

Influence of plant growth promoters and arbuscular mycorrhizal fungi (AMF) on growth, flowering and biochemical attributes of gladiolus cv Arka Amar

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ABSTRACT

The investigations on gladiolus cv Arka Amar were conducted at College of Horticulture, Anantharajupeta, Andhra Pradesh. The 13 treatments consisted of different combinations of plant growth promoters which were tested in randomized block design with three replications. Results revealed that among different plant growth promoters tried the treatment T₈ (Pre-soaking of corms with GA₃ 200 ppm + AMF + foliar spray with GA₃ 200 ppm) recorded significantly taller plants (63.35 cm), number of leaves per plant (8.67), number of florets per spike (14.27), longer spikes (75.33 cm), fresh weight of cut spikes (39.35 g) and number of spikes per plant (2.20). Total carotenoids (0.76 mg/g), phenols (1.24 mg/g) and carbohydrate content (15.21 mg/g) were recorded highest in T₁₀ (Pre-soaking of corms with BA 50 ppm + foliar spray with BA 50 ppm). It was concluded that the treatment T₈ was an optimum nutrient combination for enhancing growth and flowering and T₁₀ for various biochemical attributes in gladiolus cv Arka Amar.

Keywords: Gladiolus; GA₃; BA; AMF; growth; biochemical attributes

INTRODUCTION

Gladiolus (*Gladiolus grandiflorus* L.) also known as sword lily is one of the most beautiful and fascinating bulbous cut flowers. It has earned tremendous popularity due to its majestic flower spike with acropetal flower opening, attractive shades, varying sizes of flowers, brilliant color tones, ease in cultivation and long lasting vase life. In India the total area under gladiolus cultivation was 11.67 thousand hectares with production of 92.89 lakh spikes per hectare during 2013-14. In Andhra Pradesh it was cultivated in an area of 0.02 thousand hectares with a production of 10.00 lakh spikes during 2012-13 (Anon 2014).

Plant hormones are the organic substances which at minute doses play an active role in causing tremendous influence on the physiology of plant which in turn put forth changes in plant growth and improves flowering and yield. The plant growth regulators have been used in floriculture to manipulate plant growth in

a desired direction (Sharma et al 2004). In case of bulbous ornamental plants gibberellins, cytokinins and auxins play a key role in promoting cell division, cell elongation, biometric characters and extending vase life etc (Khan and Bahadur 2013).

Growth regulators and arbuscular mycorrhizae have been found to be the best for improving growth, quality attributes and postharvest life of gladiolus cv Jessica (Kumar and Gupta 2013). In this context the use of growth regulators and biofertilizers has been found effective in various ornamental crops. Growth and development behavior of bulbous plants are regulated either by a single or by an interaction of several hormones while biofertilizers are capable of mobilizing nutritive elements from non-usable resources in the soil to usable form through biological process (Kumar et al 2011). The conventional nutritional requirement (recommended dose of NPK fertilizers) has been standardized. However for getting more quantity of flowers farmers are using chemical fertilizers unscrupulously which are costly and create

threat to soil health. There is limited information regarding the role of micorrhizal fungi in gladiolus and optimum concentrations of growth regulators to be used for improving growth, flower quality and yield of spikes. Therefore the present experiment was conducted to elucidate the information on the effect of growth regulators and arbuscular mycorrhizal fungi (AMF) on growth, flowering and biochemical aspects in gladiolus cv Arka Amar.

MATERIAL and METHODS

The present field investigations were carried out at College of Horticulture, Dr YSR Horticultural University, Anantharajupeta, Andhra Pradesh during the year 2015. Commercially cultivated gladiolus variety cv Arka Amar was used in the experiment. Well rotten farm yard manure (25 tonnes/ha) was applied as basal dose and mixed well in the soil at the time of last ploughing and the nutrients viz N, P and K @ 100:87.50:87.50 kg per ha were applied in the form of urea, single super phosphate and muriate of potash respectively.

Urea was applied in 3 splits; the 1/3 of N was applied as basal in the soil before 15 days of planting and other two split doses were applied at 30 and 60 days after corm sowing. The entire dose of single super phosphate and muriate of potash was applied at the time of preparation of plots as per the recommendations of the Dr YSR Horticultural University for the gladiolus crop. Arbuscular mycorrhizal fungi (AMF) was procured from Agricultural Research Station, Amaravathi, Guntur district. The inoculant was mixed with soil on per corm basis @ 20 g per corm.

