Impact of harvest-aid defoliants on yield and economics of high density cotton

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ABSTRACT

A field experiment was conducted to study the effect of chemical defoliation on growth parameters, seed cotton yield and economics of cotton under high density planting during kharif, 2016. Defoliation with Etherel @ 2000 ppm at 60 boll opening percentage resulted in higher number of picked bolls plant\(^{-1}\) and boll opening percentage and seed cotton yield (2359 kg ha\(^{-1}\)). At harvest, significantly highest drymatter accumulation was recorded with Urea @ 15% (T\(_7\) (22692 kg ha\(^{-1}\)). Dropp Ultra 560 SC (Thidiazuron 360 + Diuron 180) @ 200 ml/ha recorded significantly higher leaf defoliation (99.7 %) and was superior over other defoliants tried. Application of defoliants i.e., Dropp Ultra and Etherel at 60 BOP resulted in reduction of crop duration by 20 days.

Key words: Boll opening percentage, Defoliants, Dropp Ultra, Etherel, Seed cotton yield.

INTRODUCTION

Cotton is major cash crop of kharif season in India. One of the constraints that limit realization of potential yield of cotton is poor and uneven opening of mature bolls. Excessive vegetative growth attained by cotton and thick crop canopy due to liberal use of nutrients hinders the opening of mature bolls, delays crop maturity and prolongs picking duration. Shedding of leaves with defoliants, terminate cotton development in preparation for harvest and expose the bolls to better circulation of air which in turn favours quick boll opening and early picking (Christidis and Herrisen, 1995). Defoliants normally produce ethylene, which is a ripening hormone and causes leaf drop and allow the bolls to crack open and fluff out. Secondly, it leads to clean and efficient picking as it avoids staining of leaves with pigments and increase the quality of fibre. The present investigation was, therefore, undertaken to study the effect of chemical defoliation on growth parameters, seed cotton yield and economics of cotton.

MATERIALS AND METHODS

The experiment was carried out at Agricultural College Farm, Bapatla, Andhra Pradesh, during kharif 2016. The soil of experimental field was slightly alkaline in reaction (7.64), clay in texture, low in organic carbon (0.5 %) and medium in available nitrogen (219.5 kg ha\(^{-1}\)), and phosphorus (25.2 kg ha\(^{-1}\)) and high in available potassium (310.6 kg ha\(^{-1}\)). The experiment was laid out in randomized block design replicated thrice with nine treatments consisting of T\(_1\) - Dropp Ultra 560 SC (Thidiazuron 360 + Diuron 180) @ 150 ml/ha; T\(_2\) - Dropp Ultra 560 SC (Thidiazuron 360 + Diuron 180) @ 200 ml/ha; T\(_3\) - Etherel @ 1500 ppm; T\(_4\) - Etherel @ 2000 ppm; T\(_5\) - Urea @ 10%; T\(_6\) - Urea @ 15%; T\(_7\) - NaCl @ 15%; T\(_8\) - NaCl @ 20%; T\(_9\) – Control. The chemical defoliants were applied as a foliar spray as per treatments when cotton crop attained 60 BOP and control treatment was sprayed with water only. Cotton variety Suraj was sown at high density i.e., at inter-row spacing of 45 cm and intra-row spacing of 10 cm (2,22,222 plants ha\(^{-1}\)) on 21 July 2016. Recommended cultural practices and plant protection measures were followed throughout the crop growing season. Data on growth parameters and yield attributes were recorded from five tagged plants per plot and calculated in kg ha\(^{-1}\).

RESULTS AND DISCUSSION

Growth parameters: Plant height was not significantly influenced by different defoliant treatments at different growth stages of cotton. However, at 15 days after defoliant spray (165 DAS), plant height recorded was numerically high (115.6 cm) (Table 1) with Urea @ 15% (T\(_7\)), while in Dropp Ultra 540 SC (Thidiazuron 360 + Diuron 180) @ 200 ml ha\(^{-1}\) (T\(_9\)), there was reduction in plant height (103.5 cm). This reduction in plant height might be due to complete shedding of leaves which in turn reduced assimilation of photosynthates. These results were in conformity with the findings of Karademir et al. (2007) and Meena et al. (2016). At harvest, significantly highest drymatter accumulation was recorded with Urea @ 15% (T\(_7\)) (22692 kg ha\(^{-1}\)), which was on par with Urea @ 10% (T\(_5\)) and NaCl @ 15% (T\(_8\)). However, there was decrease in drymatter accumulation (10668 kg ha\(^{-1}\)) (Table 1) by 52.9 per cent with Dropp Ultra 540 SC @ 200 ml ha\(^{-1}\) (T\(_9\)) when compared with Urea @ 15% (T\(_7\)). This could be the nature of action of Dropp Ultra 540 SC, which promotes the production of ethylene. The effect of defoliant application on number of sympodial

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Table 1: Plant height (cm), Drymatter accumulation (kg ha$^{-1}$), sympodial branches plant$^{-1}$ and days to maturity of Cotton as influenced by application of different defoliants.

