Kondra developed varieties of *B. rapa* and *B. napus* adapted to Alberta growing conditions (1969 to 1988), Dr. Gary Stringam worked on *B. napus* and *B. juncea* line development, utilizing doubled haploidy, and developed early maturing, blackleg resistant varieties (1988-2003), and in 2003 Dr. Habibur Rahman took over the program, working on *B. napus*.

The focus of U of A canola breeding is on genetic diversity and germplasm development and value-added product development. Heterotic pools are being developed for hybrid variety breeding, disease resistance breeding is important. There seems to be a positive correlation between genetic distance and % seed yield heterosis in canola. The genetic diversity in *B. napus* can be increased through resynthesis from its parent species. Blackleg resistance can be introgressed from *B. carinata* into *B. napus* through interspecific crosses, followed by backcrosses to *B. napus*. The interspecific cross introduces undesirable traits from *B. carinata* and strategies must be developed to avoid this. Resistance to Sclerotinia could possibly also be introduced from *B. carinata*, however the resistance is difficult to select in field tests. Resistance to club root disease is also important, 20% of the canola acreage in Alberta is vulnerable, club root resistant germplasm is available in *B. rapa* and *B. oleracea*. Club root can cause big economic losses, collaboration with Dr. Tiwari.

Value added products will diversify the use of canola. One objective is to develop low saturated fat *B. napus*. Canola can be engineered to produce nutraceutical compounds for the health care market, work in collaboration with Dr. Weselake (U of A) and Dr. Shah (ARC).

The Genome Prairie III project will focus on the development of yellow-seeded *B. napus* to improve canola meal feed value through reduced fibre contents.

#### Fertiseeds – Jonathan Spenser

FertiSeeds Ltd. is a technology development company for the agricultural industry. It is an Israeli agro-biotechnology company offering a universal solution for hybrid seed production. Successful hybridization requires: good combiners, one male sterile parent, effective pollen transfer and full restoration of fertility in the F<sub>1</sub> hybrid.

The system: Two genetic components are positioned precisely across from each other on homologous chromosomes, and these components interact to cause male sterility in the female seed parent. In progeny of crosses with any pollinator (wild type), the components segregate and produce a fertile hybrid. Two different homozygous maintainers for each of the two genetic components can be produced which, when crossed with each other, produce a male sterile plant. There is molecular evidence for proof of the concept. The system has been demonstrated to be effective in the model plant *Arabidopsis*. It is also functioning in tomato, cotton and rice. FertiSeeds has a joint project in rice with China.

Two generations of crosses can be performed with the use of a gametocide for sterility induction in a homozygous one-component line to produce a greater quantity of seed for sterile female line production. The female line can be maintained using a “selection gene” such as herbicide tolerance.

The advantage of this system over CMS is that no restorer genes are required, the disadvantage is that it is a new GMO technology which requires approvals.

FertiSeeds is interested in developing this technology for canola.

#### Monsanto’s new trait program – Luke Bozeman

Monsanto is working on an “enhanced nitrogen response” gene that would increase yield (yield gene) through increased biomass production and increased seed size. These are transgenic improvements that require selection of elite transformants and regulatory approvals. A 6 to 10-year period of developmental work is required.

#### 7. Meal utilization

Aqueous fractionation of deoiled canola for higher value animal feeds – David Maenz, MCN Bioproducts Inc.

Conventional canola processing uses solvent extraction or “double press” procedure which produces 40% high value oil and 60% low value meal. Soybean, in contrast, produces high value meal and oil. Canola needs new and higher valued meal product lines. Canola meal has lower protein and higher fibre (small seed) but has a well balanced amino acid profile, its value is diminished by high fibre and phytate and trades for about 60% of the price of soybean meal.

MCN wants to “unlock” the potential of canola protein through fractionation and generation of high valued protein concentrates. Products are targeted for use as animal feed ingredients that must have considerable feed value as plant-based alternatives to fish meal and other animal based protein sources.

MCN developed a unique process for production of high value protein products from canola. The solvent extraction process produces dry insoluble protein with 65% protein (21% of total meal), dry soluble protein (7% of total), Can-Sugar-Syrup (11% of total) and Can Pro protein (21% of total). They have also a non-organic solvent process. The 65% protein insoluble protein concentrate is targeted as an alternative to fishmeal in aqua feed and for swine and poultry feed, the 60% protein soluble protein concentrate could be an alternative to dairy proteins and could be used in calf milk replacers.

