Prairie Steward

Farming For Your Future Environment

The Newsletter of the Saskatchewan Soil Conservation Association — Spring Issue No. 65, 2014

Smartphone Apps for Agriculture Project Update

By Tom Wolf
SSCA Director

In 2012, the SSCA received CAAP funding for a project to develop smartphone apps for agriculture. The Board of Directors is working with Dr Ralph Deters of the U of S computer Science Department to develop these apps, and the project is proving to be quite productive. Dr Deters provides opportunities to his graduate students to work with us on various apps, and the goal is to have them available by the 2014 growing season in Android and iOS (Apple). Here is what's completed or in the works:

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1) SSCA Fertilizer Blend Calculator: This calculator requires a user to enter the desired N-P-K-S fertility for a field, and select from available fertilizer products. The app calculates the blend requirements (tonnes of each product), the rate of application, the resulting N-P-K-S fertility, and the cost. For liquid, the app allows blend calculation by the truckload batch based on tank capacity and volume remaining at fill-up. The user can enter soil test information and target recommendations to obtain the necessary fertilizer additions. (Completed Android and iOS)

2) SSCA Harvest Loss Calculator: The first step in minimizing harvest losses is to quantify them. This tool allows the user to enter the amount of seed in a sampling area of known size, either in weight, volume, or kernel number. The cutting width and sieve width are entered to determine the concentration factor. The app uses bushel or seed weight to calculate losses. These can be expressed in total loss (lbs/acre or bu/acre), as a percentage of yield, or as a cost. (Completed Android and iOS)

3) SSCA Tank Mix Calculator: This tool is intended as a guide to a spray operation. The user enters the application volume, the pesticide and adjuvant product rates, and the tank capacity to estimate the amount of water and product required. The amount remaining in the tank at fill-up can be entered to calculate the net amount of pesticide and water to put in tank. Optional entry of field size, sprayer width, swath length and headland number allows for calculation of area

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per spray round and number of rounds per tank, as well as total product requirements. Supports all common imperial, US, and blended measurements units including L/acre and acres/case. (Completed Android)

4) SSCA Buffer Zone Calculator: The Pest Management Regulatory Agency (PMRA) has imposed mandatory buffer zones (no-spray areas) downwind of an application when the risk assessment shows that spray drift could harm sensitive areas. These buffer zones can be modified (reduced) if the applicator can show that application conditions are conducive to less risk than assumed on the label. An on-line tool is required to calculate and document these new buffer zones. This app conducts the required calculations for conventional ground applications, for aerial applications, for orchard applications, and for chemigation without any additional cumbersome documentation. Applicators later use the official PMRA on-line tool to complete the documentation for their records. (Completed iOS)

5) SSCA Crop Yield Estimator: Many important farm management decisions occur in the month before harvest, such as split N application, fungicide, desiccation, and storage preparation. The yield estimator allows producers or agronomists to enter plant data: plant density, head or pod density, seeds per head or pod, estimated seed weight to estimate yield. This potential yield can then assist in better decision making. Total harvested grain amounts, gross revenue, and other parameters are calculated. (Completed Android)

6) SSCA Spray Quality Finder: With new federal laws governing low-drift application of new pesticide products, spray applicators will increasingly need to know the spray quality of their nozzles. This app helps answer this question in two ways: The lettering of an installed nozzle is entered into the app, and the app identifies the manufacturer, flow rate, fan angle, pressure range, and spray quality. If a new nozzle needs to be purchased, the user enters the required spray quality, and narrows the search by nozzle type, manufacturer, flow rate, fan angle etc. The app produces a list of nozzle candidates, and for each candidate, shows a table identifying the nozzle manufacturer, nozzle type, and model, with recommended pressures and corresponding spray qualities. An optional calculator allows for determination of nozzle flow rate requirements for a specific application volume, travel speed, and nozzle spacing. The database contains all nozzle products for which spray quality information exists from TeeJet, Hypro, Greenleaf, Hardi, Wilger, Lechler, and Albuz. (In development)

7) SSCA Flag This! Equipment operators often make observations in a field that require attention. Flagging features on GPS screens can help, but they do not immediately communicate with individuals who can take the necessary action. This app, working off Google Maps, allows user to flag a location that requires action (scouting for plant symptoms, removal of a rock, drainage standing water, etc) and then CONTINUED PAGE 10

Genetically Engineered Crops – Part 2, Current Status, Issues, Benefits and Concerns

By Graham Scoles PhD, PAg.
Graham may be contacted at graham.scoles@usask.ca

In part one of this two-part article I gave a brief history of the development of genetically engineered (GE) crops up to the mid-1990s at which point the first crops were ready to be commercialized. In part two, I will summarize the more recent history and also address some of the issues that have arisen with the introduction of GE crops (or as they are frequently referred to, GMOs).

Since the first commercialization of GE crops in the mid-1990s the acreage of such crops worldwide has shown an almost straight-line increase to about 420M acres (about 12% of the approximately 3.4M acres of cropland in the world). While initially GE crops were mostly grown in N. America, three years later significant acreages were being grown in less-developed countries and in 2012 the acreage outside of N. America and a few other developed countries was exceeded by less developed countries.

This rapid uptake of GE crops clearly demonstrates the value that producers found in them. Very rarely has a new technology been adopted so readily. The two crops where this is most evident are soybeans and cotton where it is estimated that in 2012, 81% of the worldwide acreage of both crops was genetically engineered. In the case of soybeans, genetically engineered for herbicide resistance (HR); in the case of cotton, for insect resistance. The two other major crops that are genetically engineered are corn and canola where approximately one-third of both crops worldwide is genetically engineered. In the case of canola this is again for herbicide resistance including almost all of the canola grown in Canada. In the case of corn, and to a lesser extent cotton, an increasing percentage of the crop in the USA is doubly genetically engineered for both herbicide resistance and resistance to various insects.

The four crops mentioned above represent about 95% of the 420M acres of GE crops worldwide. A few small-acreage crops make up the remainder. In Canada we now have herbicide resistant sugarbeet; in the USA, also herbicide resistant alfalfa and virus resistant squash and papaya. In China it is reported that in addition to cotton and papaya, GE tomato, sweet pepper and poplar are being grown (also rice and corn probably). At one time in N. America we also grew GE insect resistant potatoes and GE tomatoes but they are no longer on the market.

When GE crops were first commercialized in the mid-1990s it was expected that more genetically engineered traits would be on the market by now and that the technology would have been used on more crops. Why has this not occurred? Firstly, despite tremendous advances in biotechnology, gene cloning etc. it turns out that identifying genes of adequate value to insert into crops has not been as easy as thought. There are many active areas of research and some traits have even made it into field trials but as yet GE crops are pretty well limited to herbicide, insect and virus resistance. These are traits that are usually controlled by a single gene which can be easily inserted into (and fully expressed) in the GE crop. However many traits that might be of economic value are more complicated. Secondly, as mentioned in part one, as governments felt the need to have good evidence that GE crops posed no risk as food for humans or livestock and no risk to the environment, extensive (and expensive) tests were required before these crops could be brought to market. The result has been that it has only been economical (a reasonable expectation of an adequate return on investment) to commercialize large acreage crops because of the size of investment required, and that in turn has meant that for the most part the GE crops on the market have been commercialized by ag-biotech companies rather than by small companies or the public sector. There is now a growing awareness that genetic engineering may be a very valuable tool for many small acreage crops worked on by small companies or the public sector but given the cost, as yet it is not clear how such products will make it beyond field trials and get commercial-

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ized.