| Treatments | Plant height (15 Days after defoliant spray) | Drymatter accumulation (kg ha$^{-1}$ at harvest) | Sympodial branches at harvest | Days to maturity |
|------------|---------------------------------------------|-------------------------------------------------|-------------------------------|-----------------|
| T$_1$ - Dropp Ultra 540 SC (Thidiazuron 360 + Diuron 180) @ 150 ml ha$^{-1}$ | 110.3 | 11220 | 21.3 | 165 |
| T$_2$ - Dropp Ultra 540 SC (Thidiazuron 360 + Diuron 180) @ 200 ml ha$^{-1}$ | 103.5 | 10668 | 22.0 | 165 |
| T$_3$ - Etherel @ 1500 ppm | 113.8 | 16995 | 21.3 | 165 |
| T$_4$ - Etherel @ 2000 ppm | 111.1 | 15834 | 21.3 | 165 |
| T$_5$ - Urea @ 10% | 114.8 | 20532 | 22.1 | 180 |
| T$_6$ - NaCl @ 15% | 113.6 | 19842 | 21.3 | 180 |
| T$_7$ - NaCl @ 20% | 107.7 | 18876 | 21.0 | 180 |
| T$_8$ - Control | 110.3 | 18006 | 19.7 | 185 |
| SEm$^+$ | 7.72 | 1106.9 | 1.41 | - |
| CD(0.05) | NS | 3332 | NS | - |
| CV (%) | 12.0 | 11.1 | 11.3 | - |

branches per plant was also non-significant. However, numerically highest of number of sympodial branches per plant were observed in Urea @ 15% (T$_6$).

Yield attributing characters: The number of picked bolls plant$^{-1}$ and boll opening percentage increased significantly with application of defoliants (Table 2). Significantly higher number of picked bolls plant$^{-1}$ (19.0) was recorded with Etherel @ 2000 ppm than T$_5$, T$_6$, T$_7$, and T$_8$ treatments. All the levels of Etherel and Dropp Ultra 560 SC (Thidiazuron 360 + Diuron 180) resulted in significantly more number of picked bolls plant$^{-1}$ when compared with remaining all other treatments but were statistically on par with each other. Increased number of picked bolls per plant with application of defoliants might be due to increased production of ethylene inside the bolls, which tend to weaken and cause dissolution of cell walls and build up of internal pressure causing carpels to split apart and allowing bolls to open naturally. The result of present study are in conformity with the findings of Singh et al. (2003). Maximum boll opening percentage (99.1) at harvest was recorded with Etherel @ 2000 ppm (T$_4$) (Table 2) which was on par with all the other treatments except NaCl @ 20% (T$_8$) and Control (T$_9$) treatments. Increase in boll opening percentage with increased levels of defoliants was clearly evident from increased number of picked bolls per plant. These results are in conformity with those of Rajini et al. (2011) and Tuppad et al. (2016).

Seed cotton yield: Maximum seed cotton yield of 2359 kg ha$^{-1}$ was obtained with Etherel @ 2000 ppm (T$_4$) and it was on par with all the other treatments except NaCl @ 20% (T$_8$) (1975 kg ha$^{-1}$) and control (T$_9$) (1829 kg ha$^{-1}$). There was a significant increase in seed cotton yield by 22.5, 20.8, 19.3 and 17.4 % in Etherel @ 2000 ppm (T$_4$), Etherel @ 1500 ppm (T$_3$), Dropp Ultra 560 SC @ 200 ml ha$^{-1}$ (T$_5$) and Dropp

Table 2: Yield attributing characters and yield of cotton as influenced by application of different defoliants.

| Treatments | Number of unopened bolls plant$^{-1}$ | Number of picked bolls plant$^{-1}$ | BOP (%) (At Harvest) | Boll weight (g) | Seed cotton yield (kg ha$^{-1}$) |
|------------|--------------------------------------|----------------------------------|-----------------------|----------------|---------------------------------|
| T$_1$ - Dropp Ultra 540 SC (Thidiazuron 360 + Diuron 180) @ 150 ml ha$^{-1}$ | 0.81 | 17.4 | 95.2 | 3.9 | 2212 |
| T$_2$ - Dropp Ultra 540 SC (Thidiazuron 360 + Diuron 180) @ 200 ml ha$^{-1}$ | 0.68 | 17.8 | 96.5 | 4.0 | 2265 |
| T$_3$ - Etherel @ 1500 ppm | 0.44 | 18.2 | 97.7 | 4.0 | 2307 |
| T$_4$ - Etherel @ 2000 ppm | 0.20 | 19.0 | 99.1 | 4.1 | 2359 |
| T$_5$ - Urea @ 10% | 1.40 | 15.8 | 91.9 | 3.8 | 2064 |
| T$_6$ - Urea @ 15% | 1.43 | 17.6 | 92.8 | 3.9 | 2121 |
| T$_7$ - NaCl @ 15% | 2.27 | 15.1 | 91.4 | 3.7 | 2058 |
| T$_8$ - NaCl @ 20% | 1.93 | 14.7 | 87.7 | 3.6 | 1975 |
| T$_9$ - Control | 2.70 | 16.1 | 85.1 | 3.5 | 1829 |
| SEm$^+$ | 0.16 | 0.64 | 2.96 | 0.17 | 126 |
| CD(0.05) | 0.50 | 1.9 | 8.9 | NS | 379 |
| CV (%) | 21.8 | 6.5 | 5.5 | 8.03 | 10.2 |
Table 3: Economics of Cotton as influenced by application of different defoliants.

