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Effect of Plant Growth Regulators on Biophysical, Biochemical Parameters and Yield of Hybrid Cotton

Cotton (*Gossypium hirsutum* L.) is a major economic crop with an indeterminate growth habit and it is very responsive to environmental changes and management. Excessive vegetative growth results in shade within the plant canopy, increased fruit abscission and reduced yield (Guinn, 1974). Growth promoting substances have been more extensively used for the control of reproduction growth (boll) on cotton. Growth retardants are known to reduce internodal distance (Grossman, 1990), thereby reducing plant height (Deotale *et al*., 1995) and enhancing source sink relationship and stimulate the translocation of photosynthates towards sink (Chandrababu *et al*., 1995 and Reena Tagade *et al*., 1998). The present investigation was conducted to study the effect of chamatkar, Lihocin and NAA on biophysical and biochemical changes in leaves and their relationship with seed cotton yield.

A field experiment was laid out at Agricultural Research Station, Dharwad on medium black soil. The intra-hisutum hybrid (DHH-11) cotton seeds were sown in the field at a spacing of 90 cmx 60 cm and experiment was laid out in a randomized block design with three replications. The growth regulator treatments, Chamatkar (N, N-dimethyl piperidinium chloride) contains 5% mepiquat chloride (500, 750 and 1000 ppm), Lihocin (2-chloroethyl trimethyl ammonium chloride) contains 50% chlormequat chloride (750 and 1000 ppm) and NAA (α-naphthalene acetic acid) (20 ppm) were given as foliar spray at two stages i.e., 45 DAS and 90 DAS. Plants sprayed with water treated as control. Cultural practices and plant protection measures were taken throughout the crop growth period as per the recommended schedule. Rate of photosynthesis, transpiration rate and stomatal conductance were measured on the adaxial surface of the fully expanded leaf at 120 DAS, using a portable photosynthetic system (LCOR Inc, Lincon, NE Model LI-6400). Leaf chlorophyll content was estimated by ffollowing the method of Hiscox and Israelstam (1979) at 120 DAS.The leaf nitrate reductase activity was determined by the intact plant tissue assay method of Jaworski (1971) at 120 DAS.

Photosynthesis is the primary process which forms the basis for yield determination. The growth regulator treatments increased the photosynthetic rate and it was highest in NAA than Chamatkar and Lihocin treatments. In the present study, application of NAA(20 ppm)sprayed at 90 DAS recorded the highest photosynthetic rate compared to control (Table1). Such an increase in the rate of photosynthesis is due to increase in stomatal aperture which facilitates more CO_2 conductance (Guinn and Brummett, 1993). Whereas, Chamatkar (500, 750 and 1000 ppm) recorded the lower photosynthetic rate. This is in agreement with Fernandez *et al*. (1992) and Reddy *et al*. (1996) who reported that Mepiquat chloride decreased plant photosynthetic rate. This might be due to reduction in leaf diffusive resistance and decreased leaf CO_2 uptake (Gausman *et al*., 1979). NAA(20 ppm) recorded higher transpiration and stomatal conductance than control.

The total chlorophyll content determines the photosynthetic capacity of the cotton genotypes and influences the rater of photosynthesis, drymatter production and the yield(Krasichkova *et al*., 1989). In the present study, application of NAA(20 ppm) sprayed at 90 DAS recorded total chlorophyll content of 1.681 mg/g fresh weight as compared to control (1.192

mg/g fresh weight). Application of Lihocin (750 ppm)sprayed at 90 DAS resulted in significantly higher total chlorophyll content (1.693 mg/g fresh weight) than any other treatment. But, Chamatkar (1000 ppm) sprayed at 90 DAS recorded more total chlorophyll content (1.612 mg/g fresh weight) than control. This is in agreement with the results of Bhatt and Ramanujan (1971) and Reddy *et al.*(1996). Bhatt and Nathan (1970) inferred that the application of growth retardants produced thicker leaf blades.

