2012 Pennsylvania Vegetable Marketing and Research Program
Pennsylvania Vegetable Growers Association Report
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Title: Building upon BLITECAST and PA-PIPE: Evaluation of an improved decision support system for late blight

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Introduction:

Late blight caused by *Phytophthora infestans* continues to be an annual concern for tomato and potato growers both in Pennsylvania, New York and across the Northeast. Similar to many pathogens, *P. infestans* has the ability to change over time which impacts our ability to manage the disease. In the 1970's and 1980's mefenoxam was very effective for managing late blight but as the pathogen population shifted so did the efficacy of mefenoxam. Since 2009, the pathogen population has begun to shift towards being sensitive to mefenoxam again. In 2011, the Fry lab at Cornell University determined that seven of the 13 late blight were sensitive to mefenoxam thus indicating that the application of Ridomil in those fields would have been effective. In PA, growers have relied on BLITECAST to help time fungicide applications based on accumulated environmental conditions that are favorable for disease development. Historically this model was run using weather data collected from in-field weather stations and more recently using real-time mesoscale weather data from Zed X., Inc. and disseminated via the Pennsylvania Pest Information Platform for Extension and Education (PA-PIPE). A more comprehensive decision support system has been developed that builds upon the use of traditional forecasting programs, BLITECAST, to incorporate information about host resistance, pathogen characteristics and fungicide application history to manage late blight. The system is composed of four components that include 1) location specific weather data; 2) disease forecasting models BLITECAST and SimCast; 3) late blight disease simulator; and 4) an alert system. The grower sets-up a free account and inputs information regarding location, cultivar, planting date, and fungicide history. This information is saved and can be accessed when logged-in during subsequent sessions. The report provides information regarding past and forecasted temperatures, relative humidity and rainfall as well as both accumulated and forecasted disease severity values based on BLITECAST. Based on BLITECAST, the first fungicide application is made when 18 disease severity values (DSV) have accumulated and then subsequent applications are made after the accumulation of 7 additional DSVs. A SimCast report is also provided that incorporates the level of host resistance of the crop along with information regarding crop fungicide residue levels which decline over time between applications.

Field testing of the Cornell late blight decision support system on potato in 2010 and 2011 in New York reduced the number of fungicide applications needed to manage late blight compared to standard weekly spray program used by growers to achieve the same level of disease management while the untreated control plots were severely diseased.

Expansion of this system to tomato and evaluation of this decision support system for managing late blight on tomato under Pennsylvania growing conditions will provide growers with a more comprehensive tool for managing late blight that also takes into account the ever changing pathogen population along with host resistance.

Here, we report our efforts during the 2012 season to address the following objective:

1. Evaluate/field-test the use of the Cornell late blight decision support system in combination with host resistance and fungicide program for managing late blight on tomato in PA in a replicated field trial.

Methods and Results:

To evaluate the use of the Cornell late blight decision support system for managing late blight on tomato in PA, a split split plot field trial was established at the Russell E. Larson Research and Education in Rock Springs, PA with tomato cultivar as the whole plot, fungicide program as the sub-plot and application timing as the sub-sub plot. Tomato cultivars Mountain Spring and Plum Regal, selected based on their differential susceptibility to late blight, were seeded in mid- to late May and transplanted on 21 Jun using a carousel transplanter. At planting, the transplants received starter fertilizer (165 g 20-20-20/60 gal water) and Admire (60 ml/60 gal water). Plots were 10 ft long and consisted of a treatment row and an untreated guard row (cv. Heinz 9704 and 3406) and a 4 ft break between plots within the row. A single row of drip irrigation was laid adjacent to each row. Treatment rows in each plot were supposed to receive either chlorothalonil (Bravo Weather Stik 6F 2.0 pt/A) or copper (Champ WG 4.0 lb/A) following a 7-day regular schedule, using the Cornell decision support system or remain untreated (no fungicide control). Unfortunately, late blight resulting from natural inoculum was observed in the trial before any preventative fungicides were applied based on the forecasting systems therefore all the plots were sprayed on a 7-day schedule rather than using the forecasting systems. Fungicides were applied using a Solo backpack sprayer with a TX-18 hollow cone nozzle at 3 mph delivering 20 gpa up and down both sides of the row. Applications were initiated on 11 Aug and continued weekly through 25 September.

Plots were rated for late blight disease incidence and severity on a weekly basis. Weekly disease severity values were used to calculate the area under the disease progress curve. Data were analyzed using an analysis of variance and significant means were separated using Fisher's least significant difference test in SAS 9.2 (SAS Institute, Cary, NC).

In the absence of fungicides, host resistance alone significantly reduced late blight disease severity throughout the season. The area under the disease progress curve value at the end of the season for Plum Regal (a measure of cumulative disease over the season) was almost 50% lower than for Mountain Spring. It is not surprising that Plum Regal developed late blight (Figure 1)

under high disease pressure since it only contains the *Ph-3* late blight resistance gene in the heterozygous state. This means that only one allele (copy) of the gene is conferring late blight resistance. Currently, the most effective host resistance against the more recent genotypes of *Phytophthora infestans* is found in hybrid tomato and breeding lines that contain multiple resistance genes such as Mountain Merit and Mountain Magic which contain both *Ph-2* and *Ph-3*. In 2012, symptomatic tomato and potato samples collected from PA were genotyped as US23 by the Fry lab at Cornell University. US23 is characterized as the A1 mating type and is aggressive on both tomato and potato; however it produces many more spores on tomato. US23 is also characterized as sensitive to the systemic fungicide mefenoxam which was effectively used in several potato fields to manage the disease outbreak in 2012.

