

## Annual Report for Smith-Lever Funded Projects

**Project Title:** Weather-driven Grape IPM Forecast Models and Decision Aids from the Network for Environment and Weather Awareness  
**Principal Investigator:** Juliet Evelyn Carroll  
**Project Start:** 10/1/2008      **Project Term:** 9/30/2010  
**Report Fiscal Year:** 2010      **Report Author:** Juliet Evelyn Carroll

**Plan of Work Area(s):** Agricultural/Horticultural Business  
Production Processes  
Agriculture/Community  
People, Land, and Environment  
Natural Resource Management  
Water Resources Management  
Science and Technology

**Progress Summary:** The IPM applications for grapes in the Network for Environment and Weather Applications (NEWA) were improved further in 2010. The focus of the work was on the grape berry moth degree day model, on making improvements to the displays and pest management messages for the grape diseases powdery mildew, black rot and Phomopsis cane and leaf spot and on migrating the DMCAst model into the Northeast Regional Climate Center database and NEWA server. We also completed the leaf wetness algorithm investigations, presented talks on NEWA, supported Extension educators' contributions to newsletters to multiply the use of NEWA information for IPM, and grappled with the complete loss of NYS IPM Program funding support for NEWA due to the New York State budget crisis.

Weigle met with Loeb, Cornell University grape entomologist, to develop the companion text on pest management for the grape berry moth degree day model. The text describing management practices was developed for the appropriate degree day ranges for the first, second, and third generations of grape berry moth. The web page design, degree day time-frames, and pest status messages were finalized by Loeb, Weigle, and Carroll with input from Mike Saunders, Penn State University, and Rufus Isaacs, Michigan State University. The biofix to start the model, is *Vitis riparia* bloom date. The grape berry moth degree day model information was programmed by the Northeast Regional Climate Center (NRCC) into the NEWA system and went live in May 2010.

The grape berry moth model in NEWA was used to time pesticide applications in research blocks and grower vineyards in a project being conducted by Loeb and Weigle, Cornell University, and Saunders, Timer and Muza of Penn State. Results of the model were used to provide information to growers in the Lake Erie region, which was particularly helpful due to the extremely warm 2010 growing season that resulted in a fourth generation of grape berry moth. This

made it apparent that the text in the model needs to be updated to include pest management practices for a fourth generation in extremely warm years. The grape berry moth phenology model has been utilized by grape growers in the Finger Lakes, the Lake Erie region and was being explored on Long Island.

Carroll, Weigle and Wilcox met to go over the powdery mildew, black rot, and Phomopsis models. The text describing the disease management practices was developed for the appropriate vine phenology stages to accompany the infection events tables. The web page design, vine phenology time-frames, and infection event messages were finalized by Carroll, Wilcox and Weigle. The grape diseases information is currently in the final stages of being programmed by the Northeast Regional Climate Center for the NEWA website. The project was delayed by the need to source and estimate Concord grape phenology data to time the disease management message displays. These models will become available in time for the 2011 growing season.

The grapevine downy mildew model, DMCast, was re-programmed by the Northeast Regional Climate Center (NRCC) into their database and displayed in the NEWA website frame. The simulation model went live in April 2010, accessed from <http://newa.cornell.edu/index.php?page=grape-diseases>.

Actual observations of leaf wetness in vineyards following rain events that were collected hourly in 2009 on labrusca and hybrid vines growing in Fredonia, NY and Geneva, NY were compared to wet and dry results from a leaf wetness algorithm being utilized by the Maryland Grape Growers Association for their disease models. The algorithm, developed by K. Koehler, Iowa State University, estimated "dry" when leaves were actually wet less than 16% of the time (two erroneous readings for hybrid grapes and three for labrusca grapes) as compared to five (28%) and six (33%) erroneous dry readings for the leaf wetness sensor on the RainWise instrument at Fredonia. However, the algorithm performed essentially no better than the leaf wetness sensor on the Campbell instrument in Geneva, with both reading dry when leaves were actually wet over 50% of the time. The algorithm uses temperature, relative humidity, and wind speed to estimate dry or wet leaves. For the Geneva location, it was necessary to use wind speed from the Penn Yan airport and this may have contributed to the poor results from the algorithm at that location. We are currently pursuing the use of a fuzzy logic model for NEWA, developed also at Iowa State University, for estimating leaf wetness.

