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Turmeric (*Curcuma longa* L.) is one of the most important spice crop cultivated in India. India is considered as the largest producer, consumer and exporter of turmeric in the globe. Turmeric is affected by anthracnose, so for its management non-systemic fungicides evaluated under *in vitro* condition, the highest per cent inhibition was obtained by thiram followed by ziram, chlorothalonil and copper hydroxidein inhibiting the growth *C. capsici* at all the four different concentrations tested viz. 500, 1000, 1500 and 2000 ppm.

Key words: Non-systemic fungicides,*Colletotrichum capsici*

INTRODUCTION

Turmeric (*Curcuma longa* L.) is one of the most important spice crop cultivated in India. The crop yield is affected by several biotic and abiotic factors, among them, anthracnose of turmeric caused by *Colletotrichum capsici* was found increasing and occurring regularly every year. It has become as major constraint in successful cultivation of turmeric in Gujarat. -Leaf spot disease of turmeric caused by *C. capsici* was reported for the first time from Coimbatore district of Madras, Later, it was reported from turmeric growing regions like Cuddapah, Kurnool, Guntur, Krishna and Godavari districts of Andhra Pradesh and Coimbatore of Madras State. Disease is soil-borne noticed on the leaves from July to October. In Gujarat, leaf spot of turmeric caused by *C. gloeosporioides,* is the most important disease of turmeric resulting in losses of 25.83-62.12 per cent fresh weight and 42.10-62.10 per cent dry weight of rhizomes. It causes extensive spotting of leaves.

The leaves may eventually dry and thus adversely affect the formation of rhizomes. The incidence of turmeric leaf spot caused by *C. capsici* reported 50 percent yield loss. Hence, different non-systemic fungicides tested against *Colletotrichum capsici*.

MATERIALS AND METHODS

Different non-systemic fungicides (Table 1) were tested for their effect on mycelium growth of *C. capsici* using poisoned food technique at four concentrations. The technique involves cultivation of test organism on a medium containing the test chemical. In experiment PDA was used as a basal medium. The calculated quantities of fungicides were thoroughly mixed in the molten almost cool PDA medium before pouring into Petri plates aseptically, so as to get desired concentration of each fungicide separately. 20 ml of fungicide amended medium was poured in each 90 mm sterilized Petri plates and allowed to solidify. The plates were aseptically inoculated with 5 mm disc cut from the periphery of 12 days of old actively growing cultures of *C. capsici*. Controls without fungicides amended were maintained for comparison. The experiments were conducted in completely randomized design with three replication of each treatment and the inoculated plates were incubated at 28±2°C. The colony diameter was measured after 7 days when the control plates were full of fungal growth. Per cent

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inhibition of growth of mycelium for each treatment was calculated by using the formula given

$$= \frac{C - T}{C} \times 100$$

where,

I = Per cent inhibition
C = Radial growth in control
T = Radial growth in treatment

RESULTS AND DISCUSSION

The relative efficacies of seven different non-systemic fungicides were tested at 500, 1000, 1500 and 2000 ppm concentrations. The observations regarding per cent inhibition of linear growth are presented in Table 2.

It revealed from the data presented in Table.2 that all the fungicides tested were capable of inhibiting the fungal growth at all the concentrations tried in the present investigation. Their mean inhibition ranged from 26.23 to 81.77 per cent. Maximum per cent inhibitions of all treatments were observed at 2000 ppm as compared to rest of their lower concentrations.

Among different fungicides highest inhibition of 85.01 per cent was recorded with thiram at 2000 ppm with 81.77 per cent mean inhibitions. Next effective fungicide was ziram with 84.72 per cent inhibition at 2000 ppm followed by chlorothalonil with 81.56 per cent at 2000 ppm. Minimum inhibition was found in copper oxychloride with 28.81 per cent. Growth inhibition in copper hydroxide, mancozeb and sulphur was 81.35, 79.34 and 72.26 per cent, respectively. Maximum toxicity index was observed in thiram (327.09), which was closely followed by ziram (312.40).

