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STUDIES ON THE MANAGEMENT OF *PYTHIUM APHANIDERMATUM* (EDSON) FITZP, THE INCITANT OF TURMERIC RHIZOME ROT BY USING BIO INOCULANTS

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Abstract

The present studies were undertaken to investigate the effect of bio control agents against rhizome rot of turmeric. The application of combination of antagonistic fungal and bacterial was found to be more effective in suppressing the rhizome rot rather than individual application of the antagonists. Among the biocontrol agents tested, a combination of a fungal and a bacterial antagonist of (*Trichoderma viride* and *Pseudomonas fluorescens*) as rhizome dip and soil application after 3rd and 5th month of planting recorded the least disease incidence when compared to control. It was followed by the individual application of biocontrol agent's *viz., Trichoderma viride* and *Pseudomonas fluorescens* which recorded least disease suppression. The same effect which was recorded in stem girth, Plant height, number of leaves and yield in turmeric.

Key words: Turmeric, Rhizome rot, *Pythium*, Biological control

Introduction

Turmeric is susceptible to many diseases, *viz.,* leaf blight, anthracnose and rhizome rot etc. Among the various diseases, rhizome rot caused by Pythium sp. is a major problem in all turmeric growing areas of India (Ramarethinam and Rajagopal, 1999). Rhizome rot of turmeric incited by *Pythium aphanidermatum* (Edson) Fitz, was first reported in Sri Lanka by Park (1934) and in India it was reported from Krishna district of Andhra Pradesh, Tiruchirapalli and Coimbatore of Tamil Nadu by Ramakrishnan and Sowmini (1954).

The primary symptoms of the disease are drying of the leaves starting from the margin. Water soaked spots in collar region, toppling down of infected tillers, rotting of roots and the affected rhizome becoming hollow with only fibrous tissues left behind. In has given up its cultivation owing to the frequent rhizome rot disease that destroyed the crops. These soil borne diseases are difficult to manage with chemical applications. Indiscriminate use of pesticides caused adverse changes in the natural eco-system. This include persistence of undesirable chemicals in the ground water, heavy metals toxicity increased incidence of cancer and related disorders through the toxic residues carried in grain, agricultural and animal products (Lumseden *et al.,* 1983) and also development of resistant strains of the plant pathogens against the chemicals. In the light of certain constraints on management practices, biological control has been advocated as the most promising strategy (Mukhopadhyay *et al.,* 1992). The fungal bioagents *Trichodema* spp, *Gliocladium virens* and fluorescent *Pseudomonas* have been reported to be effective against several plant pathogens (Mukhopadhyay, 2001). Therefore the present studies were undertaken to investigate the effect of bio control agents against rhizome rot of turmeric.

Materials and Methods

Screening of biocontrol agents against rhizome rot of turmeric under pot culture condition

To study the biocontrol potential of the antagonists, *Trichoderma viride, Trichoderma harzianum, Pseudomonas fluorescens* an experiment was conducted under pot culture condition. The talc based formulation of the antagonistic bacteria and fungi were delivered as rhizome dip and as soil application on 3rd and 5th month after planting (MAP). The pathogen (*P. aphanider-*

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matum) mass multiplied on sand maize medium was incorporated in the pots at 5 percent (w/w) under glass house condition. The observations on the percent disease incidence of rhizome rot were recorded at the time of harvest In addition growth parameters like height, number of leaves and stem girth were recorded at bimonthly intervals.

Each treatment was replicated thrice and the treatment details include,

Treatment schedule

T_1 : *T. viride* rhizome treatment (10g/lit)

T_2 : *T. viride* rhizome dip + soil application (3rd + 5th MAP)

T_3 : *T. harzianum* rhizome treatment (10g/lit)

T_4 : *Trichoderma harzianum* rhizome dip + soil application (3rd + 5th MAP)

T_5 : *P. fluorescens* rhizome dip (10g/lit)

T_6 : *P. fluorescens* soil application (3rd + 5th MAP)

T_7 : *Trichoderma viride* + *P. fluorescens* rhizome dip + soil application (3rd + 5th MAP)

T_8 : COC (0.2%) rhizome dip + soil application (3rd + 5 MAP)

T_9 : Control (inoculated)Isolation and identification of pathogen

Table 1: Effect of Biocontrol agents on the rhizome rot of turmeric (Pot culture).

Tr. No.	Treatments	Rhizome rot incidence (%)	Yield (g/plant)
T_1	*T. viride* (rhizome treatment)	19.67b	430.00c
T_2	*T. viride* (soil application @ 5th MAP)	22.15c	335.00d
T_3	*T. harzianum*(rhizome treatment)	23.17d	325..00e
T_4	*Trichoderma harzianum* (soil application @ 5th MAP)	25.33e	320.00f
T_5	*P. fluorescens* (rhizome dip)	27.67f	318.00g
T_6	*P. fluorescens*(soil application @ 5th MAP)	29.57g	309.00h
T_7	*Trichoderma viride* +*P. fluorescens* (rhizome dip + soil application @ 3rd + 5th MAP)	17.67a	495.00a
T_8	COC	30.66h	464.00b
T_9	Control	72.66i	202.00i

Table 2: Effects of Biocontrol agents on the height of turmeric plants (Pot culture).

Tr. No.	Treatments	Plant height (cm)		
		120 days	180 days	270 days
T_1	*T. viride* (rhizome dip)	26.42b	39.80b	72.33b
T_2	*T. viride* (soil application @ 3rd and 5thMAP)	25.73c	37.16c	70.93c
T_3	*T. harzianum* (rhizome treatment)	24.06d	35.06d	69.25d
T_4	*Trichoderma harzianum* (soil application @ 3rd and 5th MAP)	23.40e	33.73e	67.16e
T_5	*P. fluorescens* (rhizome dip)	22.96f	30.76f	65.16f
T_6	*P. fluorescens* (soil application @3rd and 5thMAP)	21.76g	29.85g	60.15g
T_7	*Trichoderma viride* + *P. fluorescens* (rhizome dip + soil application @ 3rd + 5th MAP)	28.03a	47.06a	79.36a
T_8	COC	19.66h	30.07h	57.66h
T_9	Control	14.33i	25.55i	53.67i

*values in the column followed by same letters not differ significantly by DMRT (P=0.05).

Results and Discussion

Rhizome rot incidence

The biocontrol agents were screened for its efficacy under pot culture condition for the management of rhizome rot of turmeric. Application of biocontrol agents through rhizome dip and soil application enhanced the germination of turmeric rhizomes. Application of bacterial and fungal antagonists revealed that rhizome dip and soil application was effective in reducing the rhizome rot incidence. The application of combination of antagonistic fungal and bacterial was found to be more effective in suppressing the rhizome rot rather than individual application of the antagonists.

Among the biocontrol agents tested, a combination of a fungal and a bacterial antagonist of (T_7 *Trichoderma viride* and *Pseudomonas fluorescens*) as rhizome dip and soil application after 3rd and 5th month of planting recorded the least disease incidence of 17.67 percent. It was followed by the individual application of biocontrol agent's *viz.*, *Trichoderma viride* and *Pseudomonas fluorescens* which recorded 19.67 and 27.67 percent respectively. Bacterial bio inoculant *P. fluorescens* was found to be inferior to the fungal antagonist in terms of inhibition of diseases incidence and yield. The experimental results on the effect of biocontrol agents on the yield explained that the yield of rhizome was significantly influenced by the application of biocontrol agents. All the treatments were found to be superior when compared to healthy control. Maximum rhizome yield of 495g/plant was recorded in the treatment T_7 *Trichoderma viride* + *Pseudomonas fluorescens* rhizome dip + soil application (3rd + 5th MAP), whereas in the control

the rhizome yield was 202g/plant. The chemical treatment with COC recorded an yield of 464 g/ plant whereas the inoculated control showed a high disease incidence and a least yield of 202g/plant table 1.

Seed treatment with combined application of *T.viride + P.fluorescens + zimmu* leaf extract was superior in reducing the pre and post emergence damping off and increased plant growth and yield of chilli (Muthukumar *et al.,* 2010). Prabhu karthikeyan *et al.,* (2018) reported that the combined application (RD + SD) with FP7 liquid formulation reduced the incidence of rhizome rot in two field trials (10.18% and 13.29%) respectively.

Table 3: Effect of Biocontrol agents on the stem girth of turmeric plants (Pot culture).

