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Gibberellic Acid (GA_3) Mediated Growth and Flowering of Chincherinchee (*Ornithogalum thyrsoides* Jacq.) – A New Ornamental for Crop Diversification in the Plains of West Bengal

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ABSTRACT

A study was conducted to assess the effect of different concentrations of gibberellic acid (GA_3) on the growth, developing, flowering and quality of Chincherinchee (*Ornithogalum thyrsoides* Jacq.). Six different concentrations of GA_3, namely - 50ppm, 100 ppm, 150 ppm, 200 ppm, 250 ppm and 300 ppm were applied to *Ornithogalum* both as bulb dipping as well as spraying on plants at 30 days interval upto the flower spike initiation and the effects were compared to untreated control plants. The experiment was carried out during the winter season of 2021-22, following Randomized Block Design entailing seven treatments replicated thrice. Application of GA_3 @ 300 ppm showed earliness in sprouting of bulbs (14.52 days after planting) and flower spike initiation (83.22 days after planting) and better results were obtained in respects of plant height (12.55 cm), leaf production per plant (31.53), floret length (3.84 cm), floret diameter (33.32 mm) and spike length (32.17 cm) as compared to control plants. A net increase of six days in vase-life was obtained from 300 ppm GA_3 treated plants (18 days) as compared to control plants (12.00 days) rendered the GA_3 treatment towards acclimatization and quality improvement of Chincherincheein the subtropical Terai plains of West Bengal.

Key words : *Ornithogalum*, Gibberellic acid, Chincherinchee

Introduction :

The genus *Ornithogalum* belongs to the plant family Liliaceace and consists of around 80 species which are native to Asia, Africa and Europe - producing orange, yellow or white spikes (Huxley *et al.*, 1992). Chincherinchee (*Ornithogalum thyrsoides* Jacq.) is a tunicated bulbous flowering ornamental of South Africa alternatively known as Wonder Flower or Star-of-Bethlehem, demanded for its white, long-lasting, elegant cut flowers. Besides, this species is also used as potted plant (Slathia *et al.*, 2017) as well as in landscaping (Jensen and Holtzhausen, 1993). Though it has a very good demand in foreign nurseriesand flower arcades (Joshi and Yedidia, 2017), but it is not widely used in India as a landscaping or potted plant. In the hilly region scattered appearance of this plant is noticed but extensive commercial cultivation has not been seen.

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In Darjeeling hills of West Bengal occasional availability of this plant is seen in homestead areas but wide cultivation zone is not observed. But the plant has the ability to be used commercially as a cut flower (Banswal *et al.*, 2015).

Being a freezing temperature tolerant plant, it may suit well to the temperate regions (Meerow*et al.*, 2002). In India it is observed to grow in temperate Himalayas at an altitude of 2000m (Naik and Sanghamitra, 2005). Available volume of research work to assess the performance of this crop in the plains is very meagre. Hence, survivability and quality of flower in the plains of West Bengal have not been studied earlier. Recently, use of Gibberellic acid brought a revolution in floriculture industry which is known to alter the source-sink metabolisms and physiological processes in the plants (Iqbal *et al.*, 2011) thereby imparting attributes like – dormancy breaking, improved vegetative growth, early flowering and ultimately improvement in quality of flower (Emami *et al.*, 2011 and Sure *et al.*, 2012). These potential properties may become helpful for acclimatization and flowering of a temperate ornamental into a sub-tropical plain. Therefore, the present investigation was carried out to know the effect of different concentrations of gibberellic acid as pre-treatment and foliar application at regular intervals on growth, development, flowering and longevity of *Ornithoglum* under open field condition in the sub-tropical plain at Terai region of West Bengal.

Materials and methods :

