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PERFORMANCE OF Bt COTTON (*Gossypium hirsutum* L.) AS INFLUENCED BY VARIOUS PLANT GROWTH REGULATION TREATMENTS

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ABSTRACT

The experiment was conducted to study the effect of plant growth regulation treatments in Bt cotton. Different treatments included control, detopping, foliar application of mepiquat chloride (MC) 200 and 300 ppm, cycocel (CCC) 250 and 500 ppm, kinetin 25 and 50 ppm, gibberellic acid (GA_3) 25 and 50 ppm and naphthalene acetic acid (NAA) 25 and 50 ppm. Detopping and foliar application of MC and CCC were done at maximum vegetative growth stage whereas, kinetin, GA_3 and NAA where applied at flower initiation stage. Although significant reduction in plant height and increased total chlorophyll content in leaves was recorded with MC (200 and 300 ppm) and CCC (250 and 500 ppm) but maximum number of sympodial branches and picked bolls per plant, and average boll weight along with improved setting percentage was obtained with MC 200 and 300 ppm. Maximum seed cotton yield was obtained with application of MC 300 ppm and it was followed by MC 200 ppm, which was significantly better than all other treatments. All the other plant growth regulators had no significant influence on growth parameters, yield attributes and total seed cotton yield.

Key words : *Bt cotton, PGRs, cycocel seed cotton yield, GA_3, mepiquat chloride*

Cotton (*Gossypium hirsutum* L.) known as “white gold” is the important fibre crop of India and ranks second in production after China. As far as Punjab concerns, cotton occupies an area of 483 thousand hectares during 2010-11 with total production of 1822 thousand bales and an average productivity of 641 kg lint per hectare (1). The factors for low productivity in Punjab are attributed to poor plant stand, excessive vegetative growth, shedding of young fruiting bodies (like buds, flowers and bolls) and failure of insect pest control measures. Although recent introduction of Bt cotton hybrids have evoked a considerable enthusiasm in farming and scientific community for boosting cotton productivity at reduced cost of production and environmental pollution because of less pesticide load. Even then, poor boll retention and excessive vegetative growth remained the two most important constraints in cotton production.

Applying PGRs (Plant growth regulators) so far have emerged as magic chemicals that could increase agricultural production at an unprecedented rate and help in removing and circumventing many of the barriers imposed by genetics and environment (2). PGRs encompass a broad category of compounds that promote, inhibit or otherwise modify plant’s physiological or morphological behaviour. They have the potential to promote crop earliness, improve square, flower and boll retention, increase nutrient uptake and keep harmony between vegetative and reproductive growth thus improving lint yield and quality. In view of above facts, the present investigation was planned to study the effect of PGRs on growth and yield in Bt cotton.

MATERIALS AND METHODS

The experiment was conducted at PAU Ludhiana during the two consecutive kharif seasons of 2008 and 2009 and laid out in randomized complete block design with four replications comprising of twelve treatments viz. control, detopping (removal of 5 to 7 cm apical portion of the main stem), foliar application of MC (Mepiquat chloride) 200 and 300 ppm, CCC (Cycocel) 250 and 500 ppm, kinetin 25 and 50 ppm, GA_3 25 and 50 ppm and NAA 25 and 50 ppm. Application of growth retardants (MC and CCC) and detopping was done at maximum vegetative growth stage, whereas growth promoters (kinetin, GA_3, NAA) were applied at flower initiation stage. The soil was loamy sand in texture with 8.1 pH and 0.25 ds/m, electrical conductivity low in organic carbon (0.31%) and available nitrogen (258.5 kg/ha) and high in available phosphorus (24.4 kg/ha) and potassium (339.4 kg/ ha). The crop was raised with recommended package of practices for cotton. Five plants from each treatment were selected randomly and tagged for recording various observations on growth (plant height, monopodial branches per plant) and yield components (sympodial branches per plant, picked bolls per plant, boll weight). The total chlorophyll content of leaves was estimated by following the method given by (3). Setting % was computed by the formula :

