Twenty-second Annual

Maine Potato

Conference

24 - 25 January 2007

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Update on PCN/GN from a Regulatory Perspective

Terry Bourgoin, Export Certification Specialist
Animal and Plant Health Inspection Service

Cyst nematodes which infest potatoes, specifically the Golden Nematode (GN), *Globodera rostochiensis* and the Potato Cyst Nematode (PCN) *Globodera pallida,* are major pests of potato crops in cool-temperate areas. GN is considered to be potentially more dangerous than any of the insects and diseases affecting the potato industry. Once it is established, potato production is impractical except in long crop rotations or when planting GN resistant potato varieties. Potatoes and tomatoes are the principal crops of economic importance that are attacked by this pest. The nematode also reproduces on the roots of eggplant and on some wild solanaceous weeds. Damaging populations of the nematode develop when susceptible crops are planted in a monoculture or rotation. PCN is very similar to GN, primarily affecting plants within the potato family including tomatoes, eggplants, and some weeds. If left uncontrolled, potato cyst nematodes can cause up to 80 percent yield loss in potato fields.

Potato cyst nematodes have not been major pests in the United States and Canada because their distribution has been very limited and both governments have maintained very active and effective quarantines to prevent the spread of the pests. This situation changed significantly in 2006 with the confirmation of PCN in Idaho in April and GN in Quebec Province in August. Both the U.S. and Canadian government plant regulatory agencies took quick and stringent measures to quarantine the infested fields, to prevent the movement of any articles that could transport the nematodes to other fields, and to survey any contact, adjacent and suspect fields to delimit the infestations.

Both governments believe that the cyst nematode infestations in the affected areas have been delimited and are now considering the next steps in dealing with the infestations. The discovery of the two potato cyst nematodes has had an impact on the trade of potatoes from the U.S. and Canada, and steps are being taken to restore the confidence of the global marketplace in the pest status of the two countries. The current situation on the status of the cyst nematodes in the U.S. and Canada, and the steps that have been taken and are being considered to deal with the recent detections, will be discussed in this presentation.

Pink Rot Fungicide Options

Erica Fitzpatrick, Agronomist
McCain Foods USA, Inc.

Phytophthora erythroseptica (*Pe*) causal agent of potato pink rot is a major late season and storage disease problem in potato production. The disease has increased in incidence in recent years causing large economic losses annually. *Pe* is an especially difficult disease to manage in that growers have limited choices of fungicide products with *Pe* efficacy.

In the past, pink rot was controlled by fungicides, which essentially all contained either metalaxyl or mefenoxam, the enantiomeric formulation of metalaxyl. Mefenoxam is the active ingredient of Ultra Flourish® and products containing Ridomil®. A 2005 survey of mefenoxam resistance in Maine found 70% of the *Pe* populations to be mefenoxam resistant. The efficacy of mefenoxam in the future is in jeopardy due to the increasing number of mefenoxam resistant *Pe* populations. Several trials have indicated that that there are no alternative fungicides with efficacy comparable to mefenoxam when *Pe* populations are mefenoxam sensitive. However, trial results have shown some in-furrow treatments that reduced *Pe* rot by more than half compared to the untreated control.

A new fungicide with the trade name Ranman® (active ingredient cyazofamid) recently gained EPA approval for *Pe* control. The product was originally tested and registered for use on potatoes for late blight control. Ranman® prompted interest for *Pe* control when in 2004 and 2005 *Pe* trials in Maine and other states, Ranman® reduced *Pe* rot by more than half compared to the untreated control. These results lead to a supplemental local needs label (24C) for *Pe* control in Maine, Idaho, North Dakota, and Minnesota. The label (valid until 2010) allowed for an at planting in-furrow application of 6.1 fl oz followed by a lay-by/hilling application of 2.75 fl oz.

Phosphorous acid (H_3PO_3) compounds (trade names Phostrol®, Rampart®, ProPhyt®, Fosphite®, etc.) have demonstrated efficacy against *Pe* in some trials. Recently phosphorous acid post-harvest applications have gained attention in the potato industry. There have been conflicting results in many field trials evaluating phosphorous acid products applied at planting in-furrow and/or in subsequent foliar applications. Phosphorous acid applied at planting <u>in-furrow</u> has performed poorly, though recent research has indicated that phosphorous acid applied two to three times <u>foliar</u> beginning at tuber initiation may offer effective *Pe* control.

In 2006 fungicide trials Ranman® at various rates and combinations in-furrow and hilling as well as partnered with other materials were evaluated. In the same trial Ridomil Gold®, Phostrol® (two and three times foliar), as well as two experimental compounds (IR 5885MZ and IR 6141) were also assessed. The *Pe* levels in the Ranman® alone, as well as Ranman® partnered with either Phostrol® or Silwet® (surfactant), all in-furrow and hilling combinations at various rates did not differ in terms of diseased levels from the untreated inoculated control. Both the Ridomil Gold® and IR 5885MZ treatments did not differ significantly from the untreated inoculated control. The most effective *Pe* control was obtained with Phostrol® applied foliar two and three times (beginning at tuber initiation) with 1.7% and 0.5% rot, respectively compared to 15.3% rot in the untreated inoculated control. Overall, in this trial the *Pe* control provided by Ranman®, Ridomil Gold®, and the two experimental compounds were not effective.

In 2006 a limited number of commercial growers applied Ranman® in-furrow for *Pe* control under the 24C label. Each of those growers left an untreated control in the same field and some growers treated a portion in the same field with mefenoxam (Ridomil Gold® or Ultra Flourish®). The growers sampled included tablestock, processing and seed. In total fifty-two samples were hand-dug, all from low lying areas of each field (to select for rot if present), then stored and graded three separate times for rot. All rotted tubers were taken to the lab and properly identified (samples too badly rotted for isolations were identified as soft rot). Overall, the rot levels found in most samples were low. The differences found between treatments were minimal. The average *Pe* per Ranman® treatment was 1.2%, while the average rot in the untreated control was 1.3%. The average *Pe* rot per mefenoxam treatment was the lowest at 0.3%, though the sample size was less than the other two. Below are the combined results for all growers.

Table 1. Ranman® strip sampling results comparing untreated control and mefenoxam (Ridomil Gold® or Ultra Flourish®) treated strips from commercial grower fields.

Treatment:	No. of Samples	Total % Rot:	% Pink Rot:	% Soft Rot:	% Late Blight Rot:
Ranman®	24	3.40	1.30	0.10	1.60
Untreated Control	16	1.50	1.20	0.30	0.10
Mefenoxam	12	0.90	0.30	0.00	0.60

Considering that ~70% of the *Pe* in Aroostook County is mefenoxam resistant it is more important than ever to find an alternative fungicide for *Pe* control. Ranman® provided substantial *Pe* control in comparison to other products assessed in 2004 and 2005, though the 2006 results were disappointing. In the *Pe* inoculated Aroostook Research Farm trial Ranman® performed poorly using several different in-furrow and foliar rates in many different combinations. In the commercial grower sampling, there was essentially no difference between Ranman® and the untreated control. In the past three years (Aroostook Research Farms trials), Phostrol® applied in-furrow did not perform well. Phostrol® applied foliar has had disappointing results in the past, though this year the results were very positive. In the future it may be useful to look at different timing and application rates of phosphorus acid products applied foliar to determine the most effective practice. All three *Pe* treatments available; mefenoxam, Ranman®, and phosphorous acid products (e.g. Phostrol®) are expensive fungicide options. Though the investment is justified if the levels of *Pe* in a bad year are manageable in storage.

