2014 NORTHEAST POTATO TECHNOLOGY FORUM

March 12 – 13, 2014
Fredericton, New Brunswick Canada

CONSPECTUS

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2014 Northeast Potato Technology Forum

Fredericton, New Brunswick, Canada

The Northeast Potato Technology Forum is an annual event that provides potato researchers and extension specialists from Atlantic Canada and Northeast United States an opportunity to discuss potato research and promote collaboration and information exchange. The 22nd annual Northeast Potato Technology Forum was held March 12-13, 2014 at the Crowne Plaza Lord Beaverbrook Hotel in Fredericton, New Brunswick.

The 2014 program was comprised of 21 oral presentations. The innovative and diverse research presented included genomics, Potato virus Y, disease control, Colorado Potato Beetle resistance, soil compaction, soil fertility, riparian buffers and tuber physiological age.

Many thanks are extended to the session chairs, presenters and all participants of the Forum. Our appreciation and thanks go to Syngenta for sponsoring the evening reception; McCain Foods (Canada) for publication of this booklet; and the New Brunswick Department of Agriculture, Aquaculture and Fisheries for technical assistance. We also extend thanks and appreciation to our sponsors for their support.

This booklet contains the abstracts of the 21 oral presentations of the Forum. The research represented by these papers is integral to the growth and sustainability of the potato industry in the northeast region.

Thank you for making the 2014 Northeast Potato Technology Forum a success.

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Effect of Cooking and Reconstitution Methods on the Loss of Bioactive Compounds in Coloured and Non-coloured Potatoes

M. Z. Alam[1], G. Wang-Pruski,[1]* D. M. Hodges[2], G. Hawkins[3], M. D. Kubik[4]

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Total phenolics, anthocyanins and total antioxidant capacity of five coloured and two un-coloured potato varieties were assessed in fresh (with and without skin) and commercially processed/cooked/reconstituted products. Ascorbate profiles of the seven genotypes were also investigated using fresh tuber tissues. The results showed that cultivars varied greatly in their contents of bioactive compounds. Ascorbate profiles were not associated with any particular flesh pigment. However, the pigmented potatoes had 1.5 to 2.5 times higher phenolic contents and 2 to 3 times more total antioxidant capacity compared to the un-pigmented cultivars. No anthocyanin compounds were detected in the un-pigmented potatoes whereas the pigmented genotypes had levels of 13.98 to 38.57 mg C3GE^{-100g} FW. Significant losses of total phenolics, anthocyanins and total antioxidant capacities were found during the peeling (18-23%) and blanching processes (40-60%). With further cooking and reconstitution, additional losses ranged between 7-12% with no prominent genotype differences. Genotypes with greater initial levels of bioactive compounds (pigmented genotypes) lost about 65% after cooking and genotypes those had less bioactive compounds to start with (i.e. un-pigmented genotypes) lost about 50% to blanching. Together, over 65% of these bioactive compounds were lost during processing. The results suggest that coloured varieties are more susceptible to loss of pigmented bioactive compounds during blanching, cooking and reconstitution, so precautions should be taken when developing new processed products.

Use of Near-infrared Spectroscopy (NIRS) to Predict Dry Matter Content and Starch Composition in Potato Tubers

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The aim of this study was to develop a near-infrared reflectance spectroscopy (NIRS) technique to rapidly evaluate potato processing and nutritional quality. This approach provides industry professionals and researchers with a cost-effective method to rapidly assess the processing and nutritional quality of potatoes under field or storage conditions, or at delivery points. A big emphasis of the study was on the NIRS prediction of tuber dry matter content because of its impact on processing and cooking quality, and the starch composition, especially the amylose/amylopectin ratio.

Introduction

The importance of the potato (*Solanum tuberosum* L.) as one of the world's major staple crops is increasingly being recognised because of its nutritional value and its productivity per hectare compared to major cereal crops. The increasing sophistication in the market for fresh potatoes as well as the declining or steady consumption of processed potato products suggest the need for innovation and quality improvement in potato. Approximately 70% of the total dry matter of a potato tuber is starch. A rapid and cost-effective method to assess the processing and nutritional quality of potatoes is also highly desired by the industry and field researchers to rapidly predict the processing and nutritional quality under field or storage conditions.

In the last decades, NIRS has been a method of choice to measure and to predict the quality of food crops in a rapid and non-destructive way. The technique is used in routine analysis of many quality traits of small grains and it is increasingly being used with fruits and vegetables (Cen & He 2007, Nicolai et al 2007). The potential of NIRS for predicting potato tuber quality has already been demonstrated in numerous studies (Dull et al. 1989; Scalon et al 1999; Van Dijk 2002; Haase 2006). Our previous studies (Bizimungu et al., 2011 & 2012) suggest that traits of economic importance such as specific gravity (dry matter) can be adequately predicted by using NIRS on fresh or ground tubers. In this study, samples from a wider range of genotypes and environments were used.

Material & Methods

In 2013, potato tuber samples were collected from advanced breeding selections and commercial varieties grown at Vauxhall (Alberta), Fredericton and Florenceville (NB) as well as from growers' fields and industrial trials in NB. Samples (tuber slices and freeze-dried flour) were used for quality analysis as well as for NIRS spectra acquisition. Samples were weighed before and after freeze-drying to determine the percentage dry matter of the sample. Starch composition (i.e. amylose/amylopectin ratio) was determined using Megazyme kits (Megazyme International Ireland Ltd). Spectral acquisition was conducted using a SpectraStar Unit. Calibration models were developed using Calstar software to establish multivariate equations between spectral data and laboratory reference values for dry matter content and amylose/amylopectin ratio. Different calibration models were developed and their prediction abilities were tested based on various NIRS performance statistics values. The best models based on multiple correlation coefficient (MCC), the standard errors of calibration (SEC), and standard error of prediction (SEP) were selected. Pre-processing of spectra was performed in order to improve the predictability of selected models. Scatter plots between measured and predicted parameters were plotted to assess the actual predictability using NIRS.

Results and Discussion

The best calibration models are presented in figures 1-4. For the prediction of potato tuber dry matter content, the best calibration equation showed a MCC of 0.82, a SEC of 1.51, RMSEP of 2.19 for fresh tuber slices scans (Figure 1). The prediction was higher using freeze-dried flour samples NIRS scan, with the best calibration equations showing a MCC of 0.99, a SEC of 0.13, RMSEP of 1.63 (Figure 2).

For the prediction of potato tuber starch composition, the best calibration equation for amylose content (relative to amylopectin) showed a MCC of 0.84, a SEC of 1.36, RMSEP of 2.71 for fresh tuber slices scans (Figure 3). The prediction was higher using freeze-dried samples NIRS scan, with the best calibration equation showing a MCC of 0.99, a SEC of 0.15, RMSEP of 1.76 (Figure 4).

Processing and nutritional quality of potato depends on its dry matter content and composition, especially starch amylose/amylopectin relative contents. A quick and inexpensive way to obtain these analyses can speed up the identification of superior varieties, agronomic treatments, handling and storage conditions according to the end-use. The Precision of prediction models using fresh tuber slices appear to be acceptable for screening purpose. Very high precision was obtained using freeze-dried flour samples, suggesting that models can be used in many applications, including quality control in dry matter or amylose determination. Subsequent external validation of these calibration models using samples independent from the calibration set will lead to further NIRS performance values.

Conclusion

NIRS technique offers the possibility of lowering analysis costs and providing quick, environmentally friendly (no chemicals used) and reliable analyses for dry matter and starch composition. Further work should concentrate on validating the results across a wider range of genotypes and over different years and environments to develop more robust and stable predictive models, and on other important compositional traits.

Acknowledgements

Funding was provided by Potatoes New Brunswick under the Enabling Agricultural Research and Innovation (EARI) program. Technical support was provided by Yulia Kupriyanovich, Denise Leblanc and Jean-Louis Deveau.

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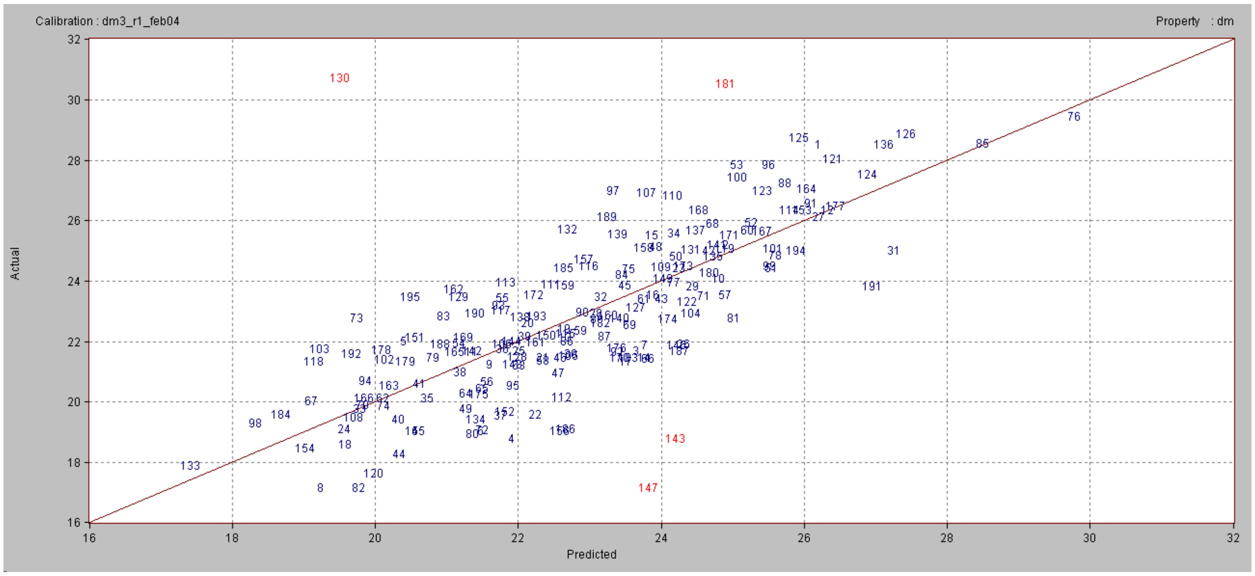

Figure 1: Calibration for percentage dry matter-NIR-predicted *vs.* measured values from fresh tuber slices (MCC of 0.82, a SEC of 1.51, RMSEP of 2.19, n=195).

