



Field efficacy of fungicides against fungal foliar diseases in cotton

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Abstract : A field trial was conducted to evaluate the efficacy of nine different fungicides against fungal foliar diseases in cotton at Regional Agricultural Research Station, Lam, Guntur during *kharif* 2019-2020. Highest reduction (73.93%) in per cent disease index (PDI) of *Alternaria* leaf spot was recorded with propiconazole @ (0.1%) followed by zineb + hexaconazole @ (0.2%) (72.80%) and myclobutanil @ (0.1%) (69.25%). Propiconazole @ (0.1%) and zineb + hexaconazole @ (0.2%) recorded (85.90%) and (85.57%) reduction in PDI of *Corynespora* leaf spot followed by propineb @ (0.3%) (80.41%). Grey mildew was reduced to the tune of (68.63%) with propiconazole @ (0.1%) and (66.04%) with zineb + hexaconazole @ (0.2%) followed by propineb @ (0.3%) (63.37%). The highest yield (47.91q/ha), B:C ratio (2.95) and maximum ICBR (39.98) were obtained with propiconazole @ (0.1%) (26.02 %) followed by zineb + hexaconazole @ (0.2%) (46.40 q/ha, 2.84 and 34.12), respectively.

Key words: *Alternaria* leaf spot, *Corynespora* leaf spot, cotton, fungicides, grey mildew

Cotton is referred as “King of Fibres” or as “White Gold”. It is a member of Malvaceae family and most important fibre crop enjoying pre-eminent status among the cash crops in the country. Fungal leaf spots caused by *Alternaria macrospora*, *Corynespora cassicola*, *Myrothecium roridum*, *Helminthosporium gossypii* and *Cercospora gossypii* are of regular occurrence in cotton. *Alternaria* and *Corynespora* leaf spots, grey mildew and rust are major diseases in Andhra Pradesh. Under congenial conditions *Alternaria* blight causes severe defoliation, cracking and breaking of stems and reduction in boll formation. The disease caused losses to the tune of 38.23 per cent in LRA 5166 (Bhattiprolu and Prasada Rao, 2009) and 33.43 per cent in Jayadhar varieties of cotton (Chattannavar *et al.*, 2010). Yield losses due to *Alternaria* leaf spot up to 5-35 per cent were reported earlier (Zanjare *et al.*, 2005, Chattannavar *et al.*, 2006 and More *et al.*, 2010). Hagan and Sikora, (2012) reported that *Corynespora* leaf spot caused loss of 100-200 lb/ac of lint in cotton. Fulmer *et al.*, (2012) reported that target spot damage on cotton varied up to 75 per cent. The disease caused lint

yield loss in susceptible cotton cultivars as high as 224 - 448 kg/ha equivalent to 5 to 40 per cent (Conner *et al.*, 2013; Hagan, 2014; Hagan *et al.*, 2015). Losses due to grey mildew upto 29.20 per cent were estimated (Monga *et al.*, 2013). In view of the economic importance, efficacy of different fungicides was evaluated to manage these diseases under field conditions.

MATERIALS AND METHODS

Field experiment was conducted during *kharif*, 2019-2020 at Regional Agricultural Research Station, Lam, Guntur, Andhra Pradesh. Popular hybrid Jaadoo BG II was sown at a spacing of 105 x 60cm. Ten treatments viz., myclobutanil (10% WP) @ (0.1%), pyraclostrobin (20% WG) @ (0.1%), metiram (70% WG) @ (0.2%), propiconazole (25% EC) @ (0.1%), propineb (70% WP) @ (0.3%), zineb (68%) + hexaconazole (4% WP) @ (0.2%), trifloxystrobin (61.3%) + propineb (35% WP) @ (0.3%), pyroxystrobin (25%) + fluxapyrad (25% SC) @ (0.06%) and metiram (55%) + pyraclostrobin (5% WG) @ (0.3%) and untreated control were imposed against major leaf spot diseases and grey mildew with three

replications in randomized block design. Three foliar sprays were given at fifteen days interval starting from the initial disease symptom appearance. Fungal foliar disease severity was recorded at seven days interval before and after spraying using 0 to 4 scale given by Sheo Raj (1988): 0 = No disease; 1 = 0 to 5 per cent; 2 = 5.1 to 20 per cent; 3 = 20.1 to 40 per cent and 4 = >40 per cent leaf area are diseased. Depending on the scores collected, per cent disease index (PDI) was calculated by using the formula of Wheeler (1969):

$$\text{PDI} = \frac{\text{Sum of numerical ratings}}{\text{Total number of leaves scored} \times \text{maximum rating}} \times 100$$

