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Effect of growth regulators on growth, yield and shelf life in amaryllis lily (*Amaryllis belladona*) cv. Zephyranthes

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Abstract
The present experiment was carried out during September, 2016 to March, 2018 in Research Field of Department of Horticulture, SHUATS, Allahabad. The experiment was conducted in Randomized Block Design (RBD), with thirteen treatments, replicated thrice. The treatments were T_0 = Control, T_1 = GA_3 150 ppm, T_2 = GA_3 200 ppm, T_3 = GA_3 250 ppm, T_4 = GA_3 300 ppm, T_5 = NAA 150 ppm, T_6 = NAA 200 ppm, T_7= NAA 250 ppm, T_8 = NAA 300 ppm, T_9 = CCC 150 ppm, T_{10} = CCC 200 ppm, T_{11} = CCC 250 ppm and T_{12} = CCC 300 ppm. To evaluate shelf life parameters 7 treatments were replicated thrice in randomized design *viz.* T_1= Silver nitrate (100 ppm), T_2 = Silver nitrate (200 ppm), T_3 Benzyladenine (100 ppm), T_4 Benzyladenine (200 ppm), T_5 Benzyladenine (100 ppm) + Silver nitrate (100 ppm), T_6 =Benzyaleadenine (200) + Silver nitrate (200ppm), T_7 = Control (water). From the present investigation from two years experimental trial it is concluded that the treatment T_3 (GA_3 250 ppm) is found to be best in terms of growth and yield parameters as well as cost benefit ratio and lowest was recorded in treatment T_0 (Control) in all the growth and yield parameters, In terms of shelf life of flower the longest shelf life (hours) and lowest physiological loss in weight was recorded in treatment T_4 (Benzyl adenine 200 ppm) followed by treatment T_5 (Benzyl adenine 100 ppm + Silver nitrate 100 ppm) and lowest was recorded in T_7 control (water).

Keywords: growth regulators, growth, yield, shelf life, amaryllis lily

Introduction
The botanical name of Amryllis is (*Amaryllis belladonna* L.) and it belongs to the family of Amaryllidaceae. Amaryllis belladonna is a native of South Africa, particularly the rockey southwest region near the cape. They have 2-6 flowers per stick. Amaryllis flowers are 2 inch wide, 4-5 inch long. Most of the bulbs sold are either Dutch or South African grown hybrids. Amaryllis is a very common bulb for plains and hills.

Hormones also determine the formation of flowers, stems, leaves, the shedding of leaves, and the development and ripening of fruit. Capable of producing hormones. Plant hormones shape the plant, affecting seed growth, time of flowering, the sex of flowers senescence of leaves and fruits. They affect which tissue grow upward and which grow downward, leaf formation and stem growth fruits. They affect which tissues grow upward and which grow downward, leaf formation and stem growth, fruit development and ripening, plant longevity and even plant death (Bhattacharjee *et al.* 1974) [2].

NAA had indirect effect through the stimulation of ethylene production, therefore, presently ethylene-generating through (ethephon) are currently used for this purpose.

Gibberellin usually enhances flowering in short-day plants growing under inductive conditions, The flower formation of long-day or short-day plants can be controlled by regulating the exogenous level of gibberellins like substances through the use of such growth retardants as CCC that inhibit gibberellins synthesis. CCC and SADH are especially effective, when shoot growth is retarded; there is less competition for the nutrients required for floral bud development.

Material and Methods
The experiment was conducted during winter season of the year 2015-16 and 2016-17 in Research field of Department of Horticulture, Sam Higginbottom University of Agricultural Technology and Sciences, Prayagraj. It is situated at $25^0.8´$N latitude and $81^0.50´$ E longitudes on elevation of 98 meters from the sea level. The maximum temperature of the location reaches up to 46 ºC – 48 ºC and seldom falls as low as 4 ºC – 5 ºC. The relative humidity ranges between 20 to 94 per cent. The average rainfalls in this area are around 1013.4 mm

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The height of the plant from the soil level to the highest level reached by the leaves in natural condition was measured for the five tagged plants with the help of graduated meter scale at 180 days after planting, The number of leaves produced was recorded by counting the number of leaves at 180 days after transplanting and the average number of leaves per plant was worked out. The days to first flower bud initiation was counted at the beginning of flower bud initiation to the end of flower bud initiation, diameter of the flower bud was measured at the point of maximum breadth, the height of the spike from the soil level to the highest level reached by the spike in natural condition was measured with the help of graduated meter scale, flower diameter was measured at the point of maximum breadth this was measured by using measuring scale, durability of flower in days was recorded by number of days taken from the first flowering to the last flowering in the plant, weight of flower was calculated from the weight of 10 flowers from each replication of the different treatments and the mean value of weight of flower was thus obtained, number of flowers/plant obtained from per bulb lets planted was counted and recorded, number of flowers/plot obtained from per plots bulb lets planted was counted and recorded, number of flowers/hectare obtained from per hectare of bulb lets planted was counted and recorded, Total number of bulb lets/hectare obtained from per bulb planted was counted and recorded.

Whereas Vase life hours was recorded after harvesting of spikes and keeping it in a jar containing tap water, and there hours taken for drying of each flower was recorded from the five tagged plants of each replication and their mean were worked out, physiological loss of weight was calculated at weekly intervals by recording the weight of each flower.

