

Chapter 2

Climate–Adaptive Pest Management for Sustainable Agriculture: Navigating Temperature, Precipitation, and Evolving Pest Dynamics


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ABSTRACT

Climate change is profoundly affecting crop pests worldwide, endangering global food security and necessitating action to mitigate losses and reduce greenhouse gas emissions. A transition to climate-adaptive pest management (CAPM) is advocated, emphasizing holistic, climate-smart strategies to minimize crop losses and bolster

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agricultural resilience. Integrated pest management (IPM), incorporating evolutionary biology principles, is highlighted as a flexible solution to address complex pest challenges. Emerging technologies like precision agriculture and biopesticides offer eco-friendly alternatives. Stakeholder collaboration, education, and outreach are essential for successful implementation. Climate-Smart pest management (CSPM) within climate-smart agriculture (CSA) is crucial for global food security. Reliable pest diagnostics are emphasized for informed decision-making. This chapter explores the comprehensive approach to climate-smart pest management to enhance global food production sustainability.

INTRODUCTION

Climate change profoundly affects agricultural insect pests, influencing various aspects of their life cycles, behavior, and distribution. One of the prominent features of climate change is the rise in temperature, which directly shapes pest population dynamics and their interactions with the environment (Jactel et al., 2019). Moreover, climate change extends beyond temperature and precipitation changes, heightening risks to trees and woodlands from pests and pathogens (Boyd et al., 2013). This leads to outbreaks of new pests and diseases, altering the frequency and severity of existing ones.

The effects of altered temperatures further induce shifts in the distribution and abundance of insect pests, adding complexity to agricultural challenges (Gullino et al., 2022). These modifications have significant ramifications for global agricultural production, impacting the distribution and severity of crop pests globally (Bajwa et al., 2020). Additionally, climate change facilitates the emergence of new invasive species in various regions, complicating the pest landscape even further. Without proper monitoring and control mechanisms, many invasive species may become severe pests in their new ecosystems (Panzavolta et al., 2021). While some effects of climate change may seem beneficial, evidence suggests an overall increase in the unpredictability and magnitude of pest problems. The indirect effects of climate change on pest dynamics include desynchronization between crop pests and their natural enemies due to differing thermal preferences (Skendžić et al., 2021). Changes in the efficacy of pest control strategies, influenced by climate change, also contribute to the overall challenge.

Moreover, shifts in land use and crop management practices, often more impactful than the direct effects of climate change, further amplify pest pressures (Subedi et al., 2023). Examining changing climatic factors in isolation reveals several direct and indirect impacts on pests. Therefore, addressing these complexities necessitates

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