Epidemiology and Control of Alternaria Leaf Blight

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Objectives

I. Epidemiology

A. Growth chamber studies to evaluate disease development under defined environmental conditions (wetness, relative humidity, temperature).
B. Develop disease progress curves in relation to microclimates in commercial orchards
   i. Compare environmental parameters (wetness, relative humidity, temperature) occurring at the edges and within an orchard and relate these to disease development.
   ii. Compare environmental parameters between different orchards and relate to disease development. Dataloggers will be placed in these different locations.
C. Determine the pathogen species composition within and between selected orchards at the beginning and at the end of the log phase of the epidemic.
   i. Identify species by morphological characters and molecular methods.
D. Evaluate the DSV model as a method of forecasting the disease with the goal of improved timing of fungicide treatments.

II. Management

A. Evaluate new fungicides for their efficacy in managing Alternaria leaf spot. Fungicides to be evaluated include strobilurins (Abound, BAS500), anilinopyrimidines (Vangard, Switch), and numbered compounds (BAS516).
B. Evaluate rotation programs that use minimal number of fungicide applications in comparison with applications based on the DSV model.

Summary

In this year’s trials, we focused on evaluating an epidemiological model for forecasting Alternaria leaf spot of almond. The model was developed for predicting black mold of

tomatoes caused by *A. alternata*. This pathogen is one of the three species of *Alternaria* identified in causing Alternaria leaf spot of almond. In this model, disease severity values or DSVs are a function of leaf wetness duration and temperature during the leaf wetness period. DSVs are accumulated over time and rapid increases in this value are indicative of infection periods. In three orchard locations in Kern Co., field dataloggers were placed in each orchard with sensors recording leaf wetness, temperature, rainfall, and relative humidity. Additionally, disease incidence and severity were measured weekly from May through early August. A critical conclusion was that an increase in the DSV value was followed by an increase in disease 21 to 27 days later.

Epidemiology. Alternaria leaf spot of almond is greatly influenced by conducive microclimatic conditions within orchards. Prediction models for Alternaria diseases that are based on wetness and temperature parameters have been developed for other crops where they are being used successfully. To optimize the timing of fungicide applications on almond and to minimize costs, models should also be developed for this crop. As a first step, in 2001 and 2002 we established disease progress curves in several orchards in Kern Co. and investigated correlations between the actual disease increase and increase in Disease Severity Values (DSV) using the DSV model for black mold of tomatoes caused by *A. alternata*.

The disease severity in this model is determined based on the number of hours of wetness within defined temperature ranges. In three orchards (Lerdo and Pond, both cv. Sonora orchards; and Kimberlina, a cv. Carmel orchard), field dataloggers were used with sensors recording leaf wetness, temperature, rainfall, and relative humidity. Each orchard was evaluated from May 1 to July 31 for disease development. Four branches on each of three trees in each orchard were tagged and the total number of leaves (100/branch), number of infected leaves, and number of lesions per leaf were counted weekly. Two types of lesions were differentiated: spreading, sporulating lesions and lesions that were localized and did not sporulate (referred to as 'spots'). These latter lesions develop into spreading, sporulating lesions under certain conditions that have not yet been characterized. From the evaluation data, disease incidence (number of infected per total leaves counted at each evaluation date), disease severity (number of spots or lesions per leaf), and incidence of defoliation (initial number of leaves evaluated – the number of leaves at evaluation date/initial number of leaves x 100) were calculated. Disease increased gradually from mid-June, and at the end of the evaluation period disease was high in two of the orchards (Kimberlina and Pond) with incidences of disease of 49.7 to 53.7% and for defoliation 43 to 57%.

In the Lerdo orchard, 6.6% disease and 21% defoliation were observed. When parameters were graphed out together with the cumulative and 7-day DSV values a correlation was evident between disease increase and increase in the 7-day DSV value (Figs. 1-3). Thus, an increase in the DSV value was followed by an increase in disease 21 to 27 days later. Similar results were obtained in 2001. In the Kimberlina orchard, at least 3 infection periods were identified as indicated by vertical arrows A-C in Fig. 1. Each of the three infection periods was characterized by a rapid increase in the accumulation of DSV and subsequently, by a rapid increase in observed disease approximately 24 days later. In the Pond orchard, four infection periods were evident, although the 7-day and cumulative DSV were not accumulated as fast as in the Kimberlina orchard (Fig. 2). Still by the end of the evaluation period the disease incidence values were similar between the two orchards. In the Lerdo orchard, only two infection periods were identified and DSVs were low overall (Fig. 3). Thus, the DSV model looks very promising as a tool for predicting infection periods for the Alternaria pathogen on almond and potentially, the model can be used to time fungicide applications.

