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Performance of gladiolus cultivars under sub-humid southern plains of Rajasthan

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ABSTRACT

An investigation was carried out during October 2011 - May 2012 to evaluate performance of 15 cultivars of gladiolus for cut-flower, corm and cormel production. Cultivar 'IIHR-G-12' gave maximum plant height (108.32cm), spike length (76.43cm), rachis length (58.27cm), number of florets per spike (14.90), number of florets open at a time (3.63), longevity of florets (3.39 days), vase life of spike (14.20 days), number of spikes per plant (2.50), field durability of spike (16.20 days), flowering duration (38.20 days), number of corms per plant (2.55), corm diameter (6.13cm) and fresh weight of cormels per plant (29.42g); while, cv. 'Gunjan' gave largest floret diameter (10.39cm) and cormels per plants (60.76). Earliness in heading (65.87 days), spike emergence (70.43 days), first floret showing colour (82.93 days) and basal floret opening (85.60 days) were observed in cv. 'IIHR-G-12'. Significantly high corm fresh weight (70.24g) and leaf width (3.28cm) were noticed in cv. 'Pusa Kiran'. However, largest cormel diameter (1.91cm) was seen in cv. 'Delhi Pink', maximum number of tillers per plant in cv. 'Punjab Dawn', whereas, number of leaves plant^{-1} (9.60) and leaf length (40.41cm) were recorded in cv. 'Dhanvantari'. Among the cultivars tested, cv. IIHR-G-12 was found to be the best for significantly high spike yield (4.17 lakh), corm yield (4.25 lakh) and cormel yield (49.03q) ha^{-1}.

Key words: Gladiolus, spike, rachis, floret, corm, cormels, durability, longevity, vase life

INTRODUCTION

Gladiolus (*Gladiolus grandiflora* L.) is one of most popular cut flowers in the domestic and international markets, and is commercially grown in many tropical, sub-tropical and temperate parts of the world. Gladiolus has gained much importance as 'Queen of bulbous flowers'. It belongs to the family Iridaceae and is native to South Africa. The genus *Gladiolus* has a chromosome number of 2n=30 to 120. This is one of the leading commercial bulbous flowers throughout the world, and ranks next only to tulip in Holland and fourth in the international cut-flower trade after rose, carnation and chrysanthemum. The magnificent inflorescence of *Gladiolus* with its attractive spike, florets of different forms, various colours and long durability has made the flower attractive for use in herbaceous borders, bedding, rockeries, exhibition, growing in pots and bowls. Performance of any crop depends largely on genotype and environment interaction. As a result, cultivars that perform well in one region may not perform equally well in other regions varying in climatic conditions. Results obtained in this study can be utilized in gladiolus improvement for induction of novel colour, earliness, disease resistance and quality-spike parameters. Hence, performance evaluation becomes necessary to find a suitable variety for a specific region. Thus, testing was done to study performance of 15 cultivars of gladiolus under sub-humid southern plains of Rajasthan.

MