Effect of Gibberellin and Cytokinin on Sucker Production and Flowering of Anthurium (*Anthurium andraeanum* Lind.) cv. Nitta in the Plains of West Bengal

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Abstract

Greenhouse grown Anthurium (*Anthurium andraeanum* Lind.) cv. Nitta plants were treated with six different levels of plant growth regulators namely BA 500 ppm, BA 1000 ppm, GA_3 500 ppm, GA_3 1000 ppm, BA 250 ppm + GA_3 250 ppm and BA 500 ppm + GA_3 500 ppm and their effect on the sucker production and flowering were compared against control (without application of plant growth regulators). Plants treated with 1000 ppm BA recorded highest number of side-shoots per plant (5.67), earliest flower bud initiation (253.83 days) and higher post-harvest life of cut flowers (12.33 days). Control plants showed the earliest spadix visibility (32.83 days) stage, longest spadix (4.17 cm) and reached the blooming stage earlier (5.83 days) along with plants treated with BA 500 ppm. GA_3 500 ppm treated plants produced the highest number of flowers per plant (3.33) and spadix circumference (1.33 cm) however, the longest stalks (15.82 cm) and spathes (6.53 cm) were obtained from the plants treated with GA_3 1000 ppm and BA 250 ppm + GA_3 250 ppm respectively. Widest spathes (5.60 cm) and maximum *in-situ* longevity of flowers (36 days) were obtained from the plant growth regulator treatment BA 250 ppm + GA_3 250 ppm and monthly leaf number, leaf length, leaf width and petiole lengths were fluctuated greatly with season and stage of crop growth. BA 1000 ppm and a mixture of BA (250 ppm) and GA_3 (250 ppm) was found better for growth, development, flowering, post-harvest life and keeping quality of anthurium flowers.

***Keywords*:** Anthurium, *Anthurium andraeanum*, plant growth regulator, cytokinin, GA_3

Anthurium andraeanum is an internationally accepted commercial flower. It ranked 8th in the list of top ten cut flowers in Dutch auction market in 2003 and 2004 (Satya and Maitra, 2007). Growth and development have profound influence

on flowering of anthurium, because after attaining a certain number of good sized leaves, the plant enters into the reproductive phase (Dai and Paull, 1990). Though, Nakasone and Kamemoto (1962) reported the ineffectiveness of Gibberellins on Growth and flowering of Anthuriums at 10-100 ppm, others reported the alteration in vegetative growth as affected by the application of various plant growth regulators [Higaki and Rasmussen (1979), Imamura and Higaki (1988)] because propensity of sucker production in anthurium has also great significance, as the separation of sucker is one of the chief methods for commercial propagation. To judge the effect of plant growth regulators on the growth, development, flowering and propensity of sucker production of anthurium, the present experiment was conducted.

Materials and Methods

Anthurium plants were grown in a semi-automated polyhouse having 50% shadenet for consecutive two years at the Jaguli Horticulture farm of Bidhan Chandra Krishi Viswavidyalaya, West Bengal, India. The protected structure was made of 4-angled alluminium bars and UV stabilized polyethylene sheet was used as cladding material. The temperature was controlled using evaporative cooling system and humidity by placing wet gunny bags on the floor. Irrigation was given with the help of rotary sprinkler nozzles. Chopped coconut husk was used as growing medium. The plants were treated with varying levels of GA_3 and BA both singly and in combination and the results were compared with control. The required plant growth regulators were weighed according to the formulae- ppm = mg/lit. The ingredients were made soluble with the help of specific solvents e.g. 0.1 (N) HCl was the solvent for BA and rectified spirit was the solvent for GA_3 by adding dropwise and the final volume was made up with distilled water. Spraying was done twice in a year at a trimonthly interval (March and June of each year). The experiment was laid out following RBD as the statistical design with 7 treatments replicated thrice. The data of both the individual years were collected and pooled analysis of the results of both the individual years was considered for evaluation through MSTATC software. The seven treatments with notations are presented below:

