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PERFORMANCE EVALUATION OF GLADIOLUS CULTIVARS UNDER ARID CLIMATE OF BAHAWALPUR

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Abstract

Corm and cormles production has major role in gladiolus industry of the world as well as in Pakistan. However, its commercial production is limited in cold to moderate climatic regions and there is inadequate research from arid regions like Bahawalpur. Keeping this into consideration, six gladiolus cultivars viz. red, pink, white (white Prosperity), orange, dark pink and yellow (Jester) with three corm sizes (i.e. small: dia. 0.5-1.5 cm, medium: 1.5 cm and large: 2 cm) were planted in Randomized Complete Block Design (RCBD) to evaluate their performance in aridlands of Bahawalpur. Statistically, there was significant variation recorded among gladiolus cultivars for number of leaves and leaf area, spike length and number of florets (9.766, 90.137, 37.77 and 13.97 cm^2, respectively) in white color glades, whereas, the highest floret diameter (113.66 mm^2) was recorded in orange color glades at $p \leq 0.05$. There was significant effect of large size corms on number of leaves and floret diameter (9.4 and 98.18mm^2, respectively). Moreover, large and medium sized corms were at par for spike length and number of florets. The highest production of large and small size corms (227) was record in red glades, while the least corms produced in orange colored glades. Moreover, the highest corm weight (93.5 g) was recorded in white colored glades with the highest corm diameter (2.1 cm^2) in red glades. The elemental analysis in produced corms indicated that N, P and K contents were the highest (4.35, 0.44 and 1.019%) in white, orange and pink colored glades, respectively. However, Mn contents (239ppm) were highest in red corms. Based on the results, it can be concluded that the selected glades cultivars performed well in arid climate and can be used for commercial production of gladiolus flowers and daughter corms by following standard cultural practices.

Key words: Corm size, Cultivars, Corm yield, Gladiolus, Cormels production, Elemental analysis.

Introduction

Gladiolus (*Gladiolus grandiflora* L.), the queen of bulbous flowers (Chanda *et al*., 2000; Riaz *et al*., 2007), belongs to family Iridaceae, is an herbaceous plant sprouts from axillary buds of an underground structure (corm) and marked as symbol of aesthetics and high economic value (Sheela, 2008; Ahmad & Rab, 2020). It is among the four famous cut flowers in the world (Bai *et al*., 2009) with magnificent inflorescence colors used in borders, beddings and pots and widely grown in Europe, Australia, Iran, India and China (Abbasi *et al*., 2005; Memon *et al*., 2009) with greatest production in United States of America (Riaz *et al*., 2007). Area under Rose, Gladiolus, Tuberose and Jasmine in Pakistan is about 9000 acres including 450 acres of Glades with export potential in United Arab Emirates (UAE), Saudi Arabia, Russian and Europe (Aftab *et al*., 2007). It is extensively used in flower arrangements, bouquets and indoor decoration (Arora *et al*., 2002).

Gladiolus is subjected to a various fungal and bacterial diseases like *Fusarium* wilt, spongy rot, neck rot and bacterial scab. Thrips, mealy bugs, aphids and some other insects make trouble for Gladiolus. Strategies have been adopted to control the diseases by soli drenching with fungicides and steeping corms (Nazir & Riazuddin, 2008; Riaz *et al*., 2008; Sajjad *et al*., 2020), however, corms dormancy lasts for 4–5 months, require to store without any type of rot (Priyakumari & Sheela, 2005). Balance nutrition for batter growth and development has vital importance; inadequate plant nutrition causes serious disorders and may eventually lead to decline in yield. Gladiolus leaf should contain more than 2.5-3.0% nitrogen, one-tenth of N should be phosphorus for good corm and floret production (Dhakal *et al.,* 2017).

For commercial production of glades corm, well developed vertical root system covered with dried leaf bases is used; however, slandered flower spike is produced by mother corm along with cormels and a standard daughter corm (Ahmad *et al*., 2000; Nagaraju *et al*., 2002). Generally, two to three seasons are required to develop slandered flower spike from cormels. Corm cost is increased as commercial production of glades does not fulfill local dement of planting material, quality of flower spike and corms is influenced by size of mother corm and cultivar (Farid Uddin *et al*., 2002) storage and dormancy of corm (Zalewska & Antkowiak, 2009), planting time and application of balanced fertilizer (Pant, 2005; Zubair *et al*., 2006; Halder *et al*., 2007). There is a direct effect of cultivar and mother corm size on flower spike quality and daughter corm-cormels production (Ogale *et al*., 1995). It is therefore essential to find out the best corm size in relation to cultivar in order to standardize conventional propagation methods for more daughter corm and cormels production. Keeping in view, this study was designed to evaluate the role of mother corm size on growth, flowering and daughter corms production in different varieties of Gladiolus under the arid climate of Bahawalpur.

