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Short communication

Evaluation of fungicides against leaf blotch of turmeric caused by *Taphrina maculans* Butler

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ABSTRACT

A field experiment was conducted in the first fortnight of July 2008, 2009 and 2010 at Horticultural Research Station, Jagtial, and in 2010-2011 at Turmeric Research Station, Kammarpally, to evaluate various fungicides against leaf blotch of turmeric. Treatments included the fungicides Propiconazole (0.1%), Hexaconazole (0.1%), Tricyclazole (0.1%) and Carbendazim + Mancozeb (0.1%) for rhizome treatment (dipping) and for foliar spray at 45 and 90 days after planting (DAP); and foliar application alone at 45 and 90 DAP. Among the treatments, rhizome treatment with Carbendazim + Mancozeb (0.1%) gave the best germination (90.52%); Rhizome treatment followed by foliar application of Carbendazim + Mancozeb (0.1%) at 45 and 90 DAP significantly reduced disease incidence of turmeric leaf blotch (16.13%) and enhanced fresh-rhizome yield (18.30t ha^{-1}) compared to other fungicide applications. High cost-benefit ratio was achieved with rhizome treatment, followed by foliar application of Carbendazim + Mancozeb at 45 and 90 DAP (1:1.92).

Key words: Turmeric, leaf blotch, fungicides

Turmeric (*Curcuma longa* L.) is one of the important spice crops of India with good export potential. Underground rhizomes of turmeric are rich in curcumin and used for medicinal, religious and culinary purposes. These are also as a cosmetic and dye (Shah, 1997). Essential oil of turmeric is antiseptic and is used in treating gall stones (Pruthi, 1976). Curcumin and oleoresin help lower total cholesterol in blood serum (Manjunatha and Srinivasa, 2008).

India is the largest producer, consumer and exporter of turmeric in the world. Over 1.58 lakh tonne of cured turmeric is produced annually, of which 92-95 % is consumed within the country. The remaining 5-8% is exported, earning foreign exchange of 40-110 million rupees per annum (Selvan, 2009). In India, turmeric crop is cultivated in an area of 1.81 lakh ha with a total production of 7.93 lakh tonne (Anonymous, 2010). Andhra Pradesh stood first both in area (73,930 ha) and production (3.75 lakh t) in 2010-11, covering to 40% of area under turmeric in India (Anonymous, 2010). Within Andhra Pradesh, Northern Telangana zone is a major turmeric growing area contributing over 50% of the state's production. The most important foliar diseases on turmeric reported so far in Andhra Pradesh are leaf spot caused by *Collectotrichum capsici* [(Syd.) Butler & Bisby] and leaf blotch caused by *Taphrina maculans* Butler. *Taphrina* leaf blotch appears late in the season, usually on the lower leaves in October-November. Severe outbreak of this disease was reported from Rayalaseema area of Andhra Pradesh (Sarma and Dakshinsmurthy, 1962). Yield losses were 37.6 to 52.9% due to This fungus (Panja *et al*, 2000). The pathogen can infect only a few cultivars, which are totally resistant to other foliar disease caused by *C. capsisi* (Reddy *et al*, 1963). Area under susceptible cultivars of turmeric is increasing because of the cultivar's high curcumin content. Nirwan *et al* (1974) and Srivastava and Gupta (1977) reported that dithiocarbamates, copper oxychloride and Carbendazim were effective in controlling leaf blotch in turmeric. Mehdi *et al* (1994) reported that Bitertenol and Tridemorph reduced leaf curl infection in peach. Prasadji *et al* (2004) reported that Propiconazile, Bitertenol and Chlorothalonil were effective in reducing leaf blotch disease in turmeric. However, very limited effort was made to develop a management strategy with new systemic fungicides. Hence, the present field trial was conducted for managing leaf blotch disease in turmeric using new systemic fungicides.

