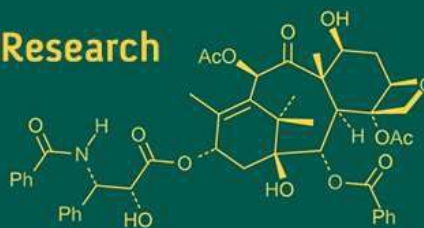


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B Mahender

Turmeric Research Station,
Kammarpally, Sri Konda
Laxman Telangana State
Horticultural University,
Siddipet, Telangana, India

P Srinivas

Turmeric Research Station,
Kammarpally, Sri Konda
Laxman Telangana State
Horticultural University,
Siddipet, Telangana, India

Priming of rhizomes with trichoprime: A new biological way to control the rhizome rot in turmeric

B Mahender and P Srinivas

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Abstract

The trial has been conducted at the turmeric research station, Kammarpally for the continuous of three years from 2020-21 to 2022-23 to assess the potential of priming of turmeric seed rhizomes with trichoprime before sowing of seeds to control rhizome rot to enhance the yield of turmeric. Significant differences were observed with all the growth parameters and the mean maximum sprouting percentage (88.34), mean maximum plant population (40.06), maximum mean plant height (116.7 cm), number of shoots (2.54), were recorded with T₁-Rhizome treatment with Trichoprime and The mean maximum fresh weight of clump (351.4 gm), maximum mean fresh rhizome yield per plot (13.12 kg/plot) and maximum mean fresh rhizome yield per hectare (34.42 t/ha) have been observed with T₁-Rhizome treatment with Trichoprime. Rhizome rot incidence (PDI) was observed minimum (3.09, 4.05 and 18.47) at 30, 60 and 90 DAP respectively in treatment with application of trichoprime followed by minimum PDI 3.88, 6.14 and 22.47 at 30, 60 and 90 DAP respectively with T₂-Rhizome treatment with metalaxyl-mancozeb @ 1.25 g/L+ Imidacloprid 0.5 ml/L for 30 minutes.

Keywords: Trichoprime, rhizome rot incidence, fresh rhizome yield, priming

Introduction

Turmeric, *Curcuma longa* L., which is a member in Zingiberaceae, was originated from South-east Asia. Turmeric is known as the “golden spice” as well as the “spice of life”. Turmeric was consumed in multidisciplinary such as food, spice, cosmetic and medicine. It has been used in India as a medicinal plant and held sacred from time immemorial. It is a dye, with varied usages in drug and cosmetic industries. It is used as medicinal for external application and taken internally as a stimulant. It is now important in medical science because curcumin and volatile oils of turmeric rhizomes have anti-inflammatory, antimutagen, anticancer, antibacterial, anti-oxidant, antifungal, antiparasitic and detoxing properties. These components also promote liver and kidney function and alleviate biliary disorders, diabetic and hepatic disorders. Various supplements and drinks derived from the turmeric are widely being used for keeping good health.

The world's largest producer, consumer and exporter of spices is India, often referred as the land of spices. Cardamom and black pepper are the two commodities that yield the most foreign exchange, followed by turmeric (*Curcuma longa* L.). About 80 percent of global production and 60 percent of exports are attributed to India, which is the leading producer of turmeric worldwide. 5,34,000 tonnes of turmeric are produced annually on 1,34,000 hectares of land in India (Ravikumar, 2002) [6]. Diseases such as rhizome rot, anthracnose and leaf blight affects turmeric. Ramarethinam and Rajagopal (1999) [7] indicated that rhizome rot incited by *Pythium* sp. is a major constraint in all areas of India that grow turmeric. According to Rathiah (1987) [8] the disease caused up to 95% of crop yield loss due to symptoms such as collapse of tillers, rotting roots and the hollow rhizome leaving only fibrous tissues. According to Nirmal (1992) [9] the disease results in 50–80% yield loss during storage and more than 60% seedling mortality in both nursery and field conditions. Rhizome rot also causes a 50% yield loss (Rajalakshmi *et al.*, 2016) [10]. Rhizome rot has become more common as a result of intensive turmeric farming. Fungicide-induced rhizome rot control has decreased soil microbial biodiversity and led to the emergence of pathogen strains that are resistant to the disease. The need for alternate plant protection techniques has arisen from growing concerns about the effects of pesticide misuse on the environment.

Corresponding Author:**B Mahender**

Turmeric Research Station,
Kammarpally, Sri Konda
Laxman Telangana State
Horticultural University,
Siddipet, Telangana, India

The present research thus focuses into the use of antagonistic bioinoculants to manage turmeric rhizome rot in a way that's environmentally friendly.

