Sustainable plant resistance management in agricultural landscapes

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Sustainable plant resistance management in agricultural landscapes

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The deployment of virus resistant crops often leads to the emergence of resistance-breaking pathogens that suppress the yield benefit provided by resistances. The theoretical analyses presented here are designed to provide guidelines for farmers aiming altogether to optimise the deployment of a resistant cultivar in a landscape over several years according to management strategies aiming either to minimise the overall yield losses due to the virus (economical strategy) or to keep the frequency of the resistance-breaking virus in the reservoir hosts under a preset threshold (patrimonial strategy).

Assuming gene-for-gene interactions, epidemics are modelled by linking genetic and epidemiological processes in a landscape composed of a mosaic of resistant and susceptible fields, subjected to seasonality, and of a reservoir hosting viruses year round.

We explored how time constant optimal cropping ratio (i.e. the proportion of resistance cultivar deployed in a landscape) defined according to either economical or patrimonial objectives depend on resistant cultivar choice and on landscape epidemiological context (defined by the landscape structure and the mean epidemic incidence observed before resistance deployment).

If the choice of the resistance gene is the main factor determining optimal cropping ratio, epidemiological contexts are also important. In some of them, patrimonial and economical strategies have close economical efficiencies, implying that both management objectives are achievable at the same time. In others, patrimonial strategies have weak economical efficiencies, meaning that both management objectives are incompatible. A way to remove such incompatibility is to design time varying strategies where the proportion of resistant fields in the landscape can change. Indeed, such strategies can at the same time comply with a patrimonial objective while substantially restoring the economical efficiency of time constant strategies and can even over performed them in landscape where epidemics are primarily driven by between fields infection events.