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Popular Article

Role of Biological Control Agents in Integrated Pest Management

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Abstract

The global population is projected to reach 8.5 billion by 2030, 9.7 billion by 2050, and exceed 11 billion in 2100. There is continued need for pest management in agriculture, with pressure continuously increasing on agriculture to achieve higher yield from limited or even lesser land. Negative impact of pesticides has brought into focus the need for safer and effective alternative such as bio agents/bio pesticides. Biological control is successful management of a pests by means of another living organisms (parasitoids, predators, pathogens) that is disseminated by human. The biocontrol agents are not only safer and specific to handle but are gifted with the self-perpetuating ability, which is more sustainable in nature than the repeated applications by chemical pesticides.

Biological Control

Biological control is an innate component of integrated pest management strategy. It is defined as the reduction of pest populations by natural enemies and typically involves an active human role. Natural enemies of insect pests, also known as biological control agents, include predators, parasitoids, and pathogens. Biological control of weeds includes mitigation of weed problems by employing insects and pathogens.

Techniques In Biological Control

Introduction

It is the introduction and establishment of natural enemies to a new locality where they did not occur to originate naturally. *Rodolia cardinalis,* the Vedalia beetle was imported from Australia to California in the 19th century, successfully controlling cottony cushion scale.

Augmentation

Propagation and release of natural enemies to supplement the numbers of naturally occurring natural enemies

- **Inoculative release**

Large number of individuals are released only once during the season and natural enemies are expected to reproduce. *Encarsia formosa,* are used to control greenhouse whitefly

While the predatory mite *Phytoseiulus persimilis* is used for control of the two-spotted spider mite.

- **Inundative release**

Involves mass multiplication and periodic release of Natural enemies when the pest populations reach damaging levels. The egg parasitoid *Trichogramma* is frequently released inundatively to control harmful moths.

Conservation

Actions to preserve and release of natural enemies by environmental manipulations to protect natural enemies. Providing a suitable habitat, such as shelter belt where natural enemies can survive and reproduce can help to ensure the populations of natural enemies. Earwigs are natural predators that can be encouraged in gardens by hanging upside-down flowerpots filled with straw.

Biological Control Agents

Parasitoids

Parasitoids are insects that parasitize other insects. The immature stages of parasitoids develop on or within its host, eventually killing it.Parasitoids may attack all stages of their host (eggs, larvae, nymphs, pupae, adults).

- *Trichogramma, Encarsia formosa and Aphidius* parasitoids such as *Aphidius ervi, A. colemani, A. matricariae* are commercially available.
- *Trichogramma* is an egg parasitoid and works well on many caterpillars.
- *Encarsia formosa* is used for the control of whiteflies in greenhouses.
- *Aphididius* parasitoids are effective against aphids.

Predators

A Predator is one which catches and devours smaller or more helpless creatures called prey. Beetles, ground beetles, lacewings, syrphid (hover) flies, mantids, yellowjacket wasps are some of the examples of predators.

Entomo Pathogens

An organism (generally a bacterium, virus, protozoan or fungus) causing disease in insects.

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These include: Entomopathogenic fungi, Entomopathogenic Bacteria, Entomopathogenic Virus, Entomopathogenic Nematodes, Entomopathogenic Protozoa.

Need For Biocontrol

The global population is projected to reach 8.5 billion by 2030, 9.7 billion by 2050 and exceed 11 billion in 2100 (UN. World Population Prospects, 2011). There is continued need for pest management in agriculture, with pressure continuously increasing on agriculture to achieve higher yield from limited or even lesser land. *(Shukla et al., (2019).* The indiscriminate use of chemical pesticides in agriculture have not only resulted in adverse effects on health, environment, but also causes depletion of natural enemies and increase of minor pests. Negative impact of chemicals has brought into focus the use of safer and effective alternative such as bioagents or biopesticides.