Colorado Potato Beetle Resistance Management

James D. Dwyer, Crops Specialist
James F. Dill, Pest Management Specialist

Colorado potato beetle resistance to insecticides has been an ongoing issue for Maine potato growers. Tolerance and resistance issues have developed with Colorado potato beetles and most of the traditional insecticides and in some locations within the State, tolerance and resistance with the newer neonicotinal materials have also become an issue.

The latest testing for resistance issues with the neonicotinal materials indicates that the resistance management plans implemented by Maine appear to be working. The 2006 resistance levels do not appear to be increasing from the 2005 levels. This is excellent news for the Maine Potato industry, and indicates that growers need to continue implementing resistance management plans.

To delay the onset of resistance to neonicotinoids:

1) Expose the beetle to the neonicotinoids once per season. If an in furrow or neonicotinoid seed treatment was used at planting, do not use any neonicotinoid formulation foliar later in the season.

2) Do not apply any insecticides below labeled rates for Colorado potato beetle control. Application of sub-lethal rates of any insecticide may result in poor product performances and an increased risk of resistance development.

3) Apply insecticides only when necessary, which is when economic damage will result. Having a few beetles in a field, below economic threshold levels, will help to preserve the genetic diversity of the population.

4) Spot treat where ever possible. This saves money and products.

5) Block rotate when ever possible. Moving potato fields at least ¼ mile away from where potatoes were planted last year delays beetles from entering the field.

As new materials become available such as metaflumizone for 2007, it will be important to implement a resistance management strategy as the product is introduced in order to maintain its useful life.

As growers select materials for foliar use the University of Maine Cooperative Extension Potato IPM program will have a screening kit available for growers which will allow growers to pre-screen several materials for efficacy.

Uptake of Nitrogen by Potatoes

Peter Sexton, Ph.D., Crops Specialist, UMCE Potato Program
Gregory Porter, Professor of Agronomy, University of Maine

This presentation will review N uptake measured in on-farm studies and also review current N recommendations used by the University of Maine Analytical Laboratory in Orono. Nitrogen uptake by 'Russet Burbank' potatoes was measured in two on-farm studies conducted in northern Maine. Total uptake, adjusted for a marketable yield of 340 cwt per acre, was 205 lbs of N per acre (Fig. 1). Average rate of uptake was 3.3 lbs N per acre per day. In these studies uptake of N continued until the crop started to senesce in early September. Current recommendations for N are given below. Note the tablestock and processing recommendations are very similar. Seed recommendations call for 10 % less N than is given for processing.

<u>Seed[a/] and Processing[b/]:</u>

Early and Low N Varieties	120 to 140 lbs per acre
Mid-Season (includes Shepody)	140 to 160 lbs per acre
Late-Season	160 to 180 lbs per acre
Russet Burbank	170 to 190 lbs per acre

a/ For seed production, decrease N rates by 10 %.
b/ For processing potatoes N rates should be reduced by 10 lbs per acre for every week the crop is planted after May 24th.

<u>Tablestock:</u>

Early and Low N Varieties	120 to 140 lbs per acre
Mid-Season	140 to 160 lbs per acre
Late-Season	160 to 180 lbs per acre
Russet Burbank, Russet Norkotah*, Superior	170 to 185 lbs per acre

* For the standard clone.

<u>N Credits for Previous Crop:</u>

Heavy clover or alfalfa – 60 lb N credit (+/- 20 lbs depending on stand; if pH is less than 5.5 assume 40 lb N).
After underseeded grains, broccoli, old sod, or non-legume green manures - 10 lb N credit.
After grain (no underseeding) – no N credit.

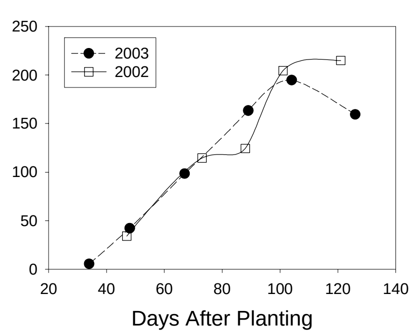


Figure 1. Nitrogen uptake over time for 'Russet Burbank ' potatoes measured in two on-farm studies. Data were adjusted to reflect a marketable yield of 340 cwt per acre.

Pineland Farms Natural Meats, Inc. Where are we heading?

Kristi White, M.S.
Feedlot Manager

Pineland Farms Natural Meats Feedlot is located in Fort Fairfield Maine. The feedlot is an expansion project for the company that started April 2006. Currently Pineland Farms Natural Meats works with other feedlots, nation wide, to meet the growing demand for its natural beef products. The term “natural” is used in this program to define a strict “never-ever” protocol. Cattle fed in this program are never fed animal byproducts in the feed, have never had growth hormones, and have never had antibiotics, from birth to harvest. Cattle are brought into the feedlot between 600 and 800 lbs, are fed a high grain diet for 200 to 220 days and then sent to be harvested at a plant in Pennsylvania. The diet is made up of barley, bakery meal, crumb meal, round bale silage, and mineral. Future plans include a five year goal of expanding to a one time capacity of 3000 to 5000 head of cattle. The goal is to work with producers in Aroostook County to purchase as many local cattle as possible, with the remainder of the cattle being purchased throughout the rest of the state as well as the northeast. Currently manure is stockpiled and then exported. A compost project is in the works to help reduce the amount of material and to produce a saleable product. The feedlot has great potential in Aroostook county.

Effect of One-Pass Hilling on Performance of Russet Burbank and Shepody Potatoes

Gilles A. Moreau[1], M. Gamache[1] and M. Everett[2]

[1]McCain Foods (Canada), P.O. Box 11400, Grand Falls, N.B. E3Z 3E3
[2]McCain Foods (Canada), 107 Main Street, Florenceville, N.B. E7L 1B2

The practice of hilling potatoes at some stage after they have emerged is common practice in most potato growing areas. Hilling is a time sensitive cultural operation often delayed due to unfavorable weather. Previous research conducted in Grand Falls, New Brunswick, between 1994 and 1996 showed that hilling Russet Burbank and Shepody anytime later than 50 days after planting can reduce marketable yield due to increased incidence of sunburn, roughs and hollow heart tubers. The same work suggested that once-over hilling at 90% emergence produced best results with Shepody. In some areas, PEI for example, it is common practice to hill the crop at emergence. In other parts of the world, planters are equipped to hill at planting. This project, conducted between 2003 and 2005, evaluates the concept of One-Pass hilling performed as soon as possible after planting in an effort to extend the window of opportunity in which this operation can be performed and avoid hilling the crop later than 50 days after planting. Crop emergence and performance was monitored and yield differences evaluated by manually harvesting paired samples from each treatment.

The project was a Field Scale Trial including both Russet Burbank and Shepody varieties, two hilling treatments and four replications. One-Pass hilling was performed on a 36-row wide field section, equivalent to one sprayer width. An adjacent section was conventionally hilled. One-Pass hilling was done 3 to 14 days after planting for Russet Burbank and 0 to 14 days after planting for Shepody. The conventional hilling treatments consisted of a first cultivation 42 days after planting followed by final hilling 47 days after planting. A Spudnik Row-Former was used for both the One-Pass and Conventional treatments.

Emergence data was collected at 3-day intervals between 23 and 45 days after planting. Measurements of seed piece depth and hill size were made immediately after hilling. Soil temperature at seed piece depth was measured at regular interval from late May to late June. For each replicate, two stems of each variety were randomly collected at five dates in each hilling treatment between mid-July and late August. Nodes were counted and observations of underground structures present were made. Underground structures observed at each node were classified as roots, stolons, tubers, leaves or non-identifiable at the time.