So what have been the benefits of GE crops and what about the concerns that some still have?

The benefits.

Given the rapid uptake of these crops by producers wherever GE crops have penetrated the market clearly producers have found that these crops benefit their bottom line. A few would argue that producers have been "brainwashed" into growing these crops but producers deserve much more credit than that. In the case of canola there have also been obvious benefits to soil and moisture conservation as well as energy savings as a result of the reduced tillage that is enabled by the post-emergence weed control allowed by HR canolas. Similarly the introduction of insect resistant cotton (also known as Bt cotton) has significantly reduced the spraying of insecticides on that crop and hence resulted in considerable economic and environmental benefits. (The same was true of Bt potatoes that were grown in Canada but the fears of McCains/Macdonalds that their use would result in a consumer backlash fueled by those opposed to GE crops led to the demise of that crop and a return to spraying insecticide to control Colorado potato beetle). In addition a Bt crop only affects pests that feed on the vegetation vs. the detrimental effect that spraying an insecticide has on non-target insects. Such is also the case with Bt corn and in addition, reduced insect damage provides fewer entry points for fungi, some of which can be highly toxic.

Finally, GE virus resistance was a very successful approach in papaya when papaya ringspot virus threatened to wipe out the papaya industry in Hawaii. GE virus resistance appears to hold tremendous potential, especially for vegetatively propagated crops. Currently the Florida orange industry is threatened by a bacterial disease "citrus greening" and a GE approach has been shown to be successful and if followed could be rapidly implemented to save the industry.

The concerns.

Space only allows me to deal very briefly with the concerns expressed by some. One is that GE approaches such as Bt resistance will eventually be rendered useless as the insect evolves. Of course this idea is nothing new to Canadian wheat breeders who since wheat was grown here have been constantly striving to stay ahead of the rust fungus as each new resistance gene was defeated. We must realize that a cropping system is a very unnatural environment (whether a small-scale organic farm or a larger intensive operation) and that crop pests (insect, fungal, bacterial, viral) are always present, need to be controlled to protect yield and crop quality when they become severe, and that they will invariably evolve to overcome breeding efforts. A GE approach such as Bt represents another weapon in arsenal of plant breeders and a very good alternative to the pesticide approach.

Like pests, weeds also threaten crop yields in any crop production system, from the backyard garden to the 1,000 acre field. Until the advent of herbicides tillage was the major weed control method, but for large-scale agriculture, particularly in semi-arid areas, tillage has resulted in soil erosion and degradation. Just as antibiotics if used inappropriately lead to antibiotic resistant bacteria, herbicides, if used inappropriately will lead to herbicide resistant weeds. This occurred before genetically engineered crops came along as witnessed by the development of herbicide resistant wild oats. There is nothing sinister about herbicide resistance - plant species (fortunately) do not all have the same biochemistry and herbicides typically exploit those differences to provide selectivity. Many of us have exploited that when we have used 2'4 D or MCPA to (try to) kill dandelions in our naturally herbicide resistant lawn. With intelligent use herbicide resistant crops provide a good alternative to tillage. The emergence of herbicide resistant weeds is certainly an issue that has to be dealt with, but amongst the many issues that producers face, it is not the environmental catastrophe that some opposed to GE crops would have us believe it is.

The final concern that has been raised is that GE crops have not been shown to be safe, particularly over the long term. GE crops have been subjected to much more rigorous testing than all of our other foods as a result of the regulatory requirements that have been put in place. True these are not long-term experiments on humans but there are many well documented studies with a number of species that show no nutritional difference between GE crops and non-GE crops. This comes as no surprise as the changes brought about by genetic engineering result in zero or very minor changes in the constituents of the crop. Similar types of change (e.g. disease or insect resistance) have often been made through traditional plant breeding and have not had any effect on the nu-

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ECRF and Parkland College - Past and Future

By Mike Hall
Parkland College

The East Central Research Foundation (ECRF) was founded in 1996 and successfully conducted applied research in the Canora area for a number of years. Recently little to no research was being conducted because the ECRF was struggling to find a suitable manager. This changed in 2013 when the ECRF signed a memorandum of understanding with the Parkland College to jointly pursue agricultural research near Yorkton. Parkland College wanted to get involved in local research because it fits with their mandate "to serve regional economic development". Conducting research in agriculture also made sense because of its regional importance. It was a match made in heaven. The College provides the research manager and summer students, the ECRF provides the field technician and field equipment and the city of Yorkton provided the partnership with a 5 year lease on land located a half mile south of the city. It is a strategic partnership, since the College and the ECRF have different strengths, contacts and access to different funding sources. Parkland College is also starting to provide training in Agriculture and the research farm provides the college with a place to educate and train students.

In 2013 the partnership conducted varietal research with Monsanto canola and soybeans from Northstar Genetics. Soybeans are currently an insignificant crop to the region but the trial identified a couple promising varieties that are tall and short season such as Tilston. A demonstration of various grass and forage legumes was established and a couple of small and large scale trials were conducted to evaluate seed brake technology.

The partnership proved to be a success in 2013 and we hope to "ramp up" in 2014. Funding for about 15 new projects is being pursued. The projects cover a number of different crops, from canola, wheat, barley, triticale, oats, canary seed and soybeans. Projects will evaluate varieties, fungicides, micronutrients, openers and ESN urea. Thanks to the city leasing us another parcel of land just west of the city, we will be conducting forage rejuvenation and termination studies. In partnership with Yorkton Tourism a demonstration of Parkland crops will be established next to the Tourism building. There, tourists and local people will see a variety of crops and learn about the importance of various agronomic practices to production.

The partnership between the East Central Research Foundation and Parkland College is proving to be a success. ECRF is in the process of establishing some infrastructure at Yorkton. ■ Click to return to menu

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tritional value of the crop.

A few studies that have usually set out to prove that GE crops are "unhealthy" (and reported such) have often received huge amounts of media attention only to have been found to be wanting upon scrutiny by other scientists. The two most famous are a 2001 study by Arpad Puzstai and a 2012 study by Eric Seralini. The latter study was retracted by the journal in which it was published in November 2013. Despite having been found to be wanting, these studies will no doubt be brought up in the future by GMO opponents.

