



Mathematical Modelling of Striga Infestation for Optimal Maize Yield

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Introduction

Maize is critical for reducing food insecurity in Sub-Saharan Africa (SSA) because of its ease of processing, high yield potential, and low cultivation costs (Stanley et al., 2021). As a result, maize has emerged as a major grain crop with significant production potential in sub-Saharan Africa, serving a variety of functions (Stanley et al., 2021). Because of the status of our soil in SSA, subsistence farmers usually produce maize in regions where the Striga's expansion diminishes harvest. Striga is an invasive root mixotrophic parasitic plant often known as witchweed. Quite a few ways have been used to deal with this parasitic weed, including traditional, biological, and chemical methods, as well as host resistance. While mathematical models have shed light on Striga's spread and population dynamics, there is still potential for improvement in depicting real-world negative repercussions such as adverse environmental effects, soil qualities, and integrated management measures.

Methodology

This study used a Susceptible-Exposed-Infected (SEI) model with a soil seed bank compartment (B, Bd) and control impact (non-host plants D, and Resistant Crops R) to simulate the spread and persistent nature of *Striga hermonthica* in maize fields, as well as to investigate critical biological variables (e.g., seed bank interactions, sprouting triggers, adhesion rates) that influence infestation. We combined the aforementioned critical components into a single SEI-type model to adapt to the various dynamics of Striga spread as indicated by seed dispersal, host plant reliance, and germination triggers. Figure 1 illustrates how our initial model is viewed as a system of seven nonlinear differential equations. The figure shows three compartments of the Striga model, the S, E, I for the host plants (maize), B, Bd for the seed bank and management impact (non-host plants D, and Resistant Crops R).

Results

The parameters that influence the dynamics of the model were first determined. A sensitivity analysis was performed utilizing both local (limited difference) and global (Latin Hypercube Sampling (LHS) method and partial rank correlation coefficients (PRCC)). The numerical simulations show that combining multiple interventions is more effective than using any single control method. These findings highlight the need of integrated pest management techniques in Africa that combine genetic, cultural, and chemical approaches to decrease Striga infestations and boost maize output and food stability.

Conclusion

A Susceptible-Exposed-Infected (SEI) model was utilized, which incorporated a soil seed bank compartment (B) to account for Striga seeds in the soil as well as management influence (non-host plants D and resistant crops R). The numerical simulations reveal that integrating various treatments is more successful than employing a single control strategy. These findings highlight the necessity for integrated pest management (IPM) techniques incorporating genetic, cultural, and chemical approaches to reduce Striga infestation for optimal maize production. Future work could explore machine learning-based predictions to optimize Striga control strategies for African agroecological zones.

Keywords: *Striga infestation, SEIR, Control strategies, Equilibrium points.*