Materials and Methods

The field experiment was conducted to study the effect priming of turmeric seed rhizomes with trichoprime on growth and yield of turmeric at Turmeric research station, Kammarpally, Nizamabad district, Telangana during 3 consecutive years from 2020 to 2023. The experimental initial soil status was less alkaline pH (7.65), electric conductivity 0.15 dS m⁻¹, low organic carbon with medium available nitrogen (250 kg ha⁻¹), high available phosphorus (32.57 kg ha⁻¹) and high available potassium (332.7 kg ha⁻¹). This experiment was laid in a randomized block design with three replications. T₁-Rhizome treatment with Trichoprime, T₂-Rhizome treatment with metalaxyl-mancozeb @ 1.25 g/L+ Imidacloprid 0.5 ml/L for 30 minutes, T₃-Rhizome treatment with tebuconazole @ 1ml /L+ Imidacloprid 0.5 ml/L for 30 minutes, T₄- Recommended state package of practices. Generally, the seed was sown in the month of June and harvested after completion of 8 months in the month of March during the experimental years.

Mode of application

1. Dissolve 1 kg of trichoprime in 10 L water
2. Soak 25 kg of the seed materials of turmeric in the dissolved solution for 15 minutes
3. Shade dry the seed materials
4. Store the treated and dried seed materials of turmeric for 2- 4 weeks

Recommended cultural practices were adopted for all treatments. Growth parameters viz., Sprouting percentage, plant population, plant height, number of tillers, recorded in the second week of January month. Yield parameters data was recorded at harvesting time. Rhizome rot incidence (PDI) was recorded at 30, 60 and 90 days after sowing. In case of growth and yield parameters data was recorded from five plants from each replication and the means are used for statistical analysis

Results

Significant differences were observed with all the growth parameters and the mean maximum sprouting percentage (88.34), mean maximum plant population (40.06), maximum mean plant height (116.7 cm), number of shoots (2.54), were recorded with T₁-Rhizome treatment with Trichoprime which may be due to the rhizome treatment

with trichoprime resulted in the reduced disease incidence, reduced rhizome rot incidence and increased plant biomass. The specific activities of the antagonists that occur during its growth are probably more important in pathogen suppression (Reddy *et al.*, 2003) [12]. Baker and Cook 1974 revealed that seed and soil application of consortia of *T. viride* and *P. fluorescens* recorded the least disease incidence of 0.79% with maximum yield of 60.19 t ha⁻¹ as compared to control and the highest cost benefit ratio of 1: 3.3. Similar results were reported by several workers. Better and effective biological control results can be expected from mixtures of antagonists rather than from high populations of a single antagonist since more the antagonists more will be the stability. Suppression of rhizome rot of turmeric was achieved through soil application of *T. viride* at the rate of 1kg ha⁻¹ (Ramarethinam and Rajagopal, 1999) [7]. Similarly application of a mixture of introduced biocontrol agents would more closely mimic the natural dynamics and might broaden the spectrum of biocontrol activity and enhance the efficacy and reliability of control (Duffy and Weller, 1998) [12]. Application of consortia formulation of *P. chlororaphis* isolate PA 23 and *B. subtilis* isolate CBE 4 as rhizome dip and soil application (third and fifth months after planting) recorded the least rhizome rot incidence with higher yield (Kavitha, 2004) [13].

The mean maximum fresh weight of clump (351.4 gm), maximum mean fresh rhizome yield per plot (13.12 kg/plot) and maximum mean fresh rhizome yield per hectare (34.42 t/ha) have been observed with T₁-Rhizome treatment with Trichoprime. Rhizome rot incidence (PDI) was observed minimum (3.09, 4.05 and 18.47) at 30, 60 and 90 DAP respectively in treatment with application of trichoprime followed by minimum PDI 3.88, 6.14 and 22.47 at 30, 60 and 90 DAP respectively with T₂-Rhizome treatment with metalaxyl-mancozeb @ 1.25 g/L+ Imidacloprid 0.5 ml/L for 30 minutes. The results are in conformity with P. Muthulaxmy *et al.*, 2006 revealed that the biocontrol agents applied plots recorded significant reduction of the disease incidence by soil application. Among the treatments, seed and soil application of *T. viride* and *P. fluorescens* recorded the maximum yield of 69.36 and free from rhizome rot symptom. The control plot recorded the disease incidence of 9.66 percent with yield of 38.63t ha⁻¹. The cost benefit ratio revealed that the seed and soil application of biocontrol agents recorded maximum ratio of 1: 3.3 followed by 1: 1.30 in *B. subtilis* sprayed plot. Seed and soil application of consortia of *T. viride* and *P. fluorescens* @ 4 g kg⁻¹ and 2.5kg ha⁻¹ was found to be effective for the control of turmeric rhizome rot.

