The Network for Environment and Weather Applications (NEWA)

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Weather data is fundamental for effective IPM, crucial for preventing crop loss, and essential for documenting damaging weather conditions. Over the last several years the New York State IPM Program's Network for Environment and Weather Applications (NEWA) has expanded through the work of Cornell University faculty, Extension educators, the Northeast Regional Climate Center, RainWise Inc. and farmers. Several apple producers, from Nassau to Niagara counties, recently installed weather stations in the network. RainWise, Inc. retrofitted their weather stations with leaf wetness sensors, developed and upgraded their software to deliver data to NEWA. NEWA's website, delivering the weather app's, was fully redesigned and launched November 2009: newa.cornell.edu. Our audience consists primarily of high-value fruit and vegetable producers. Workshops and presentations on NEWA were provided for these producers who offered suggestions for NEWA improvements. For apples, faculty revised and created pest forecast model web pages for apple scab, fire blight, sooty blotch/flyspeck, apple maggot, codling moth, oblique-banded leafroller, oriental fruit moth, plum curculio, and spotted tentiform leafminer. An apple evapo-transpiration model is in development and an apple carbohydrate model for thinning has become a proven success. These resources are made possible through coordination by the NYS IPM Program of a network of on-the-ground weather stations delivering weather data for its automated application to agricultural risk management.

> **"Weather is the number one most important thing for a farmer to know," said an apple farmer.**

Overview of NEWA

The Network for Environment and Weather Applications (NEWA) delivers weather data from weather stations primarily located on farms through the Internet at newa.cornell.edu and automatically calculates and displays weather data summaries and IPM forecast model results. NEWA provides weather information and IPM forecast models for more precise IPM and crop production practices. Our redesigned website was launched in November, 2009.

NEWA was formed in 1995 and continues to evolve to stay current with advances in pest and weather forecasting. It was founded by the New York State Integrated Pest Management (NYS IPM) Program and collaborates with the Northeast Regional Climate Center (NRCC), Department of Earth and Atmospheric Sciences, Cornell University. For more information, visit About NEWA at newa.cornell.edu/index.php?page=about-newa.

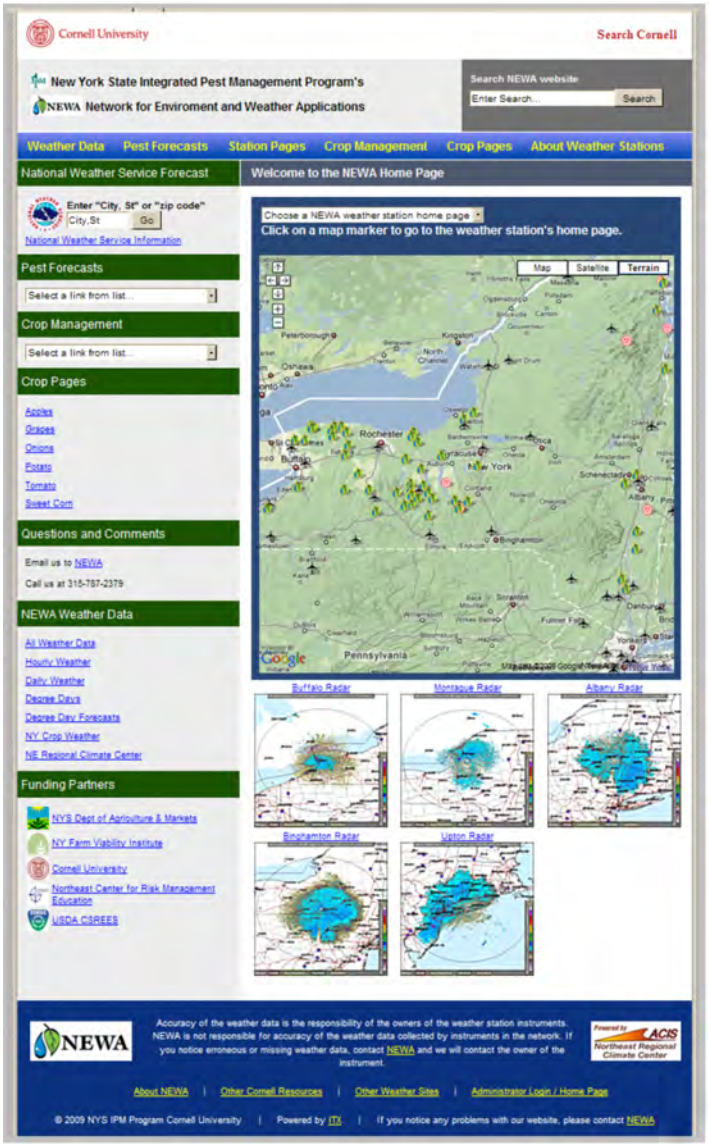

Figure 1. The NEWA Home Page of the new website launched November 2009, find it at newa.cornell.edu or www.newa.cornell.edu.

