

# BUILDING A RESPONSIVE NETWORK OF INTEGRATED PEST MANAGEMENT APPLICATIONS THAT SUPPORT GROWER ACCESS AND COMMUNICATION

## PROJECT LEADERS

Carroll, J.<sup>1</sup>, DeGaetano, A.<sup>2</sup>, Olmstead, D.<sup>1</sup>, and Grant, J.<sup>1</sup>

<sup>1</sup> NYS IPM Program, Cornell AgriTech, Geneva, NY

<sup>2</sup> Northeast Regional Climate Center, Cornell University, Ithaca, NY

## NON-TECHNICAL SUMMARY

Our project addresses the goal of enhancing agricultural biosecurity while reducing potential human health risks and minimizing adverse environmental effects from pests and related management strategies. We propose to advance the usefulness of the Network for Environment and Weather Applications (NEWA) by improving information delivery via the web, enhancing visual presentation on smart phones and tablets, and improving weather data quality. NEWA is online, open access, and user-friendly with a proven track record of improving pest management and reducing pesticide inputs. By combining meteorological data with confirmed research models on pest and crop development into interactive tools for integrated pest management (IPM) and crop management, NEWA helps growers save sprays, improve crop quality, and stay in business. The NEWA network has 573 weather stations in 25 states, mostly owned by growers who, in turn, share their data so that all growers benefit from open access to interactive decision support tools that address pests and diseases of high value fruit and vegetable crops. Our stakeholders want a responsive website design that provides improved access to NEWA's IPM tools on their smart phones and tablets so they can access IPM decision support wherever they are and whenever it's needed. Our state partners want geo-specific banners to recognize their contribution to NEWA and information resources that support location-specific management strategies. All will benefit from improved data quality to maximize the accuracy of NEWA's important weather-driven IPM tools. Our project will address grower needs by delivering in NEWA a responsive website design for smart-phone-optimized user experience with geo-specific resources and improved weather data quality via automated screening and end-user communication. We will meet with stakeholders, technology experts, agricultural scientists, website architects and extension specialists to determine the requirements for a responsive NEWA website design. We will then engage a web design company to build the responsive NEWA website. The collected weather data for rainfall, temperature, relative humidity, solar radiation, and wind speed will undergo initial automated routines to flag suspect data values, based on non-NEWA station observations and meteorological forecast model grids. The flagged suspect values will then undergo manual verification and, if found in actual error, the weather data values corrected. Workshops, blogs, newsletters and presentations to NEWA end users will inform them how to use the new website and how to help us maintain data quality. We know that 99% of growers who use NEWA would recommend it to other growers. Our project responds to known grower requests for improving NEWA's usefulness to them. This will make it easier and more likely that growers will use NEWA for IPM and crop management decision support. In the long run, expanding the reach of NEWA with its documented impacts of reducing pesticide sprays and their associated risk to the environment and human health, and improving IPM practice and decision-making, will improve food security and the quality of life for all citizens.

## ACCOMPLISHMENTS

### MAJOR GOALS OF THE PROJECT

Our major goals are to improve the Network for Environment and Weather Applications (NEWA) by facilitating access and improving weather data quality. NEWA is a network combining meteorological data with interactive IPM and crop management tools to save sprays and improve crop quality. NEWA has 557 weather stations in 25 states, and growers benefit from open access to interactive IPM and crop management decision support tools that primarily address pests and diseases of high value fruit and vegetable commodities.

Growers of diverse agricultural crops want easy-to-access, accurate tools for IPM decision-making. The Network for Environment and Weather Applications (NEWA) provides interactive, digital, open access, user-friendly IPM and crop management decision support tools to growers in New York, and many other states from [newa.cornell.edu](http://newa.cornell.edu). Users need NEWA to be updated with responsive web design to make information easily and readily available on smart phones and tablets. NEWA also needs updated technology to provide better and more efficient weather data quality assurance.

