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Screening of *Trichoderma* spp. from Andaman and Nicobar Islands

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Thirty eight isolates of *Trichoderma* were screened against six soil borne fungal plant pathogens to select some efficient isolates. The isolates ThrAN-5 and ThrAN-7 (*T. harzianum),* TvAN-3 , TvAN-5 and TvAN-8 (*T. viride)* and ThmAN-4 ThmAN-10 (*T. hamatum)* were most efficient in parasitizing the mycelial growth of all test pathogens. *R.solani* was more parasitized by the isolates of *Trichoderma* whereas *S. rolfsii, M. phaseolina* and *F.o.f.sp lycopersici* were comparatively less parasitized.The hyphae of antagonist grew parallel and coiled around the hyphae of *R. solani* and penetrated into the hyphae of pathogen by producing hook or knob like structures.There was no significant enhancement of antagonistic potential of *Trichoderma* spp. against *P. aphanidermatum* and *Phytophthora parasitica* even they were grown in chitin amended media but they had significant effect against *R. solani, F.o.f.* sp *lycopersici, M. phaseolina and S. rolfsii.* Highest percentage inhibition in growth of *P. aphanidermatum* was observed with TvAN-5 (61.7%) whereas the isolate ThrAN-5 was most efficient with respect to per cent inhibition of mycelial growth of *P. parasitica* (62.2%). Similarly, per-Tsunami chitin adapted isolate, ThrAN-5 resulted into 78.3% (*F.o.f.* sp *lycopersici.*), 77.8% (*M. phaseolina)* and 81.9% (*R. solani)* growth inhibition, whereas the isolate TvAN-3 caused highest percentage inhibition of mycelial growth of *S. rolfsii* (76.7%). Both isolates (ThrWB-1 and ThrWB-2) of *Trichoderma* from West Bengal were found to have with intermediate effect with respect to their hyperparasitic ability irrespective of pathogens tested and chitin or non-chitin adaptation.

Key words: Andaman and Nicobar Islands, *Trichoderma* spp., soil borne pathogens

INTRODUCTION

Andaman and Nicobar group of Islands are located in the Bay of Bengal and fall under the island ecosystems. The climate is unique with humid tropical (temp 28-32^{0}C and RH 75-95%), endowed with the occurrence of both South-West and North-East monsoon and the rainy season is more than eight months in a year with an average rainfall of 3100 mm. *Trichoderma* spp. are among the most frequently isolated soil fungi and present in plant root systems (Harman 2000). These fungi are opportunistic, avirulent symbionts (Harman *et al.,* 2004), and function as parasites and antagonists of many phytopathogenic fungi, thus protecting plants from disease. The abundance of *Trichoderma* in various soils, coupled with their ability to degrade various organic substrates in soils, their metabolic versatility, and their resistance to microbial inhibitors, suggests that they may possess the ability to survive in many ecological niches depending on prevailing conditions and the species or strains involved (Papavizas, 1985). The antagonistic potential of *Trichoderma* spp. in the bay Islands with refernce to its specialized agroecosystem has naver been worked out (Bhagat *et al.,* 2005) . The change in soil microbial situation particularly after massive earthquake followed by deadly Tsunami on 26th December, 2004, appeared to have immense scientific importance in the Andaman and Nicobar Islands. Accordingly the implementation of biocontrol by exploration of native isolates of *Trichoderma* appears to be a vital area of researches with the

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concept that the bay island has been declared as exclusively organic farming area by the Govt. of India. Therefore, present study has been aimed to isolate and establish the antagonistic potential of *Trichoderma* spp. against some soilborne plant pathogens.

MATERIALS AND METHODS

Rapid screening of Trichoderma isolates

Seventeen isolates of *Trichoderma harzianum,* ten isolates of *T. viride* and eleven isolates of *T. hamatum* were screened for their antagonistic potential against six soil borne fungal plant pathogens through multiple culture followed by dual culture technique. Mycelial discs (6 mm diam.) picked up from the margin of young growing 3-4 days old culture of *Trichoderma* and pathogens, were inoculated at the peripheral region at equal distance from centrally inoculated test pathogens and incubated for 5-6 days at 28 ± 1°C. The selected isolates were subjected to crossrapid screening followed by dual culture test against six pathogens separately.

