

## **2004 Northeast IPM Project Progress Report**

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### **Title: Verification of Web-based Real-Time High-Resolution Weed and Insect Predictive Models for Northeast IPM Programs**

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#### Non-technical Summary

Many mathematical models of insect and weed development are available to help predict pest management activities. The use of these models, however, has been limited by the need for high quality weather data and software to run them. In 2003, colored maps of insect and weed development were made available on the internet (10 km<sup>2</sup> resolution) through the Penn State Departments of Entomology and Crop and Soil Sciences websites to provide farmers and other agricultural professionals with early alerts to pending pest occurrence. The accuracy of the underlying models was verified at specific locations, but not on a wide-scale basis. Therefore, this project proposed to collect verification data from multiple climatic/crop production regions in Pennsylvania to assure the models are adequately tracking pest development at an accuracy required for pest management. Although the verification process is currently limited to Pennsylvania, the climatic zones represented are common across most of the field crop production region of the Northeast and Mid-Atlantic. If the models track properly across Pennsylvania, they are likely to be on target in other areas of the region. The maps are currently being provided to other cooperating states in the region.

## Introduction

In order for farmers to move away from over reliance on pesticides, reliable economic thresholds, sampling methods, management tools, and tools to time pest management activities are needed. Although all these tactics are important for an IPM program, timing of key events is probably the most difficult yet also the most important component. Without accurate straightforward methods to time critical events, such as scouting and pest management intervention, significant inefficiencies develop that result in failure and reduced profit to growers.

Because development of crops, insects and weeds are temperature dependent, their temporal occurrence during the season is greatly influenced by physical features of the region. The seasonal degree-day accumulations in this region are greatly affected by this variation in relief and the latitudinal gradient. In Pennsylvania that the accumulation of degree days for European corn borer development vary across the state from 700 to 1400. This indicates that in the warmest areas of the state, there are twice the heat units for the pest population to development than in the cooler more northern region. In fact, the pest typically completes two to three generations in the southeast and south central regions of the state and only one in the north central region. Model simulation for the European corn borer have indicated that the second generation egg laying period can vary by up to five weeks between locations in the state and up to five weeks between years at the same location. Similar differences are seen for other insect pests.

This variation can also have a major impact on spring and summer weed emergence periods. In the warmer southern areas, weed emergence occurs earlier on average and may occur over a longer or shorter time period depending on species than in cooler northern areas. These differences can greatly influence the timing and effectiveness of weed management tactics. A farmer trying to optimize the timing of pest management activities would have a difficult time knowing when to begin and stop scouting and when to implement a control tactic (chemical, mechanical, or biological).

This project is designed to test the accuracy of colored maps that predict insect and weed development across the landscape to improve the timing of key pest management activities.

## Objectives

1. Verify and demonstrate each phenology model's reliability for timing key weed emergence periods and insect life stages across climatic regions of Pennsylvania.
2. Conduct educational training sessions with farmers, consultants, and agricultural professionals to demonstrate the use of the phenology model tools.

## Approach

## Objective #1 – Model Verification.

Weed and insect model verification data will be collected at six locations across Pennsylvania and it will be repeated over two growing seasons (2004 and 2005). The six sites will be located in the four major climatic and crop production zones of Pennsylvania, as identified by average seasonal degree day accumulations: western central, central, northeast, and southeast/south central. Field-based educators within these regions will be responsible for collection of information on alfalfa weevil life stages, European corn borer life stages, corn rootworm adult emergence and key weed emergence periods. Weed and insect phenology models will be used to estimate when monitoring should begin at each of the study locations. For alfalfa weevil monitoring, fields will be sampled using a 15-inch insect sweep net to collect alfalfa weevil larvae and adults. In each field, five sets of 20 sweeps will be collected weekly until pupation of the population is predicted. Alfalfa weevil larvae collected in the samples will be placed in 70% alcohol and sent to Penn State, where the age class of each individual will be determined in Dr. Calvin's lab. Four areas within a field, 2-m<sup>2</sup> in size areas will be established for monitoring weed emergence starting in late March or as soon as conditions permit. Half of each 2-m<sup>2</sup> quadrant will remain crop free, while the other half will be planted to no-till Roundup Ready soybean. Soybean will be removed in the seedling stage from the no-crop plots by use of a nonselective herbicide (i.e. glufosinate or Liberty). This will allow us to test the impact of the crop on weed species emergence periodicity. The weekly collections will then be used to compare the field observed insect developmental stages and weed emergence with the models' predictions. The phenology model will be run for the specific location of the field by acquiring Geographic Position System (GPS) coordinates to spatially interpolate the temperature data. Adequacy in the prediction will be determined by regressing the cumulative percentage of the population observed in the field against the cumulative percentage predicted by the model. Perfect correspondence between the model and the observations would result in a regression line with a slope of 1.0, intercept of zero and R-square of 1.0. The uncertainty of the model's prediction relative to reality will be measured by the departure of the points on the regression line and departure from a slope of 1.0 and intercept of zero.

## Objective #2 – Demonstration and Education.

Several methods are being used to increase farmer and agricultural professional adoption of the web-based maps. First, the maps have been made available on the web at the Department of Entomology website ([http://www.ento.psu.edu/extension/field\\_crops/default.htm](http://www.ento.psu.edu/extension/field_crops/default.htm).) These maps are updated daily and used biweekly in the Field Crops News (state field crop newsletter) and local county extension newsletters. In the newsletters, the map information is interpreted for the users. Field days are being hosted at each location during the summer to explain and discuss the value of pest prediction. Field days are and will be conducted at times when the educational message is most clearly seen in the field. Since county agents are playing a pivotal role in this project, the educational component will clearly reach out from the local county office. In addition, an educational circular will be developed and used at each field day to discuss the merits of pest predictions.

## Progress

During the 2004 growing season, 2 fields in three counties and one at Rock Springs, PA were monitored for insect development and weed emergence. At each location WatchDog™ temperature monitors were placed at 1 and 3 inches soil depths and at 5 feet above the soil to measure ambient temperature. Temperatures were registered at 2-hour intervals over the study period. These data have been transferred in Excel™ for later analysis. ZedX, Inc. will provide spatially interpolated temperature data over the same period to test its correlation with the on-site measured temperatures. Both sets of temperature information will be used to predict insect development and weed emergence. Data were collected at each of the sites on European corn borer adult flight activities, alfalfa weevil life stages and corn rootworm developmental stages. Alfalfa weevil larvae were collected using sweep nets and mailed to the laboratory of Dr. Dennis Calvin for stage structure measurement. All the alfalfa weevil samples have been measured for stage structure and stored in Excel™. Stage structure data were also collected for corn rootworm and European corn borer. These data were also sent to Dr. Calvin's laboratory for stage structure measure and are now stored in Excel. Measurements of weed emergence were completed at all sites under no-till conditions with and without the presence of a corn crop. The information was stored in Excel for later analysis. At a few sites, the density of weeds was very low and some species were not present. Therefore, a complete data set was impossible to get. Extension educational meetings were used to begin the process of educating farmers and other agricultural professional about how to use and interpret the maps.

The 2005 season is underway and data collection is proceeding on schedule. We have planned several extension field days to demonstrate the maps and their utility to growers. At this point, we anticipate a good season and the project is proceeding on schedule.