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Effect of Atonik on Quality Parameters of Cotton

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Abstract: A field investigation was conducted on cotton during 2002-2003 at Tamil Nadu Agricultural University, Coimbatore, India to study the influence of Atonik (nitro phenolic compound) on quality improvement in cotton var. MCU 12. The quality parameters viz., fibre length, uniformity ratio, fibre fineness, bundle strength and elongation ratio was significantly influenced by Atonik treatments. Among the stages of application, Atonik applied during square formation, flowering and boll set stages was found to be superior, followed by application during flowering and square formation stages. Among the concentrations used, application of Atonik at 0.25% was found to be highly effective in increasing all the quality attributes. Increased fibre length in Atonik treated plants (0.25%) may be attributed to the increased internal auxin pool or due to modulation in the turgor of cell wall altered by cell elasticity, as it is the mode of action of auxin.

Key words: Atonik, nitrophenols, quality, auxin

INTRODUCTION

Indian cotton, as an industrial raw material for a flourishing textile industry is at the crossroads today. On the one hand, it has to relentlessly, face the onslaught from foreign cottons imported into the country that are contaminant-free, clean and of better quality. Cotton's current share of the world textile market is now estimated to be 41.9% with current projection that cotton's share will decline to 40% in 2005. This is mainly due to poor quality of fibres[1]. Hence, there is a need to improve the quality of cotton fibre. Quality in cotton can be improved by application of plant growth regulators. Foliar application of CCC improved the fibre quality in American cotton[2]. Malik *et al*.[3] reported that CCC reduced the cellulose synthesis and hence increased the rate of elongation thereby increasing the fibre length. Brassinolide application improved fibre quality characters like fibre length, uniformity ratio, fibre fineness and bundle strength in cotton[4]. Gialvalis and Seagull[5] reported that application of IAA or GA increased fibre production by increasing the proportion of epidermal cells that differentiated as fibres. Hence, an attempt was made to study the influence of Atonik on quality parameters viz., fibre length, uniformity ratio, fibre fineness, bundle strength and elongation ratio in cotton.

MATERIALS AND METHODS

Field experiment was conducted during 2002-2003, at Tamil Nadu Agricultural University, Coimbatore, India, under irrigated conditions to assess the quality effect of Atonik in cotton. The experimental design followed was factorial randomized block design with three replications by maintaining a plot size of 4x5 m.

Treatment consisted of two factors, stages of application and concentration. Stage was represented as S and concentration as T.

T_1 - Control
T_2 - Seed treatment of Atonik 3 ppm
T_3 - Foliar spray of Atonik 0.1%
T_4 - Foliar spray of Atonik 0.25%
T_5 - Foliar spray of Atonik 0.5%
T_6 - Foliar spray of NAA 40 ppm
S_1 - Foliar spray of Atonik at square formation stage
S_2 - Foliar spray of Atonik at square formation and flowering stages
S_3 - Foliar spray of Atonik at square formation, flowering and boll set stages

Bolls were collected from all the concentrations of Atonik sprayed, NAA and control plots of cotton at

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harvest. Fibre quality characters were tested at the Department of Cotton, Tamil Nadu Agricultural University, Coimbatore. Fibre characters were determined from twenty random lint samples collected from each plot. All parameters were estimated in high volume instrument Uster model: HVI Classic 900. Ginning percentage was arrived by collecting one hundred seeds with fibre (kapas) from a plant and weighed. Then they were ginned by using a hand gin to separate the lint (fibre) from the seeds. Quantity of the lint obtained was weighed. The ratio of lint obtained from kapas taken was calculated and expressed as ginning out turn in percent[6].

$$\text{Ginning\%} = \frac{\text{Weight of lint}}{\text{Weight of seed cotton}} \times 100$$

Fibre length is the length of fibre representing majority of the fibres and expressed in mm[7]. Uniformity ratio of span length at 50% span over that at 2.5%. It was worked out as per the formula given below and expressed in percent.

$$\text{Uniformity ratio} = \frac{\text{50\% span length}}{\text{2.5\% span length}} \times 100$$

Fibre fineness (micronaire value) is a relative measure of size, diameter and linear density of fibres and expressed in µg inch^{-1}. Bundle strength denotes the fibre strength and otherwise known as tensile strength. It indicates the maximum specific stress that is developed in a tenacity test to rupture the fibre. IAA was estimated according to the methodology of Dunlap and Guinn[8] and expressed in ng g^{-1} DW. Statistical analysis was carried out as per Gomez and Gomez[9].

RESULTS

Fibre length (mm): The mean values of fibre length were found to vary significantly between treatments, stages and its interaction. Among the stages of application, S_3 (application of Atonik at square formation, flowering and boll set stages) recorded a value of 32.17, which was 1.6% increase over S_1. Among the treatments, maximum fibre length was observed in T_4. The lowest fibre length was recorded by the treatment T_2. In treatment combination, S_3T_5 proved to be the best by recording a value of 33.54, followed by S_3T_4 (32.94) (Table 1).

Uniformity ratio (%): The mean values of uniformity ratio were found to vary significantly between T, S and TxS. The S_2 and S_1 recorded a value of 46.70 and 45.70, respectively (Table 1). In treatments, value of uniformity ratio varied between 45.10 (T_2) to 46.87 (T_4). The treatment T_4 and T_6 recorded the highest uniformity ratio and was followed by T_5 (46.53). The best treatment (T_4) recorded an increase of 3.8, 3.9 and 3.6% over control, seed treatment and Atonik 0.1%, respectively. In combination, S_3T_3, S_3T_4 and S_3T_5 were found to be on par with each other. S_2T_6 were found to be most superior.

Table 1: Effect of Atonik on quality parameters in cotton

Treatments	Fibre length (mm)	Uniformity ratio (%)	Fibre fineness (µg inch^{-1})	Bundle strength (g t^{-1})	Elongation (%)
T_1	31.170	45.130	3.800	23.770	4.700
T_2	31.040	45.100	3.750	24.570	4.750
T_3	31.300	45.200	4.020	25.340	4.920
T_4	32.140	46.870	3.980	25.540	5.320
T_5	31.970	46.530	3.820	25.440	5.160
T_6	32.040	46.850	4.120	25.280	5.120
CD (p=0.05)	0.013	0.026	0.003	0.015	0.004
S_1	31.650	45.700	3.950	24.510	4.920
S_2	31.550	46.700	3.950	24.910	5.020
S_3	32.170	46.700	4.070	25.560	5.220
CD (p=0.05)	0.009	0.018	0.002	0.010	0.003
*S_1T_3	31.230	44.190	4.020	24.810	4.920
S_1T_4	31.030	47.200	4.120	25.110	5.220
S_1T_5	30.830	46.200	3.520	25.210	5.120
S_1T_6	32.840	47.200	4.020	24.610	4.920
S_2T_3	31.030	45.200	3.720	25.310	4.920
S_2T_4	33.440	47.200	3.820	25.310	5.420
S_2T_5	31.540	47.200	3.820	25.310	4.820
S_2T_6	31.340	48.210	4.120	25.410	5.120
S_3T_3	31.640	46.200	4.320	25.910	4.920
S_3T_4	32.940	46.200	4.020	26.210	5.320
S_3T_5	33.540	46.200	4.120	25.810	5.520
S_3T_6	31.940	45.200	4.220	25.810	5.320
CD (p=0.05)	0.024	0.045	0.006	0.026	0.008

* Interactions only in foliar treatments

Fibre fineness (µg inch^{-1}): S_3 (application of Atonik at square formation, flowering and boll set stages) recorded an increase of 3.0% over S_1 (application of Atonik at square formation) (Table 1). The stage of application, treatments and their interaction were found to be significant. In treatments, fibre fineness ranged from 3.75 (T_2) to 4.12 (T_6). The best treatment, T_6 recorded an increase of 8.4, 9.8 and 7.8%, over control (T_1), seed treatment (T_2) and Atonik 0.5% (T_5), respectively. In the treatments combination, the highest fineness was observed in S_3T_3 (4.32), followed by S_3T_6 (4.22). S, T and SxT were found to be significant.