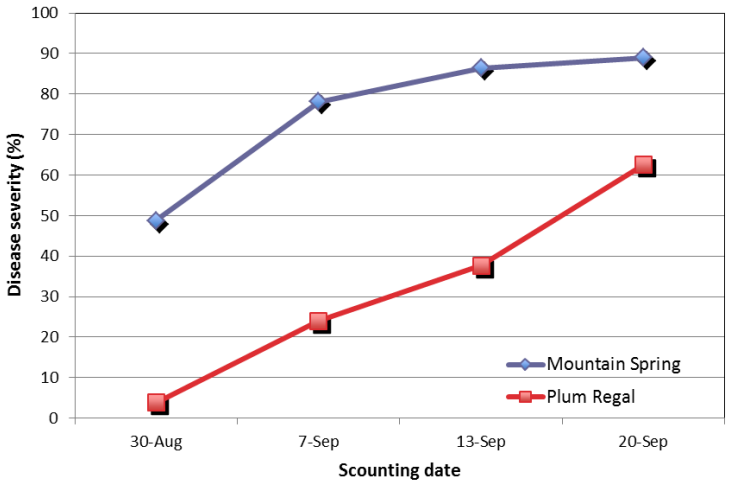

Figure 1. Late blight disease severity on tomato cvs. Mountain Spring and Plum Regal assessed on four dates during the 2012 season.

When coupled with weekly protectant fungicide applications, foliar disease severity on the highly susceptible tomato cv. Mountain Spring was reduced from 89% in the untreated plots to 75% in the plots treated with Champ (4.0 lb/A) and further reduced to 63% in the Bravo WeatherStik (2.0 pt/A) treated plots on 20 Sep (Figure 2). With the use of weekly applications of Bravo, late blight severity on Mountain Spring was reduced to the same levels achieved through the use of host resistance conferred by Plum Regal. The protectant fungicides also reduced the severity of stem lesions from 100% in the untreated plots to 80% and 52% for copper and chlorothalonil, respectively. They were not as effective at reducing fruit infection which was approximately 50% across all treatments.

The use of either protectant fungicide (copper or chlorothonil) in combination with Plum Regal reduced foliar disease severity in half from 60% to 30% (Figure 3). For organic growers, the use of late blight host resistance in combination with a OMRI approved copper fungicide such as Champ can be used to successfully reduce late blight incidence and severity even under very high disease pressure like observed in 2012. Stem lesions and fruit infection were also reduced in the fungicide treated plots.

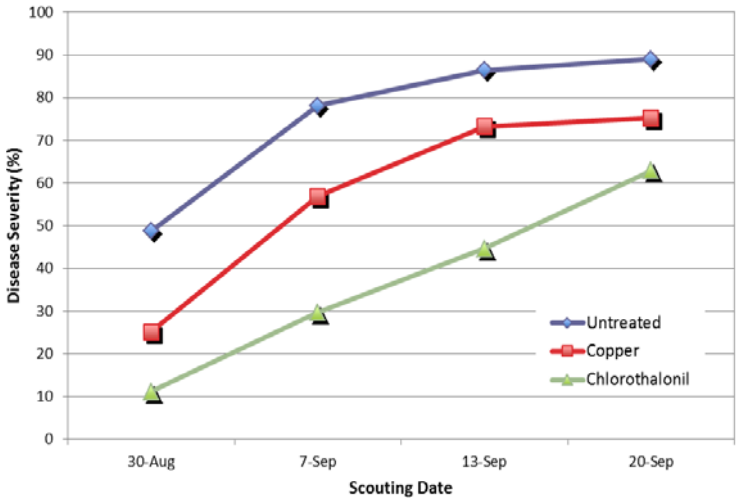

Figure 2. Late blight disease severity on the susceptible tomato cv. Mountain Spring treated with weekly applications of copper or chlorothalonil and assessed on four dates during the 2012 season.

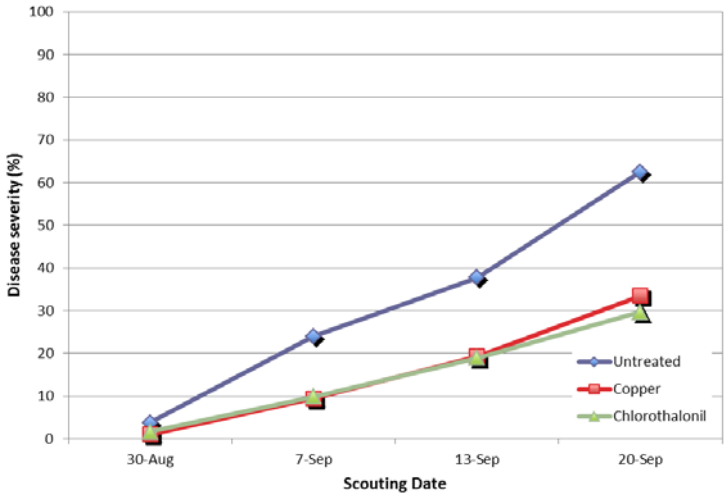

Figure 3. Late blight disease severity on the late blight resistant tomato cv. Plum Regal treated with weekly applications of copper or chlorothalonil and assessed on four dates during the 2012 season.