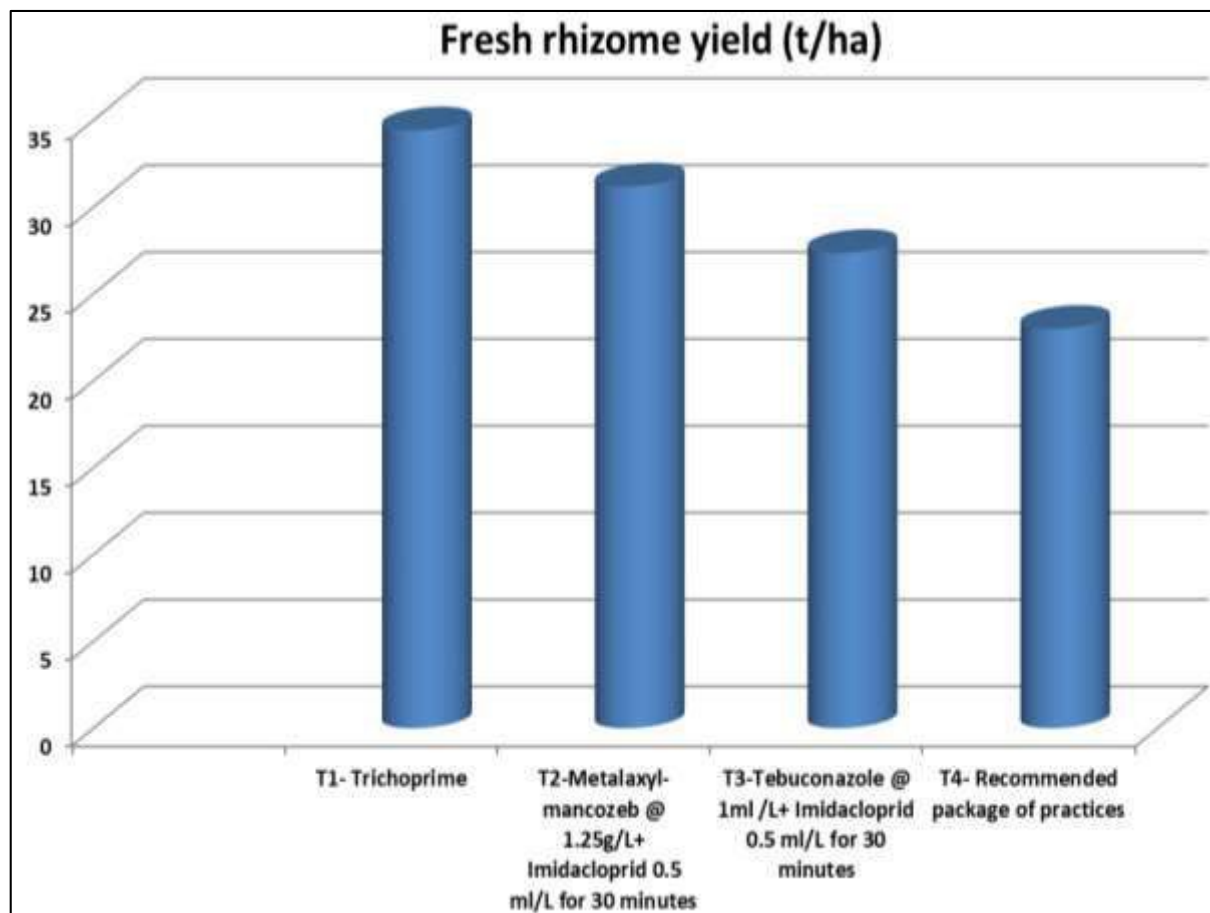


Fig 1: Priming of rhizomes with trichoprim: A new biological way to control the rhizome rot in turmeric

