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Effect of GA_3 on Growth and Flowering of Pink Rain Lily (*Zephyranthes rosea* Lindl.) in the Terai Region of West Bengal

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ABSTRACT: The experiment was conducted at the instructional farm of the Department of Floriculture, Medicinal and Aromatic Plants, Uttar Banga Krishi Viswavidyalaya, West Bengal, India, to investigate GA_3 mediated effect on growth and flowering of Pink Rain Lily (*Zephyranthes rosea* Lindl.) under the Terai region of West Bengal. The minor ornamental bulbous plant, Pink Rain Lily which is typically used for landscaping and as a potted plant possesses the problem of bulb dormancy and short field life. The experiment was conducted following Factorial Randomized Block Design with sixteen treatment combinations replicated thrice. Bulb dipping for 6 hours followed by plant spraying of GA_3 at monthly intervals after sprouting at the concentrations of 0ppm, 100ppm, 200ppm and 300ppm were considered as treatment combinations. Results revealed that dipping of bulbs in 300ppm GA_3 solution prior to planting had profound influence on growth and flowering of Pink Rain Lily over the plant spraying. On the other hand, the treatment combination of bulb dipping and foliar spraying with GA_3 300ppm resulted in early bud primordial initiation, maximum plant height, flower field-life, and floral stalk length. Among the different GA_3 concentrations, the higher concentration was found better and dipping of propagating material was found effective over the foliar application.

Key words: Pink Rain Lily, Zephyranthes, GA_3, bulb dipping, foliar spray, plant growth regulator.

INTRODUCTION

Flower, being the object of beauty and compassion, highly consumed non-edible perishable item which shares a major portion in gross horticultural produces. Among the different flowering ornamentals, the Pink Rain Lily (*Zephyranthes rosea* Lindl.) is a genus of hardy bulbous flowering plant belonging to the plant family Amaryllidaceae propagated through true bulbs. The typical pink funnel-shaped flower with six petals (Singh *et al*., 2010) generally appears after the first rain shower in summer which defines its common name as 'Pink Rain Lily'. The individual flowers are upward-facing or slightly drooping solitary on erect hollow stalks. It is widely used as landscaping ornamentals (Katoch and Singh 2015) as well as potted flowering plants (Wylie, 1952). The flowers are aesthetically appealing and sustain in minimal care and management often provides a best choice for landscaping. However the consumer acceptance is questionable due to its short span of flowers up to few days which possibly pushed this plant into the category of minor bulbous ornamental (Rai *et al*., 2022). Thus, to comprehend the fact and find the easy option to enhance the quality of flowers in all possible aspects, the use of plant growth regulator becomes relevant.

GA_3 belongs to the broad group of plant hormones known as GAs (gibberellins), which are diterpenoid carboxylic acids present in higher plants. It has an impact on a variety of developmental processes in plants, including stem elongation, germination, dormancy breaking, flowering, sex expression, enzyme induction, and leaf and flower senescence (Janowska and Schroeter 2002). However, the efficacy of this hormone largely depends on the dose and method of application. Keeping in view, the effect of GA_3 was studied here following both the mode of bulb dipping and spraying in developed plants to resolve this problem.

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 in the year 2018 and 2019. Healthy bulbs of Zephyranthes were collected from Sikkim hills and planted in the month of May. The two methods of GA_3 application were adopted namely dipping (D) of planting materials for 6 hours prior to planting and plant spraying (S) with GA_3 solution at a monthly interval with the concentrations of 0ppm, 100ppm, 200ppm and 300ppm. The concentrations of GA_3 in both the methods implied as factors were same and the interaction between the two factors were the treatment combinations (D×S). The experiment was laid out in Factorial Randomized Block Design with two factors each having four levels replicated thrice. The data of two years has been compiled and expressed in average. The treatment details are given below.

