Innovative approaches for fungicide resistance monitoring in precision management of grapevine downy mildew

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Abstract

Effective control with fungicides is essential to protect grapevine from downy mildew, a devastating disease caused by the oomycete *Plasmopara viticola*. Managing this disease faces challenges in maintaining fungicide efficacy as the number of modes of action decreases and the risk of fungicide resistance increases. Long-term measures should address strains resistant to multiple modes of action, that can be selected by the repeated use of single-site fungicides. For these reasons, a precision management of the disease, that considers the selection of the best fungicide schedule according to the sensitivity profile of the pathogen population, is needed. Traditional techniques for fungicide sensitivity monitoring usually provide a qualitative information on fungicide resistance, limited presence/absence, and lack the resolution for high-throughput quantification and isolation of resistant individuals within pathogen populations. To overcome this limitation, an automated and high-throughput approach, based on flow cytometry and fluorescence-activated cell sorting, was developed on field sporangia populations. This method enables the identification and selection of single, live sporangia from a heterogenous field spore suspension, followed by inoculation on leaf discs treated with the selected fungicides. The resistant individuals, identified by the ability of growing at discriminatory rates of the fungicides or by dose-response analysis, are then quantified and isolated in a single assay, marking a significant advancement in sensitivity monitoring. The development of an antiresistance strategy, based on the sensitivity profile of the population, aims to preserve efficacy across all modes of action and achieve optimal disease control.

Keywords: plant disease, integrated pest management, disease control, fungicide resistance*, Plasmopara viticola*.