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Cultivar Effects on Growth, Yield and Cormel Production of Gladiolus (*Gladiolus grandiflorus* L.)

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Abstract

Gladiolus (*Gladiolus grandiflorus* L.), a popular bulbous cut flower, has high demand in both domestic (Pakistani) as well as international markets. Five potential, exotic cultivars of gladiolus, 'Cantate', 'Corveira', 'Eminence', 'Essential' and 'Fado' were evaluated to determine the cultivar effects on yield and quality, to compare their relative performance and recommend their suitability for commercial production. Among the tested cultivars, 'Essential' performed best for early spike emergence (74.2 d), greater number of leaves plant^{-1} (8.8), number of florets spike^{-1} (13.9), spike length (46.8 cm), spike diameter (1.0 cm), vase life (14.3 d), cormel diameter (0.7 cm) and average weight of a cormel (0.3 g). 'Corveira' ranked second for most of the above mentioned growth and yield indices. Earlier sprouting (4.6 d), and higher number of cormels clump^{-1} (283.0) was recorded in 'Fado', while leaf area and stem length was greater in 'Cantate', (98.6 cm^{2} and 84.7 cm, respectively). 'Eminence' 'Cantate' and 'Corveira' had higher total leaf chlorophyll contents (0.2 mg g^{-1} each), while 'Eminence' took longer time for spike emergence (103.5 d) among all tested cultivars. In summary, 'Essential' followed by 'Corveira' and 'Fado' performed better than 'Eminence' and 'Cantate'. Therefore, growers may consider selection of these cultivars with improved yield and quality characteristics for commercial production.

Keywords: Commercial production, Corm, Cultivar evaluation, Cut flower, Growth, Sword lily.

INTRODUCTION

Aesthetic thrust sets the tone and tenor of growing flowers around the globe (Byczynsky, 1997). Floriculture has emerged as potential business due to divergence of growers towards high value floral crops and utilization in social, industrial and religious festivities (Riaz *et al*., 2007). As this business is flourishing day by day, the growers are heading towards growing non-conventional crops like cut flowers in order to increase their economic return. In last few years, increased awareness and recognition of high return on investments coupled with ever increasing desire to live in a healthy and sound environment and expansion in hotels and restaurants' business has led to demanding and choosy clients (Ahmad *et al*., 2008). In recent years, growing of non-traditional high value horticultural crops has become a popular way to fetch higher profits which may also help improve the economic livelihood of the growers by raising their living standards. However, to get maximum benefit of these crops, their production and postharvest handling technologies need to be optimized. Currently, there is dire need to standardize agro-techniques for potential cut flower crops for different regions, which are most suitable to local climatic and edaphic conditions (Ahmad *et al*., 2008).

Gladiolus (*Gladiolus grandiflorus* L.) a member of the family Iridaceae, ranks second top selling cut flower in Pakistan after roses (Riaz *et al*., 2007). Available in different shapes and hues with excellent vase life, gladioli are considered elite among cut flowers (Bose *et al*., 2003). Gladiolus is native to subtropical climate of South Africa (van Wyk *et al*., 1997), and different parts of Punjab, Pakistan, which lies between 31.15°N and 73.0ºE share almost similar climate (Oxford Atlas for Pakistan, 2006). It is believed that agro-ecological conditions of Punjab, Pakistan are conducive for gladiolus production. Although several cultivars are available in the local markets, yet they lack the characteristics to qualify for export to global markets. Moreover, there is always demand for promising, new cultivars with improved yield and quality attributes. This necessitated the need of evaluation of five promising exotic cultivars recently introduced in Pakistani markets by Stoop flower bulb Co., Netherlands, in order to screen them before releasing for commercial production in the region. Cultivar selection was based on their higher yield potential, disease resistance and other desirable floral quality characteristics. Cultivation of superior quality exotic cultivars is one possible tool to compete in global markets; however, it requires the evaluation of their performance and adaptability under local conditions before commercial cultivation.