$\mathbf{T_0}$ – Control (no application of plant growth regulators)

$\mathbf{T_1}$ = BA 500 ppm

$\mathbf{T_2}$ = BA 1000 ppm

$\mathbf{T_3}$ = GA_3 500 ppm

$\mathbf{T_4}$ = GA_3 1000 ppm

$\mathbf{T_5}$ = BA 250 ppm + GA_3 250 ppm

$\mathbf{T_6}$ = BA 500 ppm + GA_3 500 ppm

Results and Discussion

Effect of plant growth regulators on leaf number of anthurium

Plant growth regulators had no significant influence on leaf production of anthurium throughout the entire growth period. Results revealed that the average monthly leaf number was fluctuated greatly with stage of crop growth. (Table 1).

Table 1 : Effect of plant growth regulators on the leaf production of anthurium plants cv. Nitta.

Treatments	Average monthly leaf number of anthurium							
	1st month	2nd month	3rd month	4th month	5th month	6th month	7th month	8th month
T_0	4.00	4.00	4.67	5.00	4.67	5.00	4.67	5.00
T_1	4.33	4.00	4.33	4.33	4.33	4.00	4.00	4.33
T_2	4.33	5.00	5.00	5.00	4.33	3.67	4.33	5.00
T_3	4.00	3.67	4.00	4.33	4.00	4.00	4.33	4.67
T_4	3.67	3.67	4.00	4.33	4.33	4.00	4.00	4.33
T_5	3.00	3.33	3.33	4.00	3.33	3.67	3.67	4.00
T_6	3.33	3.33	3.33	3.33	3.67	3.67	4.00	3.67
S. Em ±	*0.58*	*0.55*	*0.60*	*0.53*	*0.28*	*0.30*	*0.26*	*0.35*
C.D. at 5%	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

(contd.....)

Treatments	Average monthly leaf number of anthurium							
	9th month	10th month	11th month	12th month	13th month	14th month	15th month	16th month
T_0	5.33	6.33	7.67	8.33	8.33	9.00	9.00	9.00
T_1	4.67	5.00	5.33	5.67	5.67	5.33	5.67	6.33
T_2	4.67	4.00	5.67	7.00	6.33	7.67	7.67	7.33
T_3	5.67	6.33	5.00	5.00	5.33	5.33	5.00	5.33
T_4	5.00	5.67	6.33	5.33	5.67	6.67	7.33	9.00
T_5	3.67	4.00	4.33	4.00	4.33	5.00	5.00	5.00
T_6	4.00	4.33	4.00	4.67	5.00	6.00	6.33	8.33
S. Em ±	*0.55*	*0.71*	*0.87*	*1.33*	*1.38*	*1.88*	*2.08*	*2.30*
C.D. at 5%	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

(contd.....)

Treatments	Average monthly leaf number of anthurium							
	17th month	18th month	19th month	20th month	21st month	22nd month	23rd month	24th month
T_0	9.00	8.67	9.67	10.33	10.33	10.33	10.67	10.33
T_1	8.00	8.67	9.33	10.00	9.67	9.33	10.00	9.67
T_2	7.67	7.67	7.33	6.67	6.33	9.33	8.67	8.67
T_3	7.00	7.33	7.33	7.67	7.00	7.67	8.33	7.67
T_4	11.67	13.67	14.33	15.67	15.00	13.67	13.00	14.33
T_5	5.33	5.00	5.00	5.00	4.00	4.67	4.67	5.00
T_6	12.00	11.67	10.00	10.00	8.33	8.00	7.33	6.00
S. Em ±	*3.18*	*3.57*	*3.37*	*3.24*	*3.12*	*2.65*	*2.39*	*2.17*
C.D. at 5%	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

Effect of plant growth regulators on leaf length of anthurium

Plant growth regulators showed varied results regarding the monthly average leaf length of anthurium. However, control Plants (T_0) produced the longest leaves from 18th to 24th month of crop growth (Table 2).

