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Research Paper

Influence of plant growth regulators on growth parameters and yield components of interspecific hybrid cotton

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ABSTRACT

Field experiments were conducted at Agricultural Research Station, Dharwad, University of Agricultural Sciences, Dharwad during *Kharif* 2005-06 and 2006-07 to know the influence of plant growth regulators on growth parameters and yield components of interspecific hybrid cotton. Significant differences were observed in all parameters studied during two years. The treatment naphthalene acetic acid (30 ppm) recorded significantly higher yield (kg/ha) and lowest in cycoceel (80 ppm) sprayed at 70 + 90 days after sowing. The absolute growth rate (AGR) and crop growth rate (CGR) were higher during flower initiation and peak flowering stages in all the treatments. In the present study, naphthalene acetic acid treatments (10, 20, 30 ppm) showed higher absolute growth rate (AGR) and crop growth rate (CGR). At initial stage (60-90 DAS), higher relative growth rate (RGR) was recorded with naphthalene acetic acid (NAA) treatments; while at later stages of crop growth, higher relative growth rate was recorded by growth retardant treatments. The net assimilation rate (NAR) decreased continuously from 90 days after sowing until harvest in all the treatments. The decrease in net assimilation rate at later stages could be due to mutual shading of leaves.

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Key words : Cotton, PGRs, Hybrid cotton, Interspecific hybrid, Growth parameters, Growth retardants

INTRODUCTION

Cotton is one of the most important fibre crops playing a key role in the economic and social affairs of the world. It is the oldest among the commercial crops of the world and is regarded as white gold. Cotton plant has a natural mechanism to prevent excessive vegetative growth with higher nitrogen levels, soil moisture, temperature and fruit loss by insect, disease and nematodes. In many cases, these factors are not well balanced and growth regulators are needed to maintain proper plant size and to synchronize boll set and to regulate maturity. Additionally, indeterminate varieties also require plant growth regulators to shift cotton from vegetative to reproductive growth.

Plant growth regulators are known to modify the source to sink relationship and increase the translocation and photosynthetic efficiency resulting in increased square and boll retention and boll set per cent (Kiran Kumar, 2001). Mepiquate chloride is an anti-gibberelin that inhibits cell expansion but not cell division. Its spray directs carbohydrates into reproductive organs and hence, used to control plant growth. It is available in different trade names that include pix, mepex, pixplus, pix ultra and others. Pix, which is a growth retardant when applied as foliar spray reduces the vegetative growth, leaves become coarse and dark green in color (Cothren and Osterhuis, 1993; Edmisten, 2000).

MATERIALS AND METHODS

Field experiments were conducted during *Kharif* 2005-06 and 2006-07 to know the influence of plant growth regulators on growth parameters and yield components of interspecific hybrid cotton. Five plants from each treatment were selected randomly and tagged for recording various observations. The design adopted for the experiment was randomized block design with three replications. The genotype used for the experiment is DHB-290. Various treatments given were cycocel (40, 60, 80 ppm), mepiquat chloride (50, 100 ppm), naphthalene acetic acid (10, 20, 30 ppm) and sprayed at 70, 90 and 70 + 90 days after sowing. But, all naphthalene acetic acid concentrations sprayed at 60 days after sowing.

RESULTS AND DISCUSSION

The results obtained from the present investigation have been discussed in the following sub heads :

Growth parameters:

The data on different growth parameters at different growth stages are presented in Table 1. Growth parameters like AGR, CGR, RGR and NAR have been extensively used in recent years for better understanding of physiological basis of yield variation in crop plants. Increase in yield is not associated with increase in photosynthetic rate alone and it is difficult to find out clear cut answer for improving the yield potential.

The average daily increment of plant stand biomass is an important characteristic which is designated as absolute growth rate by Watson (1952). The AGR and CGR were higher during flower initiation and peak flowering stages in all the treatments. In the present study, NAA treatments (10, 20, 30 ppm) showed higher AGR and CGR at two stages of growth (60-90 and 90-120 DAS). At 120-150 DAS, significantly higher AGR and CGR values were recorded by water spray, control and NAA (10 ppm) compared to MC (100 ppm) sprayed at 70 DAS (Vaibhav, 2000). The RGR was more during early stages and both CGR and RGR gradually decreased thereafter. This indicates that RGR in cotton is more closely associated with vegetative growth than seed cotton yield (Coy, 1976). At initial stage (60-90 DAS), higher RGR was recorded with NAA treatments; while at later stages of crop growth, higher RGR was recorded by growth retardant treatments (Kiran Kumar, 2001). The increase in RGR by the application of growth retardants could be attributed to increased photosynthetic efficiency as a result of increased leaf thickness, higher chlorophyll content and efficient translocation of photosynthates (Joseph and Johnson, 2006).

Net assimilation rate (NAR) expresses the rate of dry weight increase at any instant per unit leaf area and leaf representing an estimate of the size of the assimilatory surface area. The NAR decreased continuously from 90 DAS until harvest in all the treatments. The decrease in

Table 1: Effect of PGR's on growth parameters at different growth stages in cotton (pooled data of two years)

Treatments	AGR (g day^{-1})			CGR (g m^{2}day^{-1})			RGR (g g^{-1} day^{-1})			NAR(g^{-1} dm^{-2} day^{-1})		
	60-90	90-120	120-150	60-90	90-120	120-150	60-90	90-120	120-150	60-90	90-120	120-150
T_1 – CCC (40 ppm) at 70 DAS	3.35	2.28	1.28	6.21	4.22	2.37	0.0417	0.0133	0.0056	0.103	0.361	0.025
T_2 – CCC (40 ppm) at 90 DAS	3.37	2.38	1.26	6.24	4.41	2.34	0.0418	0.0137	0.0055	0.097	0.434	0.024
T_3 – CCC (40 ppm) at 70 + 90 DAS	3.31	2.23	1.26	6.12	4.13	2.33	0.0421	0.0132	0.0056	0.103	0.378	0.025
T_4 – CCC (60 ppm) at 70 DAS	3.30	2.28	1.29	6.11	4.22	2.38	0.0418	0.0134	0.0057	0.105	0.381	0.026
T_5 – CCC (60 ppm) at 90 DAS	3.31	2.37	1.30	6.12	4.38	2.41	0.0414	0.0138	0.0057	0.096	0.426	0.025
T_6 – CCC (60 ppm) at 70 + 90 DAS	3.19	2.18	1.29	5.91	4.04	2.40	0.0402	0.0131	0.0058	0.102	0.369	0.026
T_7 – CCC (80 ppm) at 70 DAS	3.19	2.28	1.25	5.91	4.22	2.31	0.0406	0.0136	0.0056	0.100	0.429	0.025
T_8 – CCC (80 ppm) at 90 DAS	3.24	2.37	1.27	6.00	4.38	2.36	0.0407	0.0139	0.0056	0.095	0.389	0.024
T_9 – CCC (80 ppm) at 70 + 90 DAS	3.19	2.18	1.28	5.90	4.04	2.38	0.0416	0.0133	0.0059	0.104	0.389	0.027
T_{10} – MC (50 ppm) at 70 DAS	3.40	2.32	1.28	6.29	4.29	2.37	0.0431	0.0135	0.0056	0.105	0.356	0.025
T_{11} – MC (50 ppm) at 90 DAS	3.42	2.43	1.28	6.33	4.50	2.37	0.0432	0.0139	0.0055	0.099	0.448	0.024
T_{12} – MC (50 ppm) at 70 + 90 DAS	3.30	2.26	1.25	6.12	4.19	2.32	0.0418	0.0133	0.0056	0.105	0.348	0.024
T_{13} – MC (100 ppm) at 70 DAS	3.20	2.29	1.23	5.92	4.25	2.28	0.0407	0.0137	0.0055	0.102	0.331	0.025
T_{14} – MC (100 ppm) at 90 DAS	3.33	2.36	1.26	6.16	4.37	2.33	0.0427	0.0138	0.0055	0.096	0.425	0.024
T_{15} – MC (100 ppm) at 70 + 90 DAS	3.20	2.19	1.26	5.93	4.05	2.34	0.0418	0.0133	0.0057	0.104	0.315	0.026
T_{16} – NAA (10 ppm) at 60 DAS	4.08	2.54	1.31	7.55	4.70	2.42	0.0477	0.0129	0.0052	0.114	0.307	0.020
T_{17} – NAA (20 ppm) at 60 DAS	4.17	2.61	1.25	7.73	4.84	2.32	0.0485	0.0131	0.0049	0.116	0.299	0.019
T_{18} – NAA (30 ppm) at 60 DAS	4.23	2.60	1.28	7.84	4.81	2.37	0.0483	0.0129	0.0049	0.117	0.302	0.020
T_{19} – Water spray	3.38	2.18	1.36	6.25	4.03	2.52	0.0419	0.0128	0.0061	0.097	0.314	0.023
T_{20} – Control	3.40	2.16	1.35	6.29	4.00	2.51	0.0431	0.0127	0.0060	0.099	0.310	0.023
Mean	3.43	2.32	1.28	6.35	4.30	2.37	0.0427	0.0133	0.0056	0.103	0.366	0.024
S.E.$\pm$	0.100	0.080	0.023	0.185	0.145	0.049	0.001	0.0002	0.0001	0.003	0.026	0.001
C.D. (P=0.05)	0.285	0.228	0.066	0.528	0.417	0.141	0.004	0.001	0.0003	0.009	0.073	0.003