Materials and Methods

A two year (2016-17) study was planned at Horticulture experimental area, University College of Agriculture and Environmental Sciences (UCA & ES), Baghdad-Ul-Jadid Campus, The Islamic University of Bahawalpur (IUB) to investigate the production of Gladiolus floret spike and mother corms and cormels under arid condition of Bahawalpur. Selected Gladiolus cultivars were:

1. Red (long stemmed)
2. Pink (charming colour)
3. White (large flower spike)
4. Orange (small size)
5. Dark Pink (very showy)
6. Yellow (Medium size)

However, different selected corm sizes were; A = ≥ 2cm^2 B= ≥ 1.5 cm^2 C = ≥ 0.5 cm^2.

Research parameters were leaves plant^{-1}, leaf area (mm^2), mother corms sprouting percentage, emergence of single and double shoots; number, diameter and weight of daughter corms and cormels.

The field was deep ploughed, fumigated and cleaned from weeds to grow mother corms at a distance of 10 cm with 20 cm row to row distance. Standard cultural practices were followed during the entire crop period. Weekly to fortnightly irrigation was done depending on climatic condition to ensure no water stress. For nutritional requirement, 5 kg DAP + 3 kg urea was dressed with soil preparation, second dose of urea (5 kg) was applied before blooming and 3rd done was applied as DAP (5 kg) after one month of 1st bloom. Harvesting of spikes and daughter corms was done by following the work of Mukhopadhyay & Yadav (1995).

Elemental analysis: Six months old healthy leaves were collected, brought to laboratory, washed with detergent and rinsed in distilled water for 2-3 times. After one-day shade dry, leaves of each variety were placed in dry oven at 65°C for overnight and powdered leaves were digested for NPK estimation in selected gladiolus cultivators. Healthy and disease free mother corms of each cultivar were prepared for NPK analysis as discussed above. Moreover, soil samples were also collected for estimation of NPK.

Nitrogen concentration in leaves, mother corms and soil was determined by following the method of Chapman & Parker (1961), involved the digestion of 0.5g of sample with concentrated perchloric acid kjeldahl digestion flask for half an hour to get transparent aliquot h which is taken in Microkjeldahl apparatus using 15 ml for each sample 40% NaOH. Ammonia vapors were received in 10ml flask, titrated against N/10 sulphuric acid till original colour of methyl red was restored and percent nitrogen was estimated using the formula:

$$N\ (\%) = \frac{\text{A-B x 100 x 100 x 0.0014}}{\text{Vol. of digested sample used}}$$

A= Quantity of acid (N/10 H_2SO_4) used; B= Blank reading (N/10 H_2SO_4 used in blank reading) 100 = Volume made after digestion; 100 = for percentage; 0.0014 = Factor (which is equal to grams of N in 1 ml of N/10 H_2SO_4).

For elimination of N present in chemicals used for samples digestion, blank reading was taken. Same technique used in digestion and titration except the addition of leaf, corm or soil sample.

Wet digestion and estimation of phosphorus and potassium: Toth *et al*., (1948) method of digestion followed for the estimation of P & K by taking 0.5g powdered samples (each of leaf, mother corms and soil samples separately) in 100ml beaker, receiving 15ml concentrated HNO_3 and lightly heated for half an hour. After cooling breakers received 10ml concentrated perchloric acid and heated again until colorless precipitate received and diluted with distilled water up to 100ml. This solution was used to estimate P & K through Chapman & Parker (1961) method. Colour of digest was developed by adding 5ml diluted H_2SO_4 (1:6), 5ml 5% ammonium molybdate and 5ml 0.25% ammonium vanadate. The standard curve was obtained by using different concentrations of potassium dihydrogen phosphate, however colour samples were fed in spectrophotometer at a wavelength of 420nm and transmittance was noted and compared with standard curve to find the quantity of P in ppm and converted into percentage using the following formula:

$$P\ (\%) = \frac{\text{ppm on graph x dilution}}{10^6} \text{ x } 100$$

Potassium was estimated by feeding digested samples into flame photometer (Chapman & Parker, 1961) and potassium was determined in ppm with comparison of slandered curve and emission of flame photometer, then converted into percentage using following formula:

$$K\ (\%) = \frac{\text{ppm x dilution}}{10^6} \text{ x } 100$$

Statistical analysis

There were 6 Gladiolus cultivars and 3 different mother corms sizes selected as treatment combinations for present research work with 6 replications. Collected data were analyzed in Randomized Complete Block Design (Steel *et al*., 1997) in factorial arrangement. Statistical software program version Statistics 8.1 (SAS Institute, 2003) were used to compare treatment means by Least Significant Difference test (DMR).

Results

Effect of mother corm size on sprouting, shoot emergence and bolting: Sprouting percentage, emergence of single and double shoots and bolting percentage was significantly affected by selected mother

corm size as shown in (Fig. 1) Sprouting percentage was highest in large mother corms (≥ 2 cm^2) as compared to medium and small size corms in all selected cultivars with highest (89.5%) value in large mother corms of Dark pink glades and least sprouting percentage (32.5%) was recorded in small size corms of cv. White (Fig. 1-A). Emergence of single shoots was highest as compared to double shoots in all corm sizes of selected cultivars. Percentage of emergence of single and double shoots was significantly different in all three selected corms size of selected cultivars with highest single shoots (91, 87.5 and 86%) recorded in medium and large size corms of Pink and red glades, respectively. The highest percentage (35%) of double shoots was recorded in selected small size corms of White glades, followed by 31.5 and 27% in medium and large size corms of red and white cultivars, respectively (Fig. 1-A). There was significant effect of number of emerged shoots on emergence of spikes, with highest spikes (83%) on single shoots of large size mother corms of white glades followed by 78% spikes recorded in orange glades of large size comes, however, least percent spikes (21%) were recorded on small size mother coms of dark pink glades. Highest spikes (46%) were emerged on double shoots of large size corms in red glades which were followed by pink and orange glades with spikes of 32 and 31%, respectively in large size mother corms as shown in figure 1-B.

Effect of cultivars and mother corm size on vegetative and floral characters: Statistically significant difference was recorded among selected gladiolus cultivars regarding various plant and flower characters (Fig. 2) with high emergence of leaves (9.8) in cv. Dark Pink followed by cv. White (9.76). Cultivars Orange, Pink, Yellow and Red were statistically at par for the emergence of leaves. The data regarding leaf area exhibited significant effect with high value (90.14 cm^2) in cv. White followed by Pink (77.79 cm^2), However Orange and Dark Pink cultivars had similar leaf area, Moreover, minimum leaf area was recorded in Red and Yellow cultivars (41.86 and 45.31 cm^2), respectively. Significant variation was recorded among glad cultivars for the spike length with highest value (37.76 cm) in White Colored Gladiolus followed by cvs. Orange, Pink, Dark Pink and Yellow with spike length of 31.74, 26.04, 23.10 and 20.97 cm, respectively; however shortest spike length (18.250 cm) was observed in Red Colored Gladiolus. Interestingly, effect of cultivars on number of florets was statistically non-significantly different in selected cultivars of Gladiolus, however, effect of cultivars on floret diameter was statistically significantly different with highest floret diameter (113.66 mm^2), recorded in Orange cultivar followed by Dark Pink and Pink colored cultivars with value of 101.8 and 84.46 mm^2, respectively. However, there was no statistical difference between Red and Pink Gladiolus regarding floret diameter with least floret diameter (72.94 mm^2) recorded in cultivar with white floret color as shown in figure 2.

There was significant effect of mother corm size on vegetative and reproductive growth pattern of Gladiolus for number of leaves per plant, spike length, number of florets and floret diameter (Fig. 3). Statistically, high number of leaves (9.40) were recorded on large size corms, followed by medium and small corms with 8.65 and 8.26 leaves $plant^{-1}$, respectively, however, non-significant effect of mother corm size was observed on leaf size. Highest spike length (29 cm) was noted in medium size corms, followed by large and small size corms with spike length of 27 and 20.03 cm, respectively. Large size corms significantly produced more number of florets (14.16) followed by 12 and 9.9 florets per spike in medium and small size corms. Moreover, corm size had significant effect on floret diameter (98.8 mm^2) in large size corms, followed by medium corms, produced florets of 88.8 mm^2 diameter, however, floret with least diameter (76.8 mm^2) were produced on small size corms.