The treatments used were T₁ (Pre-soaking of corms with GA₃ 100 ppm + AMF), T₂ (Pre-soaking of corms with GA₃ 200 ppm + AMF), T₃ (Pre-soaking of corms with BA 25 ppm + AMF), T₄ (Pre-soaking of corms with BA 50 ppm + AMF), T₅ (Pre-soaking of corms with NAA 100 ppm + AMF), T₆ (Pre-soaking of corms with NAA 200 ppm + AMF), T₇ (T₁ + foliar spray with GA₃ 100 ppm), T₈ (T₂ + foliar spray with GA₃ 200 ppm), T₉ (T₃ + foliar spray with BA 25 ppm), T₁₀ (T₄ + foliar spray with BA 50 ppm), T₁₁ (T₅ + foliar spray with NAA 100 ppm), T₁₂ (T₆ + foliar spray with NAA 200 ppm) and T₁₃ (Control). The experiment was laid out in randomized block design comprising three replications and five plants were selected randomly in each plot and labeled for recording

observations. The observations were recorded on growth, flowering and biochemical attributes. The experimental data were analyzed as per Panse and Sukhatme (1985).

The observations on total carotenoid (Srivastava and Kumar 2009), phenol (Malik and Singh 1980) and carbohydrate (Hedge and Hofreiter 1962) contents in senescent florets were also recorded.

RESULTS and DISCUSSION

Two growth parameters were significantly influenced by various plant growth promoters and AMF tried (Table 1). Significantly taller plants (63.35 cm) and higher leaf count per plant (8.67) were recorded in the treatment T₈ (pre-soaking of corms with GA₃ 200 ppm + AMF + foliar spray with GA₃ 200 ppm). It might be due to increased cell division and cell elongation owing to growth regulators and increased uptake and transport of unusable forms of nutrients due to AMF resulting in increased height of plants, number of leaves per plant and involvement of N and P in the synthesis of photosynthates, growth stimulating compounds, absorption of nutrients, cell division and cell growth. Working with gladiolus Chandana and Dorajeerao (2014) put forward similar results.

Data (Table 1) indicate that flower attributes varied significantly among different treatments. Significantly higher floret count per spike was recorded in T₈ (14.27). Sajjad et al (2015) studied the effect of foliar application of nutrient solution containing gibberellic acid on growth and flower characteristics of gladiolus plants and found an increase in stem length, number of buds and flowers. Gladiolus cv Arka Amar plants treated with T₈ produced significantly maximum number of spikes per plant (2.20). More number of spikes per plant was recorded due to the influence of combination of growth regulator and AMF which might be due to increased availability of nitrogen and phosphorus as well as micronutrient like Zn which is precursor of auxin that improves the vegetative growth, dry matter accumulation and their partitioning towards the developing spike in gladiolus. These results are in close conformity with the study of Singh et al (2007).

T₈ lead to significantly longer spikes (75.33 cm). The possible reason could be that length of the spike was directly influenced by the growth characters of the plant which was determined by nutrients, plant

Table 1. Effect of plant growth regulators and AMF on in gladiolus cv Arka Amar

Treatment	Growth parameter			Flowering attribute			Biochemical trait in senescent florets		
	Plant height (cm)	# leaves/ plant	# florets/ spike	Spike length (cm)	# spikes/ plant	Fresh weight of cut spike (g)	Carotenoid content (mg/g)	Total phenols (mg/g)	Total carbohydrates (mg/g)
T ₁	58.22 ^{bc}	7.13 ^{cd}	12.40 ^{bc}	64.37 ^{cde}	1.67 ^{cde}	34.79 ^{abcde}	0.45 ^f	0.88 ^{fgh}	11.60 ^f
T ₂	58.58 ^b	7.27 ^{cd}	12.47 ^{bc}	65.37 ^{cde}	1.93 ^{abcd}	35.25 ^{abcde}	0.53 ^e	0.90 ^{efg}	12.40 ^{de}
T ₃	56.43 ^{bc}	7.07 ^{cd}	13.00 ^b	63.58 ^{de}	1.63 ^{cde}	32.56 ^{cde}	0.51 ^e	0.90 ^{efg}	12.20 ^{de}
T ₄	58.00 ^{bc}	7.20 ^{cd}	12.93 ^b	64.61 ^{cde}	1.80 ^{bcd}	33.80 ^{bcde}	0.58 ^d	0.91 ^{def}	12.60 ^d
T ₅	56.25 ^c	7.00 ^{cd}	12.27 ^{bc}	61.43 ^{de}	1.53 ^e	31.39 ^{de}	0.32 ^h	0.85 ^h	9.80 ^h
T ₆	57.85 ^{bc}	7.07 ^{cd}	12.33 ^{bc}	62.00 ^{de}	1.60 ^{de}	31.40 ^{de}	0.33 ^{gh}	0.87 ^{gh}	10.40 ^g
T ₇	61.74 ^a	7.87 ^{abc}	13.20 ^b	70.40 ^{abc}	2.00 ^{abc}	37.72 ^{abc}	0.66 ^c	1.00 ^c	13.42 ^c
T ₈	63.35 ^a	8.67 ^a	14.27 ^a	75.33 ^a	2.20 ^a	39.35 ^a	0.73 ^b	1.20 ^b	15.00 ^a
T ₉	61.25 ^a	8.27 ^{ab}	13.13 ^b	67.80 ^{bcd}	2.00 ^{abc}	38.56 ^{ab}	0.72 ^b	1.20 ^b	14.30 ^b
T ₁₀	62.34 ^a	7.73 ^{bc}	13.27 ^{ab}	73.40 ^{ab}	2.07 ^{ab}	37.64 ^{abc}	0.76 ^a	1.24 ^a	15.21 ^a
T ₁₁	57.23 ^{bc}	7.73 ^{bc}	12.67 ^{bc}	63.97 ^{cde}	1.87 ^{abcde}	36.65 ^{abcd}	0.35 ^g	0.92 ^{de}	12.00 ^{ef}
T ₁₂	58.48 ^b	7.60 ^{bc}	12.80 ^{bc}	64.29 ^{cde}	1.93 ^{abcd}	36.79 ^{abcd}	0.45 ^f	0.94 ^d	13.20 ^c
T ₁₃ (control)	47.35 ^d	6.67 ^d	11.80 ^c	59.97 ^e	1.00 ^f	30.89 ^e	0.17 ⁱ	0.79 ⁱ	8.40 ⁱ
SEEm ±	0.72	0.30	0.35	2.34	0.13	1.90	0.007	0.013	0.149
CD _{0.05}	2.15	0.88	1.02	6.82	0.38	5.54	0.021	0.038	0.435