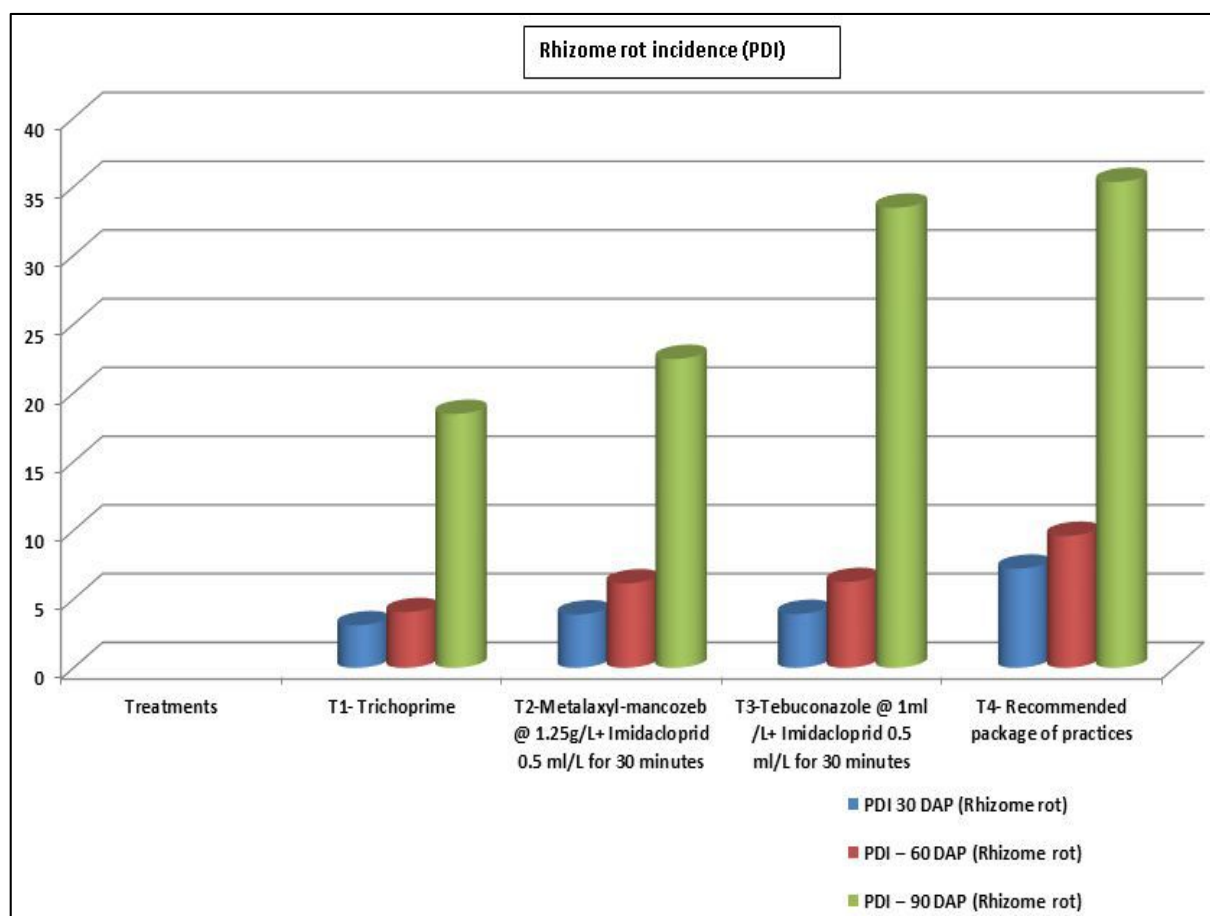


Fig 2: Priming of rhizomes with trichoprim: A new biological way to control the rhizome rot in turmeric

Table 1: Priming of rhizomes with trichoprime: A new biological way to control the rhizome rot in turmeric

Treatments	Sprouting percentage (%)			Pooled mean	Plant population (50 DAS)			Pooled mean	Plant height (cm)			Pooled mean	Number of tillers			Pooled mean
	2020-21	2021-22	2022-23		2020-21	2021-22	2022-23		2020-21	2021-22	2022-23		2020-21	2021-22	2022-23	
T ₁ - Trichoprime	85.2	81.5	98.33	88.34	39.7	40.5	40.0	40.06	100.8	133.1	116.43	116.7	2.4	2.3	2.93	2.543
T ₂ -Metalaxyl-mancozeb @ 1.25 g/L+ Imidacloprid 0.5 ml/L for 30 minutes	92.1	77.66	84.66	84.80	39.2	38.83	36.7	38.2	94.8	127.37	97.10	106.4	2.4	2.2	2.63	2.41
T ₃ -Tebuconazole @ 1ml /L+ Imidacloprid 0.5 ml/L for 30 minutes	89.6	65.0	73.33	75.97	34.6	32.83	39.4	35.6	100.5	110.06	107.90	106.1	2.2	2.2	2.33	2.24
T ₄ - Recommended package of practices	90.4	62.5	73.33	75.41	38.2	33.0	34.9	35.3	102.2	129.07	101.86	111.0	2.7	2.27	2.06	2.34
SE(m)	63.45	62.07	1.27	42.26	1.87	3.086	2.98	2.6	1.089	5.569	1.71	2.78	0.190	0.134	0.19	0.171
CD (5%)	N.S	N.S.	3.89	3.89	N.S	N.S.	N.S		3.312	N.S.	5.20	4.25	N.S.	N.S.	0.602	0.602
CV %	138.4	149.5	3.81	97.23	16.42	20.542	12.54	16.50	2.677	10.999	3.95	5.87	18.861	14.683	19.50	17.68