The work outlined in this proposal will deliver a responsive NEWA website with improved weather data quality. Directly aligned with the CPPM focus area, Enhancing Agricultural Biosecurity, our proposal will develop and maintain key information systems, networks, and decision support tools that provide the knowledge infrastructure needed for the application of science-based IPM systems for high-consequence pests that threaten U.S. agriculture. This project supports national, regional and state priorities by supporting agriculture with sustainable practices; engaging multidisciplinary teams; and helping growers deal with climate-related events.

## Objectives

We will achieve our goals through the following two objectives

### **Objective 1: Responsive design for mobile-optimized user experience with geo-specific banners**

We will build a responsive website with input from our stakeholders to make the user-interface more intuitive and NEWA tools easier to use and view, whether on desktop or mobile devices. We will prioritize the website building blocks for NEWA, define the requirements for all components of the responsive NEWA website, conduct user tests and build a mobile-ready NEWA website addressing end-user priorities of providing attribution, caching monitoring information, and delivering IPM decision support.

### **Objective 2: Improved data quality via automated screening and grower communication**

We will develop a system to facilitate the correction of erroneous precipitation, temperature, relative humidity, solar radiation, and wind speed data based on automated screening and two-way communication with users. This will enhance the accuracy of the weather-driven IPM decision support tools in NEWA. These variables are central to the algorithms used in the IPM, crop management and degree-day tools available in NEWA.

## WHAT WAS ACCOMPLISHED UNDER THESE GOALS?

### IMPACT

Increased use of digital IPM decision support systems like NEWA results in more growers making better pest management decisions with less pesticide input. In year two, we have developed the required back-end databases and front-end design elements that will heighten positive user experiences when interacting with the responsive NEWA decision support system. Improved navigation comes via an interactive NEWA map and streamlined landing page designs that echo our user-experience research. NEWA's renewed architecture now delivers geo-specific attribution for appropriate place-based extension outreach on devices as small as phones. Required common building blocks to reconstruct the IPM models into responsive design are being delineated. A user-specific NEWA dashboard will display just what the user wants from the locations they want: easy to set up through NEWA's user profile. The profile login will come equipped with storage space for essential biofix and crop information to drive accurate pest and crop forecasts for growers. When growers have access to reliable, weather-based, real time NEWA models, IPM practices increase on the farm, preventing plant disease, insect, and crop loss, reducing unnecessary inputs, and minimizing health, economic and environmental risks.

### **OBJECTIVE 1: RESPONSIVE DESIGN FOR MOBILE-OPTIMIZED USER EXPERIENCE WITH GEO-SPECIFIC BANNERS**

Project partners in the NYS IPM Program and the Northeast Regional Climate Center contracted with Cornell Information Technologies Computer Development for the architecture, design and ADA compliance aspects of the renewed NEWA website. These three groups have entered the key phase of the project working collaboratively on the back-end databases and front-end design elements that will heighten positive user experiences when interacting with the responsive NEWA decision support system.

We documented the databases required for NEWA's back-end to support the front-end defined in the strategy workshops. These include weather station metadata, data quality control, NEWA weather data, user login, user cache, model results messages, and regional content.

Elements were placed into NEWA's regional content database: information resources for place-based extension outreach and logos for attribution of NEWA partnerships. Existing weather station metadata was analyzed and new fields identified that will support NEWA's capacity to acknowledge the weather station owners that provide data to the network. We have ported existing station metadata to the new database. Weather station metadata will be available to NEWA's front-end and accessible to authorized users (NEWA personnel and state coordinators) via an online data entry system.

Back-end development for NEWA's weather data has focused on a single common access routine for all models, eliminating potential erroneous model-to-model differences. The rework of the data access software also will limit the amount of data passed from the server to the user's device; returning only data needed by the specific model. The common access routine and computation on the server will improve model responsiveness and fidelity, especially in rural locations with slow connection speeds, and will greatly improve user experience, as well as enhance NEWA's capacity to build future IPM models.

