



Field efficacy of Flint Pro 64.8 WG (Trifloxystrobin 3.5% + Propineb 61.3%) against fungal diseases in cotton

S. L. BHATTIPROLU*

Acharya N. G. Ranga Agricultural University, Regional Agricultural Research Station, Lam, Guntur – 522 034

**E-mail: bhattiprolu2023@gmail.com*

ABSTRACT: Efficacy of Flint Pro 64.8 WG (Trifloxystrobin 3.5% + Propineb 61.3%) was tested @ 1500 g/ha, 1700g/ha and 1900g/ha in comparison with trifloxystrobin (50% WG) (135g/ha), propineb (70% WP) (1670g/ha) and carbendazim (50% WP) (250g/ha) at Regional Agricultural Research Station, Lam, Guntur, during *kharif* 2016 and 2017 against fungal diseases of cotton. Different doses of Flint Pro 64.8 WG were significantly superior in controlling *Alternaria* leaf blight (53.93% to 68.36%), anthracnose (57.09 to 74.62%) and rust (75.20 to 86.79%) besides increased leaf greenness. Flint Pro 64.8 WG @ 1900g/ha (87.25%) followed by carbendazim (83.46%) and Flint Pro 64.8 WG @ 1700g/ha (82.17%) were superior against grey mildew. Highest yield increase of 51.54 per cent was obtained with Flint Pro 64.8 WG @ 1900 g/ha followed by carbendazim (42.30%) and Flint Pro 64.8 WG @ 1700 g/ha (38.94%). Flint Pro 64.8 WG @ 3800g/ha did not cause any phytotoxicity to cotton crop.

Key words : Cotton, efficacy, Flint Pro, fungal diseases, propineb, trifloxystrobin

Cotton is an important commercial crop in India with a production of 361 lakh bales of 170 kg lint from an area of 122.38 lakh ha and a productivity of 501 kg/ha in 2018-2019, which is far behind the leading countries. Andhra Pradesh stood 4th in area (6.66 lakh ha) but 7th in production (20.0 lakh bales) and 5th in productivity (617 kg/ha) (Annoymous, 2019). Cotton crop is affected by a foliar diseases throughout the season. Spraying Copper fungicides (0.25%) mixed with streptocycline (0.01%) controlled foliar diseases. Propineb @ 0.21-0.28% was found effective against fungal leaf spots (Bhattiprolu and Prasada Rao, 2014) while carbendzim (@ 0.1%) prevented losses due to grey mildew (Bhattiprolu 2012). In order to

explore the possibility of the use of new chemicals, Flint Pro 64.8 WG (Trifloxystrobin 3.5% + Propineb 61.3%) was tested against fungal diseases in cotton.

MATERIALS AND METHODS

A field trial was laid out at Regional Agricultural Research Station, Lam, Guntur during *kharif* 2016 and 2017. Cotton hybrid Jaadoo BG II was sown in plots of 25 sq. m. adopting a spacing of 105 x 60cm. Eight treatments *viz.*, Flint Pro 64.8 WG (trifloxystrobin 3.5% + propineb 61.3%) was tested @ 1500 g/ha, 1700g/ha and 1900g/ha in comparison with trifloxystrobin (50% WG) @ 135g/ha, propineb

(70% WP) @ 1670g/ha and carbendazim (50% WP) @ 250g/ha along with untreated control were imposed with three replications in randomized block design. Flint Pro 64.8 WG @ 3800g/ha was tested for phytotoxicity. Treatments were imposed at 21 days interval with first spray starting immediately after the appearance of Alternaria leaf spot. Data on Alternaria leaf spot, anthracnose, grey mildew and rust was recorded using 0 to 4 scale given by Sheo Raj (1988): 0 = No disease; 1 = (0 to 5%); 2 = (5.1 to 20%); 3=(20.1 to 40%) and 4=(>40%) leaf area are diseased. Depending on the scores collected, per cent disease index (PDI) was calculated by using the formula of Wheeler (1969):

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

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 (kg/ha) of respective treatment

Observations on phyto toxicity symptoms including yellowing, stunting, necrosis, epinasty and hyponasty etc on cotton crop due to application of Flint Pro 64.8 WG @ 3800g/ha were recorded, individually, using 1-10 scale (where 1=(0-10%), 2=(11-20%), 3=(21-30%), 4=(31-40%),

5=(41-50%), 6=(51-60%), 7=(61-70%), 8=(71-80%), 9=(81-90%), 10=(91-100%) injury on leaf tips / surface) at 1, 3, 5, 7, and 10 days after the first application.

RESULTS AND DISCUSSION

All the treatments were found significantly superior to control during 2016-2017. The PDI of Alternaria blight varied from 5.63 to 11.75 as against 18.00 in the control (Table 1). Different doses of Flint Pro 64.8 WG were statistically *on par* and superior to other treatments with PDI of 5.63 to 8.5. Carbendazim was superior (9.5PDI) to trifloxystrobin (11.75PDI) and propineb (11.75PDI). During 2017-2018 different treatments recorded Alternaria leaf spot, in the range of 4.88 to 8.25 PDI as against control (15.13PDI). Trifloxystrobin (3.5%) + propineb (61.3%) @ 1900g/ha (4.88PDI) and 1700g/ha (6.33PDI) were statistically *on par* and superior to other treatments. Trifloxystrobin (3.5%) + propineb (61.3%) @ 1500g/ha recorded 6.75PDI followed by trifloxystrobin (7.50PDI) and propineb (7.75PDI) and were statistically *on par* while carbendazim recorded 8.25PDI. Pooled data revealed that trifloxystrobin (3.5%) + propineb (61.3%) @ 1900g/ha (5.25PDI) and 1700g/ha (6.44PDI) were statistically *on par* and superior to other treatments whereas trifloxystrobin (3.5%) + propineb (61.3%) @ 1500g/ha (7.63PDI) and carbendazim (8.88PDI) were statistically *on par* while trifloxystrobin and propineb were *on par* with 9.63 and 9.88PDI, respectively. Alternaria blight disease was controlled to the tune of 40.34 to 68.36 per cent in different treatments (Fig.1). Highest reduction in Alternaria blight was recorded with

Table 1. Efficacy of Flint Pro 64.8 WG (Trifloxystrobin 3.5% + Propineb 61.3%) against cotton diseases

Treatment	Alternaria leaf spot (PDI) ^a		Anthracnose (PDI) ^a		Grey mildew (PDI) ^a		Rust (PDI) ^a	
	2016-2017	2017-2018	2016-2017	2017-2018	2016-2017	2017-2018	2016-2017	2017-2018
T ₁ - Untreated control	18.0(25.10) ^d	15.13 (22.87) ^d	14.0 (21.97) ^c	10.88 (19.24) ^d	15.25 (22.99) ^c	14.25 (22.18) ^d	14.75 (22.59) ^c	16.13 (23.66) ^c
T ₂ - Flint Pro 64.8 WG @ 1500g/ha	8.5(16.95) ^b	6.75 (15.06) ^b	7.0 (15.34) ^b	4.50 (12.25) ^a	3.75 (11.17) ^b	3.75 (11.17) ^b	3.63 (10.94) ^b	4.00 (11.40) ^b
T ₃ - Flint Pro 64.8 WG @ 1700g/ha	6.75(15.06) ^a	6.13 (14.30) ^a	5.0 (12.92) ^a	3.88 (11.32) ^a	2.50(9.10) ^a	3.00(9.98) ^a	2.63 (9.28) ^a	3.13 (10.14) ^a
T ₄ - Flint Pro 64.8 WG @ 1900g/ha	5.63(13.69) ^a	4.88 (12.73) ^a	5.0 (12.92) ^a	3.13 (10.14) ^a	1.50 (7.04) ^a	2.25(8.63) ^a	1.88 (7.82) ^a	2.13 (8.33) ^a
T ₅ -Trifloxystrobin (50% WG) @ 135g/ha	11.75(20.05) ^c	7.50 (15.89) ^b	12.0 (20.27) ^b	6.38 (14.60) ^b	4.50 (12.25) ^b	5.25 (13.25) ^c	4.88 (12.73) ^b	4.50 (12.25) ^b
T ₆ - Propineb (70% WP) @ 1670g/ha	11.75(20.05) ^c	7.75 (16.17) ^b	11.0(19.37) ^b	6.13 (14.30) ^b	3.75 (11.17) ^b	5.63 (13.69) ^c	4.69 (12.46) ^b	7.13 (15.45) ^c
T ₇ - Carbendazim (50% WP) @ 250g/ha	9.5(17.95) ^b	8.25 (16.69) ^c	5.0 (12.92) ^a	6.13 (14.30) ^b	1.75 (7.64) ^b	3.13 (10.14) ^a	2.44 (8.91) ^a	9.13 (17.56) ^d
CD (p=0.05)	2.96	1.34	2.134	1.59	1.369	1.18	1.29	1.91
CV (%)	19.3	11.2	17.0	18.3	19.8%	14.9	17.5	19.5

Figures in the parentheses are arcsine transformed values. The figures indicated with same alphabet are not significantly different.