Table 2: Effect of plant growth regulators on the monthly leaf length of anthurium plants cv. Nitta.

Treatments	Leaf length (cm)							
	1st month	2nd month	3rd month	4th month	5th month	6th month	7th month	8th month
T_0	13.47	16.00	12.83	14.00	13.67	14.67	15.67	15.00
T_1	12.67	13.00	11.33	12.00	12.83	13.67	13.83	11.67
T_2	12.43	12.33	11.00	12.00	12.50	12.00	11.67	10.83
T_3	12.87	13.07	12.67	12.83	13.17	13.00	13.17	11.33
T_4	12.93	13.47	12.33	13.00	13.33	13.00	12.83	10.67
T_5	11.47	12.00	10.33	9.33	9.50	9.50	12.00	11.50
T_6	9.97	10.67	9.83	10.00	10.50	10.67	10.67	9.50
S. Em ±	*0.63*	*0.83*	*0.75*	*0.97*	*0.78*	*1.13*	*1.25*	*1.37*
C.D. at 5%	1.94	2.54	N.S.	2.97	2.39	N.S.	N.S.	N.S.

(contd.....)

Treatments	Leaf length (cm)							
	9th month	10th month	11th month	12th month	13th month	14th month	15th month	16th month
T_0	15.00	13.67	16.63	15.50	17.10	18.00	17.33	18.00
T_1	12.00	11.67	13.87	15.63	15.33	16.43	17.70	17.80
T_2	11.50	12.00	13.30	13.67	14.00	16.53	16.33	16.57
T_3	12.00	13.67	15.17	15.23	16.80	18.33	17.67	18.33
T_4	11.33	12.33	14.93	12.40	13.37	12.83	14.87	15.17
T_5	12.17	11.33	14.77	17.07	17.47	17.00	18.30	18.83
T_6	9.50	9.33	10.17	10.73	12.00	11.03	11.17	11.00
S. Em ±	*1.18*	*1.15*	*1.47*	*1.52*	*1.53*	*1.44*	*1.19*	*1.27*
C.D. at 5%	N.S.	N.S.	N.S.	N.S.	N.S.	4.42	3.66	3.92

(contd.....)

Treatments	Leaf length (cm)							
	17th month	18th month	19th month	20th month	21st month	22nd month	23rd month	24th month
T_0	17.70	18.00	18.67	19.33	19.00	19.50	18.83	18.53
T_1	21.97	17.50	17.83	17.67	17.17	17.50	17.67	15.97
T_2	16.57	15.83	16.17	16.33	15.50	17.17	17.17	17.13
T_3	18.73	18.00	18.50	18.00	18.17	18.33	17.77	18.47
T_4	15.30	15.50	15.83	14.67	15.00	15.50	11.50	11.00
T_5	18.03	16.17	17.00	16.67	16.33	16.50	16.83	16.77
T_6	11.50	11.33	11.50	11.67	11.50	11.67	13.00	12.67
S. Em ±	*2.00*	*1.46*	*1.44*	*1.42*	*1.37*	*1.37*	*1.94*	*1.60*
C.D. at 5%	N.S.	N.S.	N.S.	4.36	4.22	4.23	N.S.	4.93

Effect of plant growth regulators on leaf width of anthurium

The effect of plant growth regulators on the leaf width of anthurium was found to be statistically non-significant in majority of the months. Results fluctuated greatly with the stage of crop growth (Table 3).

Table 3 : Effect of plant growth regulators on the monthly leaf width of anthurium plants cv. Nitta.

