

# **Biofertilizers Practical**

## **BIOCONTROL**

*Trichoderma*

### **Photographs (Identification & Application)**

Presented by  
Dr. Rajwant Kaur

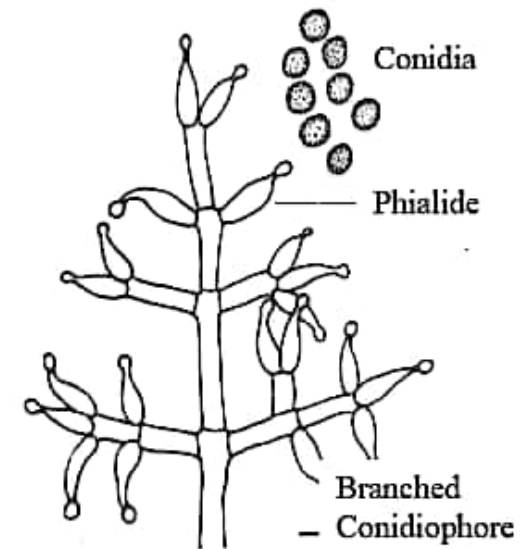
# *Trichoderma* – a biopesticide, a mycofungicide, and a hyperparasite



*Trichoderma harzianum*  
culture on Potato  
dextrose agar medium



*Trichoderma harzianum*

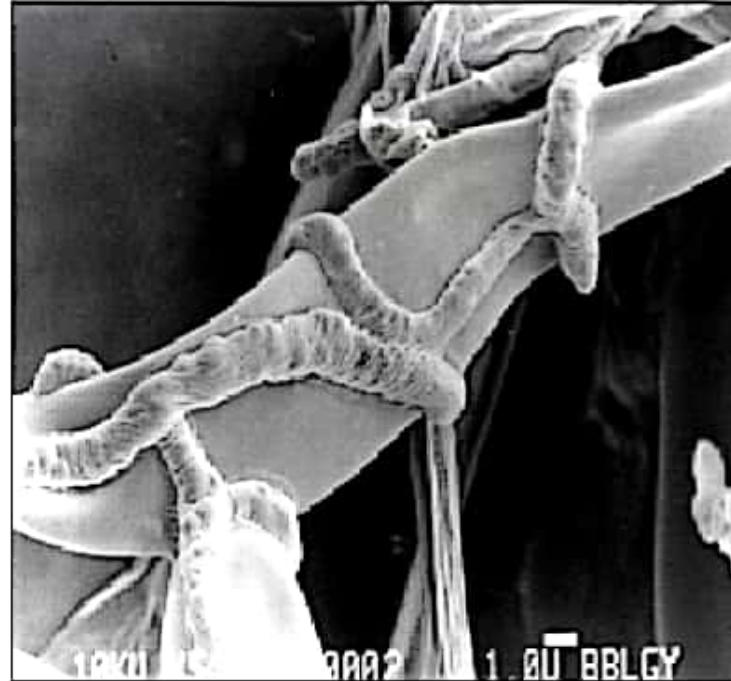


Diagrammatic sketch of  
*Trichoderma viride*  
conidiophore

# *Trichoderma* – a biopesticide, a mycofungicide, and a hyperparasite



Dual culture plate of *Sclerotium rolfsii* (phytopathogenic fungus) with *Trichoderma* species after 5th day of incubation shows a very well inhibition of *S. rolfsii* by *Trichoderma* species representing effective biological action over pathogens.



SEM micrograph showing coiling of *Trichoderma harzianum* over *Rhizoctonia solani*



*Trichoderma harzianum* product – a biopesticide, a mycofungicide



# Identification

## Taxonomic Classification

**Kingdom:** Fungi

**Division:** Ascomycota

**Class:** Sordariomycetes

**Order:** Hypocreales

**Family:** Hypocreaceae

**Genus:** *Trichoderma*

1. The genus *Trichoderma* Persoon (type species: *T. viride* Pers) is a large group of ascomycetous fungi that contains more than 250 species.
2. *Trichoderma* was initially identified as a deuteromycteous (fungi imperfecti) fungal genus. However, some *Trichoderma* species are morphologically similar to the anamorph *Hypocrea* (an ascomycetous genus) and their internal transcribed spacer (ITS) sequences have revealed their taxonomic proximity.
3. *Trichoderma* spp. are ubiquitous filamentous fungi, commonly found in habitats like soil and rotting wood. They are also found to colonize grains, leaves, and roots.
4. **Morphology:** *Trichoderma* species have rapid growth and abundant production of conidial spores as well as the capacity to produce sclerotia (dark resting body). The conidiophores are loosely or compactly tufted and often form concentric rings. Microscopically, a typical **conidiophore** is pyramidal with paired branches, terminating in one or a few **phialides**; and **conidia** are typically ellipsoidal or rarely globose, colourless to different shades of green or gray or brown tinges, depending upon species. Different *Trichoderma* spp. are identified using morphological, cultural approach, and molecular methods (e.g. TrichoBLAST). These include arrangement of conidiophores, phialides, and conidia, while cultural features include linear growth, colony color, growth pattern, and pigmentation of hyphae.