With such an imbalance of evidence supporting the safety of GE crops why the opposition by some groups? I think that the real concern of those groups is more to do with the role of "big agribusiness" in our food production system. Especially the fact that commercialization of GE crops has tended to have been carried out by such companies. It is ironic to note that the groups that are concerned about the role of agribusiness in our food supply were often the same groups that wanted extensive (and hence expensive) regulatory regimes put in place for GE crops that now make it difficult for other than large companies to commercialize such crops. ■ Click here to return to menu

Irrigation: Lake Diefenbaker's Unfinished Business

By John Linsley PAg., Crops and Irrigation Branch, Ministry of Agriculture

In 1967, the Gardiner Dam and Lake Diefenbaker were completed on the South Saskatchewan River in the centre of Saskatchewan's agricultural region. *"The project is to provide facilities for the irrigation of approximately 500,000 acres of land in central Saskatchewan and in the Qu'Appelle Valley and to provide other benefits to the area including a source of hydroelectric power, a source of rural and urban water supply, flood control and recreation facilities."* (Appendix A, July 25, 1958 Memorandum of Agreement).

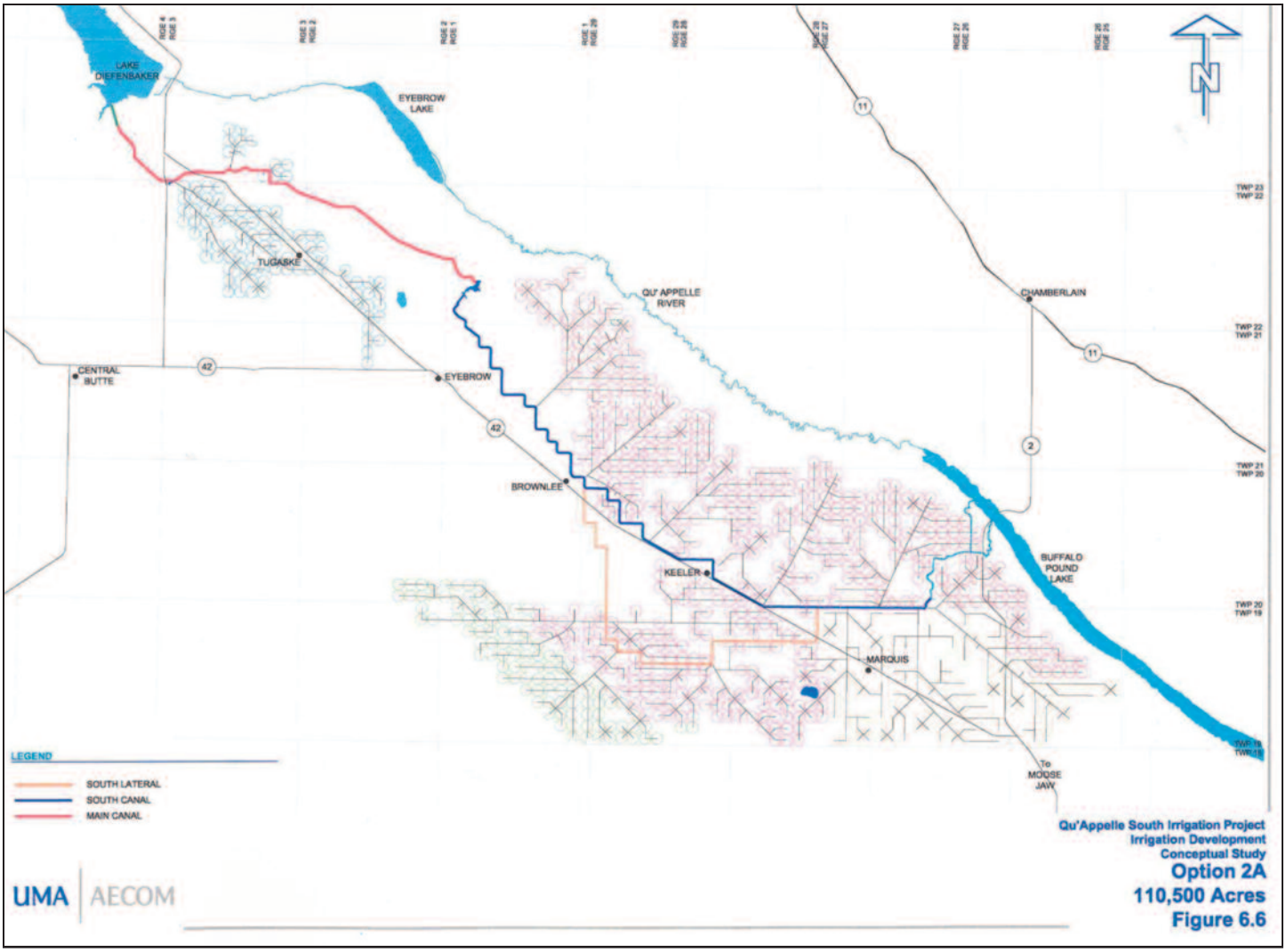
To date only 20 per cent of the 500,000 irrigated acres has been developed due to a lack of water infrastructure. Lake Diefenbaker, therefore, presents Saskatchewan with a huge water-based economic growth opportunity.

Population growth, water shortages, climate change and environmental needs are all competing for the planet's finite water resources. Canada is seen as one of only a few countries able to produce significant food surplus in the future. The pressure to expand Lake Diefenbaker's irrigation will inevitably increase.

An irrigated acre will increase agricultural output by well over $500 per acre per year compared to its dryland counterpart.

Saskatchewan is supporting the growth of irrigation under the Farm and Ranch Water Infrastructure Program (FRWIP) and The Farm Stewardship Program. FRWIP has two components: the irrigation district infill program and the non-district irrigation development program province-wide. The Farm Stewardship Program has two Beneficial Management Practices: irrigation management and irrigation equipment modification.

A conceptual plan is in place for the Qu'Appelle South Irrigation District which would provide water via a canal from Lake Diefenbaker to Buffalo Pound Lake. This additional water would, if a decision was made to proceed with the project, supply municipal and industrial economic growth in the Moose Jaw-Regina Corridor plus 110,000 irrigated acres close to the Global Trans-



Qu'Appelle South Irrigation Project conceptual plan

portation Hub.

Now let's look at the question of sustainability.

Lake Diefenbaker's water supply is governed by the 1969 Master Agreement on Apportionment. Under this agreement, Alberta passes 50 per cent of the natural flow to Saskatchewan, and we pass 50 per cent of the natural flow to Manitoba. Today, water consumption from Lake Diefenbaker totals about six per cent of the average inflow from Alberta. At three per cent, evaporation is the highest user; irrigation uses two per cent. Expanding irrigation by 500,000 acres would increase irrigation consumption to about 20 per cent, leaving 80 per cent for in-stream flow.

In a "dry" year, based on historical records, 500,000 acres of irrigation could increase the use to 22 per cent while, in a "wet" year, the use drops to three per cent.

