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Interdisciplinary Approach Mechanism of Biopesticides: Solution of *Trichoderma* in Agriculture Crops

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Abstract

Biopesticides solutions to many of the persistent problems in agriculture including problems of health hazards environmental pollution, residual effects, resurgence of pests and phytopathogens, seed borne pathogens, soil borne pathogens over reliance on pesticides / fungicides resource limitations etc. Interest in biological control of plant pathogens has been stimulated in recent years by trends in agriculture to- wards greater sustainability and public concern about the use of hazardous pesticides. The basic aim of the work was to assess the indigenous potential of bio-agents and their antagonistic potential against seed borne and soil borne & plant pathogens viz: *Aspergillus flavus, Aspergillus niger, Aspergillus ustus, Aspergillus fumigatus, Aspergillus nidulans, Aspergillus terrus, Alternaria tenuis, Fusarium oxysporium, Fusarium moniliforme, Fusarium semitectum, Macrophomina phaseolina, Penicillum citrinum, Sclerotium rolfsii, Cephalosporium acromonium, Rhizoctonia solani, Rhizoctonia bataticola, Rhizopus nigricans, Alternaria alternate, Curvularia lunata, Fusarium oxysporium f. sp. udum, Fusarium solani, Cladosporium herbarum, Drechslera longirostrata, Rhizoctonia solani, Pythium spp. Phytophthora digitatum, & infestans, Verticillium, Sclerotinia, Armillaria, Botrytis.*

Key Words: *Trichoderma*, Soil borne, Seed borne pathogens and agriculture crops

Introduction

Trichoderma spp. are fungi that are present in nearly all soils and other diverse habitats. In soil, they frequently are the most prevalent culturable fungi. They are favored by the presence of high levels of plant roots, which they colonize readily. Some strains are highly rhizosphere competent, i.e., able to colonize and grow on roots as they develop. The most strongly rhizosphere competent strains can be added to soil or seeds by any method. Once they come into contact with roots, they colonize the root surface or cortex, depending on the strain. Thus, if added as a seed treatment, the best strains will colonize root surfaces even when roots a meter or more below the soil surface and they can persist at useful numbers up to 18 months after application. **Anand** and **Jayarama (2009).** observed biocontrol potential of *Trichoderma spp.* against plant pathogens. However, most strains lack this ability. *Trichoderma sp.*, are free-living fungi that are common in soil and root ecosystems. *Trichoderma spp.* has proved to be useful in the control of phytopathogens affecting different crops. (**Guo et. al. 2004 & Soytong et . al. 2005).** Also, tomato plants treated by *Trichoderma spp*. have shown biocontrol activity against damping-off and root rot disease and gave high yield

of tomato. (**Morsy 2008 & Zaghloul et al. 2007)**. Damping-off disease caused by *Fusarium oxysporum* is strongly affects tomato yield. (**Li Jin-hua et. al. 2007 & Sun X-j et. al. 2008).** They are highly interactive in root, soil and foliar environments. *Trichoderma* strains have no sexual stage but instead produce only asexual spores. However, for a few strains the sexual stage is known, but not among strains that have usually been considered for bio control purposes.

In the United States, the Environmental Protection Agency (EPA) is responsible for regulating pesticides under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and the Food Quality Protection Act (FQPA)– Studies must be conducted to establish the conditions in which the material is safe to use and the effectiveness against the intended pest(s)The EPA regulates pesticides to ensure that these products do not pose adverse effects to humans or the environment. Pesticides produced before November 1984 continues to be reassessed in order to meet the current scientific and regulatory standards. All registered pesticides are reviewed every 15 years to ensure they meet the proper standards. During the registration process, a label is created. The label contains directions for proper use of the material in addition to safety restrictions. Based on acute toxicity, pesticides are assigned to a Toxicity Class. Some pesticides are considered too hazardous for sale to the general public and are designated restricted use pesticides. Only certified applicators, which have passed an exam, may purchase or supervise the application of restricted use pesticides. Records of sales and use are required to be maintained and may be audited by government agencies charged with the enforcement of pesticide regulations. These records must be made available to employees and state or territorial environmental regulatory agencies. Many researchers have demonstrated the potential of *Trichoderma spp*. in controlling damping-off and wilt diseases of crop plants caused by *Rhizoctonia solani* and *Fusarium spp.* **(Dubey et al., 2007 and Rojo et al., 2007).**

Colonies, at first transparent on media such as potato dextrose agar PDA). Mycelium typically not obvious on CMD, conidia typically forming within one week in compact or loose tufts in shades of green or yellow or less frequently white. Yellow pigment may be secreted into the agar, especially on PDA. A characteristic sweet or 'coconut' odour is produced by some species. Conidiophores are highly branched and thus difficult to define or measure, loosely or compactly tufted, often formed in distinct concentric rings or borne along the scant aerial hyphae. Main branches of the conidiophores produce lateral side branches that may be paired or not, the longest branches distant from the tip and often phialides arising directly from the main axis near the tip. The branches may rebranch, with the secondary branches often paired and longest secondary branches being closest to the main axis. All primary and secondary branches arise at or near 90° with respect to the main axis.

Pure culture of *Trichoderma*

Trichoderma

Mechanism of *Trichoderma* –

"The reduction in the amount of inoculum or diseases producing activity of pathogen accomplished by or through or more organisms."

