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Sustainable approaches to mosquito and pest control: A comprehensive review

Dr. S Peer MohamedDOI: <https://doi.org/10.22271/23487941.2023.v10.i5b.703>**Abstract**

Mosquitoes and pests have long been vectors of diseases and nuisances to human populations, prompting a continuous quest for effective and sustainable control methods. In recent years, there has been a paradigm shift towards eco-friendly and long-term solutions. This comprehensive review examines a range of sustainable approaches to mosquito and pest control, evaluating their efficacy, environmental impact, and potential for widespread implementation. Through a critical analysis of current research and practical applications, this article aims to provide a holistic overview of the state-of-the-art techniques and technologies in sustainable pest management.

Keywords: Mosquito, pest control, mosquito-borne diseases, vector**1. Introduction**

Mosquito-borne diseases such as malaria, dengue, and Zika continue to pose significant threats to public health in many parts of the world ^[1]. Likewise, pests in agriculture, urban environments, and natural ecosystems can cause substantial economic losses and ecological disruptions. Conventional control methods often rely on chemical pesticides with adverse environmental consequences. However, a growing awareness of ecological balance and the need for long-term solutions has spurred the development of sustainable alternatives ^[2].

2. Biological Control Strategies**2.1 Predatory Species and Biological Agents**

This section explores the use of natural predators and biological agents in controlling mosquito and pest populations. Examples include the introduction of beneficial insects, nematodes, and microbial agents that target specific life stages or behaviors of pests ^[3].

2.2 Genetic Modification and Sterile Insect Techniques

Advancements in genetic engineering and sterile insect techniques have opened new avenues for population suppression. This section delves into the principles, successes, and challenges associated with these innovative approaches ^[4].

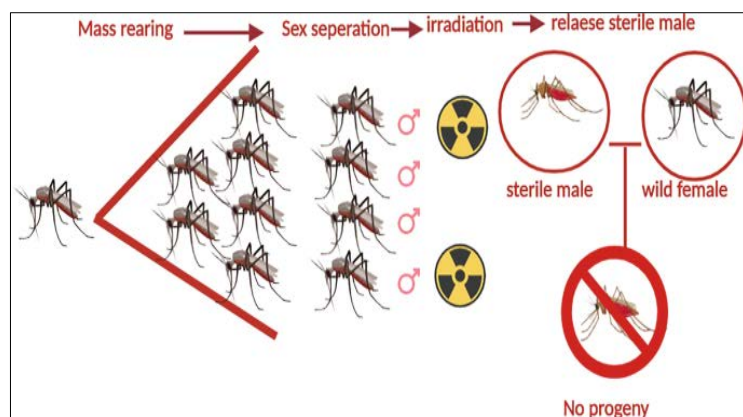


Fig 1: Genetic Improvements to the Sterile Insect Technique ^[12]

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3. Eco-Friendly Chemical Alternatives

3.1 Botanical Extracts and Essential Oils

Natural compounds derived from plants have shown promise as alternative insecticides. This section evaluates the efficacy and safety of botanical extracts and essential oils in mosquito and pest control ^[6].

3.2 Insect Growth Regulators (IGRs) and Biopesticides

IGRs and biopesticides represent a more targeted and environmentally-friendly approach to pest management. This section discusses the mechanisms of action and applications of these sustainable alternatives ^[7].

4. Integrated Pest Management (IPM)

IPM combines various tactics, including biological, cultural, and mechanical controls, to create a comprehensive and sustainable approach to pest management. This section assesses the effectiveness of IPM strategies in different settings ^[8].

5. Technological Innovations

5.1 Remote Sensing and GIS in Vector Surveillance

Advancements in remote sensing and Geographic Information Systems (GIS) have revolutionized vector surveillance and control. This section explores how these technologies enhance our ability to monitor and manage mosquito populations ^[9].

5.2 Smart Traps and Monitoring Devices

Innovations in trap design and monitoring devices offer real-time data for more precise and timely interventions. This section reviews the latest developments in trap technology ^[10].

6. Environmental Impact and Regulatory Considerations

An essential aspect of sustainable pest management is its impact on non-target organisms and ecosystems ^[11]. This section examines the ecological implications of various control methods and discusses regulatory frameworks governing their use.

7. Case Studies and Field Applications

This section provides real-world examples of successful implementation of sustainable pest management strategies in different geographic and ecological contexts.

8. Future Directions and Challenges

Anticipating future trends and addressing remaining challenges is crucial for advancing sustainable pest management. This section outlines potential research directions and discusses unresolved issues in the field.

9. Conclusion

This comprehensive review underscores the importance of sustainable approaches to mosquito and pest control in safeguarding public health, agriculture, and ecosystems. By evaluating a range of strategies and technologies, this article provides valuable insights for researchers, policymakers, and practitioners working towards a more sustainable and harmonious coexistence with mosquitoes and pests.

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