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Effect of detopping and growth retardants on physiological parameters and yield of *Bt* cotton (*Gossypium hirsutum* L.)

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ABSTRACT : Field experiment was conducted during three consecutive *kharif* 2013 to 2015 to evaluate the effect of detopping and foliar application of growth regulators on growth parameters, yield and yield attributes of *Bt* cotton. The experiment was comprised of total nine treatments with control. Detopping of cotton plants were done at 60 and 75 DAS. Foliar application of MH (30ppm) and Ethrel (40ppm) were done at 60 DAS and these PGR sprayed at 80 and 90 DAS with combination of detopping at 60 and 75 DAS. Present investigations clearly revealed that significantly highest seed cotton yield of 3923 kg/ha was obtained with detopping at 75 DAS + application of MH@30 ppm at 90 DAS and it was at par with detopping at 75 DAS (3728 kg/ha). The increase in yield was primarily due to increase in plant spread, chlorophyll content, SLW, length and number of sympodial branches and increased number of bolls/plant. This increase in seed cotton yield over control varied from 15.1 to 21.1 per cent.

Key words: Chlorophyll, detopping, growth retardants, specific leaf weight, sympodia

Cotton is most important *kharif* season cash crop of Gujarat in India. Cotton plays an important role in national economy. Cotton is cultivated on about 29.2 million ha across the world. India having the largest area under cotton cultivation in the world is ranging between 10-11 million ha. It accounts for about 36 per cent of the global cotton area and contributes 33.2 per cent (35.1 million bales) of the global cotton produce (105.72 million bales) and rank first. The yield/ha is however low *i.e.* 568 kg/ha against the world average 788 kg/ha. In India, Gujarat is the largest producer of cotton having 2.4 million ha under cotton cultivation, producing 9.18 million bales and ranks first in production (Anonymous, 2016).

Many attempts have been made to alter the growth habit of the crop (through mechanical and chemical means) so as to improve productivity and to bring about some more amenability for cultural manipulations. Literature abounds with several reports on Ethylene and MH triggered/enhanced physiological reactions and a series of growth processes leading to greater main stem node and sympodial branches, number of squares, number of bolls and enhance seed cotton yield. These results are in conformity with earlier works of Buttar and Singh (2013), Nawalkar *et al.,* (2014), Kumari and George (2012). Keeping these facts in mind, the present investigation was carried out to investigate the impacts of modification of

physiological parameters through detopping, Ethylene and MH on growth and yield of cotton.

MATERIALS AND METHODS

A field experiments were conducted at Cotton Research Farm, Junagadh Agril. University, Junagadh during the three consecutive *kharif* 2013 to 2015 on irrigated cotton. Cotton genotype Vikrum-5 BG-II was sown after rainfall with a spacing of 120 x 45cm in medium black soil. The cotton plant growth controlled by detopping (removal of 6-10 cm apical bud) the plant and by spray of growth inhibitors (Maleic hydrazide and Ethrel) and with its combinations. There were 9 treatments *viz.*, T1-Control, T2-Detopping at 60 DAS, T3- Detopping at 75 DAS, T4-ethrel@40ppm at 60 DAS, T5-MH@30ppm at 60 DAS, T6-Detopping at 60 DAS + ethrel@40ppm at 80 DAS, T7- Detopping at 60 DAS + MH@30ppm at 80 DAS, T8- Detopping at 75 DAS + ethrel@40ppm at 90 DAS and T9-Detopping at 75 DAS + MH@30ppm at 90 DAS. All recommended agronomical and plant protection measures were carried out in time to keep the crop in healthy condition.

Five plants from each treatment were selected randomly and tagged for recording various observations on morpho-physiological growth parameters and yield attributes at periodically and at harvest. Seed cotton yield was worked out from the net plot basis and expressed as kg/ha. Statistical analysis was carried out by using the procedure of Panse and Sukhatme (1985).

RESULTS AND DISCUSSION

Plant height (cm) : The plant height was recorded significantly minimum in treatment T3 (81 cm) and T9 (82 cm) in all the treatments in detopping at 75 DAS with application of MH at 90 DAS as compare to control(Table 1). The plant height was minimum due to detopping the plant and applications of growth inhibitor MH that inhibit stem inter node length (Kumari and George, 2012).

Specific leaf weight (mg)- SLW : Generally specific leaf weight was increased up to 120 DAS then after it was decreased due to photosynthate is diverted towards boll development and treatment differences were found significant. Maximum SLW decreased in the treatment T_9 followed by T_3. This shift in partitioning increased the ability of the plant to allocate more photosynthate towards reproductive structures. The results are in accordance with the findings of Kumari and George (2012).

Chlorophyll content (mg/cm^{-2}) : There were no any differences found in chlorophyll content in leaf at initial crop growth stage (at 75 DAS) but latter on treatment differences were found significant at 95 DAS. Detopping and application of MH, Ethrel combined were increased chlorophyll contend in most of the treatments at 95 DAS.

Plant spread (cm) : Application of MH, Ethrel and mechanical detopping at different

Tabe 1. Effect of different treatments on physiological growth parameters, yield and yielding characters of cotton plant (Three year pooled data).

