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

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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 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, percent disease index (PDI) was calculated by using the formula of Wheeler (1969):

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

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:

\[
\text{C} - \text{T} \times 100
\]

where;

C = PDI or yield of control
T = PDI or yield (kg/ha) of respective treatment

Observations on phytotoxicity 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

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Alternaria leaf spot (PDI)</th>
<th>Anthracnose (PDI)</th>
<th>Grey mildew (PDI)</th>
<th>Rust (PDI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T₀ - Untreated Control</td>
<td>18.0 (25.10)</td>
<td>15.13</td>
<td>2 (22.87)</td>
<td>16.56 (23.23)</td>
</tr>
<tr>
<td>T₁ - Flint Pro 64.8 WG @ 1500g/ha</td>
<td>8.5 (16.95)</td>
<td>6.75 (15.06)</td>
<td>7.63 (16.00)</td>
<td>6.44 (14.65)</td>
</tr>
<tr>
<td>T₂ - Flint Pro 64.8 WG @ 1700g/ha</td>
<td>6.75 (15.06)</td>
<td>6.13 (14.30)</td>
<td>6.44 (14.65)</td>
<td>5.0 (12.92)</td>
</tr>
<tr>
<td>T₃ - Flint Pro 64.8 WG @ 1900g/ha</td>
<td>5.63 (13.69)</td>
<td>4.88 (12.73)</td>
<td>5.25 (13.25)</td>
<td>5.0 (12.92)</td>
</tr>
<tr>
<td>T₄ - Trifloxystrobin (50% WG) @ 135g/ha</td>
<td>11.75 (20.05)</td>
<td>7.50 (15.89)</td>
<td>6.33 (10.30)</td>
<td>4.06 (11.61)</td>
</tr>
<tr>
<td>T₅ - Propineb (70% WP) @ 1670g/ha</td>
<td>9.5 (17.95)</td>
<td>8.25 (16.69)</td>
<td>8.88 (17.31)</td>
<td>5.0 (12.92)</td>
</tr>
<tr>
<td>CD (p&lt;0.05)</td>
<td>2.96</td>
<td>1.34</td>
<td>1.53</td>
<td>2.14</td>
</tr>
<tr>
<td>CV (%)</td>
<td>19.3</td>
<td>11.2</td>
<td>11.3</td>
<td>17.0</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Yield of seed cotton [g/ha]</th>
<th>Leaf greenness index</th>
</tr>
</thead>
<tbody>
<tr>
<td>T₀ - Untreated control</td>
<td>16.30</td>
<td>19.40</td>
</tr>
<tr>
<td>T₁ - Flint Pro 64.8 WG @ 1500g/ha</td>
<td>20.60</td>
<td>26.60</td>
</tr>
<tr>
<td>T₂ - Flint Pro 64.8 WG @ 1700g/ha</td>
<td>21.79</td>
<td>27.90</td>
</tr>
<tr>
<td>T₃ - Flint Pro 64.8 WG @ 1900g/ha</td>
<td>24.70</td>
<td>29.40</td>
</tr>
<tr>
<td>T₄ - Trifloxystrobin (50% WG) @ 135g/ha</td>
<td>18.55</td>
<td>22.65</td>
</tr>
<tr>
<td>T₅ - Propineb (70% WP) @ 1670g/ha</td>
<td>19.25</td>
<td>23.30</td>
</tr>
<tr>
<td>T₆ - Carbendazim (50% WP) @ 250g/ha</td>
<td>24.00</td>
<td>26.80</td>
</tr>
<tr>
<td>CD (p&lt;0.05)</td>
<td>1.94</td>
<td>1.95</td>
</tr>
<tr>
<td>CV (%)</td>
<td>6.3</td>
<td>5.2</td>
</tr>
</tbody>
</table>

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 cassiicola* (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](image-url)
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%) @ 1900g/ha (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%)) @ 1900 g/ha followed by 24.0 q/ha with carbendazim during 2016-2017. Trifloxystrobin (3.5%) + propineb (61.3%) at 1700 g/ha and 1500 g/ha recorded 21.70 q/ha and 20.60 q/ha, respectively. Lowest yield of 16.30 q/ha was observed in control. During 2017-2018, highest yield of 29.40 q/ha was recorded with trifloxystrobin (3.5%) + propineb (61.3%) @ 1900 g/ha followed by 27.90 q/ha with Flint Pro 64.8 WG at 1700 g/ha. Carbendazim (0.1%) and trifloxystrobin (3.5%) + propineb (61.3%) recorded seed cotton yield of 26.80 q/ha and 26.60 q/ha, respectively, as against 19.40 q/ha in control plots. Pooled data revealed highest yield of 27.05 q/ha with trifloxystrobin (3.5%) + propineb (61.3%) @ 1900 g/ha. Carbendazim and trifloxystrobin (3.5%) + propineb (61.3%) at 1700 g/ha resulted in 25.40 q/ha and 23.60 q/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 1900 g/ha (56.33), 1700 g/ha (55.95) and carbendazim at 250 g/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%) @ 1900 g/ha (56.50) and @ 1700 g/ha (54.83) expressed statistically significant greenness during 2017-2018. Pooled data also indicated superiority of higher test doses of 1900 g/ha (55.74) and 1700 g/ha (54.94). Data on leaf greenness before harvest showed significance of trifloxystrobin (3.5%) + propineb (61.3%) @ 1900 g/ha (59.85) and carbendazim at 250 g/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%) @ 1900 g/ha (53.81), @ 1700 g/ha (52.04) and @ 1500 g/ha (51.71).

Observations on phytotoxicity revealed that trifloxystrobin (3.5%) + propineb (61.3%) @ 3800 g/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 1900 g/ha with no phytotoxicity.

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