Treatments	Monthly leaf width of anthurium (cm)							
	1st month	2nd month	3rd month	4th month	5th month	6th month	7th month	8th month
T_0	7.93	8.47	8.50	8.83	8.67	9.17	9.33	9.00
T_1	8.07	8.37	7.67	8.17	8.50	8.67	9.00	8.50
T_2	7.63	8.23	7.33	7.83	8.33	7.83	8.17	7.33
T_3	7.73	7.73	9.00	8.50	8.17	8.33	8.33	7.00
T_4	8.03	8.37	8.00	8.50	8.50	8.50	8.33	7.00
T_5	7.17	7.70	6.83	7.67	7.17	7.17	8.00	8.17
T_6	6.30	6.83	6.67	6.67	6.67	7.17	6.83	6.00
S. Em ±	*0.56*	*0.49*	*0.63*	*0.47*	*0.60*	*0.70*	*0.62*	*0.68*
C.D. at 5%	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

(contd……)

Treatments	Monthly leaf width of anthurium (cm)							
	9th month	10th month	11th month	12th month	13th month	14th month	15th month	16th month
T_0	8.83	9.00	10.13	9.43	10.23	10.83	10.60	10.90
T_1	8.67	9.00	8.80	9.30	9.57	9.93	10.33	10.57
T_2	7.67	8.00	9.03	9.73	8.30	9.90	10.10	9.80
T_3	7.83	8.67	9.33	9.43	9.83	10.90	10.67	10.90
T_4	7.33	7.67	9.63	7.77	8.23	8.53	8.97	8.80
T_5	8.67	8.33	7.33	10.47	10.80	10.87	10.33	10.53
T_6	6.00	6.17	6.23	6.67	7.13	6.93	6.97	7.00
S. Em ±	*0.62*	*0.46*	*0.63*	*0.79*	*0.79*	*0.73*	*0.69*	*0.76*
C.D. at 5%	N.S.	1.41	1.96	N.S.	N.S.	2.26	2.12	2.33

(Contd……)

Treatments	Monthly leaf width of anthurium (cm)							
	17th month	18th month	19th month	20th month	21st month	22nd month	23rd month	24th month
T_0	11.03	10.50	10.77	11.00	10.67	10.83	11.00	11.20
T_1	10.70	10.33	10.40	10.67	10.33	10.43	10.33	10.13
T_2	9.97	9.37	9.83	9.33	9.47	9.77	10.00	10.47
T_3	10.97	10.73	10.50	10.67	10.53	10.67	10.50	11.47
T_4	9.97	9.50	9.40	9.33	9.47	9.77	7.43	7.43
T_5	10.80	10.00	9.83	9.83	10.00	10.17	10.07	10.33
T_6	7.07	6.77	6.67	6.67	6.77	6.83	7.33	7.83
S. Em ±	*0.78*	*1.14*	*0.82*	*0.71*	*0.70*	*0.70*	*1.02*	*1.17*
C.D. at 5%	2.39	N.S.	N.S.	2.18	2.15	2.16	N.S.	N.S.

Effect of plant growth regulators on the petiole length of anthurium

The effect of plant growth regulators on the petiole length of anthurium were found to be statistically significant in the 1st, 3rd, 4th, 9th-12th and 14th months of cultivation but the results of the rest months were found statistically non-significant (Table 4).

Table 4 : Effect of plant growth regulators on the monthly petiole length of anthurium plants cv. Nitta.

Treatments	Effect of plant growth regulators on petiole length of anthurium (cm)							
	1st month	2nd month	3rd month	4th month	5th month	6th month	7th month	8th month
T_0	23.80	25.00	20.00	20.67	20.67	20.67	18.33	19.67
T_1	23.17	23.93	17.00	19.17	18.17	16.67	17.77	16.83
T_2	22.77	23.27	16.50	18.50	18.67	19.33	16.77	17.00
T_3	23.20	22.17	18.00	19.50	18.67	19.00	15.00	18.67
T_4	21.73	22.00	18.00	18.50	18.67	19.33	13.83	14.67
T_5	19.30	19.00	16.00	14.83	15.33	15.33	16.00	18.67
T_6	15.33	16.20	12.33	13.17	13.83	13.67	11.67	10.67
S. Em ±	*1.70*	*2.06*	*1.07*	*1.35*	*1.58*	*1.88*	*1.52*	*1.92*
C.D. at 5%	5.25	N.S.	3.30	4.17	N.S.	N.S.	N.S.	N.S.