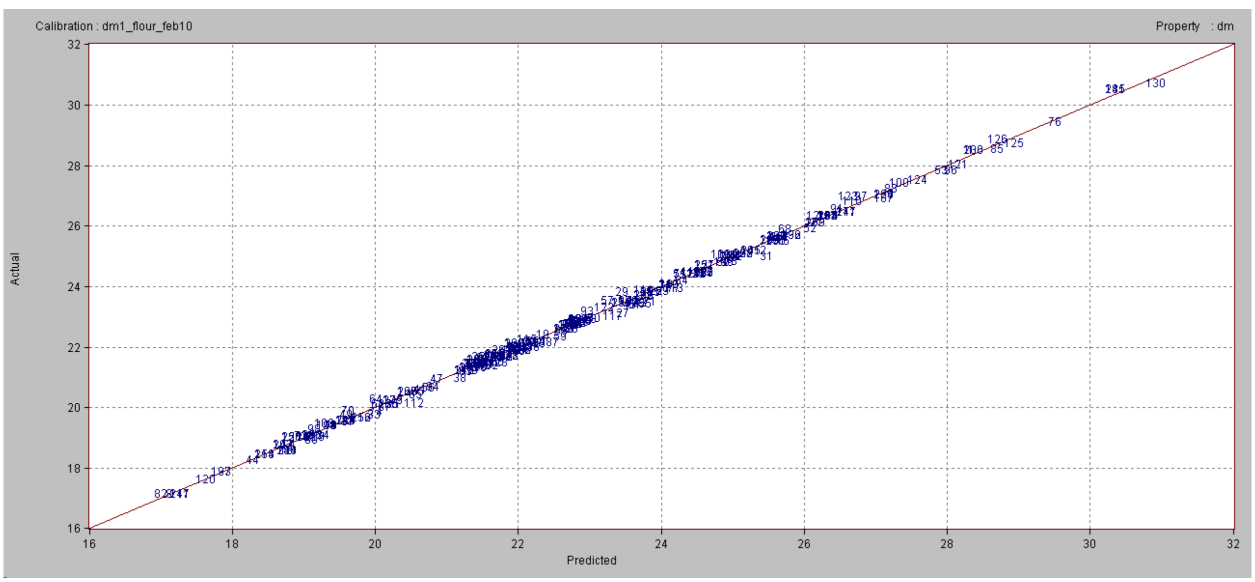

Figure 2: Calibration for percentage dry matter-NIR-predicted *vs.* measured values from freeze-dried flour (MCC of 0.99, a SEC of 0.13, RMSEP of 1.63, n=259).

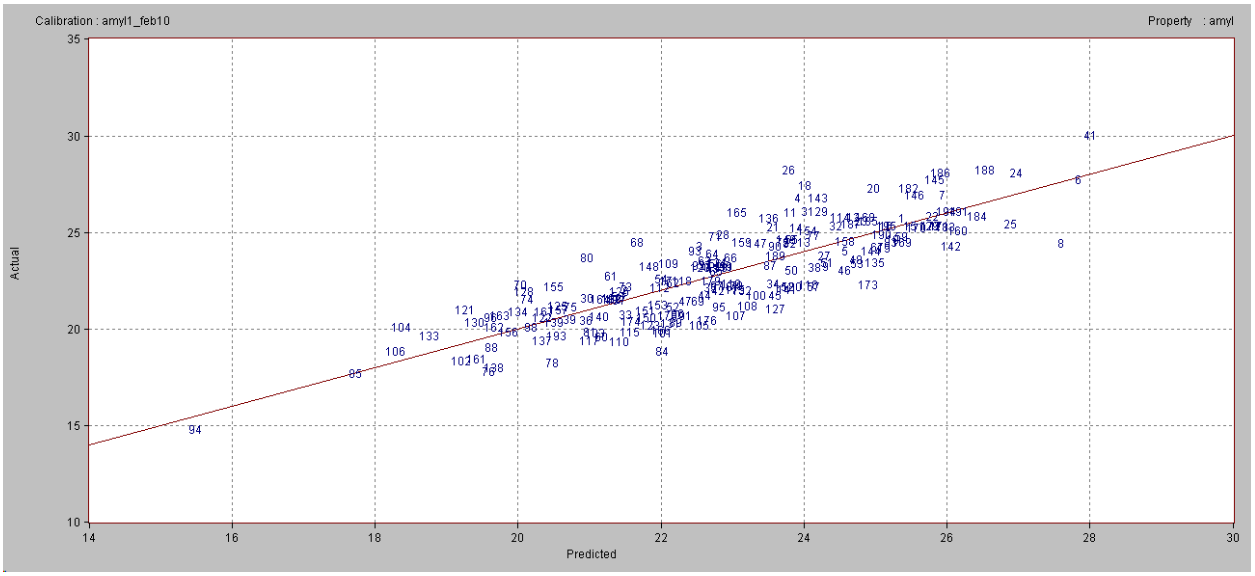

Figure 3: Calibration for amylose (relative to amylopectin) content-NIR-predicted *vs.* measured values from fresh tuber slices (MCC of 0.84, a SEC of 1.36, RMSEP of 2.71, n=195).

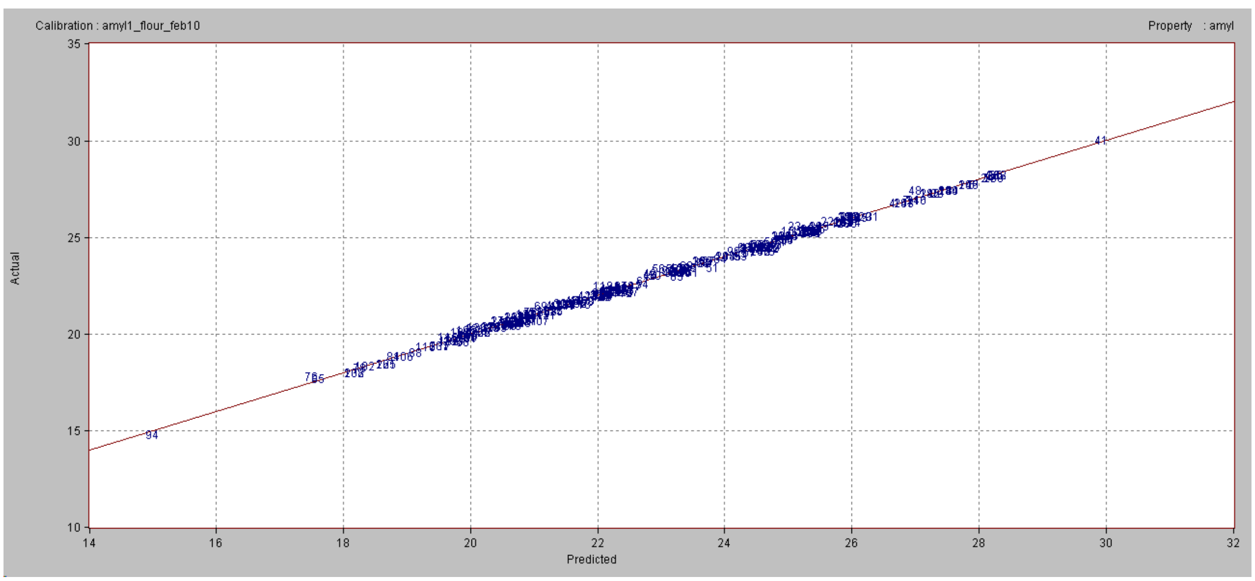

Figure 4: Calibration for amylose (relative to amylopectin) content-NIR-predicted *vs.* measured values from freeze-dried flour (MCC of 0.99, a SEC of 0.15, RMSEP of 1.76, n=259).

Resistance to Metalaxyl-m in Populations of the Potato Pink Rot Pathogen (*Phytophthora erythroseptica*) in Canada

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Pink rot, caused by *Phytophthora erythroseptica*, is a common disease of potatoes in Canada. It is particularly prevalent when high levels of moisture in autumn contribute to pathogen spore release and tuber infection. Management of pink rot has relied heavily upon application of metalaxyl-m (Ridomil Gold ®), either at planting or as a foliar spray during the growing season. In recent years, isolates of *P. erythroseptica* with resistance to metalaxyl-m have been recovered in New Brunswick and in 2012, resistant strains of the pathogen were found in Prince Edward Island.

A national survey to assess the distribution of metalaxyl-m resistant strains of *P. erythroseptica* was initiated in 2013. Samples of infected tubers from across Canada were used to obtain isolates of the pathogen for subsequent testing for metalaxyl-m sensitivity using an *in vitro* agar assay. Individual tubers were cut longitudinally and small tissue samples (10 × 5 × 3 mm) were taken from the margins of internal areas of necrosis with a sterile scalpel, surface-sterilized in 0.6% sodium hypochlorite for 1 min, rinsed twice in sterile distilled water, and blotted dry on sterile filter paper (Whatman No. 4). Tissue pieces were then plated onto 1.5% water agar in large Petri dishes (100 × 15 mm, Fisher Scientific Co., Nepean, ON). Petri dishes were incubated in the dark at 22°C for 3-4 days. Following incubation, hyphal tips from the margins of actively growing cultures were removed with a sterile probe and plated onto clarified V8 medium to generate pure cultures. In addition to isolates obtained from submitted samples, a tester isolate of *P. erythroseptica* with known sensitivity to metalaxyl-m from Prince Edward Island (PE9913) was used for reference.

Isolates were characterized for metalaxyl-m sensitivity using an amended agar assay. Briefly, agar plugs (5 mm diam.) taken from the margins of 4-day-old cultures were transferred to Petri dishes (100 × 15 mm) containing clarified V8 medium amended with 0, 1, 10, or 100 µg metalaxyl-m/mL (Metalaxyl-m, Technical grade, Syngenta Canada, Guelph, ON). Metalaxyl-m was prepared as a 100 mg/mL stock solution in pure dimethyl sulfoxide (DMSO) and added to the molten agar after autoclaving. Cultures were grown in the dark for 7 days at 22°C after which time the diameter of mycelial growth was measured using digital calipers. Two measurements, along orthogonal diameters, were taken from each of two replicate plates for a total of four measurements per concentration of metalaxyl-m used. Means were calculated and the diameter of the inoculation plug (5 mm) was subtracted from each mean. Calculated EC_{50} values (the metalaxyl-m concentration inhibiting the growth of the pathogen by 50%) were used to recognize three categories of sensitivity: metalaxyl-m-sensitive (MS; $EC_{50} < 1$ µg/mL), metalaxyl-m-moderately resistant (MMR; $EC_{50} = 1$-100 µg/mL) and metalaxyl-m-highly resistant (MHR; $EC_{50} > 100$ µg/mL).

