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# Influence of $GA_3$ and BA on Morphological, Phenological and Yield Attributes In Gladiolus cv. Red Candyman

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***Abstract :*** *The present investigation was conducted to study the effect of gibberellic acid and benzyladenine on morphological, phenological and yield attributes of gladiolus cv. Red Candyman under Assam conditions. The experiment was laid out in RBD with eleven treatments replicated three times. The results revealed that morphological characters were significantly influenced by $GA_3$ at 200 ppm which recorded the highest plant height, number of leaves per plant and leaf area. Significantly the minimum days to emergence of shoot, days to initiation of spike, days to full emergence of spike, days taken for first floret to show colour and days taken for first floret to open was exhibited by $GA_3$ at 200 ppm. The treatment $GA_3$ at 250 ppm recorded the maximum duration of flowering. The treatment with $GA_3$ at 200 ppm exhibited maximum yield in terms of length of spike, length of rachis, number of florets per spike, diameter of floret, fresh weight, and dry weight of spike. On the other hand, BA at 250 ppm exhibited maximum economic yield in terms of number of spikes per corm and number of corms per plant.*

***Keywords:*** *Gibberellic acid, Benzyladenine, gladiolus, corm production.*

## I. Introduction

Gladiolus is a flower of glamour and perfection which is known as the queen of bulbous flowers due to its flower spikes with florets of massive form, brilliant colours, attractive shapes, varying size and excellent shelf life. Gladiolus stands fourth in the international cut flower trade after carnation, rose and chrysanthemum.

Commercial floriculture is one of the most profitable agro industries in the world (Ezhilmathi et al., 2008 [1]). But, the major constraints faced by the gladiolus growers are decrease in cut flowers quality from harvesting time to market, longevity and yield. In floriculture industry, the quality of flowering crops is limited by its longevity, which is influenced by senescence. For commercial use, it is usually the life span of the petals which determines the effective life span of the flower and on the other hand flowers are the most sensitive organs as they do not have any reserve food material, senescence starts immediately after harvest. Carbohydrate status of a flower is an important factor, which affect the post harvest life of cut flowers. It is also important to know the mechanism of senescence and how it can be delayed through different treatments, which ultimately leads to the increase in the shelf harvest life of the cut flowers. The quality and yield of cut flowers is dependent on several pre and post harvest factors (Bhattacharjee and De, 2001[2]).

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 (Lee and Rhee, 2005[3]). In gladiolus, pre harvest application of chemicals and plant growth regulators was found to improve the growth and flowering of cut spikes (Raju et al., 2008[4]). 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 (Singh and Jitendra, 2008[5]). Cytokinins increased chlorophyll development and synthesis (Emonger, 2007[6]). Chlorophyll degradation in leaves of cut flowers is determined by gibberellins which prevents leaf senescence and delay proteolysis by arresting degradation of protein and chlorophyll (Emami et al, 2011[7]).

To meet the demand for cut flower in the fast growing market of North-Eastern region, improvement in flower quality and yield are of prime importance in the cultivation of gladiolus. Any attempt made to increase cut flower production in the region will not only help the florists and consumers to get fresh and quality cut

flowers regularly but also help the small and marginal farmers in the region to improve their economic status. Therefore, 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. Considering the importance and popularity of gladiolus both in National and International market, increasing the quality and production is of considerable importance. Keeping the goal in view, the present investigation was undertaken to study the effect of pretreatment of corm with growth regulators on plant growth, flower quality and yield.

## II. Materials And Methods

The present investigation was carried out at the Instructional cum Research Farm, Department of Horticulture, Biswanath College of Agriculture, Assam Agricultural University, Biswanath Chariali during 2012- 2013 to study the effect of $GA_3$ and BA treatments on morphology, phenology and yield attributes in gladiolus cv. Red Candyman.

Altogether eleven treatments including control, with three replications were allocated in a randomized block design. The treatment consists of two chemicals ($GA_3$ and BA) with five concentration each (50, 100, 150, 200, 250 ppm) and control (water). Healthy corms of uniform size were selected. The outer scales of the corms were dehusked and soaked at five different concentrations of $GA_3$ and BA for 24 hours along with control (water soaking). 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 at the rate of N:P:K :: 85:135:35 g/m² first at two leave stage and next at 45 days after first application. Half dose of 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 (Panse and Sukhatme, 1978[8]).