Feeding experiments in Atlantic salmon, by the Department of Fisheries and Oceans, Vancouver, showed that ½ of fishmeal can be replaced with canola protein concentrate, IPSP, without negative effects on performance of salmon.

Fractionation of the meal into high value protein concentrates increases revenues from canola meal. The second generation seed fractionation technology converts 75% of the whole canola seed to high value products, it isolates fibre and ash and approaches the limits of whole seed utilization.

MCN established capital and operating costs for their process, engineering feasibility studies are complete, economics of commercial implementation are positive. The goal is to initiate construction of the first plant at a site in western Canada in 2006 and commence production in 2007.

Questions:

- 1) Cold press has about 80% efficiency, in combination with aqueous extraction.
- 2) Smaller size plant is possible.

Mustard meal as an effective soil fumigant – Neil Wagner

Nematrol is “a biological solution” to nematode control in lawns.

There are nearly 20,000 species of nematodes, many are parasites of insects, plants and animals. There are free-living species that feed on bacteria, fungi and other nematodes, they are biologically poorly understood.

Nematodes can damage turf and also do damage to other plants. In 2003, research by Billy Crow, nematologist from Florida, tested mustard bran for the control of nematodes in lawn grass. The bran releases a nematicidal fumigant that is moved into the soil with irrigation water. It is applied as a topical treatment to turf and has been shown to reduce populations of several nematodes and works better than chemical treatments. Dr. Mikio Chiba from Ontario recognized the potential of his discovery as an organic alternative to chemicals.

Mustard Organic Soil Stabilizer (M.O.S.S.) from Bio-Green Technologies was developed by Dr. Chiba and was patented in 1995 in the US and South Africa, a patent was issued in Europe in 1999 and individual registrations are pending in many countries. In 2003, an international corporation purchased MOSS for the professional turf market in the US, Environmental Protection Agency (EPA) registration approval is pending.

MOSS is a 100% natural (organic) product from oriental mustard, it is safe for people and the environment and is completely biodegradable. It was developed as a growth stimulant and soil amendment, it controls nematodes. It also controls chinch bugs, crickets and fire ants, also fungi and suppresses the germination of weed seeds. MOSS is produced by Peacock Industries, PO Box 750, Hague, SK, S0K 1X0 for Bio-Green Technologies Inc., Canada.

#### Questions:

- 1) First commercial material was shipped to the UK one year ago.
- 2) Mustard seed is cold pressed to preserve allyl glucosinolate, the active ingredient in the bran.
- 3) Price for mustard seed is right and compatible with other inoculants.
- 4) The released volatile oil kills nematodes, it should be applied twice in a year on new turf, later every two years.

#### 8. Biodiesel – Saskatoon canola biobus update – Barry Hertz:

Biodiesel is an ester made from vegetable oil or animal fats, fatty acid methyl ester = FAME. Biodiesel is not a raw bio-oil, can be processed from waste frying oil and oil extracted from heat damaged or low quality seed. It is a renewable fuel or fuel supplement for diesel engines, it is CO<sub>2</sub> neutral.

Biodiesel is made by chemical transesterification: [vegetable oil (canola) + alcohol (methanol or ethanol) + catalyst (sodium or potassium hydroxide)] = canola methyl ester (CME) biodiesel. Byproducts are glycerol and neutralized salts.

One acre of canola yields ~ 2 barrels of biodiesel, Canada has 11 million acres of canola which would produce 22 million barrels/year of biodiesel. Canola can only supply ~ 3% of our fuel needs.

Diesel fuel lubricity is increased by addition of biodiesel at 0.1% to 1.0%. Research with low CME treat rates in light-duty diesel engines has shown 3 to 10% increase in fuel economy and up to 50% reduction in engine wear. We study the effects of 5% canola methyl ester biodiesel on fuel economy and engine wear with 4 Saskatoon city buses.

