SUMMARY OF 2006 PROGRESS -- PROJECT NUMBER: ORE00296

PROJECT TITLE: Reduced Fungicide Use for Hop Downy Mildew Management

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The overall goal of this research and extension project is to improve hop grower profitability and sustainability with reduced-risk pest management tactics. Hop downy mildew is one of the most economically important diseases of hops grow in the US, and management relies largely on prophylactic fungicide applications. Disease forecast models can aid growers in improved use of pesticides. Two growing degree-day models (based upon air and soil temperature) that predict the first emergence of hop shoots systemically infected with the downy mildew pathogen (i.e., primary basal spikes) were evaluated in small plots and commercial yards of cooperating growers. These models may predict when fungicide applications should begin to protect plants from the early season spread of spores from primary basal spikes.

The growing degree day model based on air temperature predicted the appearance of basal spikes eight days after the first sporulating spike was observed in experimental plots of cultivar Nugget in Corvallis. In commercial yards, the first sporulating spikes were observed on 24 March in two yards of cultivar Willamette, 12 days before the model predicted. By 31 March, spikes were observed in two other Willamette yards and three yards of cultivar Nugget, 5 days earlier than predicted by the model but still within the expected range. Therefore, the model was late in predicting disease appearance in the experimental plots and two Willamette yards with very low incidence of disease (<1%), but the emergence of basal spikes was predicted within the expected range of the model for five of the commercial yards surveyed.

A downy mildew forecast model developed in England (Royal, 1973) was also validated in small plots. The model predicts the severity of infection events in response to weather (rainfall and hours of relative humidity about 90% in the previous 48 hr period). When an infection period is predicted to have occurred, a fungicide application is recommended to limit secondary spread of disease. Fungicide applications applied according to the downy mildew risk index provided disease suppression similar to that of the standard grower spray program, but with four or five fewer applications.

The infection risk model was further validated in assays with potted hop indicator plants. Ten to 20 pots of cultivar Nugget were deployed for 24 or 48 hr periods to expose the plants to environmental conditions and natural inoculum. Concentration of sporangia in the air was measured with a volumetric air sampler positioned near the trap plants. After the exposure period, the plants where maintained in a greenhouse at approximately 25ºC for 7 days. In total, 59 sets of indicator plants were deployed for 24 hr periods over the season from 4 April through 26 October. Another set of 31 plants were deployed for 48 hr periods. Weather and inoculum factors were related to infection severity by regression

and nonparametric analyses. Disease incidence and infection severity on indicator plants varied among days when the plants were placed in the hop yard, ranging from 0 to 55 % leaf incidence and 0 to 0.04 lesion/cm^2, respectively. Disease was not observed on indicator plants after 17 July, which closely corresponds to the last date when significant airborne inoculum was trapped in the hop yard. Days when 10% or more of the leaves developed downy mildew lesions were arbitrarily classified as major infection events. On six days, major infection events were observed, while minor infection events were observed on two days, and no infection was observed on 50 days. Preliminary analysis of the weather data suggests that of the weather variables investigated, duration of morning leaf wetness was one of the best predictors of major infection events.