The mycelial discs (6 mm dia) of *F.o.*f sp *lycopersici, M. phaseolina,* and *S.rolfsii* were inoculated centrally on solidified PDA in the Petriplates one day advance to attain the point of contact at the middle of Petriplates, whereas *R. solani, P. aphanidermatum* and *P. parasitica* were inoculated on the same day with the isolates of *Trichoderma.* The inoculated plates were incubated at 28 ± 1°C for 10 days and were periodically observed for the mycelial suppression of pathogens. This set of experiment was replicated five times. The *Trichoderma* isolates were rated on the basis of their ability to suppress the mucelial growth of pathogen following the methods of modified Bell's scale (Bells *et al.,* 1982).

Chitin feeding

Twelve isolates of *Trichoderma* were grown on chitin amended potato dextrose broth (PDB) medium for at least five successive generations to assess the relative antagonistic potential in mycelial growth inhibition (%) of test plant pathogens by dual culture method. Mycelial plug (6 mm dia) of test antagonists were inoculated into Petriplates containing solidified PDA and incubated at 28 ± 1°C for 3-4 days into a BOD. The young growing culture of *Trichoderma* spp. were grown in same medium up to five consecutive generations. The chitin adapted isolates were multiplied and maintained into PDA slants and preserved in PDA slants at 4°C for subsequent use.

Dual culture technique

Both pathogens (*P. aphanidermatum, P. parasitica, F.o.*f sp. *ciceris, M. phaseolina, R. solani* and *S. rolfsii*) and antagonists were inoculated at peripheral region oposite to each other in sterilized Petriplates (90 mm dia) containing 20 ml sterilized potato dextrose agar (PDA) medium and incubated at 28 ± 1°C for 7-10 days and replicated into five times. The PDA medium inoculated either with pathogen and antagonist only served as control. The radial mycelial growth of test pathogens and antagonist were measured periodically and the per cent inhibition of mycelial growth of test pathogens by antagonists was calculated as per formulae adopted by Garcia (1991) as: % IRG = 100 [(R_1- $R_{2)}$ / R_1],where R_1 is the farthest radial distance grown by the pathogen in the direction of the antagonist (control) while R_2 represents the distance grown on a line between inoculation positions of the pathogen and the antagonist.

Hyphal interaction between *Trichoderma* isolates and the pathogen *R. solani* was studied by dual culture method following Quimio and Cumagun (2001). A cellophane membrane was placed over solidified potato dextrose agar (PDA) medium into the Petriplates, the test pathogen and antagonist were inoculated at the peripheral region opposite to each other and incubated into BOD incubator at 28 ± 1°C for 3-4 days. The zone of point of contact between pathogen and antagonists were cut along with cellophane membrane using a new blade, placed on a cleaned slide, stained with lactophenol cotton blue and observed under a phase contrast microscope (AxioStar Zeiss).

RESULTS AND DISCUSSION

The scan over the entire results (Tables 1-3) of rapid screening of *Trichoderma* spp. from Andaman and Nicobar Islands, against six fungal pathogens revealed thet there was a clear difference in three species of *Trichoderma* viz., *T. harzianum, T, viride* and *T. hamatum* in their hyperparasitic potential against the pathogens tested. However, *T. viride* was most efficient in parasitizing all the pathogens,

Table 1 : Comparative antagonistic potential of Andaman isolates of *Trichoderma harzianum* against six test pathogens