In total, 195 isolates of *P. erythroseptica* obtained from 47 individual fields or storages were tested for metalaxyl-m sensitivity (Table 1). Approximately three-quarters of the isolates in the collection were sensitive to metelaxyl-m, with one-quarter of the isolates showing some level of resistance to this chemical (Table 1). In general, most isolates with resistance to metalaxyl-m were recovered from eastern Canada. To date, isolates of *P. erythroseptica* with resistance to metalaxyl-m have been recovered from Prince Edward Island, Nova Scotia, New Brunswick, Ontario and Manitoba (Table 1).

Table 1. Distribution of strains of *Phytophthora erythroseptica* with sensitivity (MS) or resistance (MMR/MHR) to metalaxyl-m in Canada in 2013.

Province	# samples	# isolates	% samples MS	% samples MMR/MHR	% isolates MS	% isolates MMR/MHR
NS	1	3	0	100	0	100
PE	3	16	66	34	94	6
NB	17	53	41	59	47	53
ON	5	25	40	60	52	48
MB	15	83	87	13	90	10
AB	4	12	100	0	100	0
BC	1	3	100	0	100	0
Total	47	195	62	38	73	27

Therefore, an expansion of the range and distribution of metalaxyl-m resistant isolates of the pink rot pathogen is occurring in Canada. The widespread occurrence of metalaxyl-m resistance raises concerns about the efficacy of applications of Ridomil Gold ® for pink rot control and may add importance to the role played by phosphites in the management of this disease.

Key Words: metalaxyl-m, Ridomil Gold ®, pink rot, *Phytophthora erythroseptica*, potato

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Optimal Use of Phosphites for the Control of Potato Late Blight

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Oomycete organisms cause late blight and pink rot in potato plants. Foliar and postharvest applications of phosphite (Phi)-based fungicides are increasingly used to control these diseases during the season and storage. The optimal usage of the fungicides is essential to ensure the best disease management for production. In order to assess the efficiency of Phi uptake and translocation to tubers, Phi fungicides Confine™ and Phostrol™ were used following foliar and postharvest treatments of the potato crops. The amount of Phi in tubers was determined using a high pressure ion chromatography method. The quantity of Phi determined in leaves and tubers of cultivars Russet Burbank, Ranger Russet and Prospect showed a strong positive correlation with the total amount of Phi fungicides applied in the growing season as foliar treatments. After foliar applications, Phi was also efficiently translocated from leaves to tubers. Phi was unevenly distributed in the various tuber tissues following foliar or postharvest treatment. The highest amount was identified in the tuber cortex, followed by medulla and skin areas in foliar treated plants. From postharvest treated tubers, the highest concentrations of Phi were determined in skin samples and lower in cortex and medulla tissues. These findings provide significant information for optimal usage of Phi-based fungicides for disease control in field and storage conditions and for improved potato production and processing.

Preliminary Evaluations of *Brassica* species in PEI for Cover Crops and Soil Nitrogen Management in Potato Rotations

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Background- On PEI, approximately 90,000 acres of potatoes are produced each year on a limited land base. Most potato rotations are one in three years with some fields two in five and some have been one in two. From several recent accounting studies, the average total cost to produce and store potatoes is $2,800 to $3,000.00 per acre. In some situations, growers are not grossing enough pay yields to cover production costs. Some have tried adding additional fertilizer with limited yield increases. Farmers are being educated on the 4R concept of efficient fertilizer use (abstract, 2013 NE Potato Forum, Coffin *et al*). Some growers are evaluating crop rotations and types of cover crops, with the aim of increasing pay yields of potatoes.

In brief, some of the factors leading to declining yields of potatoes on PEI are soil compaction, reduced organic matter content and crop pests. Some potato fields have organic matter (OM) as low as one to two percent in comparison to well- rotated fields with OM in the 3-4 % range. Many growers acknowledge higher pay yields of potatoes in fields with long term rotations and increased organic matter. Less than ideal soil conditions can limit root growth. Low organic matter reduces the water holding capacity of the soil, and may reduce microbial activity involved in nutrient release.
Several species of *Verticillium* fungus are leading to "early dying" in some potato varieties; especially susceptible varieties such as Russet Burbank. Soil fumigation, to suppress *Verticillium* fungus, is widespread in western USA to reduce yield losses. Soil fumigation currently is not permitted on PEI. Potato growers in western USA have indicated that if fumigation was banned, they would not risk planting susceptible potato varieties such as Russet Burbank. Some varieties of potatoes have some field resistance to *Verticillium* but may not be on the acceptable list for processing for "Quick Service Restaurants". High populations of Lesion Nematodes (*Pratylenchus* spp.), in some PEI fields, have led to reduced tuber yields.

Currently, approximately 6% of the PEI potato acreage is irrigated. Numerous growers have expressed interest to increase supplementary irrigation during dry periods, but a moratorium on drilling high capacity wells has, at present, halted further development of irrigation on PEI.

One hundred percent of drinking water on PEI is from ground water wells. Surveys have revealed increasing concentrations of nitrate in ground water in areas of intensive agriculture (livestock operations, field crops). The variety Russet Burbank accounts for approximately 60% of the PEI acreage and is usually fertilized with a higher rate of nitrogen fertilizer than other varieties. Studies, on PEI, have revealed that varieties such as Russet Burbank leave considerable amounts of nitrogen in the soil after harvest, thus leading to nitrate loading in the ground water. The use of cover crops has been suggested as a method to absorb and hold the residual N, to avoid leaching to ground water. The late potato harvest (mid- October) does not allow for sufficient growth of cover crops in the fall.

Another insect pest that is increasing and adversely affecting growth of potato plants and the pay yield of tubers are several species of wire worms. Options that are being investigated for suppression of wireworm populations are insecticides and the use of *Brassica* crops for "biofumigation".

Definition of Cover crops and purported benefits

The major use of cover crops is to reduce soil erosion and add organic matter to soil. There are a wide range of cover crops grown (winter rye, oats, buckwheat, ryegrass, different types of *Brassica* i.e. mustard, rapeseed and radish).

There are numerous claims that some *Brassica* crops can also reduce some pests (nematodes, wireworms, *Verticillium* fungi and some types of weeds). In brief, it is recognized that most *Brassica* crops contain glucosinolates in plant tissues. When the plant cell structure is damaged during chopping of the foliage and/or disking the plants into the soil, there is often a release of isothiocyanates (gas) and some other compounds from the glucosinolates; that can kill/inactivate some crop pests. There are numerous types of glucosinolates in plants; over 120 have been identified.

In recent years, there has been promotion of a number of *Brassica* crops (mustard, rapeseed, and radish) as cover crops with several purported benefits. In addition to providing organic matter, some of the other claims are that the *Brassica* cover crops adsorb residual nitrogen (thus reducing nitrate leaching potential) and may cause "biofumigation", leading to reduced amounts of pests that damage potatoes.

While there are numerous scientific articles expounding the potential benefits of biofumigation from Brassica crops, local data is limited and research is needed to:

- determine the best methods of chopping and incorporating the crop to release isothiocyanates (plant cell disruption to trigger formation of isothiocyanates).
-determine the effect of weather conditions (temp, soil moisture) on the efficacy of the "biofumigation".
- quantify of the amount, rate of release and type of isothiocyanates released over specific time periods from different *Brassica.*
- assess the pest decline and yield decline/improvement in potatoes, in the same field, when a biofumigation crop is compared to a standard rotation crop.
- compare differences among varieties of oilseed radish, Daikon type radish and Indian Hot mustard/ Caliente Mustard ® to determine their glucosinolate content.

A number of long type radishes (Daikon type radish) have been marketed under registered trade mark names i.e. Tillage radish ®, Groundhog radish®, Piledriver Radish ®. The general claims are that the radish crops loosen soil due to extensive root growth, absorb/scavenge and hold nutrients from soil, add organic matter, reduce erosion and may reduce some plant pests/pathogens.

<u>Objectives of preliminary research conducted on PEI In 2011</u>

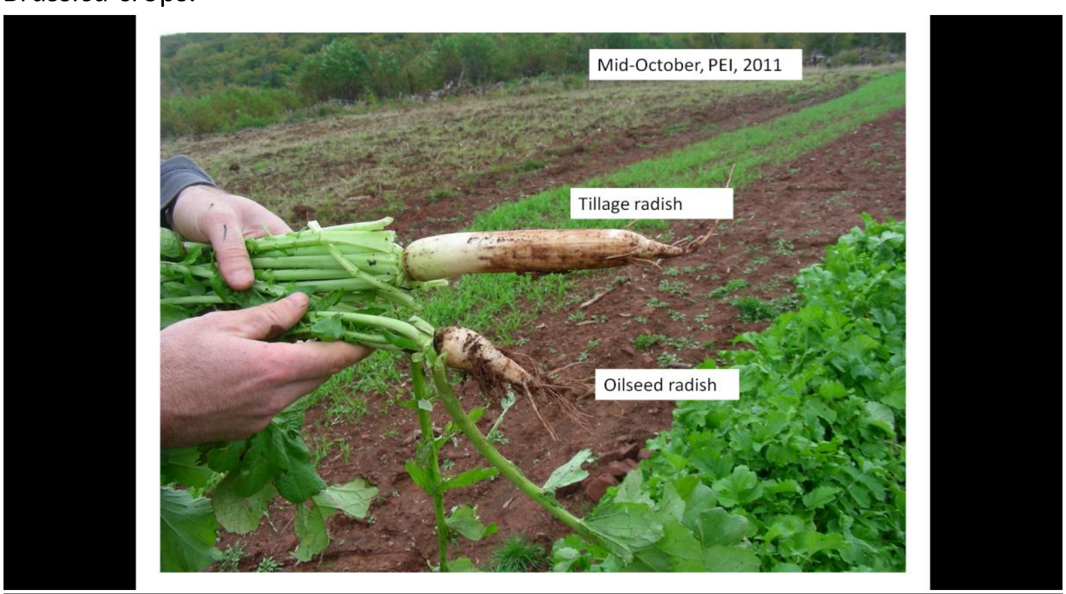
The preliminary research reported here is:

