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Management of leaf spot and flower blight of marigold caused by *Alternaria tenuissima*

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Abstract

Marigold is the one of the most important commercial flower crops grown all over India as well as in Gujarat. Although the area under marigold is increasing but overall yield with regard to flower and seed production is decreasing. The reasons for low productivity are many but one of the major constraints is due to damage caused by pest and diseases. Recently the foliar pathogen, *Alternaria tenuissima*, causing leaf spot and flower blight of marigold, has caused severe damage under the South Gujarat region. Out of eight fungicides evaluated against the disease it was concluded that zineb 68 + hexaconazole 4 WP (PDI 24.41% and FBI 25.91%) was found superior in managing the disease followed by tebuconazole 50 + trifloxystrobin 25 WG (PDI 29.26% and FBI 33.60%) and chlorothalonil 75 WP (PDI 31.74% and FBI 37.04%).

Keywords: *Alternaria tenuissima*, leaf spot and flower blight, fungicides

Introduction

Marigold (*Tagetes* spp.) is one of the most popular traditional flower crops grown commercially in different parts of India and Gujarat. The marigold belongs to the family Asteraceae and genus *Tagetes*, native to Central and South America especially, Mexico.

In India the area and production of marigold was 73.99 thousand hectares and 780.11 thousand tonnes, respectively. In Gujarat, the area under marigold cultivation was 8.74 thousand hectares and production were 83.28 thousand tonnes. In India, the maximum area (20.74 thousand hectares) and production (270.80 thousand tonnes) of marigold was observed in Madhya Pradesh (Anonymous, 2021) [2].

Although the area under marigold is increasing but overall yield with regard to flower and seed production is decreasing. The reasons for low productivity are many but one of the major constraints is due to damage caused by pest and diseases. Recently, the foliar pathogen *Alternaria* sp. causing leaf spot and flower blight has caused severe damage in marigold cultivated areas. It is one of the major destructive and economically important disease and it causes 50-60 percent losses in flower yield (Shinde *et al.*, 2018) [5].

Many systemic and non-systemic fungicides are used for managing the leaf spot and flower blight of marigold. From experiments conducted in past it was observed that non-systemic fungicide mancozeb 75 WP at 0.25 percent reduced the disease incidence by 87.52 percent (Subhendu *et al.*, 2004) [7]. Systemic fungicide like Flusilazole 40 EC at 200 ppm controlled the disease up to 88.28 percent (Bhat *et al.*, 2017) [3].

Hence, evaluation of fungicides against leaf spot and flower blight of marigold was carried out under the South Gujarat conditions.

Materials and Methods

The field experiment was carried out during *kharif* 2020 and 2021. The experiments were laid out in Randomized Block Design at the Floriculture Research Farm, Navsari Agricultural University, Navsari, with 8 treatments and 3 replications for testing the efficacy of different fungicides (Table 1) against leaf spot and flower blight of marigold. Variety Punjab Gainda-1 was used for this experiment. Sowing of seeds was carried out during mid-June in the nursery and transplanting of these seedlings was carried out during mid-July in the fields measuring 21.3 × 17.5 m. The percent disease intensity and flower blight incidence were recorded after 15 days of each spray. Ten plants were selected randomly and labelled from each plot for recording the percent disease intensity and flower blight incidence. From each plant, three leaves from upper, middle and basal portion were randomly observed.

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The selected plants were graded using 0-5 disease rating scale (Hotchkiss and Baxter, 1983)^[4] and percent disease intensity of leaf spots was worked out. The disease rating scale is presented in Table 2. Disease reduction over control was also calculated. Total 3 sprays were carried out after initiation of the disease at an interval 15 days.

