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Emerging Insect Pests of Millets and Their Management Strategies

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INTRODUCTION

Millets, such as sorghum, pearl millet, finger millet, foxtail millet, and little millet, are among the oldest cereal crops and are staple foods for many people in semi-arid and arid areas. These crops adapt well to challenging environments, including low rainfall and poor soil. Recently, millets have gained global attention due to their high nutritional value, including fiber, minerals, and antioxidants, and their role in sustainable farming.

With rising awareness and government support for millet farming, the area and intensity of millet cultivation have expanded. However, this growth, along with changing climate, has significantly altered pest populations. New insect pests have appeared, existing pests are becoming more severe, and pest dynamics are changing. This poses major challenges to millet farming, reducing yields and threatening the sustainability of these systems.

2. Factors Responsible for Emerging Pest Problems

Several interconnected factors lead to the rise of insect pests in millets. Climate change is a major factor, as higher temperatures and unpredictable rainfall create better conditions for pest growth. Warmer weather can speed up insect life cycles, resulting in more generations and greater pest pressure.

Changes in farming practices, particularly monocropping and continuous millet cultivation, reduce ecological diversity, making it easier for pests to thrive. While high-yield varieties improve productivity, they may not be resistant to local pests, increasing crop vulnerability.

Loss of biodiversity, including a decline in natural enemies like predators, further complicates pest issues. Additionally, heavy and careless use of chemical pesticides causes resistance in pests and leads to rapid population rebounds after initial control. These factors have significantly changed pest dynamics in millet farming.

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3. Major Emerging Insect Pests of Millets

3.1 Shoot Fly (*Atherigona* spp.)

Shoot flies are highly destructive pests of sorghum and pearl millet, especially in the early growth stages. Adult flies lay eggs near seedling bases. When they hatch, maggots bore into the central shoot.

This feeding creates "dead hearts," drying up the central shoot and hindering plant establishment. Early infestations can lead to severe yield losses, as affected plants struggle to produce tillers.

3.2 Stem Borers (*Chilo partellus, Sesamia inferens*)

Stem borers are significant pests that target millets at various growth stages. The larvae bore into the stem, disrupting nutrient and water flow.

Infested plants show symptoms like dead hearts in the vegetative stage and white ear heads in the reproductive stage. Warm and humid conditions favor these pests, enhancing their development.

3.3 Fall Armyworm (*Spodoptera frugiperda*)

The fall armyworm is a new invasive pest posing a major threat to millet crops. It feeds on various plants and is known for its strong migratory capability.

The larvae create large holes in leaves and cause severe defoliation. Outbreaks can lead to complete crop loss if not managed quickly.

3.4 Aphids (*Rhopalosiphum maidis*)

Aphids are sap-sucking pests that typically infest millet crops in humid conditions. They feed on plant sap, causing yellowing, leaf curling, and stunted growth.

Besides causing direct damage, aphids produce honeydew that encourages sooty mold growth on plants, reducing photosynthesis. They can also spread viral diseases, increasing crop damage.

3.5 Head Bugs (*Calocoris angustatus*)

Head bugs are key pests during grain formation. They feed on developing grains in the milky stage, extracting contents and causing shriveled, discolored grains.

This damage lowers yield and affects grain quality, making the produce less appealing to consumers and traders.

3.6 Armyworms and Cutworms

Armyworms and cutworms are sporadic yet destructive pests that feed on leaves and young seedlings. Cutworms can cut plants at the base, killing them, while armyworms consume leaves in large numbers, causing sudden outbreaks. These pests thrive under favorable conditions like high humidity and moderate temperatures.

3.7 Storage Pests (Grain Weevils and Others)

Storage pests like grain weevils attack harvested millet grains during storage. They bore into grains, leading to both quantity and quality losses.

Infestation results in reduced grain weight, poor seed viability, and contamination, making the grains unsuitable for consumption and sale.

4. Impact of Emerging Pests

The rise and intensification of insect pests in millets greatly affect agricultural productivity and sustainability. Pest infestations can significantly reduce yields and harm grain quality.

Farmers face higher costs due to increased spending on pest control, particularly on chemical pesticides. Severe infestations may lead to total crop failure, especially in resource-limited settings. These challenges threaten farmer income and food security, especially where millets are a dietary staple.

