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Eco-friendly Management of Leaf spot Disease of Turmeric

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ABSTRACT: Turmeric growers in Odisha have challenges to manage the loss in yield from 40 to 60 per cent due to leaf spot disease. To increase productivity, bio-agents and chemicals are tested in the field to minimize the incidence of disease. An experiment became conducted to evaluate the efficacy of bio-agents and fungicides *viz.*, seed remedy with *T. viride*@5gkg^{-1} of seed & *P. fluorescens* @10gkg^{-1} of seed, soil utility of 4kg bio-agents of *T. viride* & *P. fluorescens* in 10 qtls of FYM incubated in 30% moisture for 15 days under shed and bio-agents of *T. viride* & *P. flurescens* in 10qts of FYM incubated in 30% moisture for 15 days below shed and applying during earthing up, seed treatment with *T. viride* @5gkg^{-1} of seed & *P. fluorescens*@ 10gkg^{-1} of seed + soil applications of 4kg bio-agents of *T. viride* & *P. flurescens* in 10qts of FYM incubated in 30% moisture for 15 days under shed and applying throughout earthing up, Seed remedy with Propiconazole @0.1% + Foliar spray of Propiconazole (0.1%) at 45 & 60DAP for the control of leaf spot disease of turmeric (Curcuma longa) in the nearby research generation transfer Station, G. Udayagiri, Kandhamal, Odisha university of Agriculture and era, Bhubaneswar. Percent disease intensity has been substantially reduced from 42.22 (untreated control) to 14.00 in seed treatment with *T. viride* @5gkg^{-1} of seed & *P. fluorescens* @10gkg^{-1} of seed + soil application of 4kg bio-agents of *T. viride* & *P. flurescens* in 10qtls of FYM incubated in neem cake -cow dung combination @ 1.5qha^{-1} incubated in 30% moisture for 5 days underneath shed and making use of in the course of earthing up, seed application with *T. viride* @5gkg^{-1} of seed & *P. fluorescens* @10gkg^{-1} of seed + soil application of 4kg bio-agents of *T. viride* & *P. flurescens* in 10qts of FYM incubated in 30% moisture for 15 days under shed and applying throughout earthing up determined to be best treatments with highest yield 14.82 (tha^{-1}) followed by seed treatment with Propiconazole @0.1% + Foliar spray of Propiconazole (0.1%) at 45 & 60DAP with 14.11 tha^{-1} yield and 16.41 % disease intensity.

Keywords: *Curcuma longa*, fungicides, percentage disease intensity, leaf spot, turmeric.

INTRODUCTION

Turmeric (*Curcuma longa* L) the ancient and sacred spice of India known as Indian saffron is an important commercial spice crop grown in India. India is the largest producer, consumer and exporter of turmeric in the world. The world production scenario is dominated by India which contributes 80%. Major turmeric producing states in India are Andhra Pradesh, Tamil Nadu, Odisha, Karnataka, West Bengal and Gujarat. The productivity of West Bengal is very low at 2.66 tha^{-1} (Source: Directorate of Arecanut and Spices Development (DASD), Calicut). One factor behind this low productivity in West Bengal is various foliar diseases, especially turmeric leaf spot.

Leaf spot is caused by *Collectotrichum capsici* [(Syd.) Butler & Bisby]. Loss due to disease can vary from 20 to more than 60% in some cases (Nair and Ramakrishnan 1973). To increase productivity, bio-agents and chemicals are tested in the field to minimize the incidence of disease. Turmeric (*Curcuma longa* L.) is one of the most important spice crops grown in India. This crop is highly susceptible to several fungal diseases (Naidu, 1988; Purthi, 2000). Serious foliar diseases on turmeric reported in UP are leaf spot caused by *Colletotrichum capsica* (Syd.). Leaf spot is the most important disease resulting in losses of 25.83 – 62.12% fresh weight and 42.10 – 62.10% dry weight of rhizomes (Nair & Ramakrishnan 1973; Hudge & Ghogul 2020). Leaf spot usually appears in the last week of August or the first week of September when the crop is two months old.

C. capsici has been reported to reduce dry rhizome yield by 62.7% (Nair & Ramakrishnan 1973). Considering the economic importance of the crop, efforts have been made to evaluate various biological agents and fungicides to manage this disease. A field experiment was conducted at Regional Research Technology Transfer Station, G. Udayagiri, Odisha University of Agriculture and Technology, from 2020 to 2022 in Roma variety of turmeric.

MATERIALS AND METHODS

This experiment was conducted for five bio-agents and one number of fungicides at Regional Research

Technology Transfer Station, G. Udayagiri, Kandhamal, Odisha University of Agriculture Technology. The study was arranged in a randomized block design with seven treatments and three replications. The rhizomes were planted in 3 × 1 m plots at 30 × 25 cm spacing in the 2nd week of June. Other normal agronomic practices were adopted for growing crops apart from fungicide treatment. Five bio-agents and one fungicide were tested i.e. T_1-seed treatment with *T. viride*@5gm/kg seed & *P. fluorescens* @10gkg^{-1} seed, T_2- application of 4kg *T. viride & P. fluorescens* bio-agent to soil in 10 qtls FYM incubated in 30% humidity for 15 days under shelter and application during earthing up, T_3-soil application 4 kg bio-agent *T. viride* & *P. flurescens* incubated in neem cake - cow dung mix @ 1.5qha^{-1} incubated in 30% humidity for 5 days under shelter and applied during earthing up, T_4- seed treatment *T. viride* @5gkg^{-1} seed & *P. fluorescens* @10gkg^{-1}seed+soil application 4kg bio-agent *T. viride* & *P. flurescens* in 10qts FYM incubated in 30% humidity for 15 days under shelter and application during earthing up, T_5-seed treatment with *T. viride* @5gkg^{-1} seed & *P. fluorescens*@10gkg^{-1} seed + soil application 4kg bio –agents *T. viride* & *P. flurescens* in 10qts of FYM incubated at 30% humidity for 15 days under shelter and applied during earthing up, T_6-Seed fungicide treatment with Propiconazole @0.1% + foliar spray with propiconazole (0.1%) at 45 and 60DAP for treatment of turmeric leaf spot. Recommended NPK + FYM 5t/ha+ Sal leaves 6tha^{-1} in each treatment.

Observed germination was recorded at 30 DAP, leaf spot intensity was recorded 15 days after the last spray i.e. 80 DAS on 10 randomly selected plants in each replication for disease assessment. Disease scores were recorded using the 0-6 scale of Palarpawar & Ghurde (1989), where 0 = no infection (healthy plants), 1 = 0.1-10% infected leaf area, 2 = 10.1-20% infected leaf area, 3=20. 1-30% infected leaf area, 4=30.1-40% infected leaf area, 5=40.1-50% infected leaf area, 5= > 50% infected leaf area. The percentage disease intensity (PDI) was calculated according to the formula proposed by Mayee & Datar (1986) given below; PDI = [(sum of scores of infected leaves per plant)/ (total number of leaves observed × maximum disease score)] × 100 (Palarpawar & Ghurde 1989).

Observed germination was recorded at 30 DAP, leaf spot intensity was recorded 15 days after the last spray i.e. 80 DAS on 10 randomly selected plants in each replication for disease assessment. Illness ratings were recorded by adopting a 0-6 scale (Palarpawar & Ghurde 1989).

The economics of each treatment were worked out by calculating production costs, fungicide expenditure, costs and labour cost for spraying. The cost-benefit ratio was determined for treatments per hectare based on the existing selling rates of turmeric in the local market. Data obtained in all experiments were statistically analyzed. Percentage values were converted to Arcsine values. A summary analysis for this study was conducted from 2020 to 2022 and the results are shown in Table 1. All treatments showed a significantly higher effect than the control on germination, disease intensity and yield.

RESULTS AND DISCUSSION

All treatments showed significantly better effect than control on germination, PDI and yield. Germination of rhizomes varied from 89 to 92.87%. The maximum germination was found in the seed treatment of *T. viride* @ 5 gkg^{1} seed & *P. fluorescens* @ 10 gkg^{1} seed + soil application of 4 kg bio-agent *T. viride* & *P. flurescens* in 10qts FYM incubated in 30% humidity for 15 days under shelter and application during earthing up at 45 and 90DAP 0f 92.87% followed by soil application of 4kg bio-agent *T. viride* & *P. fluorescens* in 10qts incubated FYM 30% humidity for 15 days under the shed and by up to 92.83% when applied during the earthing up. Seed treatment of *T. viride* @5gkg^{1} seed & *P. fluorescens* @10gkg^{1}seed+soil application of 4kg bio-agent *T. viride & P. flurescens* in 10qt FYM incubated in 30% humidity for 15 days under shed and application during earthing up at 45 and 60°C DAS recorded the lowest leaf spot severity of 14.00. followed by seed treatment with fungicide Propiconazole @0.1% + foliar spray propiconazole (0.1%) at 45 and 60 DAP (0.1%) at 45 and 60 days after planting (T_6) in 2020 - 2022 (Leaf spot PDI 16.41 as shown in Table 1). The intensity of the disease varied from 14.00 to 42.22 during the three years of the study. The pooled analysis for this study was conducted from 2020 to 2022 and the results are shown in Table 1. All treatments showed significantly lower disease incidence than the control over the three years of investigation. The least incidence of the disease was observed in the seed treatment of *T. viride* @5 gkg^{1} seed & *P. fluorescens* @10gkg^{1} seed + soil application of 4 kg bio-agent *T. viride* & *P. fluorescens* in incubation in a mixture of neem cake and cow dung @ 1 .5 qha^{-1} incubated at 30% humidity for 5 days under shed and applied during earthing up at 45 and 90 DAP and seed treatment with propiconazole @0.1% + foliar spray with propiconazole (0.1%) at 45 and 60 DAP , which were equal to each other with a PDI of 14.00% and 16.41%, respectively, and were found to be significantly better than other treatments. The highest yield of fresh rhizome was achieved by seed treatment of *T. viride* @5gm/kg seed & *P. fluorescens* @10gkg^{1} seed+ soil application of 4kg bio-agent *T. viride & P. fluorescens* in incubated in neem-cake-dung mixture @ 1.5 qha^{1} incubated at 30% humidity for 5 days under shelter and applied during earthing at 45 and 90 DAP (14.82 t ha^{1}). The results of this study showed that rhizome treatment with seed treatment of *T. viride* @5gkg^{1} seed & *P. fluorescens* @10gkg^{1} seed + soil application of 4kg bio-agent *T. viride & P. fluorescens* in incubated in a mixture of neem cake and cow dung @ 1.5 qha^{1} incubated at 30% humidity for 5 days under shed and applied during earthing up at 45 and 90 DAP was effective in reducing disease incidence and increasing yield.

