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STUDY OF ECO-FRIENDLY MANAGEMENT OF FUNGAL BIOAGENTS AGAINST SELECTED PHYTOPATHOGENS

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The use of herbicides, insecticides, synthetic fertilizers and pestisides often leave residues with levels above maximum tolerance limits in food/horticulture products. They also contaminate the soil and give an opportunity to soil borne pathogens to cause severe hazards in the surrondings of the root system and surface of the roots of plants. The present study was aimed to identify rhizosphere pathogens of selected vegetable plants and develop appropriate eco-friendly disease management strategy. The fungal bioagents like *Trichoderma*, *Gliocladium* and AM-Fungi control soil borne pathogens like *Rhizoctonia solani*, *Phytophthora capsici* and *Fusarium oxysporum*. The present investigation is also an extension of plant disease management using eco-friendly method known as "Allelopathy" or "Biological control".

INTRODUCTION

The term "Biological control" in the broadest sense could be defined as the use of living agents to control plant pathogens. Biocontrol micro-organisms are also known as "Antagonists". The antagonist acts by reducing the population of pathogens, preventing the pathogen from infecting the plant and limiting disease development after infection. Biological control agents provide effective control only when they are applied at the right place at the appropriate time in sufficient amount to successfully establish there. Specially in view of the great diversity of climate and soil chemistry, it in essential to have a research station for the identification, characterization, mass cultivation and preservation of local strains.

Fungi are by far the most extensively researched group of biocontrol agents. A number of bio-pesticides of fungal (*Trichoderma* and *Gliocladium*) and bacterial (*Pseudomonas* and *Bacillus*) origin origin have been introduced in various parts of the world. Some of the international references in this regard include the pioneer work done by Wilding (1941) who gave the idea that *Trichoderma* has the potential as a bioagent. It is widely distributed all over the world and occurs in nearly all soil types and habitats especially in those containing or consisting of organic matters (Domesch *et al.*, 1980). *In vitro* combined effect of *Brassica napus* seed and *Trichoderma harzianum* on soil borne pathogens have been described by some workers (Dandurand, *et al.*, 2000). A similar work on antagonistic nature of *Trichoderma* has been made in China.

With the developing interest all over the world in the field of biological control, plant scientists in India have also contributed a lot to this area. The bioagents like *Trichoderma*, *Gliocladium* and AM-fungi are being commonly used for control of such soil borne pathogens. *T. harzianum* applied to fields infected with *Rhizoctonia* and *Sclerotium* successfully reduced disease incidence. The beneficial micro-organisms like plant growth promoting rhizobacteria affect plant growth indirectly by supression of bacterial, fungal and nematode pathogens (biocontrol) through production of metabolites, induction of systemic resistance and/or competing with pathogens for nutrients or space.

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At present, around 40% of all plant species have been destroyed by plant pathogens. Pesticides, insecticides and synthetic fertilizers are widely used to control plant pathogens. However, the degradation of such compounds is very difficult and their concentration and/or accumulation in food chains are leading to higher toxicity levels in human beings.

Eco-friendly management : In this respect *Trichoderma sp.* have been studied as biological control agents against soil borne plant pathogenic fungi. Isolates of *Trichoderma harzianum* can produce lytic enzymes and antifungal antibiotics and they can also be competitive with fungal pathogens and promote plant growth. It was reported that the production of metabolites from different *Trichoderma* strains depend on ecological factors and so the strains show varying effects on pathogens. *T. harzianum* is species aggregates, grouped on the basis of conidiophore branching pattern with short side branches, short-inflated phialides and smooth and small conidia. There characteristics allow for the relatively easy identification of *Trichoderma* as a genus but the species concept are difficult to interpret and there is considerable confusion over the application of specific names.

MATERIAL AND METHODS

This study was carried out to find out the antagonistic potential of *Trichoderma sp.* against important plant pathogenic fungi isolated from rhizosphere of three vegetable plants viz., *Lycopersicum esculentum, Solanum melongena* and *Capsicum capsici*. The culture of various plant pathogenic fungi were obtained *in vitro*. The antagonistic actions of six different *Trichoderma* strains viz., *T.harzianum*- I, II, III, IV, V and VI were tested against three pathogens viz., *Phytophthora capsici* and *Fusarium oxysporum* by using dual culture technique. 20 ml of PDA medium was poured aseptically in each of sterilized petriplates and allowed to solidify. Mycelial disc of 4 mm diameter from margin of four days old culture of antagonists and test fungus were placed simultaneously at a distance of 5 cm from each other on PDA medium. Each treatment was replicated thrice. The plates were incubated at 28 ± 2°C for 8 days. After incubation the growth of antagonist and test fungus was measured by linear measurement. Index of antagonism was determined by the following formula.

