

Construction and Qualitative Analysis of Mathematical Model for Biological Control on Cereal Aphid Population Dynamics

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Abstract

Cereal farming is a major economic activity for farmers in most parts of the world. In Kenya, where the agricultural sector is the backbone of the economy, cereal production is a major source of income to the farmers as it is used for both human and livestock consumption. A common sight in cereal crop farms is cereal aphids whose population has been on the rise, aided by various environmental factors that may have favoured their increase. The frequent outbreak of aphids and the extent of damage they cause on these farms have laid precedence to undertake studies aimed at understanding their population dynamics. This study analysed the impact of biological control on cereal aphid population. The study developed a mathematical model of the impact of predation on cereal aphid's population which can project stable systems of control. It also determined the extent of effectiveness of the model by comparing after modification, stability of the models. Two sets of models based Rosenzweig-MacArthur prey-predator were developed, through adjusting the function representing the prey-predator interaction. It was determined that one model demonstrated the ability to capture a more accurate analysis of data compared to the other. After finding the local stability of each, a suitable Lyapunov function was developed and used to analyze the global stability of the system.

Keywords: Qualitative analysis; Mathematical model; Biological control; Cereal aphid; Population dynamics.

