A Promising Sustainable Pest Management Technology: Microbial Bio-Control Agent

Abstract

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

Keywords: Crop protection, Microbial bio-control agents, 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 most promising components of an integrated pest management strategies (Gurr *et al*., 2017; Michaud, 2018). Generally, biological agent refers the use of living organism or living things to reduce key pest. Biological agent feed on the pest and thus suppresses the pest population (Heimpel and Mills, 2017).

The biological process in environment is rarely very complex as 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. and vice-versa. Predator, parasitism or other natural mechanism can be used to reduce key pest such as insects, mites, weeds and plant diseases. In this case involve an active human management.

It is an economical, sustainable, reliable and environmentally friendly pest management method by using living organisms to suppress the numbers of key 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 it within an agro-ecosystem. Biological control can also be considered as a potential tool for achieving sustainable integrated pest management in organic/natural farming system. Microbial bio-control agents are applied in agricultural and horticultural crops to suppress the plant pathogens (Singh *et al*., 2021).

Types of microbial biocontrol agents:

Natural antagonistic microorganisms are responsible to reduces plant pests. Different types of microbes *viz*., bacteria, fungi, viruses, and protozoans etc has enormous potential as biocontrol agents and alternative approach of chemical-based pesticides. Some of the fungal biocontrol agents are *Trichoderma harzianum, Trichoderma viride, Verticillium lecanii, Metarhizium anisopliae, Paecilomyces lilacinus etc.* Bacterial biocontrol agents *viz*., *Pseudomonas fluorescens, Bacillus subtilis, Bacillus thuringiensis* also plays an important role in suppression of soil-borne plant pathogenic organisms.

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 quite slow but effective, environmentally suitable, does not pollute and toxic to other organism than specific.

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:

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 :

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 reducing 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