Table 2: Priming of rhizomes with trichoprime: A new biological way to control the rhizome rot in turmeric

Treatments	Fresh weight of clump (gm)			Pool mean	Fresh rhizome yield (kg/plot)			Pool mean	Fresh rhizome yield (t/ha)			Pool mean
	2020-21	2021-22	2022-23		2020-21	2021-22	2022-23		2020-21	2021-22	2022-23	
T ₁ - Trichoprime	372.1	272.33	410.00	351.4	12.13	13.10	14.15	13.12	32.36	35.55	35.37	34.42
T ₂ -Metalaxyl-mancozeb @ 1.25 g/L+ Imidacloprid 0.5 ml/L for 30 minutes	265.4	216.33	221.67	234.4	10.77	12.23	12.53	11.84	28.72	33.50	31.33	31.18
T ₃ -Tebuconazole @ 1ml /L+ Imidacloprid 0.5 ml/L for 30 minutes	287.4	205.33	214.16	235.6	9.18	11.90	11.31	10.79	24.47	29.32	28.29	27.36
T ₄ - Recommended package of practices	254.1	212.0	156.86	207.6	6.49	11.57	10.09	9.383	17.31	26.44	25.22	22.99
SE(m)	12.34	14.138	5.079	10.51	0.282	0.455	0.169	0.302	0.752	0.96	0.423	0.71
CD (5%)	34.5	43.005	15.449	30.98	0.858	1.384	0.515	0.919	2.287	2.935	0.287	1.83
CV %	16.87	12.601	4.979	11.48	7.162	8.684	3.450	6.432	7.162	7.572	3.450	6.06

Table 3: Priming of rhizomes with trichoprime: A new biological way to control the rhizome rot in turmeric

Treatments	PDI 30 DAP (Rhizome rot)			Pool mean	PDI – 60 DAP (Rhizome rot)			Pool mean	PDI – 90 DAP (Rhizome rot)			Pool mean
	2020-21	2021-22	2022-23		2020-21	2021-22	2022-23		2020-21	2021-22	2022-23	
T ₁ - Trichoprime	2.96	3.12	3.21	3.09	3.98	4.12	4.05	4.05	17.65	18.65	19.12	18.47
T ₂ -Metalaxyl-mancozeb @ 1.25 g/L+ Imidacloprid 0.5 ml/L for 30 minutes	3.89	3.78	3.98	3.88	6.21	6.10	6.13	6.14	21.56	23.54	22.33	22.47
T ₃ -Tebuconazole @ 1ml /L+ Imidacloprid 0.5 ml/L for 30 minutes	3.92	3.96	3.89	3.92	6.25	6.34	6.13	6.24	32.14	33.95	34.33	33.47
T ₄ - Recommended package of practices	6.87	7.32	7.44	7.21	9.24	9.65	9.92	9.60	35.26	34.21	36.58	35.35
SE(m)	0.145	0.137	0.139	0.140	0.154	0.127	0.133	0.138	3.124	1.987	2.144	2.41
CD (5%)	6.24	6.17	7.44	6.61	8.25	7.987	9.92	8.719	11.98	13.12	12.52	12.54
CV %	0.124	0.087	0.098	0.103	0.075	0.097	0.094	0.088	47.25	43.25	56.51	49.0

Conclusion

Rhizome seed treatment with Trichoprime before the sowing of seed is proved to decrease the rhizome rot incidence and improve growth and fresh rhizome yield in turmeric. Hence the use of trichoprime priming before sowing of seed in turmeric cultivation is best for control rhizome rot and improve yield

Future scope

Further field research and testing must be conducted to completely discover the potential of trichoprime and develop feasible, widespread applications. Eco-friendly biocontrol approaches that significantly decrease the rhizome rot incidence and other diseases and enhance plant growth and increase crop yields are need to be studied.

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