The *Irrigation Act*, 1996 governs the administration of irrigation in Saskatchewan. It requires all irrigation districts to cover 100 per cent of their administration, operation, maintenance and replacement costs. Furthermore, it requires that every new irrigation project receives an Irrigation Certificate, at a one-time cost to the developer of $2,000 per parcel of land, to ensure that the soil and water meet the province's current criteria for environmental sustainability.

Lake Diefenbaker offers Saskatchewan a unique and sustainable water-based economic growth opportunity. ■

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The Answer is Winter Wheat! Now which question would you like to ask first?

By Paul Thoroughgood, PAg
Ducks Unlimited

Highest Net Income Crop 2013 Sask Ministry of Ag? Winter Wheat

Highest Net Income Crop 2013 Manitoba Ministry of Ag? Winter Wheat

Projected Highest Net Income Crop Sask Ministry of Ag Crop Planning Guide? Winter Wheat

If this were the Olympics winter wheat would be tested for performance enhancements!

	Canola	Winter Wheat	Flax	Green Peas	CWRS Wheat	CPS Wheat	Red Lentil	Feed Barley	Yellow Peas	Large Gr Lentil	Oats
Estimated Yield (bu/ac)	39.5	60.1	23.7	37.1	47.8	53.6	1298	76.8	37.1	1189.6	99.1
Estimated Market Price	$8.75	$4.39	$10.30	$7.23	$4.90	$4.14	$0.18	$2.50	$5.28	$0.19	$1.56
Estimated Gross Revenue	$346.63	$263.84	$244.11	$268.23	$234.22	$221.90	$227.15	$192.00	$195.89	$220.08	$154.60
Total Variable Expenses	$212.59	$164.25	$148.14	$163.72	$156.46	$161.88	$173.64	$149.40	$153.00	$178.22	$140.59
Total Other Expenses	$74.07	$74.07	$74.07	$83.04	$74.07	$74.07	$83.04	$74.07	$83.04	$83.04	$74.07
Total Expenses	$286.66	$228.32	$222.21	$246.76	$230.53	$235.95	$256.68	$223.47	$236.04	$261.26	$214.66
Net Returns ($/ac)	$58.97	$35.52	$21.90	$21.47	$3.69	($14.05	($29.53)	($31.47)	($40.15)	($41.18)	($60.06)

Most Profitable

Least Profitable

Western Winter Wheat Initiative

Source: Saskatchewan Ministry of Ag
Crop Planning Guide 2014 - Black Soil Zone

Many of us who have bought into the benefits of including winter wheat in our cropping systems weren't surprised when the Ministry of Ag Crop Planning Guide showed winter wheat as the highest potential income earner for 2014, narrowly edging out the crop most non-winter wheat growers would have picked as the favorite: Canola. The other spring seeded cereals vying for a place in cropping systems were unable to deliver ½ of the net income of their winter cousin.

As I prepared to write this article I thought that net income projections from December and January are all well and fine, but things have substantially changed since then. The table above illustrates the Sask Ministry of Ag Crop Planning Guide modified to reflect crop prices quoted Feb 18th.

Obviously profitability is down across the board and the earlier claim of winter wheat being the top income producing crop is no longer true. However, we can't plant the whole farm to canola every year! Winter wheat is a solid second on the profitability scale and it's a great rotation fit. When you com-

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Dr. Guy Lafond Memorial Scholarship

By Danny Petty, PAg
Executive Manager
Indian Head Research Foundation

Our dear friend and colleague Dr. Guy Lafond peacefully passed away in the spring of 2013. It is well known throughout the industry that Guy was passionate about the agricultural research which he conducted throughout his career, and the pivotal role that he played in developing today's sustainable farming systems. He had a great respect for the farmers that built the industry and enthusiastically encouraged the adoption of new technologies. He took great pride in his extension efforts; whether it was through presenting his findings during field days or seminars, publishing papers in scientific journals, or spending time with farmers on the phone or in the field helping to solve problems or questions they might have had.

Guy was instrumental in the formation of the Indian Head Agricultural Research Foundation, and strongly believed in the training of the next generation of agronomists. As such, IHARF is proud to announce the Dr. Guy Lafond Memorial Scholarship. The $2,000 award will be available to students entering or continuing a Master's or Ph.D. program within the College of Agriculture and Bioresources at the University of Saskatchewan. Potential candidates can submit a letter to IHARF containing an abstract of their research project; explain the relevance of their research and the potential impact of their project on the agriculture industry. The deadline to apply for the scholarship is January 31, with IHARF's intent to continue providing the scholarship to a different student every year. For more information on the scholarship, please call (306) 695-4200, email dpetty@iharf.ca, or watch www.iharf.ca as more details become available. ▪

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The Answer is Winter Wheat! ...continued from page 8

pare the cereal alternatives within the rotation, winter wheat is by far and away the winner from a net return perspective.

Winter wheat is a crop that holds tremendous potential to contribute to the profitability of prairie agriculture. It can do this in many ways when compared to other cereal crops, by making the overall rotation more efficient, by moving a portion of seeding out of the busy spring window and by starting harvest earlier. Making a change always involves risk and the single greatest concern I hear from non winter wheat growers is winterkill. While winterkill is a risk it is not nearly as big a risk as it is perceived to be. To illustrate this I would like to draw a parallel between Saskatchewan and Kansas, which is the largest winter wheat growing state in the US. In Kansas winter wheat is the norm within the wheat rotation and growers have grown to understand that while winterkill occurs occasionally, the benefits outweigh the risk. Examining Saskatchewan Crop Insurance data from 1998 to 2012 we see that 9% of winter wheat that was insured experienced winterkill. In the same time period in Kansas 9% of winter wheat experienced winterkill.

The ever changing world of agriculture presents us with new challenges and new opportunities every season. As you work through the questions of what to do within your operation I encourage you to think beyond the spring crop paradigm that is so entrenched in Prairie Canada. The answer to your question might very well be Winter Wheat! ▪

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Irrigation Crop Diversification Corporation (ICDC)

By Garry Hnatowich
ICDC

The Irrigation Crop Diversification Corporation (ICDC) became part of the Agri-ARM network in 2012. Since its creation in 1996 the mandate of ICDC, in part, has been to research and demonstrate to producers and irrigation districts, profitable agronomic practices for irrigated crops; and to develop or assist in developing varieties of crops suitable for irrigation conditions. ICDC conducts their efforts utilizing individual irrigator's land throughout the irrigation districts for demonstration activities; for small plot, replicated varietal evaluations or agronomic investigations. Staff utilize the land base and resources available through a partnership arrangement with the Canada Saskatchewan Irrigation Diversification Centre (CSIDC) at Outlook.

In 2013 ICDC conducted greater than twenty diverse on-farm demonstration evaluations such as liquid verses granular phosphorus fertilizer products, micronutrient applications for deficiency corrections or disease reduction, salt tolerant annual and forage varieties, irrigation water management, the relationship between GPS collected grain yield and EM38 salinity mapping, evaluation of oilseed and cereal foliar fungicides and the evaluation of plant growth regulator applications in irrigated cereal production.

The small plot replicated program is heavily skewed towards varietal evaluations. Advanced breeding material from both public and private breeding institutes of virtually all market classes of cereals (spring wheat, durum, barley, oats, corn), oilseeds (canola, flax), pulses (field pea, faba bean, dry bean , soybean) and forages (grass and legumes) are evaluated for registration and selection purposes. The best of these varieties for irrigation production are further evaluated and results are used in the development of an annual ICDC publication entitled "*Crop Varieties For Irrigation.*" Agronomic studies on various aspects of irrigation production are also conducted at CSIDC. Approximately thirty replicated studies are conducted annually; many of them at more than one site other than CSIDC.

In 2014 many of these demonstration and small plot trials will be repeated. All variety evaluations will be continued as a core base of our activities. ICDC has been awarded ADF funding by the Saskatchewan Ministry of Agriculture and the Western Grains Research Foundation to investigate the effects of planting date, row spacing, plant population and inoculation of soybean.

For further information on ICDC and its activities please refer to the ICDC website at www.irrigationsaskatchewan.com ■ Click here to return to menu

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enter a note with text, picture, or voice recording. Entry is stored and can be shared via e-mail, text or other communication. The recipient gets a Google map with a flag, which, when clicked shows the image, text, or plays the recording. (In development)

8) SSCA Accumulated GDD / CHU: Accumulated heat units are an important tool for determining crop and pest development stages. Current on-line tools use weather data from central stations, and lack resolution for many locations for which temperatures may differ significantly. This app ties into The Weather Network temperature database to present up-to-date Growing Degree Day and Corn Heat Unit data for a large number of locations across Canada. (Awaiting development)

The SSCA want to make these apps available to producers and agronomists for free. However, it intends to license the apps to interested organizations in order to recoup development costs. ■ Click here to return to menu

Grain Aeration

By Dr. Joy Agnew
PAMI

The bumper crop of 2013 and the grain transportation backlog of 2014 means that farmers will be storing more grain than usual over the winter and into the summer of 2014. Managing the risk of spoilage in stored grain is always a challenge, and this challenge is even greater when storage periods are extended.

The key to preventing or minimizing grain spoilage is to monitor the temperature (and ideally moisture content) of the grain. Even grain that was dry when it was binned is susceptible to hot spots and spoilage due to natural convection currents driven by outside temperatures. If hot spots form, turn on the fans to help even out the temperature distribution in the bin. If in doubt, turn the fans on—airflow through the grain is always better than no airflow. If the grain is in a bin with no fans, turn the grain by pulling out a few loads or move the grain to a different bin.

Natural convection currents in the bin are especially problematic for grain that was cooled in the fall and will be stored through the warm summer months. To safely store grain that was cooled in the fall through the summer months, it is recommended to slowly warm up the grain to 10°C or 15°C by running the fans in April or May. The key is to warm up the grain slowly and to continue to monitor the temperature of the grain until it can be hauled.

More information on grain aeration and natural air drying can be found in the factsheet below. If you have any questions about grain aeration and natural air drying strategies, contact Joy Agnew at PAMI (800-567-7264 ext 280).

The Facts About Grain Aeration

Each bin of grain represents thousands of dollars of investment and must be managed properly. The following information can be used to help make better management decisions.

- The risk of grain spoilage is highest when grain is hot or wet, so both temperature and moisture must be managed to prevent grain spoilage. Hot air drying systems are common for drying grain, but natural air drying (NAD) systems are lower cost and increase the capacity for managing tough grain.

- Even dry grain is susceptible to spoilage because natural convection will cause temperature variations which then result in moisture variations within the grain. Blowing air through the grain helps to limit these variations and minimize the risk of spoilage. Depending on the airflow rate of the fan, blowing air through the grain will result in grain conditioning or cooling or it may result in grain drying.

- The airflow rate from the fan depends on fan specifications and the static pressure (resistance to airflow) of the bin. Static pressure depends on grain type, depth of grain, and type of ducting.

It's all about the airflow rate

Aeration = grain conditioning/cooling → low airflow rate (0.1-0.2 cfm/bu)

Natural air drying = removing moisture from grain → high airflow rate (1-2 cfm/bu)

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Understanding the Equilibrium Moisture Content (EMC)

For aeration, if the outside air is cooler than the grain, the grain will cool. For natural air drying, if the air has "capacity to dry", the grain will dry. The air's capacity to dry is dictated by the Equilibrium Moisture Content (EMC) of grain. The EMC dpends on air temperature, air relative humidity (RH), and grain type.

For every temperature/relative humidity combination, air has a specific EMC or a point where the moisture in the air and grain have reached a steady state or equilibrium. At this point, the air will not take moisture or give moisture to the grain. The EMC of air for wheat is shown in the following table.

EMC for Wheat

Temp	Relative Humidity (%)								
°C	35	40	45	50	55	60	65	70	75
-2	11.5	12.2	13.0	13.7	14.5	15.3	16.0	16.9	17.7
2	11.1	11.9	12.6	13.4	14.1	14.9	15.6	16.4	17.3
5	10.9	11.7	12.4	13.1	13.8	14.6	15.3	16.1	17.0
8	10.7	11.5	12.2	12.9	13.6	14.3	15.1	15.8	16.7
10	10.6	11.3	12.0	12.7	13.4	14.2	14.9	15.7	16.5
13	10.4	11.1	11.8	12.5	13.2	13.9	14.6	15.4	16.2
15	10.3	11.0	11.7	12.4	13.1	13.8	14.5	15.2	16.1
18	10.1	10.8	11.5	12.2	12.9	13.6	14.3	15.0	15.8
22	9.9	10.6	11.3	11.9	12.6	13.3	14.0	14.7	15.5
26	9.7	10.4	11.1	11.7	12.4	13.0	13.7	14.4	15.2
28	9.6	10.3	11.0	11.6	12.3	12.9	13.6	14.3	15.1

- For example, if air has an RH of 50% and a temperature of 5°C, its EMC for wheat is 13.1%. That means that, if you blow air that has an RH of 50% and a temp of 5°C through wheat, that wheat will eventually equilibrate to 13.1%. Whether the wheat started at 8% or 14%, it doesn't matter.

- Remember that EMC also depends on grain type, so the EMC chart for barley and canola will be slightly different. For example, the EMC of 50% and 5°C air is 10.8% for barley and 8.1% for canola.

- This information on EMC can be used to "optimize" when natural air drying fans are operating. The ambient temperature and RH fluctuates during the day, so there are times during the day when the EMC of the air is higher than the grain so running the fans will not result in drying. This information can also be used to help even out the moisture content profile in a bin. With most air distribution systems, the air flows from the bottom up. So to dry the grain at the top of the bin, the grain at the bottom becomes over-dried. Air can be used to re-wet the over-dried grain and result in an even moisture content profile.

Using the EMC of air to optimize natural air drying — sounds simple, right?