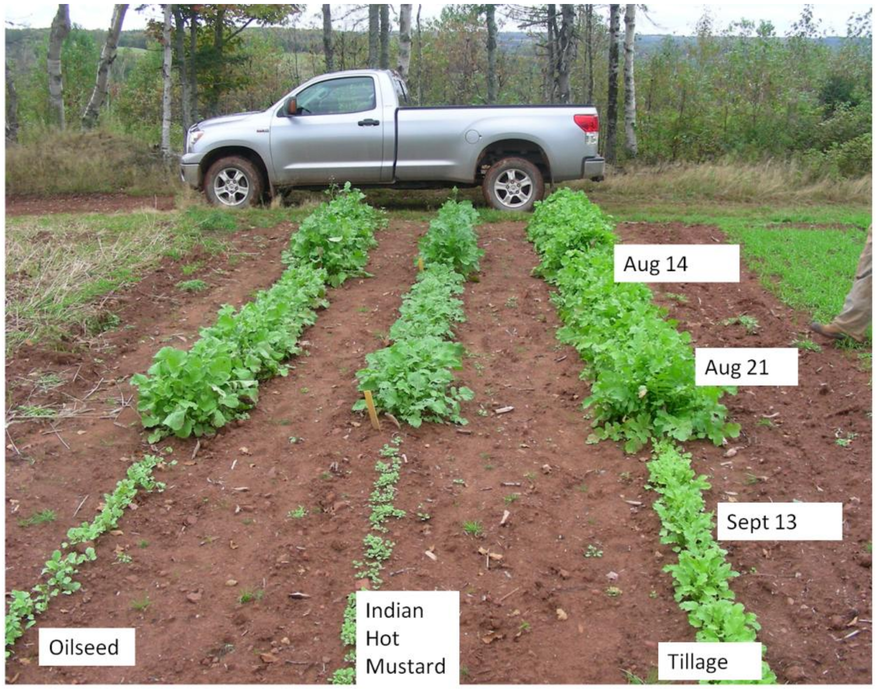
- A comparison of plant growth of Indian Hot Mustard, Oilseed radish and Tillage radish® when sown at four different times in late summer and fall of 2011 at Green Bay, PEI. (Dates August 14, 21, September 13 and October 12). Much of the performance data reported in scientific and promotional literature was generated in eastern and central USA where a longer period of warm weather usually occurs.
-An assessment of nitrogen content and dry matter in plant tissues, under fertilized and non-fertilized soil conditions (No fertilizer vs. 400 pounds per acre of 17-17-17)
- An overall assessment as a fall cover crop in soil nitrate management

<u>Observations</u>

-Seeds germinated and emerged in the field from 4-7 day after planting. The quickest emergence and earliest plant growth occurred in the Tillage radish®.
-Increased plant growth of all three *Brassica* crops was evident in fertilized plots (data in table below)

-Cabbage butterflies (*Pieris rapae*) were numerous and laid eggs on all three crops. The most extensive leaf damage from feeding larvae was in the Indian hot mustard (*Brassicae juncae*).
-Late planting, after mid -September, gave very limited plant and root growth for all three Brassica crops (see photo, taken in early November, 2011).
-Large tap roots (6-10 inches long) on Tillage radish® were only formed from early seeding (mid August). It takes time to develop a large tap root. Under PEI conditions, one would need to plant by August 15 to assure good growth of roots and foliage. Extrapolation from small samples of plants indicated that approximately 700-1,000 pounds of dry matter per acre was contributed from the early sown plots.
-The *Brassica* plants absorbed nitrogen from the soil as claimed in the literature. However, the rapid breakdown of the *Brassica* plant tissues after several hard frosts in November would lead to the release of nitrogenous components to the soil where some would be vulnerable to leaching or volatilization. It is doubtful if the *Brassica* crops, as grown in this evaluation, would have much benefit to reduce nitrate loading into soil and ground water.
-Observations in the spring revealed that no plants of the three *Brassica* species were alive. In the rows where the Tillage radish® was growing, open cavities were evident in the soil where the tap roots had grown and died. This may allow earlier soil warming and percolation of water. Soil penetrometer evaluations should be conducted to verify if soil loosening actually occurred.
-Winter rye in nearby plots wintered well and may have held nitrogen in the winter hardy, frost tolerant foliage and roots compared to the disintegrated *Brassica* crops.





<u>Evaluation of Fresh weight, dry weight, nitrogen content in roots and foliage of Tillage Radish® and Oilseed radish (evaluations conducted at PEI Dept. of Agriculture Soil and Feed Testing Laboratory)</u>

Tillage radish , 2 foot row, October, 2011

Fertility treatment	Plant part	Fresh wt. grams	Dry wt. grams	%dry matter	% nitrogen D. M. basis
fertilized	foliage	46	3	6.5	5.87
fertilized	roots	555	40	7.2	1.93
Non-fert	foliage	28	1.7	6.2	2.83
Non-fert	roots	427	31	7.3	1.35

Oilseed radish, 2 foot row, October, 2011

Fertility treatment	Plant part	Fresh wt. grams	Dry wt. grams	%dry matter	% nitrogen D. M. basis
Fertilized	foliage	46	7.4	16.2	2.37
fertilized	roots	227	25.9	11.4	2.63
Non-fert	foliage	45	2.5	5.6	2.43
Non-fert	roots	173	25.9	15.0	1.42

Effects of New Fertilizers on the Yield and Quality of Processing Potatoes

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New fertilizers are being introduced into the Canadian market every year. Many of these fertilizers are destined for the production of grains in the western parts of Canada and have not been tested on other crops such as potatoes New regulations in Canada no longer require fertilizer companies to prove the efficacy of their products through a third party research to be marketed. This study was conducted to evaluate new foliar fertilizers as well as new specialty sources of phosphorus. Tessenderlo Kerley Inc (TKI) foliar fertilizer potato program was evaluated in an irrigated trial laid out as a Randomized Complete Block design (RCBD), with five replications per treatment, with four 4.5m rows. Concomitantly, a large scale split-field trial was conducted to evaluate specialty phosphorus fertilizers MicroEssential 10® (Mes10) and MicroEssential SZ® (MesZ). Specialty fertilizers were applied in bands at planting. All samples of both trials were evaluated at the centralized grading facility of Cavendish Farms. Potatoes grown following the TKI foliar fertilizer program showed no improvement in total yield over potatoes grown without foliar fertilizer. However, TKI foliar fertilizer program increased the value of the crop by $315/ac. The increased value was due to a reduction in tuber defects, mainly pitted scab and hollow heart. A significant quantity of sulfur present in the TKI foliar fertilizers was likely responsible for the reduction in scab. Potatoes grown with specialty fertilizers MesZ showed increased yield over the standard blend by 85cwt/acre, which in return resulted to an increased crop value. Potatoes grown using MesZ had a $660/ac increase in value compared to standard fertilizer blend. The use of specialty fertilizers Mes10 and MesZ did not affect tuber size or quality. It appears that some of the newly marketed fertilizers have good potential in improving the yield and quality of processing potatoes.

Improving Profitability and Competitiveness through Mitigation of Limitations to Potato Yield

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The Canadian potato industry is rapidly losing access to global markets for potato products. The situation is particularly dire in New Brunswick where the increase in production costs of the past decade has not been associated with an increase in yield. This project is designed to address yield limitations in New Brunswick potato production as a means of increasing the profitability, sustainability and competitiveness of potato production in domestic and global markets.

The objective of this multi-disciplinary, multi-year project is 1) to develop innovative approaches to use remote sensing data to identify zones within potato fields in which yield is limited; 2) identify the soil physical, chemical or biological limitations to yield in these zones; and 3) evaluate the potential to overcome these yield limitations through mitigation strategies.

A total of fifteen fields located throughout the New Brunswick potato belt were chosen for study in 2013. Multispectral remote sensing data was acquired over the test fields a total of six times between June 6 and September 18 using a Tetracam camera flown on an unmanned airborne vehicle platform. On selected dates and locations, a number of plant and soil measurements were taken at geo-referenced sampling locations. Immediately before commercial harvest, yield was assessed in each of the 15 fields by manually digging three 10ft. strips at a predetermined number of sampling sites and soil compaction assessed at the same sites using an Eijkelkamp Penetrologger equipped with a 60^0 cone with a base area of 2.0 cm^2. Shortly after harvest, a soil pith was dug at each yield sampling location to identify horizon depths, depth to bedrock or compact layer. Soil samples were collected by soil horizon and used to determine soil texture and coarse fragments, soil pH, organic carbon and total N concentrations.

Yields varied substantially across the 15 fields. Total and marketable yield at locations with excellent growth averaged 142 and 156% of the average yield whereas the same measurements taken at locations with poor growth averaged only 48 and 37% of the average yield.

When averaged across fields, preliminary results suggest that there is a weak negative correlation between penetrometer resistance at 20 and 25 cm depth and tuber yield for fields planted to Russet Burbank. This Penetrologger data collected at harvest suggests that a compaction layer capable of reducing root growth and thereby limiting yield may be present at 20-25 cm depth in some fields.

Yield Variation Within Potato Fields: Case Studies From 2013

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In recent years, potato tuber yields in Atlantic Canada have stagnated, or perhaps even declined. As a result, a research project was initiated by Potatoes NB in cooperation with McCain Foods (Canada), AAFC and NBDAAF to study within-field variation in tuber yield. The objectives of the project include the use of remote sensing imagery to identify areas of differential growth within fields, and within-field measurements and sampling to identify causes of the yield limitation in order to identify possible mitigation strategies. Preliminary results will be presented for two fields (identified as fields D and O) which were included in this project in 2013.

A total of 15 sampling locations were identified within each field based on early season crop growth, chosen to reflect good, intermediate or poor growth. At each sampling location, total tuber yield was determined from three 10' strips and the tubers from one 10' strip were graded according to a processing contract.

Extremely wet conditions in the spring of 2013 delayed planting in many fields, and cool wet soil conditions delayed early growth. In some cases wet or flooded areas within fields resulted in a reduced plant stand, or in extreme cases resulted in the complete loss of the crop stand. Most within-field yield variation in 2013 appeared to be related to soil physical properties.

Substantial yield variability was measured in both fields. In Field O, total and marketable tuber yield of the sampling locations with poor early growth averaged 34 and 19% of the yield in the sampling locations with good or intermediate early growth, respectively. Similarly, total and marketable tuber yield of the sampling locations with poor early growth in Field D averaged 38 and 33% of the yield in the sampling locations with good or intermediate early growth, respectively.

Remote sensing imagery was collected on multiple dates using an unmanned airborne vehicle platform (i.e., a drone). Ground cover estimated from the imagery collected early in the growing season was highly correlated with tuber yield in both fields. Ground cover measured later in the growing season was less well correlated with tuber yield in Field O, and not correlated with yield in Field D. This suggests that delayed development of crop canopy early in the growing season contributed to a loss in yield potential. Similarly, tuber yield early in the growing season was also highly correlated with the NDVI (Normalized Difference Vegetation Index) in both fields.

