International Journal of Agriculture and Plant Science
www.agriculturejournal.in
Online ISSN: 2664-7664
Received: 30-01-2026, Accepted: 01-03-2026, Published: 17-03-2026
Volume 8, Issue 1, 2026, Page No. 243-246

Management of leaf spot disease of turmeric

D K Debata
Professor, RRTTS, G. Udayagiri, Kandhamal, Odisha, India

Abstract
Turmeric (*Curcuma longa*) is one of the most important commercial spice crops cultivated in Odisha state. Roma, Suroma, Ranga, Lakdong and Rasmi varieties of turmeric which has sought its place in global spice market due to high curcumin content (5-7%) of its rhizomes. The leaf spot disease caused by *Colletotrichum spp*. is considered as a major constraint of turmeric cultivation. Therefore, with an aim to organically manage the leaf spot disease, eco-friendly disease management practice was carried out at RRTTS (Regional Research Technology Transfer Station), G. Udayagiri, Kandhamal, OUAT (Odisha University of Agriulture and Technology). The causal agent was isolated and characterized through cultural, morphological and microscopical studies and proved the Koch postulate. In the field experiment,T1-seed treatment with *T. viride*@5gm/kg seed & *P. fluorescens* @10gkg^{-1} seed, T2- 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, T3-soil application 4 kg bio-agent *T. viride* & *P. flurescens* incubated in neem cake - cow dung mixture @ 1.5qha^{-1} incubated in 30% humidity for 5 days under shelter and applied during earthing up, T4- 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, T5-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, T6-Seed fungicide treatment with Propiconazole @0.1% + foliar spray with propiconazole (0.1%) at 45 and 60DAP for treatment of turmeric leaf spot.T7-Control Recommended NPK + FYM 5t/ha+ Sal leaves 6tha^{-1} in each treatment. It was found that 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 up to 64%.

Keywords: Eco -friendly, *T. viride*, *P. flurescens*, leaf spot

Introduction

India is recognized worldwide as 'Land of Spices'. It is the largest producer, consumer and exporter of spices in the world followed by China. India consumes 90 percent of its production for domestic purpose. Among 109 spices grown all over the world India alone grows about 63 of them. Turmeric (*Curcuma longa* L.) is an important spice crops which is grown in India since time immemorial. It is an herbaceous perennial plant that belongs to the family Zingiberaceae (Jansen, 1981) [9]. It is considered as a sign of well-being and future and is extensively used in ceremonies and religious functions. It is grown mainly for its underground rhizome which yields yellow powder upon drying (Chattopadhyan, *et al.*, 2004; Nongmaithem and Rebika, 2019) [3, 15]. Pharmaceutically, it is carminative, antiseptic and antiparasitic for many skin infections (Guji and Woga, 2019; Ahmad *et al.*, 2020) [1, 6]. It cures the sore throat, common cold and used as an appetizer and helps in digestion. It is also used in the preparation of cosmetics, soaps, skin ointments and tooth pastes. India dominates the turmeric market in the world as about 80 percent of turmeric production in the world comes from India with an average production of 13.34 lakh metric tons from the area of 3.50 lakh hectares. In India turmeric is grown in as many as 25 states and among them Telangana, Andhra Pradesh, Karnataka, Tamil Nadu and Gujarat are the leading producers of turmeric. In Karnataka, it is grown in an area of 21.31 thousand hectares with a production of 1.31 lakh metric tons. (Anon, 2022). The major production limitations in turmeric are long duration, low rhizome yield, low curcumin content of popular varieties and incidence of diseases. There is a quite substantial part of total harvest loss due to the diseases affecting the crop year after year. Among these, rhizome rot and foliar diseases are important ones. Among the foliar diseases, the leaf spot disease of turmeric caused by *Colletotrichum capsici* is more destructive and prevalent in major turmeric growing areas and losses caused by leaf spot are always considered to be a limiting factor for yield, quality of rhizomes and often results in heavy yield losses. In India, it was first reported from the state of TamilNadu in 1917 by McRae. He identified the causal agent as *Colletotrichum capsici* (McRae 1917). Later, it was found that *Colletotrichum gloeosporioides* was also able to cause the leaf spot disease with similar symptoms (Chawda *et al* 2012) [4]. The symptoms manifest as elliptical to oblong spots on leaves with greyish centre enclosed by a reddish-brown margin with prominent yellow halo. At the center of the spot, black coloured acervuli forms in concentric circles as black dotted structure (Ramakrishnan 1954). The disease is mainly debris borne, but the pathogen can persist in the scales of harvested rhizomes as well as in soil. The secondary spread occurs through conidia dispersed by rain splashes occurring as a result of intermittent rain and wind. The disease spreads devastatingly during summer months when there is high humidity in the air. The disease leads to reduction of 50.11 per cent of curcumin content in rhizomes and hence lowers its quality. It has been reported that the disease can cause 40-60 per centyield loss of rhizomes (Hudge and Ghugul 2010) [7]. The management approaches for leaf spotdisease

of turmeric are quite not satisfactory. Over use/mis-use of chemical fungicides may lead to development of resistant strain of the pathogen, thereby can pose more threat to turmeric cultivation. Also, higher cost involved in procuring chemical pesticides and its related harmful impacts on social as well as biological level has shifted the focus of many towards organic agriculture with sustainable approaches. Therefore, considering the gravity of the situation, the current research program me was formulated with a vision to develop a eco-friendly management practice for leaf spot of turmeric.