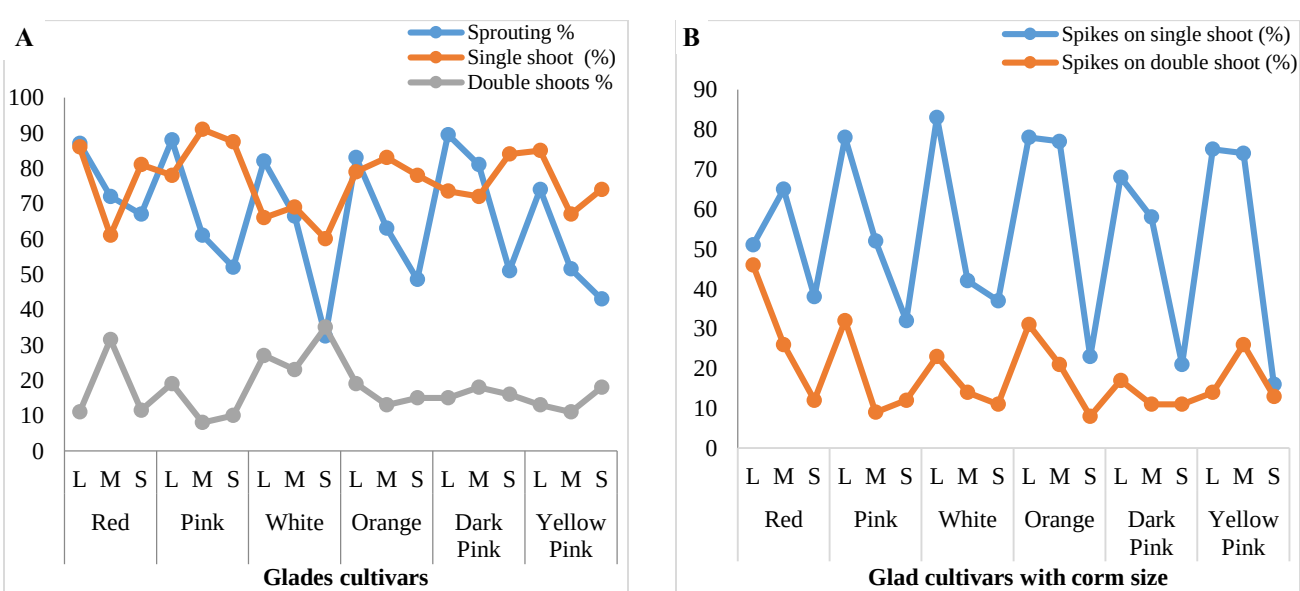
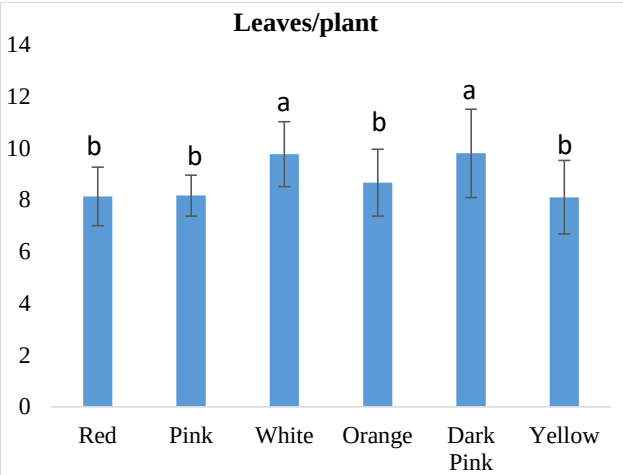
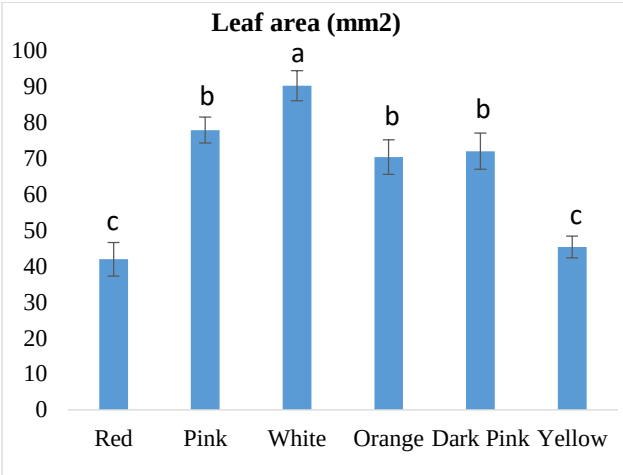
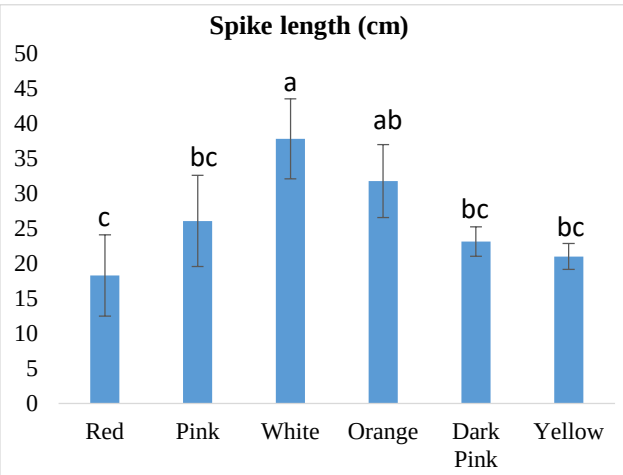
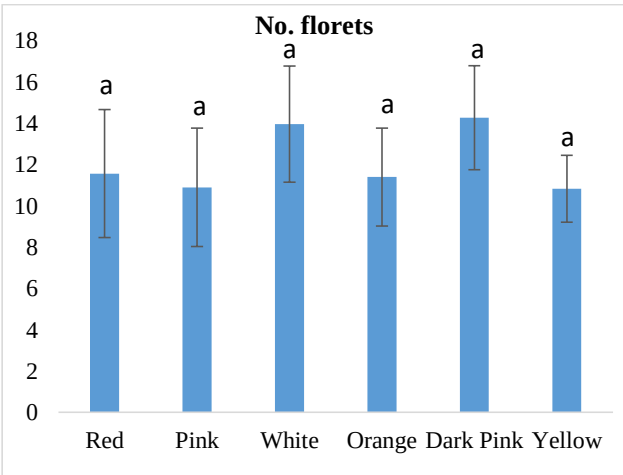


Fig. 1. Effect of glad cultivars and corm size on sprouting, single and double shoot emergence percentage (A) and single and double spikes emergence percentage (B).









