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Impact of spray schedule on *Alternaria* leaf blight in cotton

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Abstract
Cotton (*Gossypium* spp.) 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. The major cotton growing districts/area in Gujarat is Kutch, Saurashtra and North Gujarat; however, cotton is grown in almost all the districts of Gujarat. Though cotton is seriously affected by many diseases, leaf blight caused by *Alternaria macropora* Zimm., is an important destructive disease in all over in Gujarat and other part of country. Experiment was conducted to find out effective fungicides spray schedule for the management of cotton leaf blight. Different spray schedule, 35, 55, 75, 95 and 115 DAS of 0.1% hexaconazole 5% + captan 70% WP, maximum seed cotton yield 2269 kg/ha was recorded in treatment plot of hexaconazole + captan (0.1%) at 55, 75, 95 and 115 DAS with maximum percent disease control (61.10% PDC) and maximum avoidable yield loss (29.44%). Hexaconazole + captan (0.1%) at 55, 75, 95 and 115 DAS proved to be the most effective in controlling the disease in field condition for two seasons with higher yield.

Keywords: Leaf blight, cotton, management, spray schedule

1. Introduction
In the present context, cotton farming in India is far from being a sustainable agricultural system. India is the second-largest producer of conventional cotton after China. More than 90% of the cotton is produced from genetically modified, pest-resistant, high yielding Bt cotton varieties. Before 2002, cotton cultivation in India relied on natural or conventional farming techniques using indigenous seeds and some hybrid varieties. India is the largest producer of organic cotton and contributes about 70% of the world's supply. Through the review of literature on the impact of Bt cotton and organic cotton from both farming and fashion and a textile industry perspective, research emphasizes the importance of organic cotton farming which is sustainable, eco-friendly and generates a healthy livelihood for farmers (Mohapatra and Saha, 2019) [13]. Cotton plays a significant role in various aspects of the economy of the major developing countries. In India, no crop can compete with cotton for value addition and processing (Hitchings, 1984) [8]. A large number of fungal, bacterial, viral and nematode diseases have been reported on cotton crop right from early stage to maturity. Among them, the economically most important ones are bacterial blight, *Alternaria* leaf spot, grey mildew, rust and vascular wilts which occur throughout the world (Kotasthane and Agrawal, 1970) [10]. *Alternaria* leaf blight and other leaf spotting fungi pose an alarming situation (Gholve *et al.*, 2012) [7]. In India, leaf spot of cotton (*Alternaria macrospora* Zimm.) was first reported by Uppal *et al.* (1935) [19] from Bombay and later it reported by Rane and Patel in 1956 [16] from Pune and Ahmednagar. Dastur *et al.* (1960) [6] however observed it later in large scale and subsequently, many researchers recorded its occurrence from various provinces of India (Chopra and Sharma, 1975; Padmanabhan and Narayanasamy, 1976) [5, 14]. Bashi *et al.* (1983) [2] reported that epidemics of *Alternaria* leaf spot in Israel decreased the yield of Pima-S-5 by 25 per cent. Dastur *et al.* (1960) [6] reported that disease was serious on three cotton varieties of *G. hirsutum*, the other cultivated species of *Gossypium* being resistant. *Alternaria* blight (*A. macrospora*) has been reported to cause about 20-30 per cent losses in seed cotton yield (Srinivasan, 1994; Chauhan *et al.*, 1997; Mayee and Mukewar, 2007) [18, 4, 12]. However, the production potential of the crop has not been fully exploited due to several biotic and abiotic factors. The crop suffers from many fungal diseases, of which foliar diseases take a heavy toll and among the diseases, *Alternaria* leaf spot causes yield losses up to 26 per cent (Chattannavar *et al.*, 2006) [3].

Bacterial blight, *Alternaria* leaf spot and grey mildew were the major diseases on cotton identified in the central and southern parts of the country in 2004 (Ashok, 2005) [1].

2. Materials and Method

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 the effective number of sprays of hexaconazole + captan required to manage *Alternaria* leaf blight disease of cotton and to assess the influence of hexaconazole + captan sprays on seed lint yield. Nine treatments were imposed with 0.1 per cent hexaconazole 5% + captan 70% WP spray at different stages of crop growth, besides a treatment with unsprayed control (600 lit/ha) was maintained.

2.1 Methodology

For evaluation of the impact of spray schedule of 0.1% Hexaconazole 5% + Captan 70% WP fungicide against leaf blight of cotton (*A. macrospora*) in field conditions, the foliar spraying of fungicide was carried out. Nine different spray schedule were evaluated during the *Kharif* 2020-21 at Cotton Research Station, Junagadh Agricultural University, Kukada and during the *Kharif* 2021-22 at Pearl Millet Research Station, Junagadh Agricultural University, Jamnagar.