Setting % = (Total number of bolls per plant / Total number of flowers per plant) x 100

RESULTS AND DISCUSSION

Growth contributing characters : Growth regulator application had significant effect on plant height, chlorophyll content of leaf tissue and monopodial branches per plant. Maximum reduction in plant height was recorded with CCC 500 ppm as compared to control, which was statistically at par with CCC 250 ppm and MC 300 ppm (Table-1). All the other plant growth regulators were statistically at par with control for the plant height. (4) and (5) also reported that application of MC and CCC resulted in smaller and more compact plants. Higher chlorophyll content of 1.642 and 1.615 mg/g of leaf tissue was observed at 105 days after sowing with application of CCC 500 ppm and CCC 250 ppm, which was significantly higher than control except MC application at 200 ppm and 300 ppm. Detopping, kinetin (25 and 50 ppm), GA_3 (25 and 50 ppm) and NAA (25 and 50 ppm) application did not have any significant influence on the chlorophyll content of leaves. None of the PGRs had any significant influence on the number of monopodial branches per plant during both the years as PGRs were applied either at maximum vegetative growth stage or thereafter, whereas the monopodial branches arise from the lower nodes of the plant during the earlier stages of crop growth.

Yield contributing characters : Foliar application of MC 200 and 300 ppm resulted in significantly higher number of sympodial branches per plant and improved the setting percentage over control and rest of the treatments. Maximum number of sympodial branches per plant was obtained with MC 300 ppm which was statistically at par with MC 200 ppm but significantly better than control and rest of the treatments. The increase in number of sympodial branches per plant with application of MC could be contributed to its anti-gibberellin activity by which it restricts the growth of main stem, thus stimulating the growth of lateral branches. Findings of (5) also support the results. Minimum number of sympodial branches per plant was recorded with CCC application at 500 ppm which was significantly lesser than control. Decrease in number of sympodial branches per plant with CCC 500 ppm was also reported by (6). This might be due to suppression of branch primordia with application of higher concentration of CCC. MC 300 ppm also resulted in maximum setting percentage, which was significantly higher than control and rest of the treatments but was statistically at par with MC 200 ppm. Maximum number of picked bolls per plant was observed with foliar application of MC 300 ppm and was statistically at par with MC 200 ppm. These two treatments were significantly better than all the other plant growth regulator treatments and control. Significant reduction in number of picked bolls per plant was observed with application of CCC 500 ppm than control. The increase in number of picked bolls per plant with MC application was due to improved source-sink and setting percentage, while the decrease in number of picked bolls per plant with higher concentration of CCC was due to decrease in number of sympodial branches per plant and reduced setting percentage (Table-1 and 2), which might be due to suppression of branch primordia

Table-1 : Effect of plant growth regulation treatments on plant height, monopodial and sympodial branches per plant at last pick and Leaf chlorophyll content (mg/g leaf tissue) at 105 DAS.

Treatment	Plant height (cm)		Monopodial branches/plant		Sympodial branches/plant		Leaf chlorophyll content (mg/g leaf tissue)	
	2008	2009	2008	2009	2008	2009	2008	2009
Control	144.2	139.4	3.7	3.5	24.4	23.0	1.475	1.436
Detopping	141.7	136.0	3.5	3.4	24.7	23.1	1.487	1.452
MC 200ppm	120.4	117.6	3.6	3.3	28.0	26.2	1.605	1.598
MC 300ppm	118.6	114.5	3.5	3.4	29.2	27.5	1.622	1.601
CCC 250ppm	117.2	114.2	3.5	3.5	24.2	22.4	1.630	1.608
CCC 500ppm	98.1	96.0	3.4	3.5	19.7	17.6	1.642	1.615
Kinetin 25ppm	142.5	138.7	3.5	3.2	24.3	22.0	1.479	1.452
Kinetin 50ppm	145.1	142.3	3.5	3.4	24.9	22.4	1.484	1.467
GA3 25ppm	151.7	146.4	3.4	3.5	25.0	22.7	1.481	1.464
GA3 50ppm	153.4	149.4	3.4	3.4	25.2	22.7	1.489	1.465
NAA 25ppm	148.2	145.5	3.5	3.4	25.4	22.5	1.489	1.472
NAA 50ppm	150.6	146.5	3.6	3.3	25.9	23.7	1.497	1.481
LSD	20.8	19.5	NS	NS	3.23	3.11	0.136	0.127
SEm ±	7.24	6.80	0.16	0.17	1.12	1.08	0.047	0.044

