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Influence of benzyl adenine and gibberellic acid on morphological behaviour of Asiatic lily

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Abstract
An experiment on “Influence of benzyl adenine and gibberellic acid on morphological behaviour of Asiatic lily” was conducted at experimental block (protected condition) in the Department of Floriculture and Landscape Architecture, College of Horticulture, Mudigere (under University of Agricultural and Horticultural Sciences, Shivamogga), during 2019-2020. The experiment comprises of 16 treatments alone and in combinations of benzyl adenine (50, 100 and 150 ppm), gibberellic acid (100,150 and 200 ppm) and control (water soaking) replicated thrice in Randomized Complete Block Design (RCBD). The GA_3 @ 200 ppm exhibited earlier sprouting (6.00 days), maximum sprouting per cent (99.03), plant height (83.13 cm), number of leaves (67.25), leaf length (10.27 cm), leaf breadth (2.51 cm), leaf area (1139.00 cm^2) and leaf area index (3.80). The Basal stem diameter (18.06 mm), chlorophyll-a (1.31 mg/g), chlorophyll-b (0.36 mg/g) and total chlorophyll (1.94 mg/g) recorded maximum in BA @ 150 ppm. While maximum days taken for bulb sprouting (12.12), minimum plant height (36.72 cm), number of leaves (29.33), leaf length (7.11 cm), leaf area (518.33 cm^2) and leaf area index (1.71) recorded in the BA @ 150 ppm.

Keywords: Asiatic lily, Benzyl adenine (BA), Gibberellic acid (GA_3), vegetative parameters and protected condition

Introduction
Lilium is an important geophyte endowed with showy appealing flowers of different colour patterns and durable spikes belongs to the family liliaceae. The lily was known for purity and innocence. It is one of the six important genera of flower bulbs produced worldwide. It can be grown both as a cut flower and a pot plant, the beauty and charm of the blooms can enjoy throughout the year by selecting suitable cultivars. They also make an excellent and through force can be marketed throughout the year. It was originated in the northern hemisphere, many species are native to North America, Asia and Europe, though the lily is worldwide in distribution. The flower stem of lily is long and sturdy with luxuriant foliage and it has longer vase life. Lily requires a well-drained sandy loam soil with a pH of 6.5-7.5, and optimum EC of soil is 0.4-1.4 ds/m for cultivation. It performs better in partial shade and produces quality flowers at an optimum relative humidity of 80-85 per cent. Lily propagated through bulbs, bulblets and bulbils.

The growth regulator GA_3 are mainly involved in breaking dormancy of seeds and other aspects of germination and responsible for the elongation of internode, cell enlargement, flower quality and delay senescence of leaf and flower. The synthetic cytokinin like benzyl adenine play a major function like cell division, counteraction of apical dominance, promotion of chloroplast development and also helps in delay the senescence. The combined use of BA and GA_3 had many advantages concerning the bulbous flower crops in the production of good quality flowers and bulbs.

Material and Methods
The investigation on “Influence of benzyl adenine and gibberellic acid on Morphological behaviour of Asiatic lily" was carried out at experimental block (Protected condition) in the Department of Floriculture and Landscape Architecture, College of Horticulture, Mudigere (under University of Agricultural and Horticultural Sciences, Shivamogga), during 2019-2020.

The experiment was laid out in randomized complete block design with 16 treatments and 3 replications in which the bulbs are soaked in BA (50,100 and 150 ppm), GA_3 (100,150 and 200 ppm) alone and their combinations along with control (water soaking) for 12 hr and it was shade dried for 2 hr and planted with a spacing of 20 cm×15cm under the raised bed. The crop was fertilized with 30 g per m^2 of calcium nitrate, NPK of 20:20:20 g/m^2 in the form of urea, MOP and DAP. The cultural operations like irrigation, weeding, staking and earthing up are done during the experimentation as and when required. The observations are recorded and the data was analysed at CD 5%.

