



MAINE POTATO CONFERENCE

JANUARY 17-18, 2018
CARIBOU INN & CONVENTION CENTER, CARIBOU, ME



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2018 MAINE POTATO CONFERENCE

WEDNESDAY & THURSDAY, JANUARY 17-18, 2018

WEDNESDAY, JANUARY 17, 2018

- 8:40 A.M. **Challenges in Agriculture and Potential Solutions**
Dr. Lakesh Sharma,
Soil Specialist and Assistant Professor,
UMAINE COOPERATIVE EXTENSION
lakesh.sharma@maine.edu
- 9:00 A.M. **Calcium Supplement in Potatoes and Role of Calcium in Tubers**
Dr. Chris Gunter,
Extension Vegetable Production Specialist and Associate Professor,
NORTH CAROLINA STATE UNIVERSITY
cgunter@ncsu.edu
- 9:20 A.M. **Controlling Volunteer Potatoes in Rotation Crops**
Dr. John Jemison, *Soil and Water Specialist,*
UMAINE COOPERATIVE EXTENSION
jemison@maine.edu
- 9:40 A.M. **Increasing Yield Potential in Agriculture Using Remote Sensing (Drone)**
Douglas Cuffman, SWARMAG
doug.cuffman@swarmag.net
- 10:00 A.M. ****Coffee Break****
- 10:30 A.M. **Developing Smartphone Application to Identify Insects**
Ahmed Zaeen, *Graduate Student,* UMAINE
ahmed.zaeen@maine.edu
- 10:50 A.M. **Updates on Blackleg and Soft Rot of Potato**
Dr. Jay Hao,
Plant Pathologist, UMAINE
jianjun.hao1@maine.edu
- 11:10 A.M. **Potato Leafhoppers**
Jim Dwyer, *Crops Specialist*
UMAINE COOPERATIVE EXTENSION
jimdwyer@maine.edu

- 11:30 A.M. **Considering Malt Barley as Potential High Value Cash Crop**
Ellen Mallory,
Assoc. Professor & Extension Sustainable Agriculture Specialist,
UMAINE COOPERATIVE EXTENSION
ellen.mallory@maine.edu
- 11:50 A.M. ****Lunch - On Your Own****
- 1:20 P.M. **Farm Services Agency Update**
Dave Lavway, *State Director of Farm Services Agency USDA,*
David.Lavway@me.usda.gov
- 1:40 P.M. **PVY and Dandelions**
Aaron Buzza, *Assistant Scientist,* UMAINE
aaron.buzza@maine.edu
- 2:00 P.M. **Board of Pesticide Control Updates**
Megan Patterson, *Environmental Specialist*
megan.L.patterson@maine.gov
- 2:20 P.M. ****Coffee Break****
- 2:50 P.M. **Pros and Cons of Whole Seed versus Cut Seed**
Leigh Morrow,
Director Agronomy North America East
McCAIN FOODS LIMITED
leigh.morrow@mccain.com
- 3:10 P.M. **Micronutrient Supplementation for Potatoes**
Dr. Chris Gunter, *Extension Vegetable Production Specialist and Associate Professor*
NORTH CAROLINA STATE UNIVERSITY,
cgunter@ncsu.edu
- 3:30 P.M. **Fly-Ash: An Amendment Source in Agriculture to Improve Soil Health**
Sukhwinder Bali, *Extension Educator*
UMAINE COOPERATIVE EXTENSION,
sukhwinder.bali@maine.edu

- 3:50 P.M. **Aroostook Phosphorus and Water Quality Study Update**
 Greg McDonald, *M.S. Student*,
 CIVIL AND ENVIRONMENTAL
 ENGINEERING UMAINE
 Kathy Hoppe, MAINE DEP,
 kathy.m.hoppe@maine.gov
- 4:10 P.M. **UMPI Agriculture Major Updates**
 Dr. Jason Johnston,
Associate Professor of Wildlife Ecology,
Dean, College of Arts and Sciences, UMPI
 jason.johnston@maine.edu
- 4:30 P.M. **Wrap Up and Adjourn**
CENTRAL AROOSTOOK YOUNG FARMERS HOSPITALITY
ROOM WILL BE IN THE TRADESHOW AREA.
- 6-9:00 P.M. **Pesticide Applicator Training**
 Megan Patterson, *Environmental Specialist, BPC*

THURSDAY, JANUARY 18, 2018

- 8:40 A.M. **What We Can Learn from Indian Cultivation System?**
 Dr. Lakesh Sharma,
Soil Specialist and Assistant Professor,
 UMAINE COOPERATIVE EXTENSION
 lakesh.sharma@maine.edu
- 9:00 A.M. **Powdery Scab and Mop-Top: An Update**
 Jim Dwyer, *Crops Specialist*,
 UMAINE COOPERATIVE EXTENSION
 jimdwyer@maine.edu
- 9:20 A.M. **Possible Crop Rotations in Aroostook County, Maine (Panel Discussion)**
 Lead: Dr. John Jemison,
Soil and Water Specialist,
 UMAINE COOPERATIVE EXTENSION
 jemison@maine.edu
- 9:40 A.M. **Pros and Cons of Fumigation**
 Dr. Alicyn Smart, *Plant Pathology Specialist*
 UMAINE COOPERATIVE EXTENSION
 alicyn.smart@maine.edu
- 10:00 A.M. ****Coffee Break****
- 10:30 A.M. **Pink Rot Control with Foliar Applications**
 Dr. Jay Hao, *Plant Pathologist*, UMAINE,
 jianjun.hao1@maine.edu

- 10:50 A.M. **What We Have Learned About Aphids in the Last Five Years**
 Jim Dwyer, *Crops Specialist*,
 UMAINE COOPERATIVE EXTENSION
 jimdwyer@maine.edu
- 11:10 A.M. **The Effect of Neonicotinoid Insecticides on Pollinators, Global and State of Maine Perspectives**
 Dr. Frank Drummond, *Entomologist*,
 UMAINE, fdrummond@maine.edu
- 11:30. ****Lunch—On Your Own****
- 12:50 P.M. **Developments in the Domestic Market for Potatoes with an Emphasis on Retail**
 Ross Johnson, *Global Marketing Manager*,
 POTATOES USA, ross@potatoesusa.com
- 1:10 P.M. **First Aid on the Farm**
 Cary Medical Center Personnel
 CARY MEDICAL CENTER, CARIBOU
- 1:30 P.M. **Potatoes USA Update**
 Ross Johnson, *Global Marketing Manager*,
 POTATOES USA
 ross@potatoesusa.com
 Jay Lajoie, LAJOIE GROWERS,
 jay@lajoiegrowersllc.com
- 1:50 P.M. **Harvesting, Handling and Storing Potatoes in Warm Weather**
 George McLaughlin, *Ag. Engineer*,
 MAINE POTATO BOARD
 gmclaughlin@mainepotatoes.com
- 2:20 P.M. **Maine 2017 Post Harvest Testing**
 Eric Hitchcock, *Seed Certification Program Manager*, MDAFC
 eric.hitchcock@maine.gov
- 2:40 P.M. **NRCS Updates**
 Seth Jones, *District Conservationist*, NRCS
 Hollie Umphrey, *Executive Director*, CASWCD
- 3:00 P.M. **Wrap Up Questions**
- 3:10 P.M. **Adjourn**

