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## Field evaluation of fungicides for management of *Alternaria* leaf blight in cotton

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### Abstract

Field study was carried out to know the effect of nine different fungicides for minimize intensity of *Alternaria macrospora*.

The hexaconazole 5% + captan 70% WP (0.1%) was the most effective fungicide with 16.49 percent mean disease intensity. The second effective treatment was hexaconazole 5% EC (0.01%) with 20.01 percent mean disease intensity, propiconazole 25% EC (0.1%) was found effective with 20.96 percent mean disease intensity. Highest seed cotton yield was recorded in treatment of hexaconazole 5% + captan 70% WP at 0.1% (2346 kg/ha), which was at par with carbendazim 12% + mancozeb 63% WP at 0.15% (2211 kg/ha). Minimum yield was recorded in control (1490 kg/ha). Maximum avoidable yield loss of 36.49 percent was recorded in treatment hexaconazole 5% + captan 70% WP at 0.1%. Minimum 15.05 percent avoidable yield loss recorded in treatment chlorothalonil 75% WP at 0.1%.

**Keywords:** *Alternaria macrospora*, disease intensity, avoidable yield loss, fungicide

### Introduction

India is the country to grow all four species of cultivated cotton *Gossypium arboreum* and herbaceum (Asian cotton), *G. barbadense* (Egyptian cotton) and *G. hirsutum* (American Upland cotton). *Gossypium hirsutum* represents 88% of the hybrid cotton production in India and all the current Bt. cotton hybrids are *G. hirsutum*.

Cotton is one of the most ancient and important commercial crop next only to food grains and is the principal raw material for a flourishing textile industry. Cotton, although under pressure from synthetic fibers, has made resurgence worldwide and remains as the most improved crop species producing lint plus oil and meal from seed (Nosberger *et al.*, 2001). Global 2021-22 cotton area and production are projected as 32.90 million hectares (81.29 million acres) and 119.60 million bales of 217.72 kg each. Cotton productions in most of the major producing countries are expected to increase except China in 2021-22. India is projected to produce 28.50 million bales followed by China (26.80 million bales), United States (18.50 million bales), Brazil (12.50 million bales) and Pakistan (5 million bales) (Anon., 2021a).

India got first place in the world in cotton acreage with around 120.69 lakh hectares under cotton cultivation *i.e.* around 36% of the World area of 333 lakh hectares. In 2021-22 approximately 67% of India's cotton is produced on rainfed areas and 33% on irrigated lands. In terms of productivity, India (510 kg/ha) ranks poorly compared to the USA (951 kg/ha) and China (1892 kg/ha) (Anon., 2021b).

The comparative study on the incidence of diseases on Bt and non-Bt cotton carried out by the All India Coordinated Cotton Improvement Project (AICCP) revealed that both Bt and non-Bt cotton hybrids are equally susceptible to bacterial blight, *Alternaria* leaf spot and grey mildew. However, the outbreak of *Alternaria* leaf blight and grey mildew disease in Central and South zones was very significant, especially in hybrids such as Bunny and certain Bt hybrids (Anon., 2005) [3]. Similarly, an incidence of 18.26 percent para wilt, 16.71 percent boll rot and 12.32 percent grey mildew were noticed in Naigaon and Nanded during 2003-04 on MECH-184 Bt cotton in addition to the presence of *Alternaria* leaf spot and bacterial blight (Sharma *et al.*, 2005) [14].

The crop suffers from many fungal diseases, of which foliar diseases take a heavy toll. Among the diseases, grey mildew (*Ramularia areola*), *Alternaria* blight (*Alternaria*

*macrospora*) and bacterial blight (*Xanthomonas axonopodis* pv. *malvacearum*) cause the yield losses up to 30 percent (Chidambaram and Kannan, 1989) [7], 26 percent (Chattannavar *et al.*, 2006) [6], 30 percent (Ramapandu *et al.*, 1979) [12], respectively are important diseases which appear almost every year and have seriously threatened cotton production in certain areas and reduce the yield significantly. Therefore, bio rationale disease management approaches are the solution to manage such diseases in

cotton as well as other crops.