Penetrometer readings were collected prior to harvest at each sampling location. In addition, soil pits were dug at each sampling location after harvest, and soil samples collected by soil horizon. Sample and data analyses are on-going. Results will be used to assist in identifying the causes of poor growth, and to identify possible mitigation strategies.

Management of *Potato virus Y* using Mineral Oils

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Potato virus Y (PVY) has become a significant disease of concern for potato producers in New Brunswick, Canada. The focus of this study was to evaluate the effectiveness of two brands of mineral oil (SUPERIOR 70 and VAZYL-Y) in PVY management. Different concentrations and spray regimes in each mineral oil were tested in separate fields on three different potato cultivars (Russet Burbank, Innovator, and Shepody). Additionally, oil was extracted from the plants sampled from the control and Superior 70 mineral oil treated plots and quantified using Gas Chromatography-Mass Spectrometry (GC-MS). Results demonstrated that sprays of mineral oils on a weekly basis starting from crop emergence to top-kill were efficient in reducing the current season spread of PVY.

Effect of Insecticides on Aphid Behavior and Potato Virus Y Acquisition

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The objective of this work was to assess the effect of 3 contact insecticides, Matador, Beleaf, Fulfill and 2 systemic insecticides, Cygon and Admire on the behavior and PVY acquisition of three aphid species, *Macrosiphum euphorbiae* (Thomas), *Rhopalosiphum padi* L. and *Aphis fabae* (Scopoli).

Shortly after the spray, contact insecticides strongly modified aphid behavior and intoxicated them. Cygon sprayed on potato plants did not change the behavior of the three tested aphid species when compared to untreated leaflets while Admire slightly reduced the probing behavior of *M. euphorbiae* and intoxicated some *R. padi*. The residual effect of insecticides (10 to 23 days after the spray) was almost inexistent. No intoxication was found and slight changes in the behavior of *R. padi* and *A.fabae* were observed. The acquisition of PVY by aphids was reduced only on Matador and Cygon in *R. padi* for a couple of days after the spray.

Contact and systemic insecticides are efficient in intoxicating aphid soon after the spray and few of them might play a role in reducing PVY in field mostly because of their activity on PVY acquisition. However, their lenght of action in reducing acquisition by aphids is not long enough to have a significant role in the spread of PVY in field.

Characterization of Host Resistance Mechanisms Against *Potato virus Y* in Potato Cultivars/Breeding Clones

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Potato cultivar Exploits and breeding clone F87084 have been considered resistant to *Potato virus Y* (PVY) infection. To further explore the degree of resistance and whether the resistance is strain specific, Exploits and F87084 as well as Rochdale Gold-Dorée and F02010 were investigated for their response to different PVY strains including PVY^{O}, $PVY^{N:O}$, PVY^{NTN} and PVY^{N} upon graft and mechanical inoculations. Both F02010 and Rochdale Gold-Dorée were readily infected with all PVY strains after inoculation by either inoculation method, indicating susceptibility of these cultivars/clones to PVY. PVY^{O} incited severe systemic necrosis on both F02010 and Rochdale Gold-Dorée whereas $PVY^{N:O}$/PVY^{NTN}/PVY^{N} incited very mild symptoms on the cultivars. For F87084, no visible symptoms were observed in the mechanically inoculated plants, regardless PVY strains. On the other hand, chlorosis and necrotic spots occurred on newly emerging leaves; and as leaves aged, the symptoms faded away. Surprisingly, no ELISA-detectable level of PVY was found in the plants even though the virus was readily detected in the attaching PVY-scions, demonstrating an extreme resistance (ER) in the F87084 to all strains of PVY. Exploits were infected with $PVY^{N:O}$/PVY^{NTN}/PVY^{N} after either mechanical or graft inoculation. Exploits was also infected with PVY^{O} after graft-inoculation. For PVY^{O} mechanical inoculation experiments in the greenhouse, one independent repeat led to systemic necrosis and virus infection whereas the other repeat failed do to, although both repeats observed local lesions on the inoculated leaves shortly after inoculation. Greenhouse records showed that there were temperature differences between the two repeats despite the same temperature set-up. To unveil whether temperature plays a role in PVY^{O} infection in Exploits, mechanical inoculation with the virus under two temperature regimes (22^{o}C and 30^{o}C) were performed in growth chambers. Local lesions were observed on the inoculated leaves in both treatments; however, systemic necrosis/symptoms only occurred in plants under 30^{o}C. Consistently, PVY was only detected by ELISA in plants at 30^{o}C. Together, these results demonstrate that Exploits possesses a temperature-dependent hypersensitive response (HR) resistance to PVY^{O}.

Comparative Genomic Analysis of *Pectobacterium wasabiae* Strain CFIA1002

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Pectobacterium wasabiae (previously classified as *Erwinia carotovora* subsp. *wasabiae*) was first described as causing soft rot of Japanese horseradish (1), and later identified as the causal agent of potato tuber decay in New Zealand (2, 3), US (4) and Iran (5). A recent study demonstrated that *P. wasabiae* also causes blackleg-like symptoms in potato plants in Canada (6), is considered widespread in the environment, and infects a wide range of host plants. The pathogen possesses diverse regulatory systems with known virulence factors, including genes encoding pectolytic enzymes, and the type III secretion system (TTSS) (8). Horizontal gene transfer, as one major evolutionary force, may have led to the acquisition of a number of determinants that mediate the pathogenicity, virulence, and interactions with plants (7). Therefore, comparative genomics of *P. wasabiae* infecting potato and other hosts from different geographical locations would help to further identify the specific virulence factors that are part of the network responsible for the virulence and host-specificity of these pathogens.

The genome sequences of *P. wasabiae* strains WPP163 (9) and SCC3193 (10), isolated from infected potato tuber of USA and Europe, respectively, and the type strain *P. wasabiae* CFBP3394, isolated from horseradish in Japan are available at GenBank (11, 12). The variable genomic regions, especially pathogenicity related loci, were shown to be highly correlated with different environmental factors, *i.e.* geographies and hosts. Therefore, comparison of these existing genomes with our first draft genome sequence of strain CFIA1002 isolated from Canada (8) is expected to aid the study on virulence factors and develop novel and accurate diagnostic methods.

Draft genome sequence data for *P. wasabiae* strain CFIA1002 were generated using paired-end Illumina HiSeq sequencing technology with TrueSeq V3 chemistry at the National Research Council Canada (Saskatoon, Saskatchewan, Canada). A total of 876,946,640 bp were obtained from 300 bp inserts to provide approximately 175X genome coverage. After quality checking and initial de novo assembly using ABYSS (13), the final draft genome consists of 5,008,535 bp containing 324 Ns and 42 scaffolds with a G+C content of 50.59%. Annotation was conducted on the RAST server using the Glimmer 3 option (14) and predicted 4,615 protein-coding genes, including 96 noncoding RNA genes and 520 predicted SEED subsystem features. A number of predicted virulence related factors, phage-related loci, motility and chemotaxis genes were identified in the genome (Fig 1), which may facilitate its specific pathogenicity in specific environment.

Comparative genomic analysis of *P. wasabiae* CFIA1002 (Canada), SCC3193 (Europe), WPP163 (USA), and CFBP3304 (Japan), was executed using MAUVE (v2.3.1). Eighteen hypervariable regions bearing pathogenicity related factors were identified, consisting of ten INDEL rich regions and eight highly diversified regions (Table 1). OF these, only six loci have unique sequences permitting the design of specific assays using AlleleID7 (v7.8). *P. wasabiae* specificity test was performed in preliminary PCR amplificaton of all six loci on closely related species and subspecies of pectobacteria (*P. atrosepticum*, *P. carotovorum* subsp *brasiliense* , *P. carotovorum* subsp. *carotovorum* , *Dickeya spp (E. chrysanthemi*), *P. carotovorum* subsp. *odorifera*, and *P*. *wasabiae*. Evaluation for *P. wasabiae* specific real-time PCR assays is underway. Further analysis of genome sequences of strains isolated from different hosts and geography regions will provide detailed insights on the virulence, functionality and plant/pest interactions of this widely distributed pathogen.

Acknowledgement

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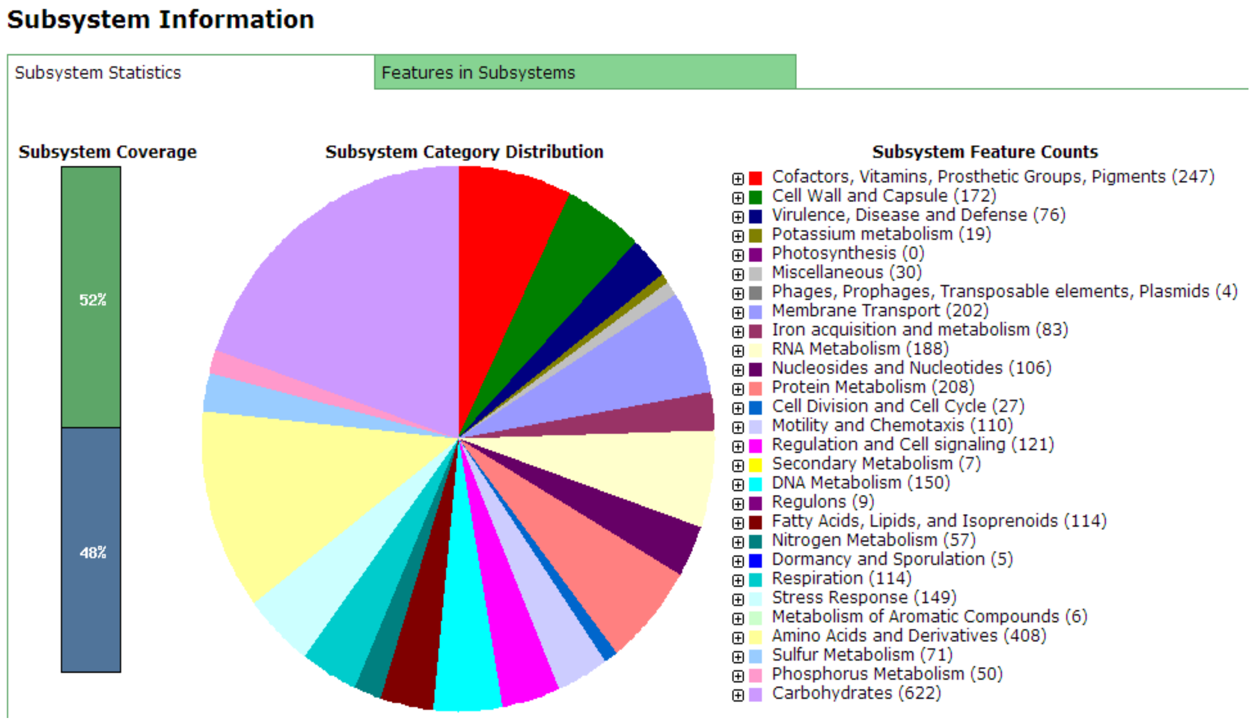

Fig 1. Genome annotation for *Pectobacterium wasabiae* strain CFIA1002 on RAST server.