Field experiments were conducted during the first

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fortnight of July 2008, 2009 and 2010 at Horticultural Research Station, Jagtial, and in 2010-2011 at Turmeric Research Station, Kammarpally, Andhra Pradesh, in shallow, red chalky soils for three years with the leaf blotch susceptible cultivar CLI-317. Field trials were laid out with nine treatments and three replications in Randomized Block Design. Forty rhizomes were planted on raised beds of 3x1 m size at a spacing of 30 x 15cm. Nitrogen, phosphorus and potassium were applied @ 190kg, 75kg and 120kg per hectare in the form of urea, single super phosphate and muriate of potash, respectively, as per recommendations of the ANGR Agricultural University, Hyderabad. Nitrogen was applied in four equal split doses, viz., at sowing, 40, 80 and 120 Days After Planting (DAP). Potassium was applied in two split doses, viz., at sowing and 80 DAP. All of the phosphorus, the first dose of nitrogen and potassium were applied by broadcast at the time of sowing. Remaining doses of nitrogen and potassium were applied by the pocket method. The experimental plot was irrigated by flood irrigation at intervals of 10-15 days. Weeding was done at 20, 40, 80 and 120 days after planting. Fungicides such as Propiconazole (0.1%), Hexaconazole (0.1 %), Tricyclazole (0.1%) and Carbendazim+Mancozeb (0.1%) were applied separately by dipping rhizomes in the fungicide solution before planting, followed by foliar application at 45 and 90 DAP, and foliar spray at 45 and 90 DAP alone. Sticker, APSA 80 @0.1%, was mixed with the spray fluid for foliar application.

Treatment details of rhizome and foliar application are furnished in Table 1.The first spray was applied at 45 DAP, and the second at 90 DAP. Observation on germination was recorded at 30 DAP, disease incidence was recorded 20 days after the last spray, i.e., 110 DAP on 10 randomly selected plants in each replication following a 0-6 disease rating scale as suggested by Nambiar *et al* (1977). Per cent Disease Index (PDI) and Per cent Disease Control (PDC) were worked out in each treatment using the following formulae:

$$\text{Per cent Disease Index (PDI)} = \frac{\text{Sum of all disease ratings}}{\text{Total No. of observations} \times \text{Maximum grade}} \times 100$$

$$\text{Per cent Disease Control (PDC)} = \frac{\text{Disease in Control} - \text{Disease in Treatment}}{\text{Disease in Control}} \times 100$$

Cost benefit ratio was calculated for all the treatments. Data was subjected to statistical analysis.

Table 1. Treatment details

T1	Dipping rhizomes in Hexaconazole (0.1%), followed by foliar spray of Hexaconazole (0.1%) at 45 and 90 DAP
T2	Dipping rhizomes in Propiconazole (0.1%), followed by foliar spray of Propiconazole (0.1%) at 45 and 90 DAP
T3	Dipping rhizomes in Tricyclozole (0.1%), followed by foliar spray of Tricyclozole (0.1%) at 45 and 90 DAP
T4	Dipping rhizomes in Carbedazim + Mancozeb (0.1%), followed by foliar spray of Carbedazim + Mancozeb (0.1%) at 45 and 90 DAP
T5	Foliar spray of Hexaconazole (0.1%) at 45 and 90 DAP
T6	Foliar spray of Propiconazole (0.1%) at 45 and 90 DAP
T7	Foliar spray of Tricyclozole (0.1%) at 45 and 90 DAP
T8	Foliar spray of Carbedazim + Mancozeb (0.1%) at 45 and 90 DAP
T9	Control

All fungicidal treatments showed significantly superior effect over Control for germination, per cent disease incidence and yield. Disease intensity varied from 14.6 to 39.1% during the three years of study.