Challenges in Agriculture and Potential Solutions

Dr. Lakesh Sharma, *Soil Specialist and Assistant Professor, UMaine Cooperative Extension*;
 Sukhwinder Bali, *Extension Educator, UMaine Cooperative Extension*

In the United States, there has been a relative shortage of research faculty, who have both adequate knowledge of crop fertility and potato production. There is some fertility work done by Jeff Stark and others as part of the Tri-State variety development program. However, there is a crucial need to improve the potato fertility program for better yield, quality and to increase in area under potato. Maine's potato business has a vital influence on its economic, \$540 million annual impacts, personal income of more than \$233 million, state and local taxes ~\$32 million, and workforce growth of ~6100 jobs (USDA, 2003). Increasing input cost on fertilizers (Figure 1) has made it impractical for producers to gain a competent revenue with ~persistent potato price (Figure 1), which indicated in decreasing farms numbers in Maine (Cheng, 2005). Three major macronutrients, N, phosphorous (P), and potassium (K) usage as fertilizer in the United States has grown over the years (Figure 1) placing an ominous threat to the ecosystem. There is a need to establish improved nutrient recommendations, by understanding specific grower needs (processing, seed, and table stock grower) and N, P, and K behavior under changing the climate (Figure 2) and soil conditions. Nitrate concentrations in groundwater continue to increase in many areas of the U.S., which is raising

human health concerns. This is particularly common in rural agricultural areas where shallow groundwater is used as a domestic water source. For example, groundwater provides over 95% of Idaho's drinking water. The U.S. Environmental Protection Agency assessed that agricultural activities are liable for emissions of 0.48 million tons of N as nitrous oxide on an annual basis. This accounts for approximately 80% of total U.S. nitrous oxide production and about 10% of the global agriculture-related nitrous oxide emissions (<http://yosemite.epa.gov/sab/sabproduct.nsf/>)

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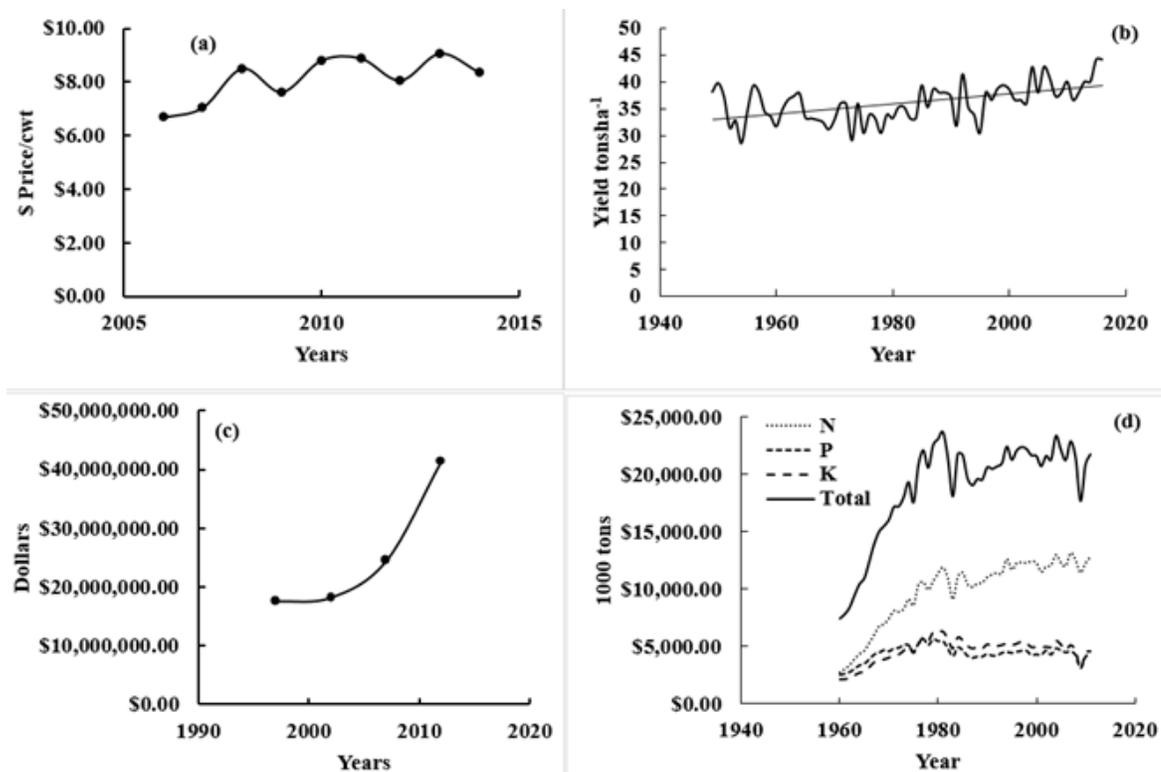


Figure 1: Potato price varies in the United States over the years (a), potato yield varies in the United States over the years (b), input (fertilizer totals including lime and soil conditioners-expense, measured in \$) expense increased over the time in Maine (c), fertilizer use in potatoes in the United States over the years (d). source: USDA, national statistics.

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WebBOARD/InitrogenCSupplemental? OpenDocument).

High P levels have been recorded in Maine lakes and rivers, resulting in a need to manage P levels to reduce eutrophication (McGuire, 2015). P is an essential macronutrient for growth and functions of Potatoes. The pH of Maine potato soils has increased due to a switch from round-white varieties to scab resistant Russet Burbank po-

tato variety and because farmers are interested in growing grains and other rotation crops that require higher soil pH. However, P recommendations in Maine were developed, when average pH was around 5 (20 years ago) that has improved to ~6 in present time. Despite 84% of soil samples in Maine were found with sufficient P, in the range of between 20-50 ppm from all soil samples since 2006, significant P has been applied to Maine agriculture.