Table 1. Pathogenicity related hypervariable regions based on MAUSE comparison of four *Pectobacterium wasabiae* genomes

Locus	**Genes/Functions**
I: INDELs	
CFIA1002	
scaffold2	
INS: 185254-188343	heat shock protein 70
scaffold3	
INS: 64644-70361	MunI regulatory protein; putative DNA-binding prophage protein
scaffold5	
INS: 90135-91673	filamentous hemogglutinin family; outer membrane protein
scaffold29	
INS: 16-1312	SPBc2 prophage-derived hypothetical protein
CFBP3304	
AKVS010000033	
42331-42679	Ig family protein
AKVS010000067	
103476-104808	Type I secretion outer membrane protein
WPP163	
2257176-2258755	Integral membrane protein, PqiA family
2585999-2586830	Virulence effector, SrfC
SCC3193	
2194544-2195942	ABC transporter ATP-binding protein uup/integral membrane protein, PqiA family
3224665-3233544	G4C polysaccharide, lipoprotein YmcA
II: Hypervariable regions	
CFIA1002	
scaffold1	
445349-454895: hypervariable	O-antigen gene cluster
scaffold2	
40147-44508: hypervariable	post-segregation antitoxin CcdA; mobilization protein
180340-185052: hypervariable	heat shock protein 70
284350-290480: variable	post-segregation antitoxin CcdA; integrase family protein; phage integrase family site-specific recombinase
scaffold7	
72246-80144: variable	lipopolysaccharide heptosyltranferase III; O-antigen polymerase
109637-114895: hypervariable	relaxase/mobilization nuclease family protein
scaffold29	
3536-6455: variable	probable integrase/recombinase
6964-7533: hypervariable region	putative phage regulatory protein

CFIA1002: Canadian strain isolated from potato; CFBP3304: Japanese strain isolated from horseradish; WPP163&SCC3193: potato strains isolated in USA and Europe respectively. Six regions highlighted were used for real-time PCR assay.

Assessment of Compaction from Previous Season Potato Harvest on Grain Yield

Growing Forward – EMP12-002

NB Potato Agency, PL Levesque Ltee, Thomas Kavanaugh & Sons Ltd, **Gordon Fairchild** Eastern Canada Soil and Water Conservation Centre (ECSWCC), **D. Savoie**, **K. MacKinley** & **P. Toner***, New Brunswick Department of Agriculture, Aquaculture and Fisheries (NBDAAF)

During the spring of 2011, above normal rainfall resulted in variable plant height for grain fields in rotation with potatoes. Upon further investigation of the soil profile, rooting depth and cone penetrometer (CP) readings, it was believe that wheel traffic from the previous fall potato harvest could have negatively impacted the grain crop. Assessment of compaction with a CP application to tractor, harvester, windrower, sprayer and truck tracks directly after harvest was conducted the fall of 2011. Results of CP readings from two fields were grouped and assessed using ANOVA at 5% confidence. Sprayer, tandem and/or 18 wheel truck tracks showed a significant reduction in depth upon which CP readings reached 300 PSI (resistance deemed negative to root growth). Post potato harvest truck tracks were selected for fall tillage treatments to potentially alleviate compaction. Replicated treatments were established for control, chisel plow and ripper to just below topsoil depth of 8-10 inches. CP readings taken in the spring of 2012 indicated that compaction was significantly reduced as a result of previous fall tillage treatments. 2012 planting of the trial to grain showed a significant increase in grain production over the control with ripper and chisel plow treatments. The chisel plow was as effective at removing compaction as ripper treatments. Producers should make every effort to control truck traffic in the field during potato harvest so that post harvest tillage operations can be limited to truck track areas for removal of potential compaction that may impact subsequent grain production.

Evaluation of a New Potassium Fertilization Table for Potatoes in NB

Évaluation d'un Nouvelle Grille de Fertilisation Potassique Pour la Pomme de Terre

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Abstract / *Résumé*

Evaluation of a New Potassium Fertilization Table for Potatoes in New-Brunswick for three cultivars: Russet Burbank (processing), Russet Norkotah (Table) and Goldrush (Table) using six rates of potassium (muriate of potassium, KCl): 0, 60, 120, 180, 240 and 300 kg K_2O/ha. The results of the first two years of the study, 2011 and 2012 will be presented. Also presented, one year results (2012) of three different sources of potassium: muriate of potassium (KCl), potassium sulphate (SOP) and potassium and magnesium sulphate (Kmag) on the yield and quality of Russet-Burkank cv processing potatoes.

Évaluation d'une nouvelle grille de fertilisation potassique pour la pomme de terre au Nouveau-Brunswick sur trois culvivars: Russet Burbank (Transformation), Russet Norkotah (Table) et Goldush (Table) en utilisant six taux de potassium (muriate de potassium, KCl) : 0-60-120-180-240 et 300 kg K_2O/ha. Les résultats des deux premières années, 2011 et 2012 seront présentés. Également présenté, les résultats d'une année (2012) de l'essai de trois différentes sources de potassium : muriate de potassium (KCl), sulfate de potassium (SOP) et du sulfate de potassium et magnésium (Kmag) sur le rendement et la qualité du cultivar Russet Burbank (Transformation).

Potato Response to Phosphorus Fertilization in Atlantic Canada and Assessment of the Degree of Soil Phosphorus Saturation

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Introduction

In potato (*Solanum tuberosum L.)* production, phosphorus nutrition is important for early root formation, for enhancing flowering, seed formation and maturation. In acidic soils, phosphorus is fixed by aluminum and iron, decreasing its availability to the plant. To sustain crop production in acidic soils and to compensate for P fixation, P fertilizers tend to be applied at high rates relative to crop requirements. However, excessive P inputs can lead to soil P saturation and loss. Studies conducted in Europe calculated the degree of phosphorus saturation using ammonium oxalate extraction (DPSox) and identified a critical value of 25% above which the potential for phosphorus loss through runoff and leaching is increased (Breeulsema et al., 1995). The degree of phosphorus saturation using Mehlich 3 (DPS_{M3}) that corresponds to the European critical value of 25% has been computed in North America including Quebec (Khiari et al., 2000) and Atlantic USA (Sims et al., 2002).The objectives of this study were to; i) identify critical DPS_{M3} over which greater soil P solubility and risk of P transport may occur; ii) asses potato response to increasing P fertilizer rates in soils with different phosphorus levels.

Material and methods

This research was a follow up to a long-term (1998-2011) study initiated by PEI Department of Agriculture and Forestry (DAF) that reported increasing phosphorus levels in fields frequently cropped to potato (PEI Soil Quality Monitoring Report, 2012). To gain further insight on soil phosphorus saturation levels, hundreds of soils with contrasting P levels were selected from the PEI DAF soil archive and were extracted with ammonium oxalate and Mehlich 3 to assess DPS_{M3} levels that correspond to the European threshold. In parallel, field trials were conducted in 2013 at 13 sites across PEI, NB, NS and NL to assess potato response to different rates of P fertilization on a range of representative soils.

Results and discussion

Using 113 soils, we plotted DPS_{M3} against DPS_{ox} and observed that the European critical value of 25% DPS_{ox} corresponded to 9.5% DPS_{M3} (Fig.1), with P, Al and Fe expressed as mmoles per kg. Across 113 soils, the DPS_{M3} ranged from 1.4% to 23% with an average of 8.4%. The Mehlich 3 method is used to simultaneously extract a broad range of soil macro and micronutrients which allows the calculation of P saturation as the ratio of P/(Al+Fe) with a single step analysis. The development of DPS_{M3} provides a supplemental soil P index for assessing environmental risk that could be integrated into routine soil analysis. Above the critical value of 9.5% identified for 113 soils used in this study, the response to P fertilizers is expected to be small and P fertilizers should be applied to match crop requirements. Our critical value is comparable to those reported by Khiari et al. (2000) and by Sims et al. (2002) in coarse textured soils from 114 fields in Quebec and 465 soils in Atlantic USA, respectively. During the 2013 growing season, marketable potato yields were not affected by P fertilizer rates at 10 out of 13 experimental sites (data not reported). Responsive sites have $DPS_{M3} \leq 4\%$.

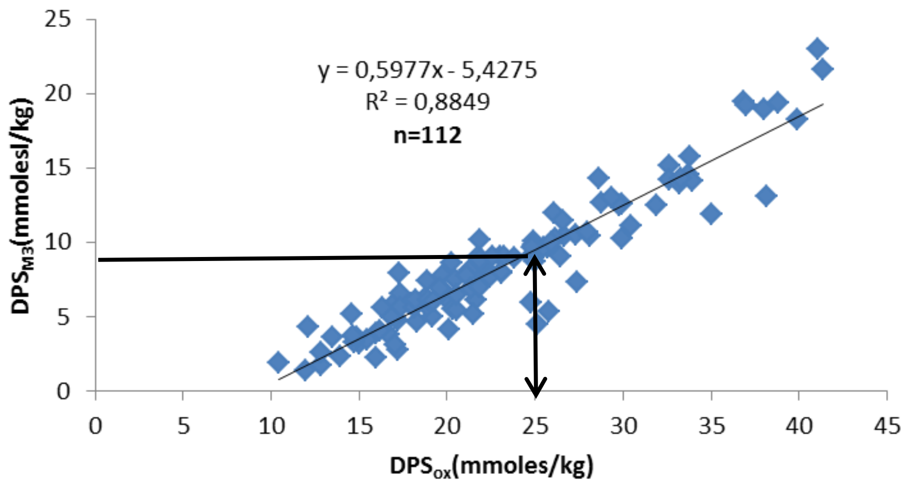

Figure 1. Linear relationship between degree of phosphorus saturation using ammonium oxalate (DPSox) and degree of P saturation using Mehlich3 [DPS_{M3} (mmoles/kg)=$P_{M3}/(Al_{M3}+Fe_{M3})$ x 100] to derive the critical DPS_{M3} value corresponding to the European critical DPSox value of 25%.
DPS_{Ox} (mmoles/kg)= ([P_{ox}] :α[Al_{ox} + Fe_{ox}]) x 100; α was equalled to 0.5 (Sims et al. 2002). N=112: 99 soils were selected from PEI Department of Agriculture and Forestry soil archive and 13 soils were from fields trials used in 2013 to assess potato response to P fertilizer rates.

