Modelling the effects of spatially distributed cropping systems on the epidemics of potato late blight and on the durability of cultivar resistances

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Background and objectives

• Potato late blight (Solanum tuberosum) caused by Phytophthora infestans is one of most damaging diseases of this culture
• Chemical control is the most widespread method used to contain this disease
• Use of resistant varieties can be the cornerstone of integrated late blight management, but resistance generally lacks durability
• It is therefore essential to preserve the efficacy of potato resistance against potato late blight

The aim of this work is to develop a model, spatially explicit, to represent:

- the effects of cropping systems on epidemics of potato late blight, the associated damage and the adaptation of pathogen populations to cultivar resistances
- the agronomic, environmental and economic performances of the simulated cropping systems

Material and Methods

The IAM concept (Integrated Avirulence Management, Aubertot et al., 2006) was used to develop a generic model called SIPPOM (Simulator for Integrated Pathogen Population Management, Figure 1)

• The work is based upon:
  i) Modelling
    - Development of a formalism to represent the durability of quantitative resistance
    - Translation of the conceptual framework (Figure 1) into a simulation model suited to potato late blight on the platform RECORD (Bergez et al, 2009) (Figure 2)
    - Evaluation of the predictive quality of the modules of SIPPOM-potato late blight
  ii) Experimentation
    - Experiments to quantify the primary inoculum production of cull piles and potato volunteers
    - Experiments to analyse the effects of potato crop management on the epidemics of late blight

First results

• Selected models to adapt SIPPOM to potato late blight:
  - Crop model: Spudgro (Johnson et al., 1986)
  - Epidemiological model: Miléos® (DGAL, Arvalis)
  - Dispersion model: the model developed by Scherm (1996)
  - Damage function: the model developed by Shtienberg et al. (1990)
• Evaluation of the predictive quality of the modules of SIPPOM-potato late blight

Conclusion

• SIPPOM late blight will help in designing strategies for integrated, collective and durable management of potato late blight
• The created tool will help in identifying appropriate ideotypes to limit the risk of potato late blight and to enhance the epidemiological modelling of Phytophthora infestans life cycle

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