ISSN NO. 2320-5407

Journal homepage: http://www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH

RESEARCH ARTICLE

Effect of Trichoderma species on germination and growth of Mungbean (Vigna radiata L.) and its antagonistic effect against fungal pathogens

Shiv Shankar Gautam, Kalpana Kanchan and G. P. Satsangi
Department of Botany, Dayalbagh Educational Institute, Dayalbagh, Agra- 282110 (India)

Manuscript Info

Manuscript History:

Received: 16 December 2014
Final Accepted: 12 January 2015
Published Online: February 2015

Key words:

Trichoderma, Antagonist, Plant pathogen, Allelopathy, Bio-control agent

Corresponding Author

Shiv Shankar Gautam

Abstract

During the present studies, antagonists viz., Trichoderma viride and T. harzianum were used for antagonize the growth of pathogenic fungi of Mungbean viz. Fusarium oxysporum and Rhizoctonia bataticola. The inhibition in colony of F.oxysporum was found 30.66% by T.viride and in the R.bataticola was 40%. The T. harzianum showed inhibition in F.oxysporum 42.54% and in R. bataticola 48.14% after 3 days of inoculation. The antagonists viz., T.harzianum and T.viride were also found to affect the growth response of Mungbean (Vigna radiata L.). The germination of Mungbean seeds was found maximum (80%) in T. harzianum and T. viride (57.77%) in comparison to control (23.33%). The pathogen growth inhibitory ability of different Trichoderma strains of same species and among different species varied significantly. Plant growth promotion measured as root and shoot lengths were significantly higher than control.

INTRODUCTION

Trichoderma is a genus belonging to the filamentous Class Deuteromycetes. The members are generally found in all types of soil. Trichoderma Spp. is well known which is capable of controlling many soils borne plant pathogen due to competition of food and space, direct parasitism, production of cellular and various mycolytic enzymes **(Karpagavalli and Ramabadan, 2001, Jangid et al., 2004).** Biological agent such as fungi and bacteria can offer protection against a number of soil borne pathogens specially Rhizoctonia spp., Sclerotium spp. and Fusarium spp. Plant defense mechanisms have also been manifested by alteration in biochemical responses of the plant which is collectively called as Induced Systemic Resistance (ISR) **(Gawande and Sharma, 2003)**. These species are distinguished on the basis of color and shape of their conidia and colony appearance. Trichoderma species are economically important for their production of enzymes (cellulases and hemicellulases), antibiotics and their action as biocontrol agents against plant pathogen fungi based on various mechanisms such as the production of antifungal metabolites, competition for space and nutrients and mycoparasitism **(Howell, 2003)**.

The antifungal enzyme system of Trichoderma spp. plays an important role for detection and destroying the host cell wall **(Schirmbock et al., 1994).** Competitiveness is based on rapid growth and the production of various asexual generated conidia and chlamydospores **(Chet, 1990; Chet et al., 1998).** The ability to promote growth and induce resistance in plants is a mechanism which has also been described for members of this genus **(Harman, 2006).** The experiment was conducted to study the interaction of antagonists viz; T.harzianum and T.viride against fungal pathogen of mungbean and its effect on growth response.

Methods and Material

Preparation of cultures:

Pure cultures of fungus species were prepared on the PDA medium in different petriplates in the aseptic environment.

Screening of T. viride and T. harzianum isolates against plant pathogenic fungi using dual culture method:- These isolates were tested for antagonism against broad range of common plant pathogen and further studies were done for selected pathogens by using dual culture techniques as developed by **Morton and Stroube,(1955).** The mycelia bits of 5 mm diameter of Trichoderma spp. and pathogen were placed opposite to each other on petriplates containing sterilized PDA medium. Plates having pathogen served as control**.** Each treatment was replicated thrice. The plates were incubated at 27 ± 1^0C for 3 days. The growth of pathogen tested against all the isolates of Trichoderma strains. Trichoderma sps. were evaluated against pathogenic fungi in vitro for their comparative potential as antagonist by dual culture techniques as described by **Johnson and Curl (1972)**. Percent inhibition over control was calculated by applying the following formula:-

$$I = \frac{C-T}{C} \times 100$$

Where: - I = Inhibition (%), C = Colony diameter in control (cm), T = Colony diameter in treatment (cm)

