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Potential Benefits of *Trichoderma* Based Products and It's Disease Management

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Abstract

Trichoderma have long been recognized as the agents for the control of plant diseases and for their ability to promote plant growth and development. There are several general methods for both bio-control and plant growth. Among them Mycoparasitism, Antibiosis and Competition are the main features that *Trichoderma* perform. During these mechanisms there will be secretion of Secondary metabolites and antibiotics. For formulation of *Trichoderma*; it should possess many important characteristic features for easy application, storage, commercialization and field use. There are many organic substrates that we use for the mass multiplication of *Trichoderma*. Vermiculite- wheat bran-based formulation, oil-based formulation and banana waste-based formulation are some examples that we need to perform for field application.

Introduction

Trichoderma is a soil fungi. It was firstly reported as biocontrol agent by Weindling (1932). Currently there are 89 accepted species in the genus *Trichoderma*. They are very fast growing fungi; that form symbiotic relationships with plant roots making them ideal for fungicidal use in agriculture. They are favored by the presence of high levels of plant roots; which they colonize readily. Some strains are highly rhizospheric competent, *i.e.*, able to colonize and grow on roots as they develop. Except colonizing root; they also attack parasite and also gain nutrition from other fungi.

Figure 1: *Trichoderma* culture on PDA media

Life Cycle

They grow and form branches/ offshoots; as - typical fungal hyphae, 5-10 micrometer in diameter. Asexual sporulation occurs as single celled, usually green conidia

(typically 3-5 micrometer in diameter) that are released in large numbers. Intercalary resting chlamydospores are also formed, these also are single celled, although 2 or more chlamydospores may be fused together.

Reproduction

Most *Trichoderma* strains have no sexual stage but they produce only asexual spores. Most strains are highly adapted to an asexual life cycle. In the absence of meiosis, chromosome plasticity is the normal and different strains have different numbers and sizes of chromosome. Most cells have numerous nuclei, with some vegetative cells processing more than 100. Various asexual genetic factors, such as parasexual recombination, mutation and other processes contribute to variations between nuclei in a single organism (thallus). So, the fungi are highly adaptive and evolve rapidly. There are also wild strains - they are highly adaptable and heterokaryotic (contain nuclei of dissimilar genotype within a single organism); hence highly variable. Strains used for bio-control in commercial agriculture are - or should be, homokaryotic (nuclei are all genetically similar/ identical).

Mode of Action

Trichoderma spp. have the ability to behave as bio-control agents. They perform some mode of actions to control fungicides and other hosts. They secrete cell wall degrading enzymes for the cell wall lysis of the host and also secondary metabolites which help them to compete with other macroorganisms.

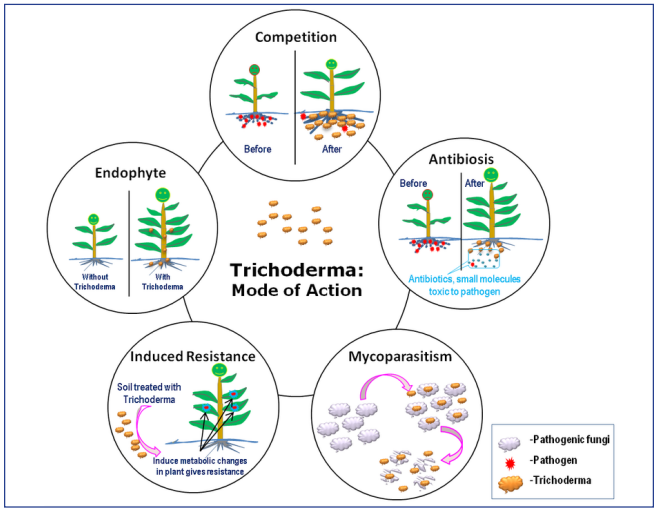

Figure 2: Model depicting mode of Action of *Trichoderma* spp. against pathogenic plant growth improvement

Mycoparasitism

It consists of a process of recognizing the host and attacking it; followed by penetrating and killing the host. *Trichoderma* produces cell wall degrading enzymes like cellulases, chitinases, glucanases and pectinases which degrade the cell wall of the host.

Antibiosis

Trichoderma produces many antibiotics and toxins which have a direct effect on other pathogenic organism and the compounds help the organism to compete with other macro-organisms, symbiosis, metal transport, differentiation *etc*. Such as - Trichothecine, Viridin, Trichodermin, Trichodermal.

Competition

It is the most important mechanism that prevents infection from pathogen. As malnourishment is the objective of death of every living organism; so *via* this mechanism *Trichoderma* and pathogen compete for limited nutrient and space availability. *Trichoderma* grows vigorously and uptake nutrients rapidly when compared to that of the other host.

Example - interaction of *T. harzianum* acting against *Fusarium oxysporum* and *F. solani* and *F. roseum*.

Formulation of Trichoderma

To develop a successful *Trichoderma* formulation, *Trichoderma* should possess-

- High rhizosphere competence.
- Enhanced plant growth.
- Broad spectrum of action.
- Safe to environment.
- Compatible to other bio-agents.
- Ease for mass multiplication.
- High competitive saprophytic ability.

Formulation Development

Trichoderma could not be used as spore suspension under field condition; so it should be prepared as formulations for easy application, storage, commercialization and filed use. Characteristics of an ideal formulation are as follows.

