Mathematical modelling for sustainable crop protection

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MATHEMATICAL MODELLING FOR SUSTAINABLE CROP PROTECTION

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Crop pests, pathogens and weeds have a major economic impact and threaten food security. Their control still heavily relies on chemical pesticides, which are harmful to both the environment and public health, and which induce pest resistance, hence the need for eco-friendly sustainable alternatives. The aim of this talk is to present modelling studies which implement alternative control methods, in particular resistant crops and biocontrol agents. These studies focus on how "best" to deploy such control methods, to limit damages cost-efficiently or in seeking some sort of bioeconomic optimum by means of a yield proxy. The models are dynamical systems derived from classical epidemiological models, adapted to the pathosystem considered. Optimisation or optimal control methods are used to determine appropriate deployment strategies.

To efficiently control the disease and avoid resistance breakdown, susceptible and resistant crops can be alternated in space or time, depending on the pathosystem under study. An example of optimal resistance deployment in time will be given to control root-knot nematodes in horticultural crops [3]. Optimising cropping practices, as in the case of banana burrowing nematode management [4], is another example of alternatives to chemical pesticides. Several biocontrol methods can be implemented, which will be illustrated for coffee crop pests: fungus-based biopesticides to control coffee berry borers [2], or predators to control coffee leaf rust [1].

Finally, several general issues, such as "small data", and perspectives will be discussed.

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