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Effect of biostimulants application on growth and yield of corm and cormels in cut gladiolus CV. Arka amar

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Abstract
The present investigation was to find out the effect of biostimulants on gladiolus with reference to corm and cormel yield attributes. The experiment was laid out in Randomized Block Design replicated thrice with eleven treatments. The results on corm and cormel yield parameters revealed that among different presoaking and foliar sprays of biostimulants at 30 and 45 days after corm sprouting, Humic acid at 4ml/l i.e T_8 resulted in significantly maximum corm weight, corm diameter (5.13 cm), cormel size (2.46 cm), maximum number of corms plant^{-1}, higher number of corms plot^{-1}, higher number of corms ha^{-1}, Further maximum cormels plant^{-1}(18.80g), cormels yied plot^{-1} and cormels yield ha^{-1} was also recorded in this treatment. It was concluded that application of presoaking and foliar sprays with Humic acid at 4ml/l appears to be an optimum treatment for enhancing growth and yield of corm and comels in cut gladiolus.

Keywords: Humic acid, corms, gladiolus, cut flower, cormels and biostimulants

Introduction
Gladiolus (*Gladiolus grandiflorus* L.) a member of the family Iridaceae, originated from South Africa, commercially propagated by corms. It is one of the top ranking cut flower crops, available in different shapes and hues with excellent vase life, gladiolus is considered as a superior bulbous cut flower. It has a high demand in global cut flowers trade; which requires development of new, promising, high yielding cultivars and their evaluation for their suitability for commercial production (Ahmad *et al*. 2008) [2]. In India the total area and production under flower crops was 3.06 lakh ha and 23.92 lakh metric tonnes with loose and cut flowers production at 16.99 and 6.93 lakh metric tonnes respectively (NHB 2016-17). The major area under floricultural crop was contributed by the traditional flower crops as they can be grown under open field conditions. They are widely used as artistic garlands, floral ornaments, bouquets etc. The long flower spikes are excellent as cut flower for table decoration when arranged in vases. Being an important bulbous ornamental plant, it occupies a prime position among commercial flower crops which has high demand in both domestic and international markets, grown in the plains as well as hills up to elevation of 2400 m from mean sea levels (Singh *et al*. 2012) [9].

Gladiolus is ideal both for use in garden and floral decorations. Nutrition is one of the most important aspects in increasing the yield and quality of gladiolus spikes. After the green revolution, use of chemical fertilizers and pesticides in plant production has increased, which is dangerous to the ecology and environment. Thus, the application of nutrients in small doses applied more frequently favours better growth and flower production. But, excessive use of chemical fertilizers and pesticides impose threat to the ecology and environment. Organic farming is one of the possible solutions for this problem, in recent days bio stimulants have emerged as supplements to mineral fertilizers and hold a promise to improve yield as well as quality of the crop (Sankari *et al*. 2015) [8]. Keeping in the view the need and importance of bio stimulants, the present investigation were conducted with the objective of studying the effect of biostimulants namely; Triacontanol, Cytozyme, Biozyme, Humic acid and Fulvic acid on growth and yield of corms and cormels of gladiolus.

Material and Methods
The experimental site is located at Floricultural Research Station, Agricultural Research Institute, Rajendranagar, Hyderabad.

The experimental site falls under subtropical climate zone with an average rainfall of 800 mm per annum. The soil of experimental site was red sandy loam with good drainage facility and low water holding capacity. Located at an altitude of 542.3 m above mean sea level with geographical bearing of 17.19° N latitude and 78.23° E longitude. Meteorological data pertaining to rainfall, mean minimum and maximum, temperature, relative humidity and sunshine hours in weekly averages recorded during the investigation period (September, 2017 to February, 2018). The Bio stimulants are applied three times i.e pre soaking of corms (1hr) before planting and foliar application on 30 and 45 days after corm sprouting. The experimental field was brought to fine tilth by ploughing and harrowing. The land was leveled, cleaned and all the weeds and stubbles of previous crop were completely removed. The experimental area was divided into plots of 1.5 m × 1.5 m size with 25 cm raised bunds. Irrigation channels of 60 cm size were provided the between replications. Organic manure like well decomposed farmyard manure 5 kg.plot^{-1} were incorporated into all the experimental plots uniformly as basal application and mixed well. N, P and K @ 25:35:35 kg. acre^{-1} were applied in form of Ammonium sulphate, single super phosphate and murate of potash respectively. Ammonium sulphate applied in 3 split doses, the first dose as basal application and other two split doses at 3 leaf stage and 6 leaf stage. The entire dose of single super phosphate and murate of potash were applied at time of planting as basal dose.