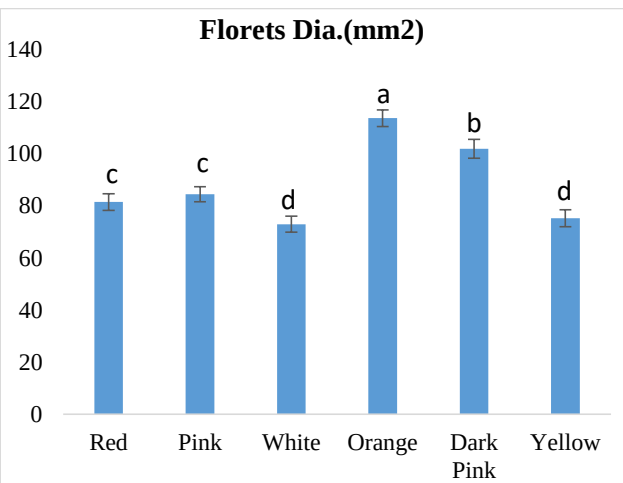


Fig. 2. Effect of selected gladiolus cultivars on No of leaves/ plant, leaf area, spike length, No of florets and floret diameter.

Effect of cultivars and mother corm size on production of Gladiolus: Effect of cultivars and corm size was significant for various plant and flower characters as shown in Table 1. Highest number of leaves (10.80) were recorded in large size mother corms, followed by medium size corms of White and Yellow cultivars with leaves per plant as 10.30 and 10, respectively. Least and statistically similar number of leaves were recorded in Red, Pink and Yellow cultivars in medium and small size corms. Effect of Gladiolus cultivars and mother com size was significantly high (91.83 cm^2) in large corms of White flower glades, however, there was no effect of corm size on leaf area of Pink, Orange and Dark Pink cultivars. Significantly less leaf area (40.63 cm^2) was recorded in Red and Yellow cultivars for different sized mother corm.

Statistically highest spike length (48.20 cm) was recorded in large size mother corms of White flower glades and least spike length (11.35 cm and 11.70 cm) was recorded in small size corms of Red and Pink cultivars, respectively. Similar effect of spike length was recorded for different corm size of Dark Pink, Yellow and Orange cultivars. Significantly high number of florets

were recorded in White, Orange, Dark Pink and Yellow cultivars of selected mother corm sizes. However, statistically least number of florets (8 and 6.20) were recorded in small size corms of Red and Pink cultivars, respectively. Large size mother corms of Orange Glades produced highest floret diameter (124.16 mm^2) followed by 112.35 mm^2 in Dark Pink cultivars. Significantly least floret diameter (64.72 mm^2) was recorded in small size corms of Yellow cultivar (Table 1).

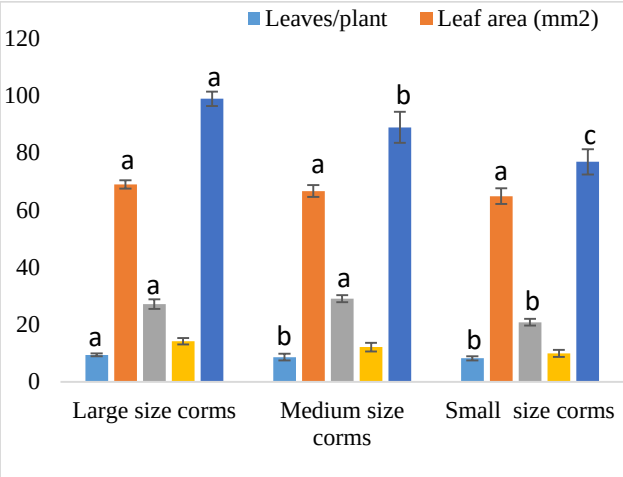


Fig. 3. Effect of mother corm size on number of leaves, spike length and floret characters.