Both the soil and climatic conditions have profound effect on the nourishment, growth and subsequent survival of plants. Growth and yield performance of gladiolus is strongly influenced by different climatic conditions (Lu *et al*., 1996). Al-Humaid (2004) demonstrated that besides the genetic make up, environmental conditions are also important factors which determine the growth and development of gladiolus under specific conditions. Many studies have reported the influence of climatic and edaphic factors on performance of different cultivars of gladiolus (Arora and Sandhu, 1987; Leena *et al*., 1993). However, limited literature is available on the performance of different gladiolus cultivars in Pakistan. Moreover, it is also need of the time to provide new cultivars to the growers for more variety of colors, extended availability, superior quality with longer vase life, and to overcome pest and disease problems associated with old cultivars.

Based on rapidly increasing demand of gladiolus in both local and global markets, this study was conducted to evaluate the comparative performance of five exotic cultivars of gladiolus in order to screen and recommend best quality and high yielding cultivars for commercial production, and to determine the cultivar effect on gladiolus yield, and quality.

MATERIALS AND METHODS

This study was conducted at the Floriculture Research Area, Institute of Horticultural Sciences, University of Agriculture, Faisalabad, Pakistan, during 2009-10. Five exotic cultivars of gladiolus viz. 'Cantate', 'Corveira', 'Eminence', 'Essential' and 'Fado' were grown in field conditions. Corms were imported from The Netherlands (Stoop Flower Bulb Co., Netherlands) and kept in cold storage at 4 ± 1°C to break their dormancy prior to planting. Before planting, corms were shifted to the laboratory and kept at 25 ± 2°C for a week. Soil used in the study was analyzed for its physico-chemical properties (Table 1). The experiment was laid out according to randomized complete block design with five treatments (cultivars) replicated thrice and 80 corms were planted per replicate for each treatment. The corms were planted at a planting depth of 10 cm during first week of November, 2009, on 60 cm spaced ridges with 10 cm between corms. All cultural practices (nutrition, irrigation, weeding, staking (supporting tall stems with sticks/ netting), earthing up (covering stem bases with additional soil during growth for providing strength to the stem and encouraging root growth), IPM etc.) were similar during the study period. The environmental conditions during the study period were recorded as reported in Table 2.

Data were recorded on time to 50% sprouting (days until 50% of corms of each cultivar sprouted), plant height (cm; at flower emergence), number of leaves plant-1 (calculated at spike emergence), total leaf chlorophyll contents (mg g-1) measured according to the method described by Arnon (1949) and Davies (1976) using following equation: Total chlorophyll contents = [20.2(OD645) + 8.02(OD663)] x V/1000 x W, time to spike emergence (days from planting to spike emergence), number of florets spike^{-1}, stem length (cm; from base of stem to top of upper floret), spike length (cm; from base of lower floret to top of upper floret), spike diameter (cm; measured at lower most floret), bud diameter (cm; of lower most floret), vase life (d; days from putting stems in water after harvest until > 50% of petals wilted on each stem), number of cormels clump^{-1}, cormel diameter (cm) and weight of a cormel (g). Total leaf chlorophyll contents were measured by first chopping fresh leaves into segments of 0.5 cm length and extracting 0.5 g sample with 5 ml 80% acetone at 10 °C over night. The material was centrifuged at 14000 rpm for five min. and the absorbance of the supernatant was measured at 645, 652 and 663 nm on spectrophotometer.

All the data were analyzed by Fisher's analysis of variance technique (Steel *et al*., 1997) and treatment means were separated using Fisher's LSD at P ≤0.05.

RESULTS AND DISCUSSION

Among the tested cultivars, 'Fado' had uniform and early sprouting (4.6 d; Fig. 1). 'Essential' (5.8 d) and 'Corveira' (5.9 d) were statistically at par. However, 'Eminence' took longer time for sprouting (7.4 d). 'Cantate' produced taller plants (55.3 cm) and was statistically similar to 'Fado' (54.5 cm) and 'Eminence' (51.6 cm) (Fig. 3). 'Essential' had greater number of leaves plant^{-1} (8.8; Fig. 1). While, higher leaf area was recorded in 'Cantate' and 'Fado' (98.64 and 94.39 cm^2, respectively; Fig. 3). 'Corveira' had smaller leaf area (83.04 cm2). 'Eminence', 'Cantate' and 'Corveira' had greater total leaf chlorophyll contents (0.2 mg g-1; Fig. 2), while 'Essential' produced spikes earlier (74.2 d) than other cultivars. 'Eminence' took longer time to produce spikes (103.5 d), therefore, may not be suitable for early production (Fig. 3). Earlier sprouting in 'Fado' might be due to differential genetic capabilities, temperature requirements, dormancy and stored food reserve, which resulted in different sprouting times under prevailing agro-climatic conditions. Different cultivar response regarding germination/ sprouting has been reported in several studies (Zubair *et al*., 2006; Arora and Sandhu, 1987). Whereas, Vinceljak (1990) reported that period between planting and sprouting was almost same for different cultivars. Taller plants were produced by 'Cantate' which depicted its compatibility with prevailing edaphic and climatic conditions. The results confirmed the findings of Al-Humaid (2004) who reported that not only the genetic make up but also the environmental conditions are important factors determining the success of gladiolus cultivars. As number of leaves was greater in 'Essential' which served as plant photosynthates synthesis factories and shortened the time for spike emergence and helped plant complete its life cycle earlier than those with less number of leaves. Although leaf area was more in 'Cantate', but it had fewer leaves, so less food producing units leading to less amount of synthesized food. Similarly, leaf chlorophyll contents were higher in leaves of 'Eminence' but with less number of leaves/food manufacturing factories. It not only promoted the vegetative attributes of growth but also floral attributes (number of florets spike^{-1}, stem length, spike length, spike diameter, bud diameter and vase life) as more carbohydrates were stored due to greater food producing units. More food synthesized by leaves contributed to better vegetative as well as reproductive growth of 'Essential'. Less photosynthates along with genetic and agro-climatic differences may have resulted in prolonged period of vegetative growth. These results are in accordance with those of Al-Humaid, (2004), Zubair *et al*. (2006) and Javvad *et al*. (2012) who reported different time durations for first flower emergence in different cultivars under prevailing agro-climatic conditions and growing different cultivars with different genetics.

Cultivars also had significantly different floral behavior (Figs. 4-6). 'Essential' had highest number of florets spike $^{-1}$ (13.9), longer spike length (46.8 cm), higher spike diameter (1.02 cm), bud diameter (1.36 cm) and longer vase life (14.3 d) as compared with other cultivars. However, 'Cantate' produced longer stem length, and statistically similar bud diameter and vase life with 'Eminence'. For cormel production, 'Fado' produced greater number of cormels (283.0 clump^{-1}) (Fig. 7), while 'Essential' had minimum number of cormels clump^{-1} (121.7). Cormel diameter was highest for 'Essential' (0.74 cm) followed by 'Corveira' (0.67 cm) while 'Fado' had very small sized cormels with only 0.55 cm diameter Fig. 8). Weight of a cormel was highest for 'Essential' (0.26 g) followed by 'Corveira' (0.22 g), while minimum cormel weight was observed in 'Fado' (0.14 g). These results revealed superiority of 'Essential' which might be more adaptable to the agro-climatic conditions of the production region. These results confirmed the findings of Khan and Ahmad (2004) and Javvad *et al*., (2012) who reported great effect of plant nutrition and cultivars (genetics) on yield, quality and vase life of gerbera.

In summary, there were significant differences between gladiolus cultivars for yield, vase life, and cormel production, which suggested that along with genetic diversity, and agro-climatic conditions and management practices, cultivar selection play pivotal role in determining yield and final product quality. In this study, 'Essential' proved best cultivar compared with other cultivars and was best suited for commercial cultivation followed by 'Corveira' and 'Fado' for their unique hue of floret colors, good quality stems, and shorter crop duration. These results may serve as useful information for the consideration of growers while selecting cultivars gladiolus for regions with similar agro-climatic conditions as Punjab, Pakistan.

Literature Cited

Ahmad, T., Ahmad I. and Qasim, M. 2008. Present status and future prospects of gladiolus cultivation in Punjab, Pakistan. J. Tekirdag Agri. Facul. 5: 227-238.

Al-Humaid, A. I 2004. Adaptation of some gladiolus cultivars to Al-Qassim environmental conditions. Arab gulf J. Scient. Res. 22: 248-256.