(contd……)

Treatments	Effect of plant growth regulators on petiole length of anthurium (cm)							
	9th month	10th month	11th month	12th month	13th month	14th month	15th month	16th month
T_0	20.00	19.67	26.13	20.93	24.80	27.00	25.90	27.53
T_1	17.33	17.67	21.90	17.00	23.80	25.63	20.53	27.73
T_2	18.67	19.00	22.30	20.23	22.63	23.13	23.67	24.67
T_3	19.67	20.67	22.97	15.83	25.60	27.10	27.37	27.73
T_4	15.50	16.00	27.33	14.40	18.83	19.60	22.37	22.83
T_5	19.00	18.33	19.57	18.33	21.07	22.33	25.33	27.10
T_6	10.50	11.00	14.90	10.23	14.10	12.33	16.60	16.47
S. Em ±	*1.74*	*1.57*	*1.93*	*2.03*	*2.53*	*2.39*	*2.34*	*2.66*
C.D. at 5%	5.35	4.83	5.95	6.24	N.S.	7.36	N.S.	N.S.

(contd.....)

Treatments	Effect of plant growth regulators on petiole length of anthurium (cm)							
	17th month	18th month	19th month	20th month	21st month	22nd month	23rd month	24th month
T_0	27.77	23.13	23.83	25.33	25.50	25.67	27.00	30.63
T_1	28.60	23.33	24.00	24.67	24.33	24.83	24.00	27.63
T_2	25.37	21.33	22.50	21.67	21.67	22.17	24.33	27.03
T_3	28.93	25.00	26.00	25.50	25.17	25.00	26.00	26.60
T_4	22.17	20.00	19.33	20.67	22.33	21.00	14.83	17.30
T_5	28.80	22.67	22.67	24.00	23.00	23.00	21.67	26.10
T_6	18.43	15.67	15.50	16.00	16.00	16.33	16.33	18.33
S. Em ±	*2.85*	*2.33*	*2.51*	*2.11*	*2.07*	*2.15*	*2.95*	*3.69*
C.D. at 5%	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

Number of side-shoots per plant

Increase in the concentration of BA resulted in the increase in the number of side-shoots per plant but the effect of GA_3 showed the reverse (Table 5). The mixture of GA_3 and BA produced inhibitory effect on the side shoot production of anthurium. The pooled result showed BA 1000 ppm (T_2) as the most effective regarding side-shoot production (5.67) which was statistically at par with GA_3 500 ppm (T_3) (4.83 side-shoots/plant). BA 500 ppm (T_1) (4.50) and GA_3 1000 ppm (T_4) also produced better results (3.67) than the control plants (3.33 side-shoots/plant). The lowest

number of side-shoots/plant (2.00) was obtained from plants treated with BA 500 ppm + GA_3 500 ppm (T_6).

Days required for flower bud initiation

The pooled effect showed that increasing the concentration of BA from 500 to 1000 ppm resulted earliness in flower bud initiation. GA_3 also followed the reverse trend (Table 5). But the individual plant growth regulators showed statistically at par effects with T_2 showed the earliest flower bud initiation (253.83 days). The mixture of GA_3 and BA was found less effective like the control plants. T_6 treated plants showed the most delayed effect (334.67 days).

Days required from flower bud initiation to spadix visible Stage

The effect exerted by the plant growth regulators on the days required for spadix visible stage of anthurium was found to be statistically significant. Results proved that growth regulators were non- effective regarding the earliness in flower production (Table 5). Control plants reached the spadix visible stage earliest (32.83 days) followed by BA 1000 ppm (34.83 days). The rests were found moderately effective except T_6 showed the most delayed effect (40.83 days) which was statistically at par with BA 250 ppm + GA_3 250 ppm [T_5 (40.33 days)] treatment.

