

Review Article

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A Review - Biocontrol Agent: A Boon for Sustainable Agriculture

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ABSTRACT

The rapidly increasing population is exerting immense pressure on agricultural lands for higher crop yields, which results in increasing use of chemical fertilizers. That's why fungicides are widely used in agricultural crop production system for quick result and to ensure crop quality and production. However, the indiscriminate use of agrochemicals resulted in adverse effect on the soil fertility, quality of produce, crop productivity and cause adverse effects to aquatic and terrestrial ecosystem. This Negative environmental impact of artificial fertilizers and their increasing costs, emphasizes the need to adopt eco-friendly agricultural practices for food production to maintain sustainable agriculture. Microorganisms have a vital role in agriculture as they not only reduce application and reliance on synthetic pesticides but also promote the exchange of plant nutrients which are very much essential for healthy growth and development of plant. Antagonist microorganism as biocontrol agents secreted substances which protect the plants against various pathogens, thus suppressing diseases by different mechanisms of action, induction of host resistance and direct antagonistic interactions between the biocontrol agent and the pathogen, leading to a more efficient use of biocontrol strategies to improve cropping systems.

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Introduction

In today's world, Sustainable agriculture is fundamentally important aspect because it offers the potential to meet our future agricultural needs.

India is primarily agrarian, and this sector provides livelihood to a major part of the population. To feed increasing population

tremendously every year, the food grain production and productivity need to be increased correspondingly (Hanson *et al.*, 2007). Towards attaining this goal, there is requirement of use of higher doses of fertilizers, it give quick result but at the same time its indiscriminate use and persistent nature in soil decrease soil productivity (Gupta *et al.*, 2015) and pollute water bodies, also hazardous for human health and environment.

So there is need for gradually shifting to biological control methods from total dependence on chemical method.

Interest in biological control has increased over recent decades as it mitigating pests and pathogen through the use of natural enemies and act as competitors in controlling pests, pathogen and their damage.

All agricultural and horticultural crop are susceptible to diseases caused by variety of pest and pathogen. Plant diseases are a major constraint in crop production and lose of crops due disease amount to 25% of the world crop production per annum. So, it is important to find alternative measures to control plant diseases in order to increase yield and improve product quality also do not harm the environment (Atkinson and McKinlay 1997; Batish *et al.*, 2007; Camprubí *et al.*, 2007). Government and manufacturing organizations are developing regulations to assure the safe and appropriate use of biocontrol. The benefits of biological control systems drive the increasing adoption of the technology. Protection of biodiversity and high benefit to cost ratio are obvious reasons to promote the use of biocontrol platforms. It will require education and awareness of the general public and those involved in agriculture to accept these alternative farming practices. It will improves workers safety, also maintaining the economic viability of crop production. This review mainly focus on effect of biological control on different aspects:

Mechanism of diseases suppression through biocontrol agents

Biocontrol agents play wide role in disease suppression thus increasing growth parameter, plant content, and yield of crop. Diseases suppression can achieve through a number of ways such as, mycoparasitism, antibiosis, competition, cell wall degradation and induced

resistance plant growth promotion and rhizosphere colonization capability. The most effective bio agent studied till date appears to antagonize pathogen using multiple mechanisms as in *Pseudomonas*, utilizing both antibiosis and induction of host resistance to suppress the disease causing microorganisms. It produces Phenazine and 2, 4- diacetylphloroglucinol (DAPG) displays improved capacities to suppress diseases in field grown wheat. Additional DAPG producers aggressively colonize roots that further contribute to increased disease suppression in the rhizosphere through competition. As the bioagent represents a living system, it needs to be mass produced and formulated into various commercial products in a way it remains viable for at least two years.

Growth and biomass parameter

Application of BCA like *Trichoderma harzianum* and *Bacillus brevis* effectively suppressed disease and also enhanced plant and root growth, leading to increased flower production and quality in bulb when tested separately and in combination against *F. oxysporum* f. sp. *tuberosa* (Nosir, 2016). *Trichoderma* spp. enhanced the plant growth, seed germination, nodulation in faba bean infected with charcoal rot caused by *Machrophomina phaseolina* by reducing the root rot severity (kumari *et. al* 2017). Plant Growth Promoting Rhizobacteria (PGPR) significantly increased the plant growth parameters when tomato seedlings were inoculated with four isolates of PGPR. *Paenibacillus polymyxa* also promote the growth and biological control of *M. javanica* in tomato crop under greenhouse conditions (Sohrabi *et al.*, 2018). Bio-control agents (*Trichoderma viride*, *Pseudomonas fluorescence* and combination of *T. viride* + *P. fluorescence*) significantly enhanced the growth (plant shoot and root length), biomass (fresh and dry weight of shoot and root) and

Among the different bio-control agents used, combination of *T. viride* + *P. fluorescence* proved best in enhancing growth i.e. plant height (47.66 cm shoot and 12.8 cm root), biomass i.e. fresh weight (shoot 15.66g and root 0.74g) and dry weight (shoot 2.41g and root 0.16g). Growth of tomato was obtained with four different *Trichoderma* concentrations as treatments, viz., T1, 100

g/m²; T2, 200 g/m² and T3, 300 g/m² and was conducted in randomized completely block design (RCBD) with four replications (Uddin, 2015) Significant increase were recorded in germination percentage, root length, shoots length, fresh weight, dry weight of root and shoot, plant height, leaf area, by the use of brassinolide up to 1.5 ppm concentration (Bagdi *et al.*, 2017) (Table 1).

