2009 Pennsylvania Vegetable Marketing and Research Program
Pennsylvania Vegetable Growers Association Report
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Tomato blight forecasting: Delivery through the Pennsylvania Pest Information Platform for Extension and Education (PA-PIPE)

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Introduction:

Early blight (*Alternaria tomatophila* formerly *A. solani*) and late blight (*Phytophthora infestans*) continue to be an annual concern 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 the pathogen and disease development rather than based on a calendar spray schedule. His research resulted in improved yields and reduced fungicide costs by eliminating unnecessary fungicide sprays. Since the passing of Dr. MacNab, the tomato early and late blight forecasts have been in a state of transition. In an effort to provide this valuable information more cost-effectively, we are currently in the process of modifying the fungicide timing models to be run using sophisticated atmospheric weather data with a 6 km (approx. 3.7 mile) resolution rather than the labor intensive field based weather stations. Models are run daily and the daily disease severity values that are traditionally assigned based on select weather parameters (relative humidity, leaf wetness, temperature, etc.) have been converted to percent disease risk ratings and are depicted using color

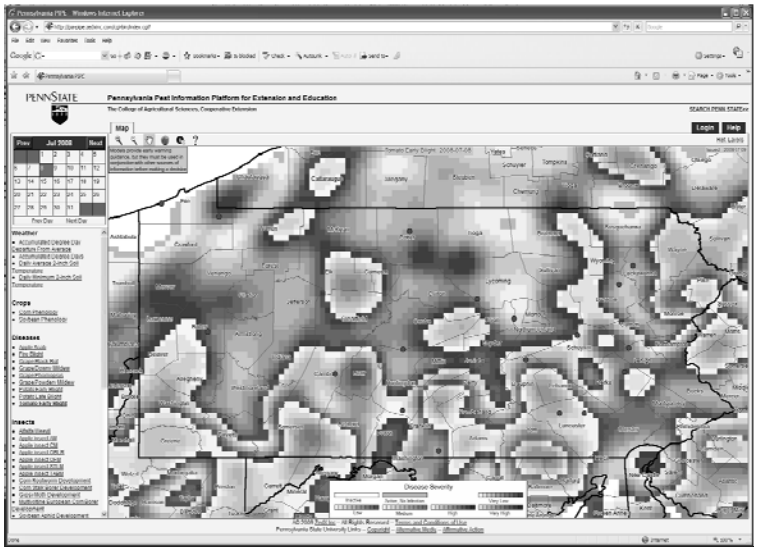

Figure 1. Early blight disease risk ratings for Pennsylvania on 6 July 2008. Each pixel/square represents 6 km. The 19 dark circles represent the 19 locations where on-farm weather stations have been historically been located.

coding on a map of Pennsylvania (similar to a weather radar map). The higher the risk, the more favorable the weather and more likely the disease will develop if the pathogen is present. Since spray recommendations using the tomato fungicide timing programs FAST and Tom-Cast are based on the accumulation of 7-day disease severity values, disease risk maps for early and late blight are in the process of being modified to reflect the cumulative risk over the past 7 days. These 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.

The significant changes in the source of weather data, as well as the delivery method need to be validated to ensure that the calculated disease risk reflects actual disease development naturally occurring in the field and that the timing of the spray recommendations will provide adequate early and late blight control.

Here, we report our efforts during 2009 to address the following objectives.

Objectives:

The purpose of this project is to:

1. Validate the early blight models used to calculate disease risk ratings by correlating the rating to commercial field observations.
2. Evaluate early blight development using different fungicide timing programs based on disease severity values calculated using RTMA high resolution weather data.

Methods and Results:

Objective 1: Validate the early blight models used to calculate disease risk ratings by correlating the rating to commercial field observations.

The tight sprays intervals that commercial growers implemented as a result of the early and widespread outbreak of late blight in Pennsylvania and the less favorable environmental conditions for early blight made it difficult to validate the early blight models this year using commercial field observations. Therefore this work will continue next season.

During winter 2009 in collaboration with Joe Russo, ZedX, Inc., modifications to the PA-PIPE were made to incorporate commentary tools that enable statewide and county commentary to be uploaded and viewed by website users. These tools are continuing to undergo refinement and improvement.