The experiment was conducted during the Winter season of 2021-22 at the instructional farm of the Department of Floriculture, Medicinal and Aromatic Plants, Uttar Banga Krishi Viswavidyalaya, Pundibari, CoochBehar, West Bengal, following Randomized Block Design, entailing seven treatments (T_1: control, T_2: 50 ppm Gibberellic acid, T_3: 100 ppm Gibberellic acid, T_4: 150 ppm Gibberellic acid, T_5: 200 ppm Gibberellic acid, T_6: 250 ppm Gibberellic acid and T_7: 300 ppm Gibberellic acid) replicated thrice. Plants were spaced at 30 cm × 30 cm consisting of 9 plants per replication of each treatment. Bulbs having diameter of 26.04mm - 26.74mm, height of 18.60mm – 19.60mm and weight of 19.01g – 21.98g, collected from Darjeeling hills of West Bengal were used as planting material. Well sprouted bulbs were treated with Carbendazim 50WP @ 1g/litre of water for 30 minutes as a prophylactic treatment - a week before planting.On the day of planting, the bulbs were soaked in different concentrations of gibberellic acid for six hours and after planting, the plants were sprayed with respective gibberellic acid concentrations at an interval of 30 days upto flowering. The nutrient application schedule was – full FYM + ½ N+ entire P_2O_5+$^1/_2$ K_2O - as basal and the rest ½ N+ ½ K_2O – as top dressing at 30 days after sprouting. Manures and Fertilizers wereapplied as – 15 tonnes of well rotten FYM+120Kg N+100Kg P_2O_5+100KgK_2O/ha. Intercultural operations were done manually and irrigation was given to the plots as and when necessary.

Results and discussion :

The effect of GA_3 on all the ten parameters of Ornithogalum studied here were found statistically significant. The bulbs treated with 300ppm GA_3(T_7)

sprouted earlier (14.52 days after planting) as compared to other treatments, while most delayed (17.86 days after planting) sprouting was observed in the untreated control bulbs (T_1) as well as in 50 ppm GA_3 application (T_2). Earliness in Chincherinchee was attributed significantly with the increase in concentration of GA_3. Occurrence of earliness in sprouting might be due to the suppressing effect of ABA which is responsible for the delayed sprouting (Genge*et al.*, 2007). Gibberellic acid is also known to stimulate the á- amylase activity that catalyses the hydrolyzation of starch into simple sugars there by providing energy to impart early sprouting (Hopkins and Huner, 2004 and Kucera *et al.*, 2005). The foliar application of gibberellic acid had shown significant effect on the plant height of Ornithogalum. The plants treated with 300 ppm of gibberellic acid had recorded maximum plant height (12.55 cm) which was statistically at par with 250ppm (12.27 cm) GA_3 application (T_6). The minimum plant height was noticed in control plants (8.01 cm). The increase in plant height with the increase in the concentration of Gibberellic acid might be due to active cell division in the shoot apical meristem. As Gibberellic acid upsurges the cell division and cell elongation thereby enhancing the cell number and cell length which ultimately results in increased plant height (Sharma *et al.*, 2004, Rana *et al.*, 2005, Bhalla and Kumar 2008, Kumar *et al.*, 2008, Awasthi *et al.*, 2012, Chopde *et al.*, 2012 and Dogra *et al.*, 2012).

Significant difference was also realized in leaf production of Ornithogalum as influenced by Gibberellic acid treatment. The plants treated with highest concentration of gibberellic acid had shown maximum number of leaves (31.53) which was statistically at par with the effects of T_5 (29.47) and T_6 (30.73), whereas the control plants produced the lowest number of leaves (21.47) per plant. Gibberellic acid driven enhanced cell division at the shoot tip and increased cell elongation ultimately reflected in the increase in leaf production of Chincherinchee (Sudhakar and Kumar, 2012 and Rahman *et al.*, 2020). The plants treated with maximum concentration of gibberellic acid disclosed earliness in flower spike initiation (83.22 days after planting) which was statistically at par with the effects of T_6 (85.22 days after planting), while maximum number of days (105.67 days after planting) was taken by control plants to initiate flower spike. Flower bud initiation depends on the C:N ratio within the plant. Earliness in spike initiation as a result of Gibberellic acid application occurred due to dose-dependent rapidity of increased vegetative growth that assisted in accumulation of more photosynthates and ultimately augmented metabolic activities to utilize photosynthates thereby improving the C:N ratio to induce flowering (Devadanam *et al.*, 2007 and Suh *et al.*, 2000). Increasing trend of spike length was also observed with the increase in the gibberellic acid concentration. The plants received highest concentration of gibberellic acid i.e., 300 ppm recorded maximum spike length (32.17 cm) which was around 10 cm longer than the control plants (22.37 cm). Gibberellic acid mediated upsurge in spike length happened due to the increased vegetative growth that helped the accretion of more photosynthates in Chincherinchee, eventually produced larger spikes (Mayoli *et al.*, 2009, Dogra *et al.*, 2012 and Janowska, 2013).