## III. Results And Discussions

### 3.1. Morphological characters

The results of the present experiment revealed that the plant growth regulators showed significant effect on the plant height at all stages of growth (Table 4.1). Treatment with $GA_3$ at 200 ppm recorded the highest plant height in all the stages of growth ranging from 46.73 cm at 30 DAP to 87.30 cm at 60 DAP. On the other hand, the lowest plant height (34.40 cm at 30 DAP and 48.63 cm at 40 DAP) was observed in BA at 250 ppm, while under BA 200 ppm lower plant height was recorded at 50 DAP (59.16 cm) and 60 DAP (67.45 cm) respectively. Increase in plant height with $GA_3$ treatment may be due to its effect on cell elongation (Tonecki, 1980[9]). Hooley (1994)[10] reported that $GA_3$ is known to be involved in various process of plant development. Taiz and Zeiger (1998)[11] 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. Similar results were also reported by Al-Khassawreh et al., (2006)[12] in Black iris and Bhalla and Kumar (2007)[13] in gladiolus.

The data presented in Table 4.1 and Fig. 4.2 showed significant effect of growth regulators on the number of leaves per plant at all stages of growth. The maximum number of leaves (4.20, 6.06, 7.73 and 9.13) was recorded in $GA_3$ at 200 ppm at all the stages of growth from 30 DAP to 60 DAP followed by $GA_3$ at 150 ppm. The minimum number of leaves was recorded in BA at 250 ppm at all the stages of growth. The increasing number of leaves per plant under the treatment of $GA_3$ may be due to the positive effect of $GA_3$ on increasing the vegetative growth as reported by Bhalla and Kumar (2008)[14] in gladiolus. Similar results were also reported by Roychoudhuri et al., (1985)[15] in gladiolus. Data presented in Table 4.1 showed that highest increase in plant height and numbers of leaves were found in plants treated with $GA_3$ compared with control and BA treatments.

A marked increase in the leaf area was recorded from spike initiation stage to flowering stage due to treatments with different growth regulators (Table 4.1). The highest leaf area at spike initiation stage (364.81 cm²) and flowering stage (579.36 cm²) were recorded in $GA_3$ at 100 ppm and $GA_3$ at 150 ppm, respectively, followed by $GA_3$ at 200 ppm, whereas the lowest leaf area at spike initiation stage (253.41 cm²) and flowering stage (437.80 cm²) were found in BA at 250 ppm and BA at 150 ppm, respectively. The effect of $GA_3$ on leaf area and length may be due to its stimulatory effect on cell division and elongation as reported by Tonecki (1980)[16] in gladiolus. Similar reports were obtained by Ismail (1997)[17] on Narcissus and Youssef (2004)[18] on Strelitzia reginae. On the other hand the reduction in leaf area may be due to the effect of BA on two competitive sinks, inflorescence or flower spike and developing corms or cormels which enhanced multiple

shooting and hence accelerated corm production leading to decrease in area of leaf (Padmalatha et al., 2012[19]).

**3.2. Phenological characters**

The data presented in Table 4.2 revealed that treatment with growth regulators had significant influence on the phenological characters in gladiolus. The treatment $GA_3$ at 200 ppm showed the minimum days (9.06 days) for emergence of shoot followed by (9.40 days) in $GA_3$ at 150 ppm whereas, the maximum days for emergence of shoot (16.60 days) was recorded in BA at 150 ppm. Similar findings were also reported by Padmalatha et al., (2013)[20] in gladiolus by soaking of corms in $GA_3$. This might be due to the reason that $GA_3$ breaks the dormancy of corms by activating the hydrolysing enzyme which results in early sprouting and emergence of shoot in gladiolus corms (Halevy et al., 1970[21]). On the other hand, the delay in the emergence of shoot in BA treatments may be due to the role of BA in cell division which leads to splitting and formation of two competitive sinks, inflorescence and corm production ultimately delaying the emergence of shoot (Padmalatha et al., 2012[22]).

The difference in the days to initiation of spike and full emergence of spike were significantly influenced by different treatments (Table 4.2). The treatment with $GA_3$ at 200 ppm recorded the minimum number of days (67.86 days) for initiation of spike and (76.26 days) for full emergence of spike. On the other hand, BA at 250 ppm recorded the highest number of days for initiation of spike (75.20 days) and full emergence of spike (85.86 days). This might be due to increase in the number of leaves per plants and leaf area due to application of $GA_3$ which had resulted in increase in the photosynthates needed to enhance reproductive growth (Yousif and Mahmoud, 2006[23]) in gladiolus. These findings are in agreement with Misra et al., (1993)[24] where they found, enhanced vegetative growth and flowering of gladiolus with $GA_3$ application.

