Popular Article

Popular Kheti

Volume -2, Issue-3 (July-September), 2014

Available online at www.popularkheti.info

ISSN: 2321-0001

Trichoderma- A Potential Bioagent in Plant Disease Management

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Plant diseases are one of the important factors that impart a direct impact on global agricultural productivity. In disease management, the judicious use of pesticides had rifted negative impact on environmental quality and elevated many pathogens to become resistant to these pesticides. *Trichoderma* plays a crucial role in biocontrol management of cereals, pulse, oilseed, fruit, vegetable and spice crops diseases by producing various type of antagonistic compound which reduces the growth and infection caused by pathogens by different mechanisms like competition, antibiosis, mycoparasitism, hyphal interactions, and enzyme secretion when employ through seed and soil treatments.

Introduction

Green revolution has escalated of agriculture crops production to rally in the world due to increasing demands for food and fiber globally. However, due to this degradation of land due to change in land use pattern and employing two and three crop rotation every year land quality has deteriorated and yield has suffered.Plant diseases are one of the important factors that impart a direct impact on global agricultural productivity.Ifpost-harvest spoilage coupled with deterioration in quality are combined these losses with,endorse losses that are endemic particularly for resource poor regions globally. Further, plant diseases are estimated to cause yield reduction of almost 20% in the principal food and cash crops globally. Relics of past thirty five years, effective management of plant diseases are one of the major concerns in cultivation worldwide.Emphasis has been laid upon to control diseases to ensure a steady and constant supply of marketable produce for the ever increasing world population. In disease management, the judicious use of pesticides had rifted negative impact on environmental quality and elevated many pathogens to becomeresistant to thesepesticides. Therefore, an alternative approach like biocontrol agents (*Trichoderma spp.*) has been used as a mycoparasitisim against a wide range of plant pathogens and management of different crop diseases.

Trichoderma promotes plant growth by solubilizing of phosphates and micronutrients and increasing ability of drought resistance. It also produces biochemical elicitors' compounds which induce ethylene production, hypersensitive responses and other defense related reactions in plant

cultivars which induces disease resistance *endochitinase* gene from *Trichoderma* are introduced into plants to elevate resistance against phytopathogenic fungi. *Trichoderma* strains play an important role in the bioremediation of soil that are contaminated with pesticides and also the potential to degrade a wide range of insecticides viz., organochlorines, organophosphates and carbonates. *Trichoderma* plays a crucial role in biocontrol management of cereals, pulse, oilseed, fruit, vegetable and spices crops diseases by producing various type of antagonistic compound which reduces the growth and infection caused by pathogens by different mechanisms like competition, antibiosis, mycoparasitism, hyphal interactions, and enzyme secretion.

Use of *Trichoderma spp.* as a potential biocontrol agent

Cereal crops: Rice, wheat, maize are widely cultivated cereals crop in the world, and their production is constrained due to various endemic, epidemic and pandemic fungal, bacterial and viral diseases. This cereal crops suffers from several seed, soiland foliar diseases that have devastating effect on crop yield and food quality. The unleashed potential of *Trichoderma spp*. is effective against different cereal crops pathogens. The combination of *T. harzianum* and *Pseudomonas fluorescens* are effective against brown leaf spot disease of paddy and with FYM is supporting maximum growth against fungus. For instance, 10g of *Trichoderma* formulation mixed with cow dung slurry when used as seed treatment viz. 1kg of seed, before sowing was found effective in management of all disease of cereal crops. Likewise, seed treatment alone or in combination with other bioagents like *T. viride, T. harzianum, P. fluorescence* and fungicide vitavax was found successful in combating loose smut of wheat and increased the yield. *Trichoderma spp.* when used with other biopesticides enhanced seed germination in various crops.

Pulse crops: Mungbean, chickpea, cowpea, pea and pigeonpea are the important pulse crops gaining importance globally in the present day scenario. In India chickpea is most popular pulse crop grown in large scale. It is frequently infected by several diseases like, wilt caused by *Fusarium oxysporum f. sp. ciceri,* and stem rot caused by *Sclerotinia sclerotiorum* and damping off caused by *Rhizoctoniasolani*. Likewise, in mungbean dry root rot caused by *Macrophomina phaseolina, and R. solani* causing web blight in mungbean. Other pathogens that infect mungbean are *Sclerotium rolfsii, Alternaria alternata, F. solani and Colletotrichum capsici.* When formulation of *Trichoderma spp* mixed with farmyard manure in a polythene bag and leaving it in sealed condition for about a span of seven days, the resultant powder was found effective against all the fungal pathogens proving that *Trichoderma* have potential to suppress all the fungal pathogens of pulse crops.