Carroll was invited to present a paper on NEWA at the Midwest Weather Working Group meeting in Charlotte, NC, on August 6. We invited R. Seem to present a paper on DMCast to grape growers at the Viticulture 2010 meeting in Rochester, NY.

During 2010, at grape field meetings and grower conferences, Weigle and Carroll presented 20 talks on NEWA and its applications to vineyard IPM and risk management, reaching over 900 audience members. At the first annual LERGP Summer Growers Conference, Weigle presented a talk on Using the Improved NEWA website in Vineyard Pest Management Decision Making

and Jody Timer, Penn State entomologist, presented a talk on Grape Berry Moth Phenology Degree Day Model Project. Seventy-three growers and industry representatives attended the meeting. Also, Lake Erie Coffee Pot meetings provided a weekly opportunity to showcase the NEWA grape model improvements to grape growers throughout the growing season. A total of 13 Coffee Pot meetings were held during the 2010 growing season. A total of 269 growers and industry representatives attended these meetings for an average of 20 growers per meeting. Meetings were held in Chautauqua (3), Cattaraugus (2) and Niagara (3) counties in New York and Erie County (5) in Pennsylvania.

**Expected and  
Observed  
Impact/Outcome:**

Our goal is to provide state-of-the-art, weather-driven grape IPM forecasts and viticulture decision aids to viticulture industries through the Network for Environment and Weather Awareness (NEWA). Grape growers and extension personnel are sourcing weather information and pest forecast models from NEWA more often than in the past.

Improved IPM forecast model outputs in NEWA for four grape diseases and grape berry moth will enhance grape IPM, reduce pesticide inputs, and prevent crop loss. Collaborations with Michigan State University researchers and the Maryland Grape Growers Association will enhance grape IPM practice in those states, as well. The impact of this grape NEWA project will be to enhance the sustainability of vineyards, minimizing environmental impact, and maintaining profitability.

Investigation of leaf wetness algorithms may pave the way to augmenting or phasing out the use of leaf wetness sensor grids for NEWA models. Because leaf wetness sensors are not standard measurements gathered by weather instruments, this will allow the geographic coverage for plant disease forecasts to expand significantly, not only for grapes but for other crops.

Specific impacts in 2010 of this project include:

We tested the leaf wetness algorithm used by the Maryland Grape Growers Association and found it to provide a reasonable, if not better, estimate of leaf wetness as compared to leaf wetness sensors, validating their use of this algorithm to support grape IPM practice in their region.

DMCast was re-programmed and deployed in 2010 and used by growers and extension educators in NY. Validation of this simulation model by Michigan State University is now possible. Validation in Michigan was delayed due to the unforeseen complexity of migrating the DMCast program to the Northeast Regional Climate Center database and NEWA website server.

We have continued to improve grape web pages on the new NEWA website, <http://newa.cornell.edu>, by combining access to all the grape insect and disease models at a single web page, the Grape Forecast Models, at <http://newa.cornell.edu/index.php?page=grape-diseases>.

The models now include: the grape berry moth degree day, DMCast for grapevine downy mildew, and infection events for powdery mildew, black rot,

and Phomopsis cane and leaf spot.

During spring of 2010, a series of freezes occurred in May throughout the fruit growing regions, causing damage to grape vineyards and data collected by the NEWA system was utilized to document these events.

Information from the NEWA grape forecast models and weather data were utilized by Extension educators in their newsletter articles appearing in contributions to monthly newsletters, including *The Lake Erie Electronic Crop Update*, *Finger Lakes Vineyard Notes*, and *Veraison to Harvest*.

