

Chapter 7

A Review on Understanding the Impact of Pesticides Towards Greener Harvests Using Mathematical Modelling

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ABSTRACT

Protecting our environment and ensuring the safety of our food supply stand as paramount concerns in today's world. Pesticides have become a global solution for managing pests and diseases in agriculture. Employing sophisticated mathematical modeling techniques allows for a comprehensive examination of their adverse effects. Pesticides have the ability to kill plants and damage soil, potentially leading to a fall in both plant numbers and soil quality. The use of delay differential equations is important in capturing the long-term effects of pesticides on plants and soil health. These equations model the various impacts of altering pesticide dosages and application rates on plants and soil, exposing crucial elements determining pesticide use's environmental implications. MATLAB also provides a graphical model of this complicated system, providing a visual understanding of the complex interaction between pesticides and ecological processes.

INTRODUCTION

Pesticides are substances or agents designed to control, repel, or eliminate unwanted organisms that harm crops, spread diseases, or cause nuisances. These unwanted organisms, often referred to as “pests,” can include insects, weeds, fungi, rodents, and other organisms that threaten the well-being of plants, animals, or humans. Pesticides play a crucial role in modern agriculture, public health, and pest management. In this comprehensive explanation, we'll explore what pesticides are, their types, uses, benefits, and potential drawbacks in easy-to-understand terms. There are many benefits of pesticides also. For example, by controlling pests, pesticides help ensure higher crop yields and protect valuable agricultural resources, contributing to global food security. Pesticides play a vital role in preventing and controlling vector-borne diseases, particularly in regions where diseases like malaria are prevalent. Herbicides help maintain the quality and productivity of cultivated lands by managing weed infestations. In many scenarios, pesticides are the most effective and targeted method for managing destructive pests that could otherwise cause extensive damage. Pesticides protect the livelihoods of farmers and support the agricultural industry, contributing to the economy of many regions. The history of pesticides is a journey that spans thousands of years, and it's all about humans finding ways to deal with pests that harm their crops and health. Here's a simplified overview: Ancient Beginnings: People in ancient civilizations, like the Sumerians and Egyptians, used natural substances like sulfur and arsenic to control pests. They also discovered that some plants, like pyrethrum and neem, had pest-repelling properties. In the Middle Ages, in medieval Europe, various mixtures of substances were used to fend off pests. People relied on materials like tobacco and quicklime to protect their crops. In 17th-18th century: nicotine sulfate from tobacco and sulfuric acid were introduced as pesticides. These were effective but had health and environmental risks and in 20th Century: The 1900s brought major advancements in synthetic chemicals. DDT, developed in the 1940s, was a game-changer for pest control, but its harmful environmental impacts later led to its ban. In the Modern Era: Today, we have a wide range of pesticides, including insecticides, herbicides, and fungicides. Many are more targeted and less harmful to the environment, thanks to extensive research and regulation. The history of pesticides is a story of trial and error, with a growing awareness of the need for safer, more sustainable pest control methods. It reminds us to balance the benefits of pest control with the protection of human health and the environment.

The word “pesticides” is derived from two key components: “pest” and “cide.” Pest: The term “pest” is used to describe any organism that is considered harmful to humans, their crops, or their property. Pests can include insects, rodents, weeds, fungi, and other unwanted organisms that can damage crops, transmit diseases, or cause nuisances. Cide: The word “cide” comes from the Latin word “caedere,” which means “to kill” or “to cut down.” It is often used in English to indicate an action that results in the death or elimination of a particular group of organisms. When you combine these two components, you get “pesticides,” which literally means substances or agents used to kill or control pests. Pesticides encompass a wide range of chemical and biological compounds, including insecticides for controlling insects, herbicides for managing weeds, fungicides for dealing with fungi, and rodenticides for eliminating rodents.

Types of Pesticides: Pesticides come in various forms, each designed to combat specific types of pests: Insecticides are those who target and control insects that can damage crops, transmit diseases, or become nuisances. They may be used in agriculture, gardens, or public health efforts to combat disease-carrying mosquitoes. Herbicides are designed to control or kill unwanted plants, commonly referred to as weeds. They are crucial in maintaining crop health and ensuring the success of agricultural activities. Fungi-

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