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EFFECT OF SPACING AND NITROGEN ON FLORAL AND VASE LIFE PARAMETER OF GLADIOLUS (*GLADIOLUS GRANDIFLORUS* L.) CV. AMERICAN BEAUTY

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ABSTRACT
An experiment conducted on effect of spacing and nitrogen on floral and vase life parameter of gladiolus (*Gladiolus grandiflorus* L.) cv. American Beauty. The treatments comprised of three levels of spacing (40 x 15 cm, 40 x 20 cm and 40 x 25 cm) and four levels of nitrogen (150, 200, 250 and 300 kg ha^{-1}) in a randomized block design with factorial concept and replicated thrice. The results revealed that wider spacing 40 x 25 cm and fertilized with 250 kg N ha^{-1} recorded best spike quality and maximum post- harvest life of gladiolus spike characters *viz*., number of florets per spike, spike fresh weight (g), floret diameter (cm), rachis length (cm), flowering span (days), *in-situ* spike longevity (days) and vase life (days).

INTRODUCTION

Gladiolus grandiflorus, generally called "sword lily" due to foliage shape belong to family Iridaceae and originated from South Africa, is a prominent bulbous cut flower plant. (Sharma *et al.,* 2013). Gladiolus is known as queen of the bulbous plants, which is valued for its beautiful flower spikes. Its cultivation is getting popular for its beautiful flowering spikes due to more vase life as a cut-flower. Its magnificent inflorescence with variety of colors and number of pretty florets has made it attractive for diversified use in the garden. It is an important cut-flower in both domestic and international market. Optimum plant spacing is an important practice for providing better light interception, moisture, nutrients which are vital for successful crop production and quality. Plant spacing affects yield, quality of spikes and corms production. Many researchers conducted various experiment related to plant spacing and found that wider spaces can produced higher number of corm and cormels. Whereas, had observed that plant spacing had non-significant effects on spike length, floret size, number of florets $spike^{-1}$ or the size of corms produced. However, number of spikes plus corms and cormels produced $plot^{-1}$ was affected by plant spacing. The best commercial quality of gladiolus was obtained at a planting density of 25 plants m^{-1}. This objective can be achieved through balanced and judicious application of plant nutrients and adopting proper spacing for plant growth.

Nutrient status of the plants can be a pointer to the response of plant to the fertilization and internal content of the nutrients determine the fertilizer requirements. Nitrogen applied as fertilizer is the main source used to meet the N requirements of plant growth. (Polara *et al.*, 2014). The nutrients such as nitrogen play a major role in the growth and development of plants. Nitrogen as an essential macro element that improves the chemical and biological properties of soil and thereby stimulates the production of higher yield in plants. It should be emphasized that to increase plant quality and productivity nutrients need to be available from the soil during a plant's growth period. Nitrogen fertilizer is one of the important factors in canopy formation that its deficiency leads to a decrease of photosynthesis. Nitrogen and phosphorous are essential macro elements for growth but potassium has effect on quality parameter.

MATERIALS AND METHODS

The experiment was conducted during winter season of 2014-2015 at the Fruit Research Station, Jambuvadi Farm, College of Agriculture, Junagadh Agricultural University, Junagadh. Which is located at 21° 30' 6.4296'' N latitude and 70° 26' 58.2504'' E longitude and at an altitude of 61 m above mean sea level. The 'Junagadh region' is included in the 'West-Coast-

Kathiawar Peninsula' of Gujarat state and under the South Saurashtra Agro Climatic Zone –VII of Gujarat state. The medium to shallow black soils of this region is classified as Verticustochrepts. Soil properties of the experimental field are EC- 0.20 dSm^{-1} pH-7.85, available N- 237.8 kg^{-1}, P- 30.30, 237.8 kg^{-1}, K- 284 $kg^{-1}$and The experiment was conducted in a factorial randomized block design involving three levels of spacing *i.e.* S_1 (40 x 15 cm), S_2 (40 x 20 cm) and S_3 (40 x 25 cm) and four levels of nitrogen doses *viz.* N_1 (150 kg ha^{-1}) N_2 (200 kg ha^{-1}), N_3 (250 kg ha^{-1}) and N_4 (300 kg ha^{-1}). Thus total 12 treatment combinations were included with three replications. Gladiolus corms have uniform size (3.5-4.0 cm) were selected and treated with Bavistin 0.1 percent solution for 20 minutes, a day before planting and allowed to dry overnight under shade.

The half-dose of nitrogen along with full dose of phosphorus and potassium was given in the form of basal dose which was thoroughly mixed in experimental plots before planting. Remaining half-dose of nitrogen applied at 30 days after planting in the form of top dressing. The various observations on floral and vase life parameters were recorded on five plants randomly selected from net plot area and tagged. The data collected for all the characters studied were subjected to statistical analysis by adopting 'Analysis of Variance' (ANOVA) technique for factorial randomized block design as suggested by Panse and Sukhatme (1967).

RESULTS AND DISCUSSION

Effect of spacing and nitrogen on floral parameter

The data represented (Table 1) on number of florets per spike was significantly influenced by different level of spacing and the maximum number of florets per spike (9.30) was recorded when plant spacing 40 x 25 cm, respectively. While, minimum number florets per spike (7.30) was observed in 40 x 15 cm spacing, respectively. The closest spacing resulted in poorest performance on size and number of florets as reported by Singh and Bijimol, (2003). It might be due to less competition among the plants for nutrient and light and wider spacing specifically required for development of proper number of florets. These results are in agreement with Ahmed *et al.* (2012), in gladiolus, Khalaj *et al.* (2012), Khalaj and Edrisi (2012) in tuberose and Pavagadhi *et al.* (2014) in candytuft.

The application of different level of nitrogen had significant effect on number of florets per spike. The data presented in Table 1 revealed that significantly the highest number of florets per spike (9.36) was recorded in 250 kg N ha^{-1}, respectively which was at par with 200 kg N ha^{-1} and minimum number of florets per spike (7.73) was observed in 150 kg N ha^{-1}. The similar result found that the spray of higher concentration urea produced maximum number of florets per spike in gladiolus. Similar results founded Kumar *et al.* (2003) in China aster, Lehri *et al.* (2011), Singh and Bijimol (2003) and Singh and Bijimol (2000) in gladiolus.

The floret diameter as influenced by different level of spacing. Significantly the maximum floret diameter (9.69 cm) was noticed in 40 x 25 cm spacing. Which was at par with 40 x 20 cm spacing. While, minimum floret diameter (8.22 cm) was observed in 40 x 15 cm spacing. Wider spacing was mainly due to less competition among the plants for nutrient and light. Similar results were also recorded by Ramachandrudu and Tangam (2007), Dogra *et al.* (2012) in gladiolus, Pavagadhi *et al.* (2014) in candytuft, Dhatt and Kumar (2007) in *Coreopsis lanceolata* and Karuppaiah and Krishna (2005) in French marigold.

The diameter of floret was significantly influenced by nitrogen application of different levels. However, highest floret diameter (9.86 cm) was observed when plant treated with 250 kg N ha^{-1} which was found statistically at par with 200 and 300 kg N ha^{-1} and the minimum floret diameter (8.22 cm) was noted in 150 kg N ha^{-1}. The positive role of nitrogen might be due to its effect on the uptake of other nutrient. The application of N enhanced the rate of utilization of P and K by gladiolus plant and K improve the quality of flower. The present findings are in accordance to the earlier observations made by other workers in gladiolus plant. Chanda *et al.* (2000), Singh and Bijimol (2000), Singh and Bijimol (2003) and Verma *et al.* (2012).

Table 1: Effect of spacing and nitrogen on floral parameters in gladiolus cv. 'American Beauty'.

