Development and Validation of a "Real-Time" Apple IPM Website for New York

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Apple growers in the Eastern US have faced challenges in managing the complex of insects and diseases of apples using conventional pesticides during the last decade because of increasing pesticide regulatory restrictions, public concerns about food safety and environmental quality, and the development of resistance to older materials by key insect and disease pests. Growers are attempting to turn to newer reduced-risk pesticides, but these are more expensive and require more precise use patterns because of their different modes of action. In addition, many current IPM protocols were designed for older conventional materials. During the last several years, an interdisciplinary group of researchers at Cornell University has developed a web-based, "Real-Time" Apple IPM Decision Support System that can deliver relevant, current information on weather data and pest populations to facilitate grower pest management decisions throughout the growing season. This system tracks seasonal development of key insect pests and diseases using Degree Day and Infection Risk models. The models indicate pest status, pest management advice and sampling options, and are linked to an interactive system that helps growers choose appropriate materials when pesticide use is recommended.

> **"An interdisciplinary group of researchers at Cornell University has developed a web-based, "Real-Time" Apple IPM Decision Support System that can deliver current information on pest populations to facilitate grower pest management decisions throughout the growing season. The system also provides pest management advice that helps growers choose appropriate materials when pesticide use is recommended."**

Insect pest developmental stages are calculated from Degree Day (DD) accumulations at NEWA (the NYS IPM Network for Environment and Weather Applications) and National Weather Service airport weather stations throughout the state. The insect pests addressed by this website are: apple maggot, oriental fruit moth, codling moth, plum curculio, obliquebanded leafroller, and spotted tentiform leafminer. Disease predictions are available for apple scab and fire blight, and a summer disease (sooty blotch and flyspeck) development model is due to be made available this summer.

Access to the Apple Insects models is through the "Pest Forecasts" list or the "Apples" link on the NEWA homepage (http://newa.cornell.edu). From the Apples homepage, clicking on the link that says "Apple Insect Phenology Models and IPM Forecasts brings up a state map showing the available weather stations, plus pull-down menus on one side (Figure 1). After the user selects a weather station, pest of interest, and the desired end date for weather data accumulation, pest DD models and historical records are used to calculate: Tree Phenological Stage, Pest Stage(s), Pest Status, and Pest Management Information, all of which appears on a "Results" page (Figure 2). The phenological stage can be adjusted according to field observations by selecting from a pull-down menu; this will generally change some of text provided in the advice boxes. Hyperlinks on this page can take the user to various other online resources, such as color photos of the bud development stages, NYS IPM Fact Sheets of the pests in question, and when appropriate, sampling charts for use in conducting field samples of specific pest life stages (e.g., eggs, larvae, mines). When a pesticide spray is recommended, a "Pesticide Information" link in the "Pest Mangement" box takes the user to the Pest Management Education Program's (PMEP) Tree Fruit IPM home page, where a pesticide decision filter helps users pick an appropriate material to use, based on anticipated pest severity and program