2.2 Disease Index

The intensity of *Alternaria* leaf blight was recorded 120 DAS. 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. These selected plants were graded into five classes using 0-4 disease rating scale on the basis of percentage area of leaf infected by the pathogen.

The disease incidence was recorded from 10 tagged plants on 0-4 scale given by given by Sheo Raj (1988) [17].

Disease grade	Symptoms
0	Immune, completely free from infection
1	Resistance, infection 0-10%
2	Moderately resistance, infection 11-20%
3	Moderately susceptible, infection 21-40%
4	Susceptible, infection >40%

The per cent disease intensity (PDI) were calculated as per given formula (Wheeler, 1969).

$$\text{Disease intensity}(\%)=\frac{\text{Sum of total rating}}{\text{Total number of leaves observed}}\times\frac{100}{\text{Maximum disease rating}}$$

2.3 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 per cent avoidable yield loss in seed cotton yield was calculated using following formula given below (Hosagoudar *et al*., 2014) [9].

$$\text{Per cent avoidable yield loss (\%)} = \frac{\text{Yield in treated plot - Yield in control plot}}{\text{Yield in treated plot}} \times 100$$

3. Results and Discussion

Field experiment was carried out during the year 2020-21 and 2021-22 with one to five sprays of 0.1% hexaconazole 5% + captan 70% WP at different stages of crop growth as per treatments. The data are presented in Table 4.1 and Table 4.2 revealed that during the year 2020-21, treatment comprising spraying of hexaconazole + captan (0.1%) at 55, 75, 95 and 115 DAS recorded significantly lowest *Alternaria* leaf blight per cent disease intensity (13.20% PDI) which was at par with hexaconazole + captan (0.1%) at 35, 55, 75, 95 and 115 DAS (16.25% PDI) and 35, 55, 75, and 95 DAS (16.84% PDI) while hexaconazole + captan (0.1%) at 115 DAS (24.59 PDI) was least effective. Overall maximum leaf blight intensity (37.66% PDI) recorded in control.

Field experiment was continued during 2021-22 for second year with one to five sprays of 0.1% hexaconazole 5% + captan 70% WP at different stages of crop growth as per treatments (Table 4.1). There was same trend observed as per previous year of experiment. hexaconazole + captan (0.1%) at 55, 75, 95 and 115 DAS treatment recorded significantly lowest *Alternaria* leaf blight per cent disease intensity (15.89% PDI) which was at par with hexaconazole + captan (0.1%) at 35, 55, 75, 95 and 115 DAS (18.62% PDI) and 35, 55, 75, and 95 DAS (18.94% PDI) while hexaconazole + captan (0.1%) at 115 DAS (27.94% PDI) was least effective. Overall maximum leaf blight intensity (36.99% PDI) recorded in control.

The pooled data are presented Table 4.1. This result revealed that the hexaconazole + captan (0.1%) at 55, 75, 95 and 115 DAS treatment recorded significantly lowest *Alternaria* leaf blight per cent disease intensity (14.52% PDI) which was at par with only treatment hexaconazole + captan (0.1%) at 35, 55, 75, 95 and 115 DAS (17.42% PDI) while hexaconazole + captan (0.1%) at 115 DAS (26.25% PDI) was least effective. Overall maximum leaf blight intensity (37.33% PDI) recorded in control.

In pooled data of 2020-21 and 2021-22 maximum per cent disease controlled (61.10% PDC) in treatment hexaconazole + captan (0.1%) at 55, 75, 95 and 115 DAS. while hexaconazole + captan (0.1%) at 115 DAS was least per cent disease control (29.68% PDC). In year 2020-21 seed cotton yield was non significant among the treatments. However, numerically maximum seed cotton yield 2235 kg/ha was recorded in treatments hexaconazole + captan (0.1%) at 55, 75, 95 and 115 DAS. While numerically minimum seed cotton yield 1639 kg/ha was recorded in control.

Continuously in year 2021-22 seed cotton yield was significant among the treatments. Maximum seed cotton yield 2302 kg/ha was recorded in hexaconazole + captan (0.1%) at 55, 75, 95 and 115 DAS. Which was at par with hexaconazole + captan (0.1%) at 35, 55, 75, 95 and 115 DAS (2203 kg/ha), hexaconazole + captan (0.1%) at 75, 95 and 115 DAS (2103 kg/ha) and treatment hexaconazole + captan (0.1%) at 95 and 115 DAS (2032 kg/ha). Minimum seed cotton yield 1563 kg/ha was recorded in control.

In pooled seed cotton yield was recorded significant among the treatments. Maximum seed cotton yield 2269 kg/ha was recorded in hexaconazole + captan (0.1%) at 55, 75, 95 and

115 DAS. Which was at par with hexaconazole + captan (0.1%) at 35, 55, 75, 95 and 115 DAS (2163 kg/ha) and hexaconazole + captan (0.1%) at 75, 95 and 115 DAS (2101 kg/ha).