Notation	Treatment
First factor	
D_0	Without dipping of bulbs in gibberellic acid solution
D_1	Dipping of bulbs in 100 ppm GA_3 solution for 6 hours
D_2	Dipping of bulbs in 200 ppm GA_3 solution for 6 hours
D_3	Dipping of bulbs in 300 ppm GA_3 solution for 6 hours
Second factor	
S_0	No spraying of plants with gibberellic acid solution
S_1	Spraying of plants with 100 ppm GA_3 twice at one month interval from the date of planting
S_2	Spraying of plants with 200 ppm GA_3 twice at one month interval from the date of planting
S_3	Spraying of plants with 300 ppm GA_3 twice at one month interval from the date of planting

RESULTS AND DISCUSSION

Days required for sprouting. The effect of bulb dipping in GA_3 solution found statistically significant where the dipping of bulbs in 300ppm GA_3 solution for six hours recorded earliest sprouting (17.17 days after planting) whereas the control bulbs showed the delayed sprouting (19.50 days).

Plant spraying with GA_3 solution was found statistically non-significant. Though, the plant sprayed with 300ppm GA_3 solution recorded early sprouting (17.71 days) as compared to control plants (18.90 days).

The combined effect of dipping of bulbs and plant spraying with GA_3 solution was found statically non-significant, still, early sprouting (16.19 days) was found in treatment combination (D_3S_3) of dipping of bulbs in 300ppm and plant sprayed with 300ppm GA_3 solution whereas, delayed (20.55 days) was observed in control (D_0S_0).

Plant height at the time of bud primordial initiation. The effect of dipping of bulbs in plant height gained was found statically significant where dipping of bulbs in 300ppm GA_3 solution recorded maximum plant height (25.99 cm) against the control plants (24.35 cm).

The result of plant spraying was found statistically non-significant, though the plant sprayed with 300ppm GA_3 solution recorded greater height (25.79 cm) as compared to control plants (25.26 cm).

The combined effect was found non-significant in which maximum plant height (26.66 cm) was found in treatment combination of dipping of bulbs and plant sprayed with 300ppm GA_3 solution (D_3S_3) and the minimum (23.71 cm) was recorded in control (D_0S_0).

Number of leaves per plant at bud emergence. The number of leaves at bud emergence was statistically non-significant. The maximum number of leaves (2.72) was found in dipping of bulbs in 300ppm GA_3 solution and the minimum (2.28) was recorded in control plants.

Similarly, plant spraying also found non-significant in which control plants recorded maximum number of leaves (2.67) and lowest (2.45) was found in plant sprayed with 300ppm GA_3 solution.

The interaction effect was found non-significant in which maximum number of leaves (3.01) was found in treatment combination of dipping of bulbs in 300ppm GA_3 solution and plant sprayed with 200ppm GA_3 solution (D_3S_2) whereas the minimum (2.18) was recorded in treatment combination of dipping of bulbs in distilled water and plant sprayed with 100ppm GA_3 solution (D_0S_1).

Days taken to bud primordial initiation. The effect of dipping of bulbs on floral primordial initiation was significant as dipping of bulb in 300ppm GA_3 solution showed earliest bud primordial initiation (24.91 days) whereas delayed (27.97 days) bud primordial initiation was seen in control plants.

Similarly, result was significant with plant spraying too in which early bud primordial initiation (24.71 days) was accomplished to plant spraying with 300ppm GA_3 solution and delayed (27.75 days) was noticed in control.

The combined effect was observed statistically non-significant in which treatment combination of dipping of bulbs and plant sprayed with 300ppm GA_3 solution (D_3S_3) showed early bud primordial initiation (23.56 days), on the other hand, control (D_0S_0) plants showed the most delayed (29.99 days) effect.

Field-life of flower (Days). The effect of dipping of bulbs in GA_3 solution on field-life of flower was found significant in which the maximum field-life of flower (2.42 days) was found with 300ppm GA_3 solution and the control plants recorded the minimum (1.85 days) field-life.

The plant spraying with GA_3 solution was also found significant where the maximum field-life of flower (2.98 days) was recorded with 300ppm GA_3 solution

whereas the minimum (1.62 days) was observed in control plants.