Materials and Methods

This experiment was conducted for five bio-agents and one number of fungicides at Regional ResearchTechnology 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. T1-seed treatment with *T. viride*@5gm/kg seed & *P. fluorescens* @10gkg $^{-1}$ seed, T2- 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, T3-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, T4- 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, T5-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, T6-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 6 tha $^{-1}$ in each treatment.

Observed germination was recorded at 30 DAP, leaf spot intensity was recorded 15 days after the last sprayi.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) [16], 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% infectedleaf area, 5=40.1-50% infected leaf area, 6= > 50% infected leaf area. The percentage disease intensity (PDI) was calculated according to the formula proposed by given below;

PDI = [(sum ofscores of infected leaves per plant)/ (total number of leaves observed × maximum disease score)] × 100 (Palarpawar & Ghurde 1989) [16].

Observed germination was recorded at 30 DAP, leaf spot intensity was recorded 15 days after the last sprayi.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) [16].

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 2024 to 2025 and the results are shown in Table 1. All treatments showed a significantly higher effect than the control on germination, disease intensity and yield.

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 (T6) in 2024 - 2025 (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 2024 to 2025 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 (21.35 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 (1:3.20) followed by rhizome treatment and foliar application of propiconazole (1:3.04). 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) [18]. Mina *et al*. (2009) [12] recorded the effectiveness of propiconazole against turmeric anthracnose disease under field conditions and found that propiconazole at 0.1 percent, hexaconazole at 0.1 percent, mancozeb at 0.25 percent and carbendazim at 0.1 percent are effective in managing of anthracnose of turmeric and also in obtaining significantly higher yield. Rao *et al*. (2012) [18, 22] evaluated the efficacy of four different fungicides *viz*., propiconazole (0.1 percent), hexaconazole (0.1 percent), tricyclazole (0.1 percent) and carbendazim + mancozeb (0.1 percent) for the management of leaf spot disease (Colletotrichum capsici) of turmeric (Curcuma longa L.) at Kammarpally (Andhra Pradesh). Rhizome treatment with carbendazim + mancozeb (0.1 percent) gave better germination (90.52 percent) and rhizome treatment and foliar application of propiconazole (0.1 percent) at 45 and 90 days after planting (DAP) were significantly superior in reducing the disease index (20.01 percent) of leaf spot disease and increasing the fresh rhizome yield (17.13 tones/ha). Mishra and Pandey (2015) [14] evaluated the efficacy of four fungicides *viz*., hexaconazole (0.1%), propiconazole (0.1%), tricyclazole (0.1%) and carbendazim + mancozeb (0.1%) for the management of leaf spot disease of turmeric through rhizome treatment + foliar spray and foliar spray alone at 45 and 90 days after planting (DAP). Rhizome treatment with carbendazim + mancozeb gave the best results for rhizome germination (91.13%) followed by propiconazole (88.40%) and hexaconazole (87.33%). Foliar application of propiconazole (0.1%) at 45 and 90 DAP was significantly superior in minimizing percent disease intensity (27.61) with increased fresh rhizome yield (33.96 - 34.33 tones/ha). Jibat and Asfaw (2021) [10] in their experiment in South-Western Ethiopia found on the efficacy of fungicides against turmeric leaf spot caused by *Colletotrichum capsici* the fungicide propiconazole superior not only in reducing disease severity but also maximizing rhizome fresh yield. Benefit cost ratio (B: C ratio) The economics of different fungicidal treatments was also studied and presented in the table 4. The fungicide carbendazim at 1 g per litre spray was proved to be the most economical treatment (BC ratio 2.44) followed by propiconazole 0.5 ml per litre (BC ratio 2.36). It is evident from the present investigations that under Bagalkot conditions the four sprays of carbendazim at the rate of 0.1 percent was the best and economical for the effective management of turmeric leaf spot followed by hexaconazole 0.05 percent with net return of Rs. 149549/- and Rs. 143467/- over the check respectively. Narasimhudu and Balasubramanian (2001) [14] reported on the fungicide mancozeb recording highest benefit: cost ratio followed by carbendazim and thiophanate-methyl in their studies on efficacy of fungicides against turmeric leaf spot disease. Similar work in the past about achieving maximum B:C ratio with the fungicide propiconazole (Mishra and Pandey, 2015; Jibat and Asfaw, 2021) [10] while working on the efficacy of fungicides against turmeric leaf spot caused by *Colletotrichum capsici* supports our findings.Das *et al* (2015) revealed about the antagonistic potential of with *T. harzianum* against *C. capsici* of 83.44 per cent growth inhibition, followed by *T. viride* with per cent inhibition of 77.62 per cent. Dutta *et al* (2018) [5] has reported that *T. pseudokoningii* is highly effective against *C.capsici*. Dutta and Das (2002), Das *et al*(2006) in-*vitro* found that apart from antagonistic activity of spp., this genus of bio-control Trichoderma agents can promote plant growth parameters, *viz*.

