Chapter 13
Integrating Biopesticides and Botanicals for Sustainable and Eco-Friendly Crop Protection Strategies

Gul Zaib Hassan
https://orcid.org/0009-0003-0072-8181
Department of Agronomy, University of Agriculture, Faisalabad, Pakistan

Saira Shafiq
Department of Botany, University of Agriculture, Faisalabad, Pakistan

Syed Abbas Raza Naqvi
Department of Agronomy, University of Agriculture, Faisalabad, Pakistan

Wardha Sarfaraz
Department of Botany, University of Agriculture, Faisalabad, Pakistan

Hina Ali
Department of Botany, University of Agriculture, Faisalabad, Pakistan

Abdul Khaliq
https://orcid.org/0000-0003-0602-3660
Sugarcane Research Institute, Ayub Agricultural Research Institute, Faisalabad, Pakistan

Muhammad Majid Islam
Department of Agronomy, University of Agriculture, Faisalabad, Pakistan

Muhammmad Tayyab Hanif
Department of Agronomy, University of Agriculture, Faisalabad, Pakistan

ABSTRACT

This chapter explores the integration of biopesticides and botanical extracts to enhance sustainable crop protection, reducing environmental harm. Biopesticides,

DOI: 10.4018/979-8-3693-3061-6.ch013

sourced from microorganisms, plant extracts, and semi-chemicals offer advantages over synthetics, with lower toxicity and reduced resistance risk. Botanical extracts, prized for their antimicrobial properties, have gained effectiveness due to extraction advances. This chapter provides an overview of the current state of research on biopesticides and botanicals, their modes of action, benefits, limitations, and potential synergistic interactions when combined with conventional or other biological control agents Challenges include inconsistent performance and regulatory hurdles, but such integrated methods promote biodiversity and ecosystem health. The chapter highlights challenges like limited availability and regulatory hurdles in implementing these alternatives. Integrated methods aim to reduce traditional pesticides' negative impacts and advance sustainability by promoting biodiversity and ecosystem health.

INTRODUCTION

The global population is increasing swiftly at an annual rate of 70 million per year, and if current trends continue, it will reach 10 billion by the end of 21st century (Monteiro & Santos, 2022). The world's rapidly rising population, coupled with limited farmland, is pushing farmers and business entities to develop sustainable and effective methods for feeding humankind. Farmers have increased crop production on the restricted amount of arable land through technological advancements, agricultural practices, and pest management (Hezakiel et al., 2023). Many pests may attack plants at any stage of their growth, including harvest and storage, causing significant damage and losses. Pests, which include insects, diseases, and weeds, are estimated to account for 27-42% of major crop losses worldwide. This jumps to a remarkable 48-83% without crop protection (Liu et al., 2021). Addressing global pest control sustainably is imperative as conventional chemical methods pose escalating environmental and health risks. Urgency mounts to adopt eco-friendly alternatives, necessitating a shift away from chemical reliance (Shafiq *et al*., 2024). While chemical pesticides initially boost crop growth, they detrimentally affect soil fertility, microbes, and pose risks to humans and aquatic life (Umapathi et al., 2021). Promising alternatives like biopesticides and botanicals offer effective pest control while minimizing harm to the environment. Microbial insecticides, for instance, address biodiversity concerns and enhance agricultural productivity without excessive dependence on synthetic chemicals (Reddy & Chowdary, 2021).

Sustainable Supply Chain Management Barriers in Shrimp Food Supply Chain: A Case Study of India by MCDM Method

Suchismita Satapathy (2022). *International Journal of Social Ecology and Sustainable Development (pp. 1-20).*
www.irma-international.org/article/sustainable-supply-chain-management-barriers-in-shrimp-food-supply-chain/290395