We are developing a database on the National Digital Forecast Data used to predict future conditions. These data will be obtained in the same way as the observed data, streamlining data access.

We documented specifications for all NEWA models to aid reconstruction. The user interface being used for each NEWA model was analyzed to determine the level of diversity among the models and the features in common. Thirty-five distinct crop/pest model combinations were identified showing a high level of diversity in the currently implemented user interface. This diversity will pose a significant challenge for reprogramming where we will endeavor to adopt a common structure to foster efficient implementation of models within NEWA.

One-on-one user experience (UX) research on navigation of the existing NEWA website, understanding of the existing content labels, and on ease-of-use and conceptual understanding of features on webpages informed development of a simpler open-access design and a dashboard with snapshots of preferred results for login users who have set up a profile. Growers on our project advisory panel were tapped for this effort. The open access home page will show a teaser of weather data from a station closest to the user and will have an interactive map of NEWA weather stations. We have implemented novel dropdown and search functions to interact with the map and enhance the user's experience. The home page will be inviting, even those outside the existing reach of NEWA's weather station network. Two landing pages, for weather tools and for crop and IPM tools, buoy simplified navigation. Content about NEWA resides in the footer and header. Using a strong call out, "The Tools I Want, Where I Want" in home's center, the user is invited to create their profile. NEWA News is featured with linkage to the Your NEWA blog.

A user login database has been created using commercial platforms. The software allows registered users to login to their NEWA dashboard, handle authorization of user name and password, and password reset. We developed the necessary software to connect user login to the responsive website. The user cache database will store user-provided profile information such as preferred models, preferred weather station(s) and their model-specific information, such as biofix date. These components have been successfully tested, assuring that the three components (login, user cache, and dashboard) can communicate with each other.

We organized content for Profile Settings, Weather Tools, Crop & IPM Tools, and About pages. Design and coding were completed for the footer and header. We are nearing completion of the interactive NEWA map, which will function equally well to guide users to locations of interest on home, model (weather, crop, IPM), profile settings, and about NEWA pages.

Cognizant of low band width in rural areas, this map will load in a split second, display all NEWA stations at all times and support searching, zooming, and panning.

An online tree test done to determine if users had strong or weak understanding of the difference between Weather Stations and Weather Data showed users were unclear on the distinction and informed our decision to develop a Weather Tools landing page grouping all weather offerings. This will organize content on weather data, weather models, weather stations, and feature similar decision support systems in the US. We will develop a Weather History Tool to compare the current year's weather summaries with the prior year.

## **OBJECTIVE 2: IMPROVED DATA QUALITY VIA AUTOMATED SCREENING AND GROWER COMMUNICATION**

We developed quality control tools focused on four main variables collected by NEWA stations: temperature, precipitation, humidity and solar radiation. The quality control checks can be queried at <http://squall2.nrcc.cornell.edu/newa-qc-viewer/>. A data editor website <http://squall2.nrcc.cornell.edu/acis-editor>, allows viewing, selecting, invalidating or editing the existing value. This site was completed and NEWA State Coordinators were given two training sessions on its use, which were recorded and are available as a resource.

During this period, we began to develop three additional quality screening algorithms for soil temperature, soil moisture, and leaf wetness. These will be based on logic similar to that used in the quality control check for other variables, namely physical and climatological limit checks, between station comparisons and where possible comparison with gridded data resources.

## **WHAT OPPORTUNITIES FOR TRAINING AND PROFESSIONAL DEVELOPMENT HAS THE PROJECT PROVIDED?**

The project provided numerous presentation and workshop opportunities to educate growers about NEWA and concomitantly to gain feedback from grower audiences on their perceived website needs. The grower community was informed about the planned outcomes of this project and how NEWA can have a positive effect on crop production and IPM practices.

We provided training to NEWA state coordinators and weather station owners on the data quality processes and its web interface.