The treatment T_7 had noted maximum floret diameter (33.32 mm) whichwas on par with T_6 (32.38 mm) and the lowermost floret diameter was recorded by the control T_1 (24.61 mm). Amplified cell division with active cell enlargement might be accountable to increased flower diameter with the application of gibberellic acid (Nowak and Mynett., 1985 and Akkalareddy *et al.*, 2018). The length of the floret was varied with the concentration of the gibberellic acid. Maximum floret length was recorded in the plants that received 300 ppm of gibberellic acid (3.84 cm) and least was observed in control plants (2.73 cm). Hastening in cell elongation at higher concentration of Gibberellic acid application finally led to an increase in floret length (Rani and Singh, 2013 and Janowska and Stanecki, 2013) of Chincherinchee. The plants which received highest concentration of gibberellic acid, took least number of days (100.20 days after planting) to develop flower bud and plants which were not treated with gibberellic acid showed the most delayed (111.58 days after planting) effect. The plants which received the highest concentration of gibberellic acid (300 ppm)needed least number of days forfloret opening (110.63 days after planting), while the plants which were not treated with gibberellic acid recorded the most delayed effect (117.02 days after planting). The vase-life studies revealed that the application of gibberellic acid at 300 ppm increased the vase-life of cut spikes of Chincherinchee by 6 days (18.00 days) when compared to the control plants (12.00 days). The shorter vase-life in control was probably due to the presence of reactive oxygen species (Ducic *et al.*, 2003). Gibberellic acid raised the internal production of catalase and superoxide dismutase enzymes those protected the cut spikes from senescence triggered by reactive oxygen species (Ramzan *et al.*, 2014).

Conclusion :

Chincherinchee, a temperate bulbous ornamental when treated with 300 ppm gibberellic acid (GA_3) as bulb dipping as well as spraying at 30 days interval upto the period of flower spike initiation, exhibited better acclimatization in the subtropical Terai plains of West Bengalwhich was reflected in respects of - days required for sprouting, plant height,leaf production,earliness in flowering, spike length, floret length and diameter as well as in vase-life of cut spikes, that created the possibility of cultivation of *Ornithogalum* as a cut flower in the plains of West Bengal.

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Table 1 : Effect of Gibberellic acid on earliness in sprouting, plant height, leaf production, earliness in flower spike initiation and spike length of Chincherinchee

Treatment	Days required for sprouting (days)	Plant Height (cm)	Number of leaves per plant	Days taken to flower initiation (days)	Spike length (cm)
T_1	17.86	8.01	21.47	105.67	22.37
T_2	17.86	9.24	23.87	96.00	23.73
T_3	17.03	10.34	25.80	94.22	25.30
T_4	15.56	11.09	28.13	91.40	25.93
T_5	15.58	11.49	29.47	88.28	26.54
T_6	15.29	12.27	30.73	85.22	26.83
T_7	14.52	12.55	31.53	83.22	32.17
SE(m)±	*0.438*	*0.278*	*0.662*	*1.09*	*0.559*
CD at 5%	**1.366**	**0.868**	**2.064**	**3.396**	**1.743**

Table 2 : Effect of Gibberellic acid on length and diameter of floret, time period requirement for floret development and openingand vase-life of Chincherinchee

Treatment	Diameter of floret (mm)	Length of floret (cm)	Time required for flower bud development (days)	Time required for first flower bud opening (days)	Vase-life (days)
T_1	24.61	2.73	111.58	117.02	12.00
T_2	27.42	3.20	111.20	114.33	13.67
T_3	28.36	3.61	110.13	113.65	14.67
T_4	30.95	3.62	107.75	113.15	15.33
T_5	31.51	3.74	106.67	112.50	16.67
T_6	32.38	3.72	104.75	112.03	17.00
T_7	33.32	3.84	100.20	110.63	18.00
SE(m)±	*1.784*	*0.206*	*1.437*	*0.89*	*0.295*
CD at 5%	**5.559**	**0.64**	**4.477**	**2.63**	**0.921**

Collected bulbs of Chincherinchee

Individual bulb of Chincherinchee

Measurement of diameter of bulbs

Chincherinchee at flowering stage

***Ornithogalum* at full bloom stage**

Vase-life study of Chincherinchee

Sprayingof Gibberellic acid (GA_3)

Figure 1 : Gibberellic Acid (GA_3) Mediated Growth and Flowering of Chincherinchee (*Ornithogalum thyrsoides* Jacq.)