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Effect of plant growth regulators on growth and yield of HDPS cotton

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Abstract : Field experiment was conducted at Agricultural College Farm, Bapatla during *kharif,* 2020. The experiment consisted of ten treatments, laidout in randomized block design with three replications. The treatments comprised of T_1: control, T_2: Mepiquat chloride 50 ppm at 45 DAS; T_3: Mepiquat chloride 50 ppm at 75 DAS; T_4: Maleic hydrazide 30ppm at 45 DAS; T_5: Maleic hydrazide 30ppm at 75 DAS; T_6: Cycocel 60ppm at 45 DAS; T_7: Cycocel 60ppm at 75 DAS; T_8: Mepiquat chloride 50 ppm at 45 DAS and 75DAS; T_9: Maleic hydrazide 30ppm at 45 DAS and 75 DAS; T_{10}: Cycocel 60ppm at 45 DAS and 75 DAS. The results of the trial revealed that among various plant growth regulators, application of Mepiquat chloride 50 ppm at 45 DAS and 75 DAS recorded higher drymatter accumulation and SPAD readings. The maximum sympodia/plant, bolls/plant, picked bolls/plant, boll weight and seed cotton yield were noticed in the treatment Mepiquat chloride 50 ppm at 45+ 75 DAS which was *at par* with T_9: Maleic hydrazide 30 ppm at 45 DAS and 75 DAS; and T_{10}: Cycocel 60 ppm at 45 and 75 DAS.

Keywords : Cotton, growth regulators, seed cotton yield.

Cotton is one of the prime important fibre crops playing a key role in the economic and social affairs of the world, providing basic input to the textile industry. It is the oldest among the commercial crops of the world and is regarded as "White Gold". Though India has an area of 13.37 m.ha. (Directorate of Economics and Statistics, DAC and FW, 2021) its productivity is very low. In Andhra Pradesh, it was grown in 5.63 lakh ha during 2019-2020 with a production of 32 lakh bales (AICCIP, 2019).

To enhance the productivity in cotton, a recently High-density Planting System (HDPS) is being recommended. It is considered as an alternate production system having the potential for improving the productivity and profitability, increasing input use efficiency, reducing input costs and minimizing the risks associated with the current production system in India (Venugopalan *et al.*, 2013). In this system of HDPS, cotton grows tall due to closer spacing adopted necessitating management strategies like the use of plant growth regulators. Plant growth regulators (PGR's) are the substances when added in small amounts modify the growth of plantsusually by stimulating or inhibiting part of the natural growth regulation. When plant growth retardants are applied to plants, internodes become shorter and leaves become thicker and greener, alters plant morphology and can alter assimilate partitioning in favor of plant growth by increasing radiation utilization efficiency and also increases net photosynthesis. An attempt has, therefore, been made to evaluate the effect of plant growth regulators on the growth and yield of cotton under HDPS.

MATERIALS AND METHODS

A field experiment was conducted at Agricultural College Farm, Agricultural College, Bapatla during *kharif,* 2020. The experiment was conducted in randomized block design with three replications. The treatments consisted of T_1: control, T_2: Mepiquat chloride 50 ppm at 45 DAS; T_3: Mepiquat chloride 50 ppm at 75 DAS; T_4: Maleic hydrazide 30 ppm at 45 DAS; T_5: Maleic hydrazide 30 ppm at 75 DAS; T_6: Cycocel 60 ppm at 45 DAS; T_7: Cycocel 60 ppm at 75 DAS; T_8: Mepiquat chloride 50 ppm at 45 DAS and 75 DAS; T_9: Maleic hydrazide 30 ppm at 45 DAS and 75 DAS; T_{10}: Cycocel 60 ppm at 45 DAS and 75 DAS. The cotton variety LHDP-1 was used in the experiment with a spacing of 60 ×10 cm and a

recommended fertilizer dose of 120:60:60 kg NPK/ha was applied for all treatments. Recommended cultural practices and plant protection measures were taken throughout the cropping season. The biometric observations on plant height, drymatter accumulation, SPAD chlorophyll readings, yield attributes, seed cotton yield and stalk yield were recorded following the standards procedures of destructive and non-destructive sampling. Rainfall of 692.3 mm was received in 28 rainy days during the entire crop growth period. The mean maximum and minimum temperatures during the crop growth period were 33.9 0C and 17.4 0C, respectively. All the data recorded in the study were subjected to statistical analysis suggested by Panse and Sukhatme (1978). 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 (pÂ0.05) to compare the effects of different treatments.