### Material and Methods

Field experiments were conducted during *Kharif* 2020-21 at Cotton Research Station, JAU, Kukada and *Kharif* 2021-22 at Pearl Millet Research Station, JAU, Jamnagar to find out efficacy of various fungicides for management of leaf blight of cotton caused by *A. macrospora*. The experimental details and procedures are as given below.

The experimental details and procedures are as given below.

<b>i.</b>	<b>Locations</b>	:	1. Cotton Research Station, JAU, Kukada 2. Pearl Millet Research Station, JAU, Jamnagar
<b>ii.</b>	<b>Year and season of expt.</b>	:	<i>Kharif</i> 2020-21 and <i>Kharif</i> 2021-22
<b>iii. Experimental details:</b>			
a.	Crop & Variety	:	Cotton, G. Cot-38
b.	Treatments	:	10 (As per Table 1)
c.	Design	:	Randomized block design
d.	Replications	:	3
e.	Plot size	:	Gross: 5.4 × 3.6 m (4 Rows) Net: 4.2 × 1.8 m (2 Rows)
f.	Spacing	:	90 × 30 cm.
g.	Seed rate	:	4.0 kg/ha
h.	Fertilizers	:	80-00-00 (N-P-K) kg/ha

For evaluation of the different fungicides against leaf blight (*A. macrospora*) of cotton in field conditions, the foliar spraying of different fungicides was carried out. Nine different fungicides were tested during the *Kharif* 2020-21 at Cotton Research Station, Junagadh Agricultural

University, Kukada and Pearl Millet Research Station, Junagadh Agricultural University, Jamnagar during the *Kharif* 2021-22.

### Preparation of fungicides for spraying

$$\text{Required concentration of fungicides} = \frac{\text{Required quantity of fungicide (\%)} \times \text{Quantity of specified spray volume (l)}}{\text{Percent } a. i. \text{ in commercial fungicide}} \times 100$$

### Disease index

First spray was given on initiation of disease and remaining two sprays of fungicides were carried out at 20 days interval. Control plot was maintained by water spraying (600 l/ha) and without spraying of any fungicides. Five plants were selected from each plot for scoring the disease intensity. From each plant ten leaves from top, middle and bottom portions were randomly selected to record observation. Data on disease caused by *A. macrospora* was recorded after fifteen days of each spray. These selected plants were graded into five classes using 0-4 disease rating scale (Sheo Raj 1988) [15] on the basis of percentage area of leaf infected by the pathogen.

### Seed cotton yield

Crop was harvested at cotton boll open stage and after harvest seed cotton weight of each replication was recorded (kg/plot) and yield per hectare was computed by using net plot yield data and it was then converted to kilograms per hectare.

The percent disease reduction over control was calculated with the help of the following formula (Mathur *et al.*, 1971) [10].

$$\text{Disease control (\%)} = \frac{\text{PDI in check} - \text{PDI in treatment}}{\text{PDI in check}} \times 100$$

### Observations recorded

1. Disease intensity (%)
2. Seed cotton yield (kg/plot)

3. Avoidable yield loss (%)

### Results and Discussion

*Alternaria macrospora* of cotton is surviving in nature with wide range of climatic conditions appears to be the most important pathogen. This study was undertaken to evaluate the relative efficacy of different fungicides for management of leaf blight disease of cotton during *Kharif* season of 2020-21 at Cotton Research Station, JAU, Kukada and 2021-22 at Pearl Millet Research Station, JAU, Jamnagar (Table 1 & 2 and Fig. 1). At present chemical fungicides are the first choice for the farmers to combat diseases because of their easy adaptability and immediate action. Due to variability in pathogen in nature and risk of resistance development against fungicides by continuous use of same fungicides in plant disease control, it is considered appropriate to try different fungicides with targeted mode of action.

