2010 Pennsylvania Vegetable Marketing and Research Program
Pennsylvania Vegetable Growers Association Report
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Title: Tomato blight forecasting: Delivery through the Pennsylvania Pest Information Platform for Extension and Education (PA-PIPE)

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Introduction:

Early blight (*Alternaria solani*) and late blight (*Phytophthora infestans*) continue to be annual concerns for tomato producers across Pennsylvania. The forecasting models developed and/or improved by Dr. Alan MacNab have enabled growers to apply fungicides based on when the environmental conditions are favorable for pathogen and disease development rather than on a calendar spray schedule. His research resulted in improved yields and reduced fungicide costs by eliminating unnecessary fungicide sprays. In an effort to provide this valuable information more cost-effectively, we are currently in the process of modifying the models using interpolated atmospheric weather data with a 6 km (approx. 3.7 mile) resolution, rather than the traditional labor intensive field-based weather stations. These models are run daily and the daily disease severity values, which are traditionally assigned based on select weather parameters (relative humidity, leaf wetness, temperature, etc.) are converted to percent disease risk ratings, which are depicted using color coding on a map of Pennsylvania (similar to a weather radar map) (Fig. 1). The higher the risk, the more favorable the weather and more likely the disease will develop if the pathogen

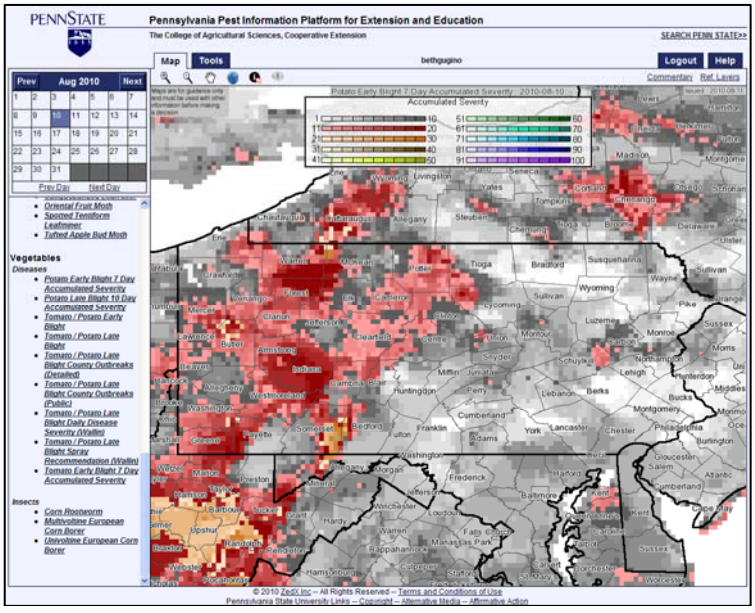

Figure 1. *Early blight 7-d accumulative disease risk ratings for Pennsylvania on 10 Aug 2010. Each pixel/square represents 6 km.*

is present. Since spray recommendations using the tomato fungicide timing programs FAST and Tomcast are based on the accumulation of 7-day disease severity values, the 2010 disease risk maps for early blight reflect the cumulative risk over the past 7 days. The maps can be viewed through the PA-PIPE (Pennsylvania Pest Information Platform for Extension and Education) website (http://pa-pipe.zedxinc.com) which has been developed in collaboration with ZedX, Inc., Bellefonte, PA (Fig. 1).

The PA-PIPE site is able to run the models for each 6 km block (represented by a pixel/square on the map) in a grid that covers Pennsylvania rather than being limited only to locations where weather stations are present. Growers who register at the site (at no cost) will also be able to enter additional farm specific information (i.e. planting date, fungicide spray dates, etc.) so that the spray recommendations generated based on accumulated disease severity values may be further tailored for their farm and retained in the system for future reference, if desired. Additionally, as needed, county and state level commentary will be posted about the incidence and severity of early and late blight across the state. Some technical complications prevented use of the commentary tools during the 2009 late blight outbreak.

During the 2008 season, the FAST/Tomcast models for early blight were run using SkyBit weather data for the 19 historic locations where Dr. McNab had located weather stations on the farms of collaborating growers. Accumulated disease severity values were totaled by hand and used to generate spray recommendations. In 2009, the Tomcast was run using the higher resolution RTMA weather data (Real-Time Mesoscale Analysis) and compared to in-field weather stations similar to those used by Dr. MacNab. Unfortunately the low incidence of early blight and high pressure from late blight in both trials challenged our ability validate the model in 2009 using commercial field observations.