Arnon, D. I., 1949. Copper enzymes in isolated chloroplasts; polyphenol oxidase in Beta vulgaris. Plant Physiol. 24: 1–15.

Arora, J.S. and Sandhu, G.S. 1987. Effect of two planting dates on the performance of fifteen gladiolus cultivars. P. Hort. J. 27: 243-249.

Bose, T.K., Yadav, L.P., Pal, P., Parthasarathy, V.A. and Das, P. 2003. Commercial Flowers. Vol. 2. Naya Udyog, Kolkata, India.

Byczynski, L. 1997. The Flower Farmer: An Organic Growers Guide to Raising and Selling Cut Flowers. White River Junction, Chelsea Green Publishing Company. VT.

Davies, B.H. 1976. Carotenoids. In: Goodwin, T. W. (ed), The Biochemistry of Carotenoids, Academic Press, NY, p. 38–165.

Hartmann, H.T., Flocker, W.J. and Kofranek, A.M. 1981. Plant Science. Growth, Development and Utilization of Cultivated Plants. Prentice Hall, Inc., NJ, p. 195-221.

Javvad, N.D.M., Mahmood, P.Y., Roya, K. and Hamideh, J.H. 2012. Effect of cultivar on water relations and postharvest quality of gerbera (Gerbera jamesonii Bolus ex. Hook f.) cutflower. World Appl. Sci. J. 18: 698-703.

Khan, M.A. and Ahmad, I. 2004. Growth and flowering of *Gladiolus hortulanus* L. cv. Winf Song as influences by various levels of NPK. Intl. J. Agri. Biol. 6: 1037-1039.

Leena, R., Rajeevan, P.K. and Aravindakshan, M. 1993. Influence of the performance of selected gladiolus varieties. J. Trop. Agri. 31: 210-214.

Lu, Y.T., Zhou, D.Y., Shen, S.J., Wang, Y.J., Chen, A.X. and Yang, S.Z. 1996. Study on gladiolus seed bulb production in South China. Acta Agric. Zhejiangensis. 8: 102-105.

Riaz, T., Khan, S.N. and Javaid, A. 2007. Scenario of gladiolus production in Punjab, Pakistan. Pak. J. Bot. 39: 2389-2393.

Steel, R.G.D., Torrie, J.H. and Dickie, D.A. 1997. Principles and Procedures of Statistics: A Biometric Approach. (3rd ed.). Mc Graw-Hill. San Francisco, CA.

van Wyk, B.E., VanOudtshoorn, B. and Gericke, N. 1997. Medicinal Plants of South Africa. Briza Publ. South Africa.

Vinceljak, T.M. 1990. The effect of corm size on corm yield of gladiolus cultivars Oscar and Peter Pears. Poljoprivredna Znanstvena Smotra. 55: 379-392.

Zubair, M., Ayub, G., Wazir, F.K., Khan, M. and Mahmood, Z. 2006. Effect of potassium on preflowering growth of gladiolus cultivars. J. Agri. Biol. Sci. 1: 36-46.

Tables

Table 1. Physico-chemical properties of experimental site. Soil was sampled before planting the corms, labeled, and forwarded to soil testing laboratory, Fauji Fertilizer Co., Faisalabad, Pakistan, for analysis

Soil characteristics	Depth (cm)	
	0-15	**15-30**
Texture	Loamy	Loamy
pH	8.30	8.20
EC (dSm^{-1})	0.36	0.24
Exchangeable Na (m mol 100^{-1}g)	0.90	0.80
Organic matter (%)	0.85	0.66
Nitrogen (%)	0.05	0.04
Available P (mg L^{-1})	8.00	6.00
Exchangeable K (mg L^{-1})	120.00	128.00

*According to Duncan's multiple rang test, values of each column followed by same letters are not significantly different (P= 0.01).