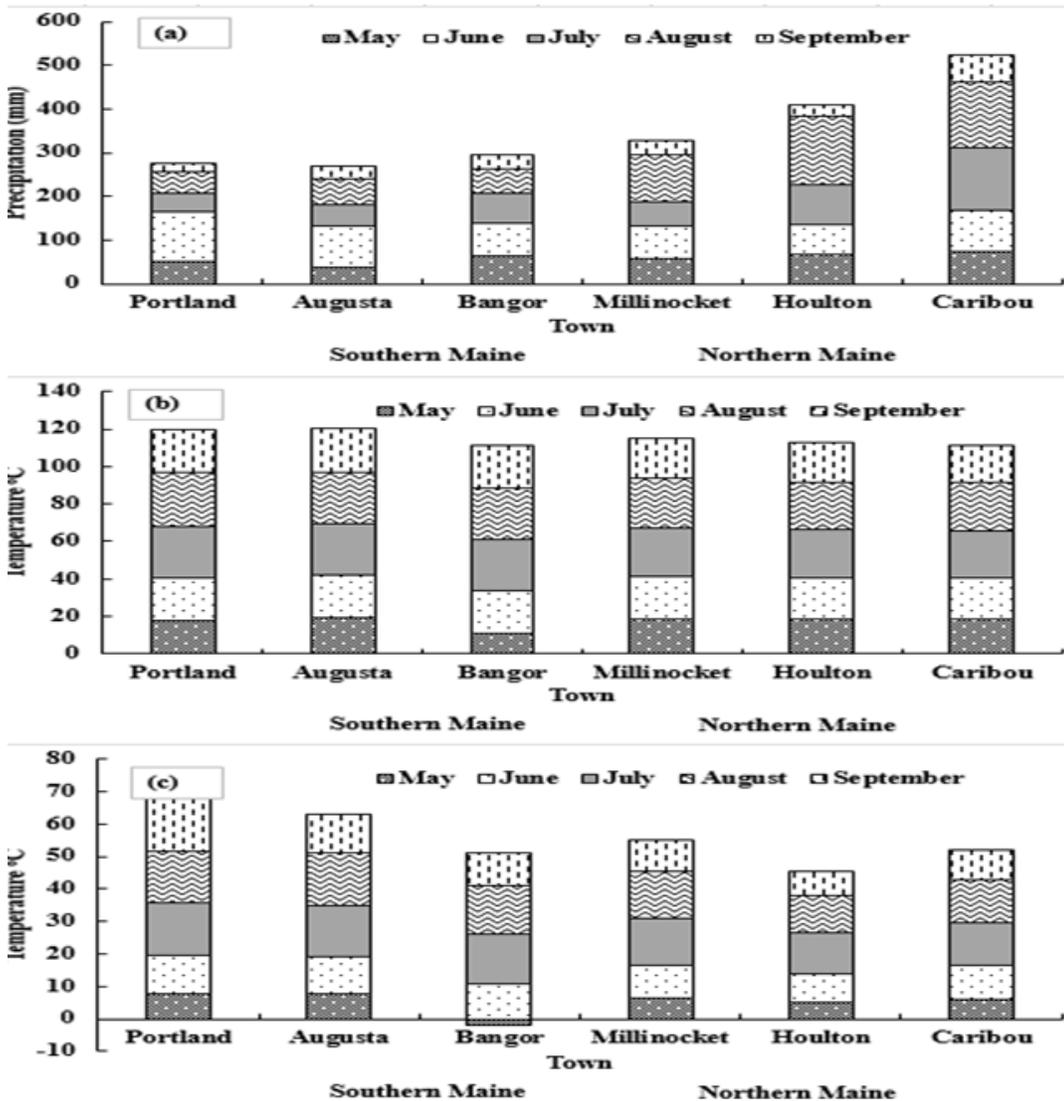


Figure 2: Average monthly precipitation (a), maximum (b), and minimum (c) temperature variations from south to north of Maine in 2016. Source: National Weather Service - Gray, ME.

Calcium Supplement in Potatoes and Role of Calcium in Tubers

Dr. Chris Gunter,

Extension Vegetable Production Specialist and Associate Professor, North Carolina State University

Previous research has provided evidence that Ca is transported to the tuber along with water via the roots on stolons and tubers. Several studies have documented that in-season Ca application can increase tuber Ca concentration and re-

duce storage rot and internal defects such as hollow heart, brown center, and internal brown spot. This presentation will explore these idea and discuss the relationship between replant soil test Ca levels and the tuber Ca concentration.

Controlling Volunteer Potatoes in Rotation Crops

John M. Jemison, Jr., *Soil and Water Specialist, UMaine Cooperative Extension*

I have often joked that potatoes (*Solanum tuberosum L.*) are a plant looking for an excuse to die. That is until you really want them to die, then it can be a challenge!

To start this discussion, we need to define a weed as a plant growing out of place. A perennial fescue lawn is desirable until it grows into your flower bed. A crop plant (corn, canola, or potato) can be a weed if it's growing in the wrong place. In this case, we are interested in potatoes growing in a rotation crop field such as canola, small grain, or corn.

Why do we care? To answer this we need to think about what most weeds do; they compete for water, nutrients and sunlight. Other weeds can do worse things; they can spread disease, provide nutrients and food for insect pests, and contaminate the rotation crop. Considering potato ... it can just about do it all. Most concern circles around volunteer potatoes as a source of inoculum for late blight and virus spread. Some fungicides registered to protect potatoes aren't available on specific rotation crops. So, it is complicated. As hard as it seems to grow a potato crop with manageable levels of disease, insects, and weeds, it is only harder when potatoes are growing in a rotation crop because you may not see them when you go spray your rotation crop herbicides, (as they may not have yet emerged), they may be chewed on by Colorado potato beetles and you might simply miss them, but they may recover to create issues, or you simply don't check for them. To make the issue even more difficult, there are very few herbicides that effectively kill potatoes. If you read weed guides like the Michigan State Weed Management Guide, you will know that the nozzle head guys like to rate weed control with an E, G, F, or P for excellent, good or fair or poor control. When they rated volunteer potato (VP) as a weed ... no product was given an excellent or even a good to excellent rating. Bummer. Being a soil and water specialist, I am also not big on fall tillage due to concerns of runoff and surface water contamination ... so we have to try something more than a standard approach.