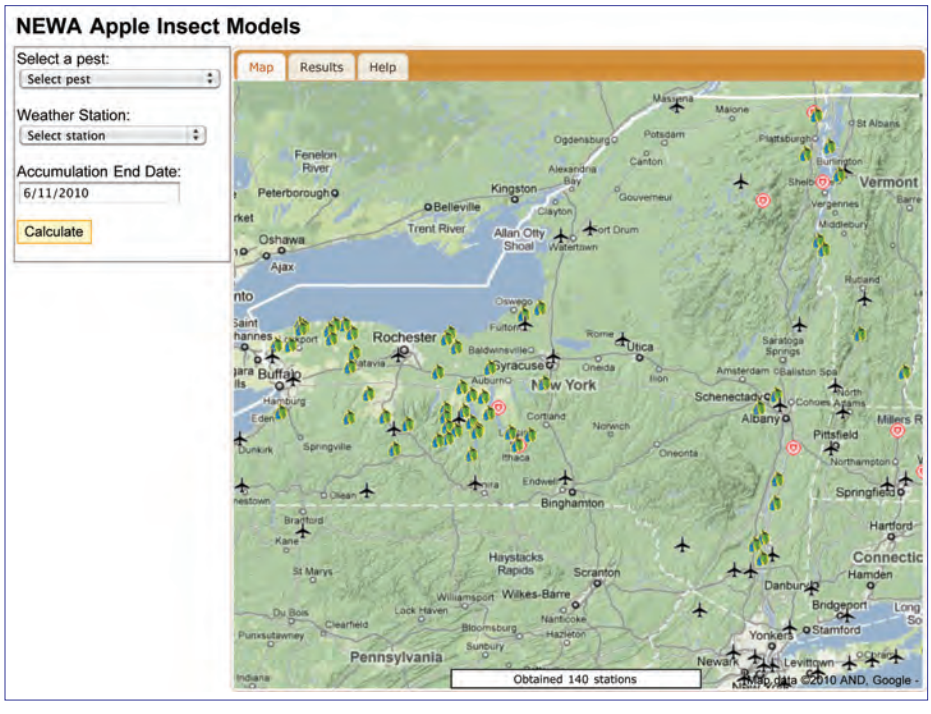

Figure 1. Home screen for initial selection of pest and weather station of interest.

type (Figure 3).

A pesticide search returns a series of profiles of all the NY-registered products fitting the specified pest species and efficacy rating (Figure 4). The profile gives the common and trade names, labeled use rate, re-entry and pre-harvest intervals, and EPA registration number of each product. Also included are some general remarks on the range of product efficacy, and any known effects on beneficial species. A "Details" link in each profile takes the user to a more extensive list of information, including notes on the active ingredient (including its mode of action classification), an overview of recommended use periods, and a link to a scanned copy of the NYS DEC-approved product label, which can be read or printed out.

All of the information presented is available online at various other university sites, but this website brings these resources together in one place that is more convenient and efficient to access. Predictions provided by the website can be refined and adjusted to reflect current insect activity by user-entered events obtained through field monitoring (such as pest biofix; i.e., the first sustained flight of a pest species). The pesticide selection filter uses Cornell University product efficacy ratings and the type of management program selected by the user (i.e., conventional, reduced-risk, non-organophosphate, organic).

During the 2009 growing season, the Apple IPM website was "beta-tested" by a group of 16 NY apple growers, along with their respective Cornell extension educators and private consultants located in Orleans, Wayne, Onondaga, Clinton, Saratoga, and Albany Counties. At each site, a planting of apples from 10-20 acres in size was monitored for crop and pest status throughout the season, and a suitable nearby weather station was designated for providing daily temperature data as a basis for crop and pest developmental predictions. Insect pests addressed by the website were: apple maggot (AM), oriental fruit moth (OFM), codling moth (CM), plum curculio (PC), obliquebanded leafroller (OBLR), and spotted tentiform leafminer (STLM).

The website uses DD information based on either historical records or user-entered biofix data, and includes: the start, peak, or progress of the oviposition or egg hatch period (for CM, OBLR, OFM, and STLM); the start, peak or end of the pest's 1st, 2nd, etc., flight (for AM, CM, OBLR, OFM, and STLM) (Figure 5); the first occurrence of adult or larval feeding, foliar or fruit damage, or mines (for OBLR and STLM). Insect monitoring traps were placed in all orchards and checked approximately once per week to monitor adult flights, and weekly fruit inspections were conducted starting in July to assess the incidence of any larval feeding damage to apples caused by leafrollers or internal feeding Lepidoptera such as codling moth or oriental fruit moth. All results of this insect monitoring were reported on a weekly basis to each respective grower and their consultant for use in determining appropriate management decisions in each block.