Table 1: List of treatments for evaluation of fungicides

Treatments	Fungicides	Dose: Per liter
T ₁	Mancozeb 75 WP at 0.2%	3 g
T ₂	Chlorothalonil 75 WP at 0.225%	3 g
T ₃	Hexaconazole 5 EC at 0.005%	1 ml
T ₄	Flusilazole 40 EC at 0.02%	0.5 ml
T ₅	Tebuconazole 5 + Trifloxystrobin 25 WG at 0.03%	0.4 g
T ₆	Zineb 68 + Hexaconazole 4 WP at 0.1%	1 g
T ₇	Neem oil 0.5%	5 ml
T ₈	Control	

Table 2: Disease rating scale

Rating scale	Area of leaf infected (%)	Percent disease intensity
0	0	No visible symptom
1	0-10%	0-10% leaf area infected
2	11-20%	11-20% leaf area infected
3	21-30%	21-30% leaf area infected
4	31-40%	31-40% leaf area infected
5	> 41%	> 41% leaf areas infected

The percent disease intensity of leaf spot was calculated by using the formula given by McKinney (1923).

$$\text{PDI (\%)} = \frac{\Sigma \text{ of ratings of infected leaves observed}}{\text{No. of leaves observed} \times \text{Maximum disease grade}} \times 100$$

Flower Blight Incidence: The data on flower blight incidence was recorded from 25 randomly selected plants of marigold and percent flower blight incidence was calculated by the following formula.

$$\text{Flower Blight incidence (\%)} = \frac{\text{No. of infected flowers}}{\text{Total no. of flowers per plant}} \times 100$$

The disease reduction over control was calculated by the following formula given by Wheeler (1969).

$$\text{Percent disease reduction over control} = \frac{\text{PDI in control} - \text{PDI in treatment}}{\text{PDI in Control}} \times 100$$

Results and Discussion

Eight different fungicides at different concentrations *viz.* mancozeb 75 WP @ 0.2%, chlorothalonil 75 WP @ 0.225%, hexaconazole 5 EC @ 0.005%, flusilazole 40 EC @ 0.02%, tebuconazole 50 + trifloxystrobin 25 WG @ 0.03%, zineb 68 + hexaconazole 4 WP @ 0.1% and neem oil @ 0.5%, were tested for their efficacy against leaf spot and flower blight of marigold under field conditions during *Kharif* 2020 and 2021. The data is presented in Table 3 and Figure 1 and 2.

The pooled data on percent disease intensity of leaf spot (PDI) revealed that zineb 68 + hexaconazole 4 WP at 0.1% was found significantly superior and most effective fungicide for control of the disease with minimum percent disease intensity of leaf spot of 24.41 percent, which was followed by tebuconazole 50 + trifloxystrobin 25 WG at 0.03% which was

found to be statistically at par with chlorothalonil 75 WP at 0.225% with percent disease intensity of leaf spot of 29.26 percent and 31.74 percent, respectively. The next best treatments for reducing the disease in order of merit were mancozeb 75 WP at 0.2% with 35 percent leaf spot intensity, followed by hexaconazole 5 EC at 0.005% which was at par with flusilazole 4 EC at 0.02% with 38.26 percent and 39.97 percent of percent disease intensity, respectively. Neem oil at 0.5% was the least effective amongst all the treatments with percent disease intensity of 45.46 percent. The untreated control showed maximum percent disease intensity of leaf spot (50.51%).

For flower blight incidence, zineb 68 + hexaconazole 4 WP at 0.1% was found significantly superior and most effective fungicide for control of the disease with minimum flower blight incidence of 25.91 percent followed by tebuconazole 50 + trifloxystrobin 25 WG at 0.03% which was statistically at par with chlorothalonil 75 WP at 0.225% with flower blight incidence of 33.60 percent and 37.04 percent, respectively. The next best treatments for reducing the disease in order of merit were mancozeb 75 WP at 0.2% which was statistically at par with hexaconazole 5 EC at 0.005% with 41.46 percent and 44.74 percent of flower blight incidence, respectively. Flusilazole 40 EC at 0.02% was found statistically at par with neem oil 0.5% with flower blight incidence of 47.16 percent and 48.52 percent, respectively. Neem oil at 0.5% was least effective with maximum flower blight incidence of 48.52 percent amongst all treatments. The untreated control showed maximum flower blight incidence of 52.68 percent.

The results were found non-significant between years and treatments for management of leaf spot and flower blight of marigold.

The data pertaining to percent disease reduction over control for percent disease intensity of leaf spot revealed that the maximum percent disease reduction over control (51.33%) was obtained in treatment of zineb 68 + hexaconazole 4 WP followed by tebuconazole 50+ trifloxystrobin 25 WG (42.25%). The least percent disease over control (8.79%) was observed in neem oil at 0.5% (Photo 4.11).

Similarly, for flower blight incidence, maximum percent disease reduction over control (50.81%) was obtained in treatment of zineb 68 + hexaconazole 4 WP followed by tebuconazole 50 + trifloxystrobin 25 WG (36.21%). The least percent disease over control (7.89%) was observed in neem oil.

The present findings are in line with Singh *et al.* (2010)^[6] who evaluated eight fungicides *viz.* mancozeb, copper oxychloride, captan, zineb, thiram, chlorothalonil, difenconazole and hexaconazole against leaf spot and flower blight of marigold caused by *Alternaria zinniae* in field condition in Solan, Himachal Pradesh. All fungicides reduced leaf spot and flower blight incidence over control. It was concluded that minimum leaf spot severity (13.3 and 11.6%) was recorded with mancozeb, followed by zineb (17 and 17.3%), thiram (19.9 and 19.3%) and chlorothalonil (20.4 and 21.2%).

Anand (2021)^[1] conducted an experiment to test the efficacy of different fungicides against the leaf spot and flower blight of marigold under field conditions at Tamil Nadu Agricultural University, Coimbatore. It was concluded that seed treatment (0.2%) + foliar spray of hexaconazole 4 + zineb 68 WP (0.2%) was found effective in reducing the incidence of leaf spot and flower blight of marigold.

Table 3: Effect of fungicides on percent disease intensity of leaf spot and flower blight incidence

Treat. No.	Technical Name	Conc.	Percent Disease Intensity (%)			Percent disease reduction over control	Flower blight Incidence (%)			Percent disease reduction over control
			2020	2021	Pooled		2020	2021	Pooled	
T ₁	Mancozeb 75 WP	0.2%	33.48	36.52	35.00	30.21	40.37	42.56	41.46	21.29
T ₂	Chlorothalonil 75 WP	0.225%	30.67	32.82	31.74	36.71	36.37	37.70	37.04	29.68
T ₃	Hexaconazole 5 EC	0.005%	36.96	39.56	38.26	23.71	45.75	43.73	44.74	15.07
T ₄	Flusilazole 40 EC	0.02%	38.45	41.48	39.97	20.29	47.36	46.97	47.16	10.47
T ₅	Tebuconazole 50 + Trifloxystrobin 25 WG	0.03%	28.45	30.07	29.26	42.25	32.69	34.51	33.60	36.21
T ₆	Zineb 68 + Hexaconazole 4 WP	0.1%	23.48	25.33	24.41	51.33	24.86	26.96	25.91	50.81
T ₇	Neem Oil	0.5%	43.33	47.59	45.46	8.79	48.23	48.80	48.52	7.89
T ₈	Control	-	49.85	51.18	50.51		52.35	53.02	52.68	
SEm ±	Treatment (T)		2.17	2.00	1.01		3.15	2.48	1.87	
	Year (Y)		-	-	0.50		-	-	0.93	
	Y×T		-	-	1.43		-	-	2.64	
CD at 5%	T		6.59	6.06	2.85		9.55	7.52	5.28	
	Y		-	-	1.43		-	-	NS	
	Y×T		-	-	NS		-	-	NS	
CV (%)			10.58	9.10	6.71		13.31	10.28	11.06	

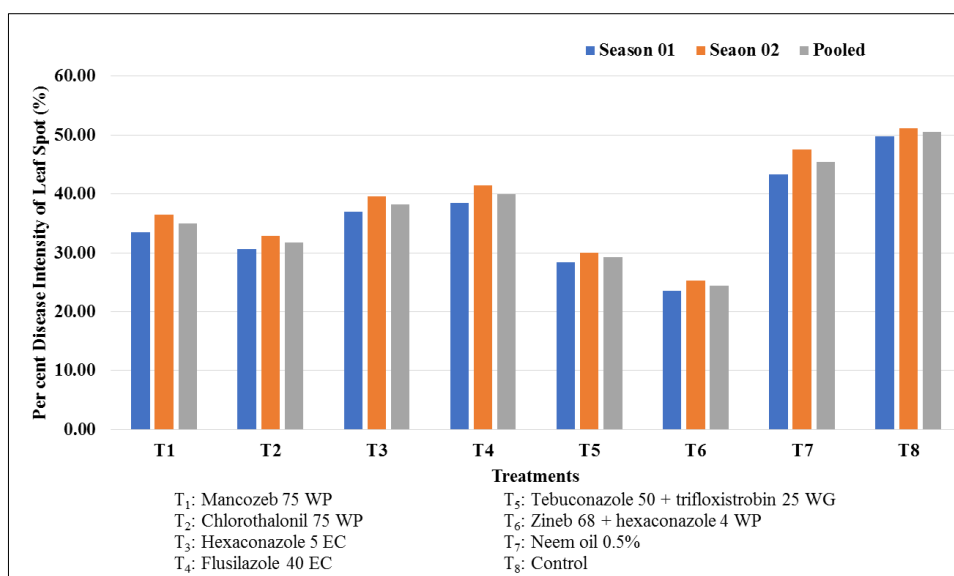


Fig 1: Effect of fungicides on percent disease intensity of leaf spot during 2020, 2021 and pooled

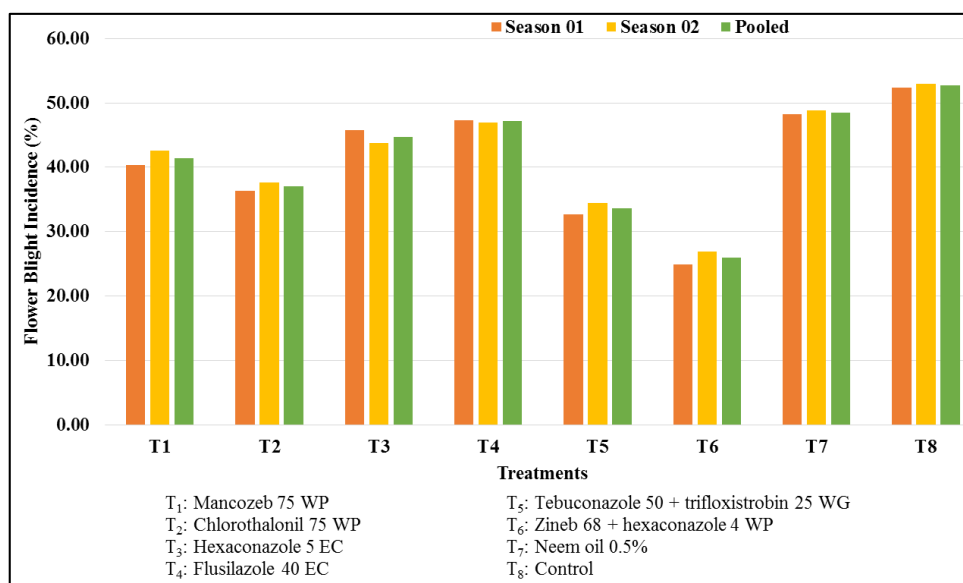


Fig 2: Effect of fungicides on flower blight incidence during 2020, 2021 and pooled

Conclusion

From eight different fungicides tested against leaf spot and flower blight of marigold caused due to *Alternaria tenuissima*, it was concluded that zineb 68 + hexaconazole 4 WP was found superior in managing the disease followed by tebuconazole 50 + trifloxystrobin 25 WG and chlorothalonil 75 WP.

From this experiment, it is very clear that fungicides such as zineb 68 + hexaconazole 4 WP, tebuconazole 50 + trifloxystrobin 25 WG and chlorothalonil 75 WP have different mode of actions such as inhibiting respiration, reproduction and interfering with the spore germination and mobility of spores which helps in effective management of the disease.

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