Bundle strength (g t^{-1}): Bundle strength was more in S_3 (25.56) followed by S_2 (24.91) (Table I). Among the treatments, T_4 recorded a highest value (25.54) and T_1 (23.77) recorded a lowest values. The treatment, T_2, T_3, T_5 and T_6 recorded a value of 24.57, 25.34, 25.44 and 25.28, respectively. Among the interaction, S_3T_4 was the best

Table 2: Effect of Atonik on IAA content (ng g^{-1}) at different growth stages in cotton

	Stages					
Treatments	Vegetative	Square formation	Flowering	Boll set	Boll development	Maturity
T_1	114.820	402.220	560.350	917.880	238.920	105.88
T_2	137.510	412.530	625.670	919.600	240.640	112.07
T_3	115.500	515.660	831.940	1100.080	410.810	197.67
T_4	116.880	921.320	1268.540	1652.190	543.160	242.36
T_5	114.820	591.290	986.660	1213.530	431.440	216.58
T_6	117.570	732.240	1141.340	1368.230	495.040	204.89
CD (P=0.05)	0.554	11.883	21.252	18.986	19.574	14.029
S_1	117.910	596.450	780.370	1061.410	306.820	154.70
S_2	118.940	596.480	959.140	1204.080	384.170	165.70
S_3	121.690	594.730	801.000	1320.270	489.020	219.33
CD (P=0.05)	NS	NS	15.027	13.425	16.770	12.849
*S_1T_3	113.440	515.660	701.300	1015.860	283.610	159.85
S_1T_4	119.630	917.880	1031.330	1351.040	402.220	201.11
S_1T_5	113.440	598.170	825.060	1031.330	309.400	167.07
S_1T_6	113.240	732.240	948.820	1134.660	371.280	185.64
S_2T_3	113.280	513.840	897.260	1046.800	391.900	175.32
S_2T_4	115.500	928.200	1392.300	1681.070	525.980	216.58
S_2T_5	115.420	587.860	1031.330	1227.280	412.530	189.76
S_2T_6	119.630	742.560	1237.600	1423.240	495.040	195.95
S_3T_3	119.620	513.980	898.140	1237.600	556.920	257.83
S_3T_4	115.510	917.840	1381.980	1924.460	701.300	309.40
S_3T_5	115.640	588.160	1103.130	1381.980	572.390	257.83
S_3T_6	119.160	721.930	1237.600	1547.000	618.800	268.14
CD (P=0.05)	NS	20.582	36.809	32.885	26.583	16.978

* Interaction only in foliar treatments

(26.21) and it was followed by S_3T_3 (25.91). The treatment, stage of application and their interaction was found to be significant.

Elongation %: Application of Atonik at square formation, flowering and boll set stages increased the elongation percent (Table 1). The per cent increase over S_1 and S_2 was 6.0 and 3.9, respectively. Among the treatments, T_4 recorded an elongation per cent of 5.32, whereas the control had an elongation per cent of 4.70. In combination, S_3T_5 recorded an elongation per cent of 5.52, which was followed by S_2T_4 (5.42) and S_3T_4 (5.32) and S_3T_6 (5.32). S, T and S x T were significant.

IAA content: IAA content showed an increasing trend over the period of growth, upto boll set stage (Table 2). Application of Atonik at square formation, flowering and boll set stage (S_3) significantly increased the IAA content by 9.6 and 24.3% over S_2 and S_1 at boll set stage, respectively.

Comparing the concentrations of Atonik foliar spray, NAA foliar spray, Atonik seed treatment, Atonik 0.25% recorded a value of 1652.19 whereas T_6 (NAA 40 ppm) had an IAA content of 1368.23, which is a 20.7% decrease over T_4 at boll set stage. This treatment recorded an increase of 80.0 and 79.6% over control and seed treatment respectively at the above said stage. There exists a significant variation in IAA, due to Atonik spray, at all growth stages.

DISCUSSION

Cotton fibre develops as a single cell epidermal trichome on the seed coat. Cotton fibre length is commercially important parameters. Among the quality characters fibre length, bundle strength and elongation ratio were positively influenced by Atonik. Uniformity ratio and fibre fineness were enhanced by NAA application. Fibre length is one of the important criteria for spinning value and it determines the yarn strength and finest yarn size into which cotton can be spun[10]. As, Atonik treatment influenced these characters positively, it can be very well exploited in economic front. It is suggested that auxin (IAA) is the major hormone produced in response to fertilization and plays an important role in fibre production. Increased fibre length in Atonik treated plants (0.25%) may be attributed to the increased internal auxin pool. Cultivars that produce long staple have more auxin-like substances followed by middle and short staple cultivars[11]. Cotton fibre grows in four distinct phases of development viz., fibre initiation, elongation, secondary deposition and maturation, and dehydration[12]. Ultra structural evidences indicate that expansion occurs through a diffused growing mechanism, albeit with some bias for deposition of newly synthesized cell wall materials at the tip[13]. In Atonik treated plant, the more fibre length may be due to modulation in the turgor of cell wall altered by cell elasticity, as it is the mode of action of auxin. Fibre elongation *per se* involves the deposition of primary cell wall via secondary mechanism involving the dictyosomes and a protein synthesis mechanism ensuring sufficient supply of proteins required for the expansion of plasma membrane and tonoplast, while the rate of biosynthesis and degradation of IAA also dictates the rate of elongation[14].