Table 2. Environmental conditions of experimental site during the study period

Months	Temperature (°C)			Relative humidity (%)	Rain fall (mm)
	Max.	Min.	Ave.		
November	25.7	10.8	18.2	65	0.7
December	22.1	7.0	14.5	64	0
January	16.2	6.0	11.1	82	0.8
February	22.0	9.5	15.7	63	11.9
March	30.4	16.5	23.5	58	8.8
April	38.4	21.4	29.9	37	1.3

Figures

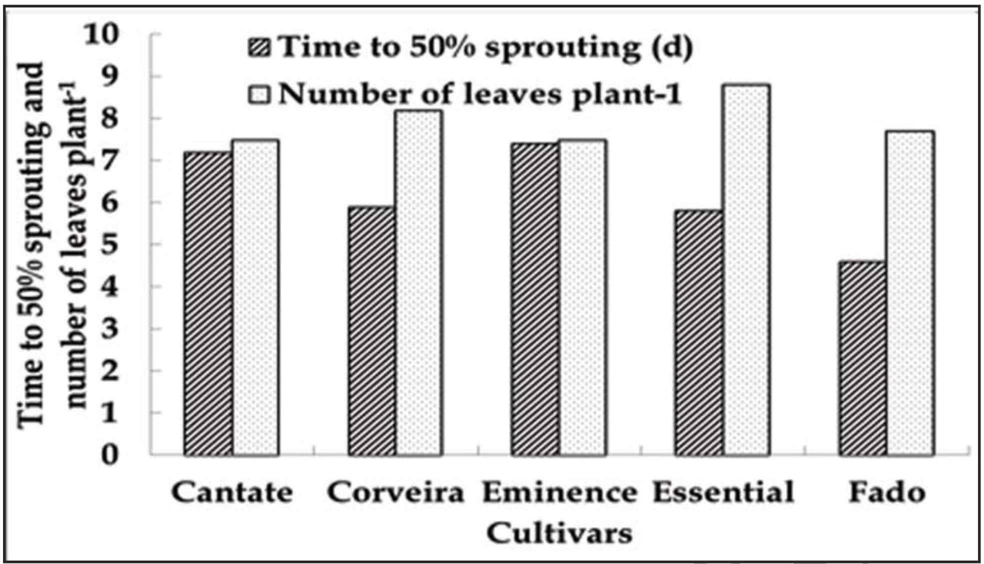

Fig.1. Time to 50% sprouting and number of leaves plant-1 of *Gladiolus grandiflorus* L. exotic cultivars.

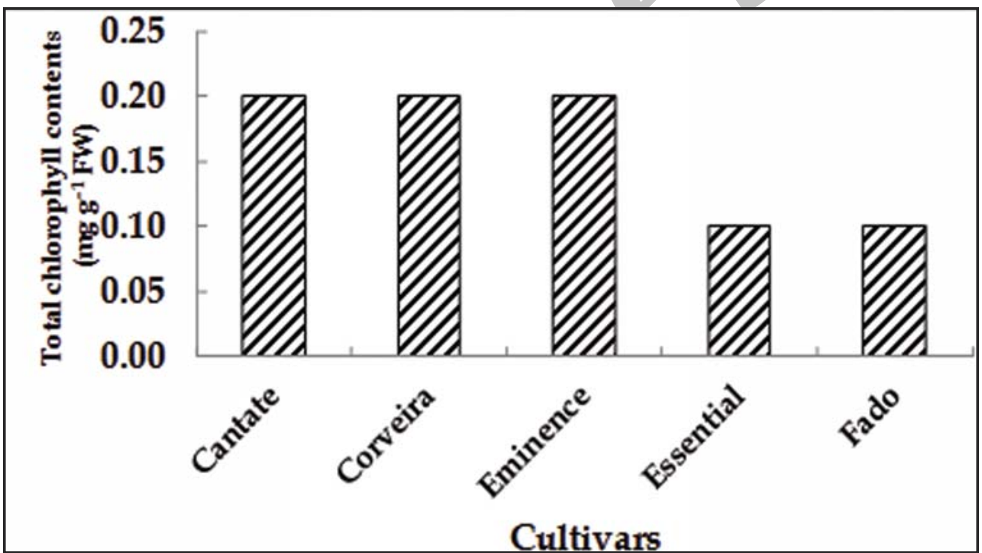

Fig. 2. Total leaf chlorophyll contents of *Gladiolus grandiflorus* L. exotic cultivars.