The weather stations are owned primarily by farmers, and also by the NYS IPM Program, Cornell University faculty, and agricultural industries. RainWise, Inc. is our partner for hardware and software development for the weather station network, see Get a NEWA Weather Station at newa.cornell.edu/index.php?page=get-weather-station. Campbell Scientific instruments are also compatible with the NEWA data format.

Weather data is collected via modem, ftp, or Ethernet interface as shown in Send Data to NEWA at newa.cornell.edu/index.

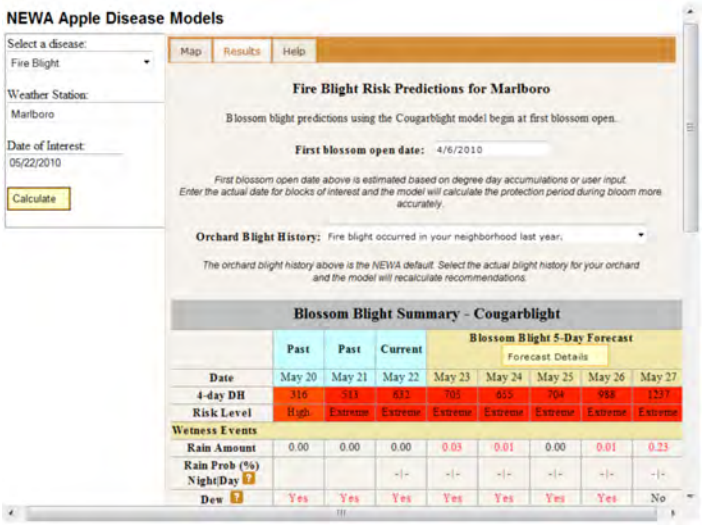

Figure 2. Fire blight model results page for the Marlboro weather station.

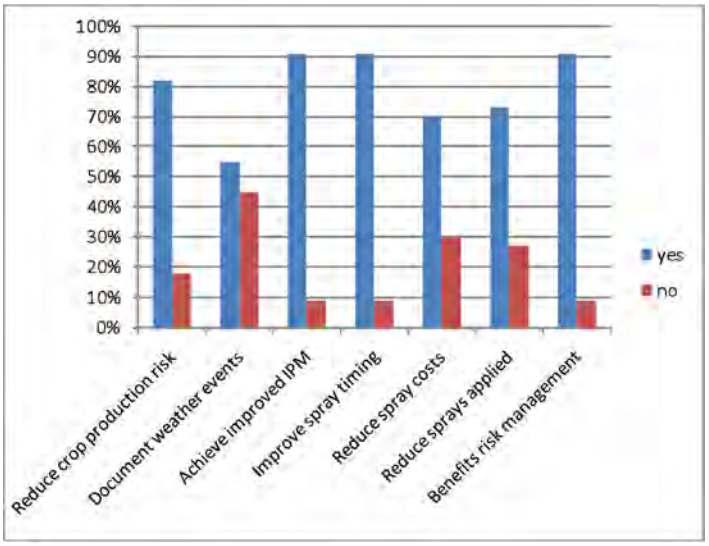

Figure 4. Farmers use NEWA information to reduce risks to their crops and to the environment.

php?page=send-data-to-newa. Weather data is archived and run through quality control routines prior to calculating and displaying degree day accumulations and IPM forecast models.

Degree days (DD) for ten base temperatures, including growing degree days (GDD), are calculated and displayed. There are 24 weather-based IPM forecast models deployed in NEWA. References for the NEWA models can be viewed at newa.cornell.edu/index.php?page=newa-pest-forecast-model-references, those for apple insects and diseases are cited in this article. More models are added as they become available or are developed and validated by faculty at Cornell University and partner institutions.

In addition, NEWA provides a portal to weather and IPM forecast products developed by other groups and researchers, such as the National Oceanic and Atmospheric Administration, the NRCC, Michigan State University, the National Weather Service (NWS), ipmPIPE and the North American Plant Disease Forecast Center.

Recent Advances in NEWA

The Website. In 2008-2010, farmers and Cornell Cooperative Extension Educators participated in NEWA web development meetings, in Eastern and Western NY, to learn about the NEWA system, provide input on its improvement and begin using NEWA on their farms. This effort provided the basis for development of a new website, launched at newa.cornell.edu, displaying weather-related risk information, with emphasis, for apple growers, on IPM forecast models for apple scab, fire blight, sooty blotch/flyspeck, apple maggot, codling moth, obliquebanded leafroller, oriental fruit moth, plum curculio, and spotted tentiform leafminer. All growers using the web site find it easy to use, with good to excellent navigation, website layout, and logical groupings.

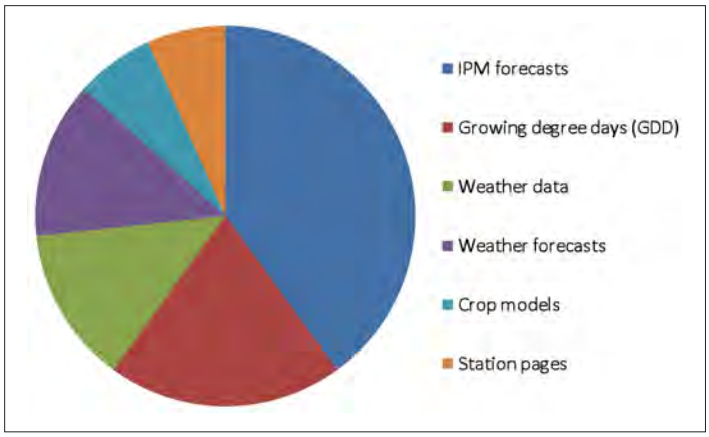

Figure 3. Favorite features of NEWA.

The Weather Stations. Initially, Sensor instruments provided weather stations for the NEWA network; these stations are now obsolete. Today, RainWise, Inc. works with NEWA, developing compatible weather stations by adding needed leaf wetness sensors and key data allocation features. In the early days of NEWA, IPM forecasts were delivered to farmers via fax and phone messages. These delivery methods gave way to modem-collection of data and ultimately to our current web pages at newa.cornell.edu. Rainwise continues to help NEWA develop data delivery software to eliminate the need for phone lines, including a new Ethernet interface which is currently being field tested.

Weather Data. The Northeast Regional Climate Center (NRCC) began working with NEWA in 2008 to archive data and run it through quality control to identify and correct missing data. Their database has allowed for rapid expansion of the weather station network in recent years. Further efforts are underway to enhance data quality control and improve data integrity. The NRCC also creates new forecast programs and has paved the way for interactive IPM models and the use of National Weather Service (NWS) forecasts in the model results pages.

Research and Extension. Extension educators feature NEWA model results and weather information in their newsletters, workshops, and presentations. Extension educators delivered daily or weekly NEWA information through their newsletters, reaching an audience exceeding 1800 farmers across NY, PA and New England. Research faculty pave the way for IPM forecast model creation, deployment, and revisions. For instance, in apple IPM, we now have linkage of the forecast model

Table 1. IPM and crop production forecasts currently available on NEWA.

apple scab infection events	black rot of grapes	onion Botrytis blight
apple scab ascospore maturity	grapevine powdery mildew	onion Alternaria blight
fire blight Cougar Blight	Phomopsis cane & leaf spot	onion downy mildew
sooty blotch & flyspeck	grapevine downy mildew DMCast	onion maggot
obliquebanded leafroller	grape berry moth	Stewart's wilt of sweet corn
spotted tentiform leafminer	cabbage maggot	cucurbit downy mildew ipmPIPE
codling moth	tomato early blight TomCast	soybean rust Forecast Center
plum curculio	potato early blight	alfalfa weevil
oriental fruit moth	late blight BLITECAST	turfgrass diseases
apple maggot	late blight decision support system	turfgrass evapotranspiration (ET)

results with a pesticide selection tool. NEWA data is widely used for research projects, for example internal browning, and development of new models, such as the carbohydrate model for predicting thinning results in apples. Through their efforts farmers learn how to access the improved NEWA website and apply weather information to managing crop and pest inputs to achieve effective pest management, crop loss prevention, and documentation of damaging weather conditions.

