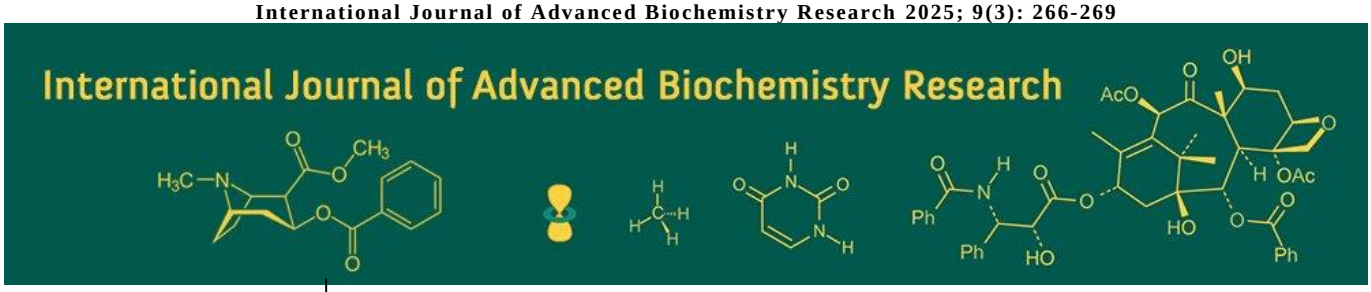

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Influence of plant growth regulators on flowering, pod and seed set, seed yield and seed quality in glory lily (*Gloriosa superba* L)

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Abstract
An experiment was conducted at Botanic Garden, Department of Seed Science and Technology, Tamil Nadu Agricultural University, Coimbatore. To study the effect of plant growth regulators on growth and yield of glory lily (*Gloriosa superba* L). Among different plant growth regulators applied spray of GA_3 @ 100 ppm at 10th and 20th days after anthesis recorded increased plant growth, number of pods plant^{-1} (39), pod set percentage (94%), maximum pod yield per plant (291.87 g), maximum seed yield per plant (193.80 g), accompanied with the maximum seed germination (52%), dry matter production (189.0 mg) and vigour index (1321). Our data show that GA_3 @ 100 ppm at 10th and 20th days after anthesis enhanced seed yield and quality compared to control.

Keywords: *Gloriosa superba,* GA_3 @ 100 ppm, pod and seed set, seed yield and quality

Introduction
Gloriosa superba L. belonging to the family Liliaceae commonly known as glory lily, superb lily, tiger lily or tiger claws, is an important medicinal plant of the Tropics (Singaravel, 2022) [15]. The glory lily is native to both Asia and Africa. *Gloriosa* was found in the wild natural fences a decade back, but now domesticated for economic gain since all parts of the plant find a diverse usage in Indian system of medicine. The plants possess an underground storage organ, the tuber, which is traditionally used as anthelmintic, abortifacient, anti-inflammatory, antipyretic and antileprotic. It is considered useful in treating colic, chronic ulcer and piles. The white starchy powder obtained by repeated grinding and washing of tuber is used for treating gonorrhoea. Tulika and Pallavi (2020) [17] stated that major problems in the cultivation of glory lily were improper pod and seed set, resulting in the lose of produce. Being an important medicinal plant with high demand, few studies were conducted on production aspects only. Besides agronomics practices, growth regulators have been reported to modify various physiological process and are being used for increasing the fruit set, yield and quality of various crops. Hence, the present investigation was carried out to study the influence of plant growth regulators on flowering, pod and seed set, seed yield and quality of glory lily.

Materials and Methods
The experiment was carried out in the Botanic Garden, Department of Seed Science and Technology, Tamil Nadu Agricultural University, Coimbatore. The experiment comprises of 9 treatments laid out in a randomized design with four replications. The treatment included GA_3 (100, 200 ppm), $ZnSO_4$ (0.1, 0.2%), GA_3 + $ZnSO_4$ (100 ppm + 0.1%, 200 ppm + 0.1%, 100 ppm + 0.2%, 200 ppm + 0.2%) along with a control. The required quantity of plant growth regulators were prepared and applied 10th and 20th days after pollination. The growth observations were recorded in ten plants randomly selected in each replication and the following observations were made on flowering, pod and seed yield and seedling quality characters.