Isolates of *Trichoderma harzianum*	Pathogens					
	Pythium aphani-dermatum	*Phytophthora parasitica*	*Fusarium oxysporum* f. sp *lycopersici*	*Macrophomina phaseolina*	*Rhizoctonia solani*	*Sclerotium rolfsii*
ThrAN- 1	*4 S_1	4 S_1	4 S_1	5 S_1	3 S_1	5 S_1
ThrAN- 2	5 S_1	4 S_1	4 S_1	5 S_1	4 S_1	6 S_1
ThrAN- 3	6 S_1	6 S_1	6 S_1	7 S_1	5 S_1	7 S_1
ThrAN- 4	5 S_1	4 S_1	5 S_1	7 S_1	4 S_1	7 S_1
ThrAN- 5	4 S_1	4 S_1	4 S_1	5 S_1	4 S_1	6 S_1
ThrAN- 6	5 S_1	5 S_1	5 S_1	5 S_1	4 S_1	6 S_1
ThrAN- 7	4 S_1	4 S_1	4 S_1	5 S_1	3 S_1	6 S_1
ThrAN- 8	6 S_1	6 S_1	6 S_1	6 S_1	5 S_1	7 S_1
ThrAN- 9	6 S_1	5 S_1	6 S_1	5 S_1	5 S_1	7 S_1
ThrAN- 10	7 S_1	6 S_1	7 S_1	7 S_1	6 S_1	7 S_1
ThrAN- 11	6 S_1	5 S_1	5 S_1	7 S_1	5 S_1	7 S_1
ThrAN- 12	5 S_1	7 S_1	6 S_1	8 S_1	5 S_1	8 S_1
ThrAN- 13	6 S_1	5 S_1	7 S_1	5 S_1	4 S_1	6 S_1
ThrAN- 14	7 S_1	5 S_1	6 S_1	6 S_1	5 S_1	6 S_1
ThrAN- 15	5 S_1	7 S_1	6 S_1	7 S_1	5 S_1	8 S_1
ThrAN- 16	5 S_1	5 S_1	7 S_1	5 S_1	6 S_1	6 S_1
ThrAN- 17	7 S_1	5 S_1	7 S_1	6 S_1	7 S_1	8 S_1

DAI= Days after inoculation; *the data based on means of 50 observations

Table 2 : Comparative antagonistic potential of Andaman isolates of *Trichoderma viride* against six test pathogens

Isolates of *Trichoderma viride*	Pathogens					
	Pythium aphani-dermatum	*Phytophthora parasitica*	*Fusarium oxysporum* f. sp *lycopersici*	*Macrophomina phaseolina*	*Rhizoctonia solani*	*Sclerotium rolfsii*
TvAN- 1	*4 S_1	4 S_1	6 S_1	4 S_1	4 S_1	6 S_1
TvAN- 2	4 S_1	4 S_1	5 S_1	5 S_1	4 S_1	5 S_1
TvAN- 3	3 S_1	3 S_1	4 S_1	4 S_1	3 S_1	4 S_1
TvAN- 4	5 S_1	5 S_1	4 S_1	5 S_1	4 S_1	5 S_1
TvAN- 5	3 S_1	3 S_1	4 S_1	4 S_1	3 S_1	4 S_1
TvAN- 6	6 S_1	6 S_1	6 S_1	7 S_1	6 S_1	7 S_1
TvAN- 7	4 S_1	5 S_1	5 S_1	5 S_1	4 S_1	5 S_1
TvAN- 8	5 S_1	4 S_1	6 S_1	4 S_1	4 S_1	6 S_1
TvAN- 9	6 S_1	6 S_1	7 S_1	5 S_1	5 S_1	7 S_1
TvAN- 10	5 S_1	4 S_1	5 S_1	5 S_1	4 S_1	5 S_1

DAI= Days after inoculation; *the data based on means of 50 observations

Table : 3 Comparative antagonistic potential of Andaman isolates of *Trichoderma hamatum* against test pathogens

Isolates of *Trichoderma hematum*	Pathogens					
	Pythium aphani-dermatum	*Phytophthora parasitica*	*Fusarium oxysporum* f. sp *lycopersici*	*Macrophomina phaseolina*	*Rhizoctonia solani*	*Sclerotium rolfsii*
ThmAN-1	*4 S_1	5 S_1	6 S_1	6 S_1	5 S_1	7 S_1
ThmAN-2	5 S_1	6 S_1	8 S_1	6 S_1	7 S_1	9 S_1
ThmAN-3	7 S_1	7 S_1	8 S_1	7 S_1	8 S_1	9 S_1
ThmAN-4	4 S_1	5 S_1	6 S_1	5 S_1	4 S_1	6 S_1
ThmAN-5	5 S_1	5 S_1	7 S_1	6 S_1	7 S_1	8 S_1
ThmAN-6	5 S_1	6 S_1	9 S_1	7 S_1	7 S_1	9 S_1
ThmAN-7	4 S_1	6 S_1	9 S_1	6 S_1	8 S_1	9 S_1
ThmAN-8	7 S_1	6 S_1	9 S_1	5 S_1	6 S_1	8 S_1
ThmAN-9	6 S_1	9 S_1	7 S_1	7 S_1	6 S_1	8 S_1
ThmAN-10	5 S_1	5 S_1	6 S_1	5 S_1	5 S_1	6 S_1
ThmAN-11	7 S_1	6 S_1	8 S_1	8 S_1	7 S_1	9 S_1