Table 2. Efficacy of Flint Pro 64.8 WG (Trifloxystrobin 3.5% + Propineb 61.3%) on yield and leaf greenness in cotton

Treatment	Yield of seed cotton (q/ha)				Leaf green ness index			
	After the sprays		Before harvest		After the sprays		Before harvest	
	2016-2017	2017-2018	2016-2017	2017-2018	2016-2017	2017-2018	2016-2017	2017-2018
T ₁ - Untreated control	16.30 ^d	19.40 ^d	52.55 ^b	49.18 ^c	51.19 ^b	55.05 ^b	43.55	49.30 ^c
T ₂ - Flint Pro 64.8 WG @ 1500g/ha	20.60 ^b	26.60 ^b	53.28 ^b	51.15 ^b	52.41 ^b	57.00 ^b	46.43	51.71 ^a
T ₃ - Flint Pro 64.8 WG @ 1700g/ha	21.70 ^b	27.90 ^a	55.95 ^a	54.83 ^a	54.94 ^a	57.13 ^b	46.96	52.04 ^a
T ₄ - Flint Pro 64.8 WG @ 1900g/ha	24.70 ^a	29.40 ^a	56.33 ^a	56.50 ^a	55.74 ^a	59.85 ^a	47.78	53.81 ^a
T ₅ -Trifloxystrobin (50% WG) @ 135g/ha	18.55 ^c	22.65 ^c	52.40 ^b	50.00 ^b	51.34 ^b	56.80 ^b	45.00	50.90 ^b
T ₆ - Propineb (70% WP) @ 1670g/ha	19.25 ^c	23.30 ^c	52.58 ^b	49.30 ^c	51.33 ^b	55.33 ^b	44.78	50.05 ^b
T ₇ - Carbendazim (50% WP) @ 250g/ha	24.00 ^a	26.80 ^b	54.68 ^a	51.70 ^b	52.74 ^b	57.30 ^a	45.85	51.58 ^b
CD (p=0.05)	1.94	1.95	2.35	1.85	1.59	2.68	NS	2.10
CV (%)	6.3	5.2	4.2	2.4	2.0	3.2	6.0	2.8

Figures in the parentheses are arcsine transformed values. The figures indicated with same alphabet are not significantly different.

trifloxystrobin (3.5%) + propineb (61.3%)@ 1900g/ha (68.6%) followed by 1700g/ha (61.11). In cotton, strobilurin fungicides are extensively used to manage *Rhizoctonia* seedling disease and target leaf spot caused by *Corynespora cassicola* (Woodward *et al.*, 2016). Propineb was found more effective against *Alternaria* blight in cotton (Dighule *et al.*, 2011) and Anil *et al.*, (2017). Propineb at a higher concentration of 0.4 per cent checked the development of *Cercospora* and *Alternaria* leaf spots (Singh *et al.*, 2010). They also reported that copper oxychloride @ 0.25 per cent was effective in controlling fungal leaf spots and gave highest yield. Propiconazole at 0.1 per cent was reported effective in preventing losses due to *Alternaria* leaf spot in cotton (Bhattiprolu and Prasada Rao, 2009) while propineb @ 1400g/ha reduced *Alternaria* and *Helminthosporium* leaf spots and significantly

increased seed cotton yield (Bhattiprolu and Prasada Rao, 2014). Hexaconazole followed by propiconazole and tebuconazole were found superior to trifloxystrobin against *Alternaria* blight (Sangeetha *et al.*, 2018).