In recent years, the increasing information, on hazardous effect of pesticides on plant, seed and animal health, have alarmed the scientist to seek alternative methods, which should not cause pollution and should be non-phytotoxic. Biological control method is such a technique which involves disease control by some biological agents (living microorganism) or macro organism, other than disease causing organism, seed borne pathogens, soil borne pathogens and damaged plants (the hosts). Use of microbes as bio control agents, which minimize the application of hazardous chemicals, is the major thrust area in present day strategy for management of the pests, seed borne soil born Antagonist microorganisms, such as *Trichoderma*, reduces growth, survival or infections caused by pathogens by different mechanisms like competition, antibiosis, mycoparasitism, hyphal interactions, and enzyme secretion. **Etebarian H.R. (2006)** evaluated of *Trichoderma* isolates for Biological Control charcoal coal stem rot in Melon caused by *Macrophomia phaseolina*. **Eziashi (2007)** studied Antagonism of *Trichoderma viride* and effect of extracted water soluble compounds from *Trichoderma* species. Antagonist microorganisms, such as *Trichoderma*, reduce growth, survival or infections caused by pathogens by different mechanisms like competition, antibiosis, mycoparasitism, hyphal interactions, and enzyme secretion. **Rathod et al. (2012).** In vitro studies on the potential for Biological Control of *Aspergillus flavus, Fusarium oxysporium, Alternaria tenuis by Trichoderma* species. Competition: It is the phenomenon in which the pathogen and the introduced biocontrol agent (antagonist) compete for the availability of space and nutrients. During this process, the antagonist may suppress the growth of the pathogen population in the rhizosphere and thus reduce disease development. Antibiosis: *Trichoderma* strains are known to produce antibiotics and toxins, which are volatile or nonvolatile in nature, and have a direct effect on other organisms. Mycoparasitism: It is the phenomenon in which the antagonist fungi parasitize other fungi and plant diseases. **Rama et. al. (2000).** reported of *Trichoderma spp.* in the management of

collar rot of groundnut caused by *Aspergillus niger.*

Trichoderma is one of the bio agent used for management of different plant disease, seed borne and soil borne diseases. *Trichoderma* are common inhabitants of soil and other natural habitats containing organic matter. *Trichoderma spp*. are common inhabitants of almost every soil, seed borne and are antagonistic to other fungi. Several antibiotics such as *gliotoxin, glycodin, viridin, trichodermin* and *trichonitrin, trichothecin ,* and *sesquiterpine, c*ell wall – degrading enzymes, and biologically - active heat stable metabolities like acetate. These substances are involved in the suppression of disease as well as the promotion of plant growth.

At present *Trichoderma* is the most common and widely used biocontrol agent of plant diseases. Research on the inhibitory effects of *Trichoderma* has resulted in the manufacture of TRICHODEX a commercially – successful fungicide the builds its foundation on the antagonistic capabilities of *Trichoderma Trichoderma spp.* are common inhabitants of almost every soil and are antagonistic to other fungi. Through the action or phenomenon of antibiosis (production of volatile and non-volatile antibiotics) and mycoparasitism (parasitizing other fungi), *Trichoderma spp.* suppress/ destroy /lyse the phytopathogenic soil borne (rhizpsphere) seed borne as well as foliage (phyllosphere) fungi. *Trichoderma spp.* has been reported as most potent antagonists and mycoparasites of the pathogenic fungi such as *Aspergillus flavus, Aspergillus niger, Aspergillus ustus, Aspergillus fumigatus, Aspergillus nidulans, Aspergillus terrus, Alternaria tenuis, Fusarium oxysporium, Fusarium moniliforme, Fusarium semitectum, Macrophomina phsaseolina, Penicillum citrinum, Sclerotium rolfsii, Cephalosporium acromonium, Rhizoctonia solani, Rhizoctonia bataticola, Rhizopus nigricans, Alternaria alternate, Curvularia lunata, Fusarium oxysporium f. sp. udum, Fusarium solani, Cladosporium herbarum, Drechslera longirostrata, Rhizoctonia solani, Pythium spp. Phytophthora digitatum, & infestans, Verticillium, Sclerotinia, Armillaria, Botrytis.*

Recommended for:

Trichoderma is most useful for all types of plants such as Groundnut (*Arachis hypogea)*, Gram (*Cicer arietinum*), Pigeon pea (*Cajanus cajan*), Green gram (*Vigna radiate*), Green gram (*Vigna radiate*), Soybean (Glycine max), Cauliflower, Cotton, Sugarcane, Sugarbeet, Banana, Tomato, Potato, Citrus, Onion, Sunflower, Brinjal, Coffee, Tea, Rice, Jowar, Ginger, Turmeric, Pepper and Cardamon.

Infected tomato fruit

After treatment of *Trichoderma* on Tomato

Late blight of potato caused by *Phytopthora infestans*

After treatment of *Trichoderma* on Potato

Potential Advantage of *Trichoderma:*

1. It is most important advantage to the use of biological control is that it typically offers longer term management than the more traditional technology area.
2. It is target specific and safely to wildlife, human, non-target organisms and environmentally friendly.
3. It is easy to produce in mass compared to other bio insecticides.
4. Protect the interest of environmentalists, manufactures, grower and consumers.
5. Decrease disease intensity leading to higher production.
6. Reduce the use of chemical fungicides and hematicides.
7. Safe for the user and the farming community.
8. Environmentally degradation is eliminated.
9. Biodiversity is preserved and natural habitat is maintained in a hospitable manner.
10. Protect host plants and gear-up their resistance potential.
11. Huge investment on chemical industry and energy is reduced.
12. Most effective tools for the management of soil/seed borne diseases.
13. Avoid/ eliminates residual toxicity effects of the pesticides.
14. Can play a key role in integrated management of crop diseases.

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