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TRICHODERMA HAMATUM – A POTENTIAL BIOCONTROL AGENT FOR BASAL STEM ROT (*GANODERMA* WILT) DISEASE OF COCONUT

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ABSTRACT

Basal stem rot (*Ganoderma* wilt) disease caused by *Ganoderma* spp is one of the major constraints in coconut cultivation, especially in light soils of Andhra Pradesh. Native bio control agents, *Trichoderma* spp were isolated and were identified as *T.viride, T.harzianum* and *T.hamatum*. The compatibility of commonly used agrochemicals with native bioagents and test pathogen was determined. Talc formulations for the three spp of *Trichoderma* were developed. Neem cake, wheat grains and farmyard manure were found to be superior over other substrates for mass multiplication as indicated by maximum growth and sporulation of these bio agents. $ZnSO_4$ (2%) was found inhibitory to *Ganoderma* spp but not to *T.viride, T.hamatum* and *T.harzianum* (1% $ZnSO_4$). Field studies indicate that the talc formulations (50 g/palm) of *T.hamatum* alone and in combination with 5 kg neem cake potentially arrested the spread of the disease (0 to 3%) followed by *T.harzianum* and *T.viride* when fortified in neem cake @ 5 kg per palm.

INTRODUCTION

Basal stem rot (*Ganoderma* wilt) disease caused by *Ganoderma* spp. is one of the major constraints in coconut cultivation, especially in light soils of Andhra Pradesh. Though, several researchers (Bhaskaran and Ramanathan, 1983; Bhaskaran *et.al.*, 1994 and Srinivasulu *et.al.*, 2001) reported different management practices against the disease, the results are inconsistent and not much work has been done relating to the aspects of greater ecological sustainability, keeping in view the minimal use of fungicides. Hence, the present investigation was taken up to exploit the bio control efficacy of native biocontrol agents existing in Coastal Ecosystem in combating the disease in Coastal Andhra Pradesh *per se*.

MATERIALS AND METHODS

Soil samples were collected from coconut gardens of Coastal Agro-Ecosystem of Andhra Pradesh. *Trichoderma* spp population was estimated in different soils by adopting serial dilution technique and the existing spp of *Trichoderma* are identified. The inhibitory effect of *Trichoderma* spp against *Ganoderma* spp was assessed on PDA by adopting dual culture technique. The efficacy of fungicides, chemicals and plant products against *Ganoderma* spp. and *Trichoderma* spp. was determined by adopting poisoned food technique. Talc formulations of *Trichoderma* spp. were developed by using broth culture homogenate and talc powder at 1 : 2 ratio along with 1 per cent carboxy methyl cellulose. Field trials were conducted in farmers' gardens in Gannavaram and Vodelarevu village of East Godavari and ARS, Vijayarai by employing 50 g of talc formulation of *Trichoderma* spp in combination with neem cake (5 kg) and farmyard manure (10 kg) per palm.

RESULTS AND DISCUSSION

The isolated native *Trichoderma* spp *viz.*, *Trichoderma viride* per., *T.harzianum* rifai., and *T.hamatum* (Bon.) Bain were found to inhibit the mycelial growth of *Ganoderma applanatum* and *G.lucidum* under *in vitro* conditions (Srinivasulu *et.al.*, 2001). The compatibility of commonly used agrochemicals in coconut cropping system with native bioagents *viz.*, *T.harzianum, T.viride, T.hamatum* and the test pathogens *viz.*, *Ganoderma applanatum* and *G.lucidum* was determined by adopting poisoned food technique. *In vitro* compatibility studies revealed that among the agrochemicals tested, all the fungicides *viz.*, Bordeaux mixture (1%), Copper oxychloride (0.3%), Bitertanol (0.1%), Trideomorph (0.1%), Hexaconazole (0.1%) and Triademifon (0.1%) were found to completely inhibit the growth of both the species of *Ganoderma* and the three spp of

Trichoderma under study (Table–1). The inhibition effect of fungicides on *Ganoderma* spp. was reported by several workers (Anbalagan and Shanmugan, 1984; Sindha mathar and Balasubramaniam, 1987). Though the fungicides proved detrimental at normal recommended dosages on the growth of *Ganoderma* spp completely, their incompatibility with all the three species of *Trichoderma* is of concern. This indicates the fact that the bioagents and these commonly used fungicides cannot be used in conjunction in controlling the basal stem rot disease. However, genetically resistant strains of *Trichoderma* spp. to these fungicides will prove an ideal combination in integrated basal stem rot disease management schedule.

Among the fertilizers tested (Table 1), neem cake, urea and potash at their normal recommended dosages inhibited both *Ganoderma applanatum* and *G.lucidum* only marginally (3.05 to 6.87% inhibition). On the other hand, none of the fertilizers under study did inhibit all the three species of *Trichoderma* (0% inhibition), indicating the fact that native *Trichoderma* species can be exploited in combating basal stem rot disease under recommended dosages of fertilizers and without altering the time and dosage of fertilizer schedule. The micronutrient fertilizer $ZnSO_4$, though found to inhibit the growth of *G.applanatum* and *G.lucidum* completely, it significantly hampered the growth of all the species of *Trichoderma* (22.22 to 44.44 per cent inhibition). The micronutrient, manganese sulphate, when applied @ 227 g/palm/year reduced the intensity of basal stem rot disease in coconut (Jaganathan and Ramasami, 1975)

Of all the plant extracts examined, garlic extract at 10% concentration completely arrested the growth of all the three spp of *Trichoderma* and both the spp of *Ganoderma*. Neem oil on the other hand, when used at 2% concentration, suppressed more of the *Trichoderma* spp growth than that of *Ganoderma* spp. From the above results (Table–1), it was evidently known that both garlic extract and neem oil individually cannot form an ideal combination with biocontrol agents in integrated management of the basal stem rot disease of coconut.

