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# Effect of pre plant soaking of corms in growth regulators on sprouting, vegetative growth and corm formation in Gladiolus (*Gladiolus grandiflorus* L.)

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**Abstract**
Field experiments was carried out at Horticulture Research Farm, Department of Horticulture**,** Naini Agricultural Institute, Sam Higginbottom University of agriculture Technology and sciences Allahabad during November 2016 to April 2017 to study the effect of different concentrations of plant growth regulators on different varieties of gladiolus. Treatment consisted of $GA_3$ @ 200 ppm and 300 ppm, BA @ 250 ppm and 300 ppm along with control on three varieties of Gladiolus viz., Deepest Red, Jessica and Estabonita. Experiment was laid-out in a Factorial Randomized Block Design and with three replications. The results revealed that various growth, flowering and corm characters were significantly affected with the application of different growth regulators at different concentrations. Earliness in corm sprouting, maximum vegetative growth observed with $GA_3$ 200 ppm. Maximum number of shoots per corm was recorded by Benzyl Adenine (BA) @ 300 ppm with variety Jessica. BA was responsible for multiple sprouting which was responsible for formation of multiple corms.

**Keywords**: Gladiolus, $GA_3$, BA

## Introduction
Bulbous flowers have become integral part of commercial floriculture. Gladiolus *(Gladiolus grandiflorus L.)* the queen of bulbous flowers (family Iridaceae) with its long flower spikes having rich variations of colours and long vase life, has ever increasing demand in the flower markets This crop possesses a great export potential to European countries especially during winter. Gladiolus a native of South Africa.

Gladiolus is monocotyledonous flowering bulbous plant. The flowers open from bottom to upwards. The flowers may be frilly, ruffled or plain, solid coloured or multi-coloured and they come in every shade and colour combination imaginable. It is largest genus in the family iridaceae and subfamily Ixoidae with 260 species, Since garden varieties of today come from diverse genetic parentage that are heteroploids ranging from 2n=30 to 180 and hypo aneuploids so the reproduction by seeds in this case has no meaning to maintain the varietal identity, but for evolution of new forms normal plant growth and development are regulated by naturally produced chemicals or phytohormones. Their role can often be substituted by application of synthetic growth regulating chemicals. Many studies have indicated that the application of growth regulators can affect the growth and development of gladiolus flowers (Chopde *et al*., 2011) [6]. Growth, flowering and yield can be improved by the use of plant growth regulators (PGRs), however for quality flower production, time of application and concentration of growth regulating chemicals are of outmost importance. Otherwise, it will lead to an undesirable effect. Plant growth regulators improve the quality and production of many cut flowers.

Gibberellic acid and cytokinins are used in the cultivation of ornamental plants in order to accelerate the flowering, increase the flower yield and improve flower quality. Gibberellins is known to exhibit dramatic effect to cause flowering in large number of plants belonging to diverse response types under conditions in which this plants would otherwise remain indefinitely vegetative. In case of bulbous ornamental plants, gibberellins stimulate the height of the plant, length of flower stalk, flower size, duration of flowering, induce early flowering, increase the number of roots, corm size, weight, including more cormel production and also lengthening the life of the spike to a significant extent.

Benzyl adenine is a growth regulator reported to be useful for enhancing sprouting, increasing sprout plant-1 and thereby yield of corms. Any attempt made to increase cut flower production in the region will help the florists and consumers to get fresh and quality cut flowers regularly but, it is very important to determine the effectiveness of various

concentration of growth regulating chemicals for its best effect on growth and flowering and also to increase the reserve food material to enhance the shelf life of the flower after harvest, which will certainly be of great benefit to the commercial growers.

## Materials and Methods

A field experiment was carried out at the Farm, Department of Horticulture, Sam Higginbottom University of Agriculture, Science and Technolgy Allahabad (U.P) -211007 during the year of 2016-17 to study the effect of $GA_3$ and BA treatments on sprouting, vegetative and flowering. The experiment site is close to the tropic of cancer situated at a latitude of 25˚ 45˙ North 81˚85' East longitude and at altitude of 98 meters above mean sea level (MSL). it experiences sub tropical climate. During summers weather can be as hot as 46˚- 48˚C and humid too. Nights are relatively cooler and temperature dips to the range of 30°C. Monsoon come in late June to early July. On the other hand winter is characterized by extremely cold winter. The minimum temperature of the location reaches up to 1°C. The relative humidity ranges between 20 to 94 percent. The average rainfalls in this area are around 900 mm annually. The experiment was laid out in Factorial randomized block design with three replications and fifteen treatment combinations. The 1st factor was different doses of growth regulators *Viz* $GA_3$ @ 200 ppm and 300 ppm and water for control and 2nd factor was different varieties *Viz* Deepest Red, Jessica and Estabinita. Before conduct of the research work, soil samples from various blocks of the experimental field were collected to assess its physico-chemical properties. Soil of the experimental site was in nature with (pH 7.4), 0.60% organic matter, and electrical conductivity 0.262 was $dS \cdot m^{-1}$. Similarly, soil nitrogen (N), phosphorous (P), and potassium (K) were 212.56 mg $kg^{-1}$, 28.3 $mg \cdot kg^{-1}$and 262.4 $mg \cdot kg^{-1}$.