Tr. No.	Treatments	Stem girth (cm)		
		120 days	180 days	270 days
T_1	*T. viride* (rhizome dip)	3.75b	5.75b	7.95b
T_2	*T. viride* (soil application @ 3rd and 5th MAP)	3.66c	5.57c	7.32c
T_3	*T. harzianum* (rhizome treatment)	3.36d	5.45d	7.25d
T_4	*Trichoderma harzianum* (soil application @ 3rd and 5th MAP)	3.20e	5.05e	7.07e
T_5	*P. fluorescens (*rhizome dip)	3.16f	4.76f	6.97f
T_6	*P. fluorescens* (soil application @ 3rd and 5th MAP)	3.03g	4.27g	6.60g
T_7	*Trichoderma viride + P. fluorescens* (rhizome dip + soil application @ 3rd + 5th MAP)	3.82a	5.85a	8.17a
T_8	COC	2.75h	3.95h	5.95h
T_9	Inoculated Control	1.44i	2.77i	3.25i

Table 4: Effects of Biocontrol agents on the no. of leaves of turmeric plants under pot culture.

Tr. No.	Treatments	No. of leaves (cm)		
		120 days	180 days	270 days
T_1	*T. viride* (rhizome dip)	7.75b	9.33b	10.67b
T_2	*T. viride* (soil application 3rd and 5th MAP)	7.23c	8.97c	9.72c
T_3	*T. harzianum* (rhizome treatment)	6.97d	7.66d	8.52d
T_4	*Trichoderma harzianum* (soil application @ 3rd and 5th MAP)	6.67e	7.56e	8.35e
T_5	*P. fluorescens* (rhizome dip)	5.52f	6.93f	7.63f
T_6	*P. fluorescens* (soil application @3rd and 5th MAP)	5.35g	6.69g	7.36g
T_7	*Trichoderma viride +P. fluorescens* (rhizome dip + soil application @ 3rd + 5th MAP)	8.69a	10.69a	12.35a
T_8	COC	5.25h	7.33h	5.33h
T_9	Control	2.00i	3.33i	4.67i

The parameters like plant height, stem girth and no. of leaves/ clump were also increased when treated with biocontrol agents when compared to untreated control. The effects of different biocontrol agents at different intervals on the height of turmeric plants are presented in the table 2.

All the biocontrol agents significantly increased the height of turmeric plants. Maximum plant height of 28.03 cm, 47.06 cm and 79.36 cm was recorded in the treatment T_7 (*Trichoderma viride + Pseudomonas fluorescens*) rhizome dip + soil application on 3rd + 5th MAP at 120, 180 and 270 days after planting respectively. Application of *P.fluorescens* as rhizome dip and soil application was on par with healthy control. The control plants recorded a height of 14.33, 25.55 and 53.67cm at 120, 180 and 270 days after planting respectively.

The stem girth was significantly influenced by the application of biocontrol agents. Fungal bio inoculants were found to be superior to bacterial inoculant in all the days of observation. The maximum stem girth was recorded in T_7 *Trichoderma viride +Pseudomonas fluorescens* rhizome dip + soil application (3rd + 5th MAP) recording stem girth of 3.82, 5.85 and 8.17 cm on the 120, 180 and 270 days after planting. The second best results were shown in T1 followed by T2 and I3. However in control the stem girth was only 1.44, 2.77, and 3.25cm on 120, 180 and 270 days after planting, which was significantly lower than the other treatments table 3.

Among the different treatments maximum no. of leaves were found on the plants treated with (*Trichoderma viride + Pseudomonas fluorescens*) rhizome dip + soil application (3rd + 5th MAP) with 12.35 leaves on the 270th day. Followed by Treatments T_2 and T_3 recording 10.67 and 9.72 no. of leaves. The control showed a severe reduction (4.67 no.of leaves) in the formation of leaves on the 270th day of observation. All the treatments were found to be superior when compared to control table 4.

Dohroo (2012) evaluated all the treatments significantly reduced disease incidence and also resulted in improvement in different growth and yield parameters of ginger as compared to control. Amongst all the treatments, soil application with *T. harzianum* proved most effective with minimum disease incidence (26.77 %), highest per cent germination (72.07 %), with total weight of rhizome per pot (223.50 g). Plant growth promotion by rhizo

bacterial strains includes production of plant growth hormones, production of iron chelating siderophores and production of 1-amino cyclopropane-1- carboxylate deaminase (Ashraf *et al.*, 2013).

Prabhu karthikeyan *et al.*, (2018) reported that an increase in the mean root length (10.70, 10.50cm) and shoot length (14.36, 13.20cm) was observed due to application of FP7 and TPF54 respectively. A maximum vigour index of 2506 was observed in turmeric treated with FP7 bacterial suspension and less vigour index of 1068.80 was recorded from the untreated control.

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