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Gibberellic Acid (GA_3) Mediated Adaptation of Temperate Easter Lily (*Lilium longiflorum*Thunb.) in the Terai Plains of West Bengal

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ABSTRACT

An experiment was conducted to evaluate the Gibberellic acid mediated adaptation of temperate Easter Lily (*Lilium longiflorum*Thunb.) in the Terai plains of West Bengal at Uttar Banga Krishi Viswavidyalaya. Six different concentrations of Gibberellic acid (GA_3)*viz.*, T_2- 50 ppm; T_3- 100 ppm; T_4- 150 ppm; T_5- 200 ppm; T_6- 250 ppmand T_7- 300 ppm were applied to Easter Lily through both as bulb dipping before planting and spraying on the plants at monthly intervals from the date of planting and the effects were compared to control plants - T_1- 0 ppm. The experiment was carried out during the winter season of the year 2021-22 following completely Randomized Block Design, comprising seven treatments replicated thrice. All the parameters except days required to flower bud initiation had shown statistically significant results.Results revealed that application of 300ppm of GA_3 had shown significantly improved effects on plant height (19.37cm), number of leaves per plant (40.93), floret length (16.43cm), floret diameter (15.07cm) and number of florets per inflorescence (7.90) as compared to the control plants. However, GA_3 had no significant role on earliness in flowering of Easter Lily and the plants of all the treatments initiated flower buds more or less at the same time, still, 300ppm GA_3 treated plants required minimum days (113.83). Hence, it may be concluded that application of GA_3 @ 300 ppm improved the quality of Easter Lily blooms in the Terai plains of West Bengal.

Key words : Easter Lily, *Lilium longiflorum*, Gibberellic acid

Introduction

The white flowering bulbous ornamental - *Lilium longiflorum* Thunb. is commonly known as Easter Lily due to its normal flowering during the Easters in spring (Sherratt *et al.*, 1996). Itisa native toRyukyu Islands of Sothern Japan and belongs to the plant family Liliaceae (Okazaki, 1994) which was first introduced to England in 1819 and later to America during 1890s (Compton, 2021). It is also termed as Bermuda Lily (Matsuo, 2012)due to the export of these from the Bermuda Islandsduring 1900s and White Trumpet Lily (Zlesak, 2006) because of its trumpet shaped icy-white florets. Easter Lily possesses large, elegant, snow-white inflorescence that can be used as cut flower, potted plant and / or garden

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ornamental (Fosler, 1958). During 2015,around five million potted Easter Lily plantswere sold in USA, which was valued at $24.31 million (Guo *et al.*, 2019).This crop needs temperate climate and well-drained soils with plenty of Sunlight (Anderson, 2000). The chilling requirement of the crop is 0°C to 10°C before flowering and a temperature range of 15°C to 24°C is required during growing season to encourage flowering (Han, 1997). The natural growing cycle of Easter Lily is associated to the spring season and undergoes dormancy during winter (Zhao *et al.*, 2022). With the increase in the day length and temperature, the lilies start to emerge and flower. Easter Liliesare sensitive to day length and as the days lengthen in the spring over winter that signals the plant from vegetative to flowering phase (Heins *et al.*, 1982). Besides, temperature also plays a crucial role in flowering of this crop and warmer temperature in the spring helps the plant to reach the reproductive phase (Kim *et al.*, 2007).Ubiquitin-proteasome activity was influenced by low temperatures (Xu and Xue, 2019) and DELLA, a flowering repressor protein was degraded by ubiquitin molecules leading to flowering in temperate crops (Xue, 2022).To compensate this chilling requirement, Gibberellic acid, a plant growth hormone can be used to enable flowering in unfavourable growing temperatures (Lin and Agehara, 2020). To adapt a purely temperate bulbous commercial ornamental in a subtropical agroclimatic condition, use of this plant bioregulator can be resorted to (Manimaran *et al.*, 2017). With an eye to this fact, an experiment was conducted to materialise the Gibberellic Acid mediated forcing of temperate Easter Lily into a subtropical climatic condition under the Terai Plains of West Bengal at Uttar Banga Krishi Viswavidyalaya.

Materials and methods

The experiment was conducted at the Instructional Farm of the Department of Floriculture, Medicinal and Aromatic Plants, Faculty of Horticulture, Uttar Banga Krishi Viswavidyalaya, Pundibari, CoochBehar, West Bengal during the period of 2021-2022. The bulbs were collected from Darjeeling Hills of West Bengal and planted during the month of October with a spacing of 50 cm × 30 cm on a plot size of 1m × 1.5 m accommodating 10 plants per plot. Different concentrations of gibberellic acid,*i.e.*, T_{1}- 0 ppm, T_{2}-50 ppm, T_{3}-100 ppm, T_{4}-150 ppm, T_{5}-200 ppm, T_{6}-250 ppm and T_{7}-300 ppm were applied as pre-planting bulb dipping as well as foliar spray at monthly intervalsupto flowering.