During *Kharif* 2020-21, nine fungicides *viz.* mancozeb 75% WP, hexaconazole 5% EC, azoxystrobin 23% SC, chlorothalonil 75% WP, propiconazole 25% EC, hexaconazole 5% + captan 70% WP, pyraclostrobin 5% + metiram 55% WG, carbendazim 12% + mancozeb 63% WP and tebuconazole 50% + trifloxystrobin 25% WG with control were tested under field conditions, which showed its potentiality in lab condition against *A. macrospora*. All fungicides tested against leaf blight disease were reduced the disease intensity significantly as compared to the control. The hexaconazole 5% + captan 70% WP (0.1%) was found most effective fungicide with 15.48 percent

disease intensity followed by hexaconazole 5% EC, (0.01%) with 20.26 percent disease intensity and propiconazole 25% EC (0.1%) with 21.42 percent disease intensity.

In *Kharif* 2021-22 same trend was observed as previous year of experiment. The hexaconazole 5% + captan 70% WP (0.1%) was found most effective fungicide with 17.53 percent disease intensity followed by hexaconazole 5% EC, (0.01%) with 19.77 percent disease intensity and propiconazole 25% EC (0.1%) was found effective with 20.52 percent disease intensity.

Pooled data showed that, the hexaconazole 5% + captan 70% WP (0.1%) was the most effective fungicide with 16.49 percent mean disease intensity. The second effective treatment was hexaconazole 5% EC (0.01%) with 20.01 percent mean disease intensity, propiconazole 25% EC (0.1%) was found effective with 20.96 percent mean disease intensity.

Percent disease control was recorded ranged from 14.98 to 55.42 percent. Maximum disease control of 55.42 percent was recorded in the treatment of hexaconazole 5% + captan 70% WP (0.1%) followed by treatment hexaconazole 5% EC (0.01%) with 45.90 percent disease control and propiconazole 25% EC (0.1%) with 40.63 percent disease control.

The results were confirmed by Kolte *et al.* (1979) [9] and Rao (2006) [9] in sunflower, Akbari (2005) [1] in sesame, Singh and Majamudar (2002) in pomegranate, Ginoya and

Gohel (2015) [8] in chilli, Shtienberg (1993) [16], Chattannavar *et al.* (2006) [6] and Anil (2013) [2] in cotton.

With respect to seed yield, all the treatments recorded significantly higher seed yield than control. Data presented in table 2 revealed that in the year *Kharif* 2020-21 highest yield was produced in the treatment of hexaconazole 5% + captan 70% WP at 0.1% (2367 kg/ha) which was at par with carbendazim 12% + mancozeb 63% WP at 0.15% (2229 kg/ha), hexaconazole 5% EC at 0.01% (2127 kg/ha) and propiconazole 25% EC at 0.1% (2056 kg/ha) as compared to control (1557 kg/ha).

Same trend was observed in year *Kharif* 2021-22, maximum yield was produced in the treatment of hexaconazole 5% + captan 70% WP at 0.1% (2325 kg/ha) which was at par with carbendazim 12% + mancozeb 63% WP at 0.15% (2192 kg/ha), mancozeb 75% WP at 0.2% (2123 kg/ha) and hexaconazole 5% EC at 0.01% (2076 kg/ha). Lowest yield was recorded in control (1423 kg/ha).

Looking to the pooled data, highest seed cotton yield was recorded in treatment of hexaconazole 5% + captan 70% WP at 0.1% (2346 kg/ha), which was at par with carbendazim 12% + mancozeb 63% WP at 0.15% (2211 kg/ha). Minimum yield was recorded in control (1490 kg/ha).

Maximum avoidable yield loss of 36.49 percent was recorded in treatment hexaconazole 5% + captan 70% WP at 0.1%. Minimum 15.05 percent avoidable yield loss recorded in treatment chlorothalonil 75% WP at 0.1%.