Pooled analysis of the trial starting from 2008-09 and up to 2010-11 was worked out and results are presented in Table 2. Results indicated that (i) rhizome treatment, followed by foliar application of Carbendazim + Mancozeb at 45 and 90 DAP; (ii) rhizome treatment, followed by foliar application of Propiconazole at 45 and 90 DAP; (iii) foliar application of Carbendazim + Mancozeb at 45 and 90 DAP, and (iv) rhizome treatment, followed by foliar application of Hexaconazole at 45 and 90 DAP, were at par with each other (with corresponding per cent disease incidence of 16.13%, 17.68%, 18.83% and 19.54%, respectively). These treatments were significantly superior over other fungicidal treatments. Highest fresh-rhizome yield was achieved in rhizome treatment, followed by foliar application of Carbendazim + Mancozeb at 45 and 90 DAP (18.3t ha^{-1}). Rhizome treatment, followed by foliar application of Propiconazole at 45 and 90 DAP; rhizome treatment, followed by foliar application of Hexaconazole at 45 and 90 DAP, and foliar application of Hexaconazole at 45 and 90 DAP, recorded 17.13t ha^{-1}, 16.98t $ha^{-1}$and 16.02t ha^{-1}, respectively. These were the next best treatments for obtaining maximum yields. Control plots recorded a disease incidence of 31.21%, with yield of 13.39t ha^{-1}. Results of this study on foliar application of Propiconazole and Carbendazim + Mancozeb are in agreement with those in earlier studies (Prasadji *et al*, 2004; Singh *et al*, 2003; Srivastava and Gupta, 1977).

Table 2. Effect of fungicides on management of leaf blotch in turmeric (pooled analysis 2008-11)

Treatment	Per cent germination	Leaf blotch incidence		Yield (t/ha)	% increase over control	Benefit costratio
		PDI	PDC			
T1- Dipping rhizomes in Hexaconazole (0.1%) + Foliar spray of Hexaconazole (0.1%) at 45 and 90 DAP	87.27 (69.12)*	19.54 (26.21)*	37.39 (37.70)*	16.98	26.81	1:1.79
T2- Dipping rhizomes in Propiconazole (0.1%) + Foliar spray of Propiconazole (0.1%) at 45 and 90 DAP	88.98 (70.54)	17.68 (24.88)	43.35 (41.45)	17.13	27.93	1:1.81
T3- Dipping of Rhizomes in Tricyclazole (0.1%) + Foliar spray of Tricyclozole (0.1%) at 45 and 90 DAP	86.36 (68.28)	21.68 (27.69)	30.85 (33.71)	15.56	16.21	1:1.65
T4- Dipping Rhizomes in Carbedazim + Mancozeb (0.1%) + Foliar spray of Carbedazim + Mancozeb (0.1%) at 45 and 90 DAP	90.52 (72.05)	16.13 (23.66)	48.32 (44.03)	18.30	36.67	1:1.92
T5- Foliar spray of Hexaconazole (0.1%) at 45 and 90 DAP	84.89 (67.13)	21.24 (27.42)	31.94 (35.00)	16.02	19.64	1:1.74
T6- Foliar spray of Propiconazole (0.1%) at 45 and 90 DAP	87.38 (69.21)	20.71 (27.06)	33.64 (35.43)	15.69	17.17	1:1.71
T7- Foliar spray of Tricyclozole (0.1%) at 45 and 90 DAP	85.95 (67.94)	24.11 (29.40)	22.75 (28.45)	15.12	12.92	1:1.65
T8- Foliar spray of Carbedazim + Mancozeb (0.1%) at 45 and 90 DAP	86.36 (68.28)	18.86 (25.70)	39.67 (39.00)	15.70	17.25	1:1.71
T9- Control	81.87 (64.75)	31.21 (33.96)	0.00 13.39		1:.1.52	
S.Em±	1.34	0.877		0.37		
CD *(P=0.05)*	3.98	5.060		1.14		

*Figures in the parentheses are arc sine transformed values
DAP=Days After Planting; PDI= Per cent Disease Index; PDC= Per cent Disease Control

Economics for each fungicide was calculated based on mean yield from pooled analysis. All the treatments were economically beneficial over the Control. Rhizome treatment+foliar application with Carbendazim+Mancozeb (0.1%) gave the best economic returns (1:1.92) among the fungicides tested (Table 2), followed by rhizome treatment+foliar application of Propiconazole (1:1.81).

Based on the three years' study, it is concluded that treatment of rhizome with Carbendazim + Mancozeb (0.1%), followed by foliar application of Propiconazole (0.1%) at 45 DAP, and foliar spray of Carbendazim + Mancozeb (0.1%) at 90 DAP were effective in managing leaf blotch and increasing yield in turmeric.

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