We compared web predictions with population trends observed in the field for as many of the pest species as was possible, although not all

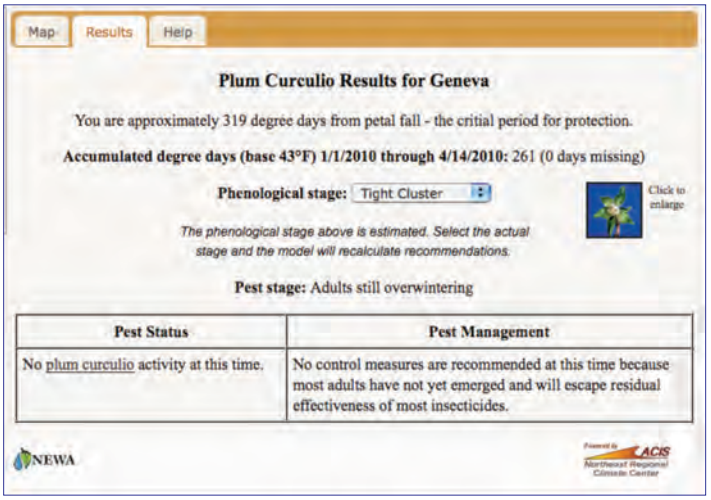

Figure 2. Results page showing pest and crop developmental status and management information.

populations of all species were large enough or distinct enough to make a practical assessment of the website's accuracy in all cases. Predictions were generally fairly accurate, although some pest occurrences were predicted too early or too late. In general, the main sources of error in the website predictions were:

- Traps were sometimes set out too late, so that we missed the first flight, and therefore the biofix was wrong (STLM and OFM, especially).
- The trap check interval was sometimes too long to precisely identify moth catch trends; our 7-day schedule could have been shortened at times, to better track important events, such as dates near the anticipated first or peak catches.
- Some target insect populations were too low to make good predictions of their developmental events; this was generally a result of the cool, wet summer weather in 2009, and so was out of our control to remedy.
- The model predictions (based on historical data) were simply not precise enough to be accurate every time; for instance, we did not have extensive records on CM peak flight periods.
- The weather stations were often not numerous enough or close enough to individual sites to be representative of true DD conditions in the orchards. This would be difficult to rectify without investing in a large number of additional grower-owned ground weather stations, or else obtaining

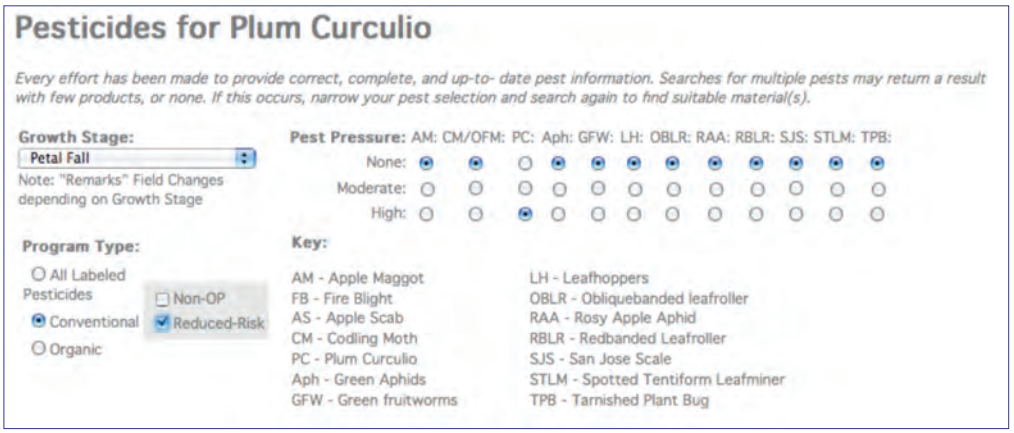

Figure 3. Pesticide decision filter for selection of appropriate choice based on pest pressure, product efficacy, and management program elected.