So ... my solution is to take an IPM or ICM type of an approach to this problem. I am drawing heavily from an excellent publication by Steiner et al., 2005 from Washington State Extension for this approach.

Conditions that promote volunteers

Most VPs emerge from the upper 8 inches of soil. A winter that is open and free of snow when the temperatures begin to drop can freeze and kill many tubers. But, many winters we'll have a foot or more of snow before extended freeze moves into the lower levels of the soil profile. In recent years, we have had enough snow to protect the soil from

freezing leading to these issues. This winter will be interesting.

Managing your potato crop with an eye to VP control

If you have managed your crop well and you are harvesting at an appropriate time, hopefully you will have very few small potatoes left behind to act as VPs. Planting with appropriate spacing, use of quality seed, adequate fertility, insects and pest scouting, and (recently and increasingly more common) effective water management will help make potato yield and size more uniform and productive leaving fewer (less than one ounce) potatoes in or on the ground. Another practice that will reduce VPs is proper desiccation prior to harvest. Green harvest is much more likely to cause issues.

Harvesting

The following practices during harvest can be quite helpful: 1) maintain appropriate blade depth to capture more potatoes. You will improve yields and leave fewer potatoes behind; 2) take care loading potatoes to not spill onto the ground; 3) maintain good tuber intake and primary chain gap size to minimize loss.

Chemical control

Maleic hydrazide (MH) has been one treatment growers have used to reduce the number of volunteer potatoes. Serving as a sprout inhibitor, MH effectiveness has been shown to be size and variety dependent. In an interesting study, Newberry and Thornton (2007) sprayed tubers two weeks prior to vine desiccation, and then replanted the tubers the following spring and rated emergence. Generally the smaller the tuber, the less MH was absorbed and the higher the rate of emergence. Russet Burbanks were more likely to emerge than Shepody or Russet Norkota. But, the authors did say that MH should be a tool in the toolbox growers should consider if conditions are conducive for a higher than expected number of small tubers, the tuber size that generally cause the most trouble as VPs.

Evaluating crop rotation as an option for VP control

Many growers only rotate potatoes with small grains. This is a limited situation as many of the herbicides used in small grain production are fairly ineffective on VPs. The strength of small grains is the potential to use dense planting populations to compete with VPs. But, the weakness is that the tubers can emerge after you can no longer spray growth regulator herbicides, leaving only expensive options like Starane for use after this.

I know corn is not frequently produced in Aroostook

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County, but if you have a market, it might be a good option for controlling VPs. As previously mentioned, only two herbicides got a good evaluation for controlling VPs: mesotrione (Callisto) and atrazine (Aatrex). Glyphosate (Roundup) got a fair to good rating in the Michigan State Weed Control Guide (2016). It seems like if you put down a mixture of three with glyphosate tolerant corn, you could easily control VPs ... you could spray Lumax (atrazine, mesotrione, and metolachlor) pre-emergence and follow up at the eighth leaf stage of development with glyphosate if you had issues. Another possible option would be to wait until July and plant brown midrib sorghum sudan grass (BMRSS). You could identify PV issues and treat them, then plant BMRSS and mow it in September. Many growers swear the soil tith is worth giving up a yield producing crop for a soil building crop.

With canola or soybeans, you are likely limited only to

glyphosate, but you could apply it a couple of times if you thought it was needed.

Innovative options

I found several people that are trying to use remote sensing to identify VPs in a rotation crop and destroy it. Some have tried using remote sensing, and others have developed robotic trucks to drive down the field rows and look for and search out VPs. These techniques and use of low flying drones should be helpful to scout for VPs in fields in the future.

References

- Michigan State Weed Management Guide. 2016.
Newberry, G. and R Thornton. 2007. Suppression of volunteer potatoes with maleic hydrazine applications. *Am. J. Potato Research*. 84:253-258.
Steiner, C.M., G. Newberry, R. Boydston, J. Yenish, and R. Thornton. 2005. Volunteer Potato Management in the Pacific Northwest. Extension bulletin EB 1995.

Increasing Yield Potential in Agriculture Using Remote Sensing

Douglas Cuffman, *SwarmAg*

“Yield potential is defined as the yield of a cultivar when grown in environments to which it is adapted, with nutrients and water non-limiting and with pests, diseases, weeds, lodging, and other stresses effectively controlled.”¹

To that end, the farmer is not in control of the variables of crop production. Rather, the farmers job is to manage the scarce resources that he does control to minimize crop stress and maximize sellable yields. And unlike a manufacturing process for example, every crop year is different. Different temperatures, rainfall, and humidity, different levels of insect and disease pressure make each year a challenge. To effectively manage the resources of land, equipment, seed fertilizers, chemicals, time (labor), and capital takes a lot of information. As farm size increases, managing the increasing volume of information takes more time and more skill. Knowing where and when to take action can add tens of thousands of dollars to the crop value, and not knowing can be devastating as mistakes can be very expensive.

And while for years now computers have been helping manage farm information, such as income and expenses, weather information, tractor engine performance, irrigation, etc, having an on-demand, analytics-driven understanding of crop health has been missing from the digital farm toolkit. That said, now we can add another level of information management. The ability to farm smarter by better understanding the complexities of crops from a data analysis perspective has become a reality.

An agricultural UAS, paired with artificial intelligence,

can now provide information about a crop in minutes. Drone surveys can direct attention and resources where they are needed to match changing crop conditions. This helps growers make more accurate decisions with fewer mistakes. Compared to walking fields or relying on random observations, a single UAS can perform a photo survey of several hundred acres quickly, on demand and without mistakes. The intense resolution of our cameras may “see” changing crop issues days before they are visible to random inspection.