DAI= Days after inoculation; *the data based on means of 50 observations

followed by *T harzianum* and *T. hamatum*. It appeared (Table 1) that the isolates of *T harzianum* attained S_1 stage from 4 to 7 days (*P. aphanidermatum, P. parasitica* and *F.o.*f. sp *lycopersici),* whereas they varied to attain S_1 stage from 3 to 7 days for *R. solani* and 5 to 8 days of incubation for both *M phaseolina* and *S. rolfsii.* Rapid screening of isolates of *T. harzianum* against all test pathogens revealed that both the isolates ThrAN-5 and ThrAN-7 were most efficient in parasitizing the mycelia growth of said pathogens. It is pursued from the results presented in Table 2, that the isolates of *T. viride* overgrown the test pathogens and attained S_1 stage at 3 to 4 days for *R. solani,* 3 to 6 days for both *P. aphanidermatum* and *P. parasitica,* 4 to 7 days of incubation for *F.o.*f. sp *lycopersici, M phaseolina* and *S. rolfsii.* Among the isolates of *T. viride,* TvAN-3, TvAN-5 and TvAN-8 were most efficient in their hyperparasitic ability and attaining S_1 stage at the earliest suppression of the growth of all test pathogens, whereas the isolates TvAN-6 and TvAN-9 being the poorest hyperparasites against the test pathogens.Similarly, the isolates ThmAN-4 and ThrAN-10 of *T. hamatum* (Table 3) were most efficient in suppression in mycelial growth of all test pathogens, attained S_1 stage at 4 days for *P. aphanidermatum* and *R. solani,* 5 days for *P. parasitica,* 6 days for *M phaseolina, F.o.*f. sp *lycopersici* and *S.rolfsii.*

Dual culture technique

In vitro antagonistic potential of twelve isolates of *Trichoderma* including two isolates from Mohanpur (W.B) were evaluated against six soil borne plant pathogens through dual culture method. The results presented in Tables 4-5, revealed that all the isolates of *Trichoderma* significantly inhibited the mycelial growth of all test plant pathogens compared to control, but they differed significantly among themselves and with the test pathogens involved. The results also suggested that pre-Tsunami isolates of antagonist fungi performed better with respect to mycelia growth inhibition of pathogens than post-Tsunami isolates regardless of pathogens considered. Highest percentage inhibition in growth of *P. aphanidermatum* was observed with TvAN-5 (61.7%) whereas the isolate ThrAN-5 was most efficient with respect to inhibition of mycelial growth of *P. parasitia* (62.2%). Similarly, pre-Tsunami chitin adapted isolates, ThrAN-5 resulted into 78.3% (*F.o.*f. sp. *lycopersici.*), 77.8% (*M. phaseolina*) and 81.9% (*R. solani*) growth inhibition, which appeared highest, whereas the isolate TvAN-3 caused high-

Table 4 : Antagonistic potential of *Trichoderma* isolates from Andaman and Nicobar Islands by dual culture test