A Spudnik Row-Former was used in both treatments to eliminate any possible difference in hill size and shape between the One-Pass and conventional treatments that could potentially have been caused by hilling equipment. Hill measurements yielded the following dimensions - base width (bw): 27 inches, top width (tw): 11.5 inches, and internal height (ih = distance between the bottom of the seed piece and the top of the hill): 7 inches, for a Net Hill Size (NHS= ih^2 + tw*ih) of 130 square inches.

Hill measurement also provided important information regarding differences in seed piece depth between the One-Pass and Conventional hilling treatments. At planting, seed piece depth typically averaged 3 inches. One-Pass hilling, performed a few days after planting, added 2 inches of additional soil above the seed piece. As a result, seed piece depth after the One-Pass hilling treatment totaled 5 inches. Averaged over three years, One-Pass hilling delayed emergence by 2 to 4 days with Shepody and Russet Burbank respectively. Averaged over measurement dates and for both varieties, soil temperatures were 2.0°C higher in the Conventional treatment than One-Pass hilling, differences ranging between 0.9 to 3°C due to time of day, AM or PM, and 1.5°C on cloudy days to 2.7°C on sunny days.

Repeated, replicated sampling of stems from both varieties in both treatments over a five-week period indicate that plants subjected to One-Pass hilling a few days after planting had a longer underground stem which developed more nodes than in the conventional treatment. Averaged over the sampling period, Shepody developed 4.5 and 5.7 nodes and Russet Burbank 4.0 and 5.0 in the Conventional and One-Pass treatments respectively. Briefly stated, One-Pass hilling significantly increased underground node production with both varieties. This may account for the higher tuber set observed with that system. Also of interest is the fact that plants in the One-Pass hilling treatment set tubers as much as a week earlier than the conventionally hilled crop.

Analysis of the 3-year Russet Burbank data indicate that One-Pass hilling triggered the production of significantly more tubers per stem than the conventional treatment. The One-Pass hilling system also resulted in a significantly higher proportion of 10-ounce tubers, +2.6%, tubers with a significantly lower specific gravity, -1 basis point, and a significantly higher incidence of sunburn, 0.9%. While significant, these differences were small and had no effect on total yield, marketable yield and crop value. These differences would also have no practical impact on the crop's processing quality.

Three years of Shepody data show that One-Pass hilling significantly reduced the number of stems per plant but significantly increased the number of tubers per stem compared to the conventional treatment. The One-Pass hilling system also resulted in a significantly lower proportion of small tubers, -1.1%, and significantly increased total yield.

In summary, One-Pass hilling before emergence had no detrimental effect on crop performance and broadens the window of opportunity to perform this most critical, time sensitive operation, possibly avoiding late hilling which damages the crop's root system, tuber set and quality.

Potato Jeopardy – An Interactive and Participatory Game

Steven B. Johnson, Ph.D.
Crops Specialist
University of Maine Cooperative Extension

Merv Griffin's idea for the game show *Jeopardy!* reportedly rose from the quiz show scandals of the late 1950's where producers were giving answers to some of the contestants. This was to increase the excitement with big winners and thereby increase the interest of viewers and sponsors. Merv's idea was to give the answers to the contestants and have them come up with the questions. In fact, the original pilot for the show was titled "What's the Question?" *Jeopardy!* first ran in 1964 to 1975 and has been revived and 1978 and again in 1984 with the format of today. This format has been borrowed and categories of Diseases, Insects, Agronomy, and Take a Chance. Host Alex Trebek and announcer Johnny Gilbert were unavailable for this presentation.

Trends and Changes in the Populations of Potato-Colonizing Aphids in Maine

Andrei Alyokhin, Ph.D.
Assistant Professor of Entomology
MAFES

Potato aphid (*Macrosiphum euphorbiae* (Thomas)), buckthorn aphid (*Aphis nasturtii* Kaltenbach), green peach aphid (*Myzus persicae* (Sulzer)), and foxglove aphid (*Aulacorthum solani* (Kaltenbach)) colonize potato plants (*Solanum tuberosum* L.) in Northeastern U.S. and Canada. Populations of these species vary widely between the years. We analyzed trends in a long series of data collected between 1949 and 2003 from the untreated control plots set up as a part of potato insecticide trials at the University of Maine Aroostook Research Farm, Presque Isle, Maine.

There was a significant change in the abundance and composition of aphid community over the years. Overall, there was a significant trend towards reduction in aphid numbers. Foxglove aphid, a fairly common species in the 1950's, virtually disappeared in the late 1960's. Similarly, buckthorn aphid used to be a dominant species during some of the earlier years. However, its populations experienced a significant reduction starting in 1995. Green peach aphid populations experienced a similar reduction in 1991. Periods of comparable low density were observed during earlier years of the study, but none of them lasted as long as the last decline. No such change was apparent for potato aphids.

Although its exact causes remain unknown, we suggest three hypothetical explanations for the observed phenomenon. First, the lady beetle community in northeastern Maine experienced a recent dramatic alteration following the introduction of two alien coccinellid species *Propylea quatordecimpunctata* (L.) and *Harmonia axyridis* (Pallas). Both new species are considered to be voracious aphid predators and economically important biological control agents. Their establishment largely coincided with reduction in populations of buckthorn and green peach aphids.

Secondly, in the mid-1990s the majority of commercial potato growers in northeastern Maine and adjacent areas stopped making repeated foliar applications of broad-spectrum insecticides to their crops for aphid and Colorado potato beetle control. Those were mostly replaced with neonicotinoid insecticides, usually applied at planting in the seed furrow or as a seed treatment. This switch allowed achieving good control of potato-colonizing aphids while having little direct impact on aphid natural enemies. Buckthorn aphid was likely to have a particularly strong response to neonicotinoids because it starts colonizing potato plants early in the season when concentration of these chemicals in plant tissue is the highest. Therefore, it is possible that the trend observed on the untreated experimental plots at least partially reflected area-wide decline in the numbers of potato-colonizing aphids, and/or area-wide increase in the numbers of their natural enemies.

Finally, throughout the study period there was a trend towards warmer weather. This might have also affected populations of buckthorn aphids and potato aphids. However, our statistical analyses did not reveal significant temperature effects on the population oscillations of either species. Furthermore, both species are known to inhabit areas with warmer conditions compared to northeastern Maine. Therefore, they should have been capable of adapting to such a change.

From the practical point of view, decline in aphid populations is certainly a good development for potato growers. This is particularly important in regard to the green peach aphid, which is a very efficient vector of potato leafroll virus. If we find out the reasons for the observed decline, it might allow us to prevent future recovery of aphid populations.

This work would not be possible without detailed annual insecticide efficiency reports prepared and archived by W. Shands, G. Simpson, and R. Storch. We also thank R. Jardine for technical assistance during the last 40 field seasons, and C. Theriault for help with entering and summarizing the data.

USDA GAP – It is Coming for Everyone

Steven B. Johnson, Ph.D.
Crops Specialist
University of Maine Cooperative Extension

Passing a GAP or Good Agricultural Practices certification audit with an 80 percent or higher score will be required for potatoes and other fresh products purchased under USDA feeding and nutrition programs on July 1, 2007. GAP certification is verification of practices on the farm that minimize microbial contamination in the production of fresh fruits, vegetables and tree nuts. The USDA GAP audit consists of verifying compliance with General Questions and some or all of part 1 through part 7 questions. Most potato growers will need to pass the General Questions, Farm Review (part 1), Field Harvest and Field Packing (part 2), and Storage and Transportation (part 4).

The General Questions confirm the implementation of a basic food safety program. The Farm Review questions confirm mitigation of hazards associated with land use and water. The Field Harvest and Field Packing questions verify the implementation of precautions and practices that mitigate microbial contamination during harvest and field packing. The audit for Part 4 needs to be conducted during harvest when harvest crews are operating.