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

On 9 and 10 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 1) either in-field weather station data or 2) meso-scale RTMA weather data provided by ZedX, Inc. Tomato transplants, cv. Heinz 3402 provided by Ken

Martin, Furmano Foods, were planted in 15ft 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. The treatments included: (1) untreated control; (2) standard 7-d 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 in the center of 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. Unfortunately, late blight moved into each trial in early August and despite several applications of Ranman and/or Curzate and Revus (no efficacy on early blight) the guard rows and the most severely infected treatment plots were plowed-in to prevent further spread to other tomato trials at the Rock Springs farm. Not surprisingly, the plots sprayed with Penncozeb on a 7d spray schedule did not need to be destroyed. The outbreak of late blight precluded the collection of yield data from the trials.

Results: The first early blight symptoms were observed on 10 July and in mid-August in the Rock Springs and Landisville trials, respectively. Due to the unusually cool and wet weather this season, very little early blight developed in either trial (Table 1; Landisville data not shown). Late blight was observed in both trials in early August confounding early blight disease ratings and precluding any tomato harvest evaluations. Applications of Ranman and/or Curzate and Revus were not able to keep late blight in check and as a result the guard rows and several treatment plots were prematurely destroyed.

In both the Rock Springs and Landisville trials, 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 and 5 weeks earlier compared to using in-field weather station data. The RTMA data based models also called for 3 subsequent fungicide applications based on the accumulation of 18 additional DSVs and/or a 14 d max spray interval for both trials compared to 0 and 1 for the in-field weather stations at Rock Springs and Landisville, 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. Some of the differences may be attributed to discrepancies in rainfall measurements. Both in-field weather stations recorded significantly less total rainfall compared to the interpolated estimates calculated for the RTMA data. The in-field weather station at Rock Springs also differed from the total rainfall accumulated for the same time interval (7.6 in) in a low-tech rain gauge located several hundred feet from the research plot.

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

		Early blight disease severity (% leaf area symptomatic)				
Treatment	**Weather data source**	**10 July**	**17 July**	**24 July**	**1 Sep**	**7 Sep**
Untreated control	n/a	0.6	0	0.5	0.3	destroyed
7d spray	n/a	0.8	0.6	1.2	0.7	0.6
Tom-Cast - 18	RTMA data	0.3	0.4	0.2	0.1	0.3
Tom-Cast - 18	In-field station	1.2	0.5	0.5	0.9	0.5
Tom-Cast – 18 + 14d	RTMA data	1.4	0.3	0.3	0.3	0.3
Tom-Cast – 18 + 14d	In-field station	0.8	0.7	0.3	1.1	0.8

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.

The work described was funded through the Pennsylvania Vegetable Marketing and Research Board and Pennsylvania Vegetable Growers Association. Continuing support for the PA-PIPE infrastructure was provided by the College of Agricultural Sciences at Penn State and ZedX, Inc.

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.

Table 2. Evaluation of Tom-Cast fungicide-timing programs using in-field and meso-scale RTMA data on the timing and number of of fungicide applications made for managing early blight on tomato.

	Rock Springs				Landisville			
Weather data source	**In-field weather station**		**RTMA data**		**In-field weather station**		**RTMA data**	
Treatment	**TomCast-18**	**TomCast-18 + 14d**	**TomCast-18**	**TomCast-18 + 14d**	**TomCast-18**	**TomCast-18 + 14d**	**TomCast-18**	**TomCast-18 + 14d**
Date trial established	10 Jun	10 Jun	10 Jun	10 Jun	9 Jun	9 Jun	9 Jun	9 Jun
Date reached 35 CDSV thresholds trigger 1st spray	31 Jul	31 Jul	2 Jul	2 Jul	12 Aug	12 Aug	3 Jul	3 Jul
Date of 1st fungicide application	5 Aug	5 Aug	15 Jul*	15 Jul*	20 Aug	20 Aug	16 Jul*	16 Jul*
No. of subsequent sprays	0	1	3	3	0	0	3	3
Subsequent spray dates	n/a	19 Aug	29 Jul 12 Aug 26 Aug	29 Jul 12 Aug 26 Aug	n/a	n/a	29 Jul 12 Aug 26 Aug	29 Jul 12 Aug 26 Aug
Total number of DSV accumulated during trial	62	62	162	162	59	59	149	149
Total rainfall (in)	3.43	3.43	10.13	10.13	7.39	7.39	13.5	13.5

* Based on 35 CDSVs to initiate fungicide applications, the 1st fungicide application for the trials at Rock Springs and Landisville should have been made on 8 July and 9 July, respectively.

Budget for tomato project:

Hourly wages (+ fringe benefits 8.5%) for a part-time assistant to help conduct proposed scouting and field work at 12 wks for 30hrs/wk at $8/hr……. $ 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