Table.1 Commercial biocontrol formulations used for control of plant diseases

Product	Biocontrol	Disease/target pathogens	Crop	Formulation	Application	Manufacture distributor
Blight ban A 506	<i>Pseudomonas fluorescens</i> A506	<i>Erwinia amylovora</i> and russet inducing bacteria	Almond, cherry, apple	Wettable powder	Spray at the time of blooming and fruiting	Nu farms LIC, Longwood, FL, USA
Cedomon	<i>Pseudomonas chlororaphis</i>	Leaf stripe, net blotch, <i>Fusarium</i> sp, spot blotch, leaf spot etc.	Barley and oat	Seed treatment	Seed dressing	Bio Agri AM, Uppsala, Sweden
Campanian	<i>Bacillus subtilis</i> GBo3, <i>B. licheniformis</i>	<i>Rhizoctonia</i> , <i>Pythium</i> , <i>fusarium</i> and <i>Phytophthora</i>	Green house and nursery	Liquid	Drench and spray	Growth products, white plains, Ny, USA
Primastop	<i>Gliocladium catenulatum</i>	Soil borne pathogens causing rots and wilt	ornamental vegetables and orchard crop	Powder	Drench spray or through irrigation system	Ag Bio development Inc., Westminster CO, USA
Rootsheild	<i>Trichoderma harzianum</i> Stain KRL	<i>Rhizoctonia, solani</i> , <i>Pythium</i> , <i>Fusarium</i>	Tree shrub ornamental vegetables	Granules or vegetable powder	Soil application as granules or drench	Biowors Inc., Genea, NY, USA
Bioject	<i>Pseudomonas aureofaciens</i>	Dollar spot, anthracnose, <i>pythium aphanidermatum</i>	Turf and others	Liquid	Overhead irrigation	Eco soil system san Diego, CA USA
Soil Gard	<i>Gliocladium virens</i> GL-21	Damping off and rot rot pathogen	Ornamental and food crop	Granules	Soil application	Certis Inc., Colombia MD, USA
Biosave	<i>Pseudomonas syringae</i>	<i>Botrytis</i> spp. <i>Penicillium</i> , <i>Mucor pyriformis</i>	Citrus, Pome Fruit, Cherries,	Lyophilized product, frozen cell pellets	Fruit tree drench, drip or spray	Village farm LLC, Longwood, FL, USA

Source: Plant Pathology an overview

Yield and yield attributes

In the Philippines, absolute grain yield of rice increases due to biofertilizer (*Azospirillum*, *Trichoderma*, or Rhizobacteria) usually below 0.5 t/ha, corresponding to an estimated additional N uptake of less than 7.5 kg N/ha but the best effects on grain yield were achieved at low to medium fertilizer rates. Nevertheless, positive effects of the biofertilizers even occurred at grain yields up to 5 t/ha. Bio-control agents (*Trichoderma viride*, *Pseudomonas fluorescence* and combination of *T. viride* + *P. fluorescence*) significantly yield of crop (pod number, pod fresh weight and weight of 100 grain without and with shell). yield i.e. number of pods/plant was 30, pod fresh weight was 3.06g and weight of 100 grains with shell (10.7g) and without shell (7.03g).

This was followed by *Trichoderma viride* and *Pseudomonas fluorescence*. Highest yield per plant of tomato (3.0 kg) obtained in T1 (100 g/m²) treatment and lowest (1.4 kg) was in control. Results also revealed that T1 (87.1%) showed the higher seedling survival rate (Uddin, 2015). Significant increase in number of spikes, length of spike per plant, number of seeds per spike, chlorophyll, relative water content, cell membrane stability, protein content and grain yield with increase in proline and carotenoid content up to 8 dSm⁻¹ by the use of brassinolide up to 1.5 ppm concentration (bagdi *et al.*, 2017).

Plant content

Chlorophyll content was extracted from lentil leaves treated with bio control agent by using dimethyl sulfoxide (DMSO) and acetone. Concentration of chlorophyll a and b was calculated using Arnon method. Chlorophyll content was higher in leaves treated with bio control agent over control (kumari *et al.*, 2018).

Synthetic fertilizer is no more efficient for sustainable production due to their indiscriminate use and Increasing cost, so there is a need of application of ecofriendly, economically viable agricultural practice such as biological control agent for enhancing maximum productivity to feed increasing population in sustainable way with better soil health. Biocontrol agent could open the door of sustainable agricultural as it improves physico-chemical and biological properties of the soil with higher yield of plants in sustained basis without deleting the fertility of soil.

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