Immunity and Mathematical Modelling to "Unify" Epidemiology (IMMUnE)

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Keywords
Host mixtures, resistance durability, disease reduction, polymorphism

Social - economic context

The harmful effects of pesticides accentuate public health issues and threaten biodiversity. This alarming state implies the urgent need to find alternative methods to control plant diseases. Host mixtures are a promising component of future agro-ecological solutions and can improve resistance durability.

Scientific context

The effectiveness of mixtures is known, but some of the associated mechanisms are not yet fully understood. This is the case with induced resistance, which is a part of plant immunity triggered via gene-for-gene interactions. In addition, there is no epidemiological model simulating these dynamics.

Objectives

The aim is to build an epidemiological and evolutionary theory specific to plants, in order to propose sustainable strategies to fight against diseases and show that plant immunity can be a major lever for disease control.
From a scientific point of view, this work aims at highlighting the importance of genetic diversity and its effects on plant immunity using an SI epidemiological model. Initially, we considered a population with two plant genotypes: susceptible and resistant. Then, several resistant genotypes will be included in the model.

Results

There is an optimal proportion of resistant plants to introduce into mixtures in order to minimize the prevalence of the disease while maintaining genetic diversity in populations of plants and pathogens. It makes it possible to reduce selection pressures on pathogens and avoid resistance breakdown.

Perspectives

Future research in behavioral epidemiology may help achieving optimal mixtures in the field.