With respect to anthracnose, all the treatments were found significantly superior to control during 2016-2017 (Table 1). The PDI of anthracnose varied from 5 to 12 as against 14 in the control. Different doses of Flint Pro 64.8 WG (5 to 7 PDI) and carbendazim (5.0PDI) were statistically *on par* and superior to other treatments. Trifloxystrobin (11 PDI) and propineb (12 PDI) were *on par*. During 2017-2018 different treatments recorded anthracnose in the range of 3.13 to 6.38 PDI as against control (10.88PDI). Different doses of Flint Pro 64.8 WG were statistically *on par* with PDI of 3.13 to 4.50 and superior to other treatments. Propineb (6.13 PDI),

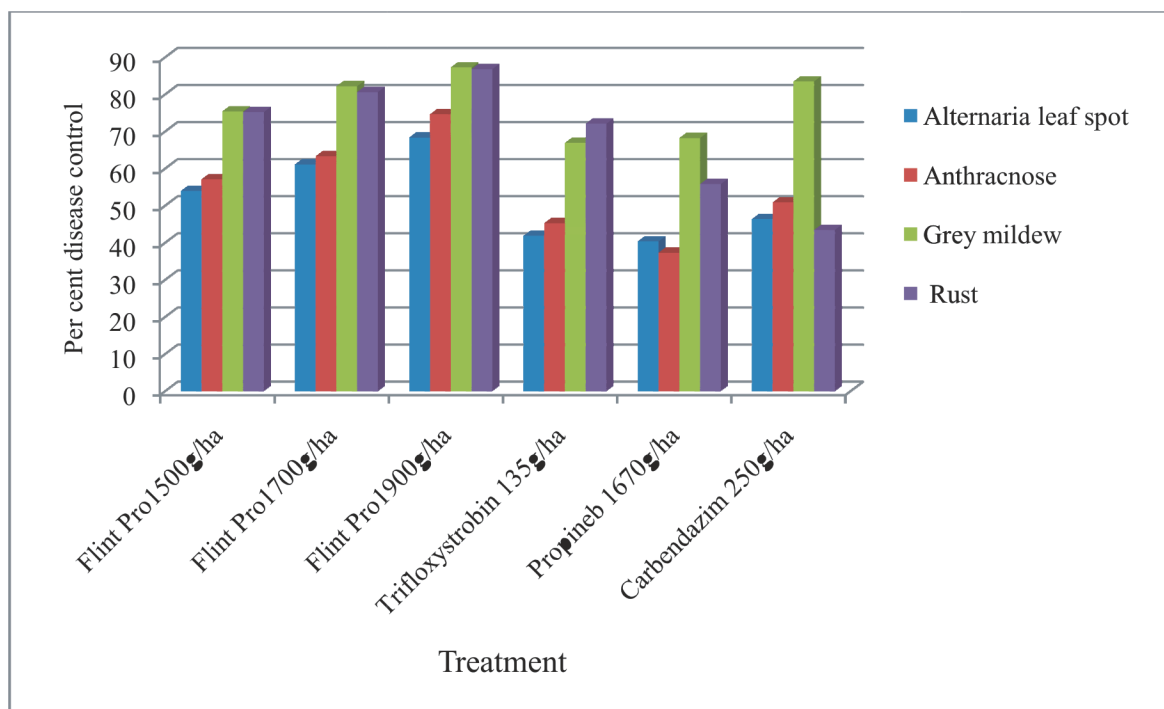


Fig 1. Effect of Flint Pro 64.8 WG (Trifloxystrobin 3.5% + Propineb 61.3%) against cotton diseases

carbendazim (6.13 PDI) and trifloxystrobin (6.38 PDI) were *on par*. Pooled data revealed that trifloxystrobin (3.5%) + propineb (61.3%) @ 1900g/ha (2.81 PDI) and 1700g/ha (4.06 PDI) were statistically *on par* and superior to other treatments. Trifloxystrobin (3.5%) + propineb (61.3%) @ 1500g/ha (4.75 PDI) and carbendazim (5.44 PDI) were *on par* whereas trifloxystrobin and propineb were *on par* with 6.06 and 6.94 PDI, respectively. Reduction in anthracnose was between 37.31 and 74.62 per cent in different treatments (Fig. 1). Highest reduction in anthracnose was recorded with trifloxystrobin (3.5%) + propineb (61.3%) @ 1900 (74.62%) followed by 1700g/ha (63.32) and @ 1500g/ha (57.09%).

