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Influence of GA_3 and BA (Benzyladenine) on flowering and post-harvest parameters in lily

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Abstract
An experiment was conducted during year 2014-15 at Banaras Hindu University to find out the effect of gibberellic acid (GA_3) and benzyladenine (BA) on the flowering character and post-harvest life of lily cut flowers. Thirteen treatments *viz*., Single and Double dose of GA_3 100 ppm, GA_3 150 ppm, GA_3 200 ppm, BA 100 ppm, BA 150 ppm, BA 200 ppm and control were replicated three times and laid out in Randomized Block Design (RBD). All the flowering characters and vase life of lily flowers were significantly influenced due to various concentrations of GA_3 and BA. Results revealed that application of Single dose of GA_3 (200 ppm) resulted in maximum number of flower buds per plant and early flowering while plants treated with Single dose of BA 100 ppm had minimum days to colour show of 1st and 3rd bud of lily flower. Maximum diameter and length of pedicle were noted with the application of GA_3 100 ppm at Single and Double dose, respectively. Vase life of cut lilies was maximum with the application of Single dose of BA (100 ppm).

Keywords: lily, GA_3, BA, flowering, vase life

Introduction
Lily (*Lilium longiflorum*), as a member of family Liliaceae, is one of the most important bulbous plant grown for cut flowers, including numerous cultivars of attractive colours and exquisite shapes. Cut lilies are distinguished due to its colourful spathe and attractive texture of petals. Profuse flowering and its longevity determines the flexibility of market, predominantly for cut flowers. Longevity and flowering of cut lilies depend upon the cultivar as well as the suitable growing condition. Apart from this, endogenous hormones play a vital role by regulating physiological process in an appreciable manner which promotes quantitative flowering and helps in extending vase life of cut flowers (Singh *et al*., 2017) [22]. Application of exogenous gibberellic acid (GA_3) acts as a growth promoter as it stimulates the cells in germinating seeds to produce mRNA molecules that code for hydrolytic enzymes. It is a potent hormone whose natural occurrence in plants controls their development as well as improves the quality of produce. Applications of GA_3 in very low concentration have a profound effect. Application of GA_3 has been found beneficial in flowering plants (Singh and Bijimol, 2001, Singh, 2005 and Yadav *et al*., 2014) [20, 24]. The influence of benzyladenine (BA) on flowering varies on the species to species and found beneficial in growth and flowering in calendula and California poppy (Singh, 2003b and Singh, 2005) [17, 19]. Hence, having these ideas as back ground, the present investigation was carried to find out the effect of GA_3 and BA on flowering attributes and post-harvest life in lily.

Materials and Methods
The present investigation "Effect of GA_3 and BA on flowering and post-harvest parameters of lily" was carried out in Horticulture Research Farm, Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi. Thirteen treatments, *viz.*, control, Single and Double dose of GA_3 100 ppm, GA_3 150 ppm, GA_3 200 ppm, BA 100 ppm, BA 150 ppm, and BA 200 ppm were replicated three times in a randomized block design (RBD) during the year of 2014-2015. Varanasi is situated in the Agro climatic Zone-4 (Northern transitional tract) of Uttar Pradesh State and is stretched between 82° 56'E-83° 03'E longitude and 25° 14'N- 25° 23.5'N latitude and at altitude of 76 m above mean sea level. The mean maximum temperature during experiment was 34.9°C (April) and mean minimum temperature was 7.8°C (January) with mean relative humidity 96% (maximum) during the month of January and 33% (minimum) during the month of May (33%). Soil was tested on the basis of availability of essential nutrients and ions for the growth of plant. A homogenous piece of land under protected cultivation was selected from the composite block of Horticulture Research Farm, Department of Horticulture having even topography with adequate irrigation,

tilth and proper drainage facilities. Uniformly sprouted bulbs of lily cv. Novana of uniform size, free from disease and insect infestation were used as planting materials. Bulbs treated with carbendazim were planted in a plot of size 3.0 × 1.5 m and spacing of 30 × 15 cm on 5th of January, 2015. Both GA_3 and BA were applied as foliar spray. First application was given at 30 days after planting of bulbs and second at 45 days after planting to run-off stage. Weeding, earthing up, staking, irrigation and other cultural operations were practiced during the crop growing period. All the parameters of flowering were observed at field condition. Cut stems were harvested and placed into bucket containing water and brought to the laboratory immediately for post-harvest studies. Observations were recorded carefully during the experiment period of post-harvest studies. Flowering parameters including days to open of first and second flower, colour show of first, second and third bud, number and diameter of flower, pedicel length were recorded. Post-harvest parameters including vase life, water uptake were also calculated. Results thus obtained were subjected to statistically analysis.