Flowering characters

Days to first flowering

The number of days taken from planting to first flowering in each treatment plot was recorded and expressed as days.

Days to 50 percent flowering

The number of days taken from planting to flowering of 50 percent of the plants in each treatment plot was recorded and expressed as days.

Number of flowers plant^{-1}

The number of flowers per plant produced from initial flowering to complete flowering in a plant was recorded in randomly selected ten plants in each treatment and the mean value was expressed in number.

Pod characters

Number of pods plant^{-1}

The number of pods per plant harvested from randomly selected ten plants in each treatment, replication wise was recorded and the mean value was expressed in number.

Pod set percentage

Number of pods set in each treatment, replication wise were recorded and the pod set percentage was worked out as follows

$$\text{Pod set percentage} = \frac{\text{Number of pods plant}^{-1}}{\text{Number of flowers plant}^{-1}} \times 100$$

Pod yield plant^{-1}

Pods harvested from the randomly selected ten plants in each treatment plot, replication wise were dried uniformly and weighed. The mean value was recorded and expressed as gram plant^{-1}.

Seed yield plant^{-1}

Seeds separated from the pods harvested from randomly selected ten plants in each treatment plot, replication wise were dried and cleaned. The weight was recorded and the mean value was expressed as gram plant^{-1}.

Seedling quality characters

Seed germination (ISTA, 2010) [8]

Immediately after extraction of seeds from pod at harvest, the germination test was conducted by roll towel method in four replications of 100 seeds each and placed in germination room maintained at 25±2 °C temperature and 95±2% relative humidity. After 30 days, the seedlings were evaluated and the normal seedlings were counted and expressed in percentage.

Dry matter production

Ten normal seedlings used for linear measurements were dried at first in shade and then dried in a hot air oven maintained at 105±2 °C for 17 h, then cooled in desiccators, weighed and expressed in milligram 10 seedling^{-1}.

Vigour index (Abdul-Baki and Anderson, 1973) [2]

The vigour index was calculated using the following formula and expressed as whole number.

Vigour index = Germination (%) x Mean length of the seedling (cm)

The statistical design adopted for laboratory experiments were completely randomized block design. The data gathered for each of the above parameters were subjected to analysis of variance and tested for significance as per Panse and Sukhatme (1999) [10] and the percentage values were transformed to arcsine values prior to statistical analysis.

Results and Discussion

The plants which are used for medicinal purposes should not have any residue of chemicals otherwise they become more of poisoness than a medicine. Moreover, the medicinal plants have several active ingredients and growing them with any residues may alter (or) deteriorate their quality. With this in view, the current study was focused on foliar application to improve plant growth parameters, yield and quality of seeds.

In the present study, the days to 50 percent flowering were minimum when the plants are sprayed with GA_3 in glory lily (Table 1). This might be due to the early production of florigine in GA_3 sprayed plants, as GA_3 is a component of florigine which required for induction of flowers in the plant system as reported by Katkar *et al.* (2005) [9]. Similar findings were also reported by Reddy and Sulladmath (1983) [13] in China aster that GA_3 application @ 200 ppm has advanced the flowering. Ramesh *et al.* (2001) [12] found that foliar spray of GA_3 100 ppm reduced the number of days to 50 percent flowering in China aster.

In this study, the maximum number of flowers (41.6), maximum number of pods per plant (39.0) and pod set percentage (94%) were recorded due to the foliar spray of 100 ppm GA_3 (Table 1 and 2). It may be due to the production of growth hormones with in the pollen is the immediate cause of pod set, it appears that the adequate quantities of growth hormones may be induced formation of sufficient hormones with in the pollen thus resultings in increased pod set (Samruddhi *et al*, 2023) [14]. Similar results were also reported by Katkar *et al*. (2005) [9] in China aster and Srivastava and Srivastava, (2007) [16] in *Catharanthus roseus*. 200 ppm GA_3 three weeks after transplanting for increased cauliflower seed production with the highest return and benefit-cost ratio in cauliflower (Prodhan *et al*. 2022) [11]

Corresponding to the increase in yield, pod yield per plant (291.87 g) and seed yield per plant (193.87 g) were also maximum in GA_3 sprayed plots (Table 2). Increase in yield was mainly due to the increase of flowers, number of pods, fruit set percentage. Similar findings in yield increase due to GA_3 application was also reported in okra and tomato. (Ayyub *et al*., 2013) [4].