Effect of cultivars on daughter corms and cormels characters: Number of large and small size daughter corms were largely produced (120 and 107, respectively) in Red cultivar followed by Pink (106) and White (70), however, least large size daughter corms (10) were produced in cv. Orange as shown in (Table 2.) Highest and lowest large size daughter cormels (156 and 18) were produced in cvs. Red and Dark pink, respectively. Highest small size daughter cormels (627) were produced in cv. Pink, followed by Red (500) and White (400) with least (59) in cultivar Orange. Highest weight in large size daughter corms (93 g) was recorded in cv. White which was statistically at par with Dark pink, Yellow and Pink. Highest corms weight (36.9 g) in small size daughter corms was recorded in Yellow cultivar, however. Red, Orange and Pink cultivars were statistically at par for least corm weight with value 12.50, 13.70 and 14.4 g, respectively. Significantly high weight (19.60 g) of large size daughter cormels was recorded in Dark pink cultivar, followed by Yellow (8.90 g), Pink (4.36 g) and Red (4.52 g), however, lowest daughter cormels weight was (3.71 g) in cv. White. Highest cormels weight (1.5 g) was recorded in Red cultivar regarding small size daughter cormels which was statistically at par with Pink, Orange, Dark pink and Yellow cultivars. Effect of cultivar on diameter of large size daughter corms was statistically non-significantly different, however, diameter of small size daughter corms was significantly different in produced by selected cultivars of glades with highest diameter (1.9mm^2) in cv. Yellow and least diameter (1.0mm^2) was recorded in Pink cultivars. Diameter of large size daughter cormels was ranging from 0.9 to 0.5 in Yellow and Red cultivar respectively. Highest average diameter in small size daughter cormels was recorded in Dark pink cultivar, followed by cv. White.

Table 1. Effect of mother corm size and cultivar on Gladiolus characters.

Cultivars	Corm size	Leaves/ plant	Leaf area (mm^2)	Spike length (cm)	No. of Florets	Floret dia. (mm^2)
Red	Large corms	8.90bcde	41.93e	24.60bc	19.9a	91.96efg
	Medium corms	7.80ef	43.03e	18.80bc	8.60b	81.46ghij
	Small corms	7.70ef	40.63e	11.35c	6.20b	70.96jk
Pink	Large corms	8.40def	82.86abc	27.40abc	14.4ab	94.96def
	Medium corms	8.00ef	78.70abc	39.00ab	10.30ab	84.46fghi
	Small corms	8.10ef	71.80abc	11.70c	8.00b	73.96ijk
White	Large corms	10.50ab	88.33ab	48.20a	15.60ab	79.94hij
	Medium corms	10.0abcd	90.25ab	38.50ab	14.10ab	79.94hij
	Small corms	8.80cde	91.83a	26.60abc	12.20ab	58.94l
Orange	Large corms	8.70cdef	73.93abc	28.80abc	11.00ab	124.16a
	Medium corms	8.70cdef	70.30bc	33.20abc	11.60ab	113.66ab
	Small corms	8.60def	66.58cd	33.20abc	11.60ab	103.16bcd
Dark Pink	Large corms	10.80a	74.02abc	24.10bc	11.00ab	112.35bc
	Medium corms	10.30abc	71.27abc	23.60bc	11.00ab	101.85cde
	Small corms	8.30ef	70.52abc	21.60bc	11.00ab	91.35efg
Yellow	Large corms	9.10bcde	44.68e	19.80bc	11.60ab	85.73fgh
	Medium corms	7.10f	46.68de	22.80bc	11.60ab	75.23hijk
	Small corms	8.10ef	44.58e	20.30bc	11.60ab	64.72kl
SE		**±0.48**	**±6.14**	**±6.72**	**±3.03**	**±3.13**

Table 2. Effect of cultivars on daughter corms and cormels characters.

	Large size daughter corms				Small size corms			Large size cormels			Small size cormels		
	No of mother corms	Numbers	Weight (g)	Corm Dia. (cm)	Numbers	Weight (g)	Corm Dia. (cm)	Numbers	Weight (g)	Cormels Dia. (cm)	Numbers	Weight (g)	Cormels Dia. (cm)
Red	200	120	64.10b	2.1	107	12.5d	1.3bc	156	4.52bc	0.5b	500	1.45a	0.10b
Pink	200	106	68.0ab	1.8	90	14.4d	1.0c	121	4.36bc	0.5b	627	1.21ab	0.91b
White	200	70	93.50a	1.9	50	21.5c	1.7ab	55	3.71c	0.4b	400	1.12b	0.12ab
Orange	100	10	55.20c	2.1	15	13.7d	1.3bc	18	5.29bc	0.8a	59	1.30ab	0.11 b
D. pink	100	15	79.40ab	2.1	15	29.5b	1.3bc	20	19.60a	0.9a	139	1.22ab	0.16 a
Yellow	100	20	71.30ab	2.0	50	36.9a	1.9 a	27	8.90b	0.9a	70	1.21ab	0.10 b
SE			**±9.59**	**±1.85**		**±2.34**	**±1.66**		**±1.59**	**±1.03**		**±0.11**	**±0.16**

Table 3. Concentration of NPK and various elements in Leaves, mother corms and soil.

