Sanitation and biocontrol strategies to control apple scab

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Integrated pest management (IPM) is an ecologically based, environmentally conscious method that combines, or integrates, biological and nonbiological control techniques to suppress weeds, insects, and diseases. It was formulated into national policy in February 1972 when President Nixon directed federal agencies to take steps to advance the concept and application of IPM in all relevant sectors. In 1979, President Carter established an interagency IPM Coordinating Committee to ensure development and implementation of IPM practices, and this was when the New Hampshire apple scab IPM research program was initiated. Its main goal was to reduce our dependency on fungicides through an integration of defensive (fungicide) and offensive (sanitation) strategies based on a prediction of "scab-risk" coupled to a "sanitation" action threshold to provide an acceptable level of scabbed fruit.

Venturia inaequalis, the fungal pathogen causing apple scab, is a very successful parasite, but it has one major weakness in its life cycle: its overwintering stage. *V. inaequalis* survives the winter in dead apple leaves in the leaf litter, and these scabbed leaves are the source of the ascospores that cause infections when the trees resume growth in the spring. Thus, the number of infections that occur in the spring is directly related to the number of ascospores produced. Sanitation is any practice aimed at eliminating the fungus during this overwintering stage, and this can be accomplished by chemical, biological, or physical means. *What is exciting is that for the first time we have the potential to eliminate 80 to >90% of the potential ascospore dose by each of these means*.

Chemical means. We reported in 2000 (1) that ascospores were reduced by 97% when 5%urea was applied to trees in the autumn before leaf fall, by an average 50% when urea was applied to the leaf litter in autumn when approximately 95% of the leaves had fallen, and by an average 70% when urea was applied to the leaf litter in spring

Physical means. Also in the 2000 article, we provided data to suggest that shredding the leaf litter in November or April will reduce the risk of scab by 80-90%. Since then, we have shown that we can remove over 90% of the leaf litter when the leaves are blown into the row alleys and then shredded with a flail mower.

Biological means. A study in Canada) reported in 2004 (2) that a biological control agent (*Microsphaeropsis ochracea*) reduced ascospore production by 94-99%, 61-93%, 64-86%, and 54,to 67%, respectively, when applied in August, September, October and November.

Current research. A study underway in New Hampshire is investigating the potential of 1-3 pre-leaf fall urea applications to reduce ascospore production and tree responses to the increased nitrogen. Another study is investigating the potential of leaf shredding to reduce the fungicide dose in a low-inoculum orchard. A project in Europe is determining the efficacy of the

biocontrol agent to reduce ascospore production under conditions in Europe. We are planning a similar study in New Hampshire once we have approval to apply *M. ochracea* in the orchard.

The status of the sanitation studies and the potential of *combined* sanitation practices to reduce the ascospore dose and the fungicide dose in low and moderate scab-risk orchards, including organic orchards, will be discussed.

1. Sutton, D. K., MacHardy, W. E. and Lord, W. G. 2000. Plant Dis 84:1319-1326.

2. Carisse, O., and Rolland, D. 2004. Effect of timing of application of the biological control agent Microsphaeropsis ochracea on the production and ejection pattern of ascospores by Venturia inaequalis. Phytopathology 94:1305-1314.