The combined effect was also found significant. The maximum field-life of flower (3.44 days) was recorded in treatment combination of dipping of bulbs as well as plant sprayed with 300ppm GA_3 solution (D_3S_3) and the minimum (1.38 days) was recorded in control (D_0S_0) plants.

Spike length (cm). The effect of dipping of bulbs on spike length was found statistically significant and the maximum spike length (27.61 cm) was recorded in dipping of bulbs in 300ppm GA_3 solution whereas minimum spike length (25.20 cm) was observed in control plants.

The effect of plant spraying on spike length was recorded statically non-significant, where the maximum spike length (26.66 cm) was recorded in plant sprayed with 200ppm GA_3 solution and the minimum spike length (26.13 cm) was recorded in plants sprayed with 100ppm.

The combined effect was recorded non-significant in which maximum spike length (27.76 cm) was recorded in treatment combination of dipping of bulbs and plant sprayed with 300ppm GA_3 solution (D_3S_3) whereas the minimum spike length (25.01 cm) was recorded in treatment combination of dipping of bulbs in distilled water and plant sprayed with 100ppm GA_3 solution (D_0S_1).

Anthocyanin (mg/g). Dipping of bulbs in GA_3 solution was found significant in enhancing anthocyanin content where the maximum was (1.13 mg/g) was recorded in dipping of bulbs in 300ppm GA_3 solution which was found statically at par with dipping of bulbs in 200ppm (1.07 mg/g) and 100ppm GA_3 solution (1.03 mg/g), while the minimum anthocyanin content (0.86 mg/g) was recorded in control plants.

The effect of plant spraying was found non-significant though, the maximum petal anthocyanin content (1.08 mg/g) was recorded in plant spraying with 300ppm GA_3 solution ant the minimum anthocyanin content (0.92 mg/g) was recorded in control plants.

Similarly, the interaction effect of dipping of bulbs and spraying was found statistically non-significant where dipping of bulbs as well as plant sprayed with 300ppm GA_3 solution (D_3S_3) recorded maximum anthocyanin content (1.24 mg/g), on the other hand, minimum anthocyanin content (0.76 mg/g) was noticed in control (D_0S_0).

Table 1: Effect of GA_3 on growth, development and flower quality of Pink Rain Lily (*Zephyranthes rosea* Lindl.).

Factors	Days require for sprouting	Plant height (cm)	No. of leaves at bud emergence	Bud primordial initiation (Days)	Field life of flower (Days)	Stalk length (cm)	Anthocyanin (mg/g)
D_0	19.50^{b}	24.35^{a}	2.28^{a}	27.97^{b}	1.85^{a}	25.20^{a}	0.86^{a}
D_1	18.17^{ab}	25.76^{b}	2.57^{a}	26.56^{ab}	1.89^{a}	25.93^{ab}	1.03^{b}
D_2	18.42^{ab}	25.9^{b}	2.58^{a}	25.43^{a}	1.93^{a}	26.93^{bc}	1.06^{b}
D_3	17.17^{a}	25.99^{b}	2.7^{a}	24.91^{a}	2.42^{b}	27.61^{c}	1.13^{b}
SEm±	0.52	0.40	0.20	0.72	0.07	0.40	0.05
CD	1.50	1.15	NS	2.08	0.20	1.16	0.15
S_0	18.90^{a}	25.26^{a}	2.67^{a}	27.75^{b}	1.62^{a}	26.23^{a}	0.92^{a}
S_1	18.11^{a}	25.59^{a}	2.50^{a}	26.52^{ab}	1.80^{a}	26.13^{a}	1.04^{ab}
S_2	18.54^{a}	25.45^{a}	2.55^{a}	25.90^{ab}	1.68^{a}	26.66^{a}	1.03^{ab}
S_3	17.71^{a}	25.79^{a}	2.45^{a}	24.71^{a}	2.98^{b}	26.64^{a}	1.08^{b}
SEm±	0.52	0.40	0.20	0.72	0.07	0.40	0.05
CD	NS	NS	NS	2.08	0.20	NS	NS
Treatment combination							
D_0S_0	20.55	23.71	2.41	29.99	1.38	25.47	0.76
D_0S_1	19.19	24.66	2.18	29.12	1.56	25.01	0.93
D_0S_2	19.37	24.51	2.26	27.23	1.44	25.08	0.91
D_0S_3	18.88	24.53	2.29	25.55	3.17	25.22	0.85
D_1S_0	18.22	26.14	2.83	28.64	1.49	25.17	1.01
D_1S_1	17.94	25.99	2.36	26.78	1.73	25.76	1.02
D_1S_2	18.93	25.15	2.63	25.78	1.71	26.96	1.05
D_1S_3	17.58	25.75	2.47	25.05	2.49	25.83	1.04
D_2S_0	18.75	25.73	2.91	25.78	1.51	26.75	0.79
D_2S_1	18.09	25.69	2.84	24.76	1.63	26.33	1.19
D_2S_2	18.67	26.32	2.29	26.49	1.73	26.92	1.05
D_2S_3	18.17	26.22	2.28	24.69	2.80	27.75	1.21
D_3S_0	18.09	25.45	2.52	26.58	2.83	27.55	1.14
D_3S_1	17.22	26.03	2.63	25.40	1.57	27.43	1.02
D_3S_2	17.19	25.81	3.01	24.11	1.84	27.70	1.12
D_3S_3	16.19	26.66	2.74	23.56	3.44	27.76	1.24
SEm±	1.04	0.79	0.40	1.44	0.14	0.80	0.10
CD	NS	NS	NS	NS	0.40	NS	NS