## **PROFESSIONAL DEVELOPMENT**

The project created multiple professional development opportunities for the NEWA Coordinator including engaging with climatologists and meteorologists at regional and national meetings to discuss the NEWA system. Gaining an understanding of Extension methodology and grower education methods were skills that were significantly refined during year two of the project.

The project has provided professional development opportunities for the computer programmers who have learned and honed skills on React.js, which will be the software of choice for the development of the responsive website. The project team consists of two programmers with NRCC and one with CIT, all have attained the skills necessary to use this programming language in the project. Additional software and programming languages, including Auth0 and GraphQL, are slated for the secure login portion of the website and the data calls made for the website, respectively.

## **HOW HAVE THE RESULTS BEEN DISSEMINATED TO COMMUNITIES OF INTEREST?**

We promoted communication and knowledge-sharing on the project through monthly conference calls with the NEWA State Coordinators and project meetings of NYS IPM Program, the Northeast Regional Climate Center, and Cornell Information Technologies Computer Development. Our 42-member project advisory panel has participated in specific areas to advise NEWA development. We sent out mini-surveys to growers via the Your NEWA blog and to state coordinators via email on topics related to user experience research and geo-specific content.

Our grower advisory panel was engaged in user experience (UX) research on an insect DD model comparing the existing design with a draft responsive design. This analysis improved our knowledge of placement for key information on the page, needed visual elements to allow at-a-glance pest status or crop risk, as well as perspectives on tables and charts of model outputs. We have initiated UX research on two plant disease models, which are more complex in their result outputs.

We presented 17 invited presentations about NEWA were given to grower audiences at numerous winter conferences and other venues. At each, we informed the audience about the website rebuild and data quality control improvements underway. We published 31 articles, and produced 3 podcasts on NEWA for grower audiences, climatologists, meteorologists, and agricultural scientists and queried them about their ideas for improving NEWA's future look and feel. The venues for these have included Extension meetings; grower conferences; the Your NEWA blog,

<https://blogs.cornell.edu/yourenewa/>; newsletters; trade magazines; and scientific meetings.

Dissemination completed to date supports and informs our audiences about our final goal of building an accurate, responsive and geographically relevant NEWA website. The results of the NEWA survey show that nearly 100% of growers responding agree that NEWA directly supports and enhances IPM practices on the farm. Being able to share these data about NEWA's impact with our varied audiences has had a significant impact and will pave the way for increased use of NEWA and similar tools by the agricultural industry when the new website is launched.

## **WHAT DO YOU PLAN TO DO DURING THE NEXT REPORTING PERIOD TO ACCOMPLISH THE GOALS?**

We will complete in year 3 the following:

### **OBJECTIVE 1 - RESPONSIVE NEWA WEBSITE**

We will hold regular meetings with NEWA State Coordinators. To continue fostering communication on the project, we will hold planning and update meetings among CIT, NRCC and NYSIPM participants. We will gather substantive and needed suggestions from the project advisory group members at regular intervals, in the areas of UX, model reconstruction, website programming and design, extension multipliers, and backend development.

We will finish collating and organizing NEWA website content including extension information resources and weather station metadata for each state partner and weather station owner in NEWA, respectively. We will store these items in the regional content and weather station metadata databases, respectively. Programming to call these items into the frontend of NEWA will be developed as the website is built out.

We will implement the other backend databases needed for NEWA: Auth0 for the user login, the user profile settings database, the user biofix cache database, and the model results messages database. A secure user login system will be incorporated into NEWA using Auth0. Auth0 may also provide secure access for weather station metadata management and will be configured to interact with the user profile settings database. These will be implemented once the design of the user profile settings page has been finalized. All models will be carefully reviewed prior to being reconstructed and all information that the user enters as they interact with the model will be organized for inclusion in the user biofix cache database. This essential biofix and crop information will accurately drive pest and crop forecast results and save the grower time repeatedly entering this information into the models. The model results database will be constructed to allow access by model authors so they can easily edit text for pest management messages and similar content on the model page.