This project had synergy with five other grant projects, three which are continuing:

1. Seneca County Soil and Water Conservation District Service, grants to defray the growers' costs for the nine new weather stations.
2. Applying weather data and forecasts for managing crop inputs and reducing crop losses. Carroll. NE Center for Risk Management Education.
3. Grape downy mildew and grape berry moth: model reimplementation and redefinition for New York. Seem, Gadoury, Carroll, Weigle, DeGaetano, and Loeb. NYS IPM Program.
4. Testing the use of a degree day model to time control of grape berry moth. Loeb, Isaacs, Saunders and Weigle. Viticulture Consortium, LERGP, NY Wine & Grape Foundation.
5. Improved timing of control for the grape berry moth, *Paralobesia viteana*, using a degree day model. Saunders, Muza, Loeb and Weigle. USDA RIPM Northeast.

Grant funding has provided for an additional six weather stations to be added to NEWA in the Lake Erie region in 2011. The addition of these weather stations will allow us to better use the grape berry moth degree day model, as well as the various disease models available on NEWA to improve IPM practice.

**Multi-State  
Activities:**

Maryland: Assisting the Maryland Grape Growers Association with setting up the grape disease models and field validation of an algorithm they use to estimate leaf wetness.

Michigan: Assisting with validation in Michigan of the downy mildew model for grapes, DMCast.

**Publication(s):**

Carroll, J. and Weigle, T. 2010. Weather-driven Grape IPM Forecast Models and Decision Aids from the Network for Environment and Weather Awareness. NYS IPM Program Project Report. 5 pp.  
<http://nysipm.cornell.edu/grantspgm/projects/proj09/fruit/carroll3.pdf>

Gibbons, J., Carroll, J., TenEyck, C., Petzoldt, C., and Weigle, T. 2010. NEWA (Network for Environment and Weather Applications) 2009: A Year in Review. NYS IPM Program Project Report. 7 pp.  
[http://nysipm.cornell.edu/grantspgm/projects/proj09/pgm\\_wide/gibbons.pdf](http://nysipm.cornell.edu/grantspgm/projects/proj09/pgm_wide/gibbons.pdf)

Weigle, T. 2010. Implementing IPM. American/Western Fruit Grower. 1 p.  
<http://www.growingproduce.com/americanfruitgrower/?storyid=3855>

Carroll, J., Petzoldt, C., DeGaetano, A., and Weigle, T. 2009. Network for Environment and Weather Applications Delivers IPM Forecasts for Fruit & Vegetable Crops. 6th International IPM Symposium, Portland, OR. 1 p.  
[http://www.ipmcenters.org/ipmsymposium09/019\\_Carroll\\_Network.pdf](http://www.ipmcenters.org/ipmsymposium09/019_Carroll_Network.pdf)

Gibbons, J., Carroll J., TenEyck, C., Petzoldt, C. and Weigle, T. 2009. NEWA (Network for Environment and Weather Applications) 2008: A year in review. Cornell Univ., NYS IPM Program Project Reports 2008-2009, NYS IPM Pub No. 509: 220-223.  
[http://nysipm.cornell.edu/grantspgm/projects/proj08/pgm\\_wide/gibbons.pdf](http://nysipm.cornell.edu/grantspgm/projects/proj08/pgm_wide/gibbons.pdf)

Weigle, T., Loeb, G., Isaacs, R., Saunders, M. 2009. Testing the use of a degree day model to time control of grape berry moth. Cornell Univ., NYS IPM Program Project Reports 2008-2009, NYS IPM Pub No. 509: 98-100.  
<http://nysipm.cornell.edu/grantspgm/projects/proj08/fruit/weigle2.pdf>

**Communication(s):** Network for Environment and Weather Applications, [newa.cornell.edu](http://newa.cornell.edu), web site, Leader, Growers, extension educators, researchers, 130,000 hits per year

NEWA Crop Pages - Grapes,  
<http://newa.cornell.edu/index.php?page=crop-page-grapes>, web page, Leader, Grape growers, extension educators, researchers, 6,000 hits per year

NEWA Grape Forecast Models,  
<http://newa.cornell.edu/index.php?page=grape-diseases>, web site, Leader, Grape growers, extension educators, researchers, 6,000 hits per year

NEWA Degree Day Data Page,  
<http://newa.cornell.edu/index.php?page=degree-days>, web site, Leader, Growers, extension educators, and researchers, 30,000 hits per year