Cultivars	N %	P %	K %	Mn (ppm)	Zn (ppm)	Fe (ppm)	Cu (ppm)	B (ppm)
				Leaves				
Red	2.09b	0.29b	0.21e	152.0b	142.33a	395.33b	3.6c	0.44c
Pink	2.92a	0.27b	0.24de	48.33c	122.33c	480.0a	3.3c	0.5b
White	2.19ab	0.38a	0.28cd	229.0a	132.33b	314.0d	4.13b	0.43d
Orange	2.89a	0.17d	0.31c	152.0b	112.0d	290.33e	4.63a	0.32e
D. pink	2.0b	0.22c	0.43b	48.0c	121.33c	188.0f	3.5c	0.33e
Yellow	2.13b	0.34a	0.64a	229.0a	122.0c	334.0c	3.57c	0.56a
SE	±0.0897	±0.0135	±0.1428	±0.4635	±0.8389	±0.6441	±0.0515	±2.434
				Daughter corms				
Red	2.17c	0.25c	0.165b	239.33a	22.0b	175.33f	4.30c	0.21d
Pink	2.17c	0.44a	1.019a	230.0b	31.0a	273.0b	4.43c	0.43b
White	4.35a	0.31b	0.33b	48.33f	32.0a	219.0e	4.40c	0.33c
Orange	3.14b	0.44a	0.18b	175.33d	33.1a	256.0c	3.43d	0.33c
D. pink	4.23a	0.24c	0.17b	152.33e	33.0a	225.0d	5.20b	0.54a
Yellow	3.28b	0.41a	0.17b	206.0c	11.67c	315.33a	5.99a	0.12e
SE	±0.2167	±0.0126	±0.0167	±0.1925	±0.590	±0.5511	±0.1306	±1.925
				Soil				
	3.29	0.44	9.33	152.0	222.0	432.0	6.30	0.64

Major and minor nutrients in Leaves, daughter corms and soil: Selected gladiolus cultivars were significantly different for various macro and micro nutrients in leaves (Table 3). Significantly high Nitrogen contents (2.92%) were recorded in leaves of cv. Pink followed by Orange glades with least N contents in Yellow glades. The White glades had significantly high phosphorus (P) contents (0.38 ppm) which was at par with Yellow glades with least contents (0.17 ppm) recorded in Orange color glades as shown in Table 3. Potassium (K) contents in leaves were significantly different in all varieties with highest K (0.64%) recorded in Yellow glades followed by cv. Dark pink. Significantly high Mn contents (229 ppm) were recorded in leaves of cvs. White and Yellow glades with least contents (48 ppm) in cv. Dark pink. Significant difference among selected cultivars was recorded regarding zinc (Zn) concentration in leaves with highest value in Red cultivar followed in cv. White and least value in leaves of cv. Orange. Significantly, high contents of Fe, Cu and Born were recorded in cultivars pink, orange and yellow, respectively. Least Fe, Cu and B contents were recorded in cultivars such as dark pink, d. pink and orange, respectively as shown in Table 3.

Macro and micro nutrients concentration was significantly different in daughter corms of selected glades cultivars. Significantly high N, P and K contents (4.35, 0.44 and 1.01%) were analyzed in white, orange and pink glades, respectively, while, least N, P and K contents were recorded in pink, dark pink and yellow, respectively. Significant difference among selected gladiolus cultivars was recorded for Mn contents in daughter corms with highest contents (239.33 ppm) in cv. Red followed by Pink and least contents in orange. Zinc contents were significantly high in daughter corms of cv. orange which was at par in dark pink, white and pink. Significantly high Fe, Cu and B contents (315.33, 5.99 and 0.54 ppm) were recorded in daughter corms of yellow, yellow and dark pink, respectively. However, least contents of Fe, Cu and B were recorded in cultivars red, white and yellow, respectively.

Macro and micro nutrients in soil samples of experimental area were also analyzed and recorded NP and K contents as 3.29, 0.44 and 9.33%, respectively. The concentrations of Mn, Zn, Fe, Cu and B were 152, 222, 432, 6.3 and 0.64 ppm, respectively as shown in Table 3.