Farmers. In response to the improvements to the NEWA website, its forecast models, and our educational efforts targeting growers, apple producers from Nassau to Niagara counties installed weather stations in the network. In the last few years, the number of NEWA weather stations on farms has almost doubled, going from around 40 to over 70. Courtesy of the NRCC, we now host weather data from Cornell agronomic research farms and NWS airport locations, bringing the number of weather stations in NEWA to over 140. Farmers use NEWA at least once per week or daily. Outside of the IPM forecasts, growing degree days, degree days, and daily weather summaries are most popular. 99.2% of farmers using NEWA say they would recommend NEWA to other farmers.

Table 2. Grower Quotes about the Benefits and Impacts of NEWA:

- "I really like the website and have been looking at the weather data daily from my site and comparing it to other sites nearby."
- "The website is right on target for delivering the needed IPM risk and weather risk information."
- "I was able to make more informed decisions on timing of sprays. I can also more accurately track growing degree days in my immediate area."
- "Risk management improved from spray timings. The possibility exists for reduction in number of sprays, but you must be experienced enough to know the ramifications."
- "Helped me keep track of things—difficult with so many crops (onions, potatoes, tomatoes, sweet corn, cabbage, cucurbits, berries, other veg)"
- "NEWA provided us with specific information to our crop that other weather programs do not provide."
- "I used GDD information to track insect/disease modeling and sustainable spray practices."
- "The biggest single value and the reason I invested in a weather station is the carbohydrate model produced by Dr. Terence Robinson for apple thinning. This model has a major impact on the total crop value. It's the best information of any kind anywhere in the world for apples!"
- "It's a great resource to direct growers to!"

Expansion Networks. The Vermont Tree Fruit Growers Association and the University of Vermont have created a VT-NEWA network. The Eco-Orchard growers in New England formed the Eco-Orchard-NEWA network. And the University of Massachusetts Extension has created a MA-NEWA network. Expansion is considered a natural evolution of our collaboration with the NRCC by our climatology colleagues. In addition, our IPM colleagues in the Northeast recognize the value of insect phenology models and plant disease forecasts for improving IPM practice and are willing to share the costs for NEWA.

NEWA's Impacts and Benefits

NEWA fills the need for agricultural weather information by summarizing weather data, displaying IPM forecast model results, linking to pertinent information, displaying weather radar images and linking to NWS forecasts. NEWA IPM forecasts allow growers to spray pesticides only when absolutely necessary, often reducing applications. Growers reported that they can save, on average, $19,500 per year in spray costs and prevent, on average, $264,000 per year in crop loss as a direct result of using the NEWA IPM forecast models.

"Avoiding apple scab can save me $2 million a year," says apple grower Tre Green of Clinton County. Green uses NEWA's disease forecasts to stay on top of diseases like apple scab, spraying only if IPM's finely-tuned forecasts show a strong likelihood of disease.

In May 2010, NEWA served a key risk management function when several spring frosts occurred across New York's fruit-growing regions, affecting fruit trees, grapes and berry crops. Growers, crop consultants, extension educators, and research faculty utilized the NEWA temperature data to predict and explain the likelihood of crop damage from these cold temperature events.

The benefits of NEWA include:

- Technical support on weather stations and data collection.
- Targeted NEWA website development, including required updates, additions, and upgrades.
- Access to all the information on the NEWA website, newa.cornell.edu.
- Crop pages for apples, grapes, onions, potatoes, tomatoes, and sweet corn.
- National Weather Service information.
- New products, as they become available.
- Access to all the weather data programming within the NEWA website, newa.cornell.edu.
- Station pages for your weather station locations.
- Weather data summaries (hourly, daily, degree days, etc.).
- Crop management (growing degree days, forecasts, drought, ET models, etc.).
- New IPM and crop production models, as they become available.
- IPM forecasts (station-specific and regional), Table 1.

NEWA's vision is to become the source for weather-related information for the IPM *practitioner* in the Northeast. NEWA's mission is to deliver, to agricultural and green industries, weather information and applications to support and advance IPM and best management practices. In agriculture, farmers will use and apply weather information and pest forecasts for improving IPM practice, reducing crop production risks and for protecting against weather-related losses. Through NEWA they will be able to apply crucial weather information to managing pests and their crops.