One problem with using the EMC is that air conditions fluctuate from hour to hour. Another problem is that the air conditions change as soon as the air hits the grain. The grain temperature and moisture content will affect the air temp and RH as it moves through the grain. So simply monitoring the outside temp and RH won't allow you to completely predict the air's capacity to dry.

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How do grain conditions affect the air's capacity to dry?

Warm air + warm grain = drying

Warm air + cool grain = wetting

Cool air + warm grain = quick (short term) drying (approx. 1-2%)

Cool air + cool grain = no change

When is the best time to run natural air drying fans?

The best time to run fans depends on grain moisture content, grain temperature, air temperature, air RH and grain type. The best fan strategy also depends on your ultimate goal. See table below

Goal	"Best" NAD fan strategy
Safe storage for all grain types in a variety of ambient conditions	Run fans continuously
Minimal fan hours (grain is only 1-2% above dry)	Run fans at night only
Minimal fan hours (grain is more than 1-2% above dry)	Run fans during day only
Uniform moisture content profile (no overdrying)	Run fans during day only until average MC is 1-2% above dry, then run fans at night until grain is cool (tough grain will try and over-dry grain will re-wet)

What about "freeze drying" grain?

Freezing tough grain will minimize the risk of spoilage over winter, but once grain is cold, it is very difficult to remove moisture without a hot air dryer system.

For more information,
contact Dr. Joy Agnew at PAMI
306-682-5033 ext. 280
jagnew@pami.ca

When is the best time to run aeration fans?

Turn aeration (conditioning) fans on as soon as the ducts are covered with grain and leave them on continuously until the average temperature of the grain is at a safe to store temperature. You can turn aeration fans off during rainstorms, but there is very little moisture movement between grain and air at low (0.1-0.2 cfm/bu) airflow rates.

World Congress on Conservation Agriculture

The sixth World Congress on Conservation Agriculture will be held this year in Winnipeg , Manitoba from June 22nd to 27th. The Saskatchewan Soil Conservation Association will be attending this event. If you are also interested in attending, please see http://www.ctic.org/WCCA for registration and conference information.

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SSCA 2014 Conference Summary

The SSCA 2014 Conference had another great line up of speakers. For those of you that missed this year's event, a summary of the speakers presentations by the Prairie Steward editor follows:

Our Keynote speaker was Dr. Jill Clapperton from Lolo, Montana. Dr. Clapperton owns and operates Rhizoterra Inc which "specializes in assisting farmers, land owners, managers and agriculture-based businesses in making informed management decisions regarding soil health, and strategies to enhance agroecosystem services and sustainability." Dr. Clapperton previously worked at the Lethbridge Research Centre.

The title of Dr. Clapperton's talk was "Setting the Foundation for Agriculture in the 21st Century."
She spoke about the multitude of bugs within our soils and how predator prey relationships drive the nutrient cycle, and how we should be sure to feed our below ground partners (bugs) a balanced diet. If we wanted to determine the value of our organic matter, she referred to the Haney Test (found here: http://research.brc.tamus.edu/snap/Default.aspx and discussed here: http://cornandsoybeandigest.com/conservation/new-soil-test-tracks-microbial-activity).

Dr. Clapperton also spoke about the importance of paying attention to soil temperature and to plant accordingly, because optimum soil temperatures result in a "high speed transport" of plant growth. It's important to dig up a plant and look at its roots, she said, and the genetics of the plant do matter - it would be helpful if seed companies told us about the roots.

Dr. Clapperton also touched on the importance of having a proper crop rotation because a poor rotation *does* affect soil health. On her own farm, Dr Clapperton coats fertilizer with polymers for slow release so she feeds the soil small meals. Her recurring statement was "When you are standing on your ground you are really standing on the roof top of another world."

Dr. Jill Clapperton can be found at:
@Rhizoterra
http://www.linkedin.com/pub/jill-clapperton/3a/707/61

Some of her presentations are on Youtube:
http://www.youtube.com/watch?v=o6daE2sYegg

http://www.youtube.com/watch?v=rhtQ7kfCXTc

http://www.youtube.com/watch?v=u8dqJMg-5IQ

http://www.youtube.com/watch?v=s5J2EGT3Bi8

Other videos / presentations:
http://www.goodfoodworld.com/2013/12/dr-jill-clapperton-rhizoterra-on-soil-health/

http://www.science.gc.ca/?Lang=En&n=FFA52B19-1

Some of her publications can be found at:
http://www.notill.org/wp-content/uploads/2012/11/The-Real-Dirt-on-No-tillage-by-Jill-Clapperton.pdf

http://pnwsteep.wsu.edu/directseed/conf99/jcdspro.htm

http://www.farmlandbirds.net/en/content/farmers-should-aim-never-use-insecticides-says-soil-scientist-jill-claperton-rhizoterra-inc

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CLC Update

The Conservation Learning Centre had another successful year in 2013. One of the major changes was that Manager Curtis Braaten resigned at the end of June to devote more time to his Haskap business. Larry White, who is also Chairman of the CLC Board took over as the A/Manager on an interim basis. Effective March 1, 2014 George Lewko PAg of Prince Albert will become the Manager. The CLC Board of Directors welcomes George on staff.

Some of the projects in 2013 included a winter wheat trial in conjunction with Ducks Unlimited; a forage biomass trial with PAMI; a forage corn variety trial; maximizing canola yields through nitrogen fertilization; and several projects related to improved weed control and fungicide use.

The CLC continued on with the School Program. The late spring and flooded roads in the area meant a lot of cancellations but over 500 students were able to do the educational tour in 2013. Bookings are being taken for the coming spring. The CLC also participated in the AgEd Showcase which saw over 500 students learn about agriculture at the Prince Albert Exhibition Centre.

The CLC has a new website at www.conservationlearningcentre.com. Reports from the 2013 projects should soon be on the site. Watch for the annual field day in July and the forage field day in August.

Some of the projects to watch in 2014 are; biological control for sclerotinia control in canola, winter wheat, foliar fertilizer application; new canola varieties; new varieties from the Crop Development Centre and continued work on weed control and fungicide use in cereals and oilseeds.

The Saskatchewan Research Council (SRC) also has a state of the art weather station on the CLC. Monthly reports are available on request from SRC. ■

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Our next two presenters were within the "Water Session." First up was Dr. Elaine Wheaton (for an excellent profile see page 3 of: (http://www.parc.ca/vacea/assets/PDF/vacea%20newsletter%20summer%202012.pdf)

Dr. Wheaton spoke on "Patterns of Weather Extremes from the Past into the Future."

We now have more temperature extremes, especially in the spring and fall. Our frost free days have been increasing approximately 5 days every 10 years since the 1960s. We now get more hot days (1 to 3 in 1960s and 2 to 5 in 2000s) as well as fewer cold days. In the 1960s the Saskatoon area experienced 110 to 115 frost free days. Today that has increase to nearly 130 days. The frost free days are lengthening more on the spring side, than on the fall side, due to less winter snow cover. The jet stream has slowed over the past several decades and now meanders more.

