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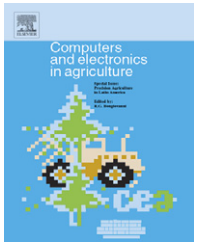

An agrometeorological approach for the simulation of *Plasmopara viticola*

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ABSTRACT

Agrometeorology can be applied to the analysis and modelling of plant disease development and creating a decision-support system for the operational management of crop protection. An approach for the simulation of grapevine (*Vitis vinifera*) downy mildew (*Plasmopara viticola*) is described in this paper. Mathematical models for grapevine leaf area growth and downy mildew development and infection have been proposed and integrated. The inputs to the models are represented by the fundamental agrometeorological variables of air temperature (°C), relative humidity (%), rainfall (mm) and leaf wetness (0–1), and tuning parameters have been included to calibrate the models for any possible behaviour differences in the patho-system. The main outputs of the model are infection intensity during the growing season, and the timing of the different infection events. The research was conducted in Tuscany (Central Italy) where, since 1995, an experimental vineyard of Sangiovese variety has been monitored for the presence of the disease, and a standard station has been established for agrometeorological data collection. The model was calibrated on data collected in 1995 and 1996 and then applied and validated on an independent data set collected from 1998 to 2003. The results presented in this paper demonstrate how, based on the biology of both host and pathogen, the simulation calculated leaf area growth and the dynamics of disease infections during the season, giving an accurate description of the field situation.

1. Introduction

In Italy, as well as in all the main viticultural areas worldwide, downy mildew (*Plasmopara viticola*) represents one of the major grapevine (*Vitis vinifera*) diseases. When weather conditions are favourable and no protection is provided, this disease is able to destroy 50–75% of the yield in one season (Agrios, 1997). It mainly affects both young clusters and leaves, causing production losses and affecting the quality of wine produced from infected grapes (Piva et al., 1997).

In Europe, due to the high susceptibility of cultivars and the presence of climatic conditions favourable to fungus growth, the disease is mainly chemically controlled with regular applications scheduled in a preventive manner (Blaise et al., 1999). Nevertheless, this strategy has several disadvantages, not only from an economic point of view considering the cost of pesticide purchase and application, but also with regard to the environmental impact of chemical residuals. Moreover, following the global climate change predictions, meteorological conditions triggering infection cycles are destined to

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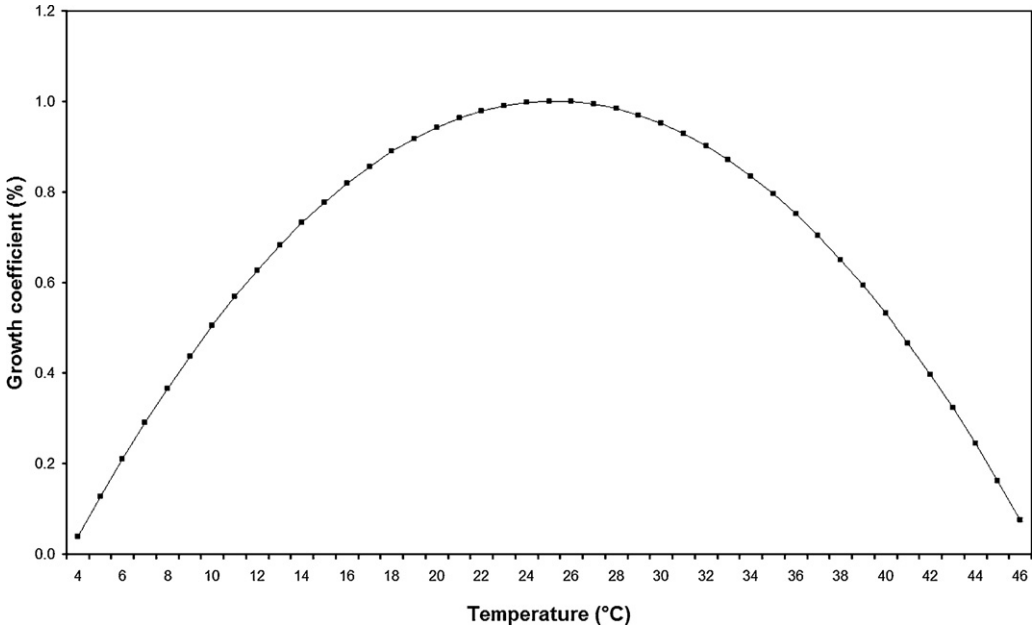

Fig. 1 – Leaf area function: hourly leaf area growth percentage in function of air temperature.

increase, leading to consequent increases of the disease pressure (Salinari et al., 2006). For all these reasons the European Community is stressing the importance of reducing chemical applications and is pushing to find more sustainable control strategies (PAN Europe, 2007).

In this context, the use of decision-support systems and the application of agrometeorological simulation models able to provide the users with specific information concerning "real time" disease development, could represent a valid alternative to regular application scheduling. The creation of a decision-support system based on models, may further increase the potential benefit to farmers, allowing them more user-friendly application of complex technical knowledge to their crops (Silver, 1991).

As regards grapevine downy mildew, all the different infection stages are driven by the agrometeorological conditions, in particular the temperature and relative humidity. On the other hand, as already mentioned, disease development depends not only on the environmental conditions but also on the susceptibility and availability of the host plants. For grapevine downy mildew, the leaf area represents the available tissue for the development

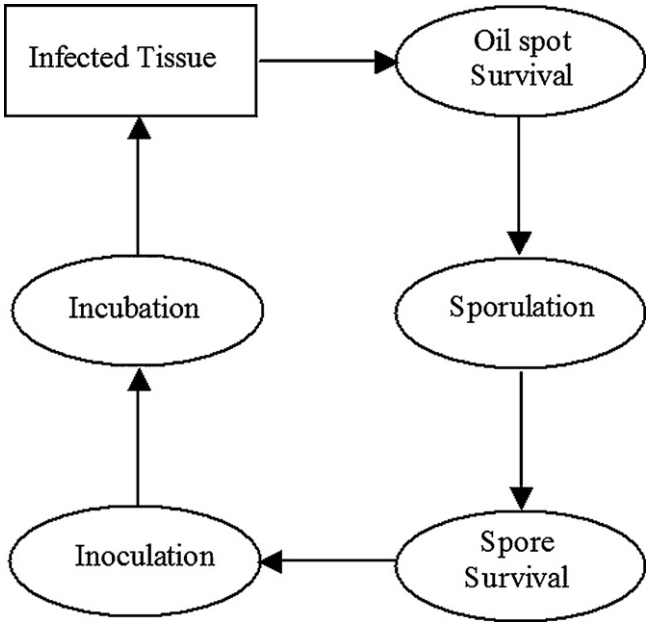

Fig. 2 – Diagram of the biological cycle of grapevine downy mildew (*Plasmopara viticola*).