An ecological model to analyze and control the dynamics of the leafminer pest Tuta absoluta on tomato (Solanum lycopersicum)

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Résumé

The South American insect Tuta absoluta is a significant leaf-mining pest for tomato plants
(Solanum lycopersicum). In the last fifteen years, it has invaded and rapidly expanded across most
European and African countries. This poses increasing threats to key tomato-growing regions
worldwide. Despite the global significance of crop damages caused by T. absoluta, existing models
have primarily focused on the developmental growth at the individual level, with limited consideration for population and community-level interactions, especially the plant-pest relationship. Here
we introduce and discuss an ecological, process-based, mathematical model that accounts for the
interdependent dynamics between a population of the herbivorous insect and the tomato plants it feeds on. The model explicitly integrates the impacts of water and nutrients availability, as
well as temperature, on the growth of both insect and plant populations. After calibrating the
model using empirical data, we found that its simulations can replicate different observed patterns.
Leveraging the mechanistic nature of our approach, we analyzed the combined effects of various
temperature, fertilization/irrigation (fertigation) and biocontrol scenarios on (i) crop growth and
(ii) the overall health of the production system. This enabled us identify knowledge gaps and to
discuss the effectiveness and trade-offs associated with different management policies.

Mots-Clés: ecological modeling, crop, pest interactions, top, down control, bottom, up control, agroecology.

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