Potato

Where: Gallery Overlook (upper level) Room A & B  
MI Recertification credits: 2 (1B, COMM CORE, PRIV CORE)  
CCA Credits: SW(0.5) PM(1.0)  
Moderator: Jim Isleib, Extension Educator, MSU Extension

2:00 pm  Colorado Potato Beetle Management  
          • Zsofia Szendrei, Entomology Dept., MSU

2:20 pm  Enviro-weather Tools for Potato Growers  
          • Beth Bishop, Enviro-weather Coordinator, Entomology Dept., MSU

2:40 pm  Three Weeds to Watch in 2013  
          • Fred Springborn, Field and Vegetable Crops Educator, MSU Extension

3:00 pm  Soil Health and Implications for Potato Production  
          • Kurt Steinke, Plant, Soil and Microbial Sciences Dept., MSU

3:25 pm  Progress in Scab Management  
          • Noah Rosenzweig, Plant, Soil and Microbial Sciences Dept., MSU

3:50 pm  Update from the MSU Potato Breeding Program  
          • David Douches, Plant, Soil and Microbial Sciences Dept., MSU

4:00 pm  Session Ends
Field Evaluations of Registered and Experimental Insecticides for Managing Colorado Potato Beetle on Potatoes

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The Colorado potato beetle (Figure 1) is the most widespread and destructive insect pest of potato crops in the eastern United States and Canada. Feeding by first generation larvae and summer adults can lead to significant defoliation and yield losses. Unfortunately, this pest is well known for its ability to develop resistance to a wide range of insecticide classes, and by the mid-1990s, growers in the Midwest had run out of effective chemical control options.

Figure 1. Colorado potato beetle larva (left) and adult (right).

Today, the two main neonicotinoid insecticides used in commercial potato production in the United States are imidacloprid and thiamethoxam. Imidacloprid was registered in 1995 and thiamethoxam in 2002 for Colorado potato beetle management on potatoes in the United States. These products appeared on the market at a time when most other registered insecticide classes were ineffective against this pest in the field. This clear need for an effective control measure led to a rapid and wide-scale adoption of neonicotinoids by commercial potato growers. According to a 2005 national survey, neonicotinoid insecticides were used on 60 – 70% of commercial potato acres in the United States (http://www.nass.usda.gov/). In a 2010 grower survey conducted in Michigan it was found that 80% of the Michigan commercial potato acreage was treated at planting with a neonicotinoid insecticide, and that the proportion of the total potato acreage treated with neonicotinoid insecticides had stayed approximately the same over the past 10 years.

The Colorado potato beetle’s ability to develop resistance to insecticides makes it very important to continue testing the efficacy of both new insecticide chemistries and existing compounds. Such tests provide data on comparative effectiveness of products and data to help support future registrations and use recommendations.
1st generation Colorado potato beetle insecticide field trial
Insecticides were applied in a field plot at the Montcalm Potato Research Farm; the graph below shows results for first (=overwintered) generation Colorado potato beetle large larval management. Insecticides were applied either once, at-planting in furrow, or foliar insecticides were sprayed at the 1 large larva or 1 adult per plant threshold. Bars with the same letters are not significantly different from each other.

RESULTS: All tested products significantly reduced first generation larvae relative to the untreated control. Platinum and an experimental compound (A16901) were the most effective at-planting treatments for suppressing large larvae. Among the foliar treatments, an experimental product called Benevia performed the best for larval control. This product was sprayed only once during the first generation, while all the other tested products had to be applied multiple times to keep larvae below threshold.

First generation Colorado potato beetle control

*numbers on bars indicate the number of times a particular insecticide was sprayed during the first generation, based on 1 large larva or 1 adult per plant threshold
2nd generation Colorado potato beetle insecticide field trial
Insecticides listed on the figure below were foliarly applied in the field on July 17, 2012. Adult Colorado potato beetles were counted on plants 24 and 72 hours after the foliar application. All the plants in this experiment were also treated with Admire Pro at-planting in furrow.

RESULTS: Twenty-four hours after foliar application all tested products significantly reduced adult abundance relative to the control, and all the insecticides performed similar to each other. Seventy-two hours after application Agri-Mek, Blackhawk and Voliam Xpress treated plants still had significantly fewer adults than the control.
Potatoes, like all crops, are adversely affected by weather-induced stress. Weather impacts potato crops directly and indirectly. Tuber growth begins when soil temperature reaches 40°F; above this development is proportional to temperature. The length of the growing season is directly influenced by temperature.