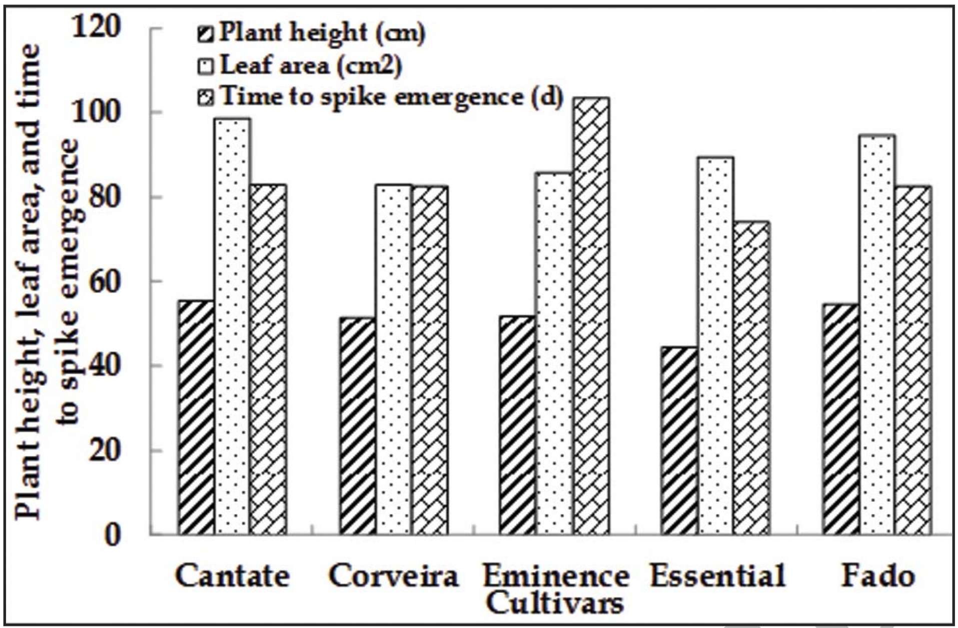

Fig. 3. Plant height, leaf area and time to spike emergence (d) of *Gladiolus grandiflorus* L. exotic cultivars.

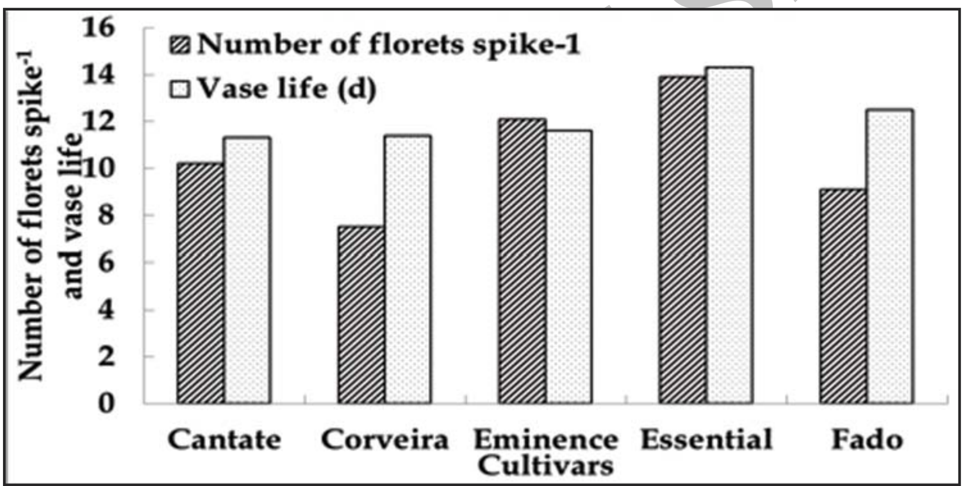

Fig. 4. Number of florets spike-1 and vase life of *Gladiolus grandiflorus* L. exotic cultivars.