Solutions of 2ml and 4ml of biostimulants were prepared in 1000 ml volumetric flask by dissolving calculated quantity of biostimulants in 0.998 and 0.996 litre distilled water respectively. The healthy and uniform selected corms were soaked in each treatment solutions for one hour (plate-1) and were accommodate about 36 to 37 in the each plot at a spacing of 30×20 cm and 5 cm depth according to treatments and layout. The prepared bio stimulant solutions were sprayed immediately after preparation with knapsack sprayer with uniform coverage at 30 and 45 days after corm sowing. After harvesting of flower spikes, the crop is maintained in the field for 1½ - 2 months period for corms and cormels development. The corms and cormels were lifted from the ground when the foliage turned yellow and harvested corms and cormels were further used for recording different attributes. Observations on corm and cormel parameters were recorded and the mean data were subjected to statistical analysis. The treatment details are furnished below.

T_1-Triacontanol @ 2ml/L, T_2-Triacontanol @ 4ml/L, T_3-Cytozyme @ 2ml/L, T_4-Cytozyme @ 4ml /L, T_5-Biozyme @ 2ml/L, T_6-Biozyme @ 4ml/L, T_7-Humic acid @ 2ml/L, T_8-Humic acid @ 4ml/L, T_9-Fulvic acid @ 2ml/L, T_{10}-Fulvic acid @ 4ml/L, T_{11}-Control. All the corms obtained from each treatment were counted in number of corms in per net plot size (2.25 square meters) and then converted into multiply the common factor of 4444.44 (10000/2.25). Thus, find out the number of corms per hectare.

Results and Discussion

The data recorded on corm weight, corm and cormel diameter, corm and cormel yield as influenced by different pre soaking and foliar sprays of bio stimulants showed in table. All the treatments of bio stimulants had shown the significant influence on weight of corm. The higher corm weight (54.83g) was produced by Humic acid 4ml/l which was on par with Humic acid 2ml/l (51.13g) followed by Fulvic acid 4ml/l produced 45.83g corm weight which was on par with Biozyme 4ml/L (45.73g) and Cytozyme 4ml/l (45.33g). Significantly maximum corm diameter was recorded in T8 (5.13cm) followed by Biozyme at 4ml/l (4.40cm) which was on par with Biozyme at 2ml/l (4.20cm), Fulvic acid at 4ml/l (4.20cm), minimum that is 3.00cm was recorded in control which was on par with Triacontanol 2ml/l (4.10cm). The humic substances are capable of chelating metal ions, such as Fe, Zn etc., retained in exchangeable form in the soil. This form of nutrients are easily absorbed by the plants leading to improved metabolic activity that might have led to increase in corm weight and corm diameter (Mato and Mendez 1970) [5]. This is in concurrence with the findings of Pansuriya *et al*. (2018) [6] significantly maximum number of corms per plant (2.01), number of cormels per plant (31.85), diameter of corm (5.10cm) and weight of corm (49.52g) were registered with an application of 0.2% humic acid.; Ahmad *et al*. (2013) [1, 7] in gladiolus.

Humic acid at 4ml/l found significantly superior in recording higher number of cormels per plant (21.16) followed by T_7 (17.86) and these two treatments differed significantly from all other treatments. The treatment T_{10} recorded more number of cormels (14.63) which was on par with T_4 (13.76), it was lesser in T_{11} (11.20) which was on par with Cytozyme 4ml/l (13.03). It might be due the effects of humic acid to make more mineral nutrients available to plants.The above findings also supported by Saleem *et al*. (2013) [1, 7]. Significantly maximum number of corms per plant (2.01), number of cormels per plant (31.85), diameter of corm (5.10cm) and weight of corm (49.52g) were registered with an application of 0.2% humic acid (Pansuriya *et al*. 2018) [6]; Ahmad *et al*. (2013) [1, 7] in gladiolus; Bashir *et al*. (2016) [4] reported that humic acid (3.0mL) produced higher number of cormels per plant (106.83), diameter of cormels (1.011cm) and weight of cormel per plant (27.45g).

