Popular Article

Popular Kheti
Volume -3, Issue-3 (July-September), 2015
Available online at www.popularkheti.info

ISSN: 2321-0001

Trichoderma: An Effective Biocontrol Agent Against Soil Borne Pathogens

Mukesh Srivastava, Sonika Pandey*, Mohammad Shahid, Vipul Kumar, Anuradha Singh, Shubha Trivedi, Manok Kumar Maurya and Y. K. Srivastava
Chandra Shekhar Azad University of Agriculture & Technology, Kanpur – 208 002, Uttar Pradesh, India
***Email of corresponding author: sonica.dey@gmail.com**

The effect of *Trichoderma* on soil borne pathogens is higher as compared to chemical fertilizers and it persists in soil for longer period after application. *Trichoderma* species are well known for the production of cell wall degrading enzymes. These CWDEs play a major role in biocontrol mechanism. They are also widely exploited in industries as sources of enzymes. Use of biocontrol agents for reducing disease incidences provides an alternative for the chemical pesticides.

Introduction

Biocontrol activity of *Trichoderma* is known since 1930s. Use of biological pesticides is continuously increasing due to public concerns about environmental pollution, human health and soil fertility. Biological pesticides are served as an alternative to chemical pesticides. Farmers generally use chemical pesticides to control plant diseases, these chemical pesticides imparts a bad impact on environment. In Europe around 250k tones of biopesticides is consumed annually. There are Two types of biocontrol agents generalists (These biocntrol agents are capable of controlling a large number of taxonomically different pathogens e.g.*Bacillus, Pseudomonas, Trichoderma*, yeast etc) and Specialist (These biocontrol agents are capable of controlling only targeted species e.g. *Agrobacterium, Aspergillus* etc).

Trichoderma species are the most commonly used biocontrol agents. The are commercially marketed as biopesticides, biofertilizers and growth enhancers. The various mycoparasitism mechanism employed by *Trichoderma* are, competition for food and space, secretion of cell wall degrading enzymes, secondary metabolite production, host immune response induction and plant growth promotion. *Trichoderma* based bioformulation are used in greenhouse, nursery, field, orchards and hydrophonics.*Trichoderma* based bioformulations are used for crop protection in whole world. *Trichoderma* species that are most commonly used for biocontrol are: *T.harzianum, T. atroviride, T. asperellum, T. polysporum, T. viride,*
Trichoderma species are also known for their biodegradation capability. *Trichoderma* species have the capability of degrading toxic compounds.

Trichoderma is highly effective on root rot, foot rot, collar rot, atem rot, damping off, wilt, blight leaf spot of crops like pulses oil seeds, *cucurbitaceous* crops (cucumber, bottle gourds, ridge gourd) *solanacceuos* crops like tomato, brinjal, chilli, capsicum etc. *Trichoderma* are also effective against sheath rot, sheath blight and bacterial leaf blight of rice.

The positive effects of *Trichoderma* on agriculture crop protection have been recognized in the whole world. Our understanding of the mechanisms of biological control employed by *Trichoderma* is continuously expanding. The molecular mechanisms of the interaction of this fungus with phytopathogen can be understood through the modern molecular techniques. The genetic diversity within the genus *Trichoderma* is very high, thus there must be some technique through which we can identify the *Trichoderma* species. The necessary characters which should be present in an effective biococntrol agent are: Good lyric enzyme producer, increased plant systemic resistytance, plant growth enhancer, God secondary metabolite production, pollutant degradation, good CFU maintenance in formulation. By gaining the knowledge of desirable characters new strains can be designed and developed. In case of Trichoderma Protoplast fusion is the technique through which we can develop hybrid strains.

Trichoderma is an excellent producer of lytic enzymes like chitinase, glucanase, cellulase and xylanase, which lyase the fungal cell wall. Besides being attacking directly it promotes plant growth and induces plant resistance. *Trichoderma* species produce a variety of secondary metabolites. The *Trichoderma* species release antibiotics and other chemicals that are harmful to pathogens and inhibit growth (antibiosis). The potential use of the *Trichoderma* species as a biocontrol agent was suggested more than 70 years ago. There are many other crops for which *Trichoderma* is used.

Table: 1 *Trichoderma* species and its uses against different plant pathogens.