Winters aren't as severe (on average). So we now have longer growing seasons, milder winters, decreased snow cover, increased heat waves, all leading to the potential for major rainstorms. The chance of multi-year droughts is now higher. As droughts develop in the winter, we need to be aware of winter dry periods which are now occurring further north. The upside of these weather changes is the potential for crop yields to increase due to the increasing growing season and heat units. But with that may come an increased risk of pests and diseases as well as greater evaporative losses. Other concerns may result from the effects of extreme weather in other countries including heat waves which affects the health of many people and animals.

Some of Dr. Wheaton's work can be found at: http://www.macleans.ca/culture/so-how-about-this-weather/

http://elainewheaton.cgpublisher.com/product/pub.185/prod.193

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Dr. Wheaton has also written a book: But it's a Dry Cold! Weathering the Canadian Prairies

Our second speaker within the "Water Session" was Dr. Kevin Shook from the Centre for Hydrology at the University of Saskatchewan. (http://www.usask.ca/hydrology/people/Shook_Kevin.php)

Dr. Shook's presentation was titled: Prairie Water Realities. The Centre for Hydrology has developed the Cold Regions Hydrological Modelling (CRHM) platform which models complex prairie hydrological processes. A complete discussion of the CRHM can be found at: http://www.usask.ca/ip3/models1/crhm.htm

The Centre has also written the Wetland DEM Ponding Model (WDPM) which applies simulated water to maps of prairie basins. The model will be made available in the spring of 2014. See:
http://onlinelibrary.wiley.com/doi/10.1002/hyp.9867/abstract

http://www.usask.ca/hydrology/papers/Armstrong_et_al_2013.pdf

http://www.usask.ca/hydrology/papers/Shook_et_al_2013.pdf

Some of Dr. Shook's other publications can be found here:
http://www.mendeley.com/profiles/kevin-shook/

Our "Apps for Agriculture" session had SSCA's very own Dr. Tom Wolf (find a great bio at: http://farmtechconference.com/speaker-profile/tom-wolf/) speaking on the smart phone (and tablet) apps that SSCA has been producing with Dr. Ralph Deters of the University of Saskatchewan. Dr. Wolf talked about how access to accurate info is essential in modern agriculture. Although smart phones are still prevalent and very useful, smaller tablets are becoming more common. As some of us have "bad eyes and big hands" these tablets, with their larger buttons and larger screens may be more useful for some of us. The apps we've produced will run on both smart phones and tablets.

For an additional explanation of the apps completed to date, please see Tom Wolf's article starting on page 1 in this edition of the Prairie Steward. Follow www.ssca.ca for updates on where to receive these if you are interested.

Tom runs his own company called Agrimetrix.
He can be contacted at: agrimetrix@gmail.com
or @nozzle_guy

Some of Tom's work can be found at:
http://umanitoba.ca/faculties/afs/agronomists_conf/media/2013_Wolf_MAC_Pres_12_Dec_9-30_am.pdf

During the noon luncheon the SSCA paid tribute to Dr. Guy Lafond who passed away in the spring of 2013. As well as being a former board member with the SSCA, Guy was a tireless supporter of conservation agriculture. A slide presentation of photos of Guy at various events was presented. The lead article in the March edition of the Prairie Steward was by Guy Lafond (he was still working with us even though he was quite ill). Guy will be inducted into the Saskatchewan Agricultural Hall of Fame in 2014.

Our lead off session during the afternoon was called "Agronomy Issues." The first speaker was Dr. Rene Van Acker of the University of Guelph speaking on "Is Agricultural Progress Making Farmers Redundant: The Fate of Farmers in the 21st Century".

Dr. Van Acker started off his presentation by saying that farm expenses always rise to meet gross farm receipts, and that the total number of farmers has been declining since 1941 in Canada. So from a strictly numbers perspective, agricultural progress has

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made many of us redundant. But given the many cumulative demands on agriculture, and the ever important need to remain sustainable, how does an ever decreasing number of farmers respond to those demands? Technology has helped enormously - biotechnology and conservation tillage has been readily adopted by farmers. If you want an additional source to seek solutions via a "computational knowledge engine," Dr. Van Acker referred to the Wolframalpha website (http://en.wikipedia.org/wiki/Wolframalpha).
Find it here https://www.wolframalha.com/

Dr. Van Acker suggested reading Michael Pollan, even if you hate his stuff, as it is a window into a percentage of how todays consumers think. (http://en.wikipedia.org/wiki/Michael_Pollan)

Dr. Van Acker also reminded us that the premier of Ontario is also Ontario's Agriculture minister. Our needs as farmers are such things as technology, knowledge, biological functionality, and perhaps most of all community.

For Dr. Van Acker's bio and "selected publications" please see:
https://www.uoguelph.ca/plant/faculty/vanacker/

Our next speaker within "Agronomy Issues" was Joanne Thiessen Martens from the University of Manitoba. Her talk was on Designing Cropping Systems for Profitability, Sustainability and Resilience

Profitability, sustainability and resilience are measures of success, But what does this look like? Ecological principles, processes and functions require long-term thinking. Varying seed varieties, cover crops, trees, livestock are examples of diversity. Joanne referred to a study by Morandin and Winston 2006 (see * below) that found that the highest profit occurs not at 100% of all acres of a field seeded to one specific crop, but that up to as much as 30% of the area can be removed from crop production and allow nature to take over and net profits actually increased. But something else can be done with the (up to 30%) area taken out of crop, by producing something else, and net profits rise even further. Grazed green manure math is very positive for the soil for instance, and it's also profitable. Where do we (farmers) begin? Observe. Build knowledge. Adapt to local conditions. Always look for interactions and synergies. See Natural Systems Agriculture website at:
http://umanitoba.ca/outreach/naturalagriculture/

For Joanne Thiessen Martens' bio please see:
http://www.umanitoba.ca/outreach/naturalagriculture/weed/files/home/authors_e.htm

* There doesn't appear to be a direct link to the Morandin and Winston 2006 study, but there are various internet links referring to the study. From doing a "Morandin and Winston 2006" internet search the following appear at least somewhat useful:
http://www.producer.com/2012/02/a-few-open-spaces-can-yield-improved-returns-study-shows/

http://books.google.ca/books?id=RNKer3ok8C&pg=PA110&lpg=PA110&dq=Morandin+and+Winston+2006&source=bl&ots=ebZHj10zZ5&sig=6VVVcuWfeERVpFStbZHkgkRfd1Q&hl=en&sa=X&ei=Dx0qU9TPEYaCrAGgnIHYDg&ved=0CEgQ6AEwAw#v=onepage&q=Morandin%20and%20Winston%202006&f=false

http://www.bio.miami.edu/horvitz/Plantanimal%20interactions%202013/conservation/required%20readings/Bee%20preference%20for%20natives.pdf

http://www.ecoagriculture.org/greatest_hits_details.php?id=911

Our next speaker within the "Agronomy Issues" section was Denis Tremorin. Denis is with Pulse Canada as Director, Sustainability. His talk was on: Measuring Sustainable Ag: A Collaborative Approach. General Mills, Unilever, and Walmart (amongst others) have Sustainability targets. Food Industry and Agriculture have very similar interests, they just use different language. Sustainable Food
Laboratory has developed "Cool Farm Tool." It was developed by Unilever

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(http://www.coolfarmtool.org/CoolFarmTool). The Cool Farm Tool is "an online greenhouse gas calculator that is free for growers to help them measure the carbon footprint of crop and livestock products." A similar tool called Holos was developed by Ag Canada (http://www.agr.gc.ca/eng/science-and-innovation/science-publications-and-resources/holos/?id=1349181297838).