NEWA's Opportunity

The funding for NEWA through the NYS IPM Program was eliminated due to New York State budget cuts. In the face of this, we firmly believe that NEWA will continue to exist because of the strength of its partnerships with growers, produce storage operators, buyers and processors, Cornell Cooperative Extension (CCE) County Associations, CCE Regional Programs, County Soil and Water Conservation Districts, the NRCC, the Pesticide Management Education Program, and Cornell University faculty.

After March 31, 2011, because of the New York State budget crisis, the NYS IPM Program may no longer receive any state funding allocation. There are several possible scenarios that will allow NEWA to continue into the future in the unfortunate event that the NYS IPM Program shuts its doors. At this time, we are certain that NEWA's future will be sustained by the NRCC with a strong collaboration with Rainwise and the continuing interest of research and extension faculty and staff at Cornell University, other institutions, and growers across the Northeast. The coming year will be a critical time for positioning the NEWA system for a bright future.

Despite the dire budget situation, our colleagues still resolve to partner with NEWA, our NY growers still continue to purchase weather stations connected to NEWA, our Cornell University faculty still pursue deployment of models within NEWA, and our Cornell Cooperative Extension educators still continue to offer NEWA workshops, run newsletter articles about NEWA, and encourage its use toward improved IPM practice. All are confident that the NEWA system will emerge from the funding crisis stronger than ever.

Acknowledgements

We gratefully acknowledge the dedicated service of the NEWA system staff: Cheryl Ten Eyck and John Gibbons. We also acknowledge the NEWA partners: Northeast Regional Climate Center, RainWise, Inc., and Pesticide Management Education Program. Funding has been provided by: New

York State IPM Program, Cornell Cooperative Extension, New York State Department of Agriculture & Markets, New York Farm Viability Institute, Northeast SARE, Northeastern IPM Center, USDA National Institute of Food and Agriculture, Northeast Center for Risk Management Education, Natural Resources Conservation Service, New York State Agricultural Experiment Station, and Cornell University Agricultural Experiment Station

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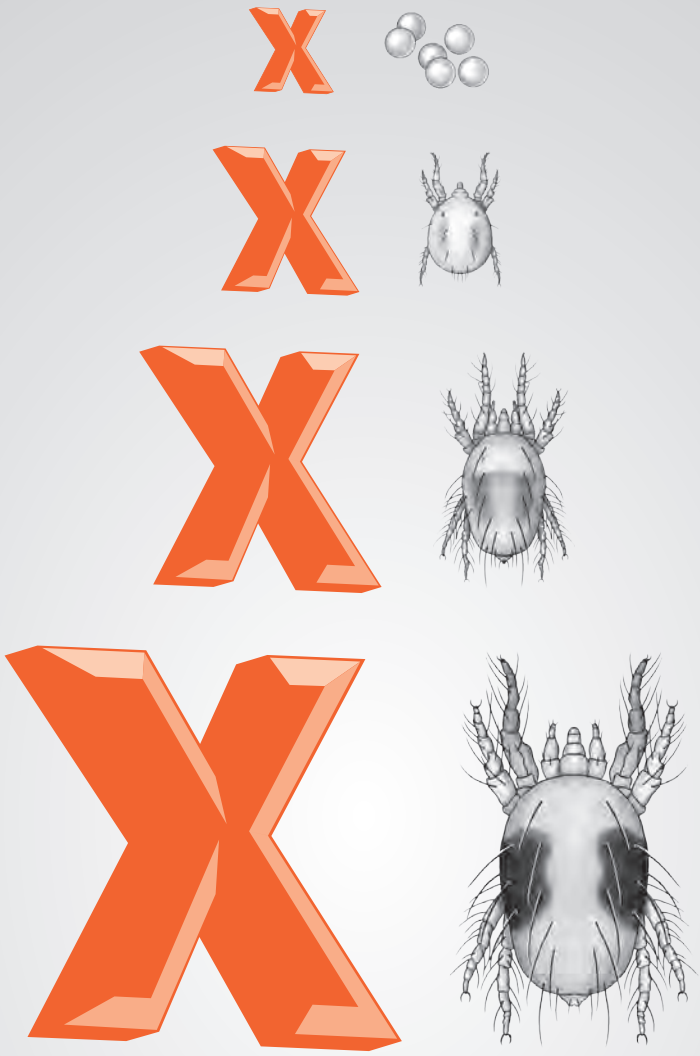

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