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Efficacy of Defoliants in American Cotton

S Sravanthi, M Sree Rekha, B Venkateswarlu, Ch Sujani Rao and K Jayalalitha

Department of Agronomy, Agricultural College, Bapatla, A. P.

ABSTRACT

An experiment was conducted at Agricultural College, Bapatla to know the effect of different defoliants and their time of application on High Density Planting American Cotton (HDPS). It was carried out with Suraj variety, for two consecutive years during 2018 and 2019 in split plot design with four replications. Three defoliants, Dropp Ultra @ 250 ml ha^{-1} (D_1), Mepiquat chloride @ 100 ml ha^{-1} (D_2) and Etherel @ 3000 ppm (D_3) assigned as main plots and three times of applications 80 % Boll Opening (T_1), Node Above Cracked Boll (NACB) and Node Above White Flower (NAWF) assigned as sub plots. Results indicated that highest defoliation percent and Boll Opening were noticed with Dropp Ultra @ 250 ml ha^{-1} (D_1) and 80 % Boll Opening (T_1), which was comparable to Node Above Cracked Boll (NACB-T_2) in defoliation percentage. Highest seed cotton yield was obtained with application of Dropp Ultra @ 250 ml ha^{-1} and found on par with Etherel @ 3000 ppm (D_3) and when sprayed at 80 % Boll Opening, which was found at par with Node Above Cracked Boll (NACB) stage.

Keywords: *Cotton, Boll open percent, Defoliants, Time of application and Yield.*

Cotton is the most important fibre crop and called as "King of Fibres". It is the backbone of textile industry, and consumes 59 % of country's total fibre production. The area and production of cotton in India was 12 m ha and 361 lakh bales (170 kg of each bale), respectively. In Andhra Pradesh, it was grown in 5.51 lakh ha with a production of 20 lakh bales and productivity of 617 kg lint ha^{-1} (All India Co-ordinated Cotton Improvement Project-Annual Report, 2019).

In India, normally farmers go for two to five pickings of cotton and it is very tedious work and ten times costlier than irrigation and twice of weeding operation. Manual picking is costlier than other agricultural operations. In recent times, due to acute labour shortage, cotton picking gets delayed causing yield loss. In this context, mechanized picking became popular which requires defoliants, that facilitates one time harvesting with synchronous boll opening. Per plant yield is usually less in varieties suitable for mechanical picking, hence high-density planting is recommended.

Chemical defoliants therefore, form an integral part of package for achieving clean pickings, increase harvest efficiency, early termination and quality cotton in developing countries. Defoliation timing also impacts various quality characteristics of cotton fiber. Early defoliation can be critical in maximizing yield. Proper time of defoliation involves balancing the value of potential increases in yield with the value of changes in fiber quality; hence its exploration is of prime importance for cotton growers for fetching maximum returns from their produce (Showler, 2009). Thus, time of application of harvest aid chemicals (defoliants) is very crucial which influence the yield of cotton. The present investigation was, therefore,

undertaken to study the effect of defoliants and time of application on defoliation percentage, boll opening percentage and on seed cotton yield.

MATERIAL AND METHODS

The experiment was conducted at Agricultural College Farm, Bapatla, which is situated in coastal region of Krishna Agro-Climatic Zone of Andhra Pradesh; during *kharif* 2018 and 2019. The soil of the experimental field was clay in texture, neutral in reaction, medium in organic carbon and low in available nitrogen, medium in phosphorus and high in available potassium. The experiment was laid out in Split plot design with four replications and nine treatments. The main plots were three defoliants *viz*., Dropp Ultra (Thiadizuron + Diuron) @ 250 ml ha^{-1} (D_1), Mepiquat Chloride @ 100 ml ha^{-1} (D_2) and Etherel @ 3000 ppm (D_3). The sub plots consisted of time of applications *viz*., 80 % boll opening (T_1), NACB - Node Above Cracked Boll (T_2) and NAWF- Node Above White Flower (T_3) in *kharif* cotton. Defoliants were sprayed with knapsack sprayer according to the treatments. Cotton variety Suraj was sown on 07 th August 2018 and 5 th August, 2019 with a spacing of 60 cm x 15 cm. Fertilizers @ 120 kg N, 60 kg P_2O_5 and 60 kg K_2O ha^{-1} were applied due to high density planting of cotton variety, uniformly in the form of urea, single superphosphate and muriate of potash. Entire quantity of phosphorus was applied basally. Nitrogen and potassium were applied in three splits at 30, 60 and at 90 DAS. Recommended cultural practices and plant protection measures were followed throughout the crop growing season. Total number of fully opened leaves on main stem and branches were recorded before application of chemical defoliants and at alternate days interval of application up to 21 days after defoliant spray and calculated as the ratio of number of leaves present on the plant after spraying of defoliants to the number of leaves present on the plant before spraying defoliants and expressed in percentage. The ratio between the number of picked bolls per plant to the total number of bolls was calculated and expressed as boll opening percentage. Seed cotton was picked from the plants in the net plot area and weighed. The yield obtained from five tagged plants was also added to this and expressed as seed cotton yield in kg ha^{-1}. Statistical analysis for the data was done following the analysis of variance technique for split-plot design as suggested by Gomez and Gomez (1984). Statistical significance was tested by applying F-test at 0.05 level of probability and critical differences were calculated for those parameters, which were found significant ($p < 0.05$) to compare the effects of different treatments.