¹Yield Potential: Its Definition, Measurement, and Significance. Available from: https://www.researchgate.net/publication/239531462_Yield_Potential_Its_Definition_Measurement_and_Significance

Developing Smartphone Application to Identify Insects

Ahmed Zaeen, S.K. Bali,
J.D. Dwyer, and L.K. Sharma,
University of Maine Cooperative Extension

Mobile applications are software programs that are created to run on smartphones, tablets, and some of them can work on the computer. In the beginning, mobile apps were

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designed to be used with computer programs, for instance, email, calendar, contacts, web browsing, and weather forecast. Nowadays, the increasing demand for new mobile applications encourages both businesses and organizations to create more mobile applications for banking, commerce, health, and tourism to meet the daily life needs. The agriculture fields, in particular, represent a significant part of the economy and business sector that fulfills the food requirements of the world population. To meet the needs of agriculture producers, a mobile application was developed, where information from various credible sources was used to identify and control insect pest in a potato cultivation system. This mobile app is user-friendly. In this mobile app, a list of the common insects, like Colorado Potato Beetle, European Corn Borer, Aphid, Potato Leafhopper,

Cut Worm, Potato Flea Beetles, Wireworms, and White Grub is added with their possible control measures. This app provides essential information about each insect's life cycle, including the stage when they get ready to attack the potato plants. This app includes a list of the active insecticides effective against specific insect-pests thereby giving information which can help potato growers to decide. With these records of pesticides, farmers can choose their pesticides regarding rotation that can help to overcome insect resistance against control. Also, this app provides information regarding using the trade name, rate or dose per acre of product, and whether it should be used in soil or on plant leaves. This app can save money and time of farmers since the farmers will not need to collect samples or drive their car to the lab. Farmers will not get the wrong diagnoses as a result of collecting a faulty sample.

Updates on Blackleg and Soft Rot of Potato

Jianjun (Jay) Hao, *School of Food and Agriculture, University of Maine, Orono, ME*

Blackleg has caused a catastrophic problem in the Northeastern states since 2015, and *Dickeya dianthicola* is confirmed to be the primary causal agent. To understand the disease epidemiology, a multi-institutional effort has been made to address this disease. In addition to *D. dianthicola*, several other *Dickeya* species have been isolated from symptomatic potato plants. It is common that *Pectobacterium* spp. are also associated with blackleg. *Dickeya* spp. have been isolated from non-potato crops, weeds and surface water, which were confirmed to be pathogenic to potato. Based on tuber inoculation assay, potato cv. 'Shepody' was relatively less susceptible to *D. dianthico-*

la. For sanitation purpose, some chemicals were screened on agar plates using a filter paper disc diffusion method. Allyl isothiocyanate, oregano essential oil, copper sulfate, and streptomycin were the most effective products. Copper sulfate completely suppressed the plant infection and protected potato yield whereas the other chemicals provided inconsistent results. When treated with copper sulfate, *D. dianthicola* went into a viable but non-culturable state. This dormant status may reduce the efficacy of chemical treatment, and help the pathogen survive and persist in the environment for a longer time period.

Potato Leafhoppers

Jim Dwyer, *Crops Specialist, UMaine Extension*; Marc Dwyer, *IPM Technician, UMaine Extension*

Potato leafhoppers, *Empoasca fabae*, are an insect that used to make occasional appearances to Maine potato fields. Potato leafhoppers are now a regular visitor to Southern Maine and a more frequent visitor to Central and Northern Maine. It is important for growers to be able to identify potato leafhoppers and the damage created by this insect because potato leafhoppers have the potential to create significant negative yield impacts.

Potato leafhoppers do not over-winter in Maine. In fact, potato leafhoppers over-winter in the Gulf Coast states and

then migrate northward each spring and summer. Some years, potato leafhoppers do not make it to Maine, however, in recent years, possibly, as a result of climate change, potato leafhoppers are becoming a more frequent visitor to northern Maine.

Potato leafhoppers are a neon green and have a sideways type of movement resembling a crab. The nymphs cause more damage than the adults. Leafhoppers have a piercing sucking mouthpart and feed directly from vascular tissue.

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The vascular tube fed upon, becomes blocked, and the tissue being fed by that vessel dies. A triangular shape of dead tissue forms which is called “hopper burn”. With intense feeding, the entire foliage of the plant can die. Feeding by potato leafhoppers also stimulates a physiological change in the plant, causing the plant to use more energy to respond to the damage and less energy for tubers.

To scout for potato leafhoppers, one should examine one hundred potato leaves in several locations within the field. A threshold level is ten nymphs per one hundred leaves surveyed. Please remember that potatoes have compound leaves.

Materials that can be used to manage potato leafhoppers include the neonicotinoids, applied at planting or foliar, synthetic pyrethroids, PyGanic (OMRI listed) and other

materials. When using any pesticide, please read and follow all label instructions.



PVY and Dandelions

Aaron Buzza, *Assistant Scientist, UMaine*

Potato Virus Y (PVY) is usually considered to have a very broad host range, infecting a variety of taxonomically unrelated plant species. Therefore, potential non-crop reservoirs could compromise grower attempts to manage inoculum sources within their crops. Dandelions have been reported in a variety of publications to be one of the most common and ubiquitous PVY hosts.

We conducted a multi-year survey of vegetation surrounding seed potato fields in northern Maine. As expected, dandelions often tested positive for PVY using standard ELISA kits, although there were differences among locations and sampling dates. However, we were not able to confirm virus presence in any of the seropositive samples

by using PCR or electron microscopy. Furthermore, we failed to transmit disease from PVY-positive dandelions to potatoes or from PVY-positive potatoes to dandelions in a greenhouse experiment. In the same time, PVY was easily transmissible between potatoes.

Based on our results, the importance of non-host vegetation in general, and of dandelions in particular, for PVY epidemiology may be exaggerated due to false positive results reported in earlier published surveys. This finding confirms that planting PVY-free seed and spraying mineral oils to reduce PVY transmission by aphid vectors are the most important techniques in managing this pathogen.

Pros and Cons of Whole Seed Versus Cut Seed

Leigh Morrow, *McCain Foods USA*

Use of cut potato seed has long been the predominant practice in North America. Meanwhile, use of sized, whole seed is a predominant practice in Northern Europe as well as the preferred seed type distributed by leading global seed export countries. Also, on this continent a few large potato growers are converting to whole-seed systems. The initial cost of seed seems to be the major hurdle of whole seed, but whole seed offers many advantages such as:

- less handling by the end-use grower
- less waste from chips and slivers

- potential to reduce seed treatment cost
- less disease risk
- better achieved plant stand and more uniform-sized plants
- higher yield resulting from consistent plant stand

The historical reference will be reviewed showing comparisons of whole versus cut seed. Also, recent studies from Maine and New Brunswick will be reported. The implications for seed handling and seed spacing will be summarized.

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rized and discussed. The following characteristics need to be considered:

- the potential vigor of potato seedlings from small versus large whole seed
- the in-row spacing requirements for small versus large whole seed
- the stem number self-adjustment tendency for some varieties such as Russet Burbank

The seed supply chain will need to also consider modifications to infrastructure if a whole-seed system is to be viable, such as sizing and long-term/temporary storage capabilities. A stepping stone approach between cut-seed and whole-seed systems might be a logical approach, whereby a large portion of the commercial crop is planted with whole seed and the remaining portion planted with cut seed. An alternate approach may be to divert large mother seed to other commercial uses.