Plant Growth Promotion:

The experiment was laid out in Randomized Block Design with its three replicates. The Petri dishes containing seeds of Vigna radiata L were daily treated with Trichoderma species solution. The germination of seed, Root length and Shoot length were recorded at regular intervals i.e. 5^{th}, 10^{th} and 15^{th} DAS. Germination percentage was calculated by following formula

$$\text{Germination \%} = \frac{\text{no. of seed germinated}}{\text{Total no. of seed placed}} \times 100$$

Allelopathic effect of Trichoderma in-vitro condition

In- vitro study petridishes containing 15 seeds of Mungbean was sprayed by Trichoderma at intervals 3, 5, 7, 9 and 11 days. The treatment without application of Trichoderma strain served as control and experiment was conducted in triplicates. Collected data was Tabulated and analyzed statistically to obtain concrete interferences.

Results and Discussion

In the present study two Trichoderma species (Trichoderma viride and Trichoderma harzianum) were selected for screening against fungal pathogen such as Rhizoctonia bataticola and Fusarium oxysporum of Mungbean

Table 1- Antagonistic activity of two isolates of Trichoderma sps. against different fungal plant pathogens of Mungbean (Vigna radiata) at 3^{rd} day:

Cultures	**Growth of Colony**			**Inhibition (%)**	**Cultures**	**Growth of Colony**			**Inhibition (%)**
	Trichoderma sp.	Pathogenic sp.	Control			Trichoderma sp.	Pathogenic sp.	Control	
T. viride v/s R.bataticola	4.83±0.76	3.5±0.50	5.5±0.25	40	T. harzianum v/s R.bataticola	3.86 ±0.35	2.80±0.25	5.4	48.14
T. viride v/s F.oxysporum	5.01±0.42	2.58±0.14	3.5 ±0.15	30.66	T. harzianum v/s F.oxysporum	3.93±0.60	3.16±0.35	5.5	42.54

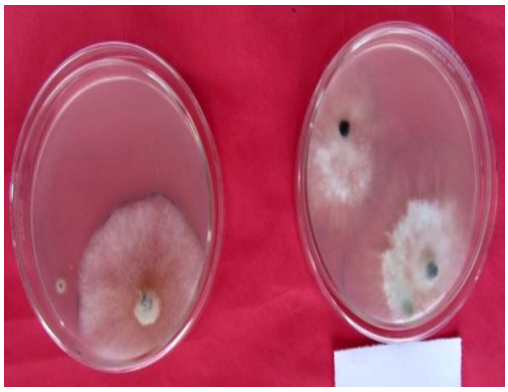

Fig. I- Zone of inhibition against R. bataticola **II-** Zone of inhibitions against F. oxysporum.

However the isolates T.viride and T. harzianum showed excellent antagonistic activity against fungal plant pathogens causing disease in Mungbean (Vigna radiata). In dual culture a clear zone of inhibition was observed exhibiting antibiosis between pathogens and antagonist. Fungal disc (5 mm diameter) of Trichoderma was placed at one side and F. oxysporum was placed on the opposite side of PDA plates in in vitro. The distance between the two inoculum discs were 7 cm. As same followed in case of other pathogenic fungi Rhizoctonia bataticola. It has been observed that 40% inhibition in the growth of Rhizoctonia bataticola and in the Fusarium oxysporum 36.66% by growth of the colony of Trichoderma viride (Fig 1,Table 1). The inhibition in colony of Rhizoctonia bataticola was found 48.14% and 42.54% in colony of Fusarium oxysporum by Trichoderma harzianum. T. harzianum was comparatively more effective in reducing the growth of R. bataticola & F. oxysporum than T.viride in vitro condition(Fig 2, Table 1). **Chet et al.,(1981)** reported that Trichoderma sps. are common inhabitant of rhizosphere and contribute to control of many soil borne plant disease caused by fungi.