But what can we develop in Canada to measure sustainability? Two approaches are: 1.) measure an entire crop or 2.) measure sustainability specifics. Denis said an On-Farm Sustainability calculator is currently being developed. He needs grower participation in a substantial way to get feedback to see what data or results will farmers see value in?

Dennis can be found:
Pulse Canada: http://www.pulsecanada.com/ or @DenisPulse

After speaking at last year's conference, Dr. Randy Kutcher, from the University of Saskatchewan returns to speak on: Best Fungicide Management Practices: Scouting and Avoiding Resistance.

Why field scout? Field scouting is a major component of intensive pest management (IPM), pest identification, fungicide decisions, and indication of future problems. How often should we field scout? Frequently... weekly would be ideal, but how about we aim for scouting to occur at specific crop growth stages? Early season scouting is good to determine if fungicide might be of benefit. Late season is also a good time to scout to determine what diseases occurred.

During swathing for instance, is a good time as you don't have to walk through standing crop. For many/most diseases, by the time symptoms are obvious it is too late to apply pesticides. What is needed for scouting? A good magnifying glass, information (DFCC, factsheets scouting guides, etc.), camera/gps, shovel/trowel, bags. Dr. Kutcher suggested we download the Crop Protection Diagnostic Lab Form from Saskatchewan Ministry of Agriculture (see: http://www.agriculture.gov.sk.ca/Crop_Protection_Lab Also see: http://www.agriculture.gov.sk.ca/avg1102_11)

Disease survey results are published yearly at http://www.cps-scp.ca.

We can also reduce the risk of fungicide resistance via genetic mutation or genetic recombination by; 1) using clean seed & seed treatment, 2) rotating crops, 3) selecting & rotating disease resistant varieties, and 4) scout and spray based on risk of disease.

Fungicides are effective for 2 to 4 weeks.

Dr. Randy Kutcher's bio and contact info can be found here: https://agbio.usask.ca/find-people/Kutcher-HRandy.php.

The next section of the conference was called "Emerging Issues." Our first of two speakers within this section was Dr. Graham Scoles of the U of S, speaking on: Biotechnology, the past and the future.

Dr. Scoles reminded us that biotechnology is all around us… in yeast used for beer, wine and bread for instance which has been around for some time. Modern biotechnology uses advances in our ability to grow animal, plant, yeast and bacterial cells in culture. Many drugs today are biotechnology derived. Other examples are yogurt, insulin, and essentially all rennet to make cheese, whether it's organic or not. Controlled mass production produces bacteria for yogurt, yeasts for beer, wine, and bread as well as plants (both house and garden plants), double haploids (plants from pollen), and inoculants. Genetic engineering is also used to mass produce enzymes, vaccines, drugs and therapeutics (molecular farming). In the future,
GE bacteria or yeasts will provide greater functionality (yeasts for higher al-

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cohol production for instance). This is currently in the experimental stage.

Biotechnology/molecular biology is now an essential tool in most research labs that work with anything that has DNA (archeology for instance). Also, genetic diagnosis can help with early detection of genetic disorders, genetic improvement of livestock and crops, forensics, paternity and seed disputes, food safety, and disease outbreaks. GE crops now make up 12% of worlds crop - over 80% of worlds cotton and soybeans. The area in GE crops in less developed areas of the world now surpasses the area of GE crops grown in North America. These areas are deriving the same value that North American farmers have experienced, namely, reduced insecticides, reduced tillage and increased profits.

The future of GE will see increasing acceptance, eventually more traits, drought tolerance and nutrient use efficiency. Also, new techniques that allow directed change of genes already in species - will they be GMOs?

Please also see Dr. Scoles second part of his two-part article on biotechnology within this edition of the Steward. Dr. Scoles can be found here: http://www.usask.ca/experts/experts/scoles_graham.php

Our final speaker of the day was Dr. Adrian Johnston who is with the International Plant Nutrition Institute (www.ipni.net). Dr. Johnston's talk was on Future Food Security: Global and Regional Perspectives.

Dr. Johnston opened by saying that food security is a global challenge that is played on a local scale. Most people of the world spend a significant percentage of their income just so they can eat. From 2000 to 2050 the world will gain about 3 billion more people, with a 1.5 billion increase in Asia and approximately 1 billion increase in India. One out of eight of the worlds population currently is chronically hungry, most of these people live in southern Africa. Not only will the worlds population increase, but for many people, their diets will change also.

As more of the worlds people achieve middle class, their consumption of meat will increase. Meat consumption is on a steady increase now. Vegetable consumption is also on the increase, but meat is really increasing on a per capita basis. For example, in 1975, China consumed 10 kg of meat per person per year. By 2050 they will consume approximately 80 kg per person per year. We'll need a 50 to 75% increase in cereal production to provide food for all this increased meat production. But the question is "How?"

Cereal production can occur through an increase in harvested area. It can increase through more cropping intensity (including more crops per year, mainly by irrigation). It can also increase by increasing yield of existing sown acres. Average yields in many areas are 20 to 80 percent of potential yields. The biggest issue to increasing those yields is poverty - poor farmers haven't the means to improve their yields.

Biotechnology will provide about a 1 to 2 % increase per year in increased production, but the world will need a 3 to 4 % increase. That additional required boost in yield will come from "integrated soil fertility management." Saskatchewan farmers have already gone through this management practice. So good seeds, and a little bit of fertilizer starts the process of increased food production in Africa.

Dr. Johnston referred to Norman Borlog's green revolution which occurred on the "indo-gangetic plain." (see: http://en.wikipedia.org/wiki/Indo-Gangetic_Plain).

Adoption of practices which exist already is the challenge to meeting the 2050 objectives. Many areas of the world are water deficient. The other concern is food loss and waste. As wealth increases, loss declines and waste increases. Fifty-one percent of total food waste/loss occurs in Asia, a reflection of its large population. Biofortified crops such as rice, sweet potato, etc can help reduce that waste by increasing shelf life.

Dr. Johnston closed with reminding us that healthy soils equate to healthy people. Food security depends on sustainable agriculture. He also referred us to www.oneacrefund.org.

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