Economics. Economics for each treatment was calculated based on the average yield of the pooled analysis.

All treatments were economically beneficial over the control.

Rhizome treatment with *T. viride* @5gmkg^{-1} seed & *P. fluorescens* @10g kg-1 seed + soil application of 4kg bio-agent *T. viride* & *P. fluorescens* in incubated in neem cake -cowdung mixture@ 1.5qha^{1} incubated in 30% moisture for 5 days under shed and applied during earthing up at 45 and 90 DAP gave the economic return (1:1.48) followed by rhzobium treatment and foliar application of propiconazole (1:1.41). Therefore, it is concluded that Rhizome treatment with *T. viride* @5gkg^{-1} seed & *P. fluorescens* @10gkg^{-1} seed+ soil application 4kg bio-agent *T. viride* & *P. fluorescens* incubated in neem cake & cow dung mixture @ 1.5qha^{1} incubated in 30% humidity for 5 days under shed and application during earthing up at 45 and 90 DAP was effective in reducing the incidence of leaf spot and increasing the yield of turmeric. All treatments significantly reduced disease intensity compared to the control. The results are supported by the findings of Rao *et al.* (2012)

Table 1.

Treatments	% of Germination	PDI	% efficacy disease control	Yield (kgplot^{-1})	Yield (tha^{-1})	B:C Ratio
T1- seed treatment with *T. viride* @5gkg^{-1} of seed & *P. fluorescens* @10gkg^{-1} of seed	89.50	25.83 (30.10)	38.58	6.07	12.24	1.22
T2 soil application of 4kg bio-agents of *T. viride & P. flurescens* in 10qts of FYM incubated in 30% moisture for 15 days under shed and applying during earthing up	92.83	24.44 (28.76)	42.11	6.51	13.12	1.31
T3 soil application of 4kg bio-agents of *T. viride & P. flurescens* in incubated in neem cake -cowdung mixture @ 1.5qha^{-1} incubated in 30% moisture for 5 days under shed and applying during earthing up .	89.50	20.28 (28.31)	44.91	6.82	13.35	1.33
T4 seed treatment with *T. viride* @5gkg^{-1} of seed & *P. fluorescens* @10gkg^{-1} of seed + soil application of 4kg bio-agents of *T. viride & P. flurescens* in 10qts of FYM incubated in 30% moisture for 15 days under shed and applying during earthing up	90.50	17.63 (24.55)	58.24	6.95	14.01	1.40
T5. - seed treatment with *T. viride* @5gkg^{-1} of seed & *P. fluorescens*@10gkg^{-1} of seed + soil application of 4kg bio-agents of *T. viride & P. flurescens* in incubated in neem cake -cowdung mixture @ 1.5qha^{-1} incubated in 30% moisture for 5 days under shed and apply during earthing up	92.87	14.00 (22.19)	64.73	7.35	14.82	1.48
T6-Seed treatment with Propiconazole @0.1% + Foliar spray of Propiconazole (0.1%) at 45 & 60DAP	92.50	16.41 (22.54)	61.73	7.00	14.11	1.41
T7-control	91.00	42.22 (40.28)	-	5.15	10.38	-
SE(m)+	1.538	2.158		0.272		
CD(0.05)	4.308	6.042		0.762		
Figures in parentheses are angular transformed values						
N.B. Recommended NPK + FYM 5tha^{-1} + Sal leafs 6t/ha in every treatments, seed treatment with *T. viride* @5gkg^{-1} of seed & *P. fluorescens* @10gkg^{-1} of seed + soil application of 4kg bio-agents *of T. viride & P. flurescens* in incubated in neem cake -cowdung mixture @ 1.5qha^{-1} incubated in 30% moisture for 5days under shed and apply during earthing up can able to manage the disease upto 64 %.						

CONCLUSION AND FUTURE SCOPE

Seed treatment with *T. viride* @5gkg^{-1} of seed & *P. fluorescens* @10gkg^{-1} of seed+ soil application of 4kg bio-agents *of T. viride & P. flurescens* in in incubated neem cake -cowdung mixture @ 1.5qha^{-1} incubated in 30% moisture for 5days under shed and apply during earthing up can able to manage the disease upto 64 %.Farmers field research and MLTs are to continued for further research.

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