Table 5: Effect of plant growth regulators on growth and flowering of anthurium cv.Nitta

Treatments	No. of side-shoots per plant	Days required for flower bud initiation	Days required for FBI-Spadix Visible stage	Days for full bloom	Number of flowers per plant	Field-life of flowers (days)
T_0	3.33	283.00	32.83	5.83	2.83	28.83
T_1	4.50	276.50	39.50	5.83	3.17	26.50
T_2	5.67	253.83	34.83	6.00	3.17	24.67
T_3	4.83	263.17	39.50	6.33	3.33	33.17
T_4	3.67	279.17	36.50	6.50	2.83	30.00
T_5	2.83	284.00	40.33	6.17	2.50	36.00
T_6	2.00	334.67	40.83	7.50	1.50	23.50
S. Em ±	*0.29*	*9.89*	*1.37*	*0.52*	*0.27*	*1.66*
C.D. at 5%	**0.85**	**28.87**	**3.99**	**N.S.**	**0.78**	**4.83**

Days required from spadix visible to full bloom stage

The effect of plant growth regulators on the days required for full bloom stage was found to be statistically non-significant. However, the results indicated that T_0 and T_1 were the most effective treatments (Table 5) required 5.83 days to reach the full bloom stage and T_6 showed the most delayed effect (7.50 days).

Number of flowers per plant

The effect of plant growth regulators on the production of flowers of anthurium was found to be statistically significant. Results reported that T_3 was the best performer produced 3.33 flowers per plant (Table 5) which was statistically at par effective with T_1 and T_2 (3.17), T_4 (2.83) and control (2.83). T_5 produced less marked effect (2.50 flowers per plant). Plants treated with T_6 produced the lowest number of flowers per plant (1.50).

Field-life of flowers (days)

The use of growth regulators differed significantly in their effect regarding the field-life of anthurium flowers. Results represented that a mixture of BA and GA_3 (T_5) as the most effective treatment regarding the field-life (36.00 days) of anthurium which was statistically at par with T_3 treated plants (33.17 days). The treatment T_6 proved harmful for the field-life (23.50 days) of flowers.

Table 6 : Effect of plant growth regulators on the flower quality of *Anthurium andraeanum* cv. Nitta.

Treatments	Spathe length (cm)	Stalk length (cm)	Spadix length (cm)	Spathe width (cm)	Spadix cumference (cm)	Vase-life (days)
T_0	5.97	15.33	4.17	5.50	1.19	11.33
T_1	5.33	14.57	3.08	4.60	0.88	12.17
T_2	5.55	12.83	3.82	5.13	1.21	12.33
T_3	5.67	14.52	4.03	4.67	1.33	11.83
T_4	5.65	15.82	3.88	4.95	1.08	11.50
T_5	6.53	14.40	4.08	5.60	1.24	11.00
T_6	5.25	13.38	3.37	4.65	0.98	10.83
S. Em ±	*0.17*	*0.42*	*0.14*	*0.15*	*0.03*	*0.25*
C.D. at 5%	**0.51**	**1.21**	**0.42**	**0.45**	**0.09**	**0.72**

Spathe length (cm)

Plant growth regulators had profound influence on the spathe lengths of anthurium flowers. The pooled result established T_5 as the most effective treatment produced

the longest spathes (6.53 cm) followed by the control plants produced spathes of 5.97 cm. The other levels of growth regulators were found less effective regarding the spathe length of anthurium. The shortest spathes (5.25 cm) were obtained from the plants treated with T_6 (Table 6).

Stalk length (cm)

Significant differences were observed between the effects of different plant growth regulators on the stalk length of anthurium flowers. T_4 was the most effective treatment produced the longest stalks (15.82 cm) statistically at par with control plants (15.33 cm). The rest of the treatments were found non-effective (Table 6). The shortest stalks were recorded with the plants treated with T_2 (12.83 cm).