A 5% (B5) blend was used which enables operation in colder climates compared to B20 fuel used in the US. Greatest fuel savings were achieved with 1.0% CME fuel. Over a 12 month period, the biobus used 55.4 L/100 km of fuel while the bus on regular diesel used 58.9 L/100 km. Similar savings were achieved with a second comparison. Engine wear was reduced by 73% with the 2-stroke type diesel engines and by 29% with the 4-stroke Detroit diesel engines. CME B5 raised lubricity by 24% in April 2005 but only by 7.8% in January 2005. CME has an average of 31% higher lubricity than commercial low sulphur diesel.

CME biodiesel blends are cost effective and become increasingly attractive as diesel fuel prices increase. More research is needed to evaluate biodiesel effects with ultra-low sulphur diesel, hybrid technology and new engine emissions systems.

#### Questions:

- 1) Biodiesel will be available from POS and Milligan Biotech, production will begin in one year.
- 2) City of Saskatoon will use biodiesel for their entire fleet of buses.
- 3) Saskatchewan Transportation Company is also considering the use of biodiesel.
- 4) We have to get rid of the tax on biodiesel to make it economically viable.
- 5) Canola methyl ester is the best vegetable oil source for biodiesel.

#### 9. Agronomy

Canola Council “The canola advantage” – Jim Bessel

Canola watch 2005: 20 weekly reports ~ 1,850 e-mail subscribers, focus of reports was on in-season issues: early frost in 2004, “missing pod syndrome” in 2005.

Canola advantage 2005: Activities included: crop walks, tours, participation in crop diagnostic school at Lethbridge and Sclerotinia challenge.

Publications included: Canola production TIPS booklet, canola seedling diagnostic chart, recognizing herbicide residue and drift injury and Sclerotinia scouting and disease identification chart. Ten canola fact sheets were published: one was on time of swathing.

#### Canola Agronomic Research Program

Areas of study: blackleg, Sclerotinia, stand establishment, fertility and harvest management.

#### Canola Colleges

2006 Theme is “Weeds and herbicides.”

2006 winter extension program

focus is on: form of sulphur and herbicide management group 2 herbicides, plant stand establishment, fertility and soil testing, straight cutting, insects, diseases, weeds, storage, variety selection.

10. Crop Reports

Canadian Grain Commission Canola Report – Doug DeClerq

Quality of western Canadian canola – 2005

99% of survey samples received were *B. napus* of 77.6% were GMO, 12.1% Clearfield and 10.3% conventional, 2005 production was 8 million tonnes with 4 million tonnes from Saskatchewan. 43% of samples were hybrids, there were more samples in 2005 than in 2004. Overall oil content was 44.4% which is very high, probably the result of cool and wet conditions. Oil contents in Saskatchewan were 1.0% higher in 2005 compared to 2004. There is an inverse relationship of oil with protein content. Chlorophyll content was also lower in 2005, samples with less than 2% green seed grade No. 1. There was a sprouted seed problem. Free fatty acid contents were low but can increase during storage.

Average glucosinolate content was 9µmoles/g seed; erucic acid was 0.06%. Linolenic acid content was 11.0% and oleic acid content was 59.8%. These are values for canola, HOLL varieties not included. Saturated fat content was 6.96%

Dr. Véronique Barthet is the new Program Manager, Oilseeds Research at the Winnipeg Grain Research Laboratory replacing Dr. Jim Daun.

- Provincial reps, crushers, CCC, etc.

2005 Manitoba canola update – Robert Park MAFRI presented by Bill Ross

There were 2.307 million acres seeded, estimated yield was 22 to 24 bu/ac compared to the 5-year average of 30.2 bu/ac. The crop had excellent quality, no green seed, no sprouting. It was a relatively pest free season.

There were 41.3% RR, 47.2%LL and 8.8% Clearfield herbicide tolerant varieties for a total of 97.2% herbicide tolerant crops. Hybrid varieties occupied 65% of total canola acreage with 5070 and 5020 Invigor hybrids being the most popular. There was increased acreage of specialty oil varieties, particularly IMC 111 RR from Cargill. There was a small production of high erucic acid varieties.

2005 was a below average year for Manitoba canola growers, due to excess water in the spring and unseeded acres. Outlook for 2006 is for similar acreages as in 2005 because of high N costs and profitability challenges.

2005 Saskatchewan crop report – Roy Button

Saskatchewan had the biggest canola crop ever: 6,370,000 acres, 30.5 bu/ac yield, for a total production of 4,400,000 tonnes of canola. One half of total Canadian canola production occurred in Saskatchewan. Production issues: heavy rainfall and hail, diamond back moth, bertha armyworm, limited Sclerotinia, wet soil and wet harvest conditions. Concerns are low commodity prices. Moisture conditions for 2006 are good.