Reconstructing the 35 distinct crop:pest model combinations will begin with the identification and documentation of model commonalities. Starting small with phone display, this approach will allow flagging of at-a-glance, snapshot views of key model results and enable the development of the login user's dashboard tiles. We have started the process of listing the model commonalities and will need to flesh out the entire matrix to establish an efficient model reconstruction path to coding all models into responsive design, as informed by the strategy workshops and UX research. We will test and debug the responsive model designs.

Overall website architecture will provide a framework for the frontend and backend components of NEWA to interact as one website. We will test and debug the website. Once the website passes all tests, we will implement the NEWA responsive website.

### **OBJECTIVE 2 - DATA QUALITY CONTROL**

The secure user profile login system will be configured to provide secure access to the weather data editor website. We will fully implement the data quality assurance processes including the ultimate reflection of edits in the NEWA database.

Additional training sessions on the data editor will be undertaken, as needed or requested.

We have plans to experiment (leveraging other resources) with using short term weather model forecast and analysis grids as a benchmark for assessing data quality.

A final component is needed to complete this objective, a mechanism by which any edits entered via the data editing website can be ingested and reflected in the database. This component is dependent on changes to the database structure discussed under Objective 1. We have mapped out this process and will implement it in the coming months.

## TARGET AUDIENCE

Target Audiences: Growers of horticultural and agronomic crops; agribusiness and consultant personnel; Extension educators and faculty; agricultural research faculty; Northeast Regional Climate Center staff; NYS IPM Program staff; computer information technology personnel at Cornell University; owners of NEWA on-site weather stations in CT, IO, IL, KY, MA, MD, MI, MN, NC, NE, NH, NJ, NY, OH, PA, VA, VT and WI; and NEWA State Coordinators; users of NEWA ([newa.cornell.edu](http://newa.cornell.edu)).

Efforts: We reached our target audiences through Extension-led meetings; grower conferences; web conferences; the NEWA blog; experiential learning opportunities; user experience and web architecture analyses; and via our project advisory panel.

## PRODUCTS

### CONFERENCE PAPERS AND PRESENTATIONS

#### 2019

- Peck, G. and Olmstead, D. 2019. Implementing the Pollen Tube Growth Model on NEWA. *Fruit Quarterly*. 26 (1): 11-15. NYS Hort Society, Geneva, NY.
- Carroll, J. 5-Mar-19. Using the NEWA blueberry pest and disease models to your best advantage. New York State Blueberry Growers Association, Ellicottville, NY.
- Carroll, J. 14-Mar-19. Using the NEWA blueberry pest and disease models to your best advantage. New York State Blueberry Growers Association, Millbrook, NY.
- Cummings, J. 23-Jan-19. Updates on spotted lanternfly, Asian long-horned tick and NEWA. Field Crop Pest Management Meeting, Norwich, NY.
- Olmstead, D. 13-Aug-19. Panel discussion: From the User's Perspective: Weather, Water and Climate Insights from Innovative Observation Networks. American Meteorological Society Summer meeting - University at Albany, Albany, NY.
- Olmstead, D. 28-Aug-19. The Network for Environment and Weather Applications: Utilization of weather data for risk assessment in specialty crops. USDA Risk Management Agency Group Tour, Geneva, NY.
- Olmstead, D. 19-Oct-19. The NEWA-Onset Partnership. Onset Corporation, webinar.
- Olmstead, D. 15-May-19. 2019 NEWA updates. Finger Lakes Grape Program Spring IPM Meeting, Hammondsport, NY.
- Olmstead, D. 16-Jan-19. Predicting Western Bean Cutworm Flights in New York with a New Online Tool. Empire State Producers Expo, Syracuse, NY.
- Olmstead, D. 17-Jan-19. NEWA: real time weather-based insect and disease risk assessments. Empire State Producers Expo, Syracuse, NY.
- Olmstead, D. 24-Jan-19. The Network for Environment and Weather Applications: where we are and where we are going. Nassau Suffolk Landscape Grounds Association, Brentwood, NY.

