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Response of cotton, *Gossipium hirsutum* L to plant growth regulators

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ABSTRACT

Field studies were conducted in Rajasthan with plant growth regulators viz GA, NAA, Cycocel, ethephon and TIBA at 100 ppm and benzyladenine at 0.5 ppm to determine their effects on yield and yield attributes of cotton cultivar RST-9. The chemicals were foliar sprayed at square formation stage and 20 days after first spray. Results showed that the foliar application of NAA at 100 ppm brought about significantly higher mean seed cotton, cotton seed and lint yield by 57.3, 53.3 and 67.6 per cent respectively over water spray which resulted due to better, balanced plant growth and greater partitioning of assimilates towards yield formation as evidenced by higher number of flowers plant^{-1} (76.9), bolls plant^{-1} (49.3), mature bolls plant^{-1} (24.5), per cent boll setting (49.8), seed cotton weight boll^{-1} (104.3 g) and cotton weight boll^{-1} (4.23 g). This treatment was closely followed by Cycocel, ethephon at 100 ppm and benzyladenine 0.5 ppm.

Keywords: Cotton; GA; NAA; Cycocel; ethephon; TIBA; benzyladenine; foliar spray

INTRODUCTION

In India cotton is grown in an area of 12.18 m ha producing 35.2 m bales. Despite large acreage under this crop average productivity of this crop is miserably low in comparison to other cotton growing countries. The factors responsible for such low yield appear to be excessive vegetative growth resulting in lesser production of squares and greater proportionate setting of squares, flowers and premature bolls. The problem is further aggravated due to improper management of pests, low nutritional status, endogenous hormonal imbalance and adverse ambient environmental conditions (Sharma and Dungarwal 2003). In order to improve productivity of this crop the rationale approach would be to curtail extravagant vegetative growth by modifying crop geometry with prolonged reproductive phase particularly by delaying leaf senescence and forestalling abscissions of squares, flowers and balls with the regulation of balanced nutritional and hormonal status at the cellular level. It can be achieved by applying growth hormones exogenously to enhance photosynthetic efficiency with greater translocation and partitioning of metabolites towards reproductive sink development which ultimately leads to a well balanced vegetative and reproductive growth. Viewed in this context the present study was planned to evaluate the comparative performance of selected plant growth regulators on productivity of cotton.

MATERIAL and METHODS

The experiment was laid out at Agricultural Research Station, Sumerpur, Rajasthan during two consecutive seasons of 1998 and 1999. The soil of the experimental area was sandy loam having 153.0, 14.32 and 252.3 kg/ha available N, P and K respectively with pH 7.9. The treatments comprised of 7 plant growth regulators viz benzyladenine 0.5 ppm, ethephon 100 ppm, Cycocel 100 ppm, 2,3,5- triiodobenzoic acid (TIBA) 100 ppm, naphthalene acetic acid (NAA) 100 ppm, gibberellic acid (GA 3) 100 ppm and water spray. All growth regulators as per treatment were foliar sprayed 2 times ie 35-40 days after sowing (square formation) and 20 days after first spray. The experiment was laid out in randomized block design with four replications. The recommended American cotton variety RST-9 was sown in the last week of June during both the seasons with a planting distance of 60 cm x 45 cm using 20 kg seed ha^{-1}. Recommended fertilizer doses of 75 kg N and 35 kg P_2O_5 ha^{-1} were applied through urea and DAP. Half the nitrogen and whole P_2O_5 were applied as basal dose by drilling 4-5 cm below seed. Remaining half N was applied at square formation stage. All other cultural practices and plant protection measures were followed as and when required as per the zonal recommendations. Seed cotton was collected manually in two prickings viz 175 and 205 DAS.

RESULTS and DISCUSSION

The data presented in Table 1 show that foliar application of all plant growth regulators viz benzyladenine, Cycocel, ethephon, TIBA, NAA and GA significantly influenced yield attributes and yield of cotton during both the years and on pooled analysis. However plant growth regulators failed to influence number of squares $plant^{-1}$ during both the years and pooled analysis.