| Treatments          | Cost of cultivation (Rs. ha\(^{-1}\)) | Gross returns (Rs. ha\(^{-1}\)) | Net returns (Rs. ha\(^{-1}\)) | B : C Ratio |
|---------------------|----------------------------------------|---------------------------------|-------------------------------|-------------|
| \(T_1\): Dropp Ultra 540 SC (Thidiazuron 360 + Diuron 180) @ 150 ml ha\(^{-1}\) | 51912 | 110592 | 58680 | 2.13 |
| \(T_2\): Dropp Ultra 540 SC (Thidiazuron 360 + Diuron 180) @ 200 ml ha\(^{-1}\) | 52035 | 113258 | 61223 | 2.18 |
| \(T_3\): Etherel @ 1500 ppm | 56694 | 115342 | 58648 | 2.03 |
| \(T_4\): Etherel @ 2000 ppm | 57623 | 117967 | 60344 | 2.05 |
| \(T_5\): Urea @ 10% | 52439 | 103208 | 50769 | 1.97 |
| \(T_6\): Urea @ 15% | 52801 | 106042 | 53241 | 2.01 |
| \(T_7\): NaCl @ 15% | 52262 | 102907 | 50655 | 1.97 |
| \(T_8\): NaCl @ 20% | 52339 | 97850 | 46411 | 1.89 |
| \(T_9\): Control | 51894 | 91458 | 39564 | 1.76 |

Costs:

- Seed cotton: Rs. 5000 q\(^{-1}\)
- Suraj variety Cotton seed: Rs. 40 kg\(^{-1}\)
- Etherel (100 ml): Rs. 1300
- Dropp Ultra 540 SC (50 ml): Rs. 450
- NaCl (1 kg): Rs. 10

Ultra 560 SC @ 150 ml/ha (\(T_1\)), respectively compared to control (\(T_9\)) treatment. Increase in yield with application of defoliants viz., Etherel and Dropp Ultra can be attributed to their favourable effect on yield determining parameters like number of picked bolls per plant, boll opening percentage and synchronized boll opening which was due to increased ethylene production within a boll to hasten opening and speed up drying of fully opened bolls. These results were in conformity with Wankhade and Bathkal (1994) and Buttar and Singh (2013).

Earliness: Application of defoliants i.e., Dropp Ultra and Etherel at 60 % boll opening had reduced the crop duration by 20 days and application of desiccants i.e., Urea and NaCl resulted in reduction of crop duration by 5 days when compared to control (\(T_9\)) (Table 1). By using defoliants in cotton early vacation of the field is possible which facilitates timely sowing of succeeding rabi crops. These results were in conformity with Ramesh babu et al. (1995) and Buttar and Singh (2013).

Economics: Application of Etherel @ 2000 ppm (\(T_7\)) resulted in highest gross returns (Rs. 1,17,967 ha\(^{-1}\)) mainly due to higher seed cotton yield (Table 3). The net returns (Rs. 61,223 ha\(^{-1}\)) and B:C ratio (2.18) were markedly higher with Dropp Ultra 540 SC @ 200 ml ha\(^{-1}\) (\(T_1\)) applied at 60 per cent boll opening percentage due to less cost of cultivation and higher yield. Although application of Etherel @ 2000 ppm (\(T_7\)) had resulted in maximum seed cotton yield of 2359 kg ha\(^{-1}\), B:C ratio (2.05) was comparatively less when compared with Dropp Ultra 540 SC @ 200 ml ha\(^{-1}\) (\(T_2\)) due to high cost of Etherel. These results were in conformity with the findings of Rajini et al. (2011).

CONCLUSION

 Etherel @ 2000 ppm was found superior for boll opening (99.1 %) and Dropp Ultra 540 SC (Thidiazuron 360 + Diuron 180) @ 200 ml ha\(^{-1}\) showed highest leaf defoliation (99.7 %) for getting higher and clean seed cotton yield, under high density planting. Cotton variety Suraj (CCH 510-4), with application of Etherel @ 2000 ppm produced higher seed cotton yield of 2359 kg ha\(^{-1}\). Higher net returns (Rs. 61,223 ha\(^{-1}\)) and B:C ratio (2.18) were obtained with Dropp Ultra 540 SC @ 200 ml ha\(^{-1}\).

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