While this immediately affects those with fresh or processing potatoes destined for USDA commodity programs such as school lunch, I anticipate that sellers and marketers of fresh potatoes will soon follow suit with a similar requirement.

University of Maine Cooperative Extension is developing training materials and programs targeted for potato growers to fulfill this USDA requirement. Upcoming training programs will aid the Maine potato grower in becoming USDA GAP certified. The certification is valid for one year. Certified USDA produce inspectors will conduct the USDA GAP audits.

Field Stresses that affect the Chemical Maturity (CM) of Potatoes

Joe Sowokinos, Professor
University of Minnesota, Department of Horticultural Science

- Definition of Chemical Maturity (CM) = When the concentration of sugar in a potato tuber is no longer decreasing

- The major sugar found in a growing potato is sucrose (12-carbon, non-reducing)

- Definition of Physical Maturity (PM) = When optimum yield, specific gravity, tuber size, are obtained along with a firm skin set

- To determine the CM of a potato…the concentration of sugars themselves must be measured

- Factors that affect the final level of CM that a potato field reaches is influenced by:

  Variety, Planting date, Growing location, Soil fertility, Disease,
  Cultural practices, and Environmental conditions

- What happens to excess sucrose in a chemically immature potato following vine death (induced or natural) or following harvest?

  It is converted to the two 6-carbon reducing sugars glucose and fructose by the action of the enzyme invertase:

  e.g. Sucrose ⟶ Glucose + Fructose

- What level of sugars do we want in a harvested chipping or French fry potato?

Chips:	Sucrose	1.0 mg/g FW & Glucose 0.35 mg/g FW
French Fries:	Sucrose	1.0 mg/g FW & Glucose 1.0 mg/g FW

- The Yellow Springs Instrument (YSI) is used to measure the CM of potato tubers

- Chemical Maturity Monitoring (CMM) helps aid the following decisions…

  When to suspend irrigation to ensure low sugars
  In deciding if and when to vine-kill
  To determine which fields to harvest first
  If a short pre-conditioning period is necessary in early storage

CMM can be used to Increase the Processing Life of Potatoes in Storage

Joe Sowokinos, Professor
University of Minnesota, Department of Horticultural Science

- When can CMM be used to help make management decisions?

    1. Pre-harvest
    2. Pre-conditioning, early storage
    3. Long-term holding in storage

- Pre-harvest CMM timing and application

    1. Run 3-4 weeks prior to harvest
    2. Assists in timing of vine-kill
    3. Aids in determining field harvesting schedules
    4. May indicate the need for a pre-conditioning period of sugar adjustment in early storage

- What storage parameters can be used to adjust sugar content in potatoes?

    1. Temperature
    2. Ventilation

- What temperatures should be used in storage?

Pre-conditioning:	56 to 60 F (4 to 6 weeks)
Intermediate holding:	48 to 52 F (1 to 3 months)
Long-term holding	42 to 46 F (4 to 8 months)

- Potato storages need outside air to replenish oxygen supply for normal respiration processes to proceed

- During wound healing and suberization of potatoes in early storage, CO_2 levels should not exceed 1% for more than 2 days.

- Throughout the major storage period, CO_2 levels should not exceed 0.1 to 0.2%

- The <u>double barrel approach</u> is used to regulate SAFE levels of sugars in storage

- In storage the concentration of sucrose should never increase above 1 mg/g FW

- Chemical Maturity Monitoring (CMM) helps aid the following decisions…

- …Which bins to process first…which last…are storage conditions stressing the potatoes?...when potatoes are approaching irreversible, senescent-sweetening

Sugar Testing and Potato Processing Quality in Maine

Gregory Porter, Professor of Agronomy and Paul Ocaya, Research Associate
Department of Plant, Soil & Environmental Sciences
University of Maine, Orono, ME 04469-5722

A potato tuber serves the plant primarily as a long-term storage site for carbohydrates. Starch represents the majority of the carbohydrates stored in tubers, while sugars such as sucrose, glucose, and fructose make up a small fraction of the stored carbohydrates. Chipping potatoes might typically contain around 23% dry matter, 16% starch, and less than 0.035% glucose. In potato processing, reducing sugars (e.g. glucose and fructose) take on a level of importance which is much greater than their relative concentration because during frying these sugars participate in a reaction which results in dark fry color. This reaction, known as the "Maillard Reaction", occurs when reducing sugars, amino acids, and other compounds are combined together under high temperatures. Starch and sucrose do not directly participate in the Maillard Reaction, but under some circumstances the starch and sucrose in potato tubers can be converted to glucose and fructose, which do result in dark fry color. For example, this conversion typically occurs in potato tubers that are exposed to cool storage temperatures. Most potato varieties will develop increased sugar concentrations if stored at 45F or lower.

Potato growers and processors are interested in tuber sugar concentrations because of the important role that the sugars play in determining fry color. Fry color and tuber sugar levels can provide useful information that can be used to help store and market the crop. Since 1995, the University of Maine's Aroostook Research Farm has provided a fry color evaluation and sugar testing service to the Maine Potato Industry. We typically analyze between 600 and 1000 samples per year. The service is available on a 14-day schedule to allow us to complete our other research duties and so that growers know when to drop off samples for analysis. Growers deliver labeled 10-tuber samples according to the 14-day schedule. It is best if we receive the samples first thing in the morning. We accept samples for either French fry or chip processing. The sugar testing procedure is the same for chipping and French fry potatoes, but the fry color evaluation procedures differ for the two markets. In either case, our research staff slices the tubers and measures fry color with an Agtron M35 instrument. We homogenize a 200 g sample of the tubers. The sucrose and glucose concentrations of the homogenate are measured with a YSI 2700 Select Industrial Analyzer. The results are converted to a tuber fresh weight basis and reported to growers within 24-48h via FAX. At this time, funding for the testing program is provided primarily by the Maine Potato Board and University of Maine. Due to the expense involved, we may eventually have to shift to a fee for service. As of January 12 of this year, 350 chipping samples and 60 French fry samples have been submitted for analysis.

In general, tubers with high glucose concentrations tend to produce darker fry color; however, the relationship between average glucose concentrations and fry color is not a perfect for several reasons. One reason is that glucose is not the only tuber constituent which is involved in the Maillard Reaction (e.g. fructose, amino acids, etc are also important). Another problem is defect areas (e.g. bruised or diseased areas of a tuber, sugars ends, etc) that can cause of poor fry color are not always part of the sampling area for the sugar analysis. Despite these limitations, the tuber concentrations of glucose and sucrose can provide a good measure of the physiological status of tubers in storage. When combined visual evaluations of fry color it can provide useful information for storage management and marketing, particularly if measured at routine intervals over time. Sampling over time allows the user to determine whether sugar concentrations are increasing, decreasing or holding steady in response to the storage conditions.

The major factors that influence tuber sugar concentrations and fry color are growing season, cultivar, and storage management. Fertilization practices, diseases, and other management practices can also have an effect. Each year, we conduct several management experiments to help us better understand how to assure good processing quality under a range of cultural practices and growing conditions. These studies are used to help us better understand how field management affects processing quality from storage. As an example, studies that we conducted with Shepody during the 2004-2005 and 2005-2006 storage seasons demonstrate that while storage temperature has the greatest effects on tuber sugars and fry color, nitrogen fertilizer rates can also have an effect. In these studies, low nitrogen rates were associated with lower tuber glucose concentrations, higher sucrose concentrations, and lighter fry color.

Managing for Quality French Fry Potatoes Out of Long-Term Storage

John Walsh, Potato Storage Specialist
McCain Foods Limited

Other than the 6-8 weeks immediately after harvest, long-term storage into the spring and summer presents the most challenges to a storage manager. Temperatures are rising and the potatoes are aging, which can lead to issues with CO_2, sugars, shrink, and tuber diseases.