Decreased IAA oxidase coupled with low polyphenol oxidase (data not shown) activity as observed in Atonik treated plants indirectly increased the internal auxin pool. At low IAA oxidase, profound effect of cellular level IAA would have effective role in cell wall extension and cell expansion. Prakash *et al.*[14] indicated that higher activity of this enzyme during the cell expansion has resulted in shorter fibre length. Further, as the secondary growth set in, the synthesis and availability of auxin became a limiting factor for fibre elongation. Increase in IAA content may positively influence the fibre development[14]. Thus, external application of Atonik might have resulted in accumulation of the IAA in ovule leading to higher numbers of fibres produced in the early stage of initiation. Increased fibre length in Atonik treated plant may be due to rapid water uptake, which might have facilitated the cell elongation. This is in accordance with the finding of Gokani and Thaker[15].

REFERENCES

1. Becerra, C.A.V., 2000. World cotton demand in the future: Issues on competitiveness. 25th International Cotton Conference, Bremen Germany, pp: 256.
2. Nagwekar, S.N., B.D. Yadav and B.P.S. Lather, 1984. Effect of defoliants on American varieties of cotton 320 F and H 655 in respect to yield, boll weight and fibre quality characteristics. Cotton Dev., 14: 30-35.
3. Malik, M.N., I.B. Makhdoom, U.F. Malik and F.I. Chaudary, 1986. Effect of CCC on yield and fibre qualities of cotton (*Gossypium hirsutum* L.). Pak. J. Agric. Res., 7: 28-30.
4. Lini, A., 2001. Physiological and biochemical effects of brassinolide on the productivity of cotton. M.Sc.(Ag.) Thesis, submitted to Tamil Nadu Agricultural University, INDIA.
5. Gialvalis, S. and R.W. Seagull, 2001. Plant hormones alter fibre initiation in unfertilized, cultured ovules of *Gossypium hirsutum*. J. Cotton Sci., 5: 252-258.
6. Santhanam, V., 1976. Cotton. ICAR, New Delhi.
7. Sundaram, V. and R.L.N. Iyengar, 1968. Hand Book of Methods of Test for Cotton Fibre, Yarns and Fabrics. Cotton Technological Research Laboratory, ICAR, New Delhi.
8. Dunlap, J.R. and G. Guinn, 1989. A simple purification of indole-3-acetic acd and abscissic acid for GC-SIM-MS analysis by microfiltration of aqueous sample through nylon. Plant Physiol., 90: 197-201.
9. Gomez, K.A. and A.A. Gomez, 1992. Statistical Procedure for Agricultural Research. New York, Wiley Inter-science Publications.
10. Gokani, S.J., R. Kumar and V.S. Thaker, 1998. Potential role of abscissic acid in cotton fibre and ovule development. J. Plant Growth Regul., 17: 1-5.
11. Thaker, V.S., S. Saroop and Y.D. Singh, 1986. Physiological and biochemical changes associated with cotton fibre development. III. Indole-3-acetaldehyde dehydrogenase. Biochem. Physiol. Pflanz., 181: 339-345.
12. Graves, D.A. and J.M. Steward, 1988. Chronology of the differentiation of cotton (*G. hirsutum* L.) fibre cells. Planta, 175: 254-258.
13. Tiwari, S.C. and T.A.Wilkins, 1995. Cotton seed trichomes expand via diffuse growing mechanism. Can. J. Bot., 73: 746-757.
14. Prakash, A.H., N. Gopalakrishnan, S.E.S.A. Khader and K. Venugopal, 2002. Biochemical factors associated in controlling fibre elongation in different cotton genotypes. Indian J. Plant Physiol., 7: 192-194.
15. Gokani, S.J. and V.S. Thaker, 2002. Physiological and biochemical changes associated with cotton fibre development. IX. Role of IAA and PAA. Field Crops Res., 77: 127-136.