Fungicide evaluations for management of Alternaria leaf spot of almond. One field trial was established in 2002 in a cv. Sonora orchard in Kern Co. with a history of the disease. Fungicides evaluated as single-fungicide applications or in mixtures or rotations included: Abound (azoxystrobin), BAS516 (mixture of pyraclostrobin and nicobifen), Bravo (chlorothalonil), Elite (tebuconazole), Flint (trifloxystrobin), and Vangard (cyprodinil). Chlorothalonil was evaluated based on the potential registration of this fungicide on almond in 2003. Two applications were done using an air-blast sprayer in the single-fungicide (Abound, BAS516, Vangard) and mixture (Elite/Flint) programs, whereas three applications were done in the rotations using Bravo with Abound or BAS516. At evaluation on August 20, disease incidence and severity were significantly reduced by the registered Abound, by BAS516, and the rotations of Bravo with Abound or BAS516 (Table 1). Two treatments with BAS516 most effectively reduced the disease from 56% incidence in the control to 8.8%. For Abound, the incidence was 27% and in the two rotation programs it was between 21.4% and 24.6%. Thus, with BAS516 a very effective fungicide has been identified and field trials using this compound will be done again in 2003. The individual compounds of the premix fungicide BAS516, pyraclostrobin and nicobifen, were evaluated in 2001 and were also shown to be effective against Alternaria leaf spot. Previously, Vangard significantly reduced the disease when applied at 10 oz/A, but not at 4.8 oz/A (see Teviotdale Annual Report, 2001). In this year's trial, however, Vangard at 10 oz/A had no significant effect on disease incidence or severity.

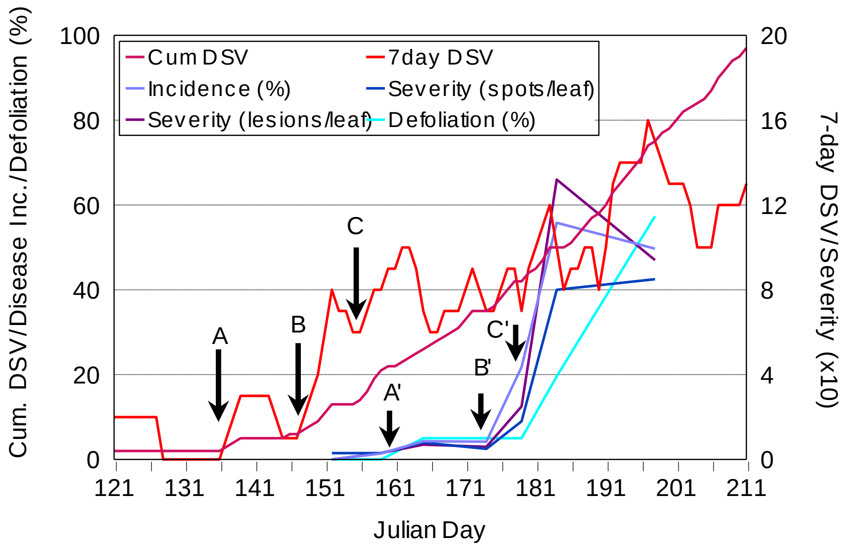

Fig. 1. Disease progress curves for Alternaria leaf spot and an evaluation of the DSV model in the Kimberlina almond orchard. Cumulative DSV (Cum DSV), disease incidence (%), and defoliation (%) are shown on the left y-axis, whereas the 7-day DSV and severity values (multiplied by 10) are on the right y-axis. Disease incidence values were based on the number of leaves remaining on the tree and were not corrected for defoliation. Using a 21-27 day latency, dates for increases in DSV and disease incidence were: A-A': 5/16-6/10, B-B': 5/26-6/22, and C-C': 6/5-6/27.

