EFFECT OF FUNGICIDES FOR THE MANAGEMENT OF LEAF BLOTCH DISEASE OF TURMERIC CAUSED BY *TAPHRINA MACULANS* BUTLER

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Abstract

The experiment was conducted at Spices Research Centre (SRC), Bangladesh Agricultural Research Institute (BARI), Shibganj, Bogra during April 2013 to February 2015 to find out effect of various fungicides for the management of leaf blotch of turmeric caused by *Taphrina maculans* Butler. Eight fungicides namely Sunvit 50 WP (0.3%), Zineb (0.2%), Ridomil gold MZ 68 WP (0.2%), Bavistin DF (0.1%), Antracole 70 WP (0.2%), Bordeaux mixture (1%), Tilt 250 EC (0.05%) and Cabrio top (0.3%) along with control (no spraying) were included as treatment. The experiment was laid out in Randomized Complete Block (RCB) design with three replications. All the fungicides reduced the disease severity significantly over control. Among the fungicides, the lowest disease severity (13.57% PDI in 2013-14 and 13.15 % PDI in 2014-15) was recorded in Cabrio top sprayed plots and the highest (48.07% PDI in 2013-14 and 44.53 % PDI in 2014-15) was in control plots. Lowest leaf area diseased (12.55% in 2013-14 and 12.28% in 2014-15) was recorded in Cabrio top sprayed plots and the highest (50.18% in 2013-14 and 48.07% in 2014-15) was in control plots. Significantly, the highest (66.27% in 2013-14 and 69.50% in 2014-15) percent disease control (PDC) was found in Cabrio top sprayed plots and the lowest (29.53% in 2013-14 and 30.81% 2014-15) was in Bordeaux mixture sprayed plots. The highest yield (35.14 t/ha in 2013-14 and 36.13 t/ha in 2014-15) was recorded from Cabrio top sprayed plots which differed significantly from other treatments. The lowest yield (17.13 t/ha) was recorded in control plots.

Key words: Turmeric, leaf blotch, fungicide, disease severity, disease control

Introduction

Turmeric (*Curcuma longa* L.) is one of the important spice crop that commercially grown in the many countries of the world. In Bangladesh, it is used as major spice crop. Underground rhizomes of turmeric are rich in curcumin and used for medicinal, religious and culinary purposes. These are also used 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). It ranks third in production among the spice crops cultivated in Bangladesh. India is the largest producer, consumer and exporter of turmeric in the world. Over 1.58 lakh ton 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). The productivity of turmeric in Bangladesh is 3.71 t/ha (AIS, 2015) which is very low compared to other turmeric producing countries of the world. This fluctuation may be due to several constraints that affect adversely turmeric yield in our country. This may include the use of low quality seed, imbalanced fertilizers, uneven irrigations; and attack of various insect- pests and diseases. Turmeric is infected by a number of diseases such as rhizome rot, leaf spot, dry rot, brown rot, leaf blight and leaf blotch. Two fungal diseases, namely leaf spot (*Colletotrichum capsici* Syd.) and leaf blotch (*Taphrina maculans* Butler) are main constraints in turmeric cultivation (Philip and Nair, 1977; Rao *et al*., 1993). Leaf blotch is more important resulting in severe blighting of leaves at all stages (Sarma and Krishnamurthy, 1962; Reddy *et al*., 1963). Leaf blotch appears late in the season, usually on the lower leaves in September-November. Most of the diseases are caused by adverse weather, air

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pollutants, soil conditions, nutritional imbalances and pest control products. The dried leaves having spots and lying in the field may function as chief source of primary inoculums. At first it appears as apple yellow discolorations, turn to dirty yellow and then brown with a chlorotic halo. The lesions coalesce, forming large necrotic blotches; leaves ultimately dry. High relative humidity (80%) and temperatures ranging from 21 to 23^0C are favorable for this disease. 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.,* 2002). 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 with high curcumin content. Plant diseases control with chemical is very popular because of its quick action, broad spectrum and easy availability to the growers. Different fungicides have been used in controlling the leaf blotch of turmeric, but fewer information were available in Bangladesh. Srivastava and Gupta (1977) reported that spraying of Dithane Z-78 (0.2%) followed by Dithane M-45 (0.3%) was effective in controlling the disease. Nirwan *et al. (*1974) reported that Dithio-carbamates and Carbendazim were effective in controlling leaf blotch in turmeric. Prasadji *et al.* (2004) reported that Propiconazile, Bitertenol and Chlorothalonil were effective in reducing leaf blotch disease in turmeric. However, limited effort was made to develop a management strategy with new fungicides. Hence, the present field trial was conducted for managing leaf blotch disease of turmeric by using new fungicides.