Plant	Causative Agent	*Trichoderma* Spp used
Vigna mungo (Black gram)	*Macrophomina phaseolina*, Alternaria alternata	*T. viride, T. harzianum*
Solanum melongena L. (Brinjal)	*Fusarium solani F. oxysporum f. sp*	*T. viride, T. harzianum*
Cicer arietinum (Chickpea)	*F. oxysporum, R. solani A. niger Chaetomium sp S. rolfsii,* Penicillum spp *M. phaseolina*	*T. harzianum, T. viride*
Capsicum annum L (Chili),	*S. rolfsii, F. oxysporum, Pythium spp, R. solani pseudokoningii 2013*	*T. viride, T. harzianum*
Cocos nucifera L (Coconut)	*Ganoderma lucidum*	*T. harzianum, T. viride*
Coffea arabica L. (Coffee)	*Phomopsis thaeae, Glomerella cingulata*	*T. harzianum*
Vigna sinensis (Cowpea)	*R. solani*	*T. harzianum*
Arachis hypogaea L.(Groundnut)	*Thievaliopsis basicola, S. rolfsii Sacc, A. niger, R. solani, P aphanidermatum, M. phaseolina*	*T. harzianum T. viride T longibrachiatum*
Agaricus bisporus (Mushroom)	*Rhizopus stolonifer, Coprinopsis kimurae, P. glabrum, F. oxysporum*	*T. viride*
Cajanus cajan (Pigeon pea)	*F. udum*	*T. viride T. harzianum*
Solanum lycopersicum (Tomato)	*F. oxysporum f. sp. lycopersici, P. aphanidermatum, R. solani, S. rolfsii*	*T. harzianum T. viride T longibrachiatum, T. virens*
Capsicum annum L (Capsicum)	*Alternaria alternata*	*T. viride T. harzianum*
Brassica oleracea (Cauliflowe)	*R. solani, P. aphanidermatum*	*T. viride T. harzianum*
Citrus	*F. solani*	*T. viride T. harzianum*
Gossypium hirsutum (Cotton)	*R. solani, S. rolfsii, P. aphanidermatum*	*T. viride T. harzianum*
Zingiber officinale (Ginger)	*P. aphanidermatum*	*T. harzianum*
Sesamum indicum L (Sesame)	*A. flavus, Curvularia lunata, P. notatum, P. chrysogenum, F. moniliforme, F. oxysporium , R. nigricans, M. phaseolina*	*T. viride T. harzianum*

Trichoderma and Phytopathogen Control

Use of *Trichoderma* as a biocontrol agent for the control of phytopathogen is a environmental friendly process. However more detailed information about the mechanism of action of this biological agent is needed. When *Rhizoctonia* come in contact with *Trichoderma harzianum*, hyphae of the *T. harzianum* start to coil around *Rhizoctonia*. It has been found that there are some lectins, secreted by *Rhizocotonia*, *Sclerotium* and other phytopathogenic fungi which stimulates *Trichoderma* to coil around pathogen hyphae. *Trichoderma* species secrete extracellular enzymes that aid in the phytopathogenic activity. A strain of *Trichoderma*, *T. lignorum* secretes gliotoxin that is harmful for both *R. soleni* and *Sclerotium* americana. It has been found that chitinolytic system of *Trichoderma* has six different enzymes two of which are classified as acetyl glucosamine and the rest four as endochitinase.

Mechanisms of plant-disease control by _Trichoderma_

When *Trichoderma* spores are added into the soil they colonize the root surface and form a zone of interaction into which *Trichoderma* Strains release bioactive compounds. These bioactive compounds enhance plant resistance. The *Trichoderma* species produce CWDEs that degrade the cell wall of pathogen, it also produces antibiotics, and it starts coiling around the pathogen hyphae.

In recent times excessive use of chemical pesticides has pose a threat on the environment. *Trichoderma* based biocontrol agents have better ability to promote plant defense response, promote plant growth and soil remediation etc. *Trichoderma* spp has gained wide acceptance as effective biocontrol agents against several commercial phytopathogens. Micropropagules of *Trichoderma* spp. in the form of conidia are preferred over chlamydospores and mycelia biomass because of the viability and stability in field application.

Benefits of _Trichoderma_

- *Trichoderma* is extensively used for post harvest disease control. It has been found effective against Fusarium, *Phytopthara, and Scelerotia* etc.
- *Trichoderma* strains have the ability to solubilize phosphates, thus they act as Plant Growth Promoting Rhizobacteria.
- There are many biocontrol genes are present in *Trichoderma*. Introduction of endochitinase gene from *Trichoderma* into plants such as tobacco and potato plants have increased their resistance to fungal growth.
- *Trichoderma* strains also play an important role in the bioremediation of soil that are contaminated with pesticides and herbicides. They have the ability to degrade a wide range of insecticides, organo chlorines, organophosphates and carbonates.
- *Trichoderma* is environmentally friendly.
- *Trichoderma* species are efficient producer of cellulase and other enzymes that degrade complex polysacchharides. Cellulase from *Trichoderma* is used for the biostoning of denims, to give it a stone washed appearance.
- *Trichoderma* is compatible with organic manures and with other biofertilizers like *Rhizobium, Azospirilium, Bacillus subtilis* etc. It can be easily applied to seeds treated with metalaxyl and thiram but not with mercurially.

Limitations

1. We should not apply chemical fungicides after application of *Trichoderma* for 4-5 days.
2. *Trichoderma* should not be used in dry fields, as it requires moisture for its survival.
3. Seeds treated with *Trichoderma* should not be dry in direct sunlight**.**

Conclusion

Trichoderma is a promising candidate for the biological control of plant pathogenic fungi. Data obtained from the past studies have provided many clues for the future studies. Data obtained by researchers clearly shows that this fungus can be efficiently used as biocontrol agent. The genes present in the fungi have the ability to enhance host plant's resistance against phytopathogenic fungi.