The experiment material was obtained from a private nursery named Sheel biotech which is situated in Delhi. Corms were of uniform but relatively small in size and they were the rested corms of six months. The experimental area was cleaned first and tilled three to four times thoroughly followed by clod breaking, levelling, and layout was prepared manually. The rested, cold stored, uniform and uniform size gladiolus corms were selected and placed at room temperature for 7 days and soaked at different doses of growth regulators and water for control for 24 hours. The treated corms were planted at a spacing of 30 cm x 20 cm at a depth of 5-6 cm in the month of October. Fertilizers were applied at two split doses 1st at the time of land preparation 2nd at the time of spike emergence N in the form of Urea, P in the form of Single Super Phosphate (SSP) and K in the form of Muriate of Potash (MOP) were applied at uniform dose to all plots and incorporated well with the soil during application. During the period of experimentation all the recommended cultural practices were followed. Data on various parameters of morphology, phenology and yield attributes were recorded and analyzed statistically.

## Results and Discussion

### Number of days for sprouting

The data presented in Table 1 showd significant effect of growth regulators on the number of days. Minimum number of days for sprouting was recorded for $GA_3$ @ 200 ppm, variety Jessica and the interaction of $GA_3$ @ 200 ppm with the variety Jessica was most suitable. Minimum number of days was (6.2) was recorded in $GA_3$ @ 200 ppm with variety Jessica followed by ($T_6$) for Jessica control. The number of days was found to be maximum (16.8) in BA @ 300 ppm with the variety Deepest Red. An increase in growth parameters with the application of $GA_3$ @ 200 ppm might have been resulted due to promotory action of gibberellic acid on dormancy of gladiolus corms and an enhanced cell division in shoot tip and cell elongation. These results can be correlated with the findings of Quyoom (2011) [13] and Sudhakar and Rameshkumar (2012) [19] in gladiolus, Days for sprouting of gladiolus corms was significantly influenced by variety of gladiolus, growth regulator and its different dose and interaction between variety and growth regulator.

### Plant Height (Cm)

The results of the present experiment revealed that the plant growth regulators showed significant effect on the plant height at all stages of growth is presented in Table 1.The maximum plant height was recorded for $GA_3$ @ 200 ppm, variety Deepest Red and the interaction of $GA_3$ @ 200 ppm with variety Deepest Red. Maximum plant height(92.8cm) after 90 days was recorded for the interaction of $GA_3$ @ 200 ppm with variety Deepest Red followed by ($T_3$) for deepest red treated with 300 ppm of $GA_3$. The plant height after 90 days was found to be minimum (67.6cm) in ($T_{10}$). Increase in plant height with $GA_3$ treatment may be due to its effect on cell elongation. Taiz and Zeiger (1998) [20] found that an application of $GA_3$ increased cell division and cell elongation in plants resulting in more number of cells and increase in cell length which ultimately affected plant growth in gladiolus. $GA_3$ induced the active cell division and cell elongation resulting in enhancement in plant height (Greulach and Haeshloop 1958) [7]. The decrease in plant height with application of BA might be due to reducing apical dominance. Similar results have been reported by Sindhu and Verma (1998) [18]; Maurya and Nagda (2002) [12] and Sharma *et al.* (2006) in gladiolus.