Per cent disease control in each treatment was calculated. Treatment wise yield data were recorded. Decrease / increase in the disease / yield over control were calculated using the formula:

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

where;

C = PDI or yield of control;

T = PDI or yield (q/ha) of respective treatment

Benefit cost ratio (B:C ratio) was calculated by dividing gross returns with gross expenditure for each treatment in comparison to untreated control. Incremental Cost: Benefit ratio (ICBR) was calculated by dividing net profit with plant protection cost for each treatment in comparison to untreated control.

RESULTS AND DISCUSSION

All the fungicides evaluated were found to be effective in reducing *Alternaria* leaf spot disease (5.83 to 9.67 PDI) in cotton after first spray against untreated control (13.33 PDI) (Table 1). The lowest PDI of 5.83 with 56.25 per cent disease control was recorded with

propiconazole @ (0.1%) followed by zineb (68%) + hexaconazole (4% WP) @ (0.2%) (6.00 PDI and (55.00%) control) and myclobutanil (10% WP) @ (0.1%) (6.17 PDI and (53.75%) control). Propineb (70% WP) @ (0.3%) and pyroxystrobin (25%) + fluxapyrad (25% SC) @ (0.06%) recorded 6.83 and 7.33 PDI with 48.75 and 45.00% disease control, respectively. Pyraclostrobin (20% WG) @ (0.01%) (8.33 PDI), metiram (5%) + pyraclostrobin (55% WG) @ (0.1%) (8.67 PDI) and metiram (70% WG) @ (0.2%) (8.75 PDI) resulted in 37.50, 35.00 and 34.38% disease control, respectively. Trifloxystrobin (61.3%) + propineb (3.5% WG) @ (0.3%) was found least effective with 27.50 per cent control and 9.67 PDI after the first spray. The PDI ranged from 3.67 (propiconazole @ 0.1%) to 7.00 (pyraclostrobin @ 0.1%) after the second spray as against 14.08 PDI in control. All the fungicides, except pyraclostrobin @ 0.1%, were statistically *on par* in controlling *Alternaria* leaf spot. Propiconazole @ 0.1% recorded the least PDI (3.67) with the highest per cent decrease over control (73.93) followed by zineb + hexaconazole @ 0.2% (3.83 PDI and 72.80% control) and myclobutanil @ 0.1% (4.33 PDI and 69.25% control). Propineb 70% WP @ 0.3% (5.33 PDI), metiram 70% WG @ 0.2% (5.33 PDI) and pyroxystrobin 25% + fluxapyrad 25% SC @ 0.06% (5.50 PDI) resulted in 62.17, 62.14 and 60.94% disease control, respectively. Metiram 5% + pyraclostrobin 55% WG @ 0.1% and trifloxystrobin 61.3% + propineb 3.5% WG registered 6.50 and 6.67 PDI with 53.84 and 52.63% disease control, respectively. Pyraclostrobin @ 0.1% recorded the least disease control of 50.28% with 7.00 PDI after the second spray (Table 1). Propiconazole @ 0.1% recorded the least AUDPC value (71.25) followed by zineb 68% + hexaconazole 4% (73.75) as against control with highest AUPDC value (205.60) (Fig.1). These results are in conformity with earlier findings. Propiconazole (0.1%) was reported with the lowest PDI of 28.5 when sprayed at fortnightly intervals from first disease

Table 1: Efficacy of fungicides against *Alternaria* leaf spot in cotton during *khari*, 2019-2020