Micronutrient Supplementation for Potatoes

Dr. Chris Gunter, *Extension Vegetable Production Specialist and Associate Professor, North Carolina State University*

Best management practices for micronutrient fertilization will be discussed. We'll show the important plant anatomy aspects that impact foliar fertility. We'll discuss why to consider foliar fertilizers. Key application timing and methods

will be compared in this presentation. Strategies to get the most success from foliar applications and best management practices for fertility will be addressed.

Fly-Ash: An Amendment Source in Agriculture to Improve Soil Health

Sukhwinder Bali, *Extension Educator, UMaine Cooperative Extension;*

Dr. Lakesh Sharma, *Soil Specialist and Assistant Professor, UMaine Cooperative Extension*

Lime application in agriculture is the typical and common practice for raising pH to the optimum level. Agricultural lime releases CO₂ emission to the atmosphere (Intergovernmental Panel on Climate Change) and plays an important role in the global fluxes of greenhouse gasses. The US EPA has estimated nine teragram CO₂ emission from 20 teragrams of applied agricultural lime (McBride and West, 2005). Thus, it is important to use an alternative source of Lime application to improve soil pH without harming the environment such as fly-ash. Fly-ash increases uptake of nutrients as well as plant growth (Weinstein et al., 1989). Fly-ash is an amendment source in agriculture that could sequester the carbon which might help in reducing CO₂ emission. Soil properties change the fly-ash potential of C sequestration. Therefore, it is important to evaluate the fly-ash potential of C sequestration in different soil and farming system. This study aims to provide growers an alternative source of maintaining soil pH and measure the effects of fly-ash on agriculture production and soil properties. Fly-ash is an amendment publicized to improve soil health along with crop yields.



Aroostook Phosphorus and Water Quality Study Update

Greg McDonald, *Department of Civil and Environmental Engineering, University of Maine, Orono;*

Kathy Hoppe, *Maine Department of Environmental Protection, Presque Isle;*

Aria Amirbahman, *Department of Civil and Environmental Engineering, University of Maine, Orono;*

Stephen Norton, *School of Earth and Climate Sciences, University of Maine, Orono;*

Ivan Fernandez, *School of Forest Resources, University of Maine, Orono;*

Jeff Dennis, *Maine Department of Environmental Protection, Presque Isle*

Amsden Brook is a second order stream in Fort Fairfield, Maine that flows southwest to the Aroostook River. Watershed land use is primarily agricultural. Agricultural practices can contribute to the excess loading of phosphorus (P) in surface waters, promoting accelerated eutrophication. The Maine Department of Environmental Protection documented stream impairment and high levels of P under baseflow conditions during dry weather periods at Amsden Brook. This study explores the sources and mechanism(s) of P mobilization within the Amsden Brook watershed, to assure more effective management strategies for securing water quality in Maine. We analyze stream sediment, surface and subsurface water, and soil samples to track the P concentrations in the watershed. These waters are monitored monthly for temperature, pH, dissolved oxygen, conductivity, P, strong acid anions, strong base cations, DOC,

Al, Fe, and Mn. P speciation within soil and sediment samples is determined by sequential fractionations. The results will be combined with data on climate, surficial geology, hydrology, and land use to determine the chemical and physical properties affecting P transport. Preliminary results show discharges of low-pH, low-P groundwater (pH 7.10-7.24, dissolved P 2.4-5.0 μgL^{-1}) to the impaired stream (pH 7.50-8.52, dissolved P 5.0 - 48.0 μgL^{-1}). Stream pH increases significantly downstream due to CO₂ degassing; preliminary results suggest this pH increase leads to the precipitation of CaCO₃. We hypothesize that P is mobilized due to pH-controlled desorption from the P-laden sediment eroded from fields. These processes produce a staged export of P from the watershed during baseflow and stormflow conditions.

UMPI Agriculture Major Updates

Dr. Jason Johnston, *Associate Professor of Wildlife Ecology, Dean, College of Arts and Sciences, UMPI*

The University of Maine at Presque Isle started a concentration in Sustainable Agriculture within our Environmental Science and Sustainability B.S. in Fall, 2014; we had our first two graduates in the Spring, 2017. While the program remains relatively small, it is poised for growth, and garners significant enthusiasm locally. In November, 2017, we gained approval from the UMaine System Chief Academic Officers to move forward with planning a new Bachelor's degree program in Agricultural Sciences to launch, Fall, 2018. The curriculum will consist of courses in the following topics: introductory sciences, agronomy, soils and natural resource management, agricultural technologies (e.g. GIS and farm equipment), integrated pest management, animal sciences, and some horticulture. We plan to grow our program through meaningful connections to our community both in service and as training for students. We have a full design plan for a 30'X80' greenhouse, which we are optimistic can be built in 2018. Once

this is complete we will have the majority of infrastructure and equipment needed to grow our program, including 60 acres of tillable land, and laboratory research facilities. By

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partnering with the University of Maine Cooperative Extension and Sustainable Agriculture program at Orono, we hope to continue to expand access to agricultural education in the County. As we grow and hope to expand faculty resources, we will seek to expand our agribusiness and technical capacity – as our recent survey made clear, today’s farm-

ers and agribusiness professionals need a solid background in business applications to succeed. We will be continuing to incorporate local agribusiness expertise into the design and the educational components of our degree program. We welcome your input to ensure that our graduates have the best prospects for careers and to support our regional agricultural economy

What We Can Learn from Indian Cultivation System?

Dr. Lakesh Sharma, *Soil Specialist and Assistant Professor, UMaine Cooperative Extension;*
Sukhwinder Bali, *Extension Educator, UMaine Cooperative Extension*

The green revolution around the world has been repeatedly characterized with the introduction of high-yielding crop variety and fertilizers. However, in recent years the growth in the productivity has been stagnant and this resulted in decline in the farmer’s income. There are serious negative environmental impacts such as depleting water table, emission of greenhouse gases, and the contamination of surface and ground water. The agriculture sector in India is in a state of distress and severely affecting peasants and marginal farmers.

One of the key obstacles to boosting farm productivity is the lack of new technologies. Despite the fact that the National Agriculture Research System played a crucial role in the green revolution, in recent years there hasn’t been any major breakthrough in technology and research. The leading reasons for this is the lack of monetary resources.