Table 1: List of different non-systemic fungicides tested and their concentrations

Technical/active Ingredient	Concentration in ppm*			
	1	2	3	4
Mancozeb 75% WP	500	1000	1500	2000
Copper hydroxide 53.8% WP	500	1000	1500	2000
Thiram 75%WP	500	1000	1500	2000
Chlorothalonil 75% WP	500	1000	1500	2000
Sulphur 80%WP	500	1000	1500	2000
Copper oxychloride 50% WP	500	1000	1500	2000
Ziram 27% SC	500	1000	1500	2000
Control	-			

*****Concentration: 1, 2, 3 and 4 used for mycelium growth inhibition of *C. capsici*

Within fungicides, all four levels of fungicides significantly differed from each other. Higher concentration of all the fungicides gave significantly more inhibition as compared to their lower level of concentrations.

The outcome of per cent growth inhibition at 500 ppm indicated that the significantly highest growth inhibition was obtained in the treatment of thiram (78.87 %) which was followed by ziram (72.41 %). The next effective treatment was chlorothalonil (61.22 %) whereas copper oxychloride (22.28 %) showed minimum growth inhibition among all treatments.

Whereas at 1000 ppm, the significantly highest growth inhibition was again obtained in the treatment of thiram (80.17 %) which was followed by mancozeb (75.89 %) and ziram (73.15 %). Copper oxychloride (25.88 %) showed minimum growth inhibition among all treatments.

Similarly at 1500 ppm,the significantly highest growth inhibition was again obtained in the treatment of thiram (83.04 %) which was followed by ziram (82.12 %), chlorothalonil (77.47 %) and mancozeb (76.46 %).

Growth inhibition at 2000 ppm showed the significantly highest growth inhibition again in thiram (85.01 %) which was followed by ziram (84.72 %), chlorothalonil (81.56 %), copper hydroxide (81.35 %) and mancozeb (79.34 %).

Among seven non-systemic fungicides tested, maximum inhibition of mycelium was recorded in thiram which was statistically at par with ziram against anthracnose pathogen in turmeric. Thiram, ziram, chlorothalonil and mancozeb were proved to be best and inhibited growth at all concentrations.

Similar results were recorded by Ushakiran *et al*. (2006).They reported mancozeb was the best fungicide to inhibit the growth of the fungus.

Availability of new fungicides necessitates evaluation of fungicides under *in vitro* conditions

Table 2: Effect of different non-systemic fungicides on growth inhibition of *C. capsici*

Technical / Active Ingredient	Per cent inhibition* 500 ppm	1000 ppm	1500 ppm	2000 ppm	Mean	Toxicity Index#
Thiram 75 % WP	62.63 (78.87)	63.56 (80.17)	65.68 (83.04)	67.22 (85.01)	64.77 (81.77)	327.09
Ziram 27 % SC	58.31 (72.41)	58.79 (73.15)	64.99 (82.12)	66.99 (84.72)	62.27 (78.1)	312.40
Chlorothalonil 75 % WP	51.48 (61.22)	52.00 (62.09)	61.66 (77.47)	64.57 (81.56)	57.43 (70.59)	282.34
Copper hydroxide 53.8 % WP	35.43 (33.61)	39.03 (39.66)	57.68 (71.41)	64.42 (81.35)	49.14 (56.51)	226.03
Mancozeb 75 % WP	43.29 (47.02)	60.59 (75.89)	60.97 (76.46)	62.96 (79.34)	56.95 (69.68)	278.71
Sulphur 80 % WP	46.08 (51.89)	57.00 (70.33)	57.66 (71.38)	58.22 (72.26)	54.74 (66.47)	265.86
Copper oxychloride 50 % WP	28.17 (22.28)	30.58 (25.88)	31.91 (27.93)	32.46 (28.81)	30.78 (26.23)	104.9
Mean	46.48 (52.47)	51.65 (61.02)	57.22 (69.97)	59.55 (73.29)	-	-
	Fungicide(F)		Concentration (C)		F×C	
S. Em ±	0.28		0.21		0.57	
C. D. at 5 %	0.81		0.61		1.61	
C. V. %			1.83			

***** Mean of three replications
# Maximum toxicity index = 400.00
Data were arcsine transformed before analysis; values in parentheses are retransformed value.

to know their efficacy, and apply them in field conditions. Hence in the present study non-systemic fungicides were found to be effective for controlling anthracnose. Among the all fungicides evaluated under *in vitro* condition, the highest per cent inhibition was obtained by thiram followed by ziram, chlorothalonil and copper hydroxide in inhibiting the growth *C. capsici* at all the four different concentrations tested viz. 500, 1000, 1500 and 2000 ppm.

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