**Table 1:** Evaluation of fungicides on *Alternaria* leaf blight in cotton under field condition

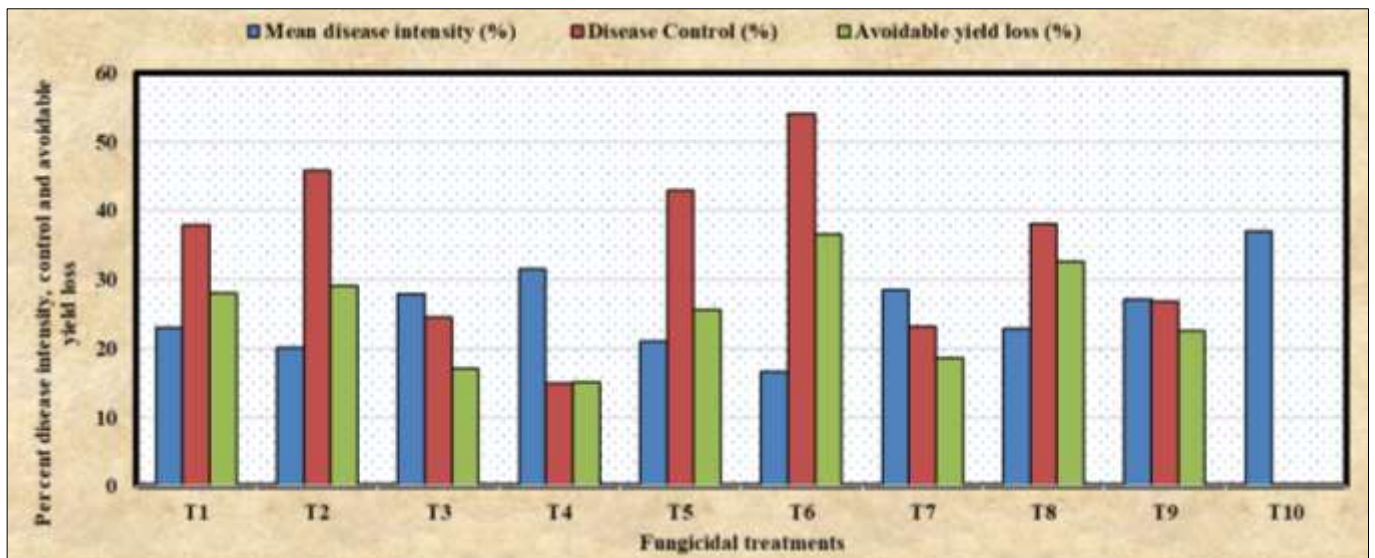
Sr. No.	Treatments	Disease intensity (%)		Pooled mean	Disease reduction over control (%)
		2020-21	2021-22		
1	Mancozeb 75% WP	28.07** (22.14)*	28.99 ** (23.49)*	28.53 (22.81)	38.33
2	Hexaconazole 5% SC	26.75 (20.26)	26.40 (19.77)	26.57 (20.01)	45.90
3	Azoxystrobin 23% SC	32.33 (28.59)	31.42 (27.17)	31.87 (27.88)	24.63
4	Chlorothalonil 75% WP	34.43 (31.97)	33.80 (30.95)	34.12 (31.45)	14.98
5	Propiconazole 25% EC	27.57 (21.42)	26.93 (20.52)	27.25 (21.96)	40.63
6	Hexaconazole 5% + Captan 70% WP	23.17 (15.48)	24.75 (17.53)	23.96 (16.49)	55.42
7	Pyraclostrobin 5% + Metiram 55% WG	32.55 (28.95)	31.86 (27.87)	32.21 (28.40)	23.22
8	Carbendazim 12% + Mancozeb 63% WP	27.58 (21.53)	29.48 (24.22)	28.53 (22.80)	38.36
9	Tebuconazole 50%+ Trifloxystrobin 25% WG	31.46 (27.24)	31.19 (26.82)	31.32 (27.03)	26.92
10	Control	37.06 (36.32)	37.85 (37.66)	37.46 (36.99)	-
	Y	S. Em. ±		0.64	
		CD at 5%		NS	
	T	S. Em. ±	1.93	2.12	1.43
		CD at 5%	5.74	6.30	4.12
		CV%	11.13	12.13	11.64
	Y × T	S. Em. ±		2.03	
		CD at 5%		NS	

\*\*Data were transformed (Arcsine) prior to analysis, \*Data given in parentheses are retransformed values, Y = Year, T = Treatment