higher percentage of seed germination, increased number of leaves, increased plant height, higher

yield etc. Patel *et al*. (2022) [17] reported the fungicide propiconazole being highly effective when tested *in vitro* against *Colletotrichum capsici*, the causal agent of chilli anthracnose.

Table 1: Management of leaf spot disease of turmeric

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	14.99	2.24
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	15.35	2.30
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	16.14	2.42
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	19.53	2.92

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	21.35	3.20
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	20.33	3.04
T7-control	91.00	42.22 (40.28)	-	5.15	9.91	1.48
SE(m)+	1.538	2.158		0.272	2.43	
CD(0.05)	4.308	6.042		0.762	7.05	
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.

References

1. Ahmad RS, Hussain MB, Sultan MT, Arshad MS, Waheed M, Shariati MA, *et al*. Biochemistry, Safety, Pharmacological Activities, and Clinical Applications of Turmeric: A Mechanistic Review. Evidence Based Complementary and Alternative Medicine,2020:2020:1-14.
2. Anonymous. Major state wise area and production of spice crops,2022. http://www.indianspices.com.
3. Chattopadhyan L, Biswas K, Bandyopadhyay U, Banerjee RI. Turmeric and curcumin: Biological action and medicinal applications. Current Sciences,2004:87:44-53.
4. Chawda SK, Salpora AN, Pandya JR. Epidemiology of turmeric leaf spot (*Colletotrichum gleosporioides* Penzand Sacc.). The Bioscan,2012:7:441-443.
5. Dutta P, Bhowmic P, Bruah S. Effect of extracellular metabolites of *Trichoderma pseudokongii* on radial growth of *Fusarium oxysporum*, *Colletotrichum capsici*, *Rhizoctonia solani*. International Journal of Current Microbiology and Applied Sciences,2018:7:874-879.
6. Guji MJ, Woga WG. Assessment of *Colletotrichum* leaf spot disease of turmeric in major growing area of Southwestern Ethiopia. International Journal of Research in Agriculture and Forestry,2019:6:24-27.
7. Hudge BV, Ghugul SA. Losses in yield and quality of turmeric due to leaf spot disease caused by *Colletotrichum capsici*. International Journal of Agricultural Sciences,2010:6:43-45.
8. Jagtap GP, Mali AK, Dey U. Bioefficacy of fungicides, bio-control agents and botanicals against leaf spot of turmeric incited by *Colletotrichum capsici*. African Journal of Microbiology Research,2013:7:1865-1871.
9. Jansen PCM. Spices, condiments and medicinal plants in Ethiopia: Their taxonomy and agricultural significance. Journal of General Microbiology,1981:98:39-66.
10. Jibat M, Asfaw M. Efficacy of fungicides in control of turmeric leaf spot caused by *Colletotrichum capsici* at Tepi, Southwestern Ethiopia. Pesticides and Phytomedicine,2021:36:119-124.
11. McRae W. Notes on some south Indian fungi. Madras Agricultural Year Book,1917:108-111.
12. Mina K, Kothikar RB, Patil CU. Fungicides and botanicals for management foliar disease of turmeric. Journal of Plant Disease,2009:4:68-71.
13. Mishra RS, Pandey VP. Management of leaf spot of turmeric (*Curcuma longa* L.) caused by *Colletotrichum capsici* through fungicides. Journal of Spices and Aromatic Crops,2012:21:151-154.
14. Narasimhudu Y, Balasubramanian KA. Fungicidal management of leaf spot of turmeric incited by *Colletotrichum capsici*. Indian Phytopathology,2001:55:527-528.
15. Nongmaithem N, Rebika T. Screening of fungicides against leaf spot of turmeric caused by *Colletotrichum capsici*. The Pharma Innovation Journal,2019:8:12-14.
16. Palarpur MY, Ghurde VR. Fungicidal control of leaf spot of turmeric incited by *Colletotrichum curcumae*. Indian Phytopathology,1989:42:576-578.
17. Patel AM, Rakholiya KB, Panara KN, Paladiya SH. *In vitro* evaluation of fungicides against *Colletotrichum capsici* (Sydow) Butler and Bisby causing anthracnose disease of chilli. The Pharma Innovation Journal,2022.
18. Rao SN, Kumar KR, Anandaraj M. Management of leaf spot of turmeric (*Curcuma longa* L.) incited by *Colletotrichum capsici* through fungicides. Journal of Spices and Aromatic Crops,2012:21:151-154.