However, temperatures that are too warm, are detrimental to potatoes. The Michigan potato industry suffers estimated annual losses between $1.5 million and $2.5 million from weather stress, particularly heat, which causes potatoes to deteriorate in storage. According to Dave Douches, MSU Professor, potato breeding and genetics, and Chris Long, MSU potato specialist, night temperatures above 70°F increase respiration, which reduces tuber specific gravity or solid content and causes stem end defects (due to the reversal of translocation of storage carbohydrates). Daytime temperatures greater than 90°F or any 24-hr period with more than 35 degree-day accumulation (base 40), may enhance internal tuber defects such as heat necrosis, internal brown spot, and hollow heart. Many of these weather-induced defects are not apparent until the potatoes come out of storage.

Other stresses that are weather-related (drought, high rainfall amounts, hail, etc.) natural (pests, diseases, etc.) or man-made (herbicide damage, etc.) can affect plant physiology and, ultimately, tuber growth and quality. However, the impact of various stressors depends on the growth stage of the crop. Potatoes are especially vulnerable during tuber initiation and/or mid to late tuber bulking and extreme high temperatures or other stress factors during that time is more likely to influence tuber quality. If growers understand the timing of stress events relative to crop development they can adapt by selling the potatoes earlier, either directly from the field at harvest or after only short-term storage, thus salvaging many potential discards.
MSU’s Enviro-weather Program provides real-time and past weather information and predictions to help grower’s make optimal management decisions. Enviro-weather consists of a network of 71 weather stations throughout Michigan (and six weather station on Wisconsin’s Door Peninsula). Each weather station is equipped with at least 12 research-quality sensors, a data logger, and a cell modem, which is used to transmit data. Every 30 to 60 minutes during the growing season data is sent to a central server on the Michigan State University campus. The data is checked for quality, is organized and archived in a database. The data is used in on-line tools, weather summaries and tables, pest and predictive models, and crop-management applications that are accessible via the Enviro-weather website (www.enviroweather.msu.edu).

When a user accesses the Enviro-weather website, he or she will see a map of Michigan with the location of Enviro-weather stations indicated by yellow dots.

Users can view current conditions at any of the weather station locations simply by moving the mouse pointer of the dot and a box will pop up.

A number of weather applications and summaries are available on Enviro-weather by selecting a station by clicking on it. Users are taken to the “station page”, which shows summaries and applications that use the data from the selected weather station.

Applications and models that are specific to a particular crop can be accessed by clicking on the commodity list at the top of the page. This will bring up the commodity page, which has a list of crops in the left column. Clicking on the crop will bring up a list of tools and applications that are specific for that crop.

Enviro-weather has a number of applications available for potato growers, including predictive models for variegated cutworm and tools to evaluate heat stress. It also displays links to the MSU Potato Disease’s Lab Potato Late Blight Risk Map (Enviro-weather data is used, along with other data sources, to produce this map).
Three tools are available to help grower’s evaluate stress. The first, the “Heat Stress Summary” displays a yearly synopsis of weather factors affecting potato growth. The table summarizes, for each of the previous five years, the number of days during the season that were excessively hot (degree-days base 40°F greater than 35), the number of hours in excess of 90°F and the number of days the temperature reached or exceeded 90°F, and the number of nights that were warm (number of days and hours night temperatures were greater than 70°F).

The second heat stress tool available on Enviro-weather is the “daily heat and moisture accumulation.” This summary table displays daily maximum and minimum air temperature, soil temperature at 2 inches, daily degree-day accumulations (base 40°F) and soil moisture at 4 inches.

In 2011 we collaborated with The Michigan Potato Industry Commission and Chris Long, MSU Potato Specialist on a project to add stations to the Enviro-weather network and to expand and improve the heat stress tools. Thanks to funding provided by MPIC and MDARD, Enviro-weather was able to add four new weather stations to the network in potato-growing regions of Michigan that were not previously served by nearby Enviro-weather stations. New stations were installed in 2012 in Mecosta, MI, Kalkaska, MI, Gaylord, MI and McMillan/Newberry in the Upper Peninsula.

In addition, Enviro-weather also worked with Chris Long and Michigan potato growers to develop a new “potato maturity and stress” graphing tool. This application, ‘Enviro-weather Potato Maturity and Stress Graph’, allows growers to visually track the...
growth and maturity of their potato crop and the timing of stress events. The graph displays cumulative growing degree-days (base 40F) over the season and includes degree-days forecasted 7 days into the future. The timing of potentially stressful weather events, such as daytime temperatures above 88F, nighttime minimum temperature above 65F, days with rainfall over 1.5 inches or with an hourly rainfall rate of more than $7/10^6$ of an inch, are designated with special symbols. There is also an option to display “average” or “normal” growing degree-days (base 40F) for that location for comparison with the current season.

