Oospore germination dynamics and disease forecasting model for a precision management of downy mildew

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Abstract

Downy mildew, caused by *Plasmopara viticola*, is the most economically impactful disease affecting grapevines. This polycyclic pathogen triggers both primary and secondary infection cycles, resulting in significant yield losses when effective disease control measures are lacking. Over the winter, the pathogen survives by forming resting structures, the oospores, derived from sexual reproduction, which produce the inoculum for primary infections. To optimize grapevine downy mildew control and obtain the desired levels of production while minimizing chemical inputs, it is crucial to optimize the timeframe for fungicide application. Disease forecasting models are useful to identify the infection risk. However, the prediction of primary infections is still a considerable challenge. A prior investigation revealed that the duration required for oospores to germinate (*t*) decreases as grapevines become susceptible to *P. viticola*. This study aimed to integrate oospore germination data with insights from the EPI forecasting model in ten vineyards located in Franciacorta, an important Italian viticultural area. The research was performed from grapevine sprouting (April) until bunch closure (July), over three consecutive years (2021-2023). Disease incidence and severity were assessed in untreated plots. Results indicated a simultaneous reduction in *t* corresponding to the infection risk signaled by the EPI model. *A posteriori* assessment highlighted the usefulness of biological data in defining the primary infection timing and the accuracy of the model in predicting the disease epidemics. In conclusion, the adoption of the EPI model integrated with the oospore germination assays significantly contributed to formulating a rational treatment strategy.

Keywords: downy mildew, forecasting model, oospore germination, disease management, infection risk.