Here we report our efforts during 2010 to address the following objectives:

1. Continuing to validate the early blight disease forecasting models used to calculate disease risk ratings by correlating them to field observations from commercial fields;
2. Continuing to evaluate early blight development using different fungicide timing programs based on disease severity values calculated using RTMA high resolution weather data as well as,
3. Further develop the interactive platform for dissemination of spray recommendations using the Pennsylvania Pest Information Platform for Extension and Education (PA-PIPE; http://pa-pipe.zedxinc.com).

Methods and Results:

Objective 1: *Validation of the early blight disease forecasting models used to calculate disease risk ratings by correlating them to field observations from commercial fields.*

To validate the disease risk models, observations of early blight percent incidence and/or severity from the routine scouting of commercial fields in several different regions across the state will be recorded regularly in collaboration with Scott Hoffman and Ken Martin of Furmano Foods. This information will be submitted to the principle investigator via email or fax. In addition detailed spray schedules will be obtained from the collaborating growers at the end of

the season. The development of early blight in the field will be correlated with the disease risk ratings for that specific date and field GPS location. To augment data from commercial fields, data from the research plots described below will also be used to validate the disease risk ratings. Validation of the disease risk ratings with disease development in the field is needed to insure that the information used to determine the spray recommendations reflects what is happening in the field.

Results:

For the second year in a row environmental conditions were not conducive for the development of early blight which challenged our ability to use commercial field observations to validate the early blight disease forecasting models in 2010.

Objective 2: *Evaluate early blight development using different fungicide timing programs based on disease severity values calculated using RTMA high resolution weather data.*

On 3 and 15 June, field trials were established at the Southeast Research and Extension Center in Landisville, PA and at the Russell E. Larson Agricultural Research Center at Rock Springs, PA to evaluate early blight development using different fungicide timing programs based on disease severity values calculated using either in-field weather station data or meso-scale RTMA weather data provided by ZedX, Inc. Tomato transplants, cv. Heinz 3402 provided by Ken Martin, Furmano Foods, were planted in 20 ft long plots with 12 in in-row spacing and 5 ft between plots in the row. Treatment rows were separated by untreated guard rows. Pre-plant fertilizers and herbicides were applied according to the Commercial Vegetable Production Guidelines for processing tomatoes. In Landisville, plots were irrigated with drip irrigation twice weekly. Due to the excessively dry conditions at Rock Springs, drip irrigation was installed on 26 July and turned on twice weekly the remainder of the season; no irrigation had been applied previously. The treatments included: (1) untreated control; (2) standard 7-d fungicide spray schedule; (3) Tom-Cast thresholds of 35 cumulative disease severity values (CDSV) for 1st spray then 18 CDSV to trigger subsequent applications (Tom-Cast – 18) calculated using in-field weather station data; (4) Tom-Cast (as described in trt c) + 14-day maximum spray interval (Tom-Cast – 18 +14d) using in-field weather station data; (5) Tom-Cast model (as described in trt 3) run using meso-scale RTMA weather data provided by ZedX, Inc and (6) Tom-Cast model (as described in trt 4) run using meso-scale RTMA weather data. Penncozeb 1.5 lb/A was applied using a tractor mounted, CO_2 powered side boom sprayer calibrated to deliver 24 gal/A at 36 psi at the tank and 30 psi through hollow-cone nozzles based on the treatment parameters listed above.

A Campbell Scientific solar powered weather station (CR-10) containing instruments/sensors to measure rainfall, temperature, relative humidity, and leaf wetness was set-up near each field trial. Weather data was downloaded to a laptop computer weekly on Sunday or Monday. ZedX, Inc. used this data as well as their meso-scale RTMA data to run the models for both field trial locations and provide daily disease severity values in an Excel spreadsheet format on a weekly basis. This information was summed weekly and based on the number of accumulated disease severity values (DSV) and model parameters it was determined whether or not the spray threshold had been met. The trial at Rock Springs and Landisville was scouted weekly and

biweekly, respectively and early blight disease severity on 10 leaves per plot was recorded. Yield data was collected at harvest from the trial conducted at Rock Springs.