Isolates of *Trichoderma*	Non-Chitin adapted						Chitin adapted					
	P.aphanidermatum		*P. parasitica*		*F.o.f sp lycopersici*		*P.aphanidermatum*		*P. parasitica*		*F.o.f sp lycopersici*	
	Radial mycelial growth (mm)	Inhibition (%)	Radial mycelial growth (mm)	Inhibition (%)	Radial mycelial growth (mm)	Inhibition (%)	Radial mycelial growth (mm)	Inhibition (%)	Radial mycelial growth (mm)	Inhibition (%)	Radial mycelial growth (mm)	Inhibition (%)
ThrWB-1	38.7*	57.0	39.5	56.1	33.3*	63.0	37.8	58.0	38.1	57.7	22.2	75.3
ThrWB-2	49.4	45.1	44.7	50.3	40.9	54.5	48.0	46.7	44.0	51.1	32.0	64.4
ThrAN-5	35.6	60.4	34.9	61.2	30.7	65.9	35.1	61.8	34.0	62.2	19.5	78.3
ThrAN-7	37.5	58.3	37.2	58.7	32.1	64.3	37.0	58.9	36.8	59.1	24.2	73.1
ThrAN-13	48.2	46.4	47.8	46.9	38.2	57.5	47.5	47.2	46.5	48.3	30.4	66.2
ThrAN-16	44.4	50.7	45.5	49.4	40.2	55.3	44.0	51.1	45.0	50.0	32.4	64.0
TvAN-3	37.8	58.0	36.5	59.4	33.5	62.8	36.0	60.0	36.2	59.8	20.4	77.3
TvAN-5	36.0	60.0	35.7	60.3	32.0	64.4	34.5	61.7	34.4	61.8	21.5	76.1
TvAN-8	43.5	51.7	46.2	48.7	43.5	51.7	42.0	53.3	45.2	49.8	28.6	68.2
TvAN-10	41.3	54.1	41.7	53.7	36.1	59.9	40.5	55.0	40.5	55.0	27.0	70.0
ThmAN-4	52.8	41.3	50.6	43.8	42.0	53.3	51.4	42.9	49.5	45.0	33.5	62.8
ThmAN-10	54.0	40.0	53.8	40.2	49.6	44.9	52.5	41.7	52.2	42.0	40.1	55.4
Control	90.0	0.0	90.0	0.0	90.0	0.0	90.0	0.0	90.0	0.0	90.0	0.0

	Antagonist	Chitin	Pathogen	Antagonist x Chitin	Antagonist x Pathogens	Chitin x Pathogen	Antagonist x Chitin x Pathogen
SE (±)	0.174	0.068	0.118	0.246	0.427	0.167	0.604
CD (0.05)	0.483	0.189	0.328	0.684	1.184	0.464	1.675

† Chitin supplementation up to 5th successive generation; *Mean of five replications

Table 5 : Antagonistic potential of *Trichoderma* isolates from Andaman and Nicobar Island by dual culture test*

Isolates of *Trichoderma*	Non-Chitin adapted						Chitin adapted					
	M. phaseolina		*R. solani*		*S. rolfsii*		*M. phaseolina*		*R. solani*		*S. rolfsii*	
	Radial mycelial growth (mm)	Inhibition (%)	Radial mycelial growth (mm)	Inhibition (%)	Radial mycelial growth (mm)	Inhibition (%)	Radial mycelial growth (mm)	Inhibition (%)	Radial mycelial growth (mm)	Inhibition (%)	Radial mycelial growth (mm)	Inhibition (%)
ThrWB-1	35.0	61.1	27.3	69.7	31.5	65.0	27.1	69.9	20.5	77.7	23.6	73.8
ThrWB-2	38.5	57.2	37.4	58.4	36.8	59.1	30.0	66.7	30.4	66.9	30.2	66.4
ThrAN-5	27.3	69.7	25.2	72.0	29.8	66.9	20.0	77.8	16.3	81.9	22.1	75.4
ThrAN-7	31.7	64.8	30.5	66.1	32.4	64.0	26.5	70.5	21.2	76.4	22.8	74.7
ThrAN-13	38.0	57.8	34.2	62.0	42.0	53.3	30.0	66.7	27.3	69.7	26.2	70.9
ThrAN-16	40.2	55.3	39.7	55.9	44.8	50.2	31.5	65.0	30.0	66.7	32.0	64.4
TvAN-3	32.9	63.4	29.0	67.8	34.5	61.7	21.2	76.4	18.5	79.4	21.0	76.7
TvAN-5	33.5	62.8	26.2	70.9	33.4	62.9	22.0	75.5	17.0	81.1	22.0	75.5
TvAN-8	40.5	55.0	32.9	63.4	43.8	51.3	25.5	71.7	22.5	75.0	29.6	67.1
TvAN-10	36.1	59.9	30.1	66.5	38.6	57.1	31.4	65.1	21.0	76.7	25.6	71.5
ThmAN-4	41.7	53.7	40.5	55.0	40.2	55.3	30.6	66.0	28.2	68.7	33.1	66.5
ThmAN-10	45.2	49.8	43.6	51.5	44.2	50.9	34.2	62.0	32.7	63.7	35.5	63.2
Control	90.0	0.0	90.0	0.0	90.0	0.0	90.0	0.0	90.0	0.0	90.0	0.0