Conclusions

This study identified a threshold DPS_{M3} of 9.5% above which crop response to P applications is expected to be small. When DPS_{M3} levels are greater than 9.5%, P fertilization can be reduced to match the crop requirements to minimize the risk of P loss. No statistically significant effect of P fertilization was observed on potato marketable yields in 10 of the 13 field trials conducted in 2013. Additional field trials are planned for the 2014 and 2015 growing season to further validate potato P requirement changes over sites and years in relation to DPS_{M3}.

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Genomics-Based Approaches for Detection and Identification of *Ralstonia solanacearum* race 3 bv 2

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For more than a century, *Ralstonia solanacearum* (Smith, 1896) Yabuuchi et al. (1995) species complex has been one of the most economically important phytopathogenic bacteria because of its lethality, complex host profile, worldwide distribution and persistent survival in soil and waterways. This bacterium causes vascular wilt in more than 200 plant species belonging to over 54 families in tropical and subtropical regions (Hayward, 1991; Cellier and Prior, 2010). *R. solanacearum* race 3 biovar 2 (R3Bv2) strains, which cause brown rot and bacterial wilt of potato, Southern wilt of geranium, and bacterial wilt of tomato and other solanaceous crops, were classified as phylotype II sequevars 1 and 2 on the basis of phylogeny of endoglucanase gene sequences. Different from other strains of the *R. solanacearum* species complex, R3Bv2 strains have adapted to a temperate climate, and have caused significant losses to the potato industry throughout Europe during the last decade. Latently infected geranium cuttings from Kenya and Central America were believed to be the cause of substantial damage in greenhouse-grown crops in Belgium, Germany, the Netherlands, and the United States (Swanson et al 2005, Denny 2006). So far, the commercial movement of infected, generally asymptomatic, planting material represents the most significant route by which the pathogen has spread on a global scale. Eradication becomes difficult or impossible once the bacterium is established in local soil and irrigation systems. Strict quarantine regulations are applied in many countries for *R. solanacerum* R3Bv2. As a result, *R. solanacearum* R3Bv2 is considered to be a quarantine pathogen in Europe and Canada, and is listed as a select agent in the US Agroterrorism Protection Act of 2002.

In this study, draft genome sequence of *R. solanacearum* R3Bv2 NCPPB909 was decoded using paired-end Illumina HiSeq sequencing technology with TrueSeq V3 chemistry (National Research Council Canada, Saskatoon, Saskatchewan, Canada). A total of 27,309,024 reads, totaling 2,758,211,424 bp, were obtained from 300 bp inserts to provide approximately 475X genome coverage. After quality checking and initial *de novo* assembly using ABYSS (Simpson et al. 2009), the final draft genome size is 4,563,671 bp consisting of 1,558 contiqs. The G+C content of draft genome is 65.5%. Annotation was conducted on the RAST server using the Glimmer 3 option (Aziz et al.

2009) and predicted 4,071 protein-coding genes, including 75 noncoding RNA genes and 158 possibly missing genes. A number of predicted virulence related factors, phage-related loci, motility and chemotaxis genes were identified in the genome (Fig 1), which may facilitate its specific pathogenicity in specific environment.

Comparative genomics analysis of *R. solanacearum* R3Bv2 NCPPB909 (Phylotype II), GMI1000 (Phylotype I), CMR15 (Phylotype III), PS107 (Phylotype IV), was executed using MAUVE (v2.3.1). Detailed comparisons with UW551 (Phylotype IIA), CFBP2957 (Phylotype IIA), Molk2 (Phylotype IIB-3), and Po82 (Phylotype IIB-4) for hypervariable regions are included in Table 1. Twenty four different loci were classified as INDEL rich and hypervariable regions bearing pathogenicity related factors (Table 1), among which, eleven loci have unique sequences for developing primers/probes for specific real-time PCR assays. Further evaluation of selected primers/probes indicated that at least 3 pairs of primers/probes demonstrated high specificity against all *R. solanacearum* R3Bv2 strain tested, and one pair of primers/probe can differentiate all pathogenic R3Bv2 strains tested from a single non-pathogenic R3Bv2 strain. These primers/probes are suitable for further evaluation as highly specific assays for detection and identification of pathogenic *R. solanacearum* R3Bv2 strains. Further analysis of these strains and available genome sequence data with their associated hosts and geographic origins will provide detailed insight on virulence, functionality, and plant/pest interactions of this widely distributed regulatory pathogen.

Acknowledgements
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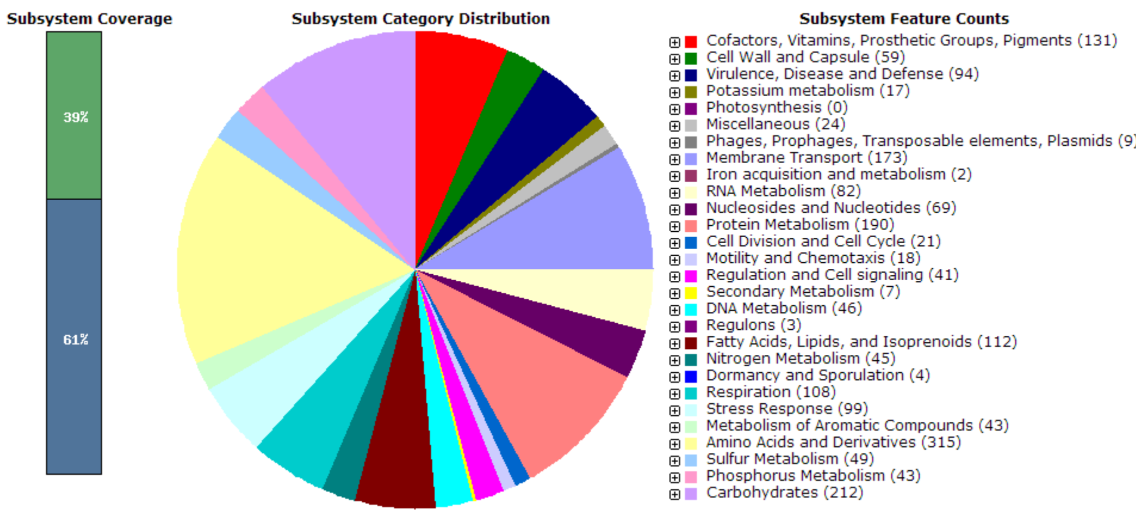

Fig1. Genome annotation for *Ralstonia solanacearum* strain NCPPB909

Table 1 Pathogenicity related hypervariable regions of *Ralstonia solanacearum* race 3 bv 2 (Phylotype II) strains based on comparative genomics analysis

PhyII genomes comparison focus on variable regions of PhyIIB					
Contiq	909/UW551 (IIB-1)	CFBP2957 (IIA)	Molk2 (IIB-3)	Po82 (IIB-4)	Notes
S1	15-42681	variable: shortest	≈ Po82: shorter		1-1577: R3bv2 specific
S11	1-17239: longest	≈ Molk2≈Po82: shorter			5075-17239: R3bv2 specific
	17408-19218	missing	missing	missing	R3Bv2 specific
S19	311-8732	missing	missing	missing	R3Bv2 specific
S38	22-11745	missing	missing	missing	R3Bv2 specific
S63	9713-10247	missing	missing	missing	8572-11745: R3bv2 specific
S73	1-9980	missing	missing	missing	1-855: R3bv2 specific
S88	37-7924	missing	missing	missing	3507-5029&6926-7908: R3bv2 specific
S138	32-1660	variable: longer	missing	variable: longest	1-1153: R3bv2 specific
S145	10-6031	tiny fragments	inserts/deletes:longest	missing	3154-5332: R3bv2 specific
S161	157-6136: variable	variable: shorter	shortest	inserts: longest	301-1442&4641-6023:R3bv2 specific
S253	8-4640	missing	missing	missing	301-3827: R3bv2 specific
S261	36-4724	missing	missing	missing	305-4419: R3bv2 specific
S265	5-3822	missing	missing	missing	1033-3259: R3bv2 specific
S286	3587-4499	tiny fragments	missing	missing	3443-4408: R3bv2 specific
S292	111-4447	missing	missing	missing	112-4253: R3bv2 specific
S411	478-3383	longest	missing	inserts/deletes vs CFBP2957	1571-2635: R3bv2 specific
S441	15-3187:	missing	missing	missing	632-3078: 909 specific
S519	13-2707	missing	missing	missing	261-1820: R3bv2 specific
S577	7-3038	missing	missing	missing	916-2044: R3bv2 specific
S798	7-1649	missing	missing	missing	165-1441: R3bv2 specific
S1059	302-788	missing	missing	missing	909 specific
S1265	304-619	missing	missing	missing	909 specific
S1488	1-449	missing	missing	missing	909 specific

Foliar Metabolites Associated with Colorado Potato Beetle Resistance

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The Colorado Potato Beetle *Leptinotarsa decemlineata* (Say) (CPB) is a coleopteran herbivore that feeds on the foliage on *Solanum* species, in particular, potato. Six resistant wild *Solanum* species were identified and two of these species had low levels of glycoalklaoids. Comparative analysis of the untargeted metabolite profiles of the foliage from the wild species and *Solanum tuberosum* was done to identify resistance-related metabolites. Hydroxycoumarin and a flavonoid were identified in all of the wild species but not *S. tuberosum*. *S. tuberosum* produced the triose glycoalkaloids Solanine and Chaconine that were not found in the wild species. Instead the six wild species produced a number glycoalkaloids that shared in common tetrose side chains.