Table 2 : Effect of plant growth regulators on yield and yield components in cotton

Treatments	Yield (kg/ha)			Boll weight (g)			No. of bolls/plant			Harvest index (%)		
	05-06	06-07	Pooled	05-06	06-07	Pooled	05-06	06-07	Pooled	05-06	06-07	Pooled
T_1 – CCC (40 ppm) at 70 DAS	943.7	1230.0	1086.8	3.33	3.76	3.54	19.3	20.4	19.9	22.6	27.7	25.2
T_2 – CCC (40 ppm) at 90 DAS	1087.0	1266.7	1176.8	3.39	3.80	3.59	21.3	22.4	21.9	25.6	28.2	26.9
T_3 – CCC (40 ppm) at 70 + 90 DAS	894.7	1156.0	1025.3	3.11	3.42	3.27	18.3	19.4	18.9	21.7	26.3	24.0
T_4 – CCC (60 ppm) at 70 DAS	907.0	1222.0	1064.5	3.21	3.70	3.46	19.1	20.1	19.6	21.8	27.6	24.7
T_5 – CCC (60 ppm) at 90 DAS	1037.3	1257.0	1147.2	3.25	3.78	3.51	21.0	22.1	21.5	24.5	28.1	26.3
T_6 – CCC (60 ppm) at 70 + 90 DAS	852.3	1118.3	985.3	3.09	3.41	3.25	18.0	19.0	18.5	20.7	25.5	23.1
T_7 – CCC (80 ppm) at 70 DAS	864.3	1207.0	1035.7	3.17	3.64	3.41	18.3	19.4	18.9	20.9	28.0	24.4
T_8 – CCC (80 ppm) at 90 DAS	970.0	1232.3	1101.2	3.20	3.74	3.47	20.2	21.2	20.7	23.1	27.6	25.4
T_9 – CCC (80 ppm) at 70 + 90 DAS	791.7	1077.0	934.3	3.09	3.36	3.23	16.8	18.0	17.4	19.3	24.8	22.1
T_{10} – MC (50 ppm) at 70 DAS	992.0	1238.0	1115.0	3.51	3.79	3.65	20.6	21.5	21.1	23.7	27.8	25.8
T_{11} – MC (50 ppm) at 90 DAS	1103.7	1278.0	1190.8	3.56	3.83	3.70	22.4	23.3	22.9	25.9	28.3	27.1
T_{12} – MC (50 ppm) at 70 + 90 DAS	911.3	1157.0	1034.2	3.18	3.43	3.31	19.3	20.2	19.8	22.0	26.3	24.2
T_{13} – MC (100 ppm) at 70 DAS	877.0	1210.7	1043.8	3.18	3.65	3.42	18.3	19.4	18.9	21.2	27.5	24.4
T_{14} – MC (100 ppm) at 90 DAS	987.7	1235.7	1111.7	3.21	3.75	3.48	20.2	21.2	20.7	23.5	27.7	25.6
T_{15} – MC (100 ppm) at 70 + 90 DAS	816.7	1080.3	948.5	3.10	3.37	3.24	16.9	18.0	17.4	19.9	24.9	22.4
T_{16} – NAA (10 ppm) at 60 DAS	1112.7	1317.3	1215.0	3.95	4.06	4.01	24.3	25.6	25.0	24.6	27.3	25.9
T_{17} – NAA (20 ppm) at 60 DAS	1182.7	1332.3	1257.5	3.97	4.06	4.01	25.0	26.3	25.6	25.6	27.5	26.5
T_{18} – NAA (30 ppm) at 60 DAS	1234.3	1347.0	1290.7	3.99	4.09	4.04	25.1	26.6	25.9	26.5	27.7	27.1
T_{19} – Water spray	906.7	1072.0	989.3	3.08	3.34	3.21	16.3	18.3	17.3	21.9	24.5	23.2
T_{20} – Control	867.7	1068.7	968.2	3.07	3.33	3.20	16.2	18.1	17.1	21.0	24.5	22.7
Mean	967.0	1205.2	1086.1	3.33	3.66	3.50	19.8	21.0	20.4	22.8	26.9	24.9
S.E.$\pm$	43.83	40.22	26.76	0.193	0.117	0.114	1.366	1.908	1.584	1.12	0.914	0.737
C.D. (P=0.05)	125.49	115.16	76.62	0.554	0.334	0.327	3.910	5.463	4.536	3.21	2.615	2.11