**Presentation(s):** NEWA website training, 4/8/10, 3 hours, Trainer - Weigle, growers, 5 attendees

NEWA website training, 5/6/10, 3 hours, Trainer - Weigle, growers, 18 attendees

Using the GBM model on NEWA to time GBM management decisions, 6/16/2010, 15 minutes, Discussion leader - Weigle, growers, 15 attendees

Using the GBM model on NEWA to time GBM management decisions, 6/23/2010, 15 minutes, Discussion leader - Weigle, growers, 34 attendees

Using the GBM model on NEWA to time GBM management decisions, 6/30/2010, 15 minutes, Discussion leader - Weigle, growers, 40 attendees

Using the GBM model on NEWA to time GBM management decisions, 7/7/2010, 15 minutes, Discussion leader - Weigle, growers, 13 attendees

Using the GBM model on NEWA to time GBM management decisions, 7/14/2010, 15 minutes, Discussion leader - Weigle, growers, 30 attendees

Alternative GBM Management Strategies using model on NEWA to time GBM management decisions, 7/21/2010, 20 minutes, Presenter - Weigle, growers, 73 attendees

Using the GBM model on NEWA to time GBM management decisions, 7/28/2010, 15 minutes, Discussion leader - Weigle, growers, 11 attendees

Using the GBM model on NEWA to time GBM management decisions, 8/4/2010, 15 minutes, Discussion leader - Weigle, growers, 11 attendees

Roundtable discussion on pest management strategies including NEWA, 8/4/2010, 30 minutes, Discussion leader - Weigle, growers, 200 attendees

Using the GBM model on NEWA to time GBM management decisions, 8/11/2010, 15 minutes, Discussion leader - Weigle, growers, 15 attendees

Roundtable discussion on pest management strategies including NEWA, 8/18/2010, 30 minutes, Discussion leader - Weigle, growers, 88 attendees

Using the GBM model on NEWA to time GBM management decisions, 8/25/2010, 15 minutes, Discussion leader - Weigle, growers, 8 attendees

Status of fruit IPM Program and NEWA update, 5/18/2010, 20 minutes, Discussion leader - Carroll, growers, 125 attendees

Status of fruit IPM Program and NEWA update, 6/30/2010, 20 minutes, Discussion leader - Carroll, growers, 30 attendees

NEWA and TracGrape, 7/14/10, 10 minutes, Discussion leader - Carroll, scientists, 55 attendees

Weather stations for NEWA, 7/28/10, 15 minutes, Discussion leader - Carroll, growers, 30 attendees

Current projects on the Network for Environment and Weather Awareness (NEWA), 8/6/10, 20 minutes, Presenter - Carroll, scientists, 28 attendees

NEWA - weather app's for IPM, 9/15/10, 5 minutes, Presenter - Carroll, scientists, 90 attendees

**Project  
Conclusion:**

We met our goal of providing state-of-the-art, weather-driven grape IPM forecasts and viticulture decision aids to viticulture industries through the Network for Environment and Weather Awareness (NEWA). Grape growers and extension personnel are sourcing weather information and pest forecast models from NEWA more often than in the past. We created the grape berry degree day model web pages, upgraded the grape disease model web pages, identified an improved method for estimating leaf wetness events, improved growing degree day outputs for grapes, sourced and served information on critical freezing temperatures, and collaborated with the Maryland Grape Growers Association and Michigan State University. NEWA's improved IPM forecast model outputs will support Extension information delivery and

enhance grape IPM, reduce pesticide inputs, and prevent crop loss.

We improved the grape web pages on the new NEWA website, <http://newa.cornell.edu>:

- Grape Home Page,  
<http://newa.cornell.edu/index.php?page=crop-page-grapes>
- Degree Days from April 1<sup>st</sup>,  
<http://newa.cornell.edu/index.php?page=degree-days>
- Grape Forecast Models,  
<http://newa.cornell.edu/index.php?page=grape-diseases> - Access to grape berry moth, downy mildew, powdery mildew, black rot, and Phomopsis forecasts.