The biggest challenge in un-refrigerated storages is maintaining temperatures. The pile is eventually going to warm up, so the trick is to keep the set temperature close to the pile temperature as it rises. By mid-May most of the cooling hours will be at night, so it is important to take full advantage of the cooling air when it is available. Periodic flushes during the day will help keep CO_2 under control when cooling air isn't available.

Sugars are also more prone to changes during the spring and summer, especially if the pile temperature rises. One risk is senescent sweetening, which will show up first as a dramatic rise in sucrose rating. That is why it is important to do regular sugar and fry color tests at this time of year.

Relative humidity becomes more important too, mostly because the higher temperatures during cooling hours result in greater dilution of the return air. At certain times this dilution will lead to a lower relative humidity going into the main plenum. Keeping the humidity above 90% until the potatoes are delivered will reduce shrink and help prevent pressure bruise.

Something else to consider is that diseases that were present before the pile was cooled down may have become dormant during the winter. Once the pile warms up they can become active again. Not only could that lead to potential rot problems, but disease organisms release CO_2 and other gases that can stress the potatoes and cause quality loss.

Refrigeration makes it much easier to maintain long-term storage temperatures. In fact, anyone storing contract potatoes beyond early June must now have refrigeration available. And although refrigeration reduces some of the issues associated with long-term storage, it is still important to maintain a high relative humidity and flush CO_2 to keep the tubers firm and the air fresh.

Update on Research Storage Projects

Stephen Belyea
Storage Engineer
PMIF, MDFAFF

The Maine Potato Research Storage provides an excellent facility for new and ongoing storage research projects. Each bin and locker is fully utilized, with multiple projects being conducted in most bins and lockers.

Lockers are used for storage of small volume lots in wood or plastic crates and mesh or paper bags. Each locker is maintained at a specific temperature at high relative humidity with constant low volume airflow. New varieties are being tested for chipping color, overall cooking quality, after cooking darkening. New and standard varieties are being subjected to bruise testing for variety and fertilizer trials. There is a test on post harvest treatments for late blight control being conducted. Maine's late blight seed screening program is using locker 5 for seed lot evaluations.

The five bins are filled with Russet Burbanks and are being utilized for several projects, including: rapid cool down effects on weight loss and processing quality; the use of ethylene as a sprout inhibitor; comparison of Amplify and CIPC on tuber weight loss, processing quality, and sprout control; and a study of ozone for control of Fusarium, soft rot, and silver scurf.

Environmental Factors Influencing Hollow Heart Incidence

Peter Sexton, Ph.D., Crops Specialist, UMCE Potato Program

Hollow heart is the occurrence of a cavity or series of cavities along the center of the tuber. The flesh around the cavity is sometimes brown in appearance. Hollow heart may occur early or late in tuber development. Hollow heart is often thought to be preceded by brown center. One theory to explain hollow heart is that it is associated with stress that slows tuber growth and/or withdraws nutrients from the tuber, resulting in injury or death of some cells in the middle of the tuber. When the stress is relieved, the return of favorable conditions results in rapid tuber growth which causes a gap or separation to develop around the injured cells. This disorder is more likely to occur on larger, more rapidly growing tubers. Some conditions that are thought to promote hollow heart are noted below:

- Cool weather resulting in soil temperatures less than 55 F for a 5 to 7 day period during tuber initiation and early bulking.

- High soil moisture (greater than 80 % available soil water) may increase both brown center and hollow heart. Excessively wet soil during tuber initiation increases the likelihood that soil temperatures will be cold, and may decrease oxygen availability to the tuber. Wet soil in the fall may increase incidence of bud-end hollow heart.

- Large applications of N at or shortly after tuber initiation may stimulate tuber growth rate and enhance development of brown center and hollow heart.

- Uneven and/or wide plant spacing increases the likelihood that the crop will develop tubers with hollow heart.

- Low soil Ca may make tubers more prone to development of brown center and hollow heart.

Late Blight Management Options for 2007

Steven B. Johnson, Ph.D.
Crops Specialist
University of Maine Cooperative Extension

Late blight was present from at least Houlton to Van Buren on both sides of the border during the crop season 2006. There was a lot more late blight going into harvest that most people realized. I expect late blight present in seed tubers in storage. As a consequence, late blight seed testing will be conducted (and required in some instances) again this winter. For the 2007 crop season, I expect late blight will be present on both sides of the border; that late blight will be present in seed tubers; and that cull piles and volunteers will be present. As a result, I am continuing the concept of late blight risk factors. Late blight risk factors include presence of late blight in the region, area or farm last season. Additional risk factors include the presence of cull piles, if 18 severity values has been reached or if weather forced longer spray intervals than recommended. Three or under risk factor values would indicate an OK situation, four to six would be risky and over six would be a dire situation.

The season is broken down into five periods: ≤ 6/15 – 6/31, 7/01 – 7/15, 7/16 – 8/15, 8/16 – 8/31 and 9/01 – ≥ 9/15. As the potato plant changes during these growth periods, so does the damage potential for tubers and foliage from late blight. Likewise, the control target, control tactic and control key will change. The control target starts the season off with initial inoculum with seed treatments, where cull pile eradication and volunteer control are critical. As the plants slow down growth toward the middle of the season, the control key becomes the rate of spread of the epidemic. Proper fungicide timing and rate and coverage of new growth become major focuses during this period. Toward the end of the season, the maximum disease proportion becomes the key control target. This would relate to killing portions of the field or perhaps the entire field early. In a similar fashion, the control tactic changes from coverage of new growth early in the season to replacing eroded material in the middle of the season to protection of tubers toward the end of the season. The control key during these phases changes as well. The timing of application is a control key early in the growing season. During the slowing of grow middle of the season, the rate of material is an important consideration to replace eroded material. As the season winds down, the choice of material targeting tuber protection is a control key.

Effects of long-term management on soil-borne diseases.

David Lambert, Ph. D.
Dept. Plant, Soil and Env Sci,
Univ. Maine

The Potato Cropping (Ecosytem) Project was established at Aroostook Farm in 1991 to study long-term management effects on potato production, weeds, insect pests and diseases. Data is derived from 96 plots (85’ by 16 rows). The study is replicated in four blocks, and is duplicated in time (half the trial repeats in even years the previous odd year treatments). From 1991 to 1997, half the plots were amended with substantial amounts of potato compost and cattle manure to improve soil texture, moisture-holding capacity, and nutritional value. Since 1998, these plots receive sufficient manure to provide some of the potato cop’s nutritional requirements and to maintain soil organic matter levels. Over this latter period, the experiment includes several cropping sequences. These include two treatments on 2-yr rotations (potato-barley and potato-soybean-potato-barley) and a 4-yr rotations (potato-soybean-barley-alfalfa) which includes two pest management (IPM vs “eco-friendly”) treatments.

The organic amendments applied have substantially altered most soil properties in treated plots, increasing soil organic matter from 2.7 to 4.9%, increasing soil moisture by 15-20% and raising average pH from 5.3 to 6.0. To determine what effects these changes and the various crop rotations might have on soil-borne diseases, the plots have been monitored over much of the study. There has been no consistent amendment effect on the incidence of Rhizoctonia on either the underground stems or the stolons, although in certain years significant differences (positive and negative) have occurred. Incidence of common scab has been greater in the amended plots, a consequence of the difference in pH. White mold occurs in some years, and has gradually increased in the amended plots relative to the unamended plots, partially related to higher soil moisture. Powdery scab has consistently been several-fold higher in amended plots for much the same reason. Silver scurf (+ black dot?) on tubers has not been affected by amendment. In contrast to white mold and common scab, powdery scab in the past two years has become several-fold higher in the 2-yr rotations than in the 4-yr rotations. Whereas the powdery scab organism requires potato as a host, *Sclerotinia* (white mold) may use other rotation crops and *Streptomyces* (common scab) has the ability to subsist on organic debris.