- Olmstead, D. 28-Jan-19. Getting started with the NEWA Pollen Tube Growth Model. Mid-Atlantic Conference Joint Committee, Hershey, PA.
- Olmstead, D. 13-Mar-19. 2019 NEWA updates: where we are and where we are going. Lake Erie Regional Grape Growers Conference, Fredonia, NY.
- Olmstead, D. 20-Mar-19. What is NEWA? Why is it useful in Agriculture? Conesus Lake Watershed Association, Lakeville, NY.
- Weigle, T. 30-Jan-19. Implementing NEWA into a Vineyard IPM Strategy. Mid Atlantic Fruit & Vegetable Convention, Hershey, PA.
- Carroll, J. 2019. Malusim app released! 3 May 2019. Your NEWA Blog. Cornell University.
- Carroll, J. 2019. Canny Climatologist Codes his Way to Excellence in IPM Award. 18 January 2019. Your NEWA Blog. Cornell University.
- Olmstead, D. 2019. NY western bean cutworm crop risk outlook for 8/15/19. Your NEWA Blog. Cornell University.
- Olmstead, D. 2019. NY western bean cutworm crop risk outlook for 8/8/19. Your NEWA Blog. Cornell University.
- Olmstead, D. 2019. NY Western bean cutworm crop risk outlook for 8/5/19. Your NEWA Blog. Cornell University.
- Olmstead, D. 2019. NY Western bean cutworm crop risk outlook for 8/1/19. Your NEWA Blog. Cornell University.
- Olmstead, D. 2019. NY Western bean cutworm crop risk outlook for 7/29/19. Your NEWA Blog. Cornell University.
- Olmstead, D. 2019. Improve your western bean cutworm scouting with NEWA flight estimates. 25 July 2019. Your NEWA Blog. Cornell University.
- Olmstead, D. 2019. The positive impacts of NEWA for grape producers. Appellation Cornell. May 2019. Cornell Viticulture and Enology Program Work Team, Cornell University.
- Olmstead, D. 2019. NEWA user feedback is needed. Please help us now! 14 June 2019. Your NEWA Blog. Cornell University.
- Olmstead, D. 2019. NEWA announces partnership with Onset Corporation. 2 May 2019. Your NEWA Blog. Cornell University.
- Olmstead, D. 2019. Sign up for eNEWA – grape disease and insect pest notifications. 30 April 2019. Your NEWA Blog. Cornell University.
- Olmstead, D. 2019. NEWA apple pollen tube growth model now available. 23 April 2019. Your NEWA Blog. Cornell University.
- Olmstead, D. 2019. New York State expertise for NEWA tools and resources. 19 March 2019. Your NEWA Blog. Cornell University.
- Olmstead, D. 2019. Spring is coming - tune up your weather stations. 12 March 2019. Your NEWA Blog. Cornell University.
- Olmstead, D. 2019. NYS Mesonet: 2018 year in review. 24 January 2019. Your NEWA Blog. Cornell University.
- Olmstead, D. and Carroll, J. 2019. NEWA apple carbohydrate model now improved. 26 April 2019. Your NEWA Blog. Cornell University.
- Olmstead, D. and Carroll, J. 2019. The 2017 NEWA Survey: discussion and future directions. 14 January 2019. Your NEWA Blog. Cornell University.

## **2018**

- Olmstead, D. 14-Nov-18. NEWA introduction and updates. Cornell Cooperative Extension In-Service, Ithaca, NY.
- Olmstead, D. 1-Nov-18. The Network for Environment and Weather Applications. NYS IPM Field Crops Call, Geneva, NY.
- Olmstead, D. 15-Nov-18. Getting started with NEWA. Conesus Lake Watershed Association, Lakeville, NY.
- Olmstead, D. 2018. NEWA annual reports are available to the public. 25 September 2018. Your NEWA Blog. Cornell University.
- Olmstead, D. and Carroll, J. 2018. The 2017 NEWA survey: use of models, tools, and resources. 17 December 2018. Your NEWA Blog. Cornell University.