Among all treatments, the input Humic acid 4ml/l recorded significantly higher corm yield per plant (2.26) which was followed by Humic acid 2ml/l (2.06), Fulvic acid 4ml/l (1.66) which was on par with T_9 (1.50) and Biozyme 4ml/l (1.46). Whereas, lesser number of corms per plant of 1.06 was recorded in T_{11} which was on par with T_1 (1.30) and T_2 (1.10), it was also observed in corm yield per plot that the treatment T_8 found significantly superior in recording number of corms per plot (39.90) followed by T_7 (36.33) and the treatments T_5 (34.33) which were on par with T_6 (33.33). However, number of corms plot^{-1} was lowest in T_{11} (28.33) and the maximum number of corm per hectare was obtained from the treatment with Humic acid at 4ml/l (1.77 lakh) which was followed by Humic acid at 2ml/l (1.61 lakh) whih was on par with Biozyme 2ml/l (1.52 lakh) while in the control (1.25 lakh) was recorded. This might be due to the translocation of humic compound to different parts of the plant, thus, enhancing the growth of corm and cormel parameters due to allowing for enhanced water penetration and better root zone growth and development by break up compacted soil and also be attributed to the mobilization of reserve food material to the sink through increased activity by hydrolyzing and oxidizing (Sankari *et al* 2015) [8]; Pansuriya *et al*.(2018) [6] reported that significantly maximum number of corms per plant (2.01), number of cormels per plant (31.85), diameter of corm (5.10 cm) and weight of corm (49.52 g) were registered with an application of humic acid 0.2%; Vasudevan *et al*. (1997) [10] in sunflower; Ahmad *et al*. (2013) [1, 7] in gladiolus.

Cormels were found to be much properly developed as examined by cormels diameter and cormels weight per plant. Various bio stimulants treatments had significant influence on cormel size, Humic acid 4ml/l found significantly superior in

recording higher cormel size (2.46 cm) which was on par with Humic acid 2ml/l (2.16 cm) and these two treatments differed significantly from all other treatments. The treatment Fulvic acid 4ml/l recorded cormel size of 1.70 cm which was on par with T_2 (1.63 cm) and T_6 (1.63cm) and Cormel size was lesser in T_{11} (1.30 cm). Which may be due to healthy soil conditions due to humic acid application (Baldotto and Baldotto 2013) [3]: Bashir *et al*. (2016) [4] reported that humic acid (3.0 mL) in combination with NPK produced higher number of cormels per plant (106.83), diameter of cormels (1.011cm) and weight of cormel per plant (27.45g). The present study indicated that the cormel yield per plant was obtained with treatment T_8 (18.80 g) which was on par with Humic acid at 2ml/l (16.70 g), followed by Fulvic acid at 4ml/l (14.63 g) which was on par with Biozyme 4ml/l and Fulvic acid 2ml/l 13.40 g and 13.66 g respectively. While treatment T_{11} recorded the minimum (11.20 g), significantly higher cormel yield plot^{-1} was recorded in Humic acid 4ml/l (360.46 g) followed by Humic acid 2ml/l (307.16 g), Fulvic acid 4ml/l (215.83g) and Fulvic acid 2ml/l (212.73 g), Minimum cormel yield per plot of 120.76g was recorded in control and the higher cormel yield ha^{-1} (165.94 kg) was produced by Humic acid 4ml/l which was followed by Humic acid 2ml/l (135.18 kg). Fulvic acid 4ml/l produced 102.62 kg cormels ha^{-1} which was on par with Fulvic acid 2ml/l (100.07 kg), Whereas minimum (67.72 kg) was observed in control The increased yield of cormels could be due to the greater effect of HA for increased microbial populations, biologically active metabolites and uptake of mineral nutrients by gladiolus plant (Baldotto and Baldotto 2013) [3]; Bashir *et al*. (2016) [4] reported that humic acid (3.0 mL) produced higher number of cormels per plant (106.83), weight of cormel per plant (27.45 g) than all other treatments. Overall, the growth and yield was similar to that of reported by Saleem *et al*. (2013) [1, 7] with minor variations might be due to the effect of Humic acid, that findings are also compatible with the research work of Mato and Mendez (1970) [5].