Treatments	Spray Conc. (%)	Alternaria leaf spot (PDI)*		Decrease over control (%)	
		After 1 st spray	After 2 nd spray	After 1st spray	After 2nd spray
T1 -Myclobutanil (10% WP)	0.10	6.17 (14.36) ^a	4.33 (11.96) ^{ab}	53.75	69.25
T2 -Pyraclostrobin (20% WG)	0.10	8.33 (16.77) ^a	7.00 (15.31) ^c	37.50	50.28
T3 -Metiram (70% WG)	0.20	8.75 (17.19) ^a	5.33 (13.32) ^{ab}	34.38	62.14
T4 -Propiconazole (25% EC)	0.10	5.83 (13.95) ^a	3.67 (10.93) ^a	56.25	73.93
T5 -Propineb (70% WP)	0.30	6.83 (15.15) ^a	5.33 (13.32) ^{ab}	48.75	62.17
T6 -Zineb (68%) + hexaconazole (4% WP)	0.20	6.00 (14.17) ^a	3.83 (11.18) ^a	55.00	72.80
T7 -Trifloxystrobin (61.3%) + propineb (3.5% WG)	0.30	9.67 (17.71) ^b	6.67 (14.95) ^b	27.50	52.63
T8 -Pyroxystrobin (25%) + fluxapyrad (25% SC)	0.06	7.33 (15.69) ^a	5.50 (13.52) ^{ab}	45.00	60.94
T9 -Metiram (5%) + pyraclostrobin (55% WG)	0.30	8.67 (17.11) ^a	6.50 (14.75) ^b	35.00	53.84
T10 -Untreated Control		13.33 (21.28) ^c	14.08 (21.85) ^d		
SEm (±)		1.19	1.02		
CD (P ≤ 0.05)		3.55	3.04		
		12.66	12.55		

*Means of three replications; Figures in parentheses are arc sine transformed values

appearance of *Alternaria* leaf spot (Arunakumara *et al.*, 2010). Kresoxim methyl at 500 ml/ha was found on par with 0.1 per cent propiconazole in controlling *Alternaria* leaf spot (Bhattiprolu 2015). Bhattiprolu and Monga (2017) reported propiconazole (0.1%) as effective fungicide against *Alternaria* leaf spot. Sangeetha *et al.* (2018) recorded hexaconazole @ (0.1%) and propiconazole @ (0.1%) as effective fungicides in managing the disease under field conditions.

With respect to *Corynespora* leaf spot, all the fungicides reduced the disease (23.65 to 54.68%) after first spray, in comparison to unsprayed control (16.92 PDI) (Table 2). Propiconazole @ (0.1%) recorded the lowest PDI of 7.67 and 54.68 per cent disease control followed by zineb 68% + hexaconazole (4% WP) @ (0.2%) (7.83 PDI and 53.69% control) and propineb (70% WP) @ (0.3%) (8.67 PDI and 48.77% control). Trifloxystrobin (61.3%) + propineb (3.5% WG) @ (0.3%) and metiram (70% WG) @ (0.2%) recorded 10.17 and 10.25 PDI with 39.90 and (39.41%) disease control respectively whereas myclobutanil (10% WP) @ (0.1%) and pyroxystrobin (25%) + fluxapyrad (25% SC) @ (0.06%) resulted in 11.17 and 11.33 PDI with 33.99 and 33 per cent control, respectively. All the fungicides, except pyraclostrobin @ (0.1%), were

statistically *on par* in controlling *Corynespora* leaf spot after the second spray. Propiconazole @ (0.1%) recorded the lowest PDI of 4.83 and 74.80 per cent disease control followed by zineb (68%) + hexaconazole (4% WP) @ (0.2%) (5.00 PDI and 73.92% control) and propineb (70% WP) @ (0.3%) (5.75 PDI and (70.01%) control). Trifloxystrobin (61.3%) + propineb (3.5% WG) @ (0.3%) (6.92 PDI), pyroxystrobin (25%) + fluxapyrad (25% SC) @ (0.06%) (7.17 PDI), metiram (5%) + pyraclostrobin (55% WG) @ (0.1%) (7.92 PDI) resulted in 63.90, 62.60 and 58.69 per cent disease control, respectively. Myclobutanil (10% WP) @ (0.1%) and metiram (70% WG) @ (0.2%) resulted in 56.55 per cent disease control with 8.33 PDI. Pyraclostrobin (20% WG) (9.58 PDI) recorded with the least disease control of 50.03% while the unsprayed control 19.17 PDI was observed. After the third spray, all the fungicides were statistically *on par* in managing *Corynespora* leaf spot (3.42 to 7.25 PDI) compared to unsprayed control (24.25 PDI) (Table 2). Propiconazole @ (0.1%) showed the least PDI (3.42) and highest per cent decrease control (85.90 per cent) followed by zineb + hexaconazole @ 0.2% (3.50 PDI and 85.57 per cent control), propineb 70% WP (4.75 PDI and 80.41 per cent control), metiram 70% WG (5.42 PDI and 77.65 per cent control).