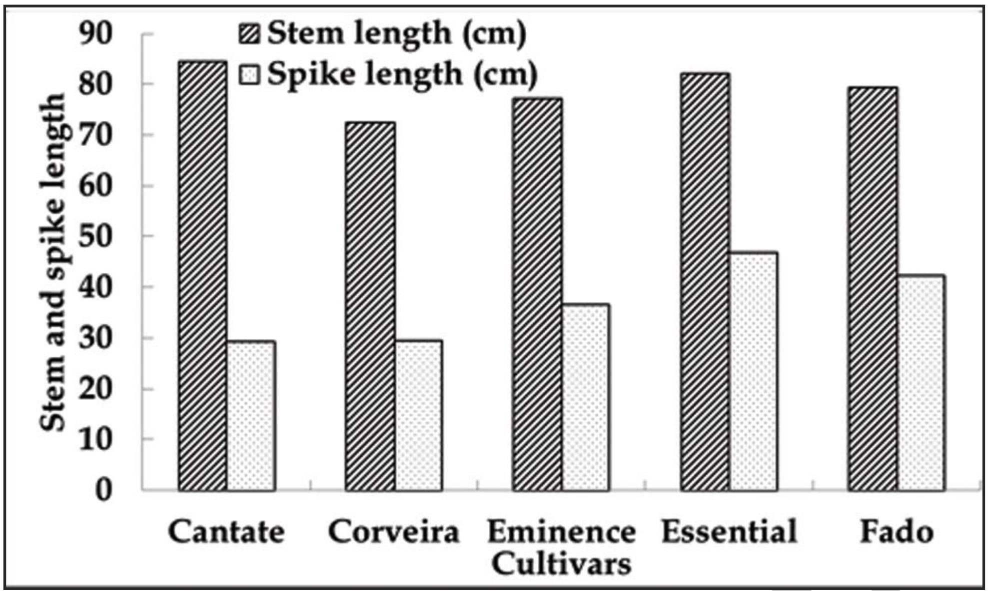

Fig. 5. Stem length and spike length of *Gladiolus grandiflorus* L. exotic cultivars.

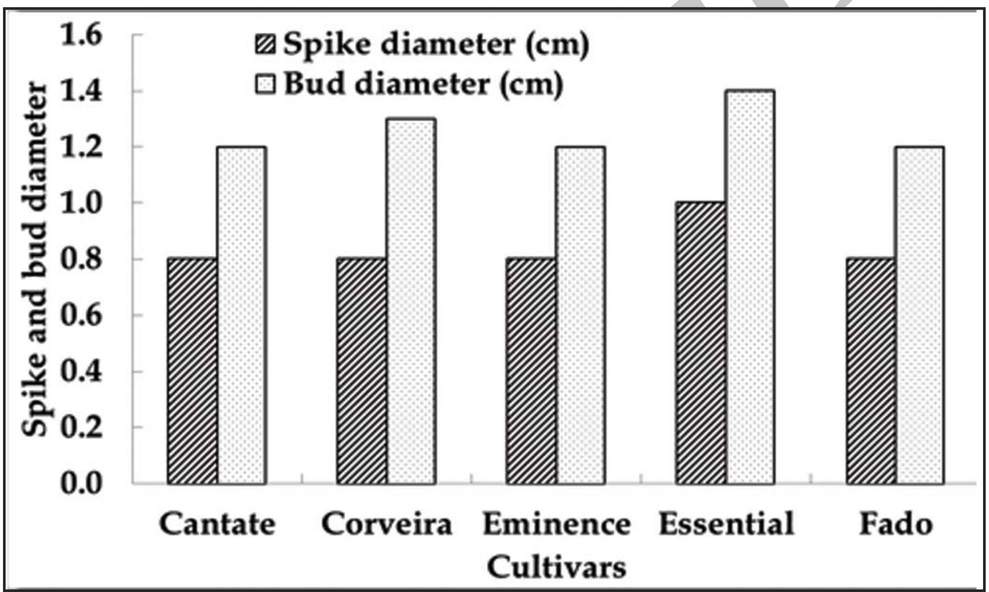

Fig. 6. Spike diameter and bud diameter of *Gladiolus grandiflorus* L. exotic cultivars.