Table-2 : Yield and yield attributes of B_t cotton as affected by various plant growth regulation treatments

Treatment	Setting percentage		Picked bolls/plant		Boll weight (g)		Seed cotton yield (q/ha)	
	2008	2009	2008	2009	2008	2009	2008	2009
Control	39.24	38.41	45.3	42.9	2.95	2.90	22.07	20.29
Detopping	37.48	37.76	44.7	42.5	2.95	2.82	21.41	19.46
MC 200ppm	45.13	43.46	52.8	48.7	3.42	3.18	29.73	25.24
MC 300ppm	46.01	44.37	54.2	50.4	3.45	3.25	30.28	27.00
CCC 250ppm	39.62	39.40	45.3	44.1	3.00	2.95	22.19	21.26
CCC 500ppm	36.99	35.71	40.5	37.7	2.73	2.64	17.26	15.41
Kinetin 25ppm	38.57	38.29	44.2	42.3	2.95	2.95	21.23	20.27
Kinetin 50ppm	40.12	39.17	46.1	44.2	3.15	2.97	23.54	21.39
GA3 25ppm	40.55	39.42	47.6	44.2	3.16	2.97	24.42	21.35
GA3 50ppm	38.77	37.00	44.7	41.8	3.12	2.80	21.84	19.01
NAA 25ppm	39.37	38.70	45.9	44.1	3.05	2.95	22.75	21.29
NAA 50ppm	41.16	39.34	49.2	45.4	3.18	3.03	25.51	22.40
LSD	3.93	4.65	4.67	4.90	0.23	0.26	4.58	4.30
SEm ±	1.36	1.62	1.62	1.70	0.08	0.09	1.59	1.49

and retardation of vegetative growth at a much higher rate, thereby lowering the photosynthetic capacity of the plants which intern lowered the retention of fruiting bodies. (7) reported results on similar lines. Maximum boll weight was obtained with MC 300 ppm which was statistically at par with MC 200 ppm but significantly better than control and rest of the treatments. (5) had also reported significant increase in boll weight with MC application. Application of CCC (250 ppm), kinetin (25 and 50 ppm), GA_3 (25 and 50 ppm), NAA (25 ppm and 50 ppm) and detopping did not cause any significant differences in the number of sympodial branches per plant, setting percentage, number of picked bolls per plant and boll weight.

Total seed cotton yield : PGRs had positive effect on total seed cotton yield. Cotton sprayed with MC 300 ppm and 200 ppm resulted in significantly higher seed cotton yield than all the other PGRs treatments. MC 300 ppm produced the maximum total seed cotton yield, but was statistically at par with MC 200 ppm. Application of CCC 500 ppm produced the minimum total seed cotton yield in both the years and was significantly lesser than control. All other growth regulator treatments failed to significantly influence the total seed cotton yield. Increase in total seed cotton yield with MC might be due to enhanced partitioning of the assimilates towards the fruiting bodies thereby exerting a favorable effect on various yield components like number of sympodes per plant, setting percentage and number of bolls per plant (Table-1 and 2) hence increasing the total seed cotton yield. (5) also reported increase in seed cotton yield with MC application. Significant reduction in seed cotton yield with higher concentration of CCC was also reported by (7).

CONCLUSION

Foliar application of MC 300 ppm and MC 200 ppm gave more seed cotton by improving the setting percentage and increasing the total number of picked (open) bolls per plant. Whereas, significant reduction in seed cotton yield was recorded with application of CCC at higher dose (500 ppm) than that of untreated control due to significant suppression of sympodial branches per plant, number of picked bolls per plant, average boll weight and setting percentage.

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