Table 2. Efficacy of fungicides against *Corynespora* leaf spot in cotton

Treatments	Conc. (%)	Per cent Disease Index (PDI)*			Per cent over Control Decrease (PDC)			Grey mildew PDI*	Decrease Over Control
		After 1st spray	After 2nd spray	After 3rd spray	After 1st spray	After 2nd spray	After 3rd spray		
T1 -Myclobutanil (10% WP)	0.10	11.17 ^b (19.48)	8.33 (16.73) ^{ab}	6.33 (14.55) ^b	33.99	56.55	73.90	6.17 (14.36) ^b	51.61
T2 -Pyraclostrobin (20% WG)	0.10	12.92 ^c (21.03)	9.58 (18.01) ^b	7.25 (15.60) ^c	23.65	50.03	70.10	6.83 (15.01) ^c	46.43
T3 -Metiram (70% WG)	0.20	10.25 (18.66) ^{ab}	8.33 ^{ab} (16.75)	5.42 (13.45) ^{ab}	39.41	56.55	77.65	5.33 (13.32) ^{ab}	58.17
T4 -Propiconazole (25% EC)	0.10	7.67 (15.98) ^a	4.83 (12.67) ^a	3.42 (10.52) ^a	54.68	74.80	85.90	4.00 (11.42) ^a	68.63
T5 -Propineb (70% WP)	0.30	8.67 (17.07) ^{ab}	5.75 (13.78) ^a	4.75 (12.56) ^{ab}	48.77	70.01	80.41	4.67 (12.44) ^{ab}	63.37
T6 -Zineb (68%) + hexaconazole (4% WP)	0.20	7.83 (16.30) ^a	5.00 (12.92) ^a	3.50 (10.80) ^a	53.69	73.92	85.57	4.33 (12.01) ^{ab}	66.04
T7 -Trifloxystrobin (61.3%) + propineb (3.5% WG)	0.30	10.17 (18.57) ^{ab}	6.92 (15.16) ^{ab}	5.67 (13.76) ^{ab}	39.90	63.90	76.62	5.83 (13.92) ^{ab}	54.27
T8 -Pyroxytrobin (25%) + fluxapyraxad (25% SC)	0.06	11.33 (19.61) ^b	7.17 (15.49) ^{ab}	5.92 (14.04) ^{ab}	33.00	62.60	75.59	6.50 (14.74) ^c	49.02
T9 -Metiram (5%) + pyraclostrobin (55% WG)	0.30	12.00 (20.19) ^b	7.92 (16.31) ^{ab}	5.58 (13.66) ^{ab}	29.06	58.69	76.99	6.17 (14.30) ^b	51.61
T10 -Untreated Control		16.92 (24.19) ^c	19.17 (25.95) ^c	24.25 (29.49) ^d	-	-	-	12.75 (20.90) ^d	
SEm ±		1.03	1.42	1.31				0.90	
CD (P = 0.05)		3.07	4.22	3.88				2.67	
CV (%)		9.37	14.92	15.29				10.87	

*Mean of three replications; Figures in parentheses are arc sine transformed values

Table 3. Economics of efficacy of fungicides against fungal foliar diseases in cotton during *kharif* 2019-2020