Talc formulations of the three spp of *Trichoderma* under study were developed under laboratory conditions. Mass multiplication studies indicated that maximum growth and sporulation

Table 1: Compatibility of commonly used agrochemicals with *Trichoderma* spp. and *Ganoderma* spp. under *in vitro* conditions

Agrochemicals/ Plant Product	Con. (%)	Per cent inhibition over control				
		T.vir	*T.har*	*T.ham*	*G.app*	*G.luc*
Bordeaux Mixture	1	100	100	100	100	100
Copper oxychloride	0.3	100	100	100	100	100
Bitertonol	0.1	100	100	100	100	100
Trideomorph	0.1	100	100	100	100	100
Hexaconazole	0.1	100	100	100	100	100
Triadimefon	0.1	100	100	100	100	100
Zinc Sulphate (1 % con.)	2	22.22	44.44	22.22	100	100
Neem cake	2	0	0	0	6.19	6.87
Urea	1	0	0	0	5.31	4.58
Potash	2	0	0	0	4.42	3.05
Neem Oil	2	22.22	22.22	22.22	5.31	5.34
Garlic Extract	10.0	100	100	100	100	100
Control (Mycelial growth in mm on PDA)	-	90	90	90	56.5	65.5

of *Trichoderma viride, T.harzianum and T.hamatum* was on neem cake and wheat grains followed by farmyard manure only after seven days (Table–2).

To test the efficacy of different treatments and their combinations in controlling the basal stem rot disease, on farm evaluation trials were taken up. The treatments were imposed on each palm and mean vertical spread of the lesions caused by *Ganoderma* spp on the coconut palm was recorded after six months (Table–3). Of all the three spp of *Trichoderma* tested alone, *T.hamatum* could effectively check the spread of the disease with absolutely no disease spread even after six months. This was followed by *T.harzianum* and *T.viride* with a lesion spread of 34.3 and 43.2 cm over 95 cm in the corresponding control. *T.viride* and *T.harzianum* were also reported to be antagonistic to *Ganoderma lucidum* (Gunashekaran *et.al.*, 1986; Bhaskaran 1990). Among the organics applied, vertical spread of the disease was checked effectively by neem cake 5 kg/palm as evident by the linear spread up to only 14.4 cm over the corresponding control. This was followed by farmyard manure @ 10 kg/palm (37.5 cm) as against 95.0 cm in control. Vijayan and Natarajan (1975) also reported that application of 5 kg neem cake or 50 kg farmyard manure or green leaves or 300 kg tank silt every year was beneficial in arresting the progress of the disease.

Table 2 : Substrate for mass multiplication of *Trichoderma* spp. and *Ganoderma* spp.

Substrate	Mycelial Growth (after 7 days)				
	T.vir	*T.har*	*T.ham*	*G.app*	*G.luc*
Neem Cake	+++	+++	+++	+	+
FYM	++	++	++	++	++
Wheat grains	+++	+++	+++	++	++
Coconut coir	—	—	—	—	—
Coconut dry leaf powder	—	—	—	—	—
Poultry manure	—	—	—	—	—

— No growth, + Slight growth, ++ Moderate growth, +++ Maximum growth

Table 3 : Efficacy of bio control agents on spread of basal stem rot disease in coconut

Treatments	per palm	Mean vertical spread (cm)
T_1	*Trichoderma viride* (50 g)	43.2 (6.26) *
T_2	*Trichoderma harzianum* (50 g)	34.3 (4.97)
T_3	*Trichoderma hamatum* (50 g)	0.0 (0.70)
T_4	*T.viride* (50 g) + Neem cake (5 kg)	0.0 (0.70)
T_5	*T.harzianum* (50 g) + Neem cake (5 kg)	0.0 (0.70)
T_6	*T.hamatum* (50 g) + Neem cake (5 kg)	3.0 (1.62)
T_7	*T.viride* (50 g) + FYM (10 kg)	30.9 (3.74)
T_8	*T.harzianum* (50 g) + FYM (10 kg)	34.5 (3.69)
T_9	*T.hamatum* (50 g) + FYM (10 kg)	18.4 (3.05)
T_{10}	Neem cake (5 kg)	14.4 (3.47)
T_{11}	FYM (10 kg)	37.5 (6.15)
T_{12}	Control	95.0 (8.17)
CD (p=0.05)	3.97	

* Figures in parenthesis are square-root transformed values

Among different combinations tested for their efficacy in checking the disease spread at field level, the combinations of bio control agents and neem cake were found effective as evidenced by the vertical spread of the disease ranging from 0 to 3 cm over control palms. The combined application of *Trichoderma* spp with farmyard manure was also found to be effective in checking the disease. This was evident by the vertical spread of lesions, which ranged from 18.4 to 34.5 cm over control. Thus, the combined application of bio agents with neem cake and farmyard manure was found to be synergistic, with the organic matter in neem cake and farmyard manure forming a substrate for growth, multiplication and establishment of the bio agents in the rhizosphere and finally in checking the disease spread. Thus, the combination of the *Trichoderma* spp and neem cake will form an ideal combination in suppressing the vertical spread of the basal stem rot disease of coconut effectively and hold promise in the integrated approach to mange the disease.

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