Allelopathic Effect of Trichoderma:

The increase in cumulative root length, root surface area and the number of root tips following Trichoderma treatment in both environments suggested a common role of T. harzianum in improving the plant root system. The rate of plant growth was higher following treatment with T.harzianum, in both systems**. Harman (2000)** suggested that Trichoderma spp. are opportunistic plant colonizers that affect plant growth by promoting abundant and healthy plant roots, possibly via the production or control of plant hormones **(Baker, 1989; Kleifield and Chet, 1992)**. T.harzianum reduced root rot of sugar beets **(Ciccarese et al., 1992)**, stem rot of ground nut **(Cilliers et al., 2000)**, damping-off and stem rot of cowpea **(Adandonon, 2000)**, root rot of beans and tomatoes **(Elad et al., 1980)**.

As such the above experiments we also performed the same experiment on Mungbean (Vigna radiata) and observe that Trichoderma harzianum significantly enhance the germination of mungbean seeds and also enhance the growth of shoot length and root length in early days after the inoculation of the mungbean seeds in vitro conditions. In this experiment two strains of Trichoderma (Trichoderma viride and Trichoderma harzianum) and consider the allelopathic effect on Mungbean (Vigna radiata) and was observed the effect of Trichoderma on the germination of Mungbean seeds.

The maximum percentage germination with Trichoderma harzianum i.e. 80% followed by with T. viride 57.77% and minimum percentage of germination was 23.33% in control. On 5^{th} day maximum shoot length was found in T. harzianum (5.73 cm) & root length was also maximum in T. harzianum (3.54 cm) than T. viride and control(Fig 2, Table 2). The same trend was found on 10^{th} and 15^{th} day. Effect of Trichoderma harzianum on shoot length and root length of Mungbean (Vigna radiata) was more positively significant

Table: 2- Effect of Trichoderma isolates on seed germination, shoot length and root length:-

Strains	Percentage	5^{th} Day	10^{th} Day	15^{th} Day

	Germination (%)	Shoot length (Mean±SD)	Root length (Mean±SD)	Shoot length (Mean±SD)	Root length (Mean±SD)	Shoot length (Mean±SD)	Root length (Mean±SD)
T. viride	57.77	4.91±0.66	3.28±0.29	11.35±0.81	5.36±0.48	14.66±0.32	4.95±0.17
T.harzianum	80	5.73±0.38	3.54±1.06	11.92±0.26	5.47±1.35	15.29±1.71	4.99±1.74
Control	23.33	4.54±0.25	3.19±0.72	11.31±0.72	4.62±0.53	12.87±0.33	3.33±0.38

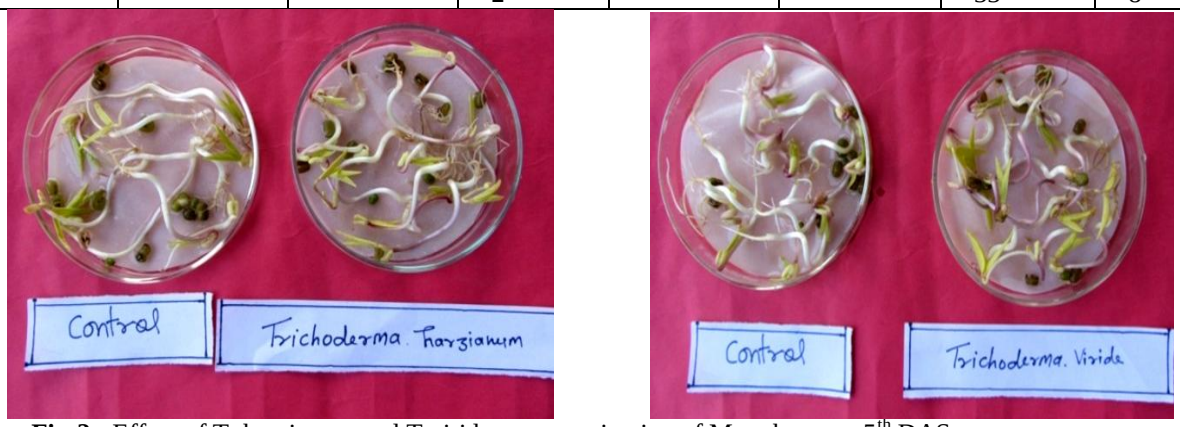

Fig-2: Effect of T. harzianum and T.viride on germoination of Mungbean on 5th DAS.