Variable-width Buffers to Reduce Water Course Pollution from Potato Production on Steep Slopes: An Analysis of the Black Brook Watershed using AgBufferBuilder

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Intensive agricultural production uses tillage, fertilizers, and often pesticides to obtain profitable yields. Particularly when land is sloped, intensive row crop production, such as potato production, leaves soil vulnerable to erosion by water, carrying sediment, nutrients and pesticides into surface waters. Riparian buffer zones mitigate the effects of water pollution by slowing surface water flow, using excess nutrients for buffer plant growth, and delaying the entry of pesticides into waterways and thereby allowing them time to degrade to less harmful forms. Many provinces in Canada, including New Brunswick, have mandatory setbacks of fixed-width to be maintained between cropped field area and waterways. While fixed-width buffers are easier to regulate than variable-width buffers, they often provide too much or too little mitigation, depending on the topography of the terrain. Variable-width buffers, afford an opportunity to increase efficacy by putting the buffers where they can be of greatest benefit. Farmers are reluctant to invest land and dollars into buffers if they are not seen as effective or necessary. A tool that could advise them on where their investments would provide the greatest environmental mitigation would help them to improve environmental performance at less cost. If an effective tool were available for the design of variable-width buffers, regulators would also have greater freedom to step out of the “one size fits none” solution offered by fixed-width buffers.

Mike Dosskey, a riparian ecologist with the USDA’s Forest Service has developed a software program based on a US mid-west context, to use a GIS approach to analyzing agricultural fields and designing variable-width buffers that put buffers where they will provide the desired mitigating effect. The software can also analyze existing buffers and evaluate their efficacy. This tool, used primarily as a research tool to date, offers an exciting opportunity to allow farmers and their agrologists to design for their farm topography, minimize cost and maximize pollution mitigation.

Research is underway to use the Black Brook Watershed, an instrumented watershed in New Brunswick's "Potato Belt" with more than 15 years of data on Best Management Practice implementation and water quality monitoring in former projects, as a context for a first look at using AgBufferBuilder to analyze the existing buffers and their theoretical efficacies, and how they differ from buffers proposed by the software to achieve a theoretical efficacy of 75%. First results on a field by field basis revealed numerous examples where buffers are largely ineffective. In one case, for example, existing buffers were analyzed and found to be just 9% effective, whereas AgBufferBuilder suggests a design that would use less area and give 47% pollution mitigation. These numbers point to a real possible economic advantage for farmers who could plant for greater efficacy at less cost, improving their environmental performance, profitability and competitiveness. Using AgBufferBuilder to analyze the five sub-basins of the watershed reveals how the software might be better used to examine buffers at a local landscape level. In addition, the second stage of the project, validation of the software using the historical data from the watershed, is discussed.

Impacts of Top Kill Date and Storage Temperatures on Physiological Age and Yield in Russet Burbank

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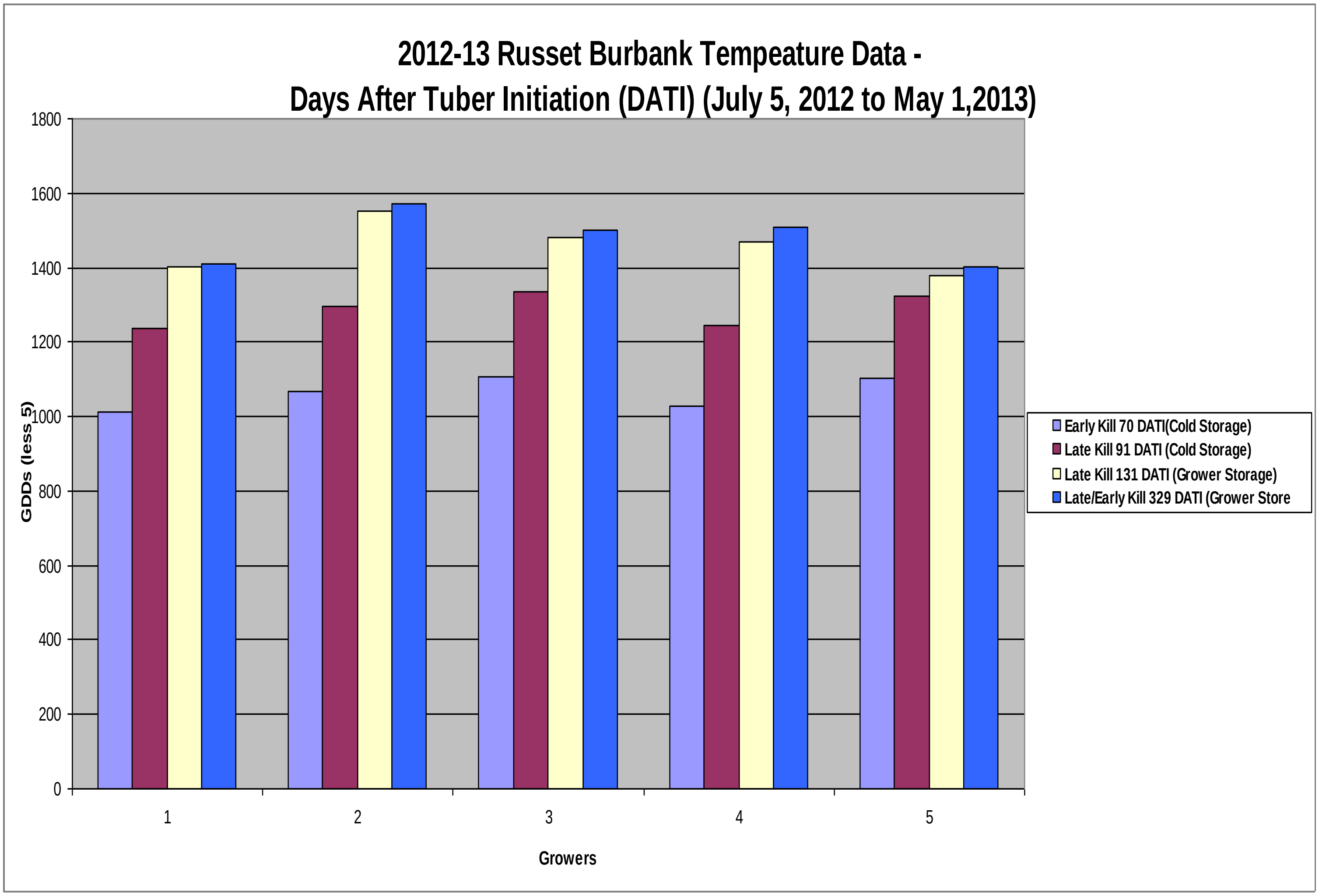
Steve Watts P.Ag. – Genesis Crop Systems

The research trial was initiated in the summer of 2012 to evaluate the effect of the top kill date and storage temperature on physiological age accumulation and subsequent yield of Russet Burbank seed potatoes. Watchdog temperatures recorders were placed above ground and about 6" below the soil surface at each of the six Russet Burbank fields at tuber initiation in early July prior to tuber initiation. Early topkill was simulated at 70 days after tuber initiation while late top kill occurred at 91 days after tuber initiation. Samples from each top kill date were hand harvested at the appropriate time and placed either directly into cold storage at 4.5 ^{oC} or were left with the individual grower to be stored at their facility. The WatchDog sensors were placed in the grower storage with the respective sample. Growing degree day (base 5) accumulation was calculated for each seed lot from each field at time of harvest and then, subsequent dates during the storage phase. All tuber samples from each treatment were removed from storage May 1 and planted at 4 sites across PEI in 2013 to determine effects of top kill date and storage temperature on growth and yield of the various seedlots.
The early kill/cold storage treatment accumulated the fewest growing degree days while the late kill/grower store accumulated the most growing degree days. (Fig. 1). Although not significant in most cases, the total and marketable yields trended higher in plots (15-30 cwt/acre) planted with seed from the early kill/cold store treatments. The study will be repeated in 2014, along with the inclusion of new varieties including Shepody, Prospect, GoldRush, Dakota Pearl and Innovator.

Figure 1:


2012-13 Russet Burbank Tempeature Data -
Days After Tuber Initiation (DATI) (July 5, 2012 to May 1,2013)
GDDs (less 5)
1800
1600
1400
1200
1000
800
600
400
200
0
1
2
3
4
5
Growers
Early Kill 70 DATI(Cold Storage)
Late Kill 91 DATI (Cold Storage)
Late Kill 131 DATI (Grower Storage)
Late/Early Kill 329 DATI (Grower Store

Recent Advances in Understanding Environmental and Management Factors Affecting Spread of *Potato virus Y* in Commercial Potato Fields of New Brunswick

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The spread of *Potato virus Y* (PVY) is a major issue in many potato growing areas around the world. Earlier work by our group (1,2) had identified widely varying rates of on-farm PVY spread in commercial fields in the main potato growing regions of New Brunswick, and several management and environmental factors that may affect that spread. For this study, we sought to create a general model and suite of best management practice (BMP) recommendations by including many fields with widely different management practices, over four crop seasons with varying inoculum, vector and environmental conditions. PVY spread was monitored in 42 fields, between 2010 and 2013. In each field, 100-110 virus-free plants were identified after emergence; marked plants were monitored for PVY infection with mid-season leaf tests and tuber test after harvesting. PVY spread to initially virus-free plants ranged from 0% to 76% across the 42 fields. The PVY spread in each field was compared to detailed records of field management, rates of seed-borne PVY for each field, local aphid abundance and weather conditions during the growing season. A logistic regression model was constructed to estimate PVY spread based on seven PVY inoculum, aphid, climate and management parameters. The single strongest factor explaining on-farm PVY spread was the number of insecticide-supplemented mineral oil sprays applied through the season, with mineral oil alone causing a substantially weaker reduction in spread. Seed-borne PVY, early-season aphid abundance, high June temperatures and low numbers of days with rain in June were all significantly associated with increased PVY spread. This regression model, using only data available by the middle of the growing season at least 6 weeks before harvest, is strongly predictive of PVY status in harvested tubers (actual vs. prediction $r^2 = 0.84$). Across the four years, 20 of 42 study fields would have exceeded the new government regulatory threshold of 5% PVY for commercial seed planting, and the developed model correctly predicted whether the harvested crop would exceed that threshold or not in over 90% of the study fields. Over the past four years included in this study, on-farm

PVY spread on average has been declining, coincident with increased use of foliar-spray insecticide, later planting of the crop and shorter times between planting and first oil and insecticide sprays. Based on these observations and the statistical analysis in this multi-year field study, recommendations for best management practices to reduce PVY spread have been produced.

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Introducing the Blue Donkey Potato Plot Harvester:
From Concept to Prototype to Pre-Commercial

Steve Watts

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On farm research experiments and demonstration activities often attract more attention from commercial growers then those conducted on small scale plot work experimentation conducted at various public and private research facilities. Often, growers tend to place more confidence in the results collected from these field experiments hosted in their own back yard.

Harvest of on farm potato research plots is tedious, back breaking work and often involves hurried action to ensure that tubers are removed before commercial harvest of the site.

This presentation will review the creation of a solution from concept through to pre-commercial stage that helps address this challenge.