$$I=\frac{CT}{C}\times 100$$

Where, I = Antagonism index

C = Area of test fungus in control

T = Area of test fungus in respective treatment

The morphology of hyphae in interaction zone was observed under light (10x) microscope. Clear and characteristically parasitized hyphae were examined under high magnification power (40x). Based on the growth and mycoparasitic nature biocontrol agents were grouped into various categories as per standard scale.

TABLE - Antagonistic Potential of Fungal Bioagents against Three Pathogens Isolated From Rhizosphere

Angagonist	*Phyfophthora capsici*			*Fusarium oxysporum*				*Rhizoctonia solani*		
	Percent Inhibition	Contact days	Modified Bell's Scale	Percent growth Inhibition	Contact days	Percent zone overlap by antagnist a 8 days of incubation	Modified Bell's Scale	Percent Inhibition	Contact days	Antagonism
Trichoderma harzianum I	85.23 (67.40)	4	S_4	92.62	3	100	S_1	57.06 (48.03)	2.0	+++
Trichoderma harzianum II	84.38 (66.73)	5	S_4	90.24	4	60	S_2	54.01 (47.34)	2.0	+++
Trichoderma harzianum III	84.66 (66.95)	3	S_4	93.25	3	100	S_1	50.20 (45.15)	2.0	+++
Trichoderma harzianum IV	93.57 (75.32)	4	S_1	71.32	4	75	S_2	54.83 (47.76)	2.0	+++
Trichoderma harzianum V	91.14 (72.68)	5	S_4	90.96	7	50	S_2	30.25 (33.36)	3.0	++
Trichoderma harzianum VI	83.38 (65.95)	3	S_4	79.40	4	-	S_4	49.97 (44.92)	2.0	++

Modified Bell's scale: S_1 = *Trichoderma* incompletely overgrow pathogen (100% overgrowth), S_2 = *Trichoderma* overgrow at least two-thirds of pathogen (75% overgrowth), S_3 = *Trichoderma* colonized on one half of growth of pathogen (50% overgrowth), S_4 = Pathogen and Antagonist locked at point of contact, S_5 = Pathogens overgrow mycoparasite-*Trichoderma*.

RESULTS AND DISCUSSION

In case of fungal bioagents, the maximum inhibition (93.57%) was recorded in presence of *T.harzianum*- IV and showed strong antagonism against the *P.capsici*. This was followed by *T. harzianum*-V (91.14%), *T. harzianum*-I (85.23%), *T. harzianum*-III (84.66%) and *T. harzianum*-II (84.38%) respectively which showed moderate antagonism. *T. harzianum*- IV showed good antagonism against the pathogen. The most of the isolates under investigation fail to overgrow the pathogen except *T. harzianum*-IV. The inhibiting capacity of isolates was directly correlated with the faster growth rate of antagonist.

The antagonistic properties and overgrowing capacity of *Trichoderma sp.* were studied by dual culture plate technique, which showed impressive results. The maximum inhibition (93.95%) was recorded in presence of *T. harzianum*-III which showed strong antagonism against *F. oxysporum*. This was followed by *T. harzianum*-I (92.62%), *T. harzianum*-V (90.96%), *T. harzianum*-II (90.24%), *T. harzianum*-IV (71.32%) and *T. harzianum*-VI (79.40%) showed good and moderate antagonism against the pathogen. The maximum inhibition (57.06%) was recorded in presence of *T. harzianum*-I and strong antagonism was found against *Rhizoctonia solani*. This was, followed by *T. harzianum*-IV (54.83%), *T.harzianum*-II (54.01%), *T. harzianum*-III (50.20%), *T. harzianum*-VI (49.97%) and *T. harzianum*-V (30.25%) which showed moderate and poor antagonism.

CONCLUSION

The antagonitic actions of six strains of *Trichoderma sp.* were evaluated against the test fungus by dual culture technique. *Trichoderma sp.* has profound antagonistic as well as parasitic capacity to inhibit devastating plant pathogens like *P. capsici*, *Rhizoctonia solani* and *F. oxysporum*.

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