Options for Reducing Erosion and Phosphorus Losses in Potato Systems

Tim Griffin, Wayne Honeycutt, and Gordon Starr
USDA-ARS New England Plant, Soil and Water Laboratory

Matt Williams
University of Maine Cooperative Extension

Growing long-season potatoes in a short-season environment makes soil conservation a challenge. Potatoes leave little residue after harvest, and this leaves soil uncovered from October until May or June of the following year. Several management options are either currently in use or being considered that could substantially improve soil conservation during these periods, including: interseeding small grains prior to potato harvest, application of mulch (straw or hay), and application of polyacrylamide (PAM), a polymer that binds soil particles together. We used a rainfall simulator to establish the relative effectiveness and efficacy of these management options, directly measuring both sediment loads and phosphorus (P) movement. This included experiments both in the greenhouse and in the field.

The objective of the greenhouse experiments, which used field soil packed into boxes and exposed to rainfall, was to evaluate different rates of mulch, barley interseeding, and PAM application. Straw mulch was added to soil at rates equivalent to 0, 600, 1200, 1800, 2400 and 3000 lb/acre. Barley was planted at rates from 0 to 300 lb/acre, and PAM was applied at rates from 0 to 20 lb/acre. Rainfall was then applied at a rate of 3 inches/hour (a very hard rain) until 30 minutes of continuous runoff occurred. This was repeated three or four times for each set of treatments.

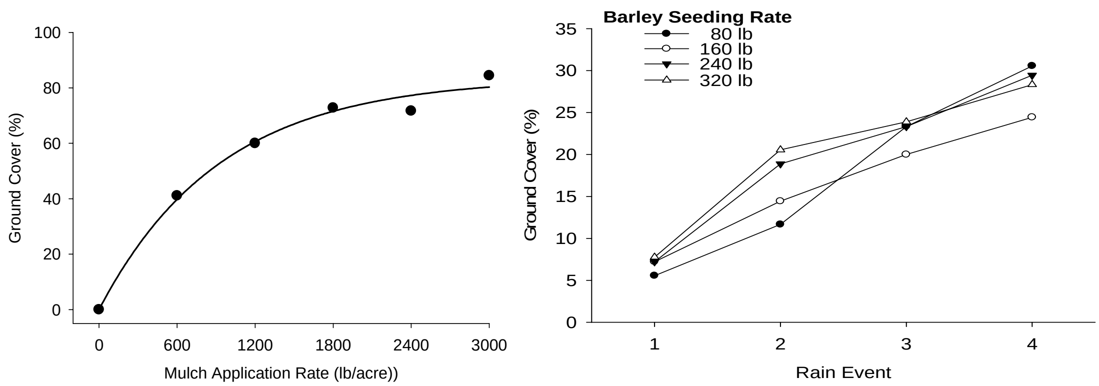


Figure 1. Effect of mulch application rate (left) and barley seeding rate (right) on ground cover.

For applied mulch or growing barley, the key to reducing erosion is ground cover. The amount of ground cover in these experiments is shown in Figures 1 and 2 (below). The barley grew during the experiment, but higher seeding rates resulted in smaller plants. Even at the higher rates, ground cover from barley was less than 40%.

Most of the P lost during erosion is attached to soil particles, so data are provided here just on sediment movement during the rainfall events. The movement of sediment is directly controlled by ground cover, as shown below. As shown in Figure 2, higher mulch rates reduced soil movement by up to 90% (this is total soil loss for four rainfall events). Rainfall simulations in the field, using mulch at 1500 lb/acre, gave similar results. Barley also reduced erosion, but to a lesser extent because ground cover was significantly less.

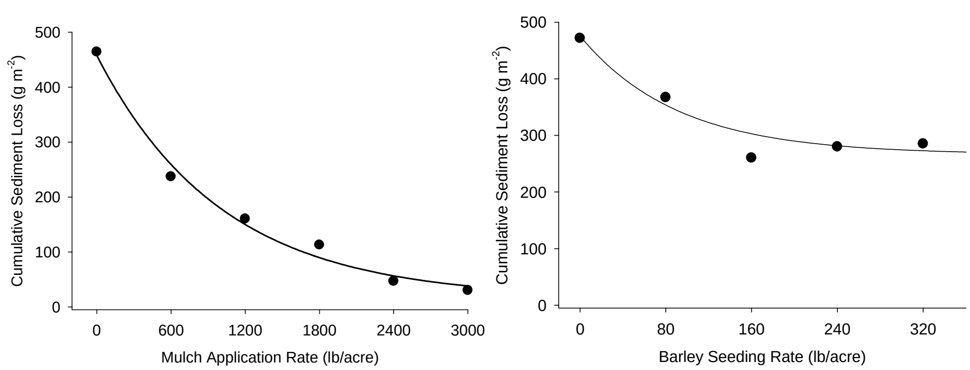


Figure 2. Effect of mulch application rate (left) and barley seeding rate (right) on erosion from four rainfall events.

Polyacrylamide, or PAM, has been used to reduce irrigation-induced erosion in potato systems in the western US. Our interest was to see how well, and for how long, it reduced erosion on bare soil. In the greenhouse, PAM applied at 15 lb/acre reduced erosion by 85% during the first rainfall; it reduced erosion by more than 50% during the fourth rainfall (about 12 days later). In the field, however, most of the benefit was observed during the first rainfall after application. Sediment loss from PAM-treated and untreated soil were similar by the third rainfall. We believe this reflects faster degradation or breakdown of PAM in the field, as a result of sunlight and fluctuating moisture and temperature.

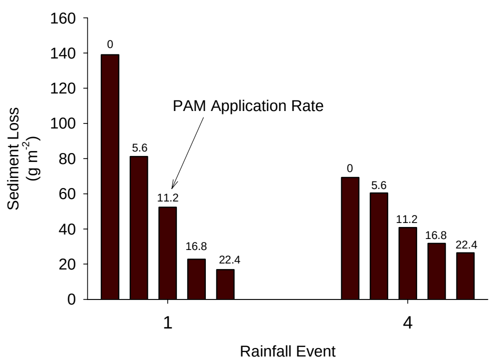


Figure 3. Erosion from PAM-treated soil during first and fourth rainfall events.

All three practices evaluated were shown to reduce the movement of soil and P. Mulch is particularly effective, but can be costly and time-consuming to apply. Interseeding with barley has the lowest cost and is relatively easy (it can be seeded using a spin-spreader driven on spray rows). However, this approach probably has the highest risk of insufficient ground cover establishment. It is not likely that PAM would be applied to entire fields, but it may be particularly useful for highly erodible soils, such as those found on steep slopes or field roads.

Fundamentals of Weed Management: Herbicide Rotation, Timing and Problematic Weeds

John M. Jemison, Jr., Ph.D.
Water Quality and Soil Specialist
University of Maine Cooperative Extension

Pest management seems to be a race between finding pest control products and losing those tools to pest resistance. Interestingly, new tools in the area of weed management are not emerging with the same frequency as with insect management. The herbicide/seed industry has spent much more time adapting plants to resist one herbicide than they have developing new effective herbicides. As more plants become resistant to diverse herbicide classes, the need to better understand herbicide resistance and ways to avoid it continues to grow.

Generally speaking, potato growers have several things going for them over dairy farmers who grow corn. Many corn growers do not rotate; for potato farmers, this is essential. Many corn growers use the same herbicide year after year; again, generally this is not the case for potato farmers. If weeds become resistant in dairy systems, seeds of resistant weeds quickly spread across the farm with manure. Finally, potato culture involves cultivation, hilling and harvest, all of which can physically kill potentially resistant weeds if they were to form.

