Eco-epidemiological Model and Optimal Control Analysis of Tomato Yellow Leaf Curl Virus Disease in Tomato Plant

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Abstract

The purpose of this study is to analyze the impact of control strategies namely insecticide spray, roguing of a diseased tomato plant, protective netting to protect tomato plant from TYLCVD. Thus, a mathematical model for the transmission dynamics of TYLCVD that includes these control strategies is formulated and analyzed. In the case of constant control, the basic reproduction number is calculated and the existence and stability of equilibria are investigated. Besides, an optimal control model with constraints is formulated and investigated. In the non-constant control case, Pontryagin's Maximum Principle is used to deduce necessary conditions for the optimal control of the disease. It is shown that all the combined efforts of two of three strategies can significantly reduce the disease except the combination of the use of insecticide spray and rouging infected tomato plants. Relatively the other, the use of roguing diseased tomato plants and protective netting, and the use of insecticides spray, roguing diseased plants and protective netting are better decreased the disease. Moreover, the use of roguing diseased plants and protective netting has a similar effect as the use of insecticides spray, roguing diseased tomato plants, and protective netting. As resources are scarce, we recommend that policy-makers should adopt the combination of the use of roguing diseased tomato plants and protective netting as a strategy.

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