Results and Discussion

The existence of a significant differences with respect to days taken for bulb sprouting and the sprouting per cent of Asiatic lily are represented in Table 1.The bulbs treated with GA_3 @ 200 ppm had sprouted earlier (6.00 days) as compare to other treatments, however it was on par with GA_3 @ 150 ppm, GA_3 @ 100 ppm, BA @ 50 ppm +GA_3 @ 200 ppm and BA @ 50 ppm + GA_3 @ 150 ppm (6.49, 6.89, 8.17 and 8.23 days respectively) and maximum sprouting percent (99.03) are noticed in the treatment GA_3 @ 200 ppm which was on par with GA_3@ 150 ppm (98.00).This might be due to the free gibberellin was active in breaking down the reserve food material by hydrolytic enzymes and resulted in early and maximum sprouting per cent. whereas the BA @ 150 ppm had taken maximum days (12.12) for sprouting and minimum sprouting per cent (89.33) was observed in control might be due to the inhibitory effect of cytokinin at a higher concentration which had delayed the sprouting. The similar results are noticed with Ganesh *et al*. (2013) [7] in Tuberose, Bhosale *et al*. (2014) [4] in Tuberose, Sarkar *et al.* (2014) [17] in gladiolus and Ragini *et al*. (2019) [14] in Asiatic lily.

The bulbs soaked in GA_3@ 200 ppm exhibited maximum plant height (83.13 cm) it might be due to gibberellin in rapid cell division, cell elongation, and enlargement of cells at the intermodal region of the intercalary meristem, which promotes increase in vegetative growth. While the minimum plant height was noticed in the BA @150 ppm (36.72 cm) might be due to the inhibition of cell division and cell elongation at higher concentrations of benzyl adenine and also might be due to antagonistic effect. The similar views observed by Parmar *et al.* (2009) [13] in *Hymenocallis speciosa,* Kumari *et al*. (2018) [9] in Asiatic lily cv. Tresor and Rahman *et al*. (2020) [15] in gladiolus.

The maximum number of leaves recorded (67.25) in GA_3 @ 200 ppm. It may be due to gibberellin, which causes the rapid growth of the plant, in turn increases the photosynthetic rate of the plant by better water and nutrient uptake. In contrast, the minimum number of leaves (29.33) recorded in BA @ 150 ppm might be due to the inhibition of cell division and cell elongation at higher concentrations of benzyl adenine, which reduced the leaf number. The results are in conformity with Mishra *et al.* (2019) [12] in *Amaryllis belladonna* cv. Zepyranthes and Maheshwari and Sivasanjeevi (2019) [10] in Tuberose Cv. Single.

The significant differences were noticed on leaf length among the treatments GA_3 @ 200 ppm showed maximum leaf length (10.27 cm), which was on par with GA_3 @ 150 ppm and GA_3 @ 100 ppm (10.17 and 10.08 cm). It might be due to cell elongation and increases in the number of cells and the cell length contributed by the gibberellic acid led to increase in the leaf length, whereas the minimum length of the leaf (7.11cm) was found in the BA @150 ppm. It may be due to effect of benzyl adenine in counteracting the apical dominance and cell elongation by encouraging the lateral branching instead of axillary growth. The results align with the findings of Sharma *et al*. (2006) [18] in Gladiolus, Manasa *et al*. (2017) [11] in Gladiolus Cv. Summer Sunshine and Rupa *et al*. (2017) [16] in *Polianthes tuberosa.*

The maximum leaf breadth (2.51cm) obtained with GA_3 @ 200 ppm. Whereas the minimum was found in control (1.30 cm). It might be due to the Gibberellin improves the sink strength of actively growing plant parts like immature leaves acts as metabolic sinks which support the growth and development of plant throughout the life cycle of the plant. Similar trends observed in Dogra *et al* (2012) [5] in Gladiolus and Rupa *et al*. (2017) [16] in *Polianthes tuberosa*.

The BA @ 150 ppm had exhibited maximum Basal stem diameter (18.06 mm), however it was on par with BA @ 150 ppm + GA_3 @ 100 ppm, BA @ 100 ppm + GA_3 @ 100 ppm, BA @150 ppm + GA_3 @ 150 ppm, BA @ 50 ppm + GA_3 @ 100 ppm and BA @ 50 ppm + GA_3 @ 200 ppm (18.04, 18.02, 17.29, 16.95 and 16.76 mm, respectively). Whereas minimum was observed in control (10.22 mm). It may be due to the accumulation of maximum carbohydrate reserve, which plays an important role in cell differentiation. The results conform with the EL-Sadek (2018) [6] in Dahlia and Ashwini *et al*. (2019) [3] in Gladiolus.

The results on leaf area are influenced by the different concentrations of benzyl adenine and gibberellic acid on the Asiatic lily. The maximum leaf area (1139.00 cm^2) was obtained in GA_3 @ 200 ppm and the minimum leaf area was recorded in BA @ 150 ppm (518.33 cm^2). This might be due to the growth promotion effect of gibberellin in rapid cell division and elongation of leaves caused the increased leaf area. Whereas the minimum leaf area was found in BA might be due to the reduced number, length and breadth of leaves in the plants are indirectly responsible for decreased leaf area. These results are similar to the work by Parmar *et al.* (2009) [13] in *Hymenocallis speciosa,* Ibrahim (2014) [8] in Freesia, Alpeshkumar *et al.* (2018) [2] in Tuberose and Ragini *et al*. (2019) [14] in Asiatic lily.