This is not to say that potato growers need not worry. No new herbicide modes of action have been developed in 20 years, and nothing is on the horizon. We have what we have, and if we lose a product to resistance, it is gone. Good weed management is important to help maximize potato production, improve air circulation around potato plants, and reduce interference and the risk of disease or insect spread through weeds acting as alternate hosts.

If weed failure occurs, it is important to determine if it is from environmental or management decisions. Generally soil applied herbicides fail if there is little or no moisture to move the herbicide into the top inch of soil. Postemergence herbicides can fail if the plants are drought stressed. If management decisions have caused the failure, it is important to determine if the problem was timing, herbicide resistance, or if it is a difficult to control weed.

Timing is particularly important for preemergence grass herbicides like Dual II Magnum or Outlook. If weeds (particularly grasses) have emerged, control is not likely. Growers should time an early cultivation to control these weeds and use shovels to bury the emerged weeds in the potato row. If after an herbicide application has been made, there appears to be patchy weediness (some weeds are dead and others are alive), a weed may be developing resistance. It is important not to let those weeds go to seed. Use an alternative mode of action or cultivation to control these. Weeds are more susceptible to resistance when the herbicide functions on a single enzyme pathway. It is useful to rotate herbicide modes of action. If your rotation is corn/potato, make sure you do not use a triazine herbicide in both crops. Understanding how these herbicides work can help prevent resistance. The three most likely problem herbicides would be resistance to lexone (Linex), rimsulfuron (Matrix) or a postemergence grass herbidice like Poast or Select. If you use these, do not use them year after year. Some 250 plant biotypes have developed resistance to specific herbicides. Potato growers should remain aware of these problems and avoid resistance to the herbicides available to them.

Efficacy and Economics of New Fungicides for Control of Early Blight

Gilles A. Moreau[1] and Y. Leclerc[2]

[1]McCain Foods (Canada), P.O. Box 11400, Grand Falls, N.B. E3Z 3E3
[2]McCain Foods (Canada), 107 Main Street, Florenceville, N.B. E7L 1B2

Early blight is a very common disease of potatoes in Maine. Caused by the fungus *Alternaria solani*, the disease survives in crop debris and soil, which is the main source of inoculum for disease initiation. Symptoms usually develop first on the older leaflets of mature plants, spreading to the younger leaves under favorable conditions. While infections can occur during most of the season, early blight is normally considered a late season, senescing or weakened plant disease. Lesions are initially small round necrotic, leathery spots that later have a dartboard appearance with concentric rings and a yellow halo. Dry, warm weather that can weaken the plants is often associated with early blight occurrences and spores are carried by wind and water to infect other leaves and tubers.

Several new generation fungicides have recently been registered for control of early blight. Most of these new products have a positive environmental profile and are considered reduced risk. The objective of this work was to evaluate the efficacy of these new fungicides and assess their potential impact on yield, quality and crop value of Russet Burbank potatoes.

The trial was conducted at the McCain Foods Research Farm in Florenceville, New Brunswick using a completely randomized block design with 4 replicates. Plots were 4 rows 30 feet long with 5 feet between blocks. Fungicide treatments and application rates were as follows:

1. Control: Allegro 500F/Omega 500F in U.S. (Fluazinam) at 0.16 L/ac. - no Early Blight protection
2. Bravo 500 (Chlorothalonil) at 1 L/ac.
3. Dithane DG (Mancozeb) at 0.9 kg/ac.
4. Headline 250EC (Pyraclostrobin) at 0.2 mL/ac.
5. Reason/Bravo (Fenamidone/Chlorothalonil) at 0.081 and 0.5 L/ac. respectively
6. Reason/Dithane (Fenamidone/Mancozeb) at 0.081 L. and 0.5 kg/ac. respectively

Plants were fertilized with 185 lbs/acre of nitrogen and 150 lbs/acre of K_20 and P_2O_5. Planting was done in mid-May at an in-row spacing of 15 inches. Visual assessment of Early Blight was conducted immediately prior to topkill on all plants from the center two rows using a 0 to 4 scale where 0 = no defoliation; 1 = 25% defoliation; 2 = 50% defoliation; 3 = 75% defoliation; and 4 = 100% defoliation. Plants were desiccated with two half-rate applications of Diquat and harvest completed in early October.

Three years of data suggest that Early Blight must be controlled to optimize crop productivity, yield and returns. However, the new generation of fungicides specifically designed to offer superior control of Early Blight have not improved crop productivity and grower returns under the low to moderate disease pressure experienced over the three years this trial has been conducted.

Potential Electricity Savings in Potato Storages

Stephen Belyea
Storage Engineer
PMIF, MDFAFF

Electricity for powering ventilation systems and refrigeration equipment is the major variable expense in potato storage. As the cost of electrical energy continues to increase, it is becoming more important to find ways to conserve power in potato storage. The Maine potato industry is quickly adapting variable speed fan motor drives as a way to provide custom ventilation airflow rates as storage and crop needs require. Variable airflow rates provide high airflows during Fall cool down and minimal airflow at holding temperatures. Variable speed drives allow the storage manager to reduce airflow during the winter holding period to significantly reduce electricity consumption.

Refrigeration requires significantly more electrical energy to operate than ventilation fans. Some storages are being equipped with a relatively new refrigeration equipment configuration, the modular or one piece design. When installed in a ventilation system with variable speed ventilation fan motor drives, the modular refrigeration unit provides an opportunity to conserve electricity.

Lighting choices are also important as a means of conserving electricity, not only in storage but for the entire farm.

Survey Results for a Potato Preference Study: Implications for the Tablestock Potato Industry.

John M. Jemison, Jr., Ph.D.
Water Quality and Soil Specialist
University of Maine Cooperative Extension

Over the past couple of decades, acreage of processing potatoes in Maine has increased, and tablestock acreage has dropped. Not surprisingly, this mirrors changes seen in US eating patterns. Fewer people cook at home, and restaurants are regularly packed with people. A staple at many of these restaurants is processed potatoes. Efforts are underway in several cities to ban the use of trans fats in cooking. Given the high amount of fried potatoes consumed in this country, potatoes could be linked by association as an unhealthy food. It should be in the potato industry's interest to promote fresh potatoes as a part of a healthy food system. There is also growing interest in locally produced foods, and this creates another positive opportunity for the Maine potato industry. Maine potatoes should be a key component of a positive Maine local food system. As I have given presentations on these issues, the one thing I regularly hear from people is "Why don't I see Maine potatoes in the grocery stores any more?" Right or wrong, it has raised a question for me … Is there a market for a high quality locally grown fresh potato?

Over the past couple of summers, I have set up potato displays at several venues (Orono Festival Days, Rogers Farm Garden Day, and the Somerset and Piscataquis County Fairs) to assess consumer interest in Maine potatoes, and specifically what they found important in their potato selection process. I chose these locations because I thought people might share a few minutes of their time and tell me about their interest in potatoes. We collected 282 surveys. The first question of the survey asked participants how many times a week did consumers cook and eat fresh potatoes at home. Of those responding, a little more than a third of the people cooked fresh potatoes at home two or three times a week. A quarter of the respondents ate fresh potatoes once a week. Another 20% cook and eat them three to five times a week.

We also asked them their favorite way to prepare potatoes at home. Baked potatoes were the most popular (39%), and mashed potatoes came in second (33%). Lastly, my personal favorite, roasted potatoes came in third at (15%). It is useful to recognize that most people use different potato varieties for each of these uses, and this adds diversity to a potential fresh market industry.