Treatments	Spray fluid Conc. (%)	Yield (q/ha)*	Gross expenditure (Rs.)	Gross returns (Rs.)	Net returns (Rs.)	Benefit cost Ratio	ICBR
T1 : Myclobutanil (10% WP)	0.10	42.80 c	76600	201160.00	124560.00	2.63	31.94
T2 : Pyraclostrobin (20% WG)	0.10	40.53 d	76000	190506.67	114506.67	2.51	34.70
T3 : Metiram (70% WG)	0.20	43.47 c	77750	204293.33	126543.33	2.63	25.06
T4 : Propiconazole (25% EC)	0.10	47.91 a	76420	225161.33	148741.33	2.95	39.98
T5 : Propineb (70% WP)	0.30	44.73 b	77200	210246.67	133046.67	2.72	29.57
T6 : Zineb (68%) + Hexaconazole (4% WP)	0.20	46.40 a	76840	218080.00	141240.00	2.84	34.12
T7 : Trifloxystrobin (61.3%) + propineb (3.5% WG)	0.30	41.73 d	85390	196146.67	110756.67	2.30	8.73
T8 : Pyroxytrobin (25%) + fluxapyraxad (25% SC)	0.06	42.41 c	80500	199311.33	118811.33	2.48	15.23
T9 : Metiram (5%) + Pyraclostrobin (55% WG)	0.30	43.53 c	77510.5	204606.67	127096.17	2.64	26.42
T10 : Control	-	35.44 e	74500	166568.00	92068.00	2.24	-
SEm (±)		0.84					
CD (P = 0.05)		2.51					
CV (%)		10.87					

*Mean of three replications; Treatment means with same alphabet do not differ significantly

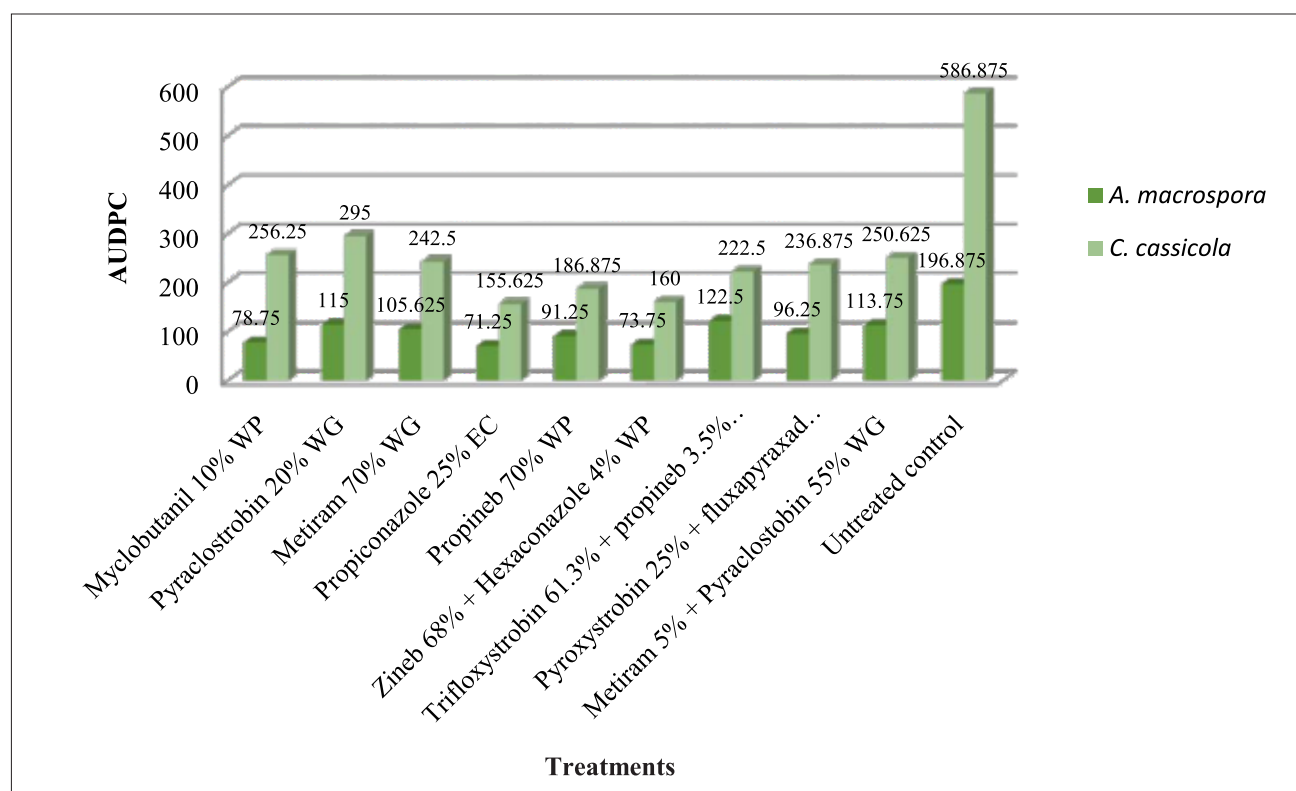


Fig. 1. Progression of AUDPC values of *Alternaria* and *Corynespora* leaf spots as affected by different fungicides

