



Management of *Colletotrichum* leaf spot of turmeric through fungicides

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Abstract

The major foliar diseases of turmeric (*Curcuma longa* L.) reported in Uttar Pradesh are leaf spot caused by *Colletotrichum capsici* and leaf blotch caused by *Taphrina maculans*. Leaf spot generally appears in September and October, which can reduce rhizome yield upto 62.5%. Therefore, the experiment was conducted to evaluate 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 (0.1%) gave the best results for rhizome germination (91.13%) followed by Propiconazole (88.40%) and Hexaconazole (87.30). Foliar application of Propiconazole (0.1%) at 45 and 90 DAP was significantly superior in minimizing percent disease intensity (27.61 PDI) in comparison to foliar spray + rhizome treatment with Hexaconazole (28.50 PDI) and Tricyclazole (33.73 PDI). The fresh rhizome yield ranged from 33.96 - 34.33 t ha⁻¹ with Propiconazole and 31.15 - 33.22 t ha⁻¹ with Hexaconazole as compared to the control (28.17 t ha⁻¹). C: B ratio was found to be highest (1:2.65) with foliar spray of Propiconazole.

Keywords: *Colletotrichum capsici*, *Curcuma longa*, fungicides, leaf spot, turmeric

Turmeric (*Curcuma longa* L.) is one of the most important spice crops cultivated in India. It is a rhizomatous herbaceous perennial plant of the family *Zingiberaceae*. Turmeric is used in flavouring, dye making, drug preparation, cosmetics and medicine (Jagtap *et al.* 2013). The annual production of turmeric in India is about 1062.5 thousand MT from an area of 199.0 thousand hectares. In Uttar Pradesh, the area covered under turmeric cultivation is 1828 ha with a production of 5149 MT (Anonymous 2012). This crop is highly prone to several

fungal diseases (Naidu 1988; Pruthi 2000). The serious foliar diseases on turmeric reported in UP are leaf spot caused by *Colletotrichum capsici* (Syd.) Butler & Bisby and leaf blotch caused by *Taphrina maculans* Butler. Among them, leaf spot is the most important disease of turmeric resulting in losses of 25.83-62.12% fresh weight and 42.10-62.10% dry weight of rhizomes (Nair & Ramakrishnan 1973; Hudge & Ghugul 2010). Keeping in view the economic importance of the crop, efforts were made to evaluate various fungicides for managing the disease.

The field experiments were conducted at Vegetable Research Farm, N.D. University of Agriculture & Technology, Kumarganj, Faizabad from 2010–2012 in sandy loam soil with leaf spot disease susceptible variety NDH-1. The trial was laid out in randomized block design with nine treatments and three replications. Rhizomes were planted on raised beds of 3 m × 1 m size at a spacing of 30 cm × 20 cm in the first fortnight of June. The other normal agronomical practices were adopted to raise the crop as and when necessary except, the fungicide treatments. Four fungicides *viz.*, Hexaconazole (0.1%), Propiconazole (0.1%), Tricyclazole (0.1%), Carbendazim + Mancozeb (0.1%) were applied by rhizome treatment as well as foliar spray at 45 and 90 days after planting (DAP) and foliar sprays alone at 45 and 90 DAP. The observation on germination was recorded at 30 DAP, leaf spot intensity was recorded 15 days after the last spray i.e. 105 DAP on 10 randomly selected plants in each replication. The disease rating was recorded by adopting 0-6 scale (Palarpawar & Ghurde 1989), where 0= No infection (healthy plants), 1= 0.1% to 10.0% leaf area infected, 2= 10.1% to 20.0% leaf area infected, 3= 20.1% to 30.0% leaf area infected, 4= 30.1% to 40.0% leaf area infected, 5= 40.1% to 50.0% leaf area infected, 6= More than 50% leaf area infected. The percent disease intensity (PDI) was calculated according to the formula suggested by Datar & Mayee (1981) given as below:

$$\text{PDI} = \frac{\text{[Sum of rating of infected leaves in plant]}}{\text{(Total no. of leaves observed} \times \text{maximum disease score)}} \times 100$$

The percent efficacy of disease control (PEDC) was calculated using the following formula-

$$\text{PEDC} = \frac{\text{[(Disease in control - Disease in treatment)]}}{\text{(Disease in control)}} \times 100$$

The yield of turmeric (fresh rhizome) in each treatment was recorded and economics of each treatment was worked out by calculating the cost of production, expenditure incurred on fungicides, costs of cultivation and labour charges for spraying and the benefit : cost (B:C) ratio was determined on hectare basis on the existing selling rates of turmeric in the local

market. The percent values were transformed into arcsine values.