RESULTS AND DISCUSSION

Growth Parameters

Plant growth regulators applied at different crop growth stages exerted significant influence on various growth parameters recorded at variouscrop stages (Table 1). At 30 DAS, plant height of cotton could not reach the level of statistical significance while numerically the highest plant height was observed in T_7. At 60 DAS plant height of cotton was significantly higher in T_5, except T_3, T_7 and control which was found to be *at par* with T_5. It can be inferred that at 60 DAS, growth regulators were still not applied in these treatments which resulted in more plant height along with the control (T_1) treatment. At 90 DAS and upto harvest, the maximum plant height of cotton was recorded in the control plot (T_1) which was *at par* with T_3, T_5 and T_7 treatments. The minimum plant height was recorded where Mepiquat chloride 50 ppm was applied at 45 DAS + 75 DAS (T_8) treatment followed by Cycocel 60 ppm at 45 DAS + 75 DAS (T_{10}) and Maleic hydrazide 30 ppm at 45 DAS + 75 DAS (T_9). There might have been reduction in cell elongation due to the inhibitory effect of mepiquat chloride in the biosynthetic pathway of gibberellins in the plant body. Similar results were reported by Gobi and Vaiyapuri (2013).

Numerically highest drymatter accumulation at 30 DAS was obtained in T_9 treatment. At 60 and 90 DAS, maximum drymatter accumulation was recorded in control (T_1) which was significantly superior over T_2, T_4, T_6, T_8, T_9, and T_{10} treatments. However, it was atpar with T_3, T_5 and T_7 treatments. Maximum drymatter accumulation at 120 DAS and harvest was recorded in control which was significantly superior over all other treatments. The lowest drymatter accumulation was recorded in T_8, T_9 and T_{10} treatments. This might be due to reduced plant height and also due to the disturbance in source sink relationship due to the application of different PGR's twice at 45DAS and 75 DAS. Similar trend was reported by Kataria and Khanpara (2012). Application of growth retardants may also enhance the chlorophyll content of leaves which helps to increase the functional life of the source for a longer period leading to improved partitioning efficiency and increased productivity as opined by Pankaj Kumar *et al.*, (2006) and Kashid *et al.*, (2013). The SPAD chlorophyll content increased from 30 DAS to 90 DAS and thereafter decreased upto maturity. At 60 and 90 DAS maximum, SPAD chlorophyll was recorded in Mepiquat chloride 50 ppm at 45 DAS + 75 DAS (T_8) which was significantly superior over control. At 120 DAS and also at harvest, the highest SPAD chlorophyll content was obtained in Mepiquat chloride 50 ppm at 45 DAS + 75 DAS (T_8) which was significantly superior over control (T_1) and Mepiquat chloride 50 ppm at 45 DAS (T_2) and was *at par* with all the other treatments. However, no significant difference in chlorophyll content was observedat 30 DAS.

Table 1. Effect of plant growth regulators on growth parameters at different stages of cotton