The upcoming challenge for Indian farmers is to meet

the guidelines of reducing carbon emission that comes from agriculture activities. The major issue is burning of wheat and rice stubble to get the soil ready quickly enough for the next crop planting. Due to lack of technology there is not much in the way of planting equipment for residue management, resulting in the continuous practice of burning the residue. The ground water is highly contaminated due to intensive use of fertilizer and pesticides. There are a record number of cancer patients in India. One of the trains that visit the renowned cancer hospital in the neighboring state of Punjab is now called a cancer train.

There are states, Punjab and Gujrat, in India that are growing 8-10% per annum in agriculture, however the other states like Uttar Pradesh, West Bengal, etc., are growing at 1-2.5% per annum.

The development of retail marketing agriculture could improve the farmer’s financial status.

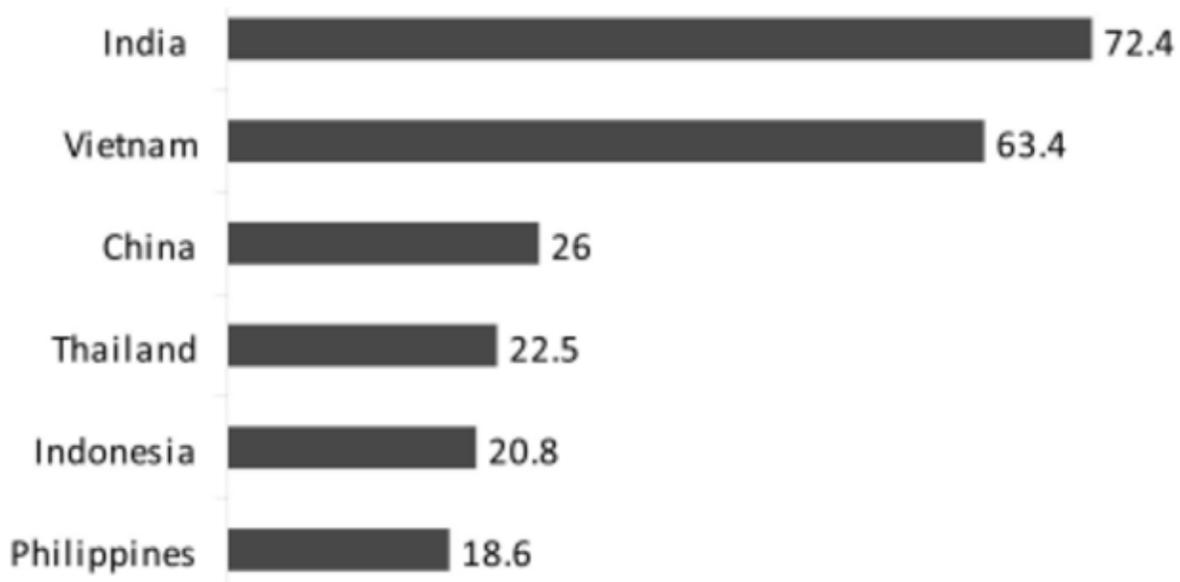


Figure 1: Top food and grocery retailers-average annual percent growth in sales 2002-2007. Source: Planet Retail (2008)

Powdery Scab and Mop-Top Update

Jim Dwyer, *Crops Specialist, UMaine Extension*; Marc Dwyer, *IPM Technician, UMaine Extension*;
Dr. Stewart Gray, *Virologist, USDA/ARS/Cornell University*

Powdery Scab, *Spongospora subterranae* is a soil borne fungal disease, which acts as a vector for the Mop-Top virus to enter the potato tuber. These diseases are becoming much more of an issue across North America. The inoculum is spread by contaminated soil and by tuber borne resting spores of the fungus. The virus is introduced to uninfested fields when infected seed tubers carrying Powdery Scab are planted. Tuber and root infections are favored by cool, moist soil conditions. Cysts may persist in the soil for up to six years (Hooker).

The Gudmestad Laboratory at North Dakota State University has developed a soil test, which can indicate whether or not Powdery Scab is present in a field and the relative level. In 2017 as part of USDA/APHIS grant coordinated by Dr. Stewart Gray, Virologist, USDA/ARS Cornell, a plot was planted in Aroostook County and the soil test process was done by the Gudmestad Laboratory

Pros and Cons of Fumigation

Dr. Alicyn Smart, *UMaine Cooperative Extension*

Fumigation can be used to manage nematodes, plant diseases, weed seed and insects in potato production. Although, when considering to implement this management strategy, you should first consider a few things. This presentation will provide an overview of those considerations that should take place before using this strategy as well as weighing the pros and cons of using this type of management. Commonly heard questions like “Will I have to continue to use this year after year?” will be addressed and other questions are welcomed.



both pre-plant and post-harvest. Five potato cultivars were planted in a randomized block design in order to look at susceptibility to these diseases. Two chemicals, Omega fungicide and RidEz fertilizer were also incorporated into the trial to evaluate their ability to suppress Powdery Scab.

Four replicates of a control, an Omega fungicide and a RidEz fertilizer were planted and evaluated for incidence and severity of Powdery Scab. Based on one year's data, there was no statistical difference in the incidence levels of the control versus the two treatments, however, there was a significant statistical difference in the severity of Powdery Scab in both the RidEz and Omega treatments. No significant difference in severity was observed between the Omega and RidEz treatments. The Gray Laboratory, USDA/ARS at Cornell University will be testing tubers from each replicate for the presence of Mop-Top Virus after the tubers have been stored for 90 days.

Pink Rot Control with Foliar Applications

Jianjun (Jay) Hao, *School of Food and Agriculture, University of Maine, Orono, ME*

Pink rot of potato is caused by *Phytophthora erythroseptica*, which is a soilborne oomycete pathogen. The pathogen produces thick-walled oospores that can survive and persist in soil for years. During the plant growing season, *P. erythroseptica* infects roots and daughter tubers, which can cause a storage problem. Currently, chemical fungicides are a major strategy to control pink rot. Although some products can be applied in furrow and effective in controlling pink rot, there is a demand for post-planting treatment. Foliar application requires the chemical to be systemic in order to reach down to roots and tubers. The used-to-be effective chemical mefenoxam has been overcome by resistant population of *P. erythroseptica*. Phostrol (a.i. phosphorous acids) is a highly systemic fungicide that has been applied for the control of oomycete pathogens. Phostrol can directly inhibit the growth of *P. erythroseptica* by in-furrow application. It inhibits the oxidative phosphorylation in the metabolism of oomycetes. It also induces systemic disease

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resistance in host plant. More importantly, it has very low risk of resistance development in pathogen populations. It is an environmentally friendly that can be used in organic

production. Phostrol may also be applied as post-harvest treatment to control the disease in storage. For the best results, Phostrol has been applied combined with other oomycetocidal chemicals.

