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Theoretical assessment of the impact of climatic factor on the dynamics of Radopholus similis, banana pest

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Abstract/Résumé:
Radopholus Similis (R. Similis) or burrowing nematode, is one of the most damaging and widespread nematodes attacking bananas, causing toppling or blackhead disease. A mathematical model for the population dynamics of R. Similis is considered, with the aim of investigating the impact of climatic factors on the growth of R. Similis. In this paper, based on the life cycle of R. Similis, we first propose a mathematical model to study and control the population dynamics of this banana pest. We show also how control terms based on biological and chemical controls can be integrated to reduce the population of R. Similis within banana-plantain roots. Sensitivity analysis was performed to show the most important parameters of the model. We present the theoretical analysis of the model. More precisely, we derive a threshold parameter N_0, called the basic offspring number and show that the trivial equilibrium is globally asymptotically stable whenever $N_0 \leq$, while when $N_0 > 1$, the non trivial equilibrium is globally asymptotically stable. After, we extend the proposed model by taking account climatic factors that influence the growth of this pest. Biological and chemical controls are now introduced through impulsive equations. Threshold and equilibria are obtained and global stabilities have been studied. The theoretical results are supported by numerical simulations. Numerical results of model with biological and chemical controls reveal that biological methods are moreeffective than chemical methods. We also found that the month February is the best time to apply these controls.

Mots clés: Continuous time Markov chain, Infectious disease, mathematical Modeling, basic reproduction number, global transmission dynamics, numerical simulation.
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