



HAL
open science

Ecophysiological modelling of plant-nematode interactions to understand plant tolerance

Joseph Junior Penlap Tamagoua, Suzanne Touzeau, Frédéric Grognard,
Valentina Baldazzi

► To cite this version:

Joseph Junior Penlap Tamagoua, Suzanne Touzeau, Frédéric Grognard, Valentina Baldazzi. Ecophysiological modelling of plant-nematode interactions to understand plant tolerance. DSABNS 2023 Conference - 14th International Conference on Dynamical Systems Applied to Biology and Natural Sciences, Feb 2023, Bilbao, Spain. 2023. hal-04146030

HAL Id: hal-04146030

<https://hal.inrae.fr/hal-04146030>

Submitted on 7 Aug 2023

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons Attribution| 4.0 International License

ECOPHYSIOLOGICAL MODELLING OF PLANT-NEMATODE INTERACTIONS TO UNDERSTAND PLANT TOLERANCE

Joseph Penlap^{*1,2}, Suzanne Touzeau^{1,2}, Valentina Baldazzi^{1,2}

and Frédéric Grognard¹

¹Université Côte d'Azur, INRIA, INRAE, CNRS, Sorbonne Université, BIOCORE, Sophia Antipolis, France

²Université Côte d'Azur, INRAE, CNRS, ISA, Sophia Antipolis, France

*joseph.penlap@inria.fr

suzanne.touzeau@inrae.fr, valentina.baldazzi@inrae.fr, frederic.grognard@inria.fr

Root-knot nematodes (RKN) of the *genus Meloidogyne spp.* cause considerable yield losses in numerous crops worldwide. The dynamics and outcome of plant-pathogen interactions depend on the ecological conditions, including the phenotypes of the interacting species, their physiology and the abiotic environment in which the interaction takes place. In theoretical ecology a broad literature exists on interactions between plants and different pest species (e.g. predation, competition, etc.). These studies investigate temporal and spatial dynamics in plant-pest systems. Yet they usually describe plants in a very simple way, neglecting their physiological response. For instance, most mathematical models that describe crop-nematode interactions either focus on plant physiology and do not consider pest dynamics, or conversely are based on the pest life cycle but neglect plant physiology and defense response [1].

We exploit methods from dynamic system modelling to build a mechanistic model of plant-RKN interactions that explicitly links plant physiology and pest demography, including both the effect of these pests on the crops and the effect of the plants on the pests.

The model is used to study the variability of plant response to pest attacks and to analyse the complex interplay among plant physiological and architectural traits, abiotic conditions and nematode biology that affects the infection dynamics. A particular attention will be devoted to the identification of key plant traits, that characterize susceptible and tolerant plants, a key challenge for varietal selection and pest management.

Understanding the origin of these phenotypic differences is a key challenge to design, improve and assess pest control strategies, including the selection of new tolerant cultivars.

References

- [1] Nilusmas, S., Mercat, M., Perrot, T., Djian-Caporalino, C., Castagnone-Sereno, P., Touzeau, S., Mailleret, L. (2020). Multi-seasonal modelling of plant-nematode interactions reveals efficient plant resistance deployment strategies. *Evolutionary applications*, 13(9), 2206-2221.