Treatments	Plant height (cm)					Drymatter accumulation (kg/ha)					SPAD Readings				
	30 DAS	60 DAS	90 DAS	120 DAS	At Harvest	30 DAS	60 DAS	90 DAS	120 DAS	At Harvest	30 DAS	60 DAS	90 DAS	120 DAS	At Harvest
T_1: Control	16.1	49.1	86.3	96.6	97.3	251	2064	4093	5733	5806	32.0	34.2	37.0	35.3	35.0
T_2: Mepiquat chloride 50 ppm at 45 DAS	16.7	45.4	70.8	77.2	78.5	272	1723	3446	4585	4619	34.4	40.8	43.5	40.8	40.2
T_3: Mepiquat chloride 50 ppm at 75 DAS	16.4	50.9	74.0	83.9	84.6	267	1864	3500	4950	5017	32.6	34.2	44.5	42.5	41.5
T_4: Maleic hydrazide 30ppm at 45 DAS	16.2	48.5	70.2	78.1	79.1	272	1833	3354	4632	4665	35.6	41.7	44.1	42.8	42.4
T_5: Maleic hydrazide 30ppm at 75 DAS	16.7	55.3	77.0	85.9	87.7	235	1912	3679	5021	5037	35.9	38.0	43.5	41.5	41.1
T_6: Cycocel 60 ppm at 45 DAS	16.3	45.8	70.3	76.0	77.0	250	1674	3174	4476	4509	35.4	41.0	45.1	43.4	43.1
T_7: Cycocel 60 ppm at 75 DAS	17.1	50.6	75.0	84.6	85.0	234	1886	3534	4995	5028	35.1	36.8	45.4	43.7	43.1
T_8: Mepiquat chloride 50 ppm at 45 DAS +75DAS	16.7	44.1	61.2	66.6	67.3	276	1712	3015	4060	4087	36.3	42.3	51.4	49.4	49.0
T_9: Maleic hydrazide 30ppm at 45 DAS +75DAS	16.6	46.2	67.6	71.8	72.1	284	1815	3125	4317	4350	36.2	40.3	48.8	46.8	46.2
T_{10}: Cycocel 60 ppm at 45 DAS + 75 DAS	16.9	44.2	65.7	70.7	71.0	272	1717	3081	4265	4298	35.8	41.3	50.3	48.7	48.0
SEm±	1.2	2.3	4.3	5.6	5.6	17.7	69.5	201.1	208.0	237.2	2.35	1.79	2.58	2.53	2.5
CD (P=0.05)	NS	7.2	13.6	18.0	17.8	NS	222	643	665	759	NS	5.7	8.3	8.2	8.0
CV (%)	12.5	8.1	10.2	12.3	12.1	11.7	6.6	10.2	7.6	8.6	11.6	8.0	9.9	10.0	10.1

Table 2. Effect of plant growth regulators on yield attributes of cotton

Treatments	Sympodia/ plant	Bolls/ plant	Picked bolls plant	Boll weight (g)
T_1: Control	11.2	28.5	23.5	3.3
T_2: Mepiquat chloride 50 ppm at 45 DAS	12.4	35.2	32.3	3.5
T_3: Mepiquat chloride 50 ppm at 75 DAS	12.1	38.5	34.0	3.5
T_4: Maleic hydrazide 30ppm at 45 DAS	12.1	38.2	35.0	3.5
T_5: Maleic hydrazide 30ppm at 75 DAS	11.9	36.7	33.3	3.4
T_6: Cycocel 60 ppm at 45 DAS	11.5	35.9	33.4	3.5
T_7: Cycocel 60 ppm at 75 DAS	11.6	37.8	34.2	3.4
T_8: Mepiquat chloride 50 ppm at 45 DAS + 75DAS	13.7	46.5	44.3	3.8
T_9: Maleic hydrazide 30ppm at 45 DAS + 75DAS	12.9	44.0	41.3	3.5
T_{10}: Cycocel 60 ppm at 45 DAS + 75 DAS	12.5	43.0	39.8	3.4
SEm±	0.63	2.45	2.5	0.25
CD (P=0.05)	NS	7.8	8.2	NS
CV %	8.9	11.0	12.6	13.0

Table. 3. Seed cotton yield (kg/ha) and stalk yield (kg/ha) of cotton as effected by application of plant growth regulators