Results revealed that the minimum days taken for first floret to show colour (80.73 days) and first floret to open (82.60 days) was recorded in $GA_3$ at 200 ppm. While the maximum days for first flower to show colour (90.46 days) and the first floret to open (93.66 days) was found in BA at 250 ppm, respectively. The improving effect of $GA_3$ on flowering characteristics may be due to their stimulatory effect on cell division, elongation and differentiation (Tonecki, 1980)[25] in gladiolus. Early flowering of treated plants by $GA_3$ might be due to their vital role in the production and regulation of floral stimulus (Ragaa, 2012)[26] in Iris plant. Similar reports were given by Abou- El-Ella (2007)[27] on Acanthus mollis.

The duration of flowering (21.91 days) was found maximum at $GA_3$ 250 ppm followed by 20.96 days in $GA_3$ 200 ppm and the minimum duration of flowering (19.47 days) was recorded at BA at 200 ppm which is in conformity with the findings of Das (1991)[28] in gladiolus.

**3.3. Yield and yield attributes**

Significant differences in respect to number of spike per corm, number of cormes per plant, length of spike, length of rachis, number of florets per spike, diameter of floret and fresh and dry weight of spike were observed due to different growth regulator treatments (Table 4.3). Significantly maximum number of spikes per corm (2.66) was observed in BA at 250 ppm followed by 2.60 and 2.53 in BA at 200 ppm and 150 ppm, respectively. The lowest number of spikes (1.00) was found under control. Increase in the yield of the spikes might be due to the reason that cytokinins stimulate cell division and lateral bud development which led to multiple shooting (Murti and Upreti, 1995[29]). This report is in conformity with Baskaran and Misra (2007)[30], they found that BA at 100 ppm as corm dip treatment gave the maximum number of shoots per corm.

It is evident from the Table 4.3 that the maximum number of corms per plant (4.26) was recorded in BA at 250 ppm whereas, the minimum number of corms per plant (1.06 and 1.13) was found in $GA_3$ at 200 ppm and control. BA, like other cytokinins characteristically causes more splitting and cell division than increasing the size of corms (Baskaran et al., 2009[31]) in gladiolus. Soaking of corms for 24 hours before planting was found to produce the highest number of corms and cormels per plant over 12 hour soaking period, reports confirmed by Pal and Choudhury (1998)[32] in gladiolus. Whereas Khan et al., (2013)[33] 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)[34] in lilies and Rajaram et al., (2002)[35] in gladiolus. On the other hand Ginzburg C., (1973)[36] reported that Kinetin induced corm formation in gladiolus whereas $GA_3$ inhibited it.

The data from Table 4.3 showed that $GA_3$ at 200 ppm showed the maximum length of spike (91.56 cm) and length of rachis (46.13 cm) followed by 91.30 cm and 44.93 cm under $GA_3$ at 250 ppm for length of spike and length of rachis, respectively. While the minimum length of spike (73.70 cm) and length of rachis (32.13 cm) was found in BA at 250 ppm. Gibberellic acid promotes vegetative growth and increases the photosynthetic and metabolic activities causing more transport and utilization of photosynthetic products (Halevy and Shilo,

1970[37]) in gladiolus due to which spike length and rachis length increased thereby allowing florets to grow larger (Taiz and Zeiger, 1998[38]).

The number of florets per spike and diameter of floret were significantly influenced by the treatment with $GA_3$ and BA. It is evident from the Table 4.3 that the highest number of florets (13.40) and diameter of floret (8.36 cm) were noted in $GA_3$ at 200 ppm and 250 ppm, respectively and lowest number of floret (9.46) and diameter of floret (6.95 cm) were recorded in BA at 250 ppm. The increase was mainly owing to the increase in the number of leaves per plants and leaf area which might have increased the production of photosythates needed to enhance reproductive growth (Yousif and Mahmoud, 2006)[39] in gladiolus. Similarly, Ali and Elkiey (1995)[40] on Zantedeschia reported that $GA_3$ may cause to increase in the accessible substance during flowering initiation time. This subject could be related to increase in flowering. The result of Funnel et al., (1992)[41] on Zantedeschia, confirm the positive and significant role of $GA_3$ in increasing bud number.