The maximum leaf area index obtained in GA_3 @ 200 ppm (3.80) and minimum leaf area index (1.73) was recorded in BA @ 150 ppm. The increased leaf area index in GA_3 treated plants might be due to the vital role of gibberellin in rapid cell division and elongation of leaves, whereas the minimum leaf area index may due to the minimum number of leaves and leaf area as compared to the other treatments. Similar views to the reports of Manasa *et al.* (2017) [11] in Gladiolus Cv. Summer sunshine and Ragini *et al*. (2019) [14] in Asiatic lily

The data regarding the chlorophyll content of leaves are varied significantly are showed in the figure 1. The BA @ 150 ppm showed maximum chlorophyll-a content of leaves (1.31 mg/g), which was on par with all the treatments except the bulbs treated with GA_3 @ 200 ppm (0.97mg/g), while minimum was observed in control (0.64 mg/g). The chlorophyll-b obtained maximum in BA @ 150 ppm (0.63 mg/g) which is on par with all the treatments, while the minimum was observed in control (0.36 mg/g).

The total chlorophyll content obtained maximum in BA @ 150 ppm (1.94 mg/g) which was on par with BA @ 100 ppm and BA @ 50 ppm (1.92 and 1.90 mg/g). while minimum was observed in control (1.00 mg/g). The increased photosynthetic pigment in benzyl adenine is might be due to the slower rate of chlorophyll degradation by delaying the protein breakdown by benzyl adenine. The results are conforming with Ahmed *et al.* (2017) [1] in Tulip and Sirisha and Naik (2017) [19] in Gladiolus indicated in Table 2

Table 1: Influence of benzyl adenine and gibberellic acid on vegetative parameters of Asiatic lily

Treatment No	Treatment details	Days taken for bulb sprouting	Sprouting per cent	Plant height (cm)	Number of leaves	Leaf length (cm)	Leaf breadth (cm)
T_1	BA @ 50 ppm	9.67	94.12	44.12	41.26	8.53	1.96
T_2	BA @ 100 ppm	10.41	94.06	40.05	37.13	8.03	1.81
T_3	BA @ 150 ppm	12.12	92.04	36.72	29.33	7.11	1.64
T_4	GA_3 @ 100 ppm	6.89	97.04	67.05	53.27	10.08	2.12
T_5	GA_3 @ 150 ppm	6.49	98.00	75.22	61.22	10.17	2.32
T_6	GA_3 @ 200 ppm	6.00	99.03	83.13	67.25	10.27	2.51
T_7	BA@ 50 ppm + GA_3 @ 100 ppm	9.03	91.00	61.12	37.31	9.26	2.01
T_8	BA@ 50 ppm + GA_3 @ 150 ppm	8.23	90.83	62.04	39.37	9.27	2.22
T_9	BA @ 50 ppm + GA_3 @ 200 ppm	8.17	93.04	62.13	44.29	9.35	2.26
T_{10}	BA @ 100 ppm + GA_3 @ 100 ppm	9.17	93.00	55.04	33.15	8.63	1.91
T_{11}	BA @ 100 ppm + GA_3 @ 150 ppm	9.13	94.00	57.08	33.36	9.14	1.95
T_{12}	BA@ 100 ppm + GA_3 @ 200 ppm	9.07	95.00	59.11	34.09	9.32	2.00
T_{13}	BA@ 150 ppm + GA_3 @ 100 ppm	10.23	92.00	46.04	30.15	8.02	1.62
T_{14}	BA @ 150 ppm + GA_3 @ 150 ppm	10.17	94.00	48.04	30.49	8.41	1.70
T_{15}	BA@ 150 ppm + GA_3 @ 200 ppm	10.13	96.00	49.08	32.41	8.52	1.82
T_{16}	Control(water soaking)	9.33	89.33	50.08	51.00	7.68	1.30
S.Em+		0.47	0.43	0.10	0.35	0.23	0.06
C.D @ 5%		1.36	1.24	0.29	1.05	0.67	0.18

Table 2: Influence of benzyl adenine and gibberellic acid on vegetative parameters of Asiatic lily