Question:

Yield estimate of 30.5 bu/ac was by Saskatchewan Agriculture, earlier estimates were 28 bu/ac.

2005 Alberta report – Murray Hartman Oilseed Specialist, AAFRD

Alberta had good growing conditions, seed quality was good, very little green seed, low levels of Sclerotinia, few grasshoppers, variety mix is not available, increased use of farm saved seed.

11. Biotech improvement of *Brassica napus* for phosphorus utilization – Zou Jitao, PBI Saskatoon

Phosphorus is usually the critical limiting element for plant production, P fertilizer is mined from a finite supply of P ore deposits. There are negative effects of P on ground water and aqua system contamination. A possible side effect of P fertilizer can be accumulation and introduction into the human food chain of heavy metal contaminants in fertilizer.

A significant portion of membrane lipids are phospholipids (PL) which make up 1/3 of total cellular organic P. Phosphorus deficiency leads to reduced proportions of PL in cell membranes. The ratio of PL to non-PL is determined by metabolic flux of two separated glycerolipid pathways in plant cells: the cytosolic pathway synthesizes PL while the chloroplast pathway primarily synthesizes non-PL. Glycerol-3-phosphate (G-3-P) is the precursor for both pathways initial step of glycerolipid synthesis.

Transgenic overexpression of bacterial G-3-P dehydrogenase gene increases G-3-P content in the model plant, *Arabidopsis*, increased G-3-P leads to increased lipid synthesis in chloroplasts and higher portion of non-PL, and decreased demand of P for PL synthesis improves phosphorus utilization efficiency.

16:3 fatty acid is only found in MGDG in chloroplasts, 16% in wild type *Arabidopsis* compared to 23% and 27% in two transgenic plants. We have shown that increased G-3-P content in transgenic plants does not decrease organic phosphate in cells. We observed lower anthocyanin and higher chlorophyll content under reduced P availability. Starch accumulation is a P-limitation response. Transgenic *Arabidopsis* is tolerant to low P-stress. An *Arabidopsis* mutant deficient in G-3-P dehydrogenase gene activity has low G-3-P content and is sensitive to low P-stress.

The G-3-P dehydrogenase gene construct was introgressed into *B. napus* canola which was tolerant to low P-stress. Transgenic canola grew fast from an early growth stage under low P-stress and low temperature conditions. Transgenic canola plants produced higher seed yields in greenhouse (groups of 18 plants) than non-transformed plants. Seed weights were also increased. Low temperature germination and growth was also improved. Results need to be confirmed in field tests.

Questions:

- 1) Protein expression studies have not been conducted.
- 2) Chile would be a good place for testing.
- 3) Choose fields low in phosphate for testing.

12. Insect situation

- Integrated Seed Pod Weevil Management – Lloyd Dosdall, University of Alberta, Edmonton.

The seed pod weevil destroys flowers and buds on canola plants (adult insect), larvae feed on developing seeds within pods, new generation adults feed on pods.

Weevils are found in southern Alberta canola fields.

Integrated management practices include:

- chemical control
- host plant resistance
- cultural controls
- biological controls.

Host plant resistance research focuses on the evaluation of different species and varieties of *Brassica* to identify sources of resistance and to move genes for resistance to elite cultivars of canola. *Sinapis alba* and *B. nigra* were found to be completely resistant in laboratory arenas and in field tests. The resistance was transferred from *S. alba* to *B. napus* variety Q2 through intergeneric crosses.

Future weevil resistance research will include development of molecular markers for the weevil resistance trait, incorporate weevil resistance into agronomically strong varieties with high quality, determine mechanism of resistance, study biochemical pathways of compounds that elicit or deter egg-laying, examine weevil behaviour in resistant versus susceptible varieties.

Cultural control procedures could use *B. rapa* as a trap crop for weevil control, also manipulating canola canopy by altering seeding date and seeding rate.

Biocontrol measures could include host specificity testing in Europe for possible introduction of biocontrol agents, monitoring parasitism in weevil populations in Canada. Several larval parasitoids of the cabbage seed pod weevil are known.

