

A prey–predator model and control of a nematodes pest using control in banana: Mathematical modeling and qualitative analysis

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Received 2 December 2020

Revised 18 April 2021

Accepted 28 June 2021

Published 25 September 2021

This study develops a mathematical model for describing the dynamics of the banana–nematodes and its pest detection method to help banana farmers. Two criteria: the mathematical model and the type of nematodes pest control system are discussed. The sensitivity analysis, local stability, global stability, and the dynamic behavior of the mathematical model are performed. Further, we also develop and discuss the optimal control mathematical model. This mathematical model represents various modes of management, including the initial release of infected predators as well as the destroying of nematodes. The theoretical results are shown and verified by numerical simulations.

Keywords: Prey–predator model; banana; nematodes pest; optimal control; Pontryagin’s maximum principle.

Mathematics Subject Classification: 92B05, 37M05, 34D20, 93C10, 93A30

1. Introduction

Banana is a globally important fruit crop production. In 2011, 107 million tons of bananas were obtained in more than 130 countries, and the total trade value of 9 billion dollars out of 0.1% of the globe’s farming fields [40]. According to [15], the global banana production increased at an annual growth rate of 3.2% between 2000 and 2017, achieving a record of 114 million tons in 2017, up from approximately 67 million tons in 2000. The major sources are India, which produced an average of 29 million tons per annum between 2010 and 2017, and 11 million tons of China. As per the latest available data from 2017, approximately 5.6 million

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