Results and discussion

The effect of GA_3 on growth and development of Easter Lily at the Terai region of West Bengal was found statistically significant except the days required for flower bud initiation.Among the different treatments maximum concentration of gibberellic acid, *i.e.*, 300 ppm resulted greater plant height (19.37 cm) while the minimum was noticed in control plants (16.13 cm). One of the notable effects of gibberellic acid is to increase the stem length by stimulating the cell elongation through synthesizing the proteins and enzymes that are involved in cell elongation (Jones and Kaufman, 1983). Maximum number of leaves was found in the plants received 300ppm of GA_3 (40.93), while the minimum was observed in control

plants (30.33). The highest concentration of Gibberellic acid promoted stem elongation, which indirectly affected the leaf arrangement along the stem, as observed by Othman(2023) in Chrysanthemum. The increased internodal length allowed more number of leaves along the stem (Brian, 1959). The data pertaining to days required for flower bud initiation was found statistically non-significant, however, 300ppm of GA_3 initiated the flower bud earliest (113.83 days after planting) and the control plants reached the flower bud initiation stage at the last of all (115.46 days). The response of gibberellic acid is often influenced by the genetic makeup of the plant species and other environmental factors such as light, temperature and humidity (Gupta and Chakrabarty, 2013). Easter lily may require specific environmental cues to respond GA_3 treatment inorder to produce early bud initiation. The length of the floret was found maximum in the 300ppm GA_3 treatment (16.43cm) and the minimum floret length was observed in control plants (12.83cm). Greater floret diameter (15.07cm) and number of florets per inflorescence (7.90) was found in the plants those received 300ppm of GA_3 and the minimum floret diameter (10.43cm) and numberper inflorescence (3.37) were observed in control plants. Gibberellic acid stimulates the activity of apical meristematic region and may lead to production of more floral primordia, which results the formation of a greater number of florets/ flowers of bigger size (Chandler, 2011). Gibberellic acid, upon receiving the receptor protein GID1, makes some confirmational changes on DELLA and leads its degradation through Ubiquitin-proteasome pathway which might have upregulated the expression of flowering genes leading to a greater number of florets per inflorescence (Hauvermale *et al.*, 2012).

Table 1 : Effect of Gibberellic Acid (GA_3) on growth, development and flowering parameter of Easter Lily (*Lilium longiflorum*Thum.) in the Terai plains of West Bengal

Treatments	Plant height (cm)	Number of leaves per plant	Days required for flower bud initiation	Floret length (cm)	Floret diameter (days) inflorescence	Number of florets per
T_1	16.13^{e}	30.33^{e}	115.46^{a}	12.83^{e}	10.43^{d}	3.37^{f}
T_2	16.78^{de}	32.40^{de}	115.11^{a}	13.90^{d}	11.37^{cd}	4.00^{ef}
T_3	17.39^{cd}	35.07^{cd}	114.30^{a}	14.57^{cd}	12.17^{bc}	4.60^{de}
T_4	17.68^{c}	35.87^{bcd}	114.26^{a}	14.70^{bc}	13.60^{ab}	5.30^{cd}
T_5	18.02^{bc}	36.53^{bc}	114.22^{a}	14.90^{bc}	14.10^{a}	5.80^{bc}
T_6	18.66^{ab}	38.93^{ab}	114.00^{a}	15.40^{b}	14.43^{a}	6.70^{b}
T_7	19.37^{a}	40.93^{a}	113.83^{a}	16.43^{a}	15.07^{a}	7.90^{a}
SE(m) ±	*0.232*	*1.087*	*0.637*	*0.233*	*0.54*	*0.331*
C.D at 5%	**0.721**	**3.386**	**NS**	**0.725**	**1.683**	**1.033**

Conclusion

Easter Lily, a temperate bulbous ornamental species, when treated with 300ppm of Gibberellic acid (GA_3)both as pre-planting bulb dipping as well as foliar spray at monthly intervals starting from planting, exhibited better performance in the subtropical Terai plains of West Bengal interms of plant height, number of leaves per plant, floret length, floret diameter and number of florets per inflorescence. But foliar application of Gibberellic acid did not show any significant effect in earliness of flowering or alteration of flowering periodin *Lilium longiflorum*.

a.

a. Collected planting materials of Easter Lily from Darjeeling hills

b.

b. Flower bud initiation stage of Easter Lily at the Terai region of West Bengal

c.

c. Experimental field of Easter Lily at Uttar Banga Krishi Viswavidyalaya, Pundibari, CoochBehar, West Bengal

d.

d. Full-grown plants of Easter Lily when treated with 300ppm GA_3

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