## **OTHER**

### **2019**

- Olmstead, D. and Carroll, J. 2019. NEWA apple carbohydrate model now improved. 26 April 2019. Your NEWA Blog. Cornell University.

- Olmstead, D. and Carroll, J. 2019. The 2017 NEWA Survey: discussion and future directions. 14 January 2019. Your NEWA Blog. Cornell University.
- Olmstead, D., Carroll, J. and Sazo, M. 2019. NEWA apple carbohydrate thinning model now improved! Scaffolds. 28 (6): 6-7. Dept of Entomology, Cornell University.
- Weigle, T. 2019. Grape Berry Moth and NEWA. LERGP Vineyard Notes. July, 1, 2019, pp 7-8. Lake Erie Regional Grape Program, Cornell University.
- Weigle, T. 2019. Grape Berry Moth/NEWA Update. The Crop Update. August 8, 2019. Lake Erie Regional Grape Program, Cornell University.
- Weigle, T. 2019. NEWA – A Tool for Lake Erie Grape Growers Economic and Environmental Sustainability. LERGP Vineyard Notes. April, pp 17-18) Lake Erie Regional Grape Program, Cornell University.
- Weigle, T. 2019. eNEWA for Grapes – Back by Popular Demand. The Crop Update. April 18, 2019. Lake Erie Regional Grape Program, Cornell University.
- Weigle, T. 2019. eNEWA for Grapes – Back by Popular Demand. The Crop Update. May 2, 2019. Lake Erie Regional Grape Program, Cornell University.

## 2018

- Olmstead, D. and Carroll, J. 2018. The 2017 NEWA survey: use of models, tools, and resources. 17 December 2018. Your NEWA Blog. Cornell University.
- Olmstead, D. and Carroll, J. 2018. The 2017 NEWA survey: IPM impact. 20 November 2018. Your NEWA Blog. Cornell University.
- Olmstead, D. and Carroll, J. 2018. The 2017 NEWA survey: current and potential users. 16 November 2018. Your NEWA Blog. Cornell University.
- Olmstead, D. and Carroll, J. 2018. The 2017 NEWA survey: understanding grower impact, needs, and priorities. 13 November 2018. Your NEWA Blog. Cornell University.
- Olmstead, D. 2018. NEWA is awarded USDA grant to improve website. 15 October 2018. Your NEWA Blog. Cornell University.

## OTHER PRODUCTS

### Audio or Video

- Weigle, T. 2019. Grape Berry Moth and NEWA. LERGP Podcast 132. August 21, 2019. Lake Erie Regional Grape Program, Cornell University. <https://youtu.be/KugLdK5pOEA>
- Weigle, T. 2019. Using NEWA Prebloom. LERGP Podcast 123. June 12, 2019. Lake Erie Regional Grape Program, Cornell University. <https://youtu.be/M0pliQp2BYM>
- Weigle, T. 2019. Get Your Weather Through eNEWA. LERGP Podcast 114. April 10, 2019. Lake Erie Regional Grape Program, Cornell University. <https://youtu.be/256R6cfewf8>

## CHANGES/PROBLEMS

We requested and received a no cost extension of 12 months. This time was needed to make certain sufficient time is available to rewrite and verify the code for the over 30 IPM models on NEWA, as well as for two new models that have been built in a hybrid platform within the past year. The user experience, new model interface, and web architecture research done by the New York State IPM Program, the Northeast Regional Climate Center, and Cornell Information Technologies Computer Development, respectively, took more time than was anticipated. Because of this, progress was delayed into the growing season of year two, slowing our ability to interact with our advisory panel and accomplish work on the website architecture, design, and responsive development.



This work is supported by the Crop Protection and Pest Management, Applied Research and Development Program grant no. #2017-04687 from the USDA National Institute of Food and Agriculture.