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Influence of Plant Growth Regulators on Growth, Flowering and Yield Characteristics of Hybrid Tea Rose cv. Bugatti during Spring-Summer Months

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Authors' contributions

The work was carried out in collaboration between both authors. Author SM designed the study, performed the analysis, wrote the protocol and wrote the first draft of the manuscript. Author MMS managed the literature searches and performed the statistical analysis. Both authors read and approved the final manuscript.

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ABSTRACT

The present investigation was conducted at Horticultural Research Station, Mandouri, BCKV, Mohanpur, West Bengal, India from February 2016 - March 2017 to study the influence of plant growth regulators on growth, flowering, yield and quality of Hybrid Tea rose cv. Bugatti during spring-summer months. The experiment was laid out in Randomised Block Design (RBD) with seven treatments and three replications. The experimental results revealed that GA_3 (Gibberellic acid) at 200 ppm + BA (Benzyladenine) at 100 ppm showed maximum plant height (82.30 cm) and chlorophyll content (16.81 mg/g). The maximum secondary shoots (13.37), leaf area (41.45 cm^2), stalk diameter (0.53 cm), flowering duration (22.15 days), vase life (7.04 days) were obtained in benzyladenine at 200 ppm. The treatment BA at 100 ppm showed maximum spread, flower diameter at cup shape and number of flowers per plant (yield). The maximum stalk length was

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under benzyladenine at 200 ppm + gibberellic acid at 100 ppm. The earliness of flowering was seen under GA_3 at 100 ppm. The maximum intermodal length was found under GA_3 at 200 ppm. Hence, it could be concluded that the highest values on vegetative and flowering parameters as well as flower quality were achieved in benzyladenine at 200 ppm as compared to other treatments.

Keywords: Rose; Bugatti; stalk length; benzyladenine; gibberellic acid; yield.

1. INTRODUCTION

Rose is cultivated for its beautiful flowers and is universially claimed as the "Queen of Flowers". Rose belongs to the family Rosaceae. Traditionally, Hybrid tea roses (*Rosa hybrida* L.) have been considered to be one of the most prized flowers of the world because of their high ornamental and commercial value. In flower trade it occupies the top position in terms of acerage, production and consumption. It is admired for their perfect blooms, exquisite colour and unique fragrance. Roses are used in the preparation of rose oil, gulkand, pankhuri, gul-roghan, potpouri, conserves, rose vinegar, rose petal wine, jam, jellies and syrups etc. But at present situation production of quality rose flower is not up to the mark in our country. Plant flowering and growth very depended on PGR equilibrium and plants quickly respond to change of hormonal balance [1].

Plant growth regulators or plant regulators are the organic chemical compounds which modify or regulate physiological process in an appreciable measure in plants when used in small concentrations. They are readily absorbed and move rapidly through tissues when applied to different parts of the plant [2]. Growth regulators have been found effective in terms of overall growth of the plants, flowering duration, floriferousness and ultimate quality of the cut blooms. Earlier workers reported the positive influence of GA_3 (Gibberellic acid) on the growth parameters like shoot length, internodal length etc. [3], and flowering parameters like early flowering [4], longer stalk, enhanced flowering period, increased yield per unit area [5], longer vase life [6]. BA (Benzyladenine) increased the number of basal shoots, flower number, flower longevity and vase life [7]. An experiment was conducted in open condition in the Gangetic alluvial plains of West Bengal during spring–summer months with the objectives of assessing performance of Hybrid Tea rose cv. Bugatti under the influence of GA_3 and BA in terms of growth and floral attributes.

2. MATERIALS AND METHODS

The experiment was carried out at Horticultural Research Station, Mondouri, Faculty of Horticulture, Bidhan Chandra Krishi Viswavidyalaya, Nadia, West Bengal, India from February 2016 - May 2016. The soil of the experimental site is sandy - loam in texture, slightly acidic in reaction with soil pH 6.6. The experiment was laid out in Randomised Block Design (RBD) with seven treatments and three replications. The treatments were as follows: T_0 = control, T_1= GA_3 at 100 ppm, T_2= GA_3 at 200 ppm, T_3= BA at 100 ppm, T_4= BA at 200 ppm, T_5= BA at 200 ppm + GA_3 at 100 ppm, T_6 = GA_3 at 200 ppm + BA at 100 ppm. During the course of experiment the plants had attained an age of three years and the observations were recorded for the period of February 2016 - May 2016 i.e. for one flowering season. At the end of February, 2016 the plants were pruned moderately at a height of 35-40 cm above the budding point. One month after pruning, spraying of growth regulators (GA_3 and BA at different concentrations) were started with three sprays at an interval of seven days. Required cultural operations (irrigation, fertilization, weeding, hoeing, pesticide application, disbudding etc.) were followed during the experiment. After one month of the last spray observations of various parameters on growth and flowering were recorded by using standard methods. Five plants selected randomly from each plot were tagged to record the observations. The chlorophyll content of fresh leaf tissue was estimated with the method described by Sadasivam and Manicham [8]. The data regarding various characters were statistically analysed according to the Fischer's analysis of variance techniques as given by Panse and Sukhatme [9].