Materials and Methods

The experiment was conducted at Spices Research Centre (SRC), Bangladesh Agricultural Research Institute (BARI), Shibganj, Bogra during 2013-14 and 2014-15. The land was medium high and the soil was clay loam in texture. The experimental plots were prepared with five ploughing and cross ploughing followed by laddering to break down the clods as well as the soil was properly leveled. The weeds and stubbles of previous crops were collected and removed from the soil. The land was fertilized with cow dung @ 5 t/ha, N @ 100 kg/ha, P @ 36 kg/ha, K @ 85 kg/ha, S @ 20 kg/ha and Zn @ 2 kg/ha. The entire quantity of cow dung, P, K, S and Zn were applied as basal dose. 50% of N was applied at 50 days after planting. Remaining 50% N was applied as top dress in two equal splits at 80 and 120 days after planting followed by irrigation. The experiment was carried out following Randomized Complete Block (RCB) design with three replications. Size of the unit plots was 4 m × 2.4 m and plant spacing was 60 cm × 25 cm. Leaf blotch susceptible turmeric variety BARI Turmeric-1 was used in this trial. Rhizomes of BARI Turmeric-1 were planted on 16 April, both in 2013-14 and 2014-15 cropping seasons. Eight fungicides with one control treatment were used. The treatments were T_1 = Sunvit 50 WP (Copper oxychloride) @ 0.3%, T_2 = Zineb (Indofil Z-78) @ 0.2%, T_3 = Ridomil gold MZ 68 WG (Metalaxyl + Mancozeb) @ 0.2%, T_4 = Bavistin DF (Carbendazim 50%) @ 0.1%, T_5 = Antracole 70 WP (Propineb) @ 0.2%, T_6 = Bordeaux mixture @ 0.2%, T_7 = Tilt 250 EC (Propiconazole) @ 0.05%, T_8 = Cabrio top (Pyraclostrobin 5% + Metiram 55% WG) @ 0 .3%, and T_9 = Control (no spraying). Insecticide (Darsban) @ 1 ml/L of water was applied in three times at an 10 days interval to control thrips. Confidor @ 0.04% was sprayed to the plant for three times at an interval of 10 days to control aphids. All fungicides were used as foliar application. Four spraying were done at an interval of 15 days (110, 125, 140 and 155 days after planting of rhizomes) while the first one was applied at the first appearance of disease symptoms. Data were recorded at 15 days after application of different spray. Three times weeding were done at 15, 30 and 45 days after emergence of rhizome. Three times earthing up were done followed by weeding. Two times irrigation were given at 16 May and 16 October in every year. The plots were inspected regularly to take observations on leaf blotch disease from starting to maturity stage of the crop. Disease plant parts were collected from the field and brought to the laboratory for identifying the causal pathogens of the disease. Data on percent disease index (PDI), leaf area diseased, percent disease infection per plant, percent disease control and yield (t/ha) were recorded. Harvesting of the crop was done on 12 February

in both the years. Disease data were recorded on 10 randomly selected plants from each plot just before each spraying and one month after last spraying and followed by 0-6 disease rating scale as suggested by Nambiar *et al*. (1977). Percent Disease Index (PDI) and Percent Disease Control (PDC) were worked out in each treatment by using the following formula as given by Rao *et al*. (2013).

$$PDI = \frac{\text{Sum of all disease ratings}}{\text{Total observations} \times \text{max. possible disease grade}} \times 100$$

$$PDI = \frac{\text{Disease in Control - Disease in Treatment}}{\text{Disease in Control}} \times 100$$

Finally, collected data were analyzed statistically to find out the level of significance and the variations among the data were compared by following Duncan's Multiple Range Test (Gomez and Gomez, 1984).

Results and Discussion

Effect of fungicides against leaf blotch disease

The effect of different fungicides on Percent Disease Index (PDI), percent leaf area diseased, percent disease infection per plant and percent disease control are presented in Table 1 and 2. Significant difference among the treatments was recorded on all the parameters in both the years. In copping year 2013-14, among the fungicides the lowest PDI (13.57) was recorded in Cabrio top sprayed plots and the highest (48.07) was in control plots. About 22.83 PDI was recorded in Sunvit 50 WP sprayed plots which was statistically similar to Tilt 250 EC (28.33) and Antracole 70 WP (29.13). Leaf area diseased was lowest (12.55%) in Cabrio top sprayed plots and the highest (50.18%) was recorded in control plots. Leaf area diseased of Zineb (28.72%), Ridomil gold MZ 68 WP (31.82%) and Antracole 70 WP (31.62%) sprayed plots was statistically similar. The maximum (40.47%) disease infection per plant was recorded in control plots and the minimum (12.53%) was in Cabrio top sprayed plots. Significantly the highest (66.27%) disease control was recorded in Cabrio top sprayed plots and the lowest (29.53%) was in Bordeaux mixture which was statistically similar to Zineb, Ridomil gold MZ 68 WP and Antracole 70 WP. Sunvit 50 WP gave 43.51 % disease reduction over control which was similar to Tilt 250 EC.

In cropping year 2014-15, among the fungicides the lowest PDI (13.15) was recorded in Cabrio top sprayed plots and the highest (44.53) was in control plots. About 20.44 PDI was recorded in Sunvit 50 WP sprayed plots which was statistically similar to Tilt 250 EC (26.86), Ridomil gold MZ 68 WP (27.80) and Antracole 70 WP (27.21). Leaf area diseased was lowest (12.28%) in Cabrio top sprayed plots and the highest (48.07%) was recorded in control plots. 18.95% leaf area disease was recorded in Sunvit 50 WP sprayed plots.

Table 1. Effect of fungicides against leaf blotch disease of turmeric in cropping year 2013-14

Treatment	Percent disease index (PDI)	Percent leaf area diseased	Percent disease infection per plant	Percent disease control
Sunvit 50WP @ 0.3%	22.83 d	22.53 d	18.61 de	43.51 b
Zineb @ 0.2%	30.36 bcd	28.72 cd	20.49 cd	32.80 d
Ridomil gold MZ 68 WG @ 0.2%	31.06 bc	31.82 cd	22.31 bcd	33.35 d
Bavistin DF @ 0.1%	35.73 bc	40.24 b	28.28 b	34.63 cd
Antracole 70WP @ 0.2%	29.13 bcd	31.62 cd	26.05 bcd	32.27 d
Bordeaux mixture @ 0.2%	36.50 b	36.04 bc	27.79 bc	29.53 d
Tilt 250 EC @ 0.05%	28.33 cd	32.45 bc	22.26 bcd	42.70 bc
Cabrio top @ 0.3%	13.57 e	12.55 e	12.53 e	66.27 a
Control	48.07 a	50.18 a	40.47 a	-
LSD (0.01)	7.308	8.820	6.936	8.140
CV (%)	10.01	11.63	11.96	9.75

In a column means followed by the same letter(s) did not differ significantly at 1% level of probability.

Table 2. Effect of fungicides against leaf blotch disease of turmeric in cropping year 2014-15

Treatment	Percent disease index (PDI)	Percent leaf area diseased	Percent disease infection per plant	Percent disease control
Sunvit 50WP @ 0.3%	20.44 c	18.95 c	18.10 c	45.16 b
Zineb @ 0.2%	29.11b	31.08 cd	23.52 bc	35.40 cd
Ridomil gold MZ 68 WG @ 0.2%	27.80 bc	31.95 cd	22.76 bc	33.50 cd
Bavistin DF @ 0.1%	30.86 b	39.05 b	24.90 b	35.91 bcd
Antracole 70WP @ 0.2%	27.21bc	31.91 cd	26.41 b	33.71 cd
Bordeaux mixture @ 0.2%	33.76 b	34.60 bc	26.57 b	30.81 d
Tilt 250 EC @ 0.05%	26.86 bc	27.18 d	20.60 bc	41.89 bc
Cabrio top @ 0.3%	13.15 d	12.28 f	11.00 d	69.50 a
Control	44.53a	48.07 a	39.64 a	-
LSD (0.01)	7.257	6.003	5.610	8.923
CV (%)	10.79	8.24	9.92	10.33

In a column means followed by the same letter(s) did not differ significantly at 1% level of probability.

Statistically similar leaf area disease was recorded from Zineb; Ridomil gold MZ 68 WP and Antracole 70 WP sprayed plots. The maximum (39.64%) disease infection per plant was recorded in control plots and the minimum (11.00%) was in Cabrio top sprayed plots. Significantly the highest (69.50%) disease control plots were recorded in Cabrio top sprayed plots and the lowest (30.81%) was in Bordeaux mixture. In both the year, the lowest disease severity was recorded in Cabrio top sprayed plots and the highest was in control plots.

Srivastava and Gupta (1977) reported that Ditahne Z-78 was the most effective fungicide tested for the control of leaf blotch disease of turmeric followed by Dithane M-45 and Biltox-50. Results of this trial on foliar application of Cabrio top, Tilt 250 EC and Sunvit 50 WP are in agreement with those of earlier studies (Prasadji *et al.*, 2004; Singh *et al.*, 2003). Singh *et al.* (2000) reported that foliar spray of Ridomil (500 ppm) against leaf blotch of turmeric gave the lowest disease severity (31.50%) and increased the rhizome yield (27.67 t/ha). In this trial, the lowest disease severity and the highest rhizome yield in both the year was recorded from Cabrio top sprayed plots. Rao *et al.* (2013) also reported that foliar spray of Carbendazim + Mancozeb @ 0.1% gave the lowest disease severity (16.13%) and the highest rhizome yield (18.30 t/ha). They also reported that the highest percent disease control (48.32%) was recorded from Carbendazim + Mancozeb sprayed plots. In this study, the highest percent disease control (66.27% in 2013-14 and 69.50% in 2014-15) was recorded from Cabrio top (Pyraclostrobin + Metiram) sprayed plots.

Effect of Fungicides on rhizome yield of turmeric

In both the cropping year, the highest yield (35.14 t/ha in 2013-14 and 36.13 t/ha in 2014-15) was obtained from Cabrio top sprayed plots which differed significantly from other treatments and the lowest yield (15.07 t/ha in 2013-14 and 36.13 t/ha in 2014-15) was recorded from control plots.

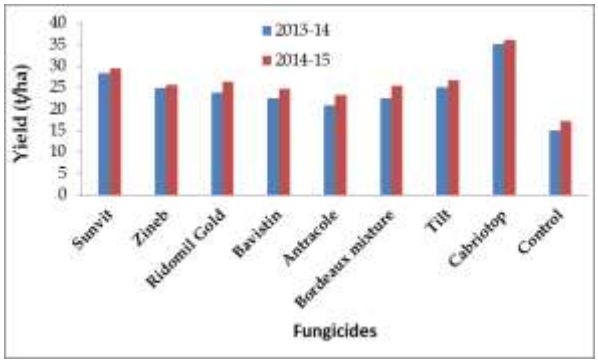

Fig 1. Effect of fungicides on rhizome yield of turmeric

Singh *et al.* (2000) reported that the highest yield (27.67 t/ha) was obtained from Ridomil @ 500 ppm sprayed plots and the lowest yield (17 t/ha) was obtained from control plots. Rao *et al.* (2013) reported that the highest (18.30 t/ha) yield was obtained from Carbendazim + Mancozeb sprayed plots and the lowest (13.39 t/ha) yield in control plots. In this study, the highest yield was

Table 3. Economic analysis of different fungicides on rhizome yield of turmeric for the year 2013-14 and 2014-15

Treatments	Rhizome yield (t/ha)		Gross return (Tk./ha)		Total variable cost (Tk./ha)		Net return (Tk./ha)		Benefit cost ratio (BCR)	
	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15
Sunvit 50WP @ 0.3%	28.33	29.40	708250	735000	187870	187870	547130	547130	3.77	3.91
Zineb @ 0.2%	24.81	25.57	620250	639250	181870	181870	457380	457380	3.41	3.51
Ridomil gold MZ 68 WG @ 0.2%	23.82	26.43	595500	660750	183270	183270	477480	477480	3.24	3.61
Bavistin DF @ 0.1%	22.42	24.77	560500	619250	183190	183190	436060	436060	3.05	3.38
Antracole 70WP @ 0.2%	20.79	23.20	519750	580000	179510	179510	400490	400490	2.89	3.23
Bordeaux mixture @ 0.2%	22.56	25.43	564000	635750	181870	181870	453880	453880	3.10	3.50
Tilt 250 EC @ 0.05%	25.05	26.80	626250	670000	179670	179670	490330	490330	3.48	3.73
Cabrio top @ 0.3%	35.14	36.13	878500	903250	191170	191170	712080	712080	4.59	4.72
Control	15.07	17.13	376750	428250	177670	177670	250580	250580	2.12	2.41

Note: Turmeric rhizome sale price-Tk. 25/kg, Rhizome for seed: Tk.40/kg, Urea: Tk.20/kg, TSP: Tk.22/kg, MOP: Tk. 15/kg, Gypsum: Tk.12/kg, Cowdung: Tk. 2.50/kg, Human labour: Tk.250/man/day, Irrigation cost: Tk.1800/ha/ irrigation, Land price: Tk.300000/ha.

recorded in Cabrio top (Pyraclostrobin + Metiram) sprayed plots and the lowest yield in control plots which was similar to the previous results.

Economic performance

Results of economic analysis of different fungicides on rhizome yield of turmeric are presented in Table 3. All the treatments were economically beneficial over control. Foliar application of Cabrio top (Pyraclostrobin + Metiram) @ 0.3% gave the best economic returns (4.59 in 2013-14 and 4.72 in 2014-15) among the fungicides tested. Rao *et al.* (2013) reported that the highest benefit cost ratio was obtained from foliar spray of Carbendazim + Mancozeb and the lowest in control plots.

Basesd on the two years' study, it is concluded that foliar spray of Cabrio top (Pyraclostrobin + Metiram) @ 0.3% at an interval of 15 days for 4 times being applied the first one at the time of appearance of disease symptoms were effective in managing leaf blotch and increasing yield in turmeric.

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