The grape berry moth degree day model created for NEWA and went live in May 2010, providing information on critical spray application windows to manage this damaging insect pest of grapes. The model has been utilized by grape growers in the Finger Lakes, the Lake Erie region and was being explored for use on Long Island by the Long Island Wine Council. Results of the model were used to provide information to growers in the Lake Erie region, which was particularly helpful due to the extremely warm 2010 growing season that resulted in a fourth generation of grape berry moth.

The disease forecast models for grapevine downy mildew (DMCast), powdery mildew, black rot, and Phomopsis cane and leaf spot track infection events. The Maryland Grape Growers Association verified their disease forecast models were programmed correctly by comparing them to the program code files provided from NEWA. NEWA's revised grape diseases information is currently in the final stages of being programmed by the Northeast Regional Climate Center for the NEWA website. These models will utilize NWS forecasts to push disease risk messages into the projected weather future to greatly enhance IPM practice and Extension alerts to growers.

DMCast was re-programmed and deployed in 2010 and used by growers and extension educators in NY. Validation of this simulation model by Michigan State University is now possible using data from three Michigan weather stations, Clarksville, Fennville and Traverse City, identified by Annemiek Schilder and Jeff Andresen, Michigan State University.

Weather station leaf wetness sensors were found to underestimate the hours leaves were actually wet to the touch. We tested the leaf wetness algorithm used by the Maryland Grape Growers Association and found it to provide a reasonable, if not better, estimate of leaf wetness as compared to leaf wetness sensors, validating their use of this algorithm to support grape IPM practice in their region. Various empirical models for estimating leaf wetness from weather data (temperature, dew point, wind speed, solar radiation) were investigated and the fuzzy logic model will be implemented in NEWA.

NEWA's degree day tables were expanded to accommodate an April 1<sup>st</sup>

accumulation start date, available from <http://newa.cornell.edu/index.php?page=degree-days>, which is utilized for grapevine and berry development by viticulture extension specialists, researchers and grape growers in NY. The berry curve, growing degree days (base 50F), has been used for Concord grapes to provide estimates of overall crop development in the Lake Erie region. Viticulturalists Bates and Creasap Gee have been analyzing the berry growth curve for hybrid grape varieties which assists growers in determining crop thinning and harvest windows in the Lake Erie Region. These new tables will contribute to improved crop management estimates in grapes.

From the NEWA website we linked to information from Michigan State University on critical temperatures for fruit crops, detailing the temperature thresholds for cold injury to buds. We met with the National Weather Service (NWS) and began working toward improved freeze warnings which were experimentally broadcast in spring 2009. However, these more frequent warnings were not continued in 2010 due to concerns expressed by the general public and the intricacies of dividing the warning regions appropriately. We identified the need for future coordination of effort and information delivery among New York fruit workers, providing growth stage information, and New York's NWS meteorologists, providing freezing temperature forecasts, to improve freeze warnings for the grape and tree fruit industries in New York.

The NEWA system was utilized to document severe weather events for crop insurance purposes - severe hail storms in 2009 in the Finger Lakes region and a series of late spring freezes in May 2010 throughout the fruit growing regions.

Ten grape growers and one researcher purchased and installed weather stations in vineyards to connect to NEWA. In NY: Thirsty Owl Wine Company, Hosmer Winery, Three Brothers Winery, Shalestone Vineyards, Lamoreaux Landing Wine Cellars, Standing Stone Vineyards, Zugilbe Enterprise LLC, Swedish Hill Winery/ Blue Water Vineyard, Wagner Winery, and the Hudson Valley Laboratory. In PA: Harbor Creek. Six additional weather stations are slated for installation in 2011 in the Lake Erie Regional Grape Program's region.

During the course of this project, at grape field meetings and conferences, Weigle and Carroll presented 45 talks on NEWA and its applications to vineyard IPM and risk management, reaching over 2000 audience members. Information from the NEWA grape forecast models and weather data were utilized by Extension educators in their newsletter articles to support IPM practice and prevent crop losses. The ongoing impact of this grape NEWA extension project will be to enhance the sustainability of vineyards, minimize environmental impact, and maintain profitability.

**Other External  
Funding to  
Continue:**

Yes, USDA NE RIPM Program and Viticulture Consortium- East/LEGREP  
\$208184.00