The graph can be customized by adding conditions and events specific to an individual field. Enviro-weather will display a graph for each field with the generic information described above, plus additional customized information. For example, growers can specify the date of key crop events (planting, emergence, flowering, tuber initiation, vine kill, harvest, etc.) and/or other stress events (herbicide injury, hail, defoliation, etc.). Users can also customize the definition of stress events. For example, they can choose a higher temperature for a nighttime heat event or a different base temperature for cumulative growing degree-days (see Figure).

To customize graphs, users must first create an account on Enviro-weather then specify their field locations. Setting up an Enviro-weather account allows you to save the specific information you enter. Then, each time you login your customized fields are displayed.

For more specific directions you can download a detailed tutorial by clicking on the “how to use the potato growth and stress graphing tool” link.

Many thanks go to the Michigan Potato Industry Commission and MSU Potato Specialist, Chris Long for their help conceiving of and developing this new tool. This work was funded by the MPIC and a MDARD Specialty Crop Grant. Enviro-weather is funded by MSU Extension, MSU AgBioResearch, Project GREEEN and generous contributions from industry and private donors.
Progress in Scab Management

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Introduction

Potato (Solanum tuberosum L.) is among the world’s most important food crops and is the highest-volume vegetable grown in the U.S. It is also one of the most intensively managed crops. It comprises the largest harvested acreage of vegetables (2007 Agriculture Census, Table 34). Potato production in the North Central region accounts for approximately 23% of the total U.S. production, with an estimated value of $716 million (USDA NASS, 2011). Potato production systems have long been plagued by a multitude of recurrent and persistent soilborne diseases (e.g. Common scab, caused by Streptomyces scabies and other Streptomyces spp.) (Stevenson et al. 2001). Typically soilborne diseases impact plant vigor, tuber quality, and at times marketable yield (Stevenson et al. 2001). Potato common scab (Figure 1), caused by Gram-positive bacteria, Streptomyces spp., is an annual production concern for commercial potato growers (Loria et al. 1997; Slack 1992). The disease is of major importance and difficult to manage in the U.S. North Central region (Stevenson et al. 2001) particularly in Michigan (Wharton et al. 2007).

Methods

Biological scab management programs. Potatoes (cut seed; “Snowden”) were planted at the Michigan State University Potato Research Farm, Enrichtan, MI. Soil treatments (Table 1) were applied and conventional cultivation practices were followed over the growing season. Randomly selected samples of 50 tubers per plot were harvested. Tubers were washed and assessed for common scab (S. scabies) incidence (%), 30 days after harvest. Severity of common scab was measured as an index calculated by counting the number of tubers (n = 50) falling in class 0:0= 0%; 1:1 to 1:6; 2:1 to 2:6; 3:1 to 3:6; 4:1 to 4:6; 5:1 to 5:6; and 6.1 to 6:6 where the first number is the type of lesion [(0= no lesions; 1= superficial discrete; 2= coalescing superficial; 3= raised discrete; 4= raised coalescing; 5= pitted discrete; 6= pitted coalescing surface area of tuber covered with tuber lesions (surface and pitted), Figure 1] and the second number is surface area affected (1=1 lesion to 2%; 2= 2.1-5%; 3=5.1-10%; 4= 10.1-25%; 5=25.1%-50%; 6, > 50% surface area).

Soil treatments for scab control. Soil treatments (Table 2) were applied at the Michigan State University Potato Research Farm, Clarksville, MI. Conventional cultivation practices were followed over the growing season. Disease incidence and severity was calculated as described above.

Results

Biological scab management programs. Common scab was severe in the trial (98–100% overall incidence, data not shown). Only the incidence and severity index in common scab class 6 (coalescing pitted lesions) and overall severity index for scab classifications 0 through 6 were reported (Table 1). Treatments with mean incidence of scab in severity class 6 ranged from 55.0 to 69.5%, and no treatments were significantly different from the untreated control (Table 1). Treatments with mean severity of scab in severity class 6 ranged from 41.5 to 54.1 and no treatments had significantly lower indices in comparison to the untreated control (Table 1). Treatments with mean severity of scab in the weighted
overall scab index rating that was inclusive of all severity classes ranged from 15.5 to 18.1 and no treatments had significantly lower indices in comparison to the untreated control except Actinogrow 0.0371WP. Treatments with total yield from 158 (untreated) to 191, 166 to 196 and 191 to 216 cwt/A were not significantly different (Table 1).