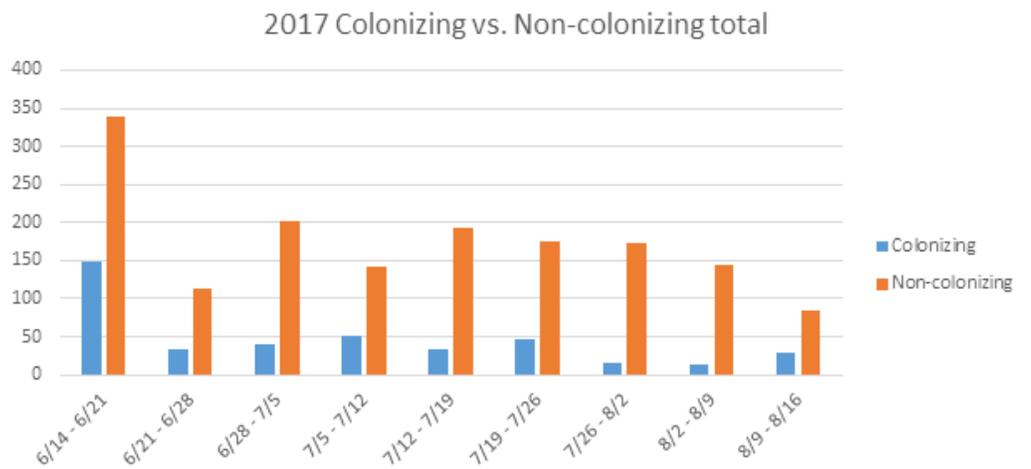
What We Have Learned About Aphids in the Last Five Years

Jim Dwyer, *Crops Specialist, UMaine Extension*; Marc Dwyer, *IPM Technician, UMaine Extension*

At one time, we would have told you that there are four aphid species that are of concern for potatoes. Now we know that aphids can be divided into two broad categories in relation to potatoes, colonizing aphids, those aphids that will live on potatoes. In addition, non-colonizing aphids, those aphids that do not live on potatoes but may pass through a field while looking for a host. Both groups of aphids have the potential to transmit Potato Virus Y.

When field scouting for aphids, in Maine, one will find essentially only four species of aphids; Potato, Buckthorn, Foxglove and Green Peach.

However, there are many more species that may have impact on the potato crop.



As shown in the above figure, we collect many more non-colonizing aphids on our yellow sticky cards.

The Effect of Neonicotinoid Insecticides on Pollinators, Global and State of Maine Perspectives

Dr. Frank Drummond, *School of Biology and Ecology, University of Maine, Orono, ME*

You can kill bees with neonicotinoids. Bees are quite sensitive to these insecticides. Levels of 20-50 parts per billion (ppb) can have behavioral and physiological effects on bees; but, exposure level or dose determines toxicity. What is the exposure to bees from these insecticides and for that matter, pesticides in general, in Maine? In 2015 we conducted a statewide survey of honeybee exposure to pesticides with assistance of volunteer beekeepers. Pollen trapping was conducted at 32 sites throughout the state of Maine in the spring, summer, and early fall. Apiary locations ranged from unmanaged natural landscapes to managed agricultural or urban landscapes. Chemical residue analysis was conducted on each pollen sample from each site for 190 pesticides and metabolites. Twenty-five different chemical residues were detected for an average of 2.9

pesticide detections per site. Detections were dominated by fungicides, but risk to honey bees, calculated as: residue concentration in pollen (ppb) / honey bee LD50 (ppb dose to kill 50% of exposed honey bees), was mostly due to insecticides. Beekeeper perceived land-use in the vicinity of the apiary was associated with significant differences in the number of detections and residue concentrations, agricultural landscapes being greater than non-agricultural. However, there was no significant difference in oral or contact risk quotients due to land-use type. The landscape composition surrounding apiaries, derived with GIS, determined pesticide exposure for honeybees when total detections, log pesticide residue concentration, and log contact risk quotients were used as measures. Partial least squares ex-

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plained 43.9% of the variation in pesticide exposure due to landscape composition. The most important predictors describing pesticide exposure were: area (ha) of blueberry, coniferous forest, and urban/developed land cover types. Maine is the most forested state in the U.S. (as determined

by % land area forested, 93%) and a negative exponential decay was observed between the land area in conifer forest and the number of pesticide detections per apiary. **In conclusion, bee exposure to pesticides is low in Maine and appears to be EXTREMELY low for neonicotinoid insecticides.**

Maine 2017 Post Harvest Testing

Eric Hitchcock, *Seed Certification Program Manager*

The certification of seed potatoes in Maine began in 1915. The purpose of the program is to control the level of regulated pests in Maine's potato industry. Certification is a three-step process that includes field inspection of seed potatoes during the summer, disease evaluation of samples submitted for testing in Florida, including laboratory testing in Presque Isle and inspection during shipping to ensure the potatoes meet grade standards. The inspections during all these three steps are conducted by trained seed certification specialists. In 2017, 106 growers entered 9,625 acres of seed potatoes for certification.

Today, Maine's winter testing, to certify seed potatoes as free from disease, is conducted at a facility in Florida on a 92-acre farm in Miami-Dade County. Purchased in 1967, the farm is now owned by the Maine Potato Board and operated by the Maine Department of Agriculture, Conservation and Forestry's Seed Potato Certification Program (SPCP). Additional winter testing is performed at the seed certification laboratory located in Presque Isle. The SPCP is responsible for carrying out the required post-harvest

tests on samples of seed produced both by the Maine Seed Potato Board's Porter Seed Farm and Maine's commercial seed potato growers. SCPC seed certification specialists prepare the fields, plant the crop in late fall and take foliage disease readings the first part of January of the following year. These results are then shared with the growers in late January to determine which seed met the tolerance levels to help them determine how they will market their crop.

Potato seed meeting the 0-.5% disease readings are classified as foundation seed, 0.5-5% readings are certified seed and readings greater than 5% are rejected from the program and are not allowed to be planted in Maine in the spring. Growers do have an opportunity to ask the Commissioner of Agriculture, Conservation and Forestry for a waiver on rejected acreage.

Maine was one of the first states in the country to require all potatoes planted commercially in the state be, at a minimum, certified seed under this program. Other states have used Maine as a model for developing their own certification standards.

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