Treatments	Florets per spike	Spike fresh weight (g)	Floret Diameter (cm)	Rachis Length (cm)	Flowering span (days)	*In- situ* spike longevity (days)
Factor - Spacing (S)						
S_1 (40 x 15 cm)	7.30	44.28	8.22	33.03	19.30	10.03
S_2 (40 x 20 cm)	8.65	46.32	8.96	35.28	19.98	11.55
S_3 (40 x 25 cm)	9.30	50.19	9.69	36.92	21.75	12.17
S.Em. ±	0.23	1.25	0.26	0.83	0.53	0.30
C.D. at 5%	0.69	3.67	0.76	2.42	1.56	0.87
Factor – Nitrogen (N)						
N_1 (150 Kg ha^{-1})	7.73	44.74	8.22	33.54	19.44	10.33
N_2 (200 Kg ha^{-1})	8.93	47.04	9.12	35.83	20.13	11.69
N_3 (250 Kg ha^{-1})	9.36	50.58	9.86	37.27	22.07	12.24
N_4 (300 Kg ha^{-1})	7.64	45.37	9.05	33.65	19.73	10.73
S.Em. ±	0.27	1.45	0.30	0.95	0.62	0.34
C.D. at 5%	0.79	4.24	0.88	2.80	1.80	1.00
Interaction (S x N)						
S.Em. ±	0.46	2.5	0.51	1.6	1.06	0.59
C.D. at 5%	NS	NS	NS	NS	NS	NS
C.V. %	9.65	9.24	10.11	8.16	9.07	9.09

Table 1: Effect of spacing and nitrogen on vase life (days) in gladiolus cv. 'American Beauty'

Treatments	Spike vase life (days)
Factor – Spacing (S)	
S_1 (40 x 15 cm)	10.10
S_2 (40 x 20 cm)	11.38
S_3 (40 x 25 cm)	12.13
S.Em. ±	0.31
C.D. at 5%	0.90
Factor – Nitrogen (N)	
N_1 (150 Kg ha^{-1})	10.31
N_2 (200 Kg ha^{-1})	11.47
N_3 (250 Kg ha^{-1})	12.20
N_4 (300 Kg ha^{-1})	10.84
S.Em. ±	0.35
C.D. at 5%	1.04
Interaction (S x N)	
S.Em. ±	0.61
C.D. at 5%	NS
C.V. %	9.49

Although fresh weight of spikes was significantly influenced by different levels of spacing and the maximum fresh weight of spikes (50.19g) was recorded when plant planted with 40 x 25 cm spacing, respectively. While, minimum fresh weight of spikes (44.28g) was observed in 40 x 15 cm spacing, respectively. The production of spikes have more florets and more carbohydrates accumulation in sink may probably be due to less competition between plants for water, mineral nutrient and light. Present finding are in conformity Ramachandrudu and Tangam (2007) in gladiolus, Khalaj *et al*. (2012) in tuberose and Pavagadhi *et al*. (2014) in candytuft.

Moreover, application of different levels of nitrogen had significant effect on fresh weight of spikes. The data presented in Table 1 revealed that significantly the maximum fresh weight of spikes (50.58g) was recorded in 250 kg N ha^{-1}, respectively. Which was statistically at par with 200 kg N ha^{-1} and the minimum fresh weight of spikes (44.74g) was observed in 150 kg N ha^{-1}. This increase in spike fresh weight might be due to greater uptake of nutrients into the plant system which involved in cell division, cell elongation as well as protein synthesis which ultimately enhanced the spike length and more accumulation of carbohydrates in sink from source.

The rachis length as influenced by different level of spacing. Significantly the maximum rachis length (36.92 cm) was noticed in 40 x 25 cm spacing which was statistically at par with 40 x 20 cm spacing. While, the minimum rachis length (33.03 cm) was observed in 40 x 15 cm spacing. This might be due to the fact that the closer spacing hampered intercultural operations and as such more competition arises among the plants for nutrients, air, and light. As a result, plant becomes weaker, thinner and consequently affects the floral parameters. These results are in agreement with the findings of Dogra *et al*. (2012), Bhat *et al*. (2010) and Ahmed *et al*. (2010), Khalaj *et al*. (1999), Singh and Singh (2000) in gladiolus.