Benefits Of Biocontrol Agents

Biological control is less expensive and more ecofriendly than any other methods. Bio control agents give protection to the crop during the critical stages of the pest incidence and avoid blanket applications. They do not cause phytotoxicity issues. The bio control agents are not only safer and specific to handle but are gifted with the self-perpetuating ability, which is more sustainable in nature than the repeated applications by chemical pesticides. Many of the bio control agents are also known to have both disease control ability and also enhance the root and plant growth by way of encouraging the beneficial soil microflora thereby increases the crop yield. Bio control agents are very safe to handle and apply to the target. Most of the bio control agents are having proven compatibility with other methods of pest control, in general, and other biocontrol agents, in particular, there by facilitating integration of different methods of pest control with more practicability.

Despite being in practice for several decades, biological control was evolving continuously, and lot of innovations has taken place in the field of biological control to suit the present day needs for the effective pest management.

Biological Control of coconut rugose spiraling whitefly with entomopathogenic fungi, *Isaria fumosorosea* (NBAIR- Pfu 5) was proved effective in managing rugose spiraling whitefly.

Trichogramma pretiosum is also produced commercially and released for the control of Fall army worm.

Encyrtid parasitoids *Acerophagus papayae*, known to suppress the papaya mealybug in its native range, effectively controlled the papaya mealybug when introduced into Guam, Palau islands

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and more recently to Sri lanka. The same was introduced in India and successfully managed papaya mealybug in India.

Limitations Of Biocontrol Agents

Biocontrol agents may take longer to achieve their maximum effectiveness compared to traditional chemical pesticides. Some biocontrol agents may have a limited range of activity or may only be effective in certain geographic regions. Biocontrol agents may be more expensive and their effectiveness may require multiple applications, which can add to the cost.

Biological Control Current Issues and Solutions

A) Communication with stakeholders and the public

Stakeholders and the public are usually poorly informed about biological control and indeed sometimes dismiss it as a feasible option for pest management. The public often express negative views on biocontrol. Biocontrol practitioners could assist in reversing some of the misconceptions about biological control by communicating the benefits of their work, not only in the scientific literature, but also verbally and in popular publications.

B) Cost effectiveness of biocontrol

Biological control practitioners are often not effective in demonstrating the financial and other benefits of their programmes. Biocontrol practitioners to involve economists, social scientists and stakeholders early in a biocontrol or IPM programme so that the desired social, economic and environmental benefits can be defined.

Present Status of Biological Control Agents in India

An overview of the current structure of biocontrol laboratories and units working in India

Biocontrol laboratories/ Units in India	361
Private sector laboratories	141
State biocontrol laboratories	98
ICAR/ SAUs/ DBT laboratories	49
Private sector	38
Central Integrated Pest Management Centres (CIMPCs)	35

In India, amongst all types of biopesticides, the percentage share of fungal products is highest. Further, in the category of fungal biopesticides, strains of *Trichoderma* are mostly used, followed by *Beauveria bassiana* and *Verticilium sps.* In India, most of the share of bacterial biopesticides is occupied by Pseudomonas followed by Bacillus. In case of Bacillus strains of *B. thuringensis*, *Bacillus sphaericus* and *Bacillus subtilis* are registered as biopesticides.

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In India, only Nucleopolyhedrosis viruses (NPVs) based viral biopesticides are being used for biocontrol of *Helicoverpa armigera*, and their percentage share is very low. Natural occurrence of granulosis virus (GVs) infecting larvae of sugarcane pests in southern and northern states of India was reported very early, yet their mass multiplication and commercial production in the form of biopesticides has not started (Easwaramoorthy and Jayaraj, 1987).

Application of nematodes in pest management has started now. *Heterorhabditis* and *Steinernema* are the two most effective entomopathogenic nematodes that are being used against different soil-borne pests under field conditions (*Sankaranarayanan et al.* 2006). However, no registered product is available in the market to date.

Conclusion

In the present scenario of Organic Farming and Natural Farming for adoption of ecofriendly plant protection measures, it is imperative that chemical control methods need to be weaned out. In view of the operating prominence the biological control methods pave a clear pathway and perfect strategy is the need of the hour. With the present status of biological control methods occupying larger share in IPM of important pests of major crops, the fine tuning of biological control technologies will continuously help in better adoption by stakeholders.

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