International Journal of Recent Research and Review, Vol. X, Issue 3, September 2017
ISSN 2277 – 8322

A Detailed Study on role of Biocontrol strategies for Fruit Crops

Rajendra Singh
Department of Horticulture
Govt. College Uniara, Tonk, Rajasthan, India

***Abstract*: Biocontrol is a method of managing pests and diseases using natural enemies, such as beneficial insects, fungi, bacteria, or viruses, to control the populations of harmful organisms. Food security has become a major concern worldwide in recent years due to ever increasing population. Providing food for the growing billions without disturbing environmental balance is incessantly required in the current scenario. In view of this, sustainable modes of agricultural practices offer better promise and hence are gaining prominence recently. Moreover, these methods have taken precedence currently over chemical-based methods of pest restriction and pathogen control. Adoption of Biological Control is one such crucial technique that is currently in the forefront. This review highlights the different methods of fruit-pathogen control, types of fruit pathogens, their modus operandi and various biocontrol approaches employing a range of microorganisms and their by-products. More importantly, a critical analysis of the various methods enumerated in the paper indicates the need to amalgamate various techniques in order to improve the degree of biocontrol offered by them.**

***Keywords*: Insect pests, Vegetable crops, Biological Control, Eco-friendly management.**

I. Introduction

In India, fruit crops are susceptible to various diseases that can significantly impact yield and quality. The introduction of general diseases in fruit crops can occur through various means, including infected planting material, contaminated tools and equipment, windborne or insect-borne spores, and soilborne pathogens. Here are some common diseases that affect fruit crops in India:

Anthracnose: Anthracnose is a fungal disease that affects several fruit crops, including mango, papaya, banana, and citrus. It causes dark, sunken lesions on fruits, leading to rotting and premature fruit drop. Fungal spores can spread through wind, rain, or insect vectors.

Fruit Rot/ Phytophthora Rot: This disease is caused by Phytophthora spp., which affects fruits like papaya, pineapple, and citrus. It causes rotting, discoloration, and softening of fruits. The pathogen thrives in waterlogged or poorly drained soil.

Fruit Fly Infestation: Fruit flies are major pests that cause damage to a wide range of fruit crops, including mango, guava, citrus, and banana. They lay eggs in ripening fruits, leading to larval infestation and fruit damage.

Powdery Mildew: Powdery mildew is a fungal disease that affects several fruit crops, including grapes, apples, peaches, and cucurbits. It causes white powdery patches on leaves, shoots, and fruits, leading to stunted growth and reduced yield.

Fruit Spot Diseases: Various fruit spot diseases, caused by different fungal pathogens, affect fruits like citrus, apple, pear, and mango. These diseases cause spots, lesions, or blemishes on fruits, affecting their appearance and market value.

Bacterial Diseases: Bacterial diseases such as bacterial canker (in citrus), bacterial spot (in peach and tomato), and bacterial blight (in pome fruits) can affect fruit crops. These diseases cause cankers, spots, or blights on leaves, shoots, and fruits, resulting in yield losses.

Wilt Diseases: Wilt diseases, caused by soil borne pathogens like Fusarium and Verticillium, affect several fruit crops, including tomato, banana, and guava. These diseases cause wilting, yellowing, and decline of the plant, leading to reduced productivity.

Fruit Rot/Brown Rot: Brown rot, caused by the fungus Monilinia spp., affects stone fruits like peach, plum, and apricot. It causes browning,

rotting, and shriveling of fruits, both in the field and during storage.

It's important for fruit crop growers in India to implement preventive measures to manage and control these diseases. This includes using disease-resistant varieties, practicing proper sanitation and hygiene, implementing cultural practices like pruning and thinning, employing biological control agents, and applying appropriate fungicides or other disease management strategies based on Integrated Pest Management (IPM) principles.

Local agricultural extension services, research institutions, and agricultural experts can provide specific guidance and recommendations for disease management in different fruit crops, considering the regional climate, prevalent diseases, and available control options.

II. ‘Fruit crops' main insect pests and the amount of their damage in India

India is home to a wide variety of fruit crops, and each crop can be affected by different insect pests. Here are some of the main insect pests that commonly infest fruit crops in India and the amount of damage they can cause:

Fruit Fly (Bactrocera spp.): Fruit flies are one of the most damaging pests of fruit crops in India. They attack a wide range of fruits, including mango, guava, citrus, and banana. Female fruit flies lay eggs in ripening fruits, and the larvae feed on the fruit pulp, causing it to rot and drop prematurely. Fruit fly infestations can lead to significant yield losses, reduced fruit quality, and market rejection.