Table 1. Efficacy of crop protection programs on incidence and severity of common scab and yield in potatoes.

<table>
<thead>
<tr>
<th>Treatment rate/1000 ft row</th>
<th>Common scab incidence and severity index</th>
<th>Total Yield (cwt/A)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Incidence SG6&lt;sup&gt;a&lt;/sup&gt; (%)</td>
<td>Scab Index SG6&lt;sup&gt;b&lt;/sup&gt; (0-100)</td>
</tr>
<tr>
<td>Serenade Soil 1.34SC 4.4 fl oz (A)&lt;sup&gt;d&lt;/sup&gt;</td>
<td>63.5&lt;sup&gt;e&lt;/sup&gt; abc</td>
<td>45.8 a-d</td>
</tr>
<tr>
<td>Serenade Soil 1.34SC 8.8 fl oz (A)...........</td>
<td>55.0 c</td>
<td>42.3 cd</td>
</tr>
<tr>
<td>Blocker 4F 11 fl oz (A).................</td>
<td>58.0 bc</td>
<td>41.5 d</td>
</tr>
<tr>
<td>Serenade Soil 1.34SC 4.4 fl oz + Blocker 4F 5.5 fl oz (A)........</td>
<td>58.0 bc</td>
<td>43.6 bcd</td>
</tr>
<tr>
<td>Blocker 4F 11 fl oz + NAA 100F 0.017 fl oz (A).........</td>
<td>65.5 ab</td>
<td>50.4 abc</td>
</tr>
<tr>
<td>Actinogrow 0.0371WP 1.67 oz (A)&lt;sup&gt;d&lt;/sup&gt;</td>
<td>69.5 a</td>
<td>54.1 a</td>
</tr>
<tr>
<td>MBI-106020 20SC 8 fl oz (A)............</td>
<td>67.5 ab</td>
<td>51.7 ab</td>
</tr>
<tr>
<td>MBI-106020 20SC 16 fl oz (A).......</td>
<td>58.0 bc</td>
<td>44.2 bcd</td>
</tr>
<tr>
<td>Untreated.................................</td>
<td>60.0 abc</td>
<td>43.1 bcd</td>
</tr>
</tbody>
</table>

<sup>a</sup>Severity of common scab was measured as an index calculated by counting the number of tubers (n = 50) falling in class 0:0= 0%; 1:1 to 1:6; 2:1 to 2:6; 3:1 to 3:6; 4:1 to 4:6; 5:1 to 5:6; and 6:1 to 6:6 where the first number is the type of lesion (0= no lesions; 1= superficial discrete; 2= coalescing superficial; 3= raised discrete; 4= raised coalescing; 5= pitted discrete; 6=pitted coalescing surface area of tuber covered with tuber lesions (surface and pitted) and the second number is surface area affected (1= 1 lesion to 2%; 2= 2.1-5%; 3=5.1-10%; 4= 10.1-25%; 5=25.1%-50%; 6, > 50% surface area). These incidence data are for Scab Severity Group 6 only.

<sup>b</sup>Severity index data are for Scab Severity Group 6 only.

<sup>c</sup>Weighted Severity index data are for Scab Severity Groups 1 through 6; each severity index 1 through 6 was multiplied by 1, 2, 3, 4, 5 and 6, respectively then divided by a constant (21) to express the severity data as an index from 1–100.

<sup>d</sup>Application dates: A= 24 May.

<sup>e</sup>Values followed by the same letter are not significantly different at P = 0.05 (Tukey Multiple Comparison).

Soil treatments for scab control. No treatment affected final plant stand or the rate of emergence (data not shown). Common scab developed in the trial and all plots had about 60-70% incidence within Scab Severity Group 6 (deep pitted scab), which on a quality scale would have made them difficult to market (Table 2). PicPlus did not significantly reduce common scab incidence and severity in comparison to the untreated control and to the Vydate program (Table 2). No soil applied products increased total yield in comparison to the untreated control although PicPlus 98 lb/A significantly increased total yield in comparison to the Vydate program. Soil treatments were not phytotoxic in terms of plant stand or rate of emergence (Table 2).
Table 2. Efficacy of PicPlus against common scab of potato, 2011-12.