Treatments	Plant height (cm)	SLW (mg/dm^2) at 120 DAS	SLW (mg/dm^2) at 150 DAS	Chlorophill content 75 DAS (mg/cm^{-2})	Chlorophill content 95 DAS (mg/cm^{-2})	Plant Spread (cm)	Symp/ plant	Symp-odial length (cm)	Days to maturity	Bolls/ plant	Boll weight (g)	Oil yield (kg/ha)	G.P. (%)	Cal. lint yield (kg/ha)	Seed cotton yield (kg/ha)
T_1	92	809.03	891.96	25.69	30.60	98	12.33	33.6	222	31.74	5.58	423.19	32.5	1062	3239
T_2	84	834.06	894.03	26.03	33.33	103	13.60	37.6	219	33.91	5.38	420.84	32.4	1045	3191
T_3	81	862.29	837.84	25.07	34.53	108	14.93	42.3	218	38.56	5.38	487.57	33.2	1249	3728
T_4	87	842.72	885.97	26.07	34.06	108	14.07	35.6	219	35.01	5.37	431.88	32.6	1081	3301
T_5	87	847.31	887.51	25.26	33.82	104	14.27	34.2	218	34.39	5.21	413.22	32.7	1026	3138
T_6	85	875.19	850.86	25.47	34.96	106	13.48	41.0	216	36.08	5.29	439.95	33.2	1126	3383
T_7	85	859.56	858.71	24.85	33.94	97	13.80	38.0	218	34.18	5.50	454.67	32.6	1124	3439
T_8	84	850.17	874.82	24.10	34.43	103	13.99	39.3	217	35.08	5.33	430.22	33.0	1094	3293
T_9	82	887.31	814.18	25.93	35.76	114	15.89	45.3	215	42.17	5.40	517.90	33.5	1317	3923
S. Em. +	1.0	8.0	9.5	0.4	0.5	1.9	0.4	1.3	0.8	1.2	0.1	16.2	0.2	40	122
CD (p=0.05)	3.0	22.9	27.0	NS	1.5	5.5	1.1	3.7	2.2	3.3	NS	46.1	0.7	115	347
CV (%)	3.7	2.8	3.3	5.2	4.7	5.6	8.4	10.2	1.1	9.7	6.0	10.9	2.2	11	11
Y															
S.Em.±	0.6	4.6	5.5	0.3	0.3	1.1	0.2	0.8	0.5	0.7	0.1	9.3	0.1	23	70
C.D. (p=0.05)	1.7	NS	NS	0.7	NS	3.2	0.6	2.2	1.3	1.9	0.2	26.6	0.4	66	201
Y X T															
S.Em.±	1.8	13.9	16.4	0.8	0.9	3.3	0.7	2.3	1.4	2.0	0.2	28.0	0.4	70	211
C.D. (p=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

stages significantly reduced plant height and increase plant spread in all treatments except treatments T_2, T_7 and T_8 than the control (Table 1). Nawalkar *et al.,* (2014) revealed that MH acts as a growth inhibitory substance and imparts its inhibitory effect in the biosynthesis of GA_3 thus causing shortening of plant height and increase plant spread.

Number and length of sympodia (cm) : Significantly highest number (15.89) and length (45.3 cm) of sympodia was produced in treatment T_9 followed by T_3. The increase in number of sympodia may be due to increased number of nodes on main stem. The MH and detopping inhibited vertical plant growth and subsequently promoted lateral growth including branching. These results are in conformity with the findings of Anonymous (2010), Kumari and George (2012).

Crop maturity (Days) : Crop maturity was observed one week early in the treatments T_9 (215 days) followed by most of the treatments in Table 1. Application of growth retardant and detopping was to restrict the vegetative growth (plant height) and enforce plant toward reproductive stage and early maturity.

Number of bolls/plant and average boll weight : The number of bolls at harvest is an important yield component having the greatest direct effect on yield. Detopping at 75 DAS with application of MH at 90 DAS (T_9) was recorded significantly highest number of bolls (42.17) followed by detopping at 75 DAS T_3 (38.56) over control T_1 (31.74) shown in Table 1. Increased number of bolls were due to increased in numbers and length of sympodia. These results are in harmony with the finding of Anonymous (2010), Nawalkar *et. al.*,(2014), Kumari and George (2012). There was no difference found among the different treatments in average boll weight (Table 1).

Oil yield (kg/ha) : There was no difference found among the treatments in oil percentage but significantly highest oil yield was obtained in T_9 (517.90 kg/ha) and it was *at par* with T_3 (487.57 kg/ha) reported in Table 1.

Seed cotton and lint yield : The analyzed data presented in Table 1 indicated that treatment differences were found significant during all the years. Among all the treatments, detopping at 75 DAS + foliar spray of MH@30 ppm at 90 DAS (T_9) recorded the consistence and significantly higher seed cotton yield (3923 kg/ha) during all the experimental years and it was at par with T_3 (3728 kg/ha) detopping at 75 DAS. Same trend was found in case lint yield and ginning percentage. The higher seed cotton yield obtained due to increase in numbers and sympodial length, chlorophyll content and transport of photosynthate towards reproductive parts, it was produced and retained more numbers of squares ultimately plant attained more number of bolls. The effect of MH and pruning in cotton crop found that it promoted lateral growth including branching, boll number and seed weight increased significantly studied by Jadhav *et al.,* (2015), Kumari and George (2012), Buttar and Singh (2013).

CONCLUSION

The experimental pooled results revealed that seed cotton yield (3923 kg/ha), lint yield (1317 Kg/ha) were recorded significantly highest at harvest with detopping at 75 DAS + foliar spray of MH@30 ppm at 90 DAS as compared to control (3239 kg/ha) and it was at par with (3728 kg/ha) detopping at 75 DAS. The seed cotton yield increment was recorded from 15 to 21 per cent as compared to control. It was found to be most effective and economically viable technology for enhancing seed cotton yield of *Bt* cotton hybrids.

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