Grey mildew was recorded to the tune of 1.5 PDI to 4.5 PDI in different treatments as against 15.25 PDI in control (Table 1). Trifloxystrobin (3.5%) + propineb (61.3%) @ 1900g/ha (1.5 PDI), carbendazim (1.75 PDI) and trifloxystrobin (3.5%) + propineb (61.3%) @ 1700g/ha (2.5 PDI) were statistically *on par* and superior to other treatments during 2016-2017. Trifloxystrobin (3.5%) + propineb (61.3%) @ 1500 g/ha (3.75 PDI), propineb (3.75 PDI) and trifloxystrobin (4.5 PDI) were *on par*. During 2017-2018, different treatments recorded grey mildew in the range of 2.25 to 5.63 PDI as against control (14.25 PDI). Trifloxystrobin (3.5%) + propineb (61.3%) @ 1900g/ha, 1700g/ha and carbendazim with 2.25 PDI, 3.00 PDI and 3.13 PDI, respectively, were *on par* and superior to other treatments during 2017-18. Trifloxystrobin (3.5%) + propineb (61.3%) @ 1500/ha recorded 3.75 PDI. Trifloxystrobin (5.25 PDI) and propineb (5.63 PDI) were *on par*. Pooled data revealed that trifloxystrobin (3.5%) + propineb (61.3%) @ 1900g/

ha (1.88 PDI), carbendazim (2.44 PDI) and trifloxystrobin (3.5%) + propineb (61.3%) @ 1700g/ha (2.63 PDI) were statistically *on par* and superior to other treatments. Trifloxystrobin (3.5%) + propineb (61.3%) @ 1500 (3.63 PDI), propineb (4.69 PDI) and trifloxystrobin (4.88 PDI) were *on par*. Reduction in grey mildew disease was between 66.92 and 87.25 per cent in different treatments (Fig.1). Highest reduction in grey mildew was recorded with trifloxystrobin (3.5%) + propineb (61.3%) @ 1900g/ha (87.25%) followed by carbendazim (83.46%) and trifloxystrobin (3.5%) + propineb (61.3%) @ 1700gha (82.17%) and @ 1500g/ha (75.39%). Carbendazim (0.1%) was recommended to avoid losses due to grey mildew (Bhattiprolu, 2012).

Rust disease appeared at later stage of the crop growth during 2017-2018 and different treatments showed rust between 2.13 PDI and 9.13 PDI as against 16.13 PDI in control (Table 1). Trifloxystrobin (3.5%) + propineb (61.3%) @ 1900g/ha (2.13 PDI) and @ 1700g/ha (3.13 PDI) were statistically *on par* and superior to other treatments during 2017-2018. Trifloxystrobin (3.5%) + propineb (61.3%) @ 1500g/ha (4.0 PDI) and trifloxystrobin (4.50 PDI) were statistically *on par*. Propineb and carbendazim recorded 7.13 PDI and 9.13 PDI, respectively. Reduction in rust disease was between 43.40 and 86.79 per cent in different treatments (Fig.1). Highest reduction in rust was recorded with trifloxystrobin (3.5%) + propineb (61.3%) @ 1900 (86.79%) followed by the same @ 1700/ha (80.60%) and @ 1500g/ha (75.20%). Propiconazole at 0.1 per cent was reported effective in preventing losses due to rust in cotton (Bhattiprolu, 2015)

Highest seed cotton yield of 24.70q/ha

was recorded with Flint Pro 64.8 WG (Trifloxystrobin (3.5%) + Propineb (61.3%)) at 1900g/ha followed by 24.0q/ha with carbendazim during 2016-2017. Trifloxystrobin (3.5%) + propineb (61.3%) at 1700 g/ha and 1500g/ha recorded 21.70q/ha and 20.60q/ha, respectively. Lowest yield of 16.30q/ha was observed in control. During 2017-2018, highest yield of 29.40/ha was recorded with trifloxystrobin (3.5%) + propineb (61.3%) at 1900g/ha followed by 27.90 q/ha with Flint Pro 64.8 WG at 1700g/ha. Carbendazim (0.1%) and trifloxystrobin (3.5%) + propineb (61.3%) recorded seed cotton yield of 26.80q/ha and 26.60q/ha, respectively, as against 19.40q/ha in control plots. Pooled data revealed highest yield of 27.05q/ha with trifloxystrobin (3.5%) + propineb (61.3%) @ 1900 g/ha. Carbendazim and trifloxystrobin (3.5%) + propineb (61.3%) at 1700g/ha resulted in 25.40q/ha and 23.60q/ha, respectively. Increase in seed cotton yield was to the tune of 15.41 to 51.54 per cent in different treatments. Highest yield increase of 51.54 per cent was obtained with Flint Pro 64.8 WG at 1900 g/ha followed by carbendazim (42.30%) and Flint Pro 64.8 WG at 1700 g/ha (38.94%).