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CORNELL FRUIT FIELD DAYS 2010

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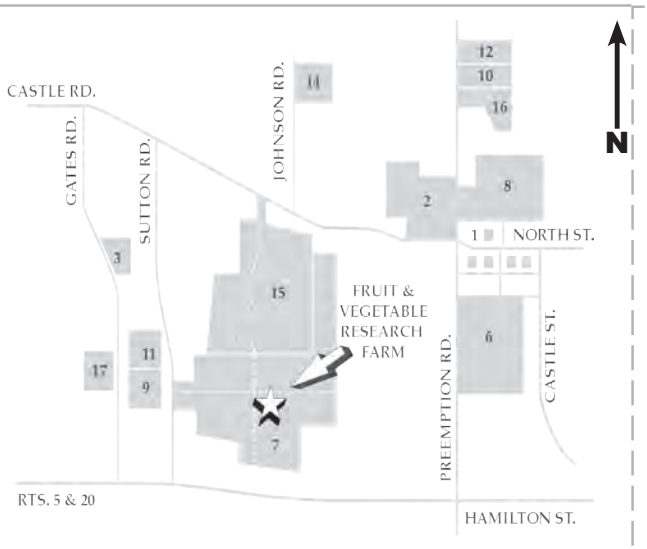
July 28 & 29th 8 am - 5 pm



1. Main Campus
2. Crittenden farm-North
3. Darrow A Farm
6. Denton Farm
7. Fruit & Vegetable Research Farm- South
8. Loomis Farm
9. Lucey Farm
10. McCarthy Farm (PGRU)-South
11. Robbins Farm
12. McCarthy-North
13. South Crittenden Farm
14. Trickler Farm
15. Fruit & Vegetable Research Farm- North
16. Wellington Farm (PGRU)
17. Gates East & West

July 28 (Grapes and Small Fruit) & 29th (Tree Fruit) 8 am - 5 pm

ADVANCE REGISTRATION IS REQUIRED

Registration is $15.00 for one day or $25.00 for both days. Lunch is included in registration fee

FOR MORE INFORMATION:
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Please mail this registration form along with payment (checks made payable to Cornell University) by July 18 to:
Nancy Long, NYS Agricultural Experiment Station
630 W. North Street, Geneva, NY 14456;
or fax your registration to Nancy at:
315-787-2443 by July 18 or register online at:
http://www.nysaes.cornell.edu/

Registration (check one): July 28th ($15) ___ July 29th ($15) ___
July 28th & 29th ($25) ___ Total amount enclosed ($US): _____

Lunch selection (check appropriate boxes)

	July 28	July 29
Chicken BBQ	☐	☐
Vegetable Lasagna	☐	☐

Name_____
Address_____
City_____State_____Zip_____
Phone:_____Email:_____

All who pre-register will be eligible for door prizes.

our DD information from national weather databases.

Also during the 2009 growing season, we conducted a field study to test two different IPM protocols integrating information obtained from the "Real Time" Apple IPM website from many of these orchards. Tests were set up in 14 orchards in the major NY apple production regions. Entomology department personnel monitored and sampled the plots throughout the season, and growers applied pesticides in their plots based on the monitoring results and web predictions of pest development. In what we called the "Fruit Monitoring Protocol," growers applied their normal sprays for insect control until plum curculio (PC) egg-laying activity was over. Then, starting in late June, 1000 apples were inspected on the tree weekly for damage from internal Lepidoptera (codling moth or oriental fruit moth) and obliquebanded leafroller (OBLR). Apple maggot (AM) traps were deployed in late July. Control sprays were recommended whenever treatment thresholds were reached (1 fruit damaged by either OBLR or internal leps; or, an average AM capture of 5 flies/trap). In the "Web-Optimized Treatment Protocol," normal control sprays were also applied until PC activity was over. Then, an initial summer spray was recommended based on web predictions of hatch of summer OBLR eggs and 1st generation internal lep eggs. A second spray was recommended based on web predictions of AM activity and 2nd generation internal lep egg hatch.