The pooled analysis for this trial was worked out from 2010 to 2012 and results are presented in Table 1. All the fungicidal treatments showed significantly higher effect over the control on germination, disease intensity and yield. The rhizome germination varied from 81.53-91.13% in all the years. The maximum germination was found in rhizome treatment + foliar spray of Carbendazim + Mancozeb (0.1%) on 45 and 90 DAP followed by rhizome treatment + foliar spray of Propiconazole (0.1%) at 45 and 90 DAP (88.43%) and rhizome treatment + foliar spray of Hexaconazole (0.1%) on 45 and 90 DAP (87.33%). All the fungicides significantly reduced the disease intensity as compared to control. Among the fungicides, minimum percent disease intensity was recorded with Propiconazole by foliar spray (27.61) and rhizome treatment + foliar spray (28.50) at 45 and 90 DAP, which were on par with each other. The next best treatment was rhizome treatment + foliar spray of Hexaconazole (29.84 PDI) and foliar spray of Hexaconazole at 45 and 90 DAP (30.23 PDI). Tricyclazole and Carbendazim + Mancozeb were less effective in managing leaf spot of turmeric. The results are in agreement with the findings of Rao *et al.* (2012) and Jagtap *et al.* (2013). The highest rhizome yield was observed in foliar spray with Propiconazole at 45 and 90 DAP (34.33 t ha⁻¹). Rhizome treatment + foliar spray of Propiconazole, Hexaconazole, Carbendazim + Mancozeb at 45 and 90 DAP recorded 33.96 t ha⁻¹, 33.22 t ha⁻¹ and 30.99 t ha⁻¹, respectively. Rhizome treatment + foliar spray and foliar spray of Tricyclazole at 45 and 90 DAP were found less effective in increasing fresh rhizome yield. The present findings regarding the superiority of Propiconazole over other fungicides to control leaf spot disease and increase in the rhizome yield are in conformity with the results of Singh *et al.* (2003) and Theerthagiri & Ramanujam (2009).

Results obtained on economics/ cost: benefit ratio in respect of various treatments revealed that all the treatments significantly reduced disease intensity and increased the fresh yield,

Table 1. Effect of fungicides on management of leaf spot disease of turmeric (pooled analysis of 2010–12)

Treatments	Germination (%)	Leaf spot/disease		Yield (t ha ⁻¹)	Yield (% increase over control)	Cost benefit ratio
		PDI	PEDC			
T ₁ Rhizome treatment + foliar spray of Hexaconazole (0.1%) on 45 and 90 DAP	87.33 (69.14)	29.84 (33.09)	35.28 (35.97)	33.22	17.92	1:2.45
T ₂ Rhizome treatment + foliar spray of Propiconazole (0.1%) on 45 and 90 DAP	88.43 (70.49)	28.50 (32.19)	42.00 (40.16)	33.96	20.55	1:2.51
T ₃ Rhizome treatment + foliar spray of Tricyclazole (0.1%) on 45 and 90 DAP	86.43 (68.42)	33.72 (35.43)	32.95 (34.62)	30.65	8.83	1:2.14
T ₄ Rhizome treatment + foliar spray of Carbendazim + Mancozeb (0.1%) on 45 and 90 DAP	91.13 (73.05)	35.90 (36.79)	27.72 (31.60)	30.99	10.06	1:2.22
T ₅ Foliar spray of Hexaconazole (0.1%) on 45 and 90 DAP	84.53 (67.09)	30.23 (33.21)	37.73 (37.29)	31.15	10.56	1:2.32
T ₆ Foliar spray of Propiconazole (0.1%) on 45 and 90 DAP	87.80 (69.32)	27.61 (31.60)	42.35 (40.24)	34.33	21.86	1:2.65
T ₇ Foliar spray of Tricyclazole (0.1%) on 45 and 90 DAP	86.10 (68.16)	36.97 (37.42)	23.42 (28.55)	30.33	7.66	1:2.21
T ₈ Foliar spray of Carbendazim + Mancozeb (0.1%) on 45 and 90 DAP	87.00 (68.52)	38.72 (38.43)	21.08 (27.17)	30.99	10.06	1:2.28
T ₉ Control	81.53 (64.62)	49.94 (44.96)	-	28.17	-	1:2.09
SEm±	1.35	2.21	4.59	2.18	-	-
CD (P<0.05)	3.97	6.61	13.72	6.48	-	-

*Figures in the paranthesis are arcsine transformed values; DAP=Days after planting; PDI=Percent disease intensity; PEDC=Percent efficacy of disease control

which gave maximum gross and additional income with better B : C ratio over control. The most economical treatment with highest B : C ratio was propiconazole (1:2.51 and 1:2.65), Hexaconazole (1:2.45 and 1:2.32), Carbendazim + Mancozeb (1:2.22 and 1:2.28) and Tricyclazole (1:2.14 and 1:2.21) in rhizome treatment + foliar spray and foliar spray only, respectively. The results obtained on the economics of fungicides for the management of foliar diseases of turmeric and other crops are in conformity with Singh *et al.* (1981), Gorawar *et al.* (2006) and Rao *et al.* (2012). It is concluded that, rhizome treatment + foliar spray and foliar spray only with Propiconazole (0.1%) at 45 and 90 DAP were effective in reducing leaf spot intensity and increasing the yield of turmeric.

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