The data presented in Table 4.3 shows significant effect of $GA_3$ and BA on fresh weight and dry weight of spike. The maximum fresh weight (106.64 g) and dry weight (8.54 g) of spike was recorded in $GA_3$ at 200 ppm, followed by 101.19 g and 8.17 g in $GA_3$ at 200 ppm, respectively. The minimum fresh weight (65.09 g) and dry weight (4.37 g) was recorded in BA at 250 ppm. Gibberellins increase cut flower's fresh weight by negation of cell water potential (Emongor and Tshwenyane, 2004[42]). In addition, BA can increase hexos sugar (sucrose and fructose) availability in the cell by increasing in α-amylase and invertase enzyme activity and at last increase the fresh weight of spike (Marousky, 1974[43]). The present result is in conformity with Mutui et al., (2001)[44] in Alestroemeria aurantiaca L. which showed that $GA_3$ had significant positive role in increasing fresh weight of spike.

## IV. Figures And Tables

**Table 4.1. Effect of plant growth regulators on morphological parameters in gladiolus cv. Red Candyman**

| Treatments | Plant Height (cm) | | | | No of Leaves per plant | | | | Leaf Area per plant (cm²) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 30 DAP | 40 DAP | 50 DAP | 60 DAP | 30 DAP | 40 DAP | 50 DAP | 60 DAP | Spike initiation stage | Flowering stage |
| Control | 42.43 | 62.10 | 71.06 | 78.45 | 3.60 | 5.40 | 7.20 | 8.00 | 300.49 | 503.88 |
| GA3 @ 50 ppm | 43.06 | 60.83 | 73.31 | 83.63 | 3.73 | 5.80 | 7.33 | 8.53 | 334.46 | 564.20 |
| GA3 @ 100 ppm | 42.80 | 60.56 | 72.45 | 83.39 | 3.80 | 5.40 | 7.26 | 8.53 | 364.81 | 539.18 |
| GA3 @ 150 ppm | 44.46 | 63.80 | 74.07 | 85.55 | 4.20 | 5.86 | 7.66 | 8.93 | 342.00 | 579.36 |
| GA3 @ 200 ppm | 46.73 | 65.53 | 77.10 | 87.3 | 4.20 | 6.06 | 7.73 | 9.13 | 354.89 | 568.22 |
| GA3 @ 250 ppm | 45.00 | 61.70 | 73.95 | 85.29 | 4.00 | 5.60 | 7.53 | 8.40 | 349.33 | 564.09 |
| BA @ 50 ppm | 40.60 | 54.63 | 68.64 | 81.68 | 3.06 | 4.73 | 6.53 | 8.66 | 292.85 | 467.37 |
| BA @ 100 ppm | 41.90 | 55.40 | 65.36 | 76.56 | 3.06 | 4.93 | 6.53 | 8.13 | 277.58 | 487.33 |
| BA @ 150 ppm | 36.10 | 51.70 | 61.76 | 72.53 | 2.80 | 4.40 | 6.26 | 8.00 | 260.42 | 437.8 |
| BA @ 200 ppm | 37.26 | 51.30 | 59.16 | 67.45 | 2.80 | 4.46 | 5.86 | 6.60 | 264.74 | 463.92 |
| BA @ 250 ppm | 34.40 | 48.63 | 62.96 | 70.03 | 2.66 | 3.80 | 5.33 | 6.53 | 253.41 | 453.62 |
| SEd ( ± ) | 1.55 | 1.71 | 2.92 | 3.89 | 0.19 | 0.23 | 0.27 | 0.35 | 23.61 | 32.72 |
| CD at 5% | 3.23 | 3.57 | 6.09 | 8.12 | 0.40 | 0.49 | 0.56 | 0.73 | 49.24 | 68.24 |