In this study the higher concentration of GA_3 solution in both the factors as well as in treatment combination showed pronounced effect on all the parameters studied. The effect of the individual factors was significant in most of the cases. The findings of Asil *et al*. (2011) in Tuberose also showed the similar trend. However, the interaction effect was not significantly varied though, the interaction of higher concentration of GA_3 showed positive effect when compared to the control. Among the two factors as the method of application - the dipping of bulbs found more radical than the plant spraying. The dipping of bulbs in GA_3 hastened sprouting which might be due to increased rate of hydrolysis of stored sugar initiated by higher activity of α-amylase and suppression of abscisic acid during dormant state, Sato *et al.* (2006). The increased plant height and length of flower stalk as compared to control plants was also reported in Hippeastrum by Jamil *et al*. (2015); Pushpa *et al*. (2022) in Lupin. Due to increase in auxin activities causing rapid cell division and cell elongation observed by Akshitha *et al.* (2022); Sharma *et al.* (2001) under the influence of GA_3 application might be the propping factors. Singh and Shanker (2011) also reported similar result in tuberose with highest concentration of 300 ppm of GA_3. The effect of GA_3 on early primordial initiation was also varied significantly as compared to control plants which were also reported in Tulip, Khan *et al*., (2007). This might be due to early cell differentiation and early utilization of nutrients and *vice versa*. Higher concentration of GA_3 might shorten the vegetative period and hasten the initiation of flowering. Similar result was found in Tulip, Kumar *et al*. (2013); Taha (2012). The field-life of individual flower was varied significantly, as GA_3 aids in the continual supply of photosynthetic assimilate to sink areas for longer period, Dalal *et al*. (2009) also recorded the similar trend in Gerbera when sprayed with GA_3.

Apart from the phenotypic expression, the anthocyanin content was also found increasing with an increase in GA_3 concentration that corroborated with the findings in Hybrid lily, Taheri *et al*. (2014). The main reason behind increasing the anthocyanin content might be due to the enhanced biosynthesis of phenylalanine ammonia layase (PAL) mobilized by GA_3 which is the rate-limiting enzyme gene in anthocyanin synthesis and accumulation, Liang *et al*. (2014).

CONCLUSIONS

In the present study, the effect of GA_3 was found reinforcing in enhancing the overall quality in studied minor bulbous ornamental. The dipping of bulbs alone in 300ppm GA_3 solution for 6 hours found more effective than plant spraying and combination of both.

FUTURE SCOPE

Future research with various plant growth regulators is required to examine the effects of combining effect of various plant growth regulators on the development and flowering of Pink Rain Lily.

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Conflict of Interest. None.

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