**Table 1:** Effect of plant growth regulators on number of days for sprouting and plant height

| Levels of PGR (D) | No. Of days for sprouting | | | | Plant height | | | |
|---|---|---|---|---|---|---|---|---|
| | Varieties(V) | | | | Varieties | | | |
| | $V_1$ | $V_2$ | $V_3$ | Mean(D) | $V_1$ | $V_2$ | $V_3$ | Mean (D) |
| $D_0$ | 10.733 | 8.600 | 11.133 | 10.156 | 88.600 | 77.433 | 83.533 | 83.189 |
| $D_1$ | 9.200 | 6.200 | 8.933 | 8.111 | 92.800 | 80.133 | 86.367 | 86.433 |
| $D_2$ | 9.600 | 8.800 | 9.267 | 9.222 | 89.567 | 78.200 | 84.900 | 84.222 |
| $D_3$ | 14.333 | 14.067 | 14.800 | 14.400 | 75.600 | 69.733 | 73.000 | 72.778 |
| $D_4$ | 16.800 | 15.133 | 15.667 | 15.867 | 74.233 | 67.600 | 71.700 | 71.178 |
| Mean (V) | 12.133 | 10.570 | 11.96o | | 84.160 | 74.620 | 79.900 | |
| Comparison | | F-test | S.Ed(±) | C.D.at5% | | F-test | S.Ed(±) | C.D.at 5% |
| Due to Varieties | | S | 0.106 | 0.21 | | S | 0.12 | 0.25 |
| Due to PGR | | S | 0.138 | 0.28 | | S | 0.21 | 0.44 |
| Inter (V×D) | | S | 0.169 | 0.48 | | S | 0.09 | 0.19 |

**Number of leaves**

The data presented in Table 2 showed significant effect of growth regulators on the number of leaves per plant due to growth regulator and due to variety at all stages of growth while it was non- significant for the interaction effect of growth regulator and varieties for 90 DAP. The maximum number of leaves was recorded for $GA_3$ @ 200 ppm, variety Deepest Red and for interaction of $GA_3$ @ 200 ppm with Deepest Red. The maximum number of leaves (9.07) after 90 days was recorded for interaction of $GA_3$ @ 200 ppm with Deepest Red followed by ($T_3$) for deepest red treated with 300 ppm of $GA_3$. The number of leaves was found to be minimum (6.13) in ($T_{10}$).

The increasing number of leaves per plant under the treatment of $GA_3$ may be due to $GA_3$ improves the physiological efficiency of the plant such as improvement of rate of photosynthesis, control of transpiration and photorespiration, efficient water and nutrient uptake, control of leaf senescence. The number of plant per hill was influenced by the application of different growth regulators the of $GA_3$ on increasing the vegetative growth Bhalla and Kumar (2008) [5] in gladiolus. Similar results were also reported by Roychoudhuri *et al.* (1985) [14] in gladiolus.

**Number of sprouts**

The data presented in Table 4.8 and 4.9 and in Fig. 4.4 showed significant effect of growth regulators on the number of sprouts per plant due to growth regulator, due to variety and due to interaction of variety and growth regulator at all stages. Maximum number of sprouts was recorded for BA @ 300 ppm, variety Jessica and for the interaction of BA @ 300 ppm with variety Jessica.Maximum number of sprouts (5.20) after 60 days was recorded for the interaction of BA @ 300 ppm with variety Jessica followed by ($T_9$) $V_2$ with 250 ppm of BA. The number of sprouts was found to be minimum (1.06) in ($T_{11}$). This may be due to breaking of dormancy by BA and thereby enhanced sprouting. BA promotes cell division and shoot differentiation resulting into increased number of shoots per corm. Similar result was found by Abou-El-Ella (2007) [1]. He found that BA at 100 ppm as corm dip treatment gave the maximum number of shoots per corm that the maximum number of corms per plant (4.26) was recorded in BA at 250 ppm. Khan *et al.* (2013) [10] found that higher concentration of BA enhanced multiple shooting and accelerated corm production in gladiolus. The results are in line with findings of Baskaran and Misra (2007) [3] in gladiolus.

**Table 2:** Effect of plant growth regulators on number of leaves and number of sprouts per plant

| Levels of PGR (D) | No. Of leaves | | | | No. Of sprouts | | | |
|---|---|---|---|---|---|---|---|---|
| | Varieties(V) | | | | Varieties | | | |
| | **$V_1$** | **$V_2$** | **$V_3$** | **Mean(D)** | **$V_1$** | **$V_2$** | **$V_3$** | **Mean (D)** |
| $D_0$ | 8.067 | 7.133 | 7.867 | 7.689 | 1.267 | 1.333 | 1.067 | 1.222 |
| $D_1$ | 9.067 | 8.267 | 8.800 | 8.711 | 1.533 | 1.733 | 1.200 | 1.489 |
| $D_2$ | 8.867 | 7.800 | 8.467 | 8.378 | 1.467 | 1.600 | 1.133 | 1.400 |
| $D_3$ | 7.400 | 6.467 | 6.867 | 6.911 | 3.600 | 4.067 | 3.200 | 3.622 |
| $D_4$ | 6.867 | 6.133 | 6.400 | 6.467 | 3.733 | 5.200 | 3.400 | 4.111 |
| Mean (V) | 8.053 | 7,160 | 7.680 | | 2.320 | 2.787 | 2.000 | |
| Comparison | | F-test | S.Ed(±) | C.D.at5% | | F-test | S.Ed(±) | C.D.at 5% |
| Due to Varieties | | S | 0.07 | 0.15 | | S | 0.04 | 0.08 |
| Due to PGR | | N.S | 0.12 | 0.26 | | S | 0.05 | 0.11 |
| Inter (V×D) | | S | 0.05 | 0.11 | | S | 0.09 | 0.19 |