DAP = Days after planting

**Table 4.2. Effect of plant growth regulators on phenological parameters in gladiolus cv. Red Candyman**

| Treatments | Days to emergence of shoots | Days to initiation of spike | Days to full emergence of spike | Days taken for first floret to show colour | Days taken for first floret to open | Duration of flowering (Days) |
|---|---|---|---|---|---|---|
| Control | 11.00 | 70.66 | 79.43 | 83.73 | 87.26 | 20.31 |
| GA3 @ 50 ppm | 10.86 | 69.26 | 76.73 | 82.40 | 89.46 | 19.87 |
| GA3 @ 100 ppm | 12.93 | 69.46 | 77.66 | 82.36 | 84.33 | 20.56 |
| GA3 @ 150 ppm | 9.40 | 68.40 | 76.90 | 81.53 | 83.73 | 19.80 |
| GA3 @ 200 ppm | 9.06 | 67.86 | 76.26 | 80.73 | 82.60 | 20.96 |
| GA3 @ 250 ppm | 11.13 | 69.66 | 77.80 | 83.00 | 84.86 | 21.91 |
| BA @ 50 ppm | 15.00 | 74.53 | 84.60 | 89.86 | 92.86 | 20.45 |
| BA @ 100 ppm | 13.40 | 74.66 | 82.86 | 87.96 | 90.96 | 20.75 |
| BA @ 150 ppm | 16.60 | 75.20 | 85.33 | 90.06 | 92.13 | 19.65 |
| BA @ 200 ppm | 14.26 | 73.33 | 85.46 | 89.66 | 92.20 | 19.47 |
| BA @ 250 ppm | 15.73 | 75.20 | 85.86 | 90.46 | 93.66 | 20.59 |
| SEd ( ± ) | 1.87 | 1.86 | 1.65 | 1.84 | 1.65 | 0.58 |
| CD at 5% | 3.91 | 3.89 | 3.45 | 3.83 | 3.43 | 1.21 |

**Table 4.3. Effect of plant growth regulators on yield and yield attributes in gladiolus cv. Red Candyman**

| Treatments | Number of spike per corm | Number of cormes per plant | Length of spike (cm) | Length of rachis (cm) | Number of florets per spike | Diameter of floret (cm) | Fresh weight of spike (g) | Dry weight of spike (g) |
|---|---|---|---|---|---|---|---|---|
| Control | 1.00 | 1.13 | 80.27 | 40.65 | 12.20 | 7.30 | 80.99 | 7.14 |
| GA3 @ 50 ppm | 1.00 | 1.26 | 89.63 | 44.58 | 12.80 | 8.16 | 91.96 | 7.21 |
| GA3 @ 100 ppm | 1.13 | 1.60 | 85.89 | 41.71 | 12.80 | 7.92 | 92.01 | 7.89 |
| GA3 @ 150 ppm | 1.13 | 1.20 | 91.30 | 44.93 | 13.06 | 8.08 | 97.58 | 7.88 |
| GA3 @ 200 ppm | 1.00 | 1.06 | 91.56 | 46.13 | 13.40 | 8.16 | 106.64 | 8.54 |
| GA3 @ 250 ppm | 1.20 | 1.40 | 88.66 | 44.45 | 13.00 | 8.36 | 101.19 | 8.17 |
| BA @ 50 ppm | 1.73 | 2.26 | 76.25 | 35.91 | 10.80 | 7.58 | 75.06 | 6.41 |
| BA @ 100 ppm | 1.80 | 2.60 | 75.46 | 38.22 | 10.40 | 7.75 | 73.54 | 7.38 |
| BA @ 150 ppm | 2.53 | 2.93 | 77.02 | 32.78 | 10.46 | 7.36 | 66.48 | 5.49 |
| BA @ 200 ppm | 2.60 | 3.80 | 74.62 | 33.16 | 9.56 | 7.41 | 76.83 | 6.83 |
| BA @ 250 ppm | 2.66 | 4.26 | 73.70 | 32.13 | 9.46 | 6.95 | 65.09 | 4.37 |
| SEd ( $\pm$ ) | 0.21 | 0.33 | 2.25 | 3.49 | 0.59 | 0.39 | 6.47 | 0.81 |
| CD at 5% | 0.43 | 0.69 | 4.69 | 7.30 | 1.25 | 0.82 | 13.49 | 1.69 |

## V. Conclusion

It can be inferred from the results of the present investigation, that the treatment with $GA_3$ at 200 ppm proved to be the best in improving the plant height, number of leaves per plant, leaf area per plant, days to emergence of shoot, days to initiation of spike, days to full emergence of spike, days taken for first floret to show colour, days taken for first floret to open, duration of flowering, length of spike, length of rachis, number of florets per spike, fresh and dry weight of spike. Whereas in case of number of spikes per corm and number of corms per plant the treatment with BA at 250 ppm was found to be the best.

However, for quality flower production for export purpose the treatment with $GA_3$ at 200 ppm may be recommended to get good quality spike with longer vase life. On the other hand from economic point of view, the treatment with BA at 250 ppm can be considered best for getting more number of spikes and corms.

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