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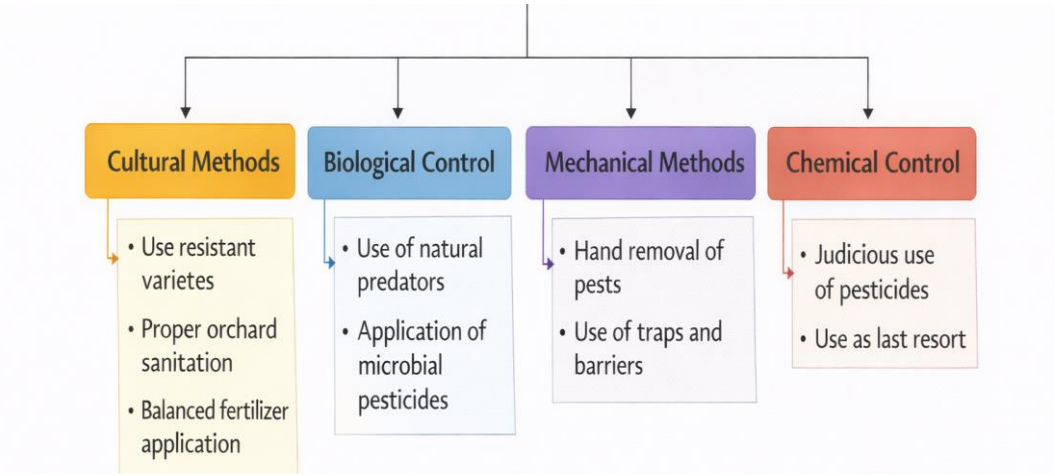
5. Management Strategies



5.1 Cultural Practices

Cultural methods serve as the first line of defense against insect pests. Timely sowing allows crops to avoid peak pest periods, reducing damage.

Crop rotation and intercropping with legumes boost soil health and interrupt pest life cycles. Removing and destroying infested plant parts helps lower pest populations. Deep summer plowing exposes and destroys pupae in the soil, minimizing carryover.

5.2 Host Plant Resistance

Using pest-resistant or tolerant varieties is an effective and cost-efficient pest management method. Breeding programs aim to develop improved cultivars resistant to major pests, reducing reliance on chemical control.

5.3 Mechanical and Physical Control

Mechanical methods include hand-picking and destroying insect eggs, larvae, and infested plants. Light traps and pheromone traps are effective for monitoring pest populations and trapping certain insect species.

5.4 Biological Control

Biological control uses natural enemies to reduce pest populations. Protecting beneficial organisms like parasitoids and predators is essential.

Biopesticides such as *Bacillus thuringiensis* (Bt) and *Beauveria bassiana* offer environmentally safe alternatives to chemical pesticides and are effective against many pests.

5.5 Chemical Control

Chemical control should be used carefully and only when necessary, based on economic threshold levels. Treating seeds with systemic insecticides offers early pest protection.

Selecting appropriate insecticides and following recommended doses is crucial to prevent resistance and minimize environmental harm.

5.6 Integrated Pest Management (IPM) Approach

Integrated Pest Management combines several control strategies for effective and sustainable pest management. Regular monitoring of pest populations, use of economic thresholds, and integration of cultural, biological, and chemical methods are vital to IPM.

Educating farmers and providing training programs support the successful application of IPM strategies.

5.7 Climate-Smart Pest Management

Climate-smart pest management uses modern tools and technologies to manage pests amid changing climate. Weather-based pest forecasting models help predict outbreaks and enable timely action.

Digital tools, including mobile apps and remote sensing technologies, provide real-time advice to farmers. Adopting resilient cropping systems helps farmers cope with climate-related pest challenges.

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6. Future Perspectives

Future research should focus on understanding pest behavior and ecology in changing climates. Developing pest-resistant varieties using new breeding techniques and biotechnology will be crucial.

Promoting eco-friendly pest management approaches that lessen reliance on chemical pesticides is essential. Strengthening extension services and raising farmer awareness of sustainable practices will be important in managing emerging pest issues.

CONCLUSION

The emergence and resurgence of insect pests in millets under changing climatic and agricultural conditions present significant challenges to sustainable production. Effective management requires a holistic and integrated approach that combines traditional knowledge with modern scientific advancements.

Emphasizing Integrated Pest Management, biological control, and climate-smart strategies will be essential to mitigate pest-related losses. Ensuring the sustainability of millet production systems is crucial for achieving food and nutritional security, particularly in vulnerable regions.

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