Results:

In general the prolonged hot and dry conditions were not favorable for the development of early blight. In fact, conditions at Landisville were so unfavorable that the 35 cumulative DSV threshold used to trigger the initiation of a fungicide spray program was never reached and very little, if any, early blight was observed in that trial during the season. At Rock Springs, thresholds were not reached until August, over a month later than in 2009 and as a result, disease severity was low at <3% of the leaf surface showing symptoms (Table 1). In the Rock Springs trial, the early blight Tom-Cast models run using the meso-scale RTMA data reached the 35 cumulative disease severity threshold for triggering the first fungicide application 3 weeks earlier compared to using in-field weather station data. The RTMA data based models also called for 2 and 3 subsequent fungicide applications based on the accumulation of 18 additional DSVs and a 14-d max spray interval compared to 0 and 1 for the in-field weather stations, respectively (Table 2). In addition, over the course of the trial, the models run using the RTMA data accumulated over 2.5 times the number of disease severity values compared to when the models were run using in-field weather station data.

The use of RTMA data to run the Tom-Cast forecasting models and delivery through the PA-PIPE represents a significant and forward-thinking change in how fungicide spray timing recommendations are made. The increased number of fungicide applications recommended based on the accumulation of daily disease severity values using the RTMA data warrants further investigation and validation. We plan to continue this work as well as work with ZedX, Inc. to further improve the user-ability of PA-PIPE website.

Table 1. Evaluation of Tom-Cast fungicide-timing programs using in-field and meso-scale RTMA data on foliar early blight disease severity.

		Early blight disease severity (% leaf area symptomatic)	
Treatment	**Weather data source**	**22 Sep**	
Untreated control	n/a	2.12	a
7d spray	n/a	0.42	b
Tom-Cast - 18	RTMA data	1.38	ab
Tom-Cast - 18	In-field station	1.22	ab
Tom-Cast – 18 + 14d	RTMA data	1.17	ab
Tom-Cast – 18 + 14d	In-field station	0.64	b
Fisher's LSD *P*-value		0.0316	

Table 2. Evaluation of Tom-Cast fungicide-timing programs using in-field and meso-scale RTMA data on the timing and number of fungicide applications made for managing early blight on tomato, Rock Spring, PA. The trial was established on 3 June.

	Weather data source			
	In-field weather station		**RTMA data**	
Forecasting Program	**TomCast-18**	**TomCast-18 + 14d**	**TomCast-18**	**TomCast-18 + 14d**
Date reached 35 CDSV thresholds trigger 1st spray	26 Aug	26 Aug	4 Aug	4 Aug
Date of 1st fungicide application	26 Aug	26 Aug	5 Aug	5 Aug
No. of subsequent sprays	0	1	2	3
Subsequent spray dates	n/a	9 Sep	19 Aug 9 Sep	19 Aug 2 Sep 16 Sep
Total number of DSV accumulated during trial	46		117	

Objective 3: *Further develop the interactive platform for dissemination of spray recommendations using the Pennsylvania Pest Information Platform for Extension and Education (PA-PIPE; http://pa-pipe.zedxinc.com).*

Improvements continue to be made in the PA-PIPE in collaboration with Zed X, Inc. An outbreak map was added to provide the latest information regarding the counties where late blight has been confirmed. Also a tool is currently being developed that would enable growers to calculate disease severity values based on their planting and fungicide application dates. The Penn State Cooperative Extension Vegetable and Small Fruit Production team is in the process of developing a website that will provide links and information that will make this information as well as other disease management information more accessible for growers.

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The project investigator would like to acknowledge the help of John Stepanchak, Jim Bollinger and Tim Elkner with the establishment and maintenance of the Landisville field trial. In addition, Tim Elkner helped to download the weather station data weekly. Randy Driebelbis and Ryan Boonie helped with the establishment and maintenance of the Rock Springs trial. Special thanks to Scott Isard, Department of Plant Pathology, Penn State for providing and configuring the two in-field weather stations and Ken Martin for providing the tomato transplants for both trials.

Budget:

Hourly wages (+ fringe benefits 8.5%) for research technician and summer help to assist conducting proposed scouting and field work for 15 wks for 8hrs/wk at $16 and $8/hr, respectively……	$ 3125
Supplies to establish, maintain, harvest and evaluate two field trials……...	$ 1200
Travel (towards car rental expenses to establish, maintain, scout and harvest field trials)……..	$ 600
Total…….	**$ 4925**