- Should have increased shelf life.
- Should not be phytotoxic to the crop plants.
- Should dissolve well in water.
- Should be cost effective and should give reliable control of plant diseases.
- Should be compatible with other agrochemicals.

Mass Multiplication of Trichoderma

Vermiculite - Wheat Bran Based Formulation

Trichoderma is multiplied in molasses-yeast medium for 10 days. 100 g vermiculite and 33 g bran are sterilized in an oven at 70 °C. for 3 days. Then, 20 g of fermentor

biomass, 0.05 N medium and concentrated or entire biomass with HCl are added, then mixed well and dried in shade.

Oil Based Formulation

It can be prepared by mixing the conidia harvested from the solid state/ liquid state fermentation with a combination of vegetable/ mineral oils in stable emulsion formulation. The oils used should not have toxicity to the fungal spores, plants, humans and animals. Such formulations of *Trichoderma* is now being used as foliar sprays.

Banana Waste Based Formulation

The mass multiplication of *Trichoderma* spp. in Banana waste was proposed by Balasubramanian *et al*. (2008). A pit of different banana and core is chopped in the length of 5-8 cm. A pit is prepared and different ingredients are placed in five different layers. Each layer contains 1 ton banana waste, 5 kg urea, 125 kg rock phosphate and 1 L broth culture of *B. polymixa*, *P. sajor caju* and *T. viride*. Five different layers are prepared similarly. Banana waste is decomposed within 45 days and enriched culture is mass available for field application.

Uses

Trichoderma strains are used commercially in a variety of ways, including the following.

- Food and textiles.
- Biocontrol agents.
- Plant growth promotion.
- As a source of transgenes.
- Used as biofertilizers.
- Used as biostimulants.

Table 1: Different *Trichoderma* species effective against different plant disease causing pathogens

Trichoderma spp.	Crop	*Effectiveness against pathogens*
T. viride, T. koningii, T. harzianum	Rice	*Rhizoctonia solani, Fusarium* spp., *Alternaria alternaria*
T. longibrachiatum, T. harzianum	Tomato	*A. solani, Sclerotium rolfsii*
T. reesei, T. viride	Onion	*A. porri, A. alternaria, C. circinans*
T. hamatum, T. lignorum, T. viride	Wheat	*Ustiligo segatum, Tilletia indica*
T. harzianum	Maize	*Penicillium notatum, R. solani, A. alternaria*

Table 2: Some commercial products of *Trichoderma* spp. available in India

Product	Species/ Strain of *Trichoderma*
Ecofit	*Trichoderma viride*
Bip T	*Trichoderma viride*
Trichogourd	*Trichoderma viride*
Biocon	*Trichoderma viride*
Defense SF	*Trichoderma viride*

Applications (Delivering of Trichoderma for Disease Management)

Seed Treatment

Seed treatment or coating is the most effective method of application of *Trichoderma* into an agricultural system. *Trichoderma* is delivered in the surface of seed coat (infection coat) as protectant during planting. This method limits the growth of competitive micro-flora and provides conducive growth for the biocontrol agent.

Root Treatment

Seedling roots can be treated with spore or cell suspension of antagonists either by drenching the *Trichoderma* in nursery beds or by dipping roots in *Trichoderma* suspension before transplanting. This not only reduces disease severity but also enhances seedling growth in rice, tomato, brinjal, chili and capsicum. There are also reports on the reduction of sheath blight disease of rice by root dip of seedlings before transplantation.

Soil Treatment

Delivering of *Trichoderma* spp. to soil will suppress the establishment of pathogenic microbes on to the infection coat and will increase the population dynamics of augmented fungal antagonists. Soil application of *T. viride* either alone or in combination with other treatments reduces red rot caused by *C. falcatum*.

Wound Dressing

The liquid suspension of *Trichoderma* has been successfully applied to the aerial plant parts for the biocontrol. *T. harzianum* and *E. purpurascens* reduce the disease incidence in the field on spraying by 17.8% and 10% respectively. Sharma *et al.* (2012) carried out field trails in Rajasthan on the groundnut root rot disease caused by multiple pathogen complex mainly *A. niger*, *A. flavus*, *S. rolfsii*, *R. solani* by the application of *T. harzianum* in the form of powder and liquid bio-formulation and found it effective.

Conclusion

As *Trichoderma* is evidenced as a best pesticide to control diseases; so future research should focus on it's formulation in a good way. The biological control of plant diseases depends on it's effective formulation. Bio-agents cause no harm to environment but it promotes growth of the host plants. So, it is the best way to remove toxic chemicals or pathogens which may cause harm to human health and surrounding.

References

Balasubramanian, C., Udaysoorian, P., Prabhu, C., Kumar, G.S., 2008. Enriched compost for yield and quality enhancement in Sugarcane. *J. Ecobiol* 22, 173-176.

Sharma, P., Patel, A.N., Saini, M.K., Deep, S., 2012. Field demonstration of *Trichoderma harzianum* as a plant growth promoter in wheat (*Triticum aestivum* L). *J. Agric. Sci.* 4(8), 65-73.

Weindling, R., 1932. *Trichoderma lignorum* as a parasite of other soil fungi. *Phytopathology* 22, 837-845.