We also gave the survey participants the chance to rate 10 factors on a scale of one to five specific characteristics they thought were most important in their decision making process. We included the following characteristics: 1) size; 2) price; 3) source (Maine vs. other state); 4) skin color; 5) flesh color; 6) lack of blemishes on skin; 7) grown using organic practices; 8) specific variety; 9) novelty potatoes; and 10) potato surface cleanliness. Summarizing all the data, we found that the most highly rated factor was source (3.99/5.0). The second most highly rated characteristic was lack of blemishes on the skin (3.79/5.0) and the third factor was size (3.48/5.0). My interpretation of these data is this: Maine consumers would like a locally grown potato, free of surface blemishes, that meet their size requirements of what they want to cook. Interestingly, potato price came out ninth out of these ten characteristics (3.16/5.0).

With trends of obesity increasing annually, we were concerned if people thought potatoes were a healthy food. Interestingly, 268 of 282 people stated that they thought potatoes were a healthy food choice. However, when asked “I would eat more fresh potatoes if: …” over 50 people stated “if I thought they were a healthier food to eat”. I don’t think this is a contradiction because in the comments section, many wrote that they could not eat many potatoes because of diabetes or were trying to reduce carbohydrate consumption. With many fast food meals, potatoes are the healthiest part of the meal. Fries and chips are still a huge portion of the industry, but that could fall steadily if potatoes were to become associated with unhealthy foods. Since most people believe that potatoes are a healthy food, efforts to actively stay ahead of any potential negativity by promoting potatoes as a healthy potato consumption seems like a good idea.

It is an interesting time for the potato industry. Potato acreage has slowly declined, and potato contract prices continue to be tight. The US cheap food model has not helped. Perhaps the time is right for a change. We appear to have a population that wants local Maine potatoes and may be willing to pay more for a quality potato since cost was rated very low. The time may be right to explore development of a system that would guarantee specific quality and give Mainers what they are looking for. There are many models out there from which the industry could draw. We don’t know now exactly where this may go, but it is worth looking into.

The Maine Potato Breeding Program: Progress and Prospects

Zenaida N. Ganga Ph.D.
Potato Breeder
University of Maine
Aroostook Research Farm
Presque Isle, Maine 04769

The Maine Potato Breeding program is the only program in the northeast that has focused its objective to the development and selection of processing-type potatoes particularly for fries. Statistics show that majority of the total production in the state for the last five years were utilized as processed potatoes. The program supports the increasing demand for processed potatoes by the growing processing industry in Maine by developing and selecting new varieties that are suitable for fries and other frozen potato products. It also selects for varieties that are suitable for chips, as table-type and as specialty-colored potatoes.

For the last five years the breeding program has focused on the development and selection of new processing-type potatoes. Reeves Kingpin was licensed to McCains but its large-scale commercialization was limited due to the incidence of some external defects like greening and misshapen tubers. Tolerance to these external defects including bruising incidence were identified as major limitations to some promising processing clones.

Durable resistances to major pests and diseases like late blight and scab were also given more emphasis in the program including incorporation of insect resistances from trichome-mediated and high foliar glycoalkaloid sources of resistances.

A progress report of the program's recent accomplishments and activities will be presented including a summary of selected promising clones. Prospects potentials and present limitations of the breeding program will also be discussed.

Potato host traits affecting white mold incidence and severity

Andrew B. Plant
Potato IPM Professional, UMCE

White mold of potatoes caused by *Sclerotinia sclerotiorum* (Lib.) de Bary has been observed on potatoes in Maine for approximately two decades. *S. sclerotiorum* is a ubiquitous pathogen that is estimated to attack over 400 plant species. Included in this vast host range are many economically important crops such as potato, canola, soybean, carrot, sunflower, peas, beans, and cabbage. In potatoes, the disease produces wilting, premature senescence and death of above ground plant parts that include leaves, stems, and flowers. It is generally thought that potato cultivars vary in their susceptibility to the disease; some varieties display low incidence and severity, while other varieties have been associated with significant yield losses.

Past research in various susceptible crops has identified several factors that have effect upon *S. sclerotiorum* and the resulting disease on a specified host. Host agronomic traits such as flowering time, flower propensity, maturity, canopy density, and oxalic acid (pathogenic determinant) sensitivity have been assessed in several crops (Jamaux et al., 1995; Atallah and Johnson, 2004; Sun and Yang, 2000; Jiang, 2001; Chipps et al, 2005).

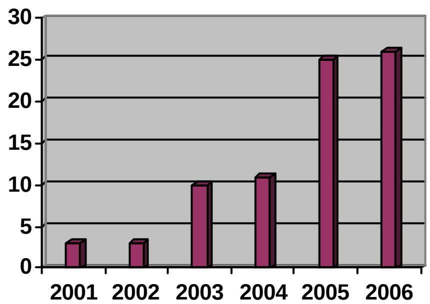
The goal of this research was to identify and quantify host factors that may affect the incidence and severity of white mold in potatoes. Quantifying the host factors of flower propensity, flower timing, canopy density, oxalate sensitivity, and maturity will allow qualitative identification of those factors which have the greatest affect on white mold. The ultimate goal of this project is to provide potato producers with information that will allow them to manage white mold through the cultural selection of cultivars least likely to be affected. Future importance of white mold management in potatoes is likely to increase as crop rotations are likely to diversify; as is the case in Maine, as utilization of the white mold susceptible crops of canola, soybean, and sunflower increases, and white mold inoculum associatively increases.

Population Dynamics of Potato Pests

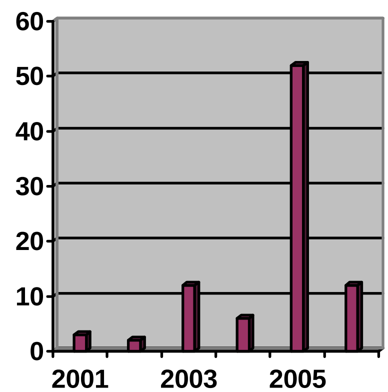
James D. Dwyer, Crops Specialist
James F. Dill, Pest Management Specialist

Webster's Dictionary defines the word dynamic as "relating to or tending to change". Population dynamics would then be the change or tendency for change in a population or populations. As we look at pest populations which the Maine Potato Industry faces, change or variability has become the norm.

Our growers face a continual changing pest profile which includes, which pests are going to be present at economically significant levels and what that timing is going to be.



The chart above indicates the number of IPM plots that exceeded the economic threshold for Colorado potato beetles each year since 2001.



This chart indicates the number of IPM plots that exceeded the economic threshold for European corn borer from 2001 until 2006.

As one can see from the above charts populations of various insect species vary from year to year and from field to field within a given year. Growers can not generally assume that various pests will or will not be present in a given year.

An additional issue that Maine growers face is new pests entering the profile or increasing populations to the point of becoming an issue. For example the insect the Red Headed Flea Beetle, the weed Hairy Night Shade and the fungus Black Spot have now become issue for some growers.

2006 Florida Test Results

Robert I. Batteese, Jr.
Acting Director, Division of Plant Industry
Maine Department of Agriculture, Food & Rural Resources

Maine's certified seed potato law requires that all seed lots produced in state pass a post-harvest test in order to become certified for sale and planting. After the 2006 fall harvest, seed certification specialists in the Division of Plant Industry collected samples from growers that generally consisted of 400 tubers per lot. The samples were treated to break dormancy and then shipped to the Maine Seed Board's test farm in Homestead, Florida. During the first two full weeks of November, 1,160 samples were planted on 28.5 acres. This land was then cultivated and sprayed as needed to promote plant growth for at least nine weeks. A crew will return to Homestead during the first two weeks of January to examine the plants for disease and varietal differences. The results of this work will be reported at the Potato Conference.