The benefit to cost ratio was worked out by using the following formula

$$\text{Benefit: Cost ratio} = \frac{\text{Gross income (Rs/ha)}}{\text{Cost of cultivation (Rs/ha)}}$$

Results and Discussion

The growth regulators significantly influenced growth parameters, yield and shelf life were presented in Table 1 where the maximum height (45 cm), highest number of leaves per plant (17.67 cm) has been observed in T_3 (GA_3 250 ppm) at 180 days after planting (DAP). The enhancement in the growth characteristics might due to the application of growth promoters that have helped in cell enlargement and cell division. The days taken to first flower bud initiation was recorded minimum (179.33) in treatment T_0 (Control) where as maximum days for flower bud initiation were found in treatment T_0 (Control) this might be due to gibberellins that are quite effective in reducing juvenile period of plants. The maximum flower bud diameter (2.13 cm) has been found in T_3 (GA_3 250 ppm) in both the years of experiment, higher values for quality parameter with GA_3 might be due to more production of food material in leaves due to enhanced physiological activities in turn led to production of bigger sized flowers. The highest stalk length of (44.03 cm) has been observed with treatment T_3 (GA_3 250 ppm) in both the years respectively, this significant increase in the stalk length in GA treatment may be due to the cell elongation and cell division or both. The maximum diameter of flower (4.20 cm) has been observed with treatment T_3 (GA_3 250 ppm) because GA_3 might be responsible for more production of food material in leaves due to enhanced physiological activities in turn led to production of bigger sized flowers and yield parameters, where the maximum durability of flowers (647 days), maximum average weight of flower (9.07 gm), highest number of flowers /plant (4 each), maximum number of flowers / hectare (1.80 lakh each), maximum number of bulb lets/plant (6.87), maximum number of bulb lets/ ha (3.09 lakh) has been recorded under treatment T_3 (GA_3 250 ppm) during both the years of the investigation, the influence in yield characteristics might be due to the availability of desirable food materials and more carbohydrate supply which ultimately leads to the production of optimum plant stature,

increased number of leaves, leaf area and plant spread, which in turn enabled them to produce increased amount of photosynthesis ultimately resulting in accumulation of maximum dry matter which might have promoted flower production and yield as well.

Table 1: Effect of Plant growth regulators on growth parameters, yield and shelf life in Amaryllis lily.

Trt. No.	First flower bud initiation (Days)	Flower bud diameter (cm)	Stalk length	Flower diameter (cm)	Plant height (cm) 180 DAP	No. of leaves / plant (180 DAP)	Weight of flower (g)	No. of flowers per plant	No. of flowers / ha (Lakhs)	No. of bulblets/ plant	No. of bulblet/ ha (Lakhs)	durability of flowers (days)
T_0	179.33	0.60	26.80	2.00	28.47	4.63	4.43	2.17	0.98	2.27	1.02	3.07
T_1	170.17	0.90	35.47	2.90	34.87	8.30	6.43	2.77	1.25	4.37	1.97	4.47
T_2	167.50	1.13	38.67	3.30	37.20	10.79	7.23	3.30	1.49	4.90	2.21	4.93
T_3	148.83	2.13	44.03	4.20	45.00	17.67	9.07	4.00	1.80	6.87	3.09	6.47
T_4	164.50	1.60	40.77	3.60	41.03	13.70	7.80	3.67	1.65	5.50	2.48	5.43
T_5	170.33	0.83	33.57	2.80	34.20	7.63	6.17	2.60	1.17	4.03	1.82	4.33
T_6	168.50	1.03	38.17	3.13	36.63	9.53	6.87	3.00	1.35	4.70	2.12	4.80
T_7	155.00	1.83	41.90	3.93	43.23	15.47	8.47	3.90	1.76	6.10	2.75	5.77
T_8	166.17	1.40	39.80	3.53	39.87	12.70	7.57	3.57	1.61	5.33	2.40	5.13
T_9	175.17	0.77	33.23	2.70	33.70	6.73	5.87	2.37	1.07	3.63	1.64	4.23
T_{10}	169.50	0.97	36.53	2.97	35.83	9.17	6.57	2.87	1.29	4.50	2.03	4.67
T_{11}	157.17	1.67	41.40	3.77	42.17	14.90	8.10	3.77	1.70	5.77	2.60	5.57
T_{12}	167.17	1.27	39.30	3.40	38.33	12.13	7.43	3.40	1.53	5.20	2.34	5.07
F-Test	S	S	S	S	S	S	S	S	S	S	S	S
S.Ed. (±)	0.44	0.05	0.23	0.08	0.26	0.25	0.09	0.16	0.07	0.07	0.03	0.06
C.D.(P=0.05)	0.92	0.10	0.48	0.16	0.53	0.51	0.18	0.33	0.15	0.14	0.06	0.12

Conclusion

Based on the present investigation from two years experimental trial it is concluded that the treatment T_3 (GA_3 250 ppm) is found to be best in terms of growth and yield parameters as well as cost benefit ratio and lowest was recorded in treatment T_0 (Control) in all the growth and yield parameters, In terms of shelf life of flower the longest shelf life (hours) and lowest physiological loss in weight was recorded in treatment T_4 (Benzyl adenine 200 ppm) followed by treatment T_5 (Benzyl adenine 100 ppm + Silver nitrate 100 ppm) and lowest was recorded in T_7 control (water).

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