Results and Discussion

Various concentrations of GA_3 and BA had significant effect on flowering and vase life of lily (Table 1). Single dose of GA_3 at 200 ppm exhibited the maximum number of flower buds per plant which was significant to control and other treatments. Single dose of BA 100 ppm resulted in early colour show of first and third flower buds and exhibited longest vase life. While at double dose, the second bud resulted in early days to colour show which was significant with control and GA_3 100 ppm (single dose) treatment. Higher Single dose of GA_3 (200 ppm) proved effective in early flowering of first flower while BA 150 ppm (Double dose) resulted early flowering in second flower and significant with control and GA_3 100 ppm (Single dose) treatment. GA_3 significantly increased flower diameter of lily as compared to BA. Application of GA_3 200 ppm (Single dose) exhibited maximum number of flowers per plant. Plants treated with GA_3 100 ppm (Double dose) recorded maximum pedicle length. Minimum rachis length was observed with higher dose of BA (200 ppm) at Double dose, resulting stunting growth of pedicle. While, solution uptake by this treatment was not up to the mark. Regardless of the GA_3 concentration, solution uptake was found maximum with the application of BA 200 ppm (Single dose). GA_3 through α-amylase activity, stimulate auxin which results in cell loosening, division and elongation process influencing flowering. Therefore, leaf area increased resulting to more photosynthates and accumulates more carbohydrate in plant body which helps in early flower, bud initiation as well as bud opening, increased number of flowering and flower buds, extending shelf life of flower. The result is also in conformity with those of Pobudkiewicz and Nowak (1992) [12], Nair *et al*. (2002) [8], Dalal *et al*. (2009) [2] in gerbera, Neetu *et al*. (2013 a & b) [9, 10] in gladiolus, Sharma and Singh (2012) [15] in tuberose, Singh and Sharma (2004) [18] in calendula, Singh (2004) [21] in California poppy and Prashanth *et al*. (2006) [13] in floribunda rose cv. Iceberg. However, BA application helps in extending shelf life of flowers by reducing abscission process. Exogenous application of cytokinins reduce respiration rate (Franco and Han, 1997) [5] result in delaying flower senescence (Jaroenkit and Paull, 2003; Padhye *et al*., 2008; Faraji *et al*., 2011) [7, 11, 4] and enhance the vase life of cut flowers. BA improves cell membrane permanency, delays lipid peroxidation in cells and decrease ion leakage which results in increase vase life of cut flowers (Emami *et al*., 2011; Ranwala and Miller, 2000; Gulzar *et al*., 2005 and Asil *et al*., 2011) [3, 14, 6, 1] Present finding is also lent credence with the obserevation made by Singh (2003b) [17] and Singh (2005) [19].

Table 1: The influence of GA_3 and BA on flowering and vase life of lily.

Treatment	No. of flower buds/ plant	Days to colour show of flower			Days to flowering		Diameter of Flower (cm)	Length of pedicle (cm)	No. of flowers/ plant	Solution uptake (ml)	Vase life (days)
		1st bud	2nd bud	3rd bud	1st flower	2nd flower					
Control	3.33	72.00	73.00	72.67	73.00	75.33	14.05	7.30	3.31	56.33	6.33
GA_3 100 ppm (Single dose)	5.00	75.00	73.00	76.00	75.33	77.00	17.92	7.24	3.33	59.67	6.33
GA_3 100 ppm (Double dose)	4.67	71.33	69.00	71.33	71.67	72.67	14.44	10.01	3.67	61.67	5.00
GA_3 150 ppm (Single dose)	5.00	70.33	69.33	71.33	73.33	73.67	13.23	7.22	3.67	63.00	3.67
$GA_3$150 ppm (Double dose)	4.67	70.33	69.33	70.67	70.33	72.00	14.33	6.85	3.67	53.67	6.67
GA_3 200 ppm (Single dose)	6.67	70.33	69.67	69.67	68.00	72.33	15.30	7.04	5.67	62.67	4.33
GA_3 200 ppm (Double dose)	5.00	70.67	69.33	70.67	70.00	72.67	17.17	9.47	4.00	62.00	7.00
BA 100 ppm (Single dose)	4.67	68.00	68.33	69.00	71.00	73.30	15.13	7.25	3.67	51.33	8.00
BA 100 ppm (Double dose)	5.33	69.67	68.00	72.00	71.00	72.67	16.20	9.99	3.67	58.00	4.67
BA 150 ppm (Single dose)	4.67	74.00	70.67	71.33	72.67	74.33	15.33	6.99	3.67	62.00	5.00
BA 150 ppm (Double dose)	4.67	70.33	68.00	72.67	71.83	71.67	15.08	8.05	3.33	58.00	6.33
BA 200 ppm (Single dose)	4.00	71.00	69.00	71.67	71.00	73.00	16.33	7.15	3.67	66.67	7.33
BA 200 ppm (Double dose)	5.00	70.00	69.00	71.00	71.87	73.67	16.21	5.67	3.67	64.67	7.00
C.D. at 5%	1.42	2.10	3.14	3.21	3.35	2.70	1.73	0.72	1.20	8.58	1.72

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