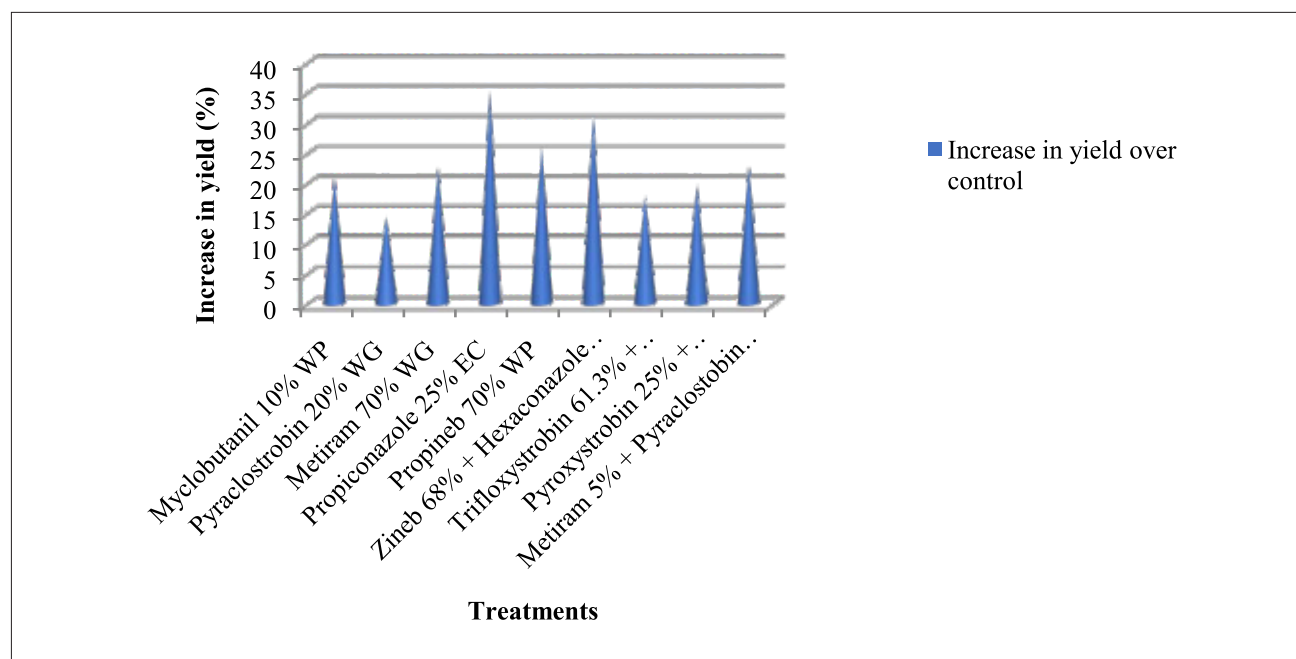


Fig. 2. Effect of disease management on seed cotton yield (q/ha)

The increase in disease throughout the assessment days indicated the spread of the disease in space. The data showed highly significant differences among treatments. The

study showed that the pathogen *C. cassicola* had spread and developed faster in unsprayed plots than the protected plots. The results indicated the least AUDPC value in propiconazole @ 0.1%

(155.63) followed by propineb @ (0.3%) (186.90) and zineb (68%) + hexaconazole 4% (191.20) whereas the highest AUDPC value was recorded in control (595.68) (Fig 1).