The seed quality parameter such as, seed germination (52%), dry matter production (189 mg) and vigour index (1321) were also maximum due to foliar spray of 100 ppm GA_3 and 100 ppm GA_3 + 0.2% $ZnSO_4$ (Table 3). The enhancement of germination, due to GA_3 application might be due to the favourable physiological mechanisam trigged by the GA_3 (Azizi Kh *et al*. 2012) [5]. Similar results were also reported by Andrew and Savigny, (2004) [3], Greedly *et al*., (2005) [6], Ilias *et al*. (2007) [7] and Abdel-Mouty and El-Greadly, (2008) [1].

Table 1: Effect of plant growth regulators on flowering and pod quality in glory lily

Treatments	Days to first flowering	Days to 50% flowering	Number of flowers plant^{-1}	Number of pods plant^{-1}
Control (water spray)	50.0	58.3	29.5	23.4
100 ppm GA_3.	46.8	50.7	41.6	39.0
200 ppm GA_3	47.3	52.6	35.8	30.4
0.1% $ZnSO_4$.	48.7	52.7	30.8	24.9
0.2% $ZnSO_4$.	49.0	55.3	32.7	26.9
100 ppm GA_3 + 0.1% $ZnSO_4$.	49.3	55.7	39.3	36.0
200 ppm GA_3 + 0.1% $ZnSO_4$.	49.0	54.3	35.5	31.5
100 ppm GA_3 + 0.2% $ZnSO_4$.	48.7	53.3	38.2	34.3
200 ppm GA_3 + 0.2% $ZnSO_4$.	49.0	55.6	36.8	31.8
Mean	48.64	54.27	35.58	30.91
SEd	1.567	1.791	1.123	0.971
CD (P=0.05)	NS	3.797	2.382	2.060

Table 2: Effect of plant growth regulators on pod set, pod yield and seed yield in glory lily

Treatments	Pod set percentage	Pod yield plant^{-1} (g)	Seed yield plant^{-1}(g)
Control (water spray)	79 (62.72)	138.44	82.51
100 ppm GA_3.	94 (75.82)	291.87	193.80
200 ppm GA_3	85 (67.21)	239.72	146.06
0.1% $ZnSO_4$.	81 (64.15)	199.42	124.84
0.2% $ZnSO_4$.	82 (64.89)	181.14	109.08
100 ppm GA_3 + 0.1% $ZnSO_4$.	92 (73.57)	259.96	161.56
200 ppm GA_3 + 0.1% $ZnSO_4$.	89 (70.63)	210.14	131.61
100 ppm GA_3 + 0.2% $ZnSO_4$.	90 (71.56)	199.42	127.85
200 ppm GA_3 + 0.2% $ZnSO_4$.	86 (68.02)	196.93	126.98
Mean	86.44 (68.39)	213.00	133.81
SEd	2.748	6.546	4.103
CD (P=0.05)	5.826	13.877	8.698

Table 3: Effect of foliar spray on seed germination, dry matter production and vigour index in glory lily

Treatments	Germination (%)	Dry matter production (mg seedlings-^{10})	Vigour index
Control (water spray)	40 (39.23)	167	940
100 ppm GA_3.	52 (46.14)	189	1321
200 ppm GA_3	42 (40.39)	174	1145
0.1% $ZnSO_4$.	40 (39.23)	176	1075
0.2% $ZnSO_4$.	42 (40.39)	186	1159
100 ppm GA_3 + 0.1% $ZnSO_4$.	43 (40.97)	169	1132
200 ppm GA_3 + 0.1% $ZnSO_4$.	42 (40.39)	184	1154
100 ppm GA_3 + 0.2% $ZnSO_4$.	50 (45.00)	177	1265
200 ppm GA_3 + 0.2% $ZnSO_4$.	49 (44.42)	181	1220
Mean	44.44 (41.80)	178	1076
SEd	0.775	5.263	68.920
CD (P=0.05)	1.630	11.0581	146.106

Figures in parentheses indicate transformed (arcsine) values

Conclusion

The results of the above study revealed that the foliar application of 100 ppm GA_3 at 10th and 20th days after anthesis was significantly increased the flowering, pod and seed yield and seed quality parameters in glory lily.

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