

Progress Report 2006 - USDA NE IPM 2005-34103

A. Grant Data

- Title: Site-specific Management of Resistance in the Control of Apple Scab
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- State(s) involved: New York, Massachusetts, West Virginia
- Years funded: 2005-2008
- Funding amount: \$ 177,785

B. Nontechnical Summary.

In climates with cool and rainy spring weather, apple scab caused by the fungus *Venturia inaequalis* represents the most important disease of apple trees. Under severe infection conditions, diseased trees can be defoliated prematurely, but the economically most important symptoms are scab blemishes on fruits, which are not tolerated by the profitable fresh apple market. In the US, scab affects the production of apples in all states of the NE-IPM region, Michigan, Virginia, North Carolina and the coastal regions of Oregon and California.

Control of scab with fungicides continues to be the major management tool available to commercial apple growers, with 4-10 applications made during the scab season. During the past six decades, apple growers have utilized several classes of scab fungicides, starting in the 1940s with the introduction of the carbamates such as ferbam followed by the EBDCs (such as mancozeb) and captan, both introduced in the 1950s. These old fungicides act non-specifically and, therefore, must protect apple leaves and fruits prior to infections taking place, requiring weekly sprays at high application rates. In addition, they interfere with proven IPM practices of providing mite control.

Modern fungicide classes were first introduced in the late 1960s. These fungicides act highly specific, allowing effective scab control after infections by the scab fungus already occurred. They also are fully IPM-compatible. Unfortunately, the originally excellent properties of all of the five fungicide classes eroded or are in the process of eroding, because the scab fungus developed or is developing resistance. In most cases, the transition from good control of scab to control failures caused by resistance is abrupt. Individual apple growers cannot foresee such abrupt and economically severe crop losses. A solution to this problem would require knowledge

of the levels of resistance to all available classes of modern low-risk fungicides in particular orchards, allowing individual growers to change their scab control tactics before resistance becomes a problem. Biological tests were developed to retrieve this knowledge. Adjusting these tests to grower's needs and implementing these tests as a service offered to growers is the focus of this project.

C. Introduction.

Apples are the most important fruit crop grown in the NE-IPM region, with a value of \$260 Million in 2003. The profitability of producing apples for the processing market has sharply declined, and the sustained viability of the industry will rely on the fresh apple market. One of the most serious and most common causes of intolerable blemishes on fresh apples are scab lesions caused by *Venturia inaequalis*. The disease is ubiquitous in the NE and must be managed with 4-10 applications of fungicide per season.

The arsenal of scab fungicides includes conventional fungicide such as mancozeb or captan. These nonspecific and purely protective fungicides, which have to be applied on a weekly schedule and at high rates, have been under continuous scrutiny regarding their toxicology and their poor fit into IPM programs. Several classes of 'low-risk' fungicides with post-infection activities are available as alternatives. Unfortunately, all 'low-risk' fungicides have developed or will develop resistance, rendering them ineffective in scab control. Outbreaks of scab caused by resistance are unexpected by the growers affected and have caused increasingly frequent economical losses. Our research over the past 15 years has shown that levels of resistance can vary considerably from orchard to orchard. Many growers, who still could effectively use particular classes of 'low-risk' fungicides, have converted back to the conventional protectants to avoid potential crop losses caused by resistance. Other growers continue to apply 'low-risk' fungicides in spite of resistance, thereby risking unexpected losses.

The goal of the proposed work is to establish and implement **Site-specific Management Of Resistance (SMOR)** as a service to apple growers. The novel SMOR concept consists of orchard-specific sensitivity tests combined with management recommendations based upon the sensitivity of the particular scab population to **all** 'low-risk' options available. SMOR will allow growers to utilize 'low-risk fungicides without risking unexpected damage. Implementation of SMOR requires to validate the diagnostic precision of our orchard-specific sensitivity test, and to establish an infrastructure allowing the implementation of SMOR as a service on demand. The proposed work is conducted in cooperation between New York as the most important apple-producing state, Massachusetts representing New England, and West Virginia as one of the southern regions of apple production.

D. Objectives.

Implementation of SMOR as the major objective of the project will allow apple growers to assess the sensitivity status of *V. inaequalis* in their individual orchards and then to design 'tailor-made' scab control programs without risking unexpected economical hardship. We have developed a simplified and unified sensitivity test in the past. Successful implementation of SMOR requires:

- A final technical development phase to refine the important questions of sampling and shipment of diseased apple leaves and to insure the validity and success of site-specific management recommendations.

Narrative: Leaves with scab symptoms were collected from and tested for a total of 39 individual orchards from NY, MA and WV. The sampling and shipment protocol we had

developed posed no problem and will be implemented. Results from orchards tested in both 2004 and 2005 were highly consistent. Tests with samples collected throughout individual orchards and from several orchards with identical fungicide histories were in support of the high precision of the test. Inconsistencies were only apparent for the anilino pyrimidine pyrimethanil. The problems were addressed and will be accounted for during 2006.

- Promoting the awareness of current problems with resistance and conveying the benefits offered by SMOR. This task will be crucial to the implementation of SMOR, because the cost for the service will have to be covered by the growers requesting the service and will necessitate the establishment of a fee structure to make this crucial service available to growers.

Narrative: Articles in the *New York Fruit Quarterly* and *Scaffolds* and respective extension efforts in New England and West Virginia were aimed at a summary of the problem and the availability of SMOR. In order to test grower acceptance of a 'fee-for-service' structure, this service was advertised. As expected, no requests were received from the participating states, but requests were received and processed from Ohio and Wisconsin.

E. Approach.

Diseased apple leaves are collected throughout an orchard with scab outbreaks, or from corner trees left unsprayed until scab symptoms develop. Leaves are placed in paper envelopes and sent via overnite express to our test site at Cornell University. Here, individual lesions are cut from leaves and placed into open Eppendorff tubes until they are processed.

Sample processing starts with suspending conidia from individual scab lesions in water. Fractions of these suspensions are dispersed over agar surfaces void of a fungicide, or over agar surfaces containing dodine, myclobutanil, trifloxystobin or pyrimethanil at single discriminatory dose. The quantitative sensitivity measure of relative growth is determined for conidia of 30 individual lesions per orchard. The size of very small colonies after incubation for seven days is measured with a computerized imaging system. The results, which reflect the level of sensitivities/resistances of the orchard tested, are then reported to the participating growers, accompanied by a recommendation made concerning the predicted utility of the various fungicide classes in future scab management programs.

F. Progress.

The major objectives envisioned for the first year of the three-year project have been fully accomplished. We have verified the functionality of our sampling and shipping protocol, we have verified the diagnostic value of the sensitivity test through repetitive sampling of leaves, and we have increased the awareness of the problem, as exemplified by the large number of growers interested in the SMOR concept and willing to cooperate.

Problem areas encountered were year-to-year inconsistencies in the test results for pyrimethanil, and the reluctance of growers to accept a 'service-for-a-fee' price structure. The technical problem with pyrimethanil test results are being addressed by increasing the discriminatory test dose for the 2006 test season, with several orchards being tested at both discriminatory doses. The apparent and expected reluctance of apple growers to accept services provided for-a-fee will be emphasized in the broad grower survey we have anticipated to be initiated in 2006.