The PDI of grey mildew ranged from 4.00 to 6.83 as against 12.75 PDI in control. All the fungicides, except pyraclostrobin @ (0.1%), were statistically *on par* in reducing grey mildew. Propiconazole @ (0.1%) recorded the least PDI (4.00) and the highest per cent decrease of disease over control (68.63) followed by zineb + hexaconazole (4.33 PDI and 66.04% control) and propineb @ 0.3% (4.67 PDI and 63.37% control). Metiram (70% WG) @ (0.2%) (5.33 PDI) and trifloxystrobin 61.3% + propineb (3.5% WG) @ (0.3%) (5.83 PDI) resulted in 58.17 and 54.27 per cent reduction in disease. Myclobutanil (10% WP) @ 0.1% and metiram (5%) + pyraclostrobin (55% WG) @ (0.1%) treated plots were observed with 6.17 PDI and 51.61 per cent control of disease whereas pyroxystrobin 25% + fluxapyroxad 25% SC @ 0.06% (6.50 PDI) was found with 49.02 per cent reduction of disease. Pyraclostrobin 20% WG @ 0.01% (6.83 PDI) registered least reduction of 46.43% (Table 2).

The present results are in accordance with Shastry and Tomar (2008) who noticed that propiconazole treatment (14.39%) as most effective and found it to be significantly superior over all treatments in reducing the per cent disease incidence of grey mildew. Khodke and Raut (2009) also observed that propiconazole (0.05%) with minimum incidence of grey mildew. Kresoxim methyl (0.1%), myclobutanil (0.04-0.05%), propiconazole (0.1%) and carbendazim (0.05%) were found *on par* against grey mildew (Bhattiprolu, 2021)

Rust disease appeared very late *i.e.*, at boll busting stage at low intensity, additional spray was not taken up as it was opined not cost effective.

Seed cotton yield among the treatments ranged from 35.44q/ha (unsprayed check) to 47.91q/ha (propiconazole @ 0.1%). Propiconazole recorded increased yield of 35.18 per cent

followed by zineb + hexaconazole @ 0.2% (46.40q/ha) and propineb @ 0.3% (44.73q/ha) which *on par* (Table 3 and Fig. 2).

The highest B: C ratio was obtained with propiconazole @ 0.1% (2.95) followed by zineb + hexaconazole @ 0.2% (2.84), propineb @ 0.3% (2.72), metiram @ 0.2% (2.63), myclobutanil @ 0.1% (2.63), metiram + pyraclostrobin @ 0.1% (2.64), pyroxystrobin + fluxapyroxad 0.06% (2.48), pyraclostrobin @ 0.1% (2.51) and trifloxystrobin + propineb @ 0.3% (2.30) (Table 3). Maximum ICBR of 39.98 was obtained from propiconazole @ 0.1% followed by zineb + hexaconazole @ 0.2% (34.12) and pyraclostrobin @ 0.1% (34.70). Least ICBR was obtained from trifloxystrobin + propineb @ 0.3% (8.73) (Table 3).

Dighule *et al.*, (2011) reported that mancozeb (0.3%) and propiconazole (0.1%) were effective in reducing the losses due to leaf spot diseases (*Alternaria* leaf blight, *Myrothecium* leaf spot, *Helminthosporium* leaf spot) and increased the seed cotton yield. Difenconazole at a rate of 0.125 kg a.i. /ha and tebuconazole at 0.187 kg a.i. /ha suppressed *Alternaria* leaf spot and increased yield (15.6–39.0% increase) in cotton (Shtienberg and Dreishpoun, 1991). Both Taqat and propiconazole significantly increased the yield to the tune of 22.6% (Bhattiprolu, 2010). Three sprays of hexaconazole and difenconazole produced highest yields with lowest PDI of cotton rust (Shridhar Shetty Pindikur *et al.*, 2012). Sangeetha *et al.*, (2018) observed that both hexaconazole and propiconazole at 0.1 per cent concentration to be effective in managing the *Alternaria* leaf spot by recording akapas yield of 15.37 and 14.84q/ha with a benefit cost ratio of 2.04 and 1.70, respectively.

Based on these results it is concluded that propiconazole 0.1% or zineb + hexaconazole 0.2% or pyraclostrobin @ 0.1% @ 0.3% or Myclobutanil 10% WP are effective against leaf spots and grey mildew with highest net profits in cotton.