Fruit Borers (Helicoverpa armigera and others): Fruit borers, including the Helicoverpa armigera (also known as the American bollworm), attack various fruit crops like tomato, brinjal (eggplant), and okra. The larvae bore into the fruit, causing internal damage and rendering the fruit unmarketable. Fruit borer infestations can result in yield losses and economic damage.

Mango Hoppers (Idioscopus spp.): Mango hoppers, such as Idioscopus spp., are common pests of mango trees. They feed on the sap of young shoots, causing wilting, drying, and deformation of leaves. Heavy infestations can lead to reduced growth, defoliation, and a decline in fruit quality and yield.

Mealybugs (Planococcus spp.): Mealybugs are sap-sucking insects that affect various fruit crops, including grapes, citrus, and papaya. They feed on plant tissues, causing stunted growth, leaf curling, and premature fruit drop. Mealybug infestations can also result in the secretion of sticky honeydew, which promotes the growth of sooty mold on the fruit surface.

Thrips (Frankliniella spp.): Thrips are tiny, slender insects that attack a wide range of fruit crops, including mango, grapes, and papaya. They feed on plant tissues, causing distortion, silvering, and scarring of fruits. Thrips infestations can reduce the market value of fruits and make them unappealing to consumers.

Scale Insects (Lepidosaphes spp.): Scale insects are pests that infest fruit crops like citrus and mango. They have a protective scale covering and feed on plant sap, causing yellowing, wilting, and reduced fruit quality. Scale infestations can weaken plants and make them more susceptible to other diseases.

Citrus Psyllids (Diaphorina citri): Citrus psyllids are pests that primarily affect citrus crops. They feed on plant sap and transmit the bacteria responsible for citrus greening disease (huanglongbing). Infected trees exhibit symptoms such as yellowing, stunted growth, and small, misshapen fruits. Citrus psyllids pose a significant threat to the citrus industry in India.

The extent of damage caused by these insect pests varies depending on factors such as pest population levels, crop management practices, natural enemies, and pest control measures employed by growers. Integrated Pest Management (IPM) strategies, including cultural practices, biological control, pheromone traps, and judicious use of insecticides, can help manage these insect pests and minimize their damage in fruit crops.

It's important for fruit crop growers to stay informed about specific pests that affect their crops in their particular region and seek guidance from local agricultural extension services, research institutions, and agricultural experts for effective pest management recommendations.

III. Need for Biological Pest Control

The need for biocontrol strategies for fruit crops arises from several important factors:

Environmental sustainability: Traditional pest control methods often rely on the use of synthetic pesticides, which can have adverse effects on the environment. These pesticides may contaminate water sources, harm beneficial insects, pollinators, and other non-target organisms, and contribute to soil degradation. Biocontrol strategies offer an environmentally sustainable alternative by utilizing natural enemies and reducing the dependence on chemical pesticides.

Resistance management: Pests and diseases have the potential to develop resistance to chemical pesticides over time. This can render certain pesticides ineffective and limit the options available for pest control. Biocontrol strategies, on the other hand, utilize diverse mechanisms of action that are less likely to lead to resistance development. By incorporating biocontrol agents into pest management programs, farmers can reduce the risk of resistance and preserve the effectiveness of chemical pesticides for when they are truly necessary.

Food safety and quality: Consumers are increasingly concerned about the safety and quality of the food they consume. Excessive pesticide residues on fruits can pose risks to human health. Biocontrol strategies can help minimize pesticide residues by reducing the reliance on chemical pesticides, thereby improving food safety and quality.

Market access and regulations: Many countries have established regulations and standards for pesticide residues in agricultural products. Exceeding these limits can result in restrictions on market access and export opportunities. By implementing biocontrol strategies, farmers can adhere to these regulations more easily and ensure their produce meets the required standards, enhancing market access and competitiveness.

Preservation of beneficial organisms: Chemical pesticides can have unintended consequences on beneficial insects, such as pollinators and natural enemies of pests. Biocontrol strategies prioritize the conservation of these beneficial organisms, contributing to biodiversity and maintaining the ecological balance in agricultural systems.

