



The Efficacy of Sticky Trap for Optimal Control the Spread of Tungro Virus Adaptation with a Deterministic SEI Model Stability Analysis

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Abstract

Rice tungro disease (RTD) is caused by the outbreak of green leafhopper (GLH). This research aimed to (1) develop a mathematical model of RTD, (2) investigate the trap design that maximizes the capture efficiency of GLH, and (3) predict the disease incidence using a mathematical model. The study focused on three factors: (1) trap color, including white and yellow; (2) trap shape, including square, triangular, and circular; and (3) an SEI model for RTD. The study was conducted using KDML105. The research began with the development of the mathematical model for RTD, followed by model validation through the analysis of positivity and boundedness of the solution, disease-free equilibrium, epidemic equilibrium, basic reproduction number, and local stability analysis at the disease-free and epidemic equilibrium. The field experiments were conducted using traps ($\bar{X}=415.45$ square centimeter). A total of 18 experimental plots were established, and the traps were deployed for one week. Subsequently, the traps were collected, and the number of captured GLH was recorded. These data were used in rice tungro disease model of this research. The results showed that: (1) the local stability analysis indicated that all eigenvalues of the Jacobian matrix satisfied $\text{Re}(\lambda) < 0$, confirming that the proposed model is locally asymptotically stable and suitable for disease forecasting; (2) the yellow square trap exhibited the highest capture efficiency $\bar{x}_C=31$ individuals/day; and (3) the yellow square trap achieved the greatest reduction in RTD incidence, decreasing the infection rate by 81.35%.

Keywords: Rice tungro disease, Green leafhopper, SEI Model