REFERENCES

- Bhattiprolu, S.L. 2010.** Efficacy of Taqat against Fungal Leaf Spot Diseases of Cotton. *J. Cotton Res. Dev.* **24**: 243–44.
- Bhattiprolu, S.L. 2021.** Field efficacy of Myclobutanil (10% WP) against major diseases of cotton. *J. Cotton Res. Dev.* **35**: 260-66.
- Bhattiprolu, S.L. and Monga, D. 2017.** Integrated management of foliar diseases in cotton *J. Cotton Res. Dev.* **31**: 97-101.
- Bhattiprolu, S.L. and Prasad Rao, M.P. 2009.** Estimation of crop losses due to Alternaria leaf spot in cotton. *J. Cotton Res. Dev.* **23**: 135-137.
- Chattannavar, S.N., Kulkarni, S. and Khadi, B.M. 2006.** Chemical control of Alternaria blight of cotton. *J. Cotton Res. Dev.* **20**: 125-26.
- Chattannavar, S. N., Hosagoudar, G. N. and Ashtaputre, S. A. 2010.** Crop loss estimation due to foliar diseases in cotton. *Karnataka J. Agric. Sci.* **23**: 559 – 601.
- Conner, K.N., Hagan, A.K and Zhang, L. 2013.** First report of *Corynespora cassiicola*-incited target spot on cotton in Alabama. Plant Dis. <http://dx.doi.org/10.1094/PDIS-02-13-0133-PDN>
- Dighule, S.B., Perane, R.R., More, P.E and Amle, K.S. 2011.** Efficacy of chemical fungicides and bioagents against major cotton fungal foliar diseases. *Int. J. Plant Prot.* **4**: 263-66.
- Fulmer, A.M., Walls, J.T., Dutta, B., Parkunan, V., Brock, J. and Kemerait, R.C. 2012.** First report of target spot caused by *Corynespora cassiicola* on Cotton in Georgia. *Plant Dis.* **96**: 1066
- Hagan, A. 2014.** Target spot management options in Albama. Beltwide Cotton Conf. 18.
- Hagan, A.K. and Sikora, E.J. 2012.** Leaf spot management in Alabama cotton, control of potash- incited leaf spot diseases and *Corynespora* leaf spot. Plant Pathol. Series. *Ext. Pl. Path.* 961.
- Hagan, A.K., Bowen., K.L., Pegues, M. and Jones, J. 2015.** Relationship between target spot intensity and seed cotton yield. *Phytopatholog.* 105:4.
- Monga, D., Sree Lakshmi, B. and Prakash, A. H. 2013.** Crop losses due to important cotton diseases. Central Institute for Cotton Research, Regional Station, Sirsa-125055, India, *Tech. Bull.*, pp1-23.
- More, K.G., Dhoke, P.K., Deosarkar, D.B., Bhatade, S.S., Patil, D.V and Gaikwad, A. R. 2010.** Present status of cotton diseases in Marathwada region. *J. Cotton Res. Dev.* **24**: 106-07.
- Sangeetha, K.D., Ashtaputre, S.A., Ramya, T.S., Kavyashree, M.C. and Anil, G.H. 2018.** Exploration of fungicides against Alternaria leaf blight of cotton in Northern parts of Karnataka. India. *Int. J. Chem. Stud.* **6**: 2127-29.
- Sheo Raj. 1988.** Grading system for cotton diseases, Nagpur. CICR, *Tech. Bull.*, pp.1-7.

Rajanna, Jaime A. Teixeira da Silva, Supriya Doijode and Gururaj Sunkad 2012. In vitro and in vivo evaluation of fungal toxicants for the control of cotton rust caused by *Phakopsora gossypii* (Arth.) Hirat. The Asian Australas. J. Plant Sci. Biotechnol. **6**: 7-13.

Wheeler, B.E.J. 1969. *An Introduction to Plant Diseases*. John Wiley publication, London. 301.

Zanjare, S. K., Lambhate, S.S., Rajmane, S.B. and Mehetre, S.S. 2005. Assessment of crop loss due to *Alternaria* leaf blight of cotton (*Gossypium hirsutum* L.). J. Maharashtra Agric. Univ. **30**: 98-99.

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