The figures in column bearing same alphabet do not differ significantly, T₁ (Pre-soaking of corms with GA₃ 100 ppm + AMF), T₂ (Pre-soaking of corms with GA₃ 200 ppm + AMF), T₃ (Pre-soaking of corms with BA 25 ppm + AMF), T₄ (Pre-soaking of corms with BA 50 ppm + AMF), T₅ (Pre-soaking of corms with NAA 100 ppm + AMF), T₆ (Pre-soaking of corms with NAA 200 ppm + AMF), T₇ (T₁ + foliar spray with GA₃ 100 ppm), T₈ (T₂ + foliar spray with GA₃ 100 ppm), T₉ (T₃ + foliar spray with BA 25 ppm), T₁₀ (T₄ + foliar spray with BA 50 ppm), T₁₁ (T₅ + foliar spray with NAA 100 ppm), T₁₂ (T₆ + foliar spray with NAA 200 ppm), T₁₃ (Control)

growth regulators and AMF. These results are in alliance with the observations of Kumari et al (2013) and Aier et al (2015) in gladiolus. Maximum fresh weight of spike (39.35 g) was also recorded in T₈ which could be due to the reason that gibberellic acid increased hexose sugar availability in the cell by increasing α -amylase activity. Similar results were also obtained by Padmalatha et al (2013) in gladiolus.

Different growth regulator combinations along with AMF showed significant influence on all biochemical traits. The input T₁₀ (Pre-soaking of corms with BA 50 ppm + AMF + foliar spray with BA 50 ppm) resulted in significantly maximum carotenoid content (0.76 mg/g) in senescent flowers. Decreased carotenoid content in senescent florets might be due to increased pH of the florets. Increase in pH might have resulted in accumulation of ammonia that limited the carbohydrate content in petal tissues which is responsible for low pigmentation. Pre-soaking and foliar application of BA might have effectively increased the carotenoid content and delayed the degradation of carotenoids in senescent flowers in comparison to control. The results are in agreement with the findings of Kumar and Gupta (2013) in gladiolus.

Significantly highest total phenol content in senescent florets was also recorded in T₁₀ (1.24 mg/g). The reason for the above finding could be that abolition of the compartment of the vacuole and the release of hydrolytic enzymes result in the cell death and leakage of phenol from the vacuole and their consequent interaction with the remaining function elements of the cells that leads to senescence. Similar type of results were also reported by Kumar and Gupta (2013) in gladiolus. The phenolic compounds help in strengthening the defense system of plant against diseases and abiotic stresses.

The treatment T₁₀ was found significantly superior in recording total carbohydrate content (15.21 mg/g). Increased total carbohydrate content might be due to increased synthesis of photosynthates. Flower senescence was characterised by a decline in the content of carbohydrates. The changes in total carbohydrates are accompanied by starch hydrolysis and increased respiration rate. These results are in accordance with the findings of Eid and Abou-Leila (2006) who reported that foliar application of gibberellic acid on ornamental plants increases carbohydrates in leaves.

CONCLUSION

From the above investigations it was concluded that pre-soaking of corms with GA₃ 200 ppm + AMF + foliar spray with GA₃ 200 ppm appears to be an optimum nutrient combination for enhancing growth and flowering and pre-soaking of corms with BA 50 ppm + AMF + foliar spray with BA 50 ppm for biochemical traits in gladiolus cv Arka Amar.

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