	Antagonist	Chitin	Pathogen	Antagonist x Chitin	Antagonist x Pathogens	Chitin x Pathogen	Antagonist x Chitin Pathogen
SE (±)	0.174	0.068	0.118	0.246	0.427	0.167	0.604
CD (0.05)	0.483	0.189	0.328	0.684	1.184	0.464	1.675

† Chitin supplementation up to 5th successive generation; *Mean of five replications

est percentage inhibition of mycelial growth of *S. rolfsii* (76.7%).It also appeared that the isolate ThrAN-10 did not showed enough antagonistic potential irrespective of test pathogens causing only 41.2% reduction in growth in case of both *P. aphanidermatum* and *P. parasitica.* But it caused 63.7% inhibition in mycelial growth for *R. solani,* 62.0% for *M. phaseolina,* 63.2% for *S. rolfsii* and 55.4% for *F.o.*f. sp *lycopersici.* However, both isolates (ThrWB-1 and ThrWB-2) of *Trichoderma* from West Bengal were found to have with intermediate effect with respect to their hyperparasitic ability irrespective of pathogens tested and chitin or non-chitin adaptation. The chitim feeding of all *Trichoderma* isolates did not improved their antagonistic potential against both oomycetes fungi, *P. aphanidermatum* and *P. parasitica,* but they singnificantly enhanced antagonistic potential of *Trichoderma* spp. in the same condition exhibiting increased mycelial growth inhibition in case of *F.o.*f. sp *lycopersici, M. phaseolina, R. solani* and *S. rolfsii* as these pathogens having chitin as a main component in their cell wall composition.

Hyphal interaction

The microscopic observation of mycelia collected from the intersection zone of growth of both pathogen and antagonist revealed that the hyphae of antagonist grew parallel, coiled around the hyphae of *R. solani* and penetrated into the hyphae of pathogen by producing hook or knob like structures. The mycelia of pathogen, *R. solani,* twisted and curled, often fragmented hyphae of pathogen due to intense coiling and secretion of antifungal substances including cell wall degrading enzymes.

The fungal biocontrol agent, *Trichoderma* is known to antagonize numerous soil borne pathogenic fungi *in vitro* and under gree house/field conditions (Bell *et al.,* 1982; Papavizas, 1985; Mukhopadhyay, 1987; Harman, 2000; Harman *et al.,* 2004; Joshi *et al.,* 2007; Pan and Bhagat, 2007).Though the results of *in vitro* studies reflecting the antagonistic potential of the biocontrol agents are not always equally reflected to the same degree under field condition, yet such studies are of immense important for initial screening of the antagonists against host fungi (Bell *et al .,* 1982; Papavizas, 1985; Vinale *et al.,* 2008). All isolates of *Trichoderma* had not shown same degree of hyperparasitic activity against all test plant pathogens, the isolates showing intermediate reaction against one pathogen exhibited highly hyperparasitic activity against another pathogen. Accordingly, strong selectivity of the isolates of *Trichoderma* in their antagonistic potential towards a particular pathogen had been observed in the present investigation, though same isolates like ThrAN-5, TvAN- 3 and TvAN-5 were more or less got edge over other isolates of *Trichoderma* in their hyperparasitic actions against most of the pathogens screened. Variability in antagonistic potential among the different species of *Trichoderma* against different pathogens has been reported (Bell *et al.,* 1982; Dubey *et al.,*2007; Joshi *et al.,*2007; Pan and Bhagat, 2007). D'suza *et al.,*(2001) have observed clear variation in antagonistic potential on screening of *Trichoderma* against *S.rolfsii* and *Phytophthora parasitica* var. *nicotianae,* respectively. Similarly, Bell *et al.,* (1982) have screened 77 isolates of *T. harzianum* against six fungal pathogens and recorded significant differences between pathogen- antagonist interactions. Studies by several researchers (Mukherjee *et al.,* 1989; Kumar and Dubey, 2001, Gangwar *et al.,* 2004) had similarly shown that while same isolates were highly antagonistic to some pathogens yet there was clear variation in degree of antagonism. In fact, strain specificity against a particular pathogen is one of the major deterrent factors to commercialize the antagonist (Papavizas, 1985).In present finding, some of the *Trichoderma* isolates like ThrAN-5, TvAn-5 and TvAN-3 were highly efficient and more less equivalent to West Bengal isolate, ThrWB-1, in their antagonistic potential against all test pathogens. The possible explanation of this result may be due to their inherent potentiality to adapt well in introduced conditions (Papavizas, 1985), though it rarely occurs (Whips, 2001). Higher growth rate and greater competitive ability of the selected strains are the indicative of their better antagonistic potential. Mathur and Sarbhoy (1978) have reported that *T. viride* and *T. harzianum* inhibited the growth of *S. rolfsii* by 88 and 86%, respectively. Mathew and Gupta (1998) have showed that *T. harzianum* exhibited the maximum antagonistic activity causing 58.3% inhibition of pathogen followed by *T. hamatum, T. viride* and *T. virens* inhibiting 48.3, 46.1 and 44.9%, respectively. Recently, Noveriza and Quimio (2004) have reported that *Trichoderma* spp. were able to cause 66.36% growth inhibition of *P. capsici* through dual culture technique and the pathogens like *R. solani, Pythium* sp., *S. rolfsii, M. phaseolina* and *F.o.*f. sp.