Spadix length (cm)

The exogenous application of plant growth regulators exhibited significant effects on the spadix length of anthurium. The pooled results revealed that control plants produced the longest spadix (4.17 cm), which was statistically at par with the plants treated with T_5 (4.08 cm), T_3 (4.03 cm), T_4 (3.88 cm) and T_2 (3.82 cm) respectively (Table 6). The shortest spadix length (3.08 cm) was obtained with the plants treated with T_1 statistically at par with the effect of T_6 (3.37 cm).

Spathe width (cm)

The pooled result established T_5 as the most effective treatment produced widest spathes (5.60 cm) statistically at par with control plants (5.50 cm). The rest treatments were proved less effective. The shortest spathe width (4.60 cm) was obtained from the plants treated with T_1 (Table 6).

Spadix circumference (cm)

The effect of plant growth regulators on spadix circumference of anthurium was found to be statistically significant. GA_3 at lower concentration (T_3) recorded the highest spadix circumference of anthurium (1.33 cm). Plants treated with T_5 (1.24 cm) and T_2 (1.21 cm) performed at par with control plants (1.19 cm). The rests were found less effective regarding the spadix circumference. The shortest spadix circumference (0.88 cm) was obtained from the plants treated with T_1 (Table 6).

Vase-life of flowers (days)

Plant growth regulators had significant influence on the post-harvest life of cut anthurium flowers. T_2 was identified as the best treatment recorded the maximum (12.33) days of vase-life followed by T_1 (12.17 days). Other plant growth regulator applications showed less marked effect (Table 6) including T_6 recorded the minimum days of post-harvest life (10.83 days).

Results revealed that the plants treated with BA or GA_3 at any concentration produced greater number of side-shoots per plant than control. A mixture of BA and GA_3 responded negatively regarding the side-shoot production of anthurium. BA @ 1000 ppm treated plants produced the maximum number of side-shoots/ plant may be due to its counteraction of apical dominance. Apical dominance might be under the control of a balance of concentrations between cytokinin like substance and auxin (IAA). Higaki and Rasmussen (1979) reported that maximum shoot formation of anthurium was produced by BA at 1000 ppm treated plants. Imamura and Higaki (1988) reported with increasing concentration of BA, the number of lateral shoots increased in both topped and intact plants.

Application of BA and GA_3 alone at different levels made the flowering earlier than the control plants. BA at 1000 ppm showed earliest flower bud initiation. This is probably due to its capacity of influencing the activity of the specific enzyme. Growth regulators were not effective during flower bud initiation to spadix visible and spadix visible to full bloom stage. Control plants showed better effects. Maximum number of flowers (3.33) per plant was produced with GA_3 at 250 ppm treatment. The results are in close conformity with the results of Henny and Hamilton (1992). They reported that a greater increase in flower production was obtained by GA_3 application and the response increased with GA_3 concentrations with applications of 375 or 500 mg/lit resulting in > 3 blooms/plant.

The *in-situ* longevity of flowers was found maximum with the application of a mixture of GA_3 250 ppm + BA 250 ppm might be due to the synergistic effect of the anti-senescing property of BA by GA_3. Improved post-harvest longevity was found with the flowers resulted from the application of BA might be due to its anti-senescing activity by lowering the respiration rate of the cut blooms. A mixture of BA 250 ppm and GA_3 250 ppm was found helpful for production of longest and widest spathes might be due to the synergistic effect of the growth substances. But growth regulators affected the spadix length negatively. Control plants produced the longest spadix. Stalk length was found maximum with GA_3 at 1000 ppm probably due to its inherent and natural growth promoting ability. Boschi *et al.,* (1998) reported that application of GA_3 produced longest floral buds without reducing leaf number.

Conclusion

Greenhouse grown Anthurium (*Anthurium andraeanum* Lind.) cv. Nitta plants when treated with BA and GA_3 either singly or in combination showed significant variation in sucker production and flowering. BA 1000 ppm and a mixture of BA (250 ppm) and GA_3 (250 ppm) was found better for growth, development, side-shoot production, earliness, flowering and post-harvest life of cut-anthurium flowers.

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