# Applications

1. *Trichoderma* is the most commonly used fungal biological control agent (BCA) and have long been known as effective **antagonists** against soil-borne plant pathogenic fungi, viz. *Fusarium oxysporum*, *Rhizoctonia solani*, *Pythium aphanidermatum*, *Fusarium culmorum*, *Gaeumannomyces graminis var. tritici*, *Sclerotium rolfsii*, *Phytophthora cactorum*, *Botrytis cinerea* and *Alternaria* species.
2. The most common BCAs of the *Trichoderma* genus are strains of *T. virens*, *T. viride* and, above all, *T. harzianum*, which is a species-aggregate (complex).
3. *Trichoderma* strains exert antagonism to fungal phytopathogens either directly, by mechanisms such as (a) **mycoparasitism** (involves tropic growth of bio control agent towards the target organism, coiling, final attack and dissolution of target pathogens cell wall or membrane by the activity of enzymes) , or indirectly by (b) **competition** for nutrients (they produces efficient siderophores to chelate Fe and deprive pathogen of Fe) and space (e.g. *T. harzianum* T35 controls *Fusarium oxysporum* by competing for both rhizosphere colonization and nutrients) with phytopathogens, (c) **modifying the environmental conditions** (by acidifying the soil, so that pathogens cannot grow), or (d) **promoting plant growth and plant defensive mechanisms** (they colonize plant roots by mechanisms similar to those of mycorrhizal fungi and produce compounds like phytohormones, organic acids that solublize nutrients that stimulate growth and plant defense, and (e) **antibiosis** (It produces antibiotics and toxins such as trichothecin and a sesquiterpine, Trichodermin, which have a direct effect on other organisms).
4. These indirect and direct mechanisms may act coordinately and **synergistically** and their importance in the biocontrol process depends on the *Trichoderma* strain, the antagonized fungus, the crop plant, and the environmental conditions, including nutrient availability, pH, temperature, and iron concentration.

# Applications (contd.)

## **Benefits of *Trichoderma*:**

**Disease Control:** *Trichoderma* is a potent biocontrol agent and used extensively for soil born diseases. It has been used successfully against pathogenic fungi belonging to various genera, viz. *Fusarium*, *Phytophthora*, *Scelerotia* etc.

**Plant Growth Promoter:** *Trichoderma* strains solubilize phosphates and micronutrients. The application of *Trichoderma* strains with plants increases the number of deep roots, thereby increasing the plant's ability to resist drought.

**Biochemical Elicitors of Disease:** *Trichoderma* strains are known to induce resistance in plants. Three classes of compounds that are produced by *Trichoderma* and induce resistance in plants are now known. These compounds induce ethylene production, hypersensitive responses and other defense related reactions in plant cultivars.

**Transgenic Plants:** Introduction of endochitinase gene from *Trichoderma* into plants such as tobacco and potato plants has increased their resistance to fungal growth. Selected transgenic lines are highly tolerant to foliar pathogens such as *Alternaria alternata*, *A. solani*, and *Botrytis cinerea* as well as to the soil-borne pathogen, *Rhizectonia* spp.

**Bioremediation:** *Trichoderma* strains 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: organochlorines, organophosphates and carbonates.



## **Method of application:**

**Seed treatment:** Mix 6 - 10 g of *Trichoderma* powder per Kg of seed before sowing.

**Nursery treatment:** Apply 10 - 25 g of *Trichoderma* powder per 100 m<sup>2</sup> of nursery bed.  
Application of neem cake and FYM before treatment increases the efficacy.

**Cutting and seedling root dip:** Mix 10g of *Trichoderma* powder along with 100g of well rotten FYM per liter of water and dip the cuttings and seedlings for 10 minutes before planting.

**Soil treatment:** Mix 1kg of *Trichoderma* formulation in 100 kg of farmyard manure and cover it for 7 days with polythene. Sprinkle the heap with water intermittently. Turn the mixture in every 3-4 days interval and then broadcast in the field.

**Plant Treatment:** Drench the soil near stem region with 10g *Trichoderma* powder mixed in a liter of water

### ***Trichoderma* formulations:**

Important commercial formulations are available in the name of Sanjibani, Guard, Niprot and Bioderma. These formulations contain  $3 \times 10^6$  cfu per 1 g of carrier material. Talc is used as carrier for making powder formulation.