**Number of daughter corms per plant**

The data presented in Table 3 showed significant result of number of daughter corms per plant due to growth regulators, due to different varieties and the interaction of growth regulators and varieties on number of daughter corm per plant. Maximum number of corm was recorded for BA @ 300 ppm and for the variety Jessica. Maximum number of daughter corms (5.20) was recorded for the interaction of BA @ 300 ppm with variety Jessica followed by ($T_9$) Jessica with 250 ppm of BA. The number of daughter corm was found to be minimum (1.07) in ($T_{11}$).

BA, like other cytokinins characteristically causes more splitting and cell division than increasing the size of corms (Baskaran et al., 2009) [4] in gladiolus. Khan *et al.* (2013) [10] found that higher concentration of BA enhanced multiple shooting and accelerated corm production in gladiolus. The result is in conformity with the work of Raju (2000) [15] in lilies and Rajaram *et al.* (2002) [16] in gladiolus. BA promoted the sink activity of developing corm and cormels at the expense of flower spike, this might be the reason for increase in number of corms and cormels and poor quality flower spikes. Similar results were also observed by Tawar *et al.* (2007) [21] in gladiolus cv. Jester.

**Average size/diameter of corm (mm)**

The data presented in Table 3 showed significant result average diameter of daughter corms due to growth regulators due to different and the interaction of growth regulators and varieties on average diameter of daughter corms. Maximum average diameter of daughter corms was recorded for $GA_3$ @ 200 ppm and for the variety Estabonita. Maximum average diameter of corms (81.05) was recorded for the interaction of GA3 @ 200 ppm with variety Estabonita followed by ($T_{13}$) $V_3$ with 300 ppm of $GA_3$. The average diameter of daughter corms was found to be minimum (41.21) in ($T_{10}$).

Some research workers have already reported that $GA_3$ treatments increased diameter of corms in gladiolus (Arora *et al.* 1992 Siraj and Al-Safar, 2006 and Khan *et al.* 2011) [2, 17, 9]. The increase in weight, size and volume of the corm with the application of $GA_3$ can be attributed to increase in number of leaves per plant which increased the photosynthetic assimilates. These assimilates are transported to the resulting daughter corms, thereby, increasing their weight, size and volume. Similar findings have also been reported by Kumar *et al* (2002) [8] and Suresh Kumar *et al* (2008) [11] in gladiolus.

**Table 3:** Effect of plant growth regulators on number and size/diameter of daughter corm per plant

| Levels of PGR (D) | Number of daughter corms per plant | | | | Size/diameter of daughter corm per plant | | | |
|---|---|---|---|---|---|---|---|---|
| | Varieties(V) | | | | Varieties | | | |
| | $V_1$ | $V_2$ | $V_3$ | Mean(D) | $V_1$ | $V_2$ | $V_3$ | Mean (D) |
| $D_0$ | 1.267 | 1.333 | 1.067 | 1.222 | 66.847 | 65.370 | 68.480 | 66.899 |
| $D_1$ | 1.533 | 1.733 | 1.200 | 1.489 | 73.540 | 70.847 | 81.050 | 75.146 |
| $D_2$ | 1.467 | 1.600 | 1.133 | 1.400 | 71.637 | 69.923 | 77.623 | 73.061 |
| $D_3$ | 3.600 | 4.067 | 3.200 | 3.622 | 49.923 | 45.893 | 51.770 | 49.196 |
| $D_4$ | 3.733 | 5.200 | 3.400 | 4.111 | 48.983 | 41.207 | 50.773 | 46.988 |
| Mean (V) | 2.320 | 2.787 | 2.000 | | 62.186 | 58.648 | 65.939 | 62.258 |
| Comparison | | F-test | S.Ed (±) | C.D.at 5% | | F-test | S.Ed (±) | C.D.at 5% |
| Due to Varieties | | S | 0.04 | 0.08 | | S | 0.39 | 0.81 |
| Due to PGR | | S | 0.05 | 0.11 | | S | 0.51 | 1.04 |
| Inter (V×D) | | S | 0.09 | 0.19 | | S | 0.88 | 1.81 |

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