RESULTS AND DISCUSSION

At 21 days after defoliants spray, the highest defoliation percentage was recorded with application of Dropp Ultra @ 250 ml ha^{-1} (D_1) over other two defoliants during both the years and in pooled data (Table 1). Defoliants applied at 80 % Boll Opening stage (T_1) recorded maximum defoliation percent which was found to be on par with defoliants applied at Node Above Cracked Boll (NACB-T_2). The hormone defoliant, Dropp Ultra, stimulates a massive increase in ethylene synthesis and thus acts as a defoliant. Application of chemical defoliants in the later crop growth stages resulted in maximum defoliation which lead to less number of leaves and leaf area. The number of intact leaves to the plant was reduced due to defoliant spray at 145 days compared to 130 days as reported by Ratnakumari *et al.* (2013) Fang *et al.* (2018) and Mrunalini and Sree Rekha (2018).

With respect to boll opening percentage, Highest boll opening percentage was recorded with Dropp Ultra and 80 % Boll Opening during both the years and in pooled data. Interaction between

Table 1. Number of leaves before spraying of defoliants and 21 days after defoliant spray and percent defoliation (%) in cotton as influenced by defoliants and time of application during *kharif* 2018, 2019 and in pooled data

Treatment	2018		2019		Pooled data	
	Number of leaves before spraying	At 21 days after spraying	Number of leaves before spraying	At 21 days after spraying	Number of leaves before spraying	At 21 days after spraying
Defoliants						
D_1- Dropp Ultra	58.40	92.00 (4.70)	63.40	90.90 (5.80)	60.90	91.50 (5.20)
D_2- Mepiquat Chloride	59.70	71.00 (17.30)	61.60	70.00 (18.50)	60.70	70.50 (17.90)
D_3-Etherel	59.10	85.10 (8.80)	61.10	84.50 (9.50)	60.10	84.70 (9.20)
SEm±	2.34	0.56	1.46	0.56	1.94	0.55
CD (p = 0.05)	NS	1.90	NS	1.90	NS	1.90
CV (%)	13.70	18.80	8.20	18.80	11.10	17.60
Time of Application						
T_1- 80 % Boll Opening	60.70	88.50 (7.00)	62.00	87.90 (7.50)	61.40	88.30 (7.20)
T_2- NACB	57.30	87.10 (7.40)	60.00	86.80 (7.90)	58.70	86.90 (7.70)
T_3-NAWF	59.10	72.10 (16.50)	64.10	71.50 (18.30)	61.60	71.80 (17.40)
SEm±	1.80	0.57	1.41	0.57	1.33	0.51
CD (p = 0.05)	NS	1.70	NS	1.70	NS	1.50
CV (%)	10.50	19.30	7.90	17.60	7.60	16.40
Interaction						
D*T	NS	NS	NS	NS	NS	NS
T*D	NS	NS	NS	NS	NS	NS

*(Figures in parentheses indicate the number of leaves)

defoliants and time of spraying was found non significant for the first year, where as significant in second year of study and in pooled data (Table 2). Dropp Ultra @ 250 ml ha^{-1} (D_1) and spraying at 80 % boll opening (T_1) recorded maximum boll opening percentage during both the years and also in pooled data. The main reason for maximum boll open percentage is more number of pickable bolls $plant^{-1}$. The hormonal defoliant thidiazuron accelerates boll dehiscence by increasing ethylene level in cotton leaves. Early defoliation leads to less number of bolls that can be picked, which resulted in less percentage of boll opening. Under delayed defoliation, highest boll open percentage was recorded.

The highest seed cotton yield (2006 kg ha^{-1}) was recorded with application of Dropp Ultra @ 250 ml ha^{-1} (D_1) which was on par with application of Etherel @ 3000 ppm (D_3 - 1955 kg ha^{-1}) during first

Table 2. Boll Opening Percentage and Seed Cotton Yield (kg ha^{-1}) as influenced by defoliants and time of application during *kharif*, 2018,2019 and in pooled data.