Biocontrol parasitoids were released near Vancouver in 1949 and were recovered in 2004 and 2005.

Some canola lines selected from the *S. alba* x *B. napus* intergeneric cross have levels of resistance 4 times greater than *B. napus*. *B. rapa* is more susceptible than *B. napus*. Weevil densities are highest in early-seeded fields, weevil parasitoid levels have increased 50 fold in southern Alberta and Saskatchewan from 2001 to 2004. Enhancing the effectiveness of parasitoids should be key component in integrated management of the seed pod weevil.

#### Questions:

- 1) Larvae of the seed pod weevil can be distinguished from larvae of parasites.
- 2) Larvae exit holes in pods can lead to seed shattering.
- 3) Trapping seed pod weevil on field edges with *B. rapa* effective? Good question.
- 4) Parasite lays one egg into one larvae, one female lays about 150 eggs, there are 2 to 3 generations of the parasitoid.

Swede midge, flea beetles, etc. – Scott Hartley, Insect specialist, SAF

Flea beetles: high populations in spring 2004, fall 2004 populations were lower, 2005 flea beetle pressure lower in both spring and fall.

Diamond back moth: arrived early in 2005, fields in NW and SE had severe damage in late May, subsequent generations did not materialize, there was parasitism.

2006 grasshopper forecast is low.

Bertha armyworm: low populations, increasing in 2006? 180 pheromone traps. There was a huge migration of painted lady butterflies, not much damage, some damage on Borage. Missing pod syndrome could be caused by insects. True armyworm is largely a cereal insect. Insect identification is important. There are also beneficial insects.

#### Stored grain insects

Poor harvest conditions in many part of province, malathion should not be used in empty grain bins if canola is to be stored. With high moisture content, there is potential for fungal growth, aeration is best management option.

### 13. Diseases

Club root – Murray Hartman, Oilseed specialist, AAFRD

Clubroot is serious disease of cruciferous crops worldwide. Found in cole crops in eastern Canada. It is a problem on canola in Europe and Australia. A 2003 survey of more than 70 fields near Edmonton found 12 infested fields involving 4 producers, it was a low level of infestation. The disease is caused by *Plasmodiophora brassicae*, an obligate parasite. It infects roots and causes gall formation which restricts the flow of water and nutrients to the plant: result is wilting, stunting and yellowing of plants. There are no air-borne spores, resting spores are long lived.

In 2004, no clubroot was found in provincial canola disease surveys (over 200 fields), it was found on volunteer canola in areas with clubroot the year before. All Alberta samples, except for one, were classified as race 3 according to Williams' scale or as 16/15/12 according to the European clubroot differential.

2005 surveys and voluntary reports indicated that the disease is spreading. Over 50 fields were confirmed to be infested. Good moisture conditions promote the disease, low lying areas, loam-clay textured soils, poor drainage. Acid soils with low pH (<6.5) are in danger, liming to a pH of >7.2 is an accepted control measure, but it does not eradicate the disease. A significant proportion in the traditional canola growing areas in Alberta is acidic, and therefore in danger.

Question:

- 1) Soil movement with equipment can spread the disease.

Other diseases – Randy Kutcher, AAFC Melfort

Disease issues of concern: blackleg, variability of pathogen, Sclerotinia stem rot, fusarium wilt in Manitoba, clubroot in Alberta.

General disease surveys: 107 fields in Saskatchewan, 81 fields in Manitoba, no general survey in Alberta.

Blackleg: found in 53% Saskatchewan fields, average disease incidence was 4%, 60% of fields in Manitoba infested, most samples in Alberta were avirulent, hailed fields have higher blackleg infections.

Sclerotinia was found in 61% of Saskatchewan fields, average incidence was 2.8% which was lower than in 2004, genetic resistance to Sclerotinia would be desirable.

Other diseases, aster yellows, foot rot and *Alternaria* were present at low levels.

There was no fusarium wilt found in Alberta, and only one field in Saskatchewan (of 107), in Manitoba 17 of 81 fields had fusarium wilt. The Manitoba fields were very wet, could this have caused more fusarium wilt?

Questions:

- 1) Herbicide injury can favour wilt.
- 2) Ralph Lange isolated *Fusarium oxysporium* from infected plants.

The meeting was adjourned at 17:10 hours.