Observations on leaf greenness after the sprays indicated increased values at higher test doses of 1900g/ha (56.33), 1700g/ha (55.95) and carbendazim at 250g/ha (54.97) as against other treatments (52.40 to 52.58) and control (52.55) during 2016-2017. Trifloxystrobin (3.5%) + propineb (61.3%) @ 1900g/ha (56.50) and @ 1700g/ha (54.83) expressed statistically significant greenness during 2017-2018. Pooled data also indicated superiority of higher test doses of 1900g/ha (55.74) and 1700g/ha (54.94). Data on leaf greenness before harvest showed

significance of trifloxystrobin (3.5%) + propineb (61.3%) @ 1900g/ha (59.85) and carbendazim at 250g/ha (57.30) as against other treatments and control (51.19) during 2016-2017 whereas all the treatments showed numerical superiority during 2017-2018. Pooled data exhibited the superiority of different test doses of trifloxystrobin (3.5%) + propineb (61.3%) @ 1900g/ha (53.81), @ 1700g/ha (52.04) and @ 1500g/ha (51.71).

Observations on phytotoxicity revealed that trifloxystrobin (3.5%) + propineb (61.3%) @ 3800g/ha did not induce any symptoms including yellowing, stunting, necrosis, epinasty, hyponasty on cotton crop at 1, 3, 5, 7, and 10 days after the first application.

The study revealed broadspectrum activity of Flint Pro 64.8 WG (Trifloxystrobin (3.5%) + Propineb (61.3%)) against *Alternaria* leaf blight, anthracnose, grey mildew and rust diseases in cotton with increased leaf greenness and statistically superior yields at 1700 to 1900g/ha with no phytotoxicity.

REFERENCES

- Anil, G. H., Astaputre, S. A. and Rao, M. S. L. 2017.** Chemical management of *Alternaria* leaf blight of *Bt* cotton. *Internat. J. Plant Sci.* **12** : 267-70.
- Anonymous, 2019.** *Annual Report*. ICAR-All India Coordinated Research Project on Cotton, Coimbatore, Tamil Nadu, India.
- Bhattiprolu, S. L. 2012.** Estimation of crop losses due to grey mildew (*Ramularia areola* Atk.) disease in *Bt* cotton hybrid. *J. Cotton Res. Dev.* **26** : 109-12.
- Bhattiprolu, S. L. 2015.** Estimation of crop losses due to rust *Phakopsora gossypii* (Arth.) Hirat.f

- disease in *Bt* cotton hybrid. *J Cotton Res. Dev.* **29** : 301-04.
- Bhattiprolu, S. L. and Prasada Rao, M. P. 2009.** Estimation of crop losses due to *Alternaria* leaf spot in cotton. *J. Indian Soc. Cotton Impr.* **34** : 151-54.
- Bhattiprolu, S. L. and Prasada Rao, M. P. 2014.** Efficacy of propineb against fungal leaf spot diseases of cotton. *J Cotton Res. Dev.* **28** : 324-26.
- Dighule, S. B., Perane, R. R., Amle, K. S. and More, P. E. 2011.** Efficacy of chemical fungicides and bio-agents against major cotton fungal foliar diseases *in vitro*. *Internat. J. Plant Sci.* **6** : 247-50.
- 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** : 2129-32.
- Sheo Raj, 1988.** Grading system for cotton diseases. Nagpur. *CICR. Tech. Bull.* 1-7.
- Singh, D., Mohan, C., Rewal, H. S. and Brar, J. S. 2010.** Management of foliar diseases in *Bt* cotton with agrochemicals. *J. Mycol. Pl. Path.* **40** : 560-63.
- Wheeler, B. E. J. 1969.** *An Introduction to Plant Diseases*. John Wiley and Sons Limited, London. 301.
- Woodward, J. E., Dodds, D. M., Main, C. L., Barber, L. T., Boman, R. K., Whitaker, J. R. Edmisten K. L., Banks, J. C., Buehring, N. W. and Allen, T. W. 2016.** Evaluation of Foliar Applications of Strobilurin Fungicides in Cotton across the Southern United States. *J. Cotton Sci.* **20** : 116-24.

Received for publication : December 10, 2019

Accepted for publication : April 16, 2020