Treatment No	Treatment details	Basal stem diameter (mm)	Leaf area (cm^2)	Leaf area index	Chlorophyll-a (mg/g)	Chlorophyll-b (mg/g)	Total chlorophyll (mg/g)
T_1	BA @ 50 ppm	15.11	540.00	1.80	1.29	0.61	1.90
T_2	BA @ 100 ppm	14.38	589.33	1.96	1.30	0.62	1.92
T_3	BA @ 150 ppm	18.06	518.33	1.73	1.31	0.63	1.94
T_4	GA_3 @ 100 ppm	11.18	974.33	3.25	1.19	0.52	1.71
T_5	GA_3 @ 150 ppm	11.24	1059.13	3.53	1.09	0.41	1.50
T_6	GA_3 @ 200 ppm	12.71	1139.00	3.80	0.97	0.40	1.37
T_7	BA @ 50 ppm + GA_3 @ 100 ppm	16.95	821.50	2.74	1.11	0.51	1.62
T_8	BA@ 50 ppm + GA_3 @ 150 ppm	16.76	848.38	2.83	1.10	0.49	1.59
T_9	BA @ 50 ppm + GA_3 @ 200 ppm	14.16	863.45	2.88	1.07	0.48	1.55
T_{10}	BA @ 100 ppm + GA_3 @ 100 ppm	18.02	806.12	2.69	1.16	0.51	1.67
T_{11}	BA @ 100 ppm + GA_3 @ 150 ppm	15.28	821.54	2.74	1.14	0.55	1.69
T_{12}	BA @ 100 ppm + GA_3 @ 200 ppm	15.03	827.71	2.76	1.13	0.52	1.65
T_{13}	BA@ 150 ppm + GA_3 @ 100 ppm	18.04	746.38	2.49	1.25	0.58	1.83
T_{14}	BA @ 150 ppm + GA_3 @ 150 ppm	17.29	781.67	2.61	1.22	0.57	1.79
T_{15}	BA @ 150 ppm + GA_3 @ 200 ppm	15.14	785.74	2.62	1.16	0.54	1.70
T_{16}	Control (Water soaking)	10.22	826.00	2.75	0.64	0.36	1.00
S. Em+		0.55	0.85	0.016	0.11	0.09	0.019
C.D @ 5%		1.60	2.46	0.045	0.32	0.26	0.056

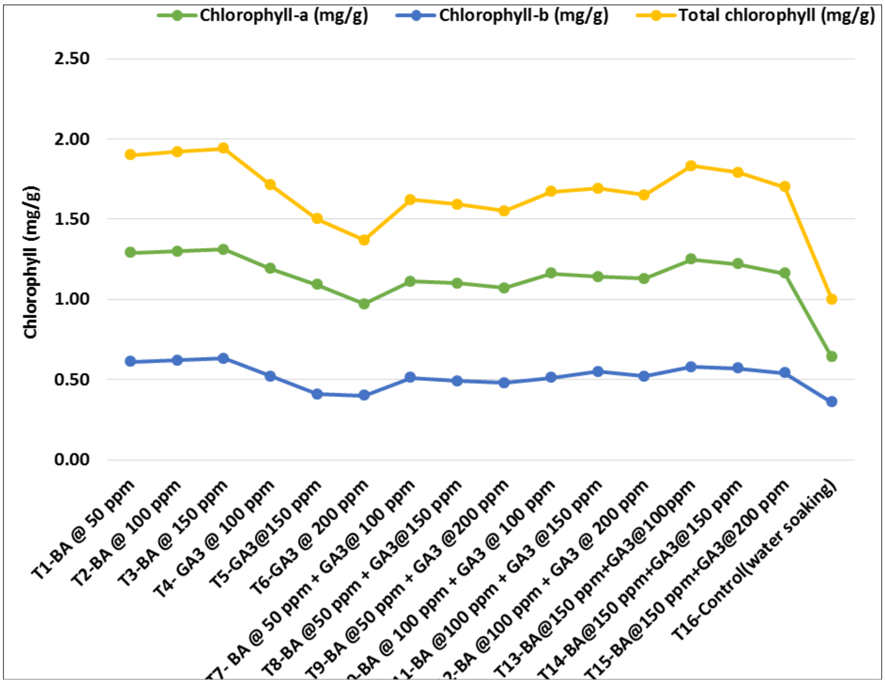

Fig 1: Influence of benzyl adenine and gibberellic acid on chlorophyll content of Asiatic lily

Conclusion
The GA_3 @ 200 ppm showed a significant difference among the treatments and exhibited the better results in related to the vegetative parameters. So for commercial production GA_3 @ 200 ppm can be recommended for achieving the better vegetative growth of the Asiatic lily.

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