Growers would have applied an average of 2.0 and 1.3 summer sprays, respectively, in the Web-Based and Fruit Monitoring plots, if they had followed all the recommendations as given. Grower spray records were collected and compared to assess the actual numbers of sprays applied to the orchards in this trial. The number of sprays turned out to be higher than recommended in both cases (an average of 2.9 in the Web-Based plots, and 3.4 in the Fruit Monitoring plots); however, the average number of sprays applied, as well as the deviation from the recommended number, was less using the Web-Based 2-spray program. Insect damage at harvest was similar for both protocols (2.9%, Web-Based; 3.2%, Fruit Monitoring). Fewer sprays were recommended in these plots than have been previously applied in NY apple orchards under traditional IPM programs over the past 40 years, which has ranged from 3-6 sprays during the same period of the summer. We feel that, with further development and field validation, this decision support website could be a useful tool in allowing growers to optimize their efforts by combining weather-based pest development predictions, historical records, and minimal field monitoring sessions to obtain an acceptable level of fruit quality without making excessive spray applications.

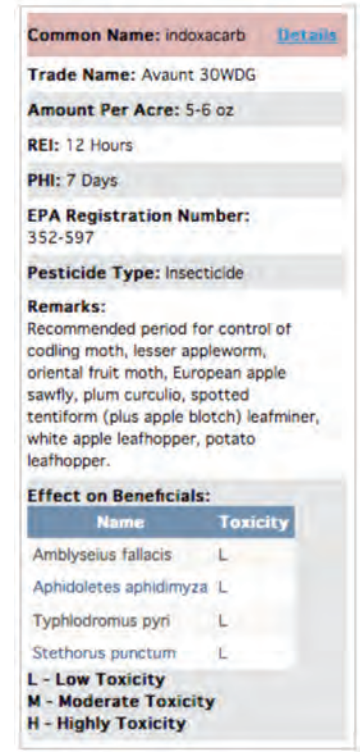

Figure 4. Example of an insecticide product profile generated as one choice by the pesticide filter.

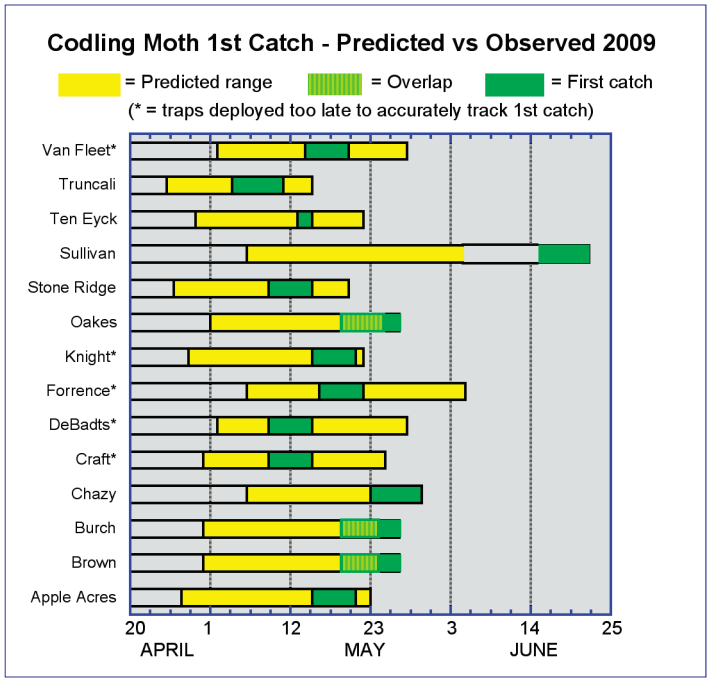

Figure 5. Predicted vs. observed first trap capture of codling moth 1st generation adults.

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