Conclusion:

Antagonistic interactions of Trichoderma strains showed excellent activity against various plant pathogens causing disease in Mungbean (Vigna radiata) thus the Trichoderma strains could be further exploited for commercial scale up under localized climatic condition. Effect of Trichoderma harzianum on shoot length and root length of Mungbean (Vigna radiata) was positively significant. Thus it is concluded that Trichoderma is the beneficial fungi for the growth of the crops and other plants by inhibiting the growth of pathogenic microorganisms.

References:

Adandonon, A. (2000): Damping-off of cowpea in Benin and South Africa M.Sc. Thesis. University of Pretoria, Pretoria, South Africa.

Chet, I., Harman, G. E. and Baker, R. (1981): Trichoderma hamatum : its hypal interaction with Rhizoctonia solani and Pythium spp. Micro. and Eco., 7: 29-38.

Ciccarese, F., Frisullo, S., Amenduni, M. and Cirulli, M. (1992): Biological control of Sclerotium rolfsii root rot of sugar beet with Trichoderma harzianum. (Eds.): E.C. Tjamos, G.C. Papavizas and R. J. Cook. pp. 243-248.

Cilliers, A. J., Herselman, L. and Pretoius, Z. A. (2000): Genetic variability within and among mycelial compatibility groups of Sclerotium rolfsii in South Africa. Phytopathol., 90: 1026-1031.

Elad, Y., Chet, I. and katan J. (1980): Trichoderma harzianum: A biocontrol agent effect against Sclerotium rolfsii and Rhizoctonia solani. Phytopathol., 70: 119-121.

Gawande, S. and Sharma, P. (2003): Changes in host enzyme activity due to induction of resistance against downy mildew in cauliflower. Ann. Agric. Res., 24(2):322-331.

Harman G.E. (2006): Overview of mechanisms and uses of Trichoderma spp. Phytopathol., 96: 190–194.

Harman, G. E. (2000): Myths and dogmas of biocontrol Changes in perceptions derived from research on Trichoderma harzianum T22. Pl Dis., 84(4): 377-393.
Howell, C. R. (2003): Mechanisms employed by Trichoderma spp. in the biological control of plant diseases: the history and evolution of current concepts. Pl. Dis., 87: 4-10. ICRISAT, Patancheru, A. P., India: 303-347.

Jangid, P. K., Mathur, P. N. and M. Kusum (2004): Role of chitinase and beta -1, 3 glucanase elicitation in the Trichoderma harzianum induced systemic resistance in capsicum. Indian phytopathol., 57(2): 217-221.

Johnson, L. F. and Curl, E. A. (1972): Methods for research and their ecology of soil borne plant pathogens. Burgess Pub. Com. Mim., pp. 247.

Karpagavalli, S. and Ramabadan, R. (2001): Effect of fungicides and Trichoderma species on cellulolytic enzyme production, damping-off incidence and seedling vigour of tomato. Plant Dis. Res. 16(2): 179-185.

Morton, D. J. and Stroube W. H. (1955): Antagonistic and stimulating effects of soil micro-organism of Sclerotium. Phytopathol., 45:417-420.

Schirmbock, M., Lorito, M., Hayes., C.K., ArisanAtac, I., Scla, F., Harman, G. E. and Kubicek,C. P. (1994): Parallel formation and synergism of hydrolytic enzymes and peptaibol antibiotics, molecular mechanisms involved in the antagonistic action of Trichoderma harzianum against phytopathogenic fungi. Appl. Environ. Microbiol., 60: 4364-4370.