Treatments	Seed cotton yield (kg/ha)	Stalk yield (kg/ha)
T_1: Control	600	3436
T_2: Mepiquat chloride 50 ppm at 45 DAS	840	2835
T_3: Mepiquat chloride 50 ppm at 75 DAS	894	3006
T_4: Maleic hydrazide 30 ppm at 45 DAS	879	2855
T_5: Maleic hydrazide 30 ppm at 75 DAS	863	3144
T_6: Cycocel 60 ppm at 45 DAS	674	2855
T_7: Cycocel 60 ppm at 75 DAS	851	3017
T_8: Mepiquat chloride 50 ppm at 45 DAS + 75DAS	1063	2393
T_9: Maleic hydrazide 30 ppm at 45 DAS + 75DAS	968	2647
T_{10}: Cycocel 60 ppm at 45 DAS + 75 DAS	929	2745
SEm±	45.3	155.9
CD (P=0.05)	145	498.7
CV (%)	9.1	9.33

Yield Attributes and Yield

The sympodial branches/plant did not significantly alter due to different plant growth regulators application (Table2). However, maximum sympodial branches were observed in T_8 (Mepiquat chloride 50 ppm at 45 DAS + 75 DAS). The bolls/plant (Table.2) were found to be significantly influenced by the application of various plant growth regulators at harvest. The maximum bolls/plant were recorded with application of Mepiquat chloride 50 ppm at 45 DAS + 75 DAS (T_8) which was significantly higher than other treatments except T_9 and T_{10} treatments. Whereas, lowest bolls/plant^{-1} were observed in control. The highest bolls/plant with mepiquat chloride spray might be due to reduction in the abscission of buds and bolls. In addition, mepiquat chloride might have completely counteracted the effect of abscisic acid and thus reduced the shedding of reproductive structures compared to control. The results are in conformity with the findings of Uma Maheswari *et al.*, 2019. The maximum picked bolls/plant were recorded in T_8 which was atpar with T_9 and T_{10} treatments and significantly superior over other treatments (Table.2). Similar results were reported by Paslawar *et al.*, (2015). Application of different plant growth regulators had no significant effect on boll weight of cotton (Table.2). However, highest boll weight (3.8 g) was recorded with Mepiquat chloride 50 ppm at 45 DAS+75 DAS (T_8) among all the treatments.

Application of plant growth regulators at different stages had a significant influence on

total seed cotton yield (Table3). Maximum seed cotton yield (1063 kg/ha) was obtained with the application of mepiquat chloride 50 ppm at 45 DAS +75 DAS (T_8) which was *at par* with maleic hydrazide 30 ppm at 45+75 DAS (968 kg/ha) (T_9) and cycocel 60 ppm at 45 DAS + 75 DAS (929 kg/ha) (T_{10}) and significantly superior over all the other treatments. However, lowest seed cotton yield was obtained in control plot (T_1) with 600 kg ha^{-1}. Similar results were reported by Khetre *et al.*, (2018). The increase in seed cotton with various plant growth regulators might be due to increased chlorophyll formation in plants leading to increased carbohydrate synthesis, proteins and sugars. This might have resulted in increasing boll number and ultimately in seed cotton yield as reported by Oosterhuis and Robertson (2000). Application of different plant growth regulators significantly influenced stalk yield in cotton. The highest stalk yield was observed in control (3436 kg/ha) due to more drymatter kg/ha), T_7 (Cycocel 60 ppm at 75 DAS) (3017 kg/ha) and T_3 (Mepiquat chloride 50 ppm at 75 DAS) (3006 kg/ha). The lowest stalk yields were obtained in T_8 (Mepiquat chloride 50 ppm at 45 DAS +75 DAS) because of decreased plant height along with low dry matter accumulation (Table.3). Similar results were reported by Bhorage (2016).

CONCLUSION

It can be concluded from the study that among the application of different plant growth regulators, mepiquat chloride 50 ppm at 45 DAS and 75 DAS resulted in increased growth and yield parameters of cotton under high density planting system which was *at par* with Maleic hydrazide 30 ppm at 45 DAS+75 DAS and cycocel 60 ppm applied at 45 DAS + 75 DAS.

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