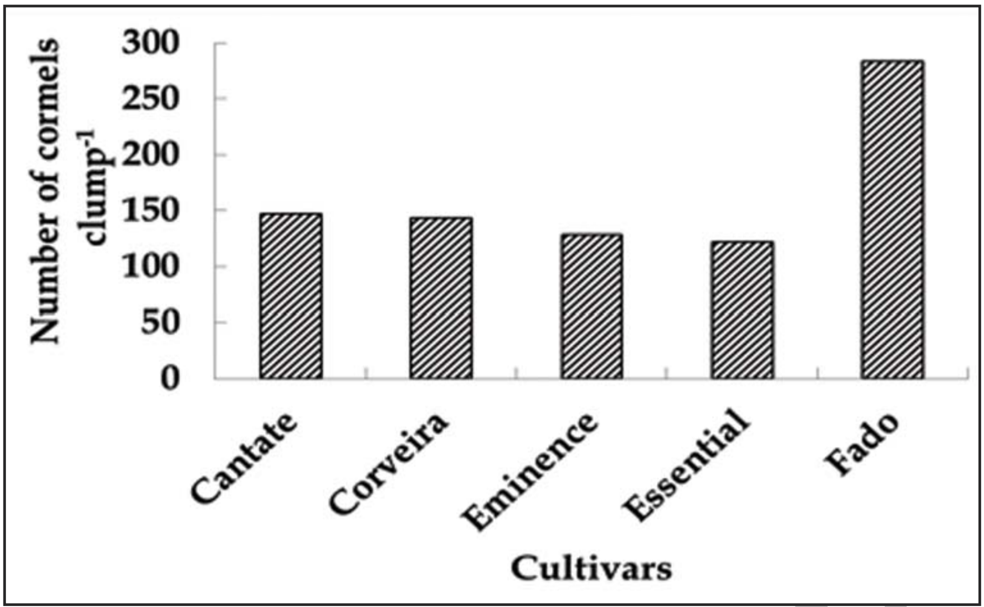

Fig.7. Number of cormels clump^{-1} of *Gladiolus grandiflorus* L. exotic cultivars.

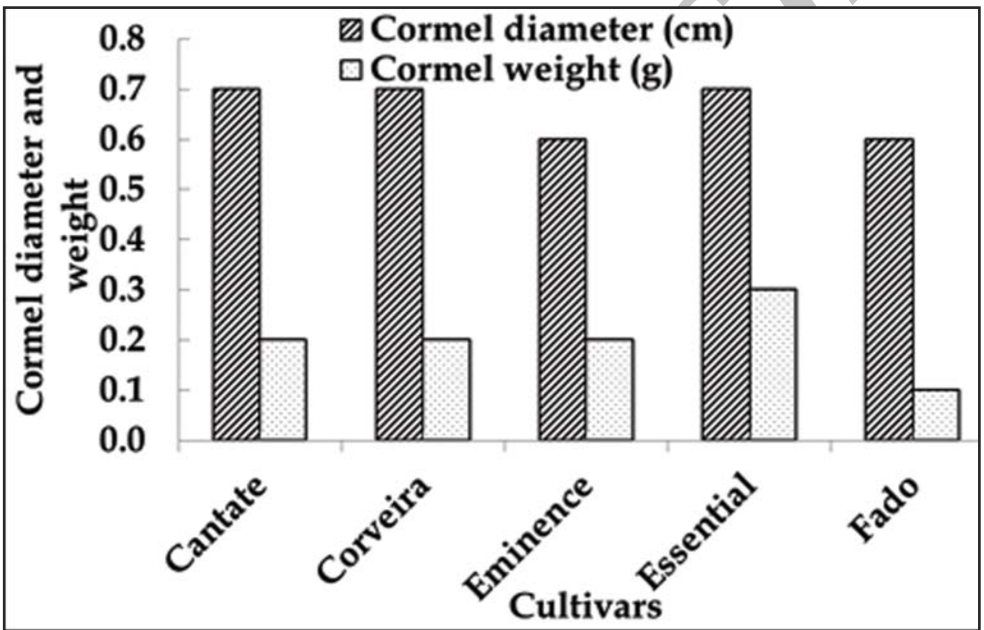

Fig.8. diameter and cormel weight of *Gladiolus grandiflorus* L. exotic cultivars