<table>
<thead>
<tr>
<th>Treatment and rate/A</th>
<th>Incidence SG6b (%)</th>
<th>Scab Index SG6b,c,e (0-100)</th>
<th>Scab Index Overall b,d,e</th>
<th>Total Yield (cwt/A)b</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vydate 3.77SL 4.2 pt (B³),</td>
<td>72.0 a</td>
<td>58.5 a</td>
<td>21.2 a</td>
<td>333 b</td>
</tr>
<tr>
<td>Vydate 3.77SL 2.1 pt (C)</td>
<td>71.5 a</td>
<td>58.5 a</td>
<td>21.0 ab</td>
<td>351 ab</td>
</tr>
<tr>
<td>PicPlus 85.5AP 70 lb (A)</td>
<td>66.5 a</td>
<td>49.6 a</td>
<td>18.9 b</td>
<td>410 a</td>
</tr>
<tr>
<td>PicPlus 85.5AP 98 lb (A)</td>
<td>70.0 a</td>
<td>52.8 a</td>
<td>19.1 ab</td>
<td>388 ab</td>
</tr>
<tr>
<td>PicPlus 85.5AP 136 lb (A)</td>
<td>76.5 a</td>
<td>59.7 a</td>
<td>20.4 ab</td>
<td>367 ab</td>
</tr>
<tr>
<td>PicPlus 85.5AP 164 lb (A)</td>
<td>71.5 a</td>
<td>54.8 a</td>
<td>19.2 ab</td>
<td>357 ab</td>
</tr>
<tr>
<td>Untreated Check</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HSD₀.₀₅</td>
<td>13.82</td>
<td>12.65</td>
<td>2.24</td>
<td>68.5</td>
</tr>
</tbody>
</table>

a A = Soil treatments applied on 13 Oct, 2011 by a tractor-mounted soil injection system; B= in-furrow at planting application in 8 gal H₂O/A 8 May, 2012; C= hilling application in 8 gal H₂O/A 12 Jun, 2012.

b Values followed by the same letter are not significantly different at p = 0.05 (Honest Significant Difference; Tukey Multiple Comparison).

c Severity of common scab was measured as an index calculated by counting the number of tubers (n = 50) falling in class 0:0= 0%; 1:1 to 1:6; 2:1 to 2:6; 3:1 to 3:6; 4:1 to 4:6; 5:1 to 5:6; and 6:1 to 6:6 where the first number is the type of lesion (0= no lesions; 1= superficial discrete; 2= coalescing superficial; 3= raised discrete; 4= raised coalescing; 5= pitted discrete; 6=pitted coalescing surface area of tuber covered with tuber lesions (surface and pitted) and the second number is surface area affected (1= 1 lesion to 2%; 2= 2.1-5%; 3=5.1-10%; 4= 10.1-25%; 5=25.1%-50%; 6, > 50% surface area). These incidence data are for Scab Severity Group 6 only.

d Severity index data are for Scab Severity Group 6 only.

e Weighted Severity index data are for Scab Severity Groups 1 through 6; each severity index 1 through 6 was multiplied by 1, 2, 3, 4, 5 and 6, respectively then divided by a constant (21) to express the severity data as an index from 1-100.

Summary

Effective management of potato common scab is still elusive and inconsistent, and this disease has remained one of the top four diseases of potato (Loria et al. 1997; Slack 1992). As consistent, effective control measures are lacking and host resistance cannot be relied upon as a sole disease control measure (Loria et al. 1997; Slack 1992), common scab disease in potato production is largely managed using a combination of varietal resistance, fungicides, fumigation, and cultural practices including crop rotation, soil amendments, delayed planting, and irrigation management. Reduced availability of chemical fungicides effective for potato soilborne disease control necessitates biopesticides for disease management, with the added benefit of reducing chemical pesticide inputs (Chandler et al. 2008). We will continue to evaluate the effectiveness of promising biologically based and conventional treatments on common scab management, tuber yield and quality, with the added component of overall soil health under multiple field conditions and locations over the coming growing seasons.

Acknowledgements

This project was partially supported by the Michigan Potato Industry Commission, and the Michigan State University Project GREEEN.

References


Figure 1. Potato (*Solanum tuberosum*) tubers infected with potato common scab caused by *Streptomyces* spp., A: 1= superficial discrete; B: 2= coalescing superficial; C: 3= raised discrete; D: 4= raised coalescing; E: 5= pitted discrete; F: 6=pitted coalescing surface area of tuber covered with tuber lesions (surface and pitted).