3. RESULTS AND DISCUSSION

The application of BA and GA_3 resulted in significant influence on vegetative growth of Hybrid tea rose cv. Bugatti. Discounting the concentration levels GA_3 and BA sprays proved superior in terms of vegetative parameters over control. Among the treatments BA at 100 ppm + GA_3 at 200 ppm (T_6) influenced plant height (82.30 cm) and chlorophyll content (16.81 mg/g) to maximum limit, as compared to the control (Table 1). The observations recorded are in conformity with the results reported by Sardoei [10] on *Dizigotheca elegantissima, Ficus benjamina and Schefflera arboricola.* The increase in height may be attributed to the effect of GA_3 on cellular processes by stimulating cell elongation, lengthening cells caused increased growth and influence of BA on cell division and formation of meristamatic growth [11].

The number of primary branches was not significant among the treatments. Among the treatments primary branches were maximum (3.53) in the plants treated with BA at 200 ppm (T_4) as compared to other treatments. Secondary branches were maximum (13.37) in plants treated with BA at 200 ppm (T_4) as compared to control (5.23). Enhanced branching due to application of BA was also reported by Gowda [12] in rose cv. Superstar. The branching reinforcement may be considered as a result of the ability of cytokinin (BA) to promote lateral bud development by disrupting the apical dominance acting in opposition to auxin. The data furnished in Table 1 showed that plant spread both in East - West and North – South direction was greatest (57.22 and 59.36 cm, respectively) in plants treated with BA at 100 ppm (T_3) followed by BA at 200 ppm (T_4), this may be attributed to higher branch count as a result of BA application regardless of the concentration levels. Exogenous cytokinin has been found to improve branching of numerous species of ornamental plants viz. Crossandra cv. Delhi [13] and Gaillardia [14] leading to abundant flowering. Internodal length was maximum (3.36 cm) in the treatment GA_3 at 200 ppm (T_2) followed by GA_3 at 100 ppm (T_1). The results were in conformity with the results of Verma et al. [15] in Chrysanthemum cv. Cotton Ball. Leaf area was maximum (41.45 cm^2) in the treatment BA at 200 ppm (T_4), least leaf area (34.45 cm^2) was seen in control plants. The result was in conformity with the results of Sardoei [16] on *Dizigotheeca elegantissima*.

The tabular representation (Table 2) showed significant variation among the treatments in terms of flowering parameters. Plants receiving GA_3 at 100 ppm and BA at 200 ppm (T_5) sprays showed advanced bud formation (30.12 days). The result was supported by earlier findings of Muthu Kumar et al. [17] in rose cv. First Red; Janowska and Andrzejak [18] in calla lily and Yamaguchi [19]. Compared to the GA_3 treated plants BA at 200 ppm (T_4) registered longer (22.15 days) duration of flowering followed by BA at 100 ppm (T_3). Unappreciable influence of GA_3 on flowering duration was also reported by Schroeter-Zakrzewska and Janowska [20] in *Impatiens walleriana*.

Flower stalk length was maximum (29.61 cm) in the plants receiving BA at 200 ppm + GA_3 at 100 ppm (T_5) closely followed by GA_3 at 100 ppm (T_1). The plants in the control plots produced shortest flowering shoots (19.34 cm). Increase in stalk length as a result of GA_3 and BA application may be due to cell elongation induced by gibberellic acid and cell division promoted by cytokinin [21]. Thicker stalks (0.53 cm) were recorded in plants receiving BA at 200 ppm (T_4) followed by BA at 100 ppm (T_3). Flower diameter at cup shape stage was maximum (3.25 cm) in the plants receiving BA at 100 ppm (T_3) closely followed by GA_3 at 200 ppm (T_2). Positive effect of BA on flower size was also reported by Nambiar et al. [22] in *Dendrobium* orchid. Maximum yield (18.77) were recorded in plants treated with BA at 100 ppm (T_3) followed by BA at 200 ppm and GA_3 at 100 ppm (T_5). The results were in agreement with the findings of Nambiar et al. [22] in *Dendrobium* orchid and Janowska [23] in calla lily. The higher yield in BA treated plants may be attributed to higher chlorophyll levels leading to increased photosynthesis. The lower yield potential was found in the treatments GA_3 at 100 and 200 ppm. Similar result was found by Randoux et al*.* [24] during summer months due to inhibitory effect of flowering by GA_3 at that time.

The flowers harvested from plants under the treatment BA at 200 ppm and BA at 100 ppm exhibited delayed senescence with a longer vase life (7.04 and 6.91 days respectively) compared to control and GA_3 treated plants. The observations recorded also revealed that combined application of GA_3 + BA (T_5 and T_6) also registered longer vase life compared to GA_3 at 100 and 200 ppm (T_1 and T_2) and control. The positive effect of BA on vase life may be attributed to the ability of cytokinin to retard senescence and slow the ageing process. Delayed senescence by the application of BA was also reported by Mutui et al. [25]. The finding was also supported by Mayak and Halevy [26]. Delayed senescence may be also manifested to high chlorophyll content in the leaves as a result of BA application.