Discussion

Effect of corm size on vegetative and reproductive characters: Large size mother corms of all selected Gladiolus cultivars not only had significant impact on various plant and flower characters but also differently response in corm multiplication in arid regions. These findings are in line with the results of Bhattacharjee, (1981); Dod *et al*., (1989); Mohanty *et al*., (1994) Farid-Uddin *et al.*, (2002), proved that selected corm size had significant impact on plant and spikelet characters in Gladiolus and other bulbous flower family. Moreover, different plant response to corm size is primarily related to the size of storage tissue which subsequently influence corm sprouting, vigor and its growth as proved by Mckay *et al*., 1981 and Singh *et al*., 2002). However, sprouting of corms was not influenced by the used corm size in this study, which was supported by Mohanty *et al*., (1994). Gladiolus plants produced from large size corms in our experiment were significantly taller than small size corms with more leaf breadth, as it was also reported by Mohanty *et al*., (1994) and Farid Uddin *et al.*, (2002), and observed taller plants from large size corms (dia. 2.45-2.55 cm) with more number of leaves and longer leaf blade as compared to medium (dia. 1.25-1.30 cm) and small corms (dia. 0.50-0.53cm). However, contradiction was reported by Singh (2000) who observed greater plant height from corm size >5.10 to <6.00 cm as compared to those from the largest size grade (>6.0 to <6.50 cm dia.). Positive effect of corm size on various flower parameters was recorded in selected Gladiolus cultivars with maximum spike length and number of florets in large size corms. These results are in accordance with those reported by Farid Uddin *et al*., (2002) with highest number of florets (11.94) in highest length spikelet (66 cm) on large corms as compared to medium and small corms.

The larger size mother corms positively correlation with weight and size of daughter corms and cormels in selected cultivars of Gladiolus which was in line with the findings of Misra *et al*., (1985). They used corms of 9 different sizes ranging from giant to 0.6 cm diameter and observed that weight and number of daughter corms and cormels increased significantly with the increase number and weight of produced corms and cormels was significantly increased with increase in size of mother corm. Generally the farmers use medium size corms to reduce the initial cost of planting material however cost of planting material can be reduced indirectly by cultivating large size corms which produce standard size of daughter corms and good quality flower spike (Misra *et al*., 1985). It has been observed that Slandered daughter corms and good quality spikes ensure maximum economic output to the farmers as compared to medium size corms. In this study, it has been observed that small size mother corms also produce few large size daughter corms but maximum number of small size corms. The findings of present study were in accordance with findings of Mukhopadhyay and Yadav (1984). They reported that more cormels and corm were from large size corms (4.6-5.0 cm in dia.).

The size and weight of selected corms significantly improved vegetative growth, good quality spikes and production of standard daughter corms and cormels in Gladiolus under desert zone of Bahawalpur with provision of best agronomic practices like irrigation and fertilizer application.

Effect of Gladiolus cultivars on plant, flower and corm production traits: Selected Gladiolus cultivars had proved significant variation regarding various flower and plant parameters with highest and least floret diameter in Orange and Red color Gladiolus, respectively which might be due to genetic potential of cultivar. Result is in line with the findings of Abbasi *et al.*, (2005) and Sheela, (2008). Variation in average number of florets per spike among the cultivars was 1.83 to 3.43; however, this range was 5.33 to 20.0 as reported by Negi *et al*., (1982) in their experiment at the Hariana Agricultural University Farm, Hissar, India. Moreover, Lal & Plant (1989) recorded 8 and 18 florets per spike in Gladiolus cvs. GL-06 and GL-15, respectively produced in Maharashtra under best agro-climatic conditions of these region. There was significant effect of cultivar on leaf area, which was maximum in White and minimum in Red color Gladiolus cultivars. Result is in accordance with Bhagur (1989), recorded significant variation in respect of leaf area among thirty cultivars of Gladiolus. Significant variation was observed in number of leaves per plant among selected cultivars, thus more food synthesized result in high flower production as also reported by Husain *et al.*, (2011). A great deal of genotypic variation in spike length (3.99 to 19.15cm) was observed in our results in cv. White and lowest in Red color Gladiolus, supported by Bhagur, (1989) who found high spike length in varietal evaluation of Gladiolus. Findings are in contract with the results of Anuradha & Gowda, (1994), reported that spike length was highest (51.77cm) in Deep Red genotype.

Mineral nutrition in leaves and daughter corms of Gladiolus cultivars: Significant effect of corm size and cultivar on level of various macro and micro elements in leaves and daughter corms might be due to cultivar and corm size effect under arid region of Bahawalpur. Similar findings are shared by Bozkurt *et al*., (2001); Asiey *et al*., (2007); Erdal *et al*., (2005); Ekholm *et al*., (2007) and Kazankaya *et al*., (2008) and reported that chemical contents of plant leaves and corms were influenced by genetic makeup of genotype, environment, climatic conditions, irrigation, fertilizing and soil conditions.

Conclusion

This study determined the performance of some gladiolus cultivars for their qualitative and quantitative attributes in arid climte of Bahawalpur. Based on the experimental procedure, large and medium size mother corms can be used for commercial production of gladiolus flowers and daughter corms by following standard cultural practices such as deep ploughing with fumigation, weekly to fortnightly irrigation and fertilizer scheduling with soil dressing (5kg DAP + 3kg Urea) at the time of soil preparation, 2nd dose before blooming (5kg Urea) and 3rd dose after blooming (5kg DAP) under arid climatic conditions of Bahawalpur.

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