Long-term economic viability: Over-reliance on chemical pesticides can lead to escalating costs for farmers, as pests may develop resistance, requiring increased pesticide application or stronger formulations. Biocontrol strategies, once established, can provide long-term pest management solutions, reducing input costs and improving economic viability for farmers.

Consumer preferences: There is a growing demand for sustainably produced, pesticide-free, and environmentally friendly food products. By adopting biocontrol strategies, farmers can meet these consumer preferences and differentiate their products in the market, potentially commanding premium prices.

IV. Biocontrol strategies for fruit crops

Biocontrol strategies for fruit crops typically involve the following:

Biological control agents: These are organisms that are introduced or conserved in the field to control pests. They can include predators, parasitoids, pathogens, or competitors that target specific pests damaging fruit crops.

Conservation of natural enemies: This involves creating or enhancing habitats that support the population of beneficial insects, birds, or other organisms that naturally control pests. This can be done by providing suitable food sources, shelter, or nesting sites.

Microbial control: The use of beneficial microorganisms, such as bacteria or fungi, to

control pests and diseases. These microorganisms can directly attack the pests or suppress their growth and reproduction.

Integrated pest management (IPM): This is a holistic approach that combines various pest control methods, including biocontrol, cultural practices, monitoring, and judicious use of pesticides when necessary. IPM aims to minimize the use of chemical pesticides while effectively managing pest populations. The effectiveness of biocontrol strategies for fruit crops can vary depending on various factors such as the specific pests or diseases targeted, environmental conditions, crop management practices, and the selection of appropriate biological control agents. Researchers and agricultural experts continue to study and develop new biocontrol strategies to improve fruit crop production while reducing environmental impacts.

V. Future Possibilities & Scope

The future scope of biocontrol strategies for fruit crops is promising and holds several potential benefits. Here are some aspects that indicate the potential for further development and implementation of biocontrol strategies:

Sustainability: Biocontrol methods align with sustainable agriculture practices by reducing reliance on synthetic pesticides. As environmental and health concerns regarding pesticide use continue to rise, biocontrol offers a more environmentally friendly and sustainable approach to managing pests and diseases in fruit crops.

Reduced chemical residues: Biocontrol strategies can help minimize chemical residues in fruit crops. This is particularly important for fruits destined for export or those consumed directly, as consumers increasingly demand produce with lower pesticide residues.

Preservation of beneficial insects: By utilizing biocontrol agents, the population of beneficial insects and other organisms can be conserved. This contributes to the overall biodiversity and ecological balance of agricultural systems.

Integration with other pest management practices: Biocontrol strategies can be integrated into broader integrated pest management (IPM) programs. By combining multiple approaches such as cultural practices, monitoring, and targeted pesticide use, growers can achieve effective pest management while minimizing negative impacts on the environment.

Development of new biocontrol agents: Research continues to identify and develop new biocontrol agents that are specific to particular pests or diseases affecting fruit crops. This includes exploring the potential of microbial agents, natural predators, parasitoids, and genetically modified organisms (GMOs) for targeted pest control.

Technological advancements: Advances in biotechnology, genomics, and genetic engineering provide opportunities to enhance the effectiveness of biocontrol agents. Researchers can identify genes responsible for insecticidal properties or disease resistance and transfer them to beneficial organisms, creating more potent biocontrol agents.

Adoption and awareness: Increased awareness among farmers and stakeholders about the benefits and effectiveness of biocontrol strategies can drive greater adoption. Educational programs, training, and knowledge dissemination efforts can help bridge the gap between research and practical implementation. It's important to note that while biocontrol strategies offer numerous advantages, their success relies on several factors, including thorough research, proper implementation techniques, site-specific considerations, and understanding the dynamics of pest populations. Continued research, collaboration between researchers, growers, and policymakers, and investment in biocontrol research and development will play a crucial role in realizing the full potential of these strategies for fruit crop production in the future.

VII. Conclusion

In this article we discussed about various disease related to fruits and different methodology to control them. This article covers a detailed study about various disease related to fruits such as Anthracnose, Fruit Rot/Phytophthora Rot, Powdery Mildew, Fruit

Spot Diseases, Bacterial Diseases, Wilt Diseases and Fruit Rot/Brown Rot. This also elaborates the basic need of biological paste control. This also contains the study about the Biocontrol strategies for fruit crops such as Biological control agents, Conservation of natural enemies, Microbial control and Integrated pest management (IPM).

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