It is evident from the data (Table 1) revealed that the rachis length was significantly influenced by nitrogen application of different level. The maximum rachis length (37.27 cm) was observed when plant treated with 250 kg N ha^{-1} which was statistically at par with 200 kg N ha^{-1} and the minimum rachis length (33.54 cm) was noted in 150 kg N ha^{-1}. This increase in rachis length might be due to greater uptake of nutrients into the plant system which involved in cell division, cell elongation as well as protein synthesis which ultimately enhanced the rachis length and quality parameters. The similar results found by Kumar *et al*. (2003) in China aster and Lehri *et al*. (2011) in gladiolus.

The variations in flowering span due to different treatments were found significant. The maximum flowering span (21.75 days) was noted in spacing 40 x 25 cm. While minimum flowering span (19.30 days) observed in spacing 40 x 15 cm. and in case of nitrogen flowering span significantly influenced was noticed when nitrogen applied 250 kg ha^{-1} (22.07 days) and minimum flowering span (19.44 days) was observed in 150 kg N ha^{-1}. Chanda *et al*. (2000) reported that increase the doses of nitrogen resulted delayed the emergence of spike and nitrogen promotes vegetative growth in gladiolus.

In-situ spike longevity was significantly influenced different levels in spacing. Significantly the maximum spike longevity (12.17 days) was obtained in 40 x 25 cm which was statistically at par with spacing at 40 x 20 cm and the minimum spike longevity (10.03 days) was observed in 40 x 15 cm spacing. These results are in agreement with the findings of Singh and Bijimol (2003) observed that the spike harvested from the wider spacing absorbed maximum water during vase life of cut gladioli and the widest spacing recorded highest vase life as compared to closest spacing. Tuberose vase life increased with increasing plant spacing in tuberose Mane *et al*. (2006).

In-situ spike longevity was significant differences observed due to applications of different levels of nitrogen. The maximum spike longevity (12.24 days) was recorded in 250 kg N ha^{-1} which was at par with 200 kg N ha^{-1} and the minimum spike longevity (10.33 days) was observed at 150 kg N ha^{-1}. Singh and Bijimol (2003) observed that the nitrogen is essential constituent of various proteins and take active part in various metabolic processes which might have some role in augmenting the *in-situ* longevity of cut gladioli.

Vase life parameters

The data indicated (Table-2) on spike vase life of spike was significantly influenced by different levels of spacing. Significantly the maximum spike vase life (12.13 days) was obtained in 40 x 25 cm and the minimum spike vase life (10.10 days) was observed in 40 x 15 cm spacing, which was statistically at par with 40 x 20 cm spacing.

This positive response of wider spacing resulted more vegetative growth and quality cut spike production might be due to availability of more area per plant for absorption of nutrients and moisture, no shading effect which ultimate increased the rate of net photosynthesis and translocation of assimilates to the storage organs. The carbohydrate reserves in the flower and spike probably maintains pool of dry matter and repairable substance, especially in petals, thus promoting respiration and extending longevity in gladiolus. These results are in agreement with the findings of Singh and Bijimol (2003) observed that the spike harvested from the wider spacing absorbed maximum water during vase life of cut gladioli and the widest spacing recorded highest vase life as compared to closest spacing. Tuberose vase life increased with increasing plant spacing in tuberose Mane *et al*. (2006).

Significantly the maximum spike vase life (12.20 days) was recorded 250 kg N ha^{-1} which was statistically at par with 200 kg N ha^{-1} and the minimum spike vase life (10.31 days) was observed at 150 kg N ha^{-1} respectively. The maximum spike vase life there were significant differences observed due to applications of different level of nitrogen Singh and Bijimol (2003) observed that the nitrogen is essential constituent of various proteins and take active part in various metabolic processes which might have some role in augmenting the vase life of cut gladioli.

Interaction effect

The interaction effect for floral and spike vase life parameters were found non-significant.

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