The seed cotton yield depends on the accumulation of photoassimilates and partitioning of these in reproductive parts of the plant. The higher yield was the result of higher rate of photosynthesis and higher photoassimilate supply to the reproductive sink. In the present investigation, higher yield was obtained in the treatments spreayed with NAA (20ppm) followed by chamatkar 1000 and 750 ppm sprayed at 90 DAS as compared to control. This increased yield was due to higher seed cotton yield per plant and more number of bolls and boll weight as compared to control (Table 2). Application of NAA increased the boll retention percentage, which inturn helped in getting higher seed cotton yield. These results are similar with the findings of Dastur and Bhatt (1956), Bhatt *et al.*(1972),

Table 1. Effect of plant growth regulators on biophysical and biochemical parameters of hybrid cotton

Treatments	Photosynthetic rate (μ mol $CO_2/m^2/s$)	Stomatal t conductance (μ mol $/m^2/s$)	Transpiration rate (m mol $/m^2/s$)	Total Chlorophill content (mg/g fresh wt.)	Nitrate reductase activity (μg NO_2 /g fresh weight)
Chamatkar (500 ppm) at 45 DAS	21.09	0.245	4.27	1.472	33.89
Chamatkar (500 ppm) at 90 DAS	23.04	0.304	4.12	1.546	73.40
Chamatkar (750 ppm) at 45 DAS	19.95	0.241	4.08	1.406	38.19
Chamatkar (750 ppm) at 90 DAS	22.12	0.307	4.16	1.546	81.39
Chamatkar (1000 ppm) at 45 DAS	19.24	0.238	3.98	1.315	51.77
Chamatkar (1000 ppm) at 90 DAS	21.25	0.320	4.18	1.612	85.52
Lihocin (750 ppm) at 45 DAS	19.23	0.243	4.00	1.445	30.24
Lihocin (750 ppm) at 90 DAS	22.67	0.273	3.99	1.693	67.46
Lihocin (1000 ppm) at 45 DAS	18.95	0.247	3.72	1.400	74.30
Lihocin (1000 ppm) at 90 DAS	21.29	0.287	3.65	1.431	76.63
Naa(20 ppm) at 90 DAS	24.98	0.340	4.52	1.681	90.51
Control	20.79	0.243	4.13	1.192	53.23
S.Em$\pm$	0.74	0.019	0.118	0.047	6.92
C.D.at 5%	2.19	0.055	0.02	0.139	20.31

Patel (1993), Pothiraj *et al*. (1995) and Sawan *et al.* (1998). Decreased seed cotton yield of Lihocin treatmets compared with control might be associated with the stand growth. Because plants receiving higher concentrations at earlier stages of crop growth, recorded less yield components

In conclusion, the application of NAA 20 ppm followed by Chamatkar 1000 ppm sprayed at 90 DAS was more economical as compared to control by recording maximum yield and yield components including photosynthesis and nitrate reductase enzyme activity.

Table 2. Effect of growth regulators on yield and yield components of cotton

Treatments	Boll number per plant	Boll weight (g)	Yield (g/plant)	Yield (kg/ha)
Chamatkar (500 ppm) at 45 DAS	26.0	5.10	39.46	730.79
Chamatkar (500 ppm) at 90 DAS	21.1	5.25	45.82	848.51
Chamatkar (750 ppm) at 45 DAS	23.8	5.25	39.42	729.99
Chamatkar (750 ppm) at 90 DAS	23.2	5.15	53.27	986.47
Chamatkar (1000 ppm) at 45 DAS	21.4	5.31	38.05	704.62
Chamatkar (1000 ppm) at 90 DAS	25.4	5.58	56.18	1040.42
Lihocin (750 ppm) at 45 DAS	18.9	4.16	37.00	685.18
Lihocin (750 ppm) at 90 DAS	19.1	5.53	45.12	835.55
Lihocin (1000 ppm) at 45 DAS	17.6	4.80	31.57	584.62
Lihocin (1000 ppm) at 90 DAS	19.0	5.40	41.55	769.44
Naa(20 ppm) at 90 DAS	27.8	5.56	71.87	1330.91
Control	23.8	5.41	50.20	929.62
S.Em±	1.34	0.17	3.44	63.85
C.D.at 5%	0.02	0.139	2.19	0.055

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