Microbial Biological Control Agent: An Ecologically Sustainable Strategy For Pest Management

Abstract

Microbial biocontrol agents play an important role in integrated pest management in modern agriculture for controlling pests without affecting environment and human. Recently, microbial biocontrol agents gaining more attention as they are easy to use, safe and an alternative eco-friendly approach of chemicals. Biological control agents are ecologically sustainable and effective crop protection approach in agriculture and horticultural crops including organic systems. Predator, parasitism, herbivory or other natural mechanism can be use to control pest such as insects, mites, weeds and plant diseases. In this case involve an active human management.

Keywords: Crop protection, herbivory, natural mechanism, parasitism

Introduction

Biological control agents are ecologically sustainable and effective crop protection approach in agriculture and horticultural crops including organic systems. It is one of the promising component of an integrated pest management strategy (Gurr et al. 2017; Michaud 2018). Generally, biological agent refers the use of living organism or living things to control pest. It can be through bacteria, fungus, insect or birds that control agricultural pest. Biological agent feed on the pest; suppress the population of the pest, through this population of the pest can be manage, thus it is ecologically suitable.

In ecology the biological process in environment, the relation / interaction between plants, animal and other living or non-living organism in the environment that make balance in the system. Natural process that they depend on each other feeding on lower organism to higher organism and decomposer etc vice-versa. Predator, parasitism, herbivory or other natural mechanism can be use to control pest such as insects, mites, weeds and plant diseases. In this case involve an active human management.

It is an economical, sustainable, cheapest, reliable and environmentally friendly pest management method by using living organisms to suppress the numbers of pest species. The adverse effect on the environment, human being, livestock etc is minimized by reducing the dependence on chemical pesticides (Damalas and Eleftherohorinos 2011). It increases species diversity and conserves biodiversity within an agro-ecosystem. Biological control can also be considered as a potential tool for achieving sustainable pest management in organic/natural farming system.

Mode of action: Antibiosis, Mycoparasitism / Hyperparasitism, Competition, Lytic enzymes, Hydrogen cyanide, Induced Systemic Resistance and Plant growth promotion etc (Köhl et al 2019). This process is slow but effective, environmentally suitable, does not pollute and toxic to other organism than specific.

Types of microbial biocontrol agents:

Micro-organisms act as biocontrol agents in three ways, either they cause diseases in the pests or compete with them or kill them. There are different types of microbes *viz*., bacteria, fungi, viruses, and protozoans etc which act as microbial biological control agent.

Example:

1) Fungal biocontrol agents: *Trichoderma harzianum, Trichoderma viride, Verticillium lecanii, Metarhizium anisopliae, Paecilomyces lilacinus.*

2) Bacterial biocontrol agents: *Pseudomonas fluorescens, Bacillus subtilis, Bacillus thuringiensis*

Mode of application:

Seed treatment: Seeds can be treated with *Trichoderma harzianum or T. viride* @ 5-10 g/kg seed or *Pseudomonas fluorescens* @ 5-10 g/kg seed or *Beauveria bassiana* or *Metarrhizium anisopliae* @ 10 g/kg seed or *Verticillium lecanii* @ 20 ml/kg or *Paecilomyces lilacinus* @ 4-6 g/kg seed or *Bacillus subtilis* @ 10 g/kg seed and kept for shade drying for 30 minutes.

Nursery treatment: Drench nursery bed with *Trichoderma* @ 5g/L or 10-25g of *Trichoderma* per 100 square meter area or *Pseudomonas fluorescens* 50 -100g formulation per square meter area or *Paecilomyces lilacinus* 50g formulation per square meter area.

Seedling treatment: Roots of the seedlings are dipped into Trichoderma solution (20 – 25 g/L) or *Pseudomonas fluorescens* solution @ 5g/L or *Verticillium lecanii* solution @ 20 ml/L or *Paecilomyces lilacinus* solution @ 10 g/L or *Bacillus subtilis* solution @ 5g/L for 20-30 minutes before transplanting.

Soil application: Apply 4-5 kg *Trichoderma* or 2.5 kg *Pseudomonas fluorescens* or *B. bassiana* or *M. anisopliae* @ 10 kg/ha or *Verticillium lecanii* @ 1L/acre or *Paecilomyces lilacinus* @ 2kg/acre or *Bacillus thuringiensis* @ 1.12kg/ha or 2.5-5 kg *Bacillus subtilis* with 100kg decomposed manure/farm yard manure 20-25 days before applying in field and cover it with

polythene sheet. Sprinkle the heap with little water immediately. Turn the mixture in every 3-4 days interval.

Foliar application: 5 kg/ hectare in 500 liters of water i.e., 5 gm per liter of water.

Advantages of using biocontrol agent in pest management: Biological control agents are eco-friendly approach and do not have any adverse effect on the environment, human being, livestock etc (Syed-Ab-Rahman et al 2017). Comparatively cheaper than other agrochemical like pesticides and insecticides. These methods are also easy to use, attack only target organism, readily available and can used in any season. The most crucial use of biocontrol agents gives protection to crops throughout cropping season and help in reducing the use of chemicals and pesticides which have harmful effect for human beings (Peshin et al 2009).

Limitations of using biocontrol agent:

High specificity against the target pest resulting multiple microbial pesticides to be used. The biocontrol agents do not eradicate all the pests and are a useful and economical tool for pest control only when used on a large scale.

Conclusion:

Microbial biocontrol agents play an important role in integrated pest management in modern agriculture for controlling pests without affecting environment and human. Recently, microbial biocontrol agents gaining more attention as they are easy to use, safe and an alternative eco-friendly approach of chemicals.

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Fig 1: Demonstration of biocontrol agents at Pathalia village, Sepahijala Tripura

Fig 2: Paddy seedlings root dip method

Fig 3: Treated seedlings transplanted in lines

Fig 4: Method demonstration on biocontrol agents in farmers field

Fig 5: Method demonstration on biocontrol agents in farmers field

Fig 6: Seed treatment with biocontrol agents