lycopersici were also significantly inhibited by *Trichoderma* spp *in vitro* (Pan and Bhagat, 2007; Chaudhary *et al.,* 2007).

Mycoparasitism, the direct attack of one fungus on another, is a very complex process that involved sequential events, including recognition, attack and subsequent penetration and killing of the host. *Trichoderma* spp. may exert direct biocontrol by parasitizing a range of fungi, detecting other fungi and growing towards them (Harman *et al.,* 2004). Mycoparasitism involves morphological changes such as coiling and formation of appressorium like structures, which serve to penetrate the host and contain high concentrations of osmotic solutes such as glycerol (McIntyre *et al.,* 2004). *Trichoderma* attached to the pathogen with cell wall carbohydrates that bind the pathogen lectin.Once *Trichoderma* attaches itself, it coils around the pathogens hyphae and forms appressoria, which facilitates the entry of *Trichoderma* hyphae into lumen of the parasitized fungus and form the appressoria. The following consists of the production of various CWDEs and peptaibols (Howell, 2003).

The supplementation of chitin in the growth medium for successive generations seems to improve the antagonistic potential of *Trichoderma* spp. (Mach *et al.,* 1999; El- Katatny *et al.,* 2000, 2004; Donzelli and Harman, 2001; Vinale *et al.,* 2008). This is due to enhanced expression of chitinase gene which is responsible for secretion of chitinase. Though there is no direct relationship between chitin feeding and secretion of other cell wall degrading enzymes, but definitely there is some synergistic action of cell wall degrading enzymes (CDEs) and the plethora of antibiotics (both volatile and non-volatile substances) (Sivasithamparam and Ghisalberti, 1998; Vinale *et al.,* 2008) with biological activity, called " secondary metabolite. In present investigation, the chitin adapted isolates of *Trichoderma* exhibited better antagonistic potential against all the test pathogens except *P. aphanidermatum* and *P. parasitica,* since they lack chitin in their cell wall composition. Both *Pythium* and *Phytophthora* have glucan and cellulose in their cell walls. This result is consistent with the earlier findings (Tronsmo, 1991; Lorito *et al.,* 1993 and 1994) where they have conclusively reported that the purified CWDEs when tested alone or in combinations, showed broad spectrum of fungal pathogens i.e. species of *Rhizoctonia, Fusarium, Alternaria, Ustilago, Venturia* and *Colletotrichum,* as well as the oomycetes *Pythium* and *Phytophthora* which lack chitin in their cell walls. The present finding also suggested that the pre-Tsunami isolates exhibited better antagonistic potential by dual culture technique against all the test pathogens. This result may be due to sudden inundation with sea water after deadly Tsunami wave on 26th Dec. 2004, which lead salt deposition in the soil with great varieties of cations and anions.This temporary and much stress condition might have adversely affected the physiology of the antagonist resulting in reduction of hyperparasitic activity center dual culture technique.

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