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USE OF PREDICTING MODELS TO FORECAST THE APPEARANCE OF DOWNY MILDEW OF GRAPES

Abstract

Regarding the management of pests and diseases, forecasting models assist producers in estimating the possibility of disease in their crops and in the selecting and timing of preventative applications. The aim of this study was to evaluate the accuracy of weather-driven models for predicting infection by *Plasmopara viticola* in vineyard located in Giannakochori Naoussas, Macedonia, Greece. A spray programme, applied based on the models index, was compared with the conventional spray programme applied by growers. The results showed that the use of the model for scheduling spray applications reduced the number of sprays relative to the conventional spray programme, while achieving similar levels of disease control.

Keywords: Disease forecast model, *Plasmopara viticola*, vineyard.

Introduction

The system of precision agriculture has been introduced in European countries in the last decade of the 20th century. It spreads rapidly mainly in order to reduce chemical inputs (pesticides-fertilizers) in agricultural industry. So far, the introduction of this system in agriculture demonstrates the significant contribution to the protection of consumer health, to produce quality and safe agricultural products, to increase the economic performance of farm and environmental protection.

Plant protection is probably the most important and also the most difficult part of these systems. In particular, regarding the management of diseases, forecasting models assist producers in estimating the possibility of disease in their crops and in the selecting and timing of preventative applications. The use of fungicides (systemic or protectant), normally applied on a regular schedule throughout the growing season, to control downy mildew is an essential component of grapes in many parts of world. However, raising cost, environmental pollution and food safety has driven governments to force producers to consider more efficient approaches to the use of fungicides. A rational and cost-effective policy of fungicide use must consider the effects of environment, host, fungicide, and pathogens on the efficacy of downy mildew management. Analysis with plant disease models may aid these considerations. Computer-assisted Decision Support Systems (DSSs) have proven to be reliable in reducing the use of plant-protection products without affecting net returns in many countries (Murali

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and Secher, 1996; Rogers and Stevenson, 2006; Tamošiunas et al., 2000).

The aim of this study was to evaluate the accuracy of weather-driven model for predicting infection by *Plasmopara viticola,* in Giannakochori Naoussas, Macedonia, Greece.

Materials and Methods

The generic model developed by Magarey et al. (2005) modified for downy mildew was used. All the experiments were conducted in the commercial vineyards of the Company Kir Giannis, located in Giannakochori Naoussa (Imathia Prefecture), where a telemetric meteorological station was established at the orchard level. The following parameters were used to run the model based on the results produced in the above experiments: minimum temperature, maximum temperature, optimum temperature, minimum leaf wetness, maximum leaf wetness. The leaf wetness is estimated from the hourly data.

The presence of overwintering inoculum was assured because the two peach orchards had shown leaf symptoms in the previous season and had not been sprayed with fungicide at leaf fall or at the end of winter. The vineyard was grown according to common cultural practices so that the results would be representative of those from commercial orchards. A spray programme applied based on the models index was compared with the conventional spray programme applied by growers. Three treatments were applied: unsprayed vines (control), sprayed according to the conventional spray programme and vines sprayed according to the model indexThe experimental design was completely randomized. There were 4 replicates of 3 trees for each treatment.

To test significant differences between treatments, the Generalized Linear Models procedure of SPSS was applied (SPSS Grad Pack 17, SPSS Inc., Chicago, Illinois). Significant differences between treatments were tested by the Wald Test at P= 0.05.

Results and Discussion

Disease forecasting has become an essential component of quantitative epidemiology. The mathematics of disease dynamics is the core of several disease forecasting models that have been developed in the last four decades (Orlandini et al., 2008).

The results showed that the use of the model for scheduling spray applications reduced the number of sprays relative to the conventional spray programme while achieving similar levels of disease control. The number of sprays applied following the model was 2 less than the number applied following the conventional spray programme (Table 1).

Table 1.

Spray programme applied against downy mildew of grapes

Conventional Spray Programme		
Date of Application	Trade Name	Active Ingredients
6th May	M45	Mancozeb
17th May	Acrobat	Dimethomorph
3rd June	Dynali + Forum	Difenoconazole:Cyflufenamid + Dimethomorph
15th June	Forum	Dimethomorph
Spray Programme Applied According to the Model Index		
2/5/2014	Stroby	Krezomyl Methyl
18/6/2014	Ridomil	Metalaxyl + Mancozeb

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There were no significant differences among the conventional spray programme and the spray programme applied according the model index. In contrast the unsprayed vines had a significantly higher incidence of infected leaves than vines in all other treatments (Table 2).

Table 2.

Level of infections from downy mildew in different treatements

Treatments	Percentage of Infected leaves	
Conventional spray programme	3.6	a
Spray Programme Applied According to the Model Index	12.8	a
Untreated control	23.4	b

This work indicated that the forecasting model can be used to predict infection by *Plasmopara viticola* and to schedule fungicide applications. Thus, growers in Greece should spray their vineyards only when the model predicts a risk for infection. Further investigations should be conducted to correlate the level of risk by *Plasmopara viticola* incidence in order to determine when fungicide sprays are economically justified.

Values in the same column followed by different letters are significantly different at P=0.05 according to Wald Test.

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