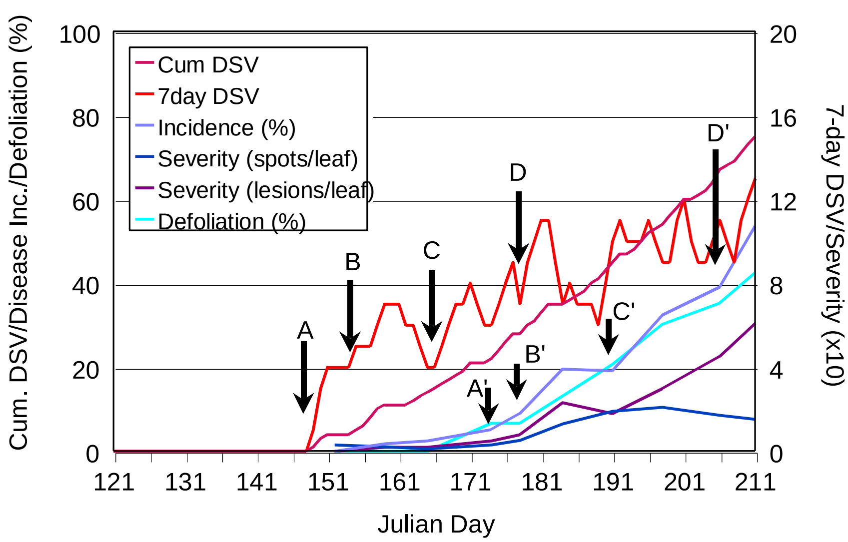

Fig. 2. Disease progress curves for Alternaria leaf spot and an evaluation of the DSV model in the Pond almond orchard. Cumulative DSV (Cum DSV), disease incidence (%), and defoliation (%) are shown on the left y-axis, whereas the 7-day DSV and severity values (multiplied by 10) are on the right y-axis. Disease incidence values were based on the number of leaves remaining on the tree and were not corrected for defoliation. Using a 23-25 day latency, dates for increases in DSV and disease incidence were: A-A': 5/27-6/21, B-B': 6/3-6/26, C-C': 6/14-7/9, and D-D': 6/30-7/25.

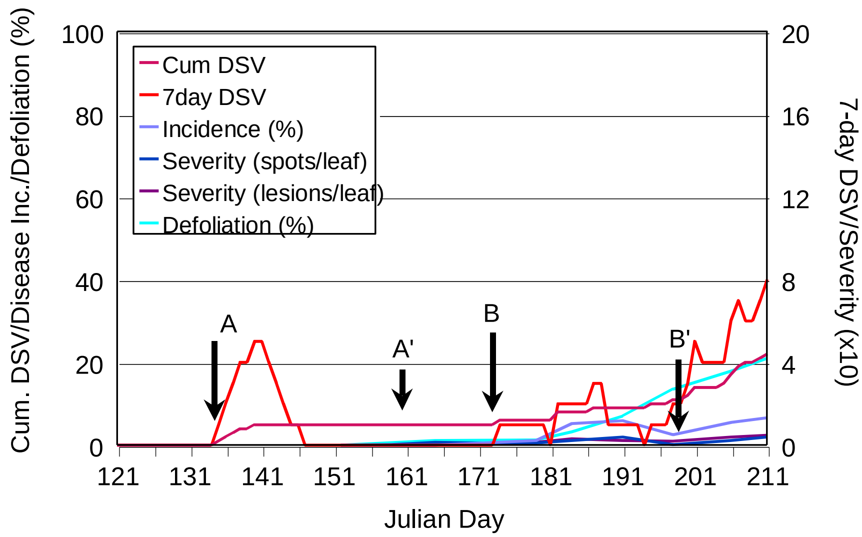

Fig. 3. Disease progress curves for Alternaria leaf spot and an evaluation of the DSV model in the Lerdo almond orchard.Cumulative DSV (Cum DSV), disease incidence (%), and defoliation (%) are shown on the left y-axis, whereas the 7-day DSV and severity values (multiplied by 10) are on the right y-axis. Disease incidence values were based on the number of leaves remaining on the tree and were not corrected for defoliation. Using a 25 day latency, dates for increases in DSV and disease incidence were: A-A': 5/16-6/10 and B-B':5/26-6/22.

Table 1. Fungicide efficacy for management of Alternaria leaf spot of almond using two to three mid-spring season applications of fungicides.

Treatment	Rate (/A)	Application 4/4	4/17	5/8	Incidence (%)	LSD	Severity (lesions/leaf)	LSD
Check	---	---	---	---	56	A	213	A
Vangard 75WG	10 oz	---	@	@	44.2	AB	190	AB
Abound 2F	12.8 fl oz	---	@	@	27	BCD	95	BC
BAS516 38WG	0.92 lb	---	@	@	8.8	D	24.6	C
Elite 45WP/Flint 50WG	2.9 oz/2.6 oz	---	@	@	34.8	ABC	121.8	ABC
Bravo 720/	4 pts	@	---	---	21.4	CD	65.4	C
Abound 2F	12.8 fl oz	---	@	@				
Bravo 720	4 pts	@	---	---	24.6	BCD	52.4	C
BAS516 38WG	0.92 lb	---	@	@				

Fungicides were applied using an air-blast sprayer calibrated to 100 gal/A.