Maximum avoidable yield loss 29.44 per cent in treatment hexaconazole + captan (0.1%) at 55, 75, 95 and 115 DAS, while least 14.80 per cent avoidable yield loss recorded in treatment hexaconazole + captan (0.1%) at 35 DAS.

Earlier Kumar and Rathi (2018) [11] mentioned that hexaconazole (0.05%) found most effective at 60 DAS with mancozeb at 45 DAS. Rakholiya (2011) [15] reported in fruit rot of chilli, propiconazole @ 0.025% found effective during spraying on 120, 135 and 150 DAS. Hosagoudar *et al.* (2014) evaluated propiconazole (0.1%) at 35, 55, 75, 95 and 115 DAS recorded significantly lowest *Alternaria* disease in cotton.

Table 4.1: Impact of spray schedule on *Alternaria* leaf blight in cotton under field condition

Sr. No.	Treatment details		Disease intensity (%)		Pooled mean	Disease control (%)
			2020-21	2021-22		
1	0.1% Hexaconazole 5% + Captan 70% WP at 35 DAS		28.54** (22.83)*	29.88** (24.81)*	29.20 (23.81)	36.22
2	0.1% Hexaconazole 5% + Captan 70% WP at 35 and 55 DAS		27.40 (21.18)	29.04 (23.57)	28.22 (22.36)	40.10
3	0.1% Hexaconazole 5% + Captan 70% WP at 35, 55 and 75 DAS		26.52 (19.94)	27.14 (20.81)	26.83 (20.37)	45.43
4	0.1% Hexaconazole 5% + Captan 70% WP at 35, 55, 75 and 95 DAS		24.23 (16.84)	25.80 (18.94)	25.01 (17.88)	52.10
5	0.1% Hexaconazole 5% + Captan 70% WP at 35, 55, 75, 95 and 115 DAS		23.78 (16.25)	25.56 (18.62)	24.67 (17.42)	53.34
6	0.1% Hexaconazole 5% + Captan 70% WP at 55,75, 95 and 115 DAS		21.31 (13.20)	23.50 (15.89)	22.40 (14.52)	61.10
7	0.1% Hexaconazole 5% + Captan 70% WP at 75, 95 and 115 DAS		25.07 (17.95)	27.22 (20.93)	26.14 (19.42)	47.98
8	0.1% Hexaconazole 5% + Captan 70% WP at 95 and 115 DAS		25.49 (18.52)	29.05 (23.58)	27.26 (21.01)	43.61
9	0.1% Hexaconazole 5% + Captan 70% WP at 115 DAS		29.73 (24.59)	31.91 (27.94)	30.82 (26.25)	29.68
10	Unsprayed control		37.86 (37.66)	37.46 (36.99)	37.66 (37.33)	-
	Y	S.Em. ±			0.53	
		CD at 5%			1.52	
	T	S.Em. ±	1.6	1.75	1.18	
		CD at 5%	4.75	5.19	3.40	
		CV%	10.26	10.55	10.42	
	Y × T	S.Em. ±	-	-	1.67	
		CD at 5%	-	-	NS	

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

Table 4.2: Impact of spray schedule on seed cotton yield

Sr. No.	Treatment details		Seed cotton yield (kg/ha)		Pooled mean	Avoidable yield loss (%)
			2020-21	2021-22		
1	0.1% Hexaconazole 5% + Captan 70% WP at 35 DAS		1900	1858	1879	14.80
2	0.1% Hexaconazole 5% + Captan 70% WP at 35 and 55 DAS		1960	1893	1927	16.92
3	0.1% Hexaconazole 5% + Captan 70% WP at 35, 55 and 75 DAS		1983	1945	1964	18.48
4	0.1% Hexaconazole 5% + Captan 70% WP at 35, 55, 75 and 95 DAS		2034	1969	2002	20.03
5	0.1% Hexaconazole 5% + Captan 70% WP at 35, 55, 75, 95 and 115 DAS		2123	2203	2163	25.98
6	0.1% Hexaconazole 5% + Captan 70% WP at 55,75, 95 and 115 DAS		2235	2302	2269	29.44
7	0.1% Hexaconazole 5% + Captan 70% WP at 75, 95 and 115 DAS		2098	2103	2101	23.80
8	0.1% Hexaconazole 5% + Captan 70% WP at 95 and 115 DAS		2067	2032	2050	21.90
9	0.1% Hexaconazole 5% + Captan 70% WP at 115 DAS		1984	1901	1943	17.60
10	Unsprayed control		1639	1563	1601	-
	Y	S.Em. ±			36.65	
		CD at 5%			NS	
	T	S.Em. ±	116.38	115.37	81.94	
		CD at 5%	NS	342.81	235.22	
		CV%	10.07	10.11	10.09	
	Y × T	S.Em. ±	-	-	115.88	
		CD at 5%	-	-	NS	

Where, Y = Year, T = Treatment

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