Data further show that application of NAA at100 ppm recorded maximum number of flowers $plant^{-1}$, bolls $plant^{-1}$, mature bolls $plant^{-1}$ and per cent boll setting which were significantly higher by 29.5, 11.2, 28.3 and 15.8 per cent respectively over water spray but was found at par with foliar application of ethephon, GA and Cycocel at 100 ppm. This stimulating effect of NAA on number of flowers, bolls and

Table 1. Effect of growth substances on yield attributes and yield of cotton (pooled data 1998 and 1999)

Treatment	Dose (ppm)	Squares $plant^{-1}$	Flowers $plant^{-1}$	Bolls $plant^{-1}$ $plant^{-1}$	Mature bolls	% Boll setting	Weight $boll^{-1}$ (g)		yield (kg ha^{-1})		
							Seed cotton	Cotton	Seed cotton	Cotton seed	Lint
Benzyladenine	0.5	118.5	68.1	47.95	21.4	44.5	92.8	4.04	19.1	13.3	5.9
Ethephon	100	122.2	69.8	48.90	22.7	46.0	91.3	4.05	19.5	13.4	6.0
Cycocel	100	121.0	68.1	48.20	21.9	45.4	95.9	4.01	19.5	13.4	6.0
TIBA	100	117.3	67.2	46.83	20.5	43.7	90.8	3.72	17.7	12.1	5.6
NAA	100	120.5	76.9	49.32	24.5	49.8	104.3	4.23	20.0	13.8	6.2
GA	100	119.4	68.7	48.90	22.1	45.3	91.1	3.96	17.3	11.8	5.6
Water spray	-	119.2	59.4	44.36	19.1	43.0	80.3	3.68	12.7	9.0	3.7
SEm±	-	4.20	3.06	1.08	0.95	1.28	4.41	0.08	0.58	0.41	0.10
$CD_{0.05}$	-	NS	9.10	3.20	2.82	3.82	13.10	0.23	1.72	1.22	0.31

boll setting per cent may also be attributed to the effective utilization of carbohydrates and increased enzymatic activity through the production of endogenous auxins and higher rate of photosynthetic activity (Verma 1976). The aforesaid improvement brought about significantly higher weight of seed cotton and cotton boll^{-1} representing 29.9 and 14.9 per cent respectively higher over water spray. The NAA was also found significantly superior and increased weight of seed cotton boll^{-1} by 8.8, 12.3, 14.2, 14.9 and 14.5 per cent over application of Cycocel, BA, ethephon, TIBA and GA respectively. The corresponding increases on cotton weight boll^{-1} were to the tune of 5.5, 4.7, 4.4, 13.7 and 6.8 per cent. In the present study the application of NAA might have reduced the shedding of flowers and bolls probably due to its counter effect with abscissic acid (Verma 1976) and maintenance of cell wall integrity and selective permeability which tends to prevent secretion of pectinase and cellulose through the plasma membrane.

Data further reveal that application of NAA recorded higher seed cotton (20.0 q ha^{-1}), cotton seed (13.8 q ha^{-1}) and lint (6.2 q ha^{-1}) yield which were significantly higher by 57.5, 53.3 and 67.6 per cent respectively over water spray. The foliar application of ethephon, Cycocel and BA were found next best plant growth regulator which significantly increased yield of seed cotton by 53.5, 53.5, 50.4 per cent, cotton seed by 48.9, 48.9, 47.8 per cent and lint by 62.1, 62.1, 59.5 per cent respectively over water spray. The application of NAA might have induced large number of reproductive sink leading to greater activity of carboxylating enzymes thus resulting in higher photosynthetic rate with greater translocation and accumulation of metabolites in the sink and eventually greater seed cotton yield as evident by increased flowers, bolls and seed cotton weight boll^{-1}. This view is in cognizance with the findings of Gupta and Chauhan (2005), Sarlach et al (2010), Rajendran et al (2011) and Koler and Patil (2013).

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