Table 1. Effect of GA_3 and BA on vegetative and chemical parameters of hybrid tea rose cv. Bugatti

Treatments	Plant height (cm)	Plant spread (E-W)	Plant spread (N-S)	Number of primary branches	Number of secondary branches	Internodal length (cm)	Leaf Area (cm^2)	Chlorophyll content (mg/g)
T_0	64.67	44.51	41.60	3.33	5.23	2.70	34.45	12.61
T_1	67.10	45.55	42.33	3.48	7.25	3.21	38.26	14.05
T_2	76.60	44.78	51.53	3.25	9.11	3.36	40.59	13.2
T_3	74.27	57.22	59.36	3.43	11.52	2.63	40.32	15.32
T_4	74.40	49.51	56.43	3.53	13.37	3.2	41.45	16.47
T_5	73.36	48.55	45.06	3.30	10.37	2.86	36.47	16.48
T_6	82.30	49.30	50.42	3.34	9.25	3.08	37.53	16.81
C.D. at 5%	3.34	2.47	3.70	N/A	2.64	0.28	4.27	1.74
S. Em (±)	1.07	0.793	1.188	0.106	0.849	0.09	1.371	0.557

Table 2. Effect of GA_3 and BA on flowering parameters of Hybrid Tea rose cv. Bugatti

Treatments	Stalk length (cm)	Stalk diameter (cm)	Number of days required from last spray to FBE	Flowering duration (Days)	Flower diameter at cup shape stage (cm)	Number of flowers per plant	Vase life (Days)
T_0	19.34	0.37	36.14	15.56	2.00	11.83	5.20
T_1	28.66	0.39	30.75	16.42	2.40	12.36	6.56
T_2	27.71	0.46	31.29	16.78	2.55	14.11	6.35
T_3	24.39	0.49	33.30	21.74	3.25	18.77	6.91
T_4	25.52	0.53	32.65	22.15	2.82	15.22	7.04
T_5	29.61	0.48	30.12	20.58	2.51	17.48	6.90
T_6	28.50	0.47	32.73	18.18	2.60	16.04	6.75
C.D. at 5%	2.48	0.04	3.60	1.94	0.28	2.09	0.20
S. Em (±)	0.795	0.011	1.156	0.625	0.089	0.67	0.063

Table 3. Correlation coefficient values of growth characters on yield (number of flowers per plant) of hybrid tea rose cv. Bugatti

	Plant height	Plant spread (E-W)	Plant spread (N-S)	Number of primary branches	Number of secondary branches	Number of flowers per plant(yield)
Plant height	1	0.415	0.785**	-0.026	0.694**	0.601**
Plant spread (E-W)		1	0.774**	0.136	0.615**	0.849**
Plant spread (N-S)			1	0.094	0.808**	0.840**
Number of primary branches				1	0.014	0.074
Number of secondary branches					1	0.743**
Number of flowers per plant(yield)						1

Table 4. Correlation coefficient values of flowering and quality characters on yield (number of flowers per plant) of hybrid tea rose cv. Bugatti

	Internodal length	Stalk length	Stalk diameter	Chlorophyll content	Number of flowers per plant(yield)
Internodal length	1	0.636**	0.163	-0.022	-0.237
Stalk length		1	0.238	0.286	0.032
Stalk diameter			1	0.687**	0.670**
Chlorophyll content				1	0.489*
Number of flowers per plant(yield)					1

Data represented in Tables 3 and 4 revealed the correlation among the growth, flowering and quality parameters with yield (Number of flowers per plant). The estimates for correlation co-efficient for plant height, plant spread, branches per plant and yield (number of flowers per plant) in Table 3. Almost all the growth and yield attributing characters were shown to be in highly significant positive correlation with yield. Highly significant positive association with yield was shown by secondary branch per plant (r= 0.743**), East-West (r= 0.849**) and North-South (r= 0.840**) spread. Similarly, the yield was positively correlated with flowering and quality attributes, viz. stalk diameter, chlorophyll content and yield (number of flowers per plant) (Table 4). The parameter like stalk diameter (r= 0.670**) was highly significant with yield. While chlorophyll content (r= 0.489**) was significantly correlated with number of flowers per plant (yield).

4. CONCLUSION

Though spring – summer months are not appropriate for better growth and flowering of rose due to adverse climatic condition in that zone of West Bengal, the experimental results expressed an advantageous effect of the growth regulators regardless of its concentration levels over control. Among the treatments the performance efficiency of the plants in the vegetative growth, flower characteristics and quality attributes were conspicuous with maximum readings recorded under BA at 200 ppm. Therefore, application of BA at 200 ppm can be suggested for overall crop performance and cut flower quality.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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