NAR at later stages could be due to mutual shading of leaves. At 60-90 DAS, significantly higher NAR was observed in NAA treatments (10, 20, 30 ppm) as compared to other treatments. While, 90-120 DAS, significantly higher NAR was observed with MC (50 ppm) compared to NAA treatments. At 120-150 DAS, significantly higher NAR was recorded in CCC (80 ppm) sprayed at 70 + 90 DAS compared to other treatments.

Yield and yield components:

The data on yield (kg/ha), boll weight (g), number of bolls per plant and harvest index are presented in Table 2. There was significant difference between treatments at yield and yield components. The treatment NAA 30 ppm (1290.7) recorded significantly more seed cotton yield compared to other treatments. However, it was at par with NAA 20 ppm (1257.5) and NAA 10 ppm (1215.0). This increased yield was due to higher seed cotton yield per plant, more number of bolls and boll weight as compared to other treatments. Several authors have also reported increased seed cotton yield due to NAA spray (Patel, 1993). Significantly lowest yield was recorded by CCC 80 ppm sprayed at 70 + 90 DAS (934.3) compared to other treatments. Among the growth retardants, increased yield were also observed in mepiquat chloride (50 ppm) sprayed at 90 DAS. It was due to delayed senescence of leaves which helped in increasing the photo assimilate supply for an extended period (Russell *et al.,* 2006). Application of growth retardants at later stage (90 DAS) had beneficial effect on seed cotton yield and this was in conformity with the findings of Brar *et al.* (2000). Significantly higher boll weight and boll numbers were recorded in NAA treatments. However, they were at par with MC 50 ppm sprayed at 90 DAS (3.70). The application of NAA increased the boll set percentage, which inturn helped in getting higher yield of seed cotton. These results are in conformity with the findings of Patel (1993). Significantly higher harvest index was recorded in MC 50 ppm sprayed 90 DAS (27.1), NAA 30 ppm (27.1) and CCC 40 ppm sprayed at 90 DAS (26.9) compared to other treatments.

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