Table 1: Effect of bio stimulants on corm and cormel parameters of cut gladiolus cv. Arka amar

Treatments			Weight of corm (g)	Corm diameter (cm)	No. of Cormels plant^{-1}	Cormel size (cm)	Corm yield per plant (No)	Corm yield plot^{-1} (No)	Corm yield ha^{-1} (No.)	Cormels yield per plant (g)	Cormels yield per plot (g)	Cormels yield ha^{-1} (Kg.h^{-1})
T_1	Triacontanol	2ml	42.83	3.50	12.63	1.56	1.30	30.33	134814.70	12.63	160.50	80.99
T_2	Triacontanol	4ml	43.36	3.80	13.03	1.63	1.10	31.66	140740.60	13.03	165.73	81.06
T_3	Cytozyme	2ml	44.46	4.06	13.53	1.56	1.20	32.33	143703.56	13.53	163.26	81.30
T_4	Cytozyme	4ml	45.33	4.10	13.76	1.46	1.40	31.66	140740.60	13.76	164.70	81.56
T_5	Biozyme	2ml	44.26	4.20	12.53	1.56	1.36	34.33	152592.46	12.53	164.53	81.16
T_6	Biozyme	4ml	45.73	4.40	13.40	1.63	1.46	33.33	148148.00	13.40	167.16	86.62
T_7	Humic acid	2ml	51.13	4.10	17.86	2.16	2.06	36.33	161481.30	16.70	307.16	135.18
T_8	Humic acid	4ml	54.83	5.13	21.16	2.46	2.26	39.90	177333.16	18.80	360.46	165.94
T_9	Fulvic acid	2ml	44.03	4.06	13.66	1.60	1.50	31.16	138518.36	13.66	212.76	100.07
T_{10}	Fulvic acid	4ml	45.83	4.20	14.63	1.70	1.66	31.50	139999.86	14.63	215.83	102.62
T_{11}	Control	Without spray	35.76	3.00	11.20	1.30	1.06	28.33	125925.80	11.20	120.76	67.72
	SEM ±		1.31	0.10	0.71	0.11	0.12	1.10	4915.74	0.64	13.32	4.35
CD (P = 0.05)			3.89	0.31	2.10	0.32	0.36	3.24	14418.20	1.90	39.35	12.76

Fig 1: Imposition of treatments

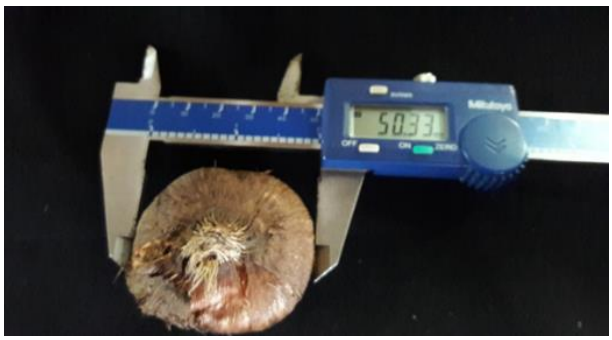

Fig 2: Diameter of corm

Fig 3: Diameter of cormel

Fig 4: Number of corms and cormels per plant

Conclusion

The corm and cormel attributes were significantly influenced by different pre soaking and foliar spray of bio stimulants treatments. The treatment Humic acid at 4ml/l i.e T_8 recorded higher values for number of corms and cormels per plant, plot and hectare, maximum weight of corm, diameter of the corm and cormel size while lowest values recorded in control. Taking into account of all the aspects of bio stimulants pre soaking and foliar sprays effect, it was concluded that Humic acid at 4ml/l i.e T_8 appears to be an optimum treatment for enhancing growth and yield of corms and cormels in cut gladiolus Cv. Arka amar.

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