Treatment	2018		2019		Pooled data	
	Boll Opening Percentage	Seed Cotton Yield	Boll Opening Percentage	Seed Cotton Yield	Boll Opening Percentage	Seed Cotton Yield
Defoliants						
D_1- Dropp Ultra	67.1 (84.00)	2006	67 (84.10)	2114	66.9 (84.10)	2060
D_2- Mepiquat Chloride	51.4 (61.00)	1392	52.4 (62.50)	1439	51.9 (61.80)	1416
D_3-Etherel	61.3 (75.70)	1955	55.4 (67.80)	1758	58 (71.70)	1857
SEm±	1.38	74.4	0.55	94.7	0.77	73
CD (p = 0.05)	11.9	257	4.7	328	7.7	253
CV (%)	8	14.4	3.3	18.5	4.6	14.2
Time of Application						
T_1- 80 % Boll Opening	65.5 (80.90)	2032	62.2 (77.00)	1984	63.4 (78.70)	2008
T_2- NACB	60.7 (75.10)	1887	58.9 (72.90)	1732	59.6 (74.00)	1810
T_3-NAWF	53.7 (64.60)	1434	53.7 (64.50)	1595	53.8 (64.90)	1515
SEm±	1.21	88.1	0.87	73.1	0.77	67.2
CD (p = 0.05)	3.6	262	2.6	217	2.3	200
CV (%)	7	17.1	5.2	14.3	4.5	13.1
Interaction						
D*T	NS	NS	S	NS	S	NS
T*D	NS	NS	S	NS	S	NS

*(Figures in parentheses indicate the original values)

year of the study (Table 3). During second year, Dropp Ultra @ 250 ml ha^{-1} (D_1) registered highest seed cotton yield (2114 kg ha^{-1}) which was significantly superior over other defoliants. In pooled data, similar trend was noticed as it was observed in first year of study. Defoliants applied at 80 % boll opening stage (T_1) recorded the highest seed cotton yield (2032 kg ha^{-1}), which was on par with Node Above Cracked Boll (T_2- 1887 kg ha^{-1}). In second year of study, T_1 (80 % boll opening) recorded significantly highest seed cotton yield (1984 kg ha^{-1}) over other two stages.

The factors which have a direct influence on seed cotton yield are yield components. Higher seed cotton yield might be due to synchronized boll opening which was due to Dropp Ultra and Etherel. Kulvir and Pankaj (2015) also reported that Dropp Ultra and Etherel when applied at 150 DAS (delayed defoliant application) allowed for manipulation of physiological processes in plant growth and

Table 3. Interaction between defoliants and time of application on boll opening percentage in cotton

	2019				Pooled			
Treatment D/T	T_1	T_2	T_3	Mean	T_1	T_2	T_3	Mean
D_1	73.4	66.2	61.4	67.0	73.5	66.3	60.9	66.9
	(92.7)	(83.8)	(75.5)	(84.0)	(91.8)	(83.6)	(77.1)	(84.1)
D_2	58.2	53.3	45.7	52.4	57.3	52.4	46.0	51.9
	(69.6)	(58.7)	(54.8)	(61.0)	(72.1)	(64.3)	(51.2)	(62.5)
D_3	55.0	57.3	54.0	55.4	59.3	60.1	54.6	58.0
	(80.5)	(82.9)	(63.7)	(75.7)	(67.1)	(70.8)	(65.4)	(67.8)
Means	62.2	58.9	53.7		63.4	59.6	53.8	
	(80.9)	(75.1)	(64.6)		(77.0)	(72.9)	(64.5)	

*(Figures in parentheses indicate the original values)

	SEm±	CD (p = 0.05)	CV (%)	SEm±	CD (p = 0.05)	CV (%)
D	0.55	2.6	3.3	0.77	3.7	4.6
T	0.87	2.6	5.2	0.77	2.3	4.5
D at T	1.34	5.8		1.34	5.8	
T at D	1.5	6.6		1.34	6	

development for more efficient crop management resulting in better source – sink portioning which ultimately lead to increased seed cotton yield. Similar views were also expressed by Rajni *et al.* (2011), Buttar and Singh (2013) and Raghavendra and Rama Reddy (2020) which are in conformity with the present results.

CONCLUSION

From the two year study it can be concluded that application of Dropp Ultra @ 250 ml ha^{-1} at 80% boll opening can be a good management practice for maximum defoliation and higher yields in cotton.

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