Oilseed crops: Mustard, soybean, groundnut, linseed, sesame and sunflower are important oil seed crops grown in India and elsewhere. These crops are infected by several pathogens that not only reduce the yield of crops but alsodeteriorate theoil quality. In mustard *Alternaria brassicae,* causes blight disease that is effectively managed by *Trichoderma harzianum,* similar is the trend with soybean infected by seedling rot complex caused by *R. solani* and is controlled by same spp. *Trichoderma species* are renowned for their antagonistic effect and inhibiting growth of several oilseed borne fungi like, *Aspergillus flavus, Alternaria alternata, Curvularia lunata,*

Fusarium moniliforme, Fusarium oxysporum, Rhizopus nigricans, Penicillium notatum and Penicillium chrysogenum, Phaeoisriopis arichidicola, Phaeoisriopis personata, Puccinia arichidis, A. niger, S. rolfsii , M. phaseolina.

Cash crops: Sugarcane, Tea, Coffee, Tobacco, Saffron, are important cash, commercial and beverage crops that are growing many developing and developed countries. These crop are enticed to be attacked by several important plant pathogens viz, *Colletotrichum falcatum, Sporisorium scitamineum,* of sugarcane *Phomopsis theae, Glomerella cingulata,* of tea, *R. solani, M. phaseolina* of coffee, *F. oxysporum f. sp. nicotianae, Pythium spp. and R. solani* and the root-knot nematode of tobacco,corm rot of saffron are the most destructive diseases that are effectively managed by using of potential species of *Trichoderma.*

Fibre crops: Jute, mesta, cotton, flax are commercial and valuable crop that is providing employment and generates revenue worldwide. These crops also infected by several destructive diseases that reduce the fibre quality. Jute isinfected by stem rot fungi *M. phaseolina,* whereas, mesta, by foot and stem rot caused by *Phytopthora parasitica var, sabdariffa*. In cotton, wilt disease caused by *Fusarium vasinfectum,* root rot caused by *R. bataticola,* anthracnose caused by *Collectotricum gossypium, Alternaria* leaf spot, bacterial blight and damping off caused by *Pythium ultimum* are important diseases. When *Trichoderma* applied through the seed &soil application,are best in controlling seedling blight, collor rot, stem rot and root rot disease of cotton.

Spice crops: Ginger, cumin, black pepper, cardamom are important spices growing almost in all state. These spices are attacked by various pathogens. In ginger rhizome rot caused by *Pythium aphanidermatum,* bacterial wilt *Ralstonia solanacearum,* and yellows caused by *F.o.f. sp. zingiberi,* are the major diseases affecting the seed rhizomes and incurring significant yield losses. While, in cumin wilt disease caused by *F. oxysporum f. sp. cumini* is one of the major diseases of the crop. In black pepper, foot rot caused by *Phytophthora capsici* is one of the serious diseases. The above said diseases are effectively managed by *Trichoderma spp*. when it is used with seed and soil application.

Vegetable crops: Combination of *Trichoderma spp*. and *P. fluorescens* when used with seed and root application, was found effective in management of diseases like late blight caused by *P. infestans,* early blight caused by *A. solani,* wilt caused by *F. oxysporumf. sp. lycopersici,* damping off caused by *P. aphanidermatum,* collar rot caused by *S. rolfsii,* bacterial leaf spot by *Xanthomonas campestris pv. vesicatoria,* and bacterial wilt by *Ralstonia solanacearum* of tomato, brinjal and capsicum. Applying a multicomponent formulation consisting of a number of species of *Trichodermaviz, T. harzianum, T. polysporum, T. virens and T. viride* not only reduced the disease incidence but also increased theyield of vegetable crops.

Fruit crops: Mango is leading fruit in India. It suffers from great economic loss due to many pathogens like *F. moniliforme var. subglutinans* causing mango malformation, *R. solani and S. rolfsii.* guava isinfected by some pre-harvest diseases like, die back, decline, affect the plant growth and production, while post-harvest diseases such as *Phytophthora, Macrophomina* and

several other fungithat spoil the fruits in field, storage and in transit. These pathogens are effectively controlled by using *Trichoderma spp* as antagonistic fungi.

Conclusion

Though *Trichoderma spp.* has been proved successful in combatting several phytopathogens in cereal, pulses, oilseeds, vegetable, commercial and horticultural crops still many new strains are to be explored from different sources for an effective management of new races of pathogens that are evolving in the present agricultural scenario. Another avenue of futuristic research relies on exploiting native strains of *Trichoderma spp*. of a particular geographic location against pathogenic fungi of other location. Research pertaining to transgenic *Trichoderma* is still at infancy, the potential of this transgenic *Trichoderma*under field condition is still questionable or wanting.