**Table 2:** Efficacy of fungicides on seed cotton yield

Sr. No.	Treatments		Seed cotton yield (kg/ha)		Pooled mean	Avoidable yield loss (%)
			2020-21	2021-22		
1	Mancozeb 75% WP		2014	2123	2069	27.98
2	Hexaconazole 5% SC		2127	2076	2101	29.08
3	Azoxystrobin 23% SC		1861	1747	1804	17.41
4	Chlorothalonil 75% WP		1774	1733	1754	15.05
5	Propiconazole 25% EC		2056	1952	2004	25.65
6	Hexaconazole 5% + Captan 70% WP		2367	2325	2346	36.49
7	Pyraclostrobin 5% + Metiram 55% WG		1860	1804	1832	18.67
8	Carbendazim 12% + Mancozeb 63% WP		2229	2192	2211	32.61
9	Tebuconazole 50%+ Trifloxystrobin 25% WG		1952	1894	1923	22.52
10	Control		1557	1423	1490	-
	Y	S. Em. ±			42.21	
		CD at 5%			NS	
	T	S. Em. ±	127.96	138.79	94.39	
		CD at 5%	380.21	412.38	270.95	
		CV%	11.20	12.47	11.84	
	Y × T	S. Em. ±			133.49	
		CD at 5%			NS	

Where, T = Treatment, Y × T = Year × Treatment



T <sub>1</sub> :	Mancozeb 75% WP	T <sub>6</sub> :	Hexaconazole 5% + Captan 70% WP
T <sub>2</sub> :	Hexaconazole 5% SC	T <sub>7</sub> :	Pyraclostrobin 5% + Metiram 55% WG
T <sub>3</sub> :	Azoxystrobin 23% SC	T <sub>8</sub> :	Carbendazim 12% + Mancozeb 63% WP
T <sub>4</sub> :	Chlorothalonil 75% WP	T <sub>9</sub> :	Tebuconazole 50%+ Trifloxystrobin 25% WG
T <sub>5</sub> :	Propiconazole 25% EC	T <sub>10</sub> :	Control

**Fig 1:** Percent disease intensity, control and avoidable yield loss influenced by different fungicides during Kharif 2020-21 and Kharif 2021-22

**Conclusion**

For studying the efficacy of different fungicides against *A. macrospora* on cotton, nine different fungicides were tested in field condition during Kharif 2020-21 and 2021-22. Statistically, hexaconazole 5% + captan 70% WP (0.1%) was the most effective fungicide with minimum mean 16.49 percent disease intensity. The second effective treatment was hexaconazole 5% EC (0.01%) with 20.01 percent mean disease intensity. Percent disease control was recorded from 14.98 to 55.42 percent. Maximum disease control of 55.42 percent was recorded in the treatment of hexaconazole 5% + captan 70% WP (0.1%) followed by treatment hexaconazole 5% EC (0.01%) with 45.90 percent disease control. Minimum percent disease control recorded in treatment chlorothalonil 75% WP (0.1%) was 14.98 percent.

Highest seed cotton yield (2346 kg/ha) and maximum avoidable yield loss (36.49%) recorded in treatment hexaconazole 5% + captan 70% WP at 0.1%, which was at par with carbendazim 12% + mancozeb 63% WP at 0.15% (2211 kg/ha). Minimum yield was recorded in control (1490 kg/ha).

**Application of research:** The research used to minimize the *alternaria macrospora* effect for using different fungicides field conditions.

**Research Category:** Different fungicide comparative study

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**Study area:** Cotton Research Station, Junagadh Agricultural University, Kukada, ta. Muli, dist. Surendrnagar-363 510, Gujarat, India and Pearl Millet Research Station, Junagadh Agricultural University, Jamnagar-361 006, Gujarat, India.

**Cultivar/Variety/Breed name:** Cotton, G. Cot-38

**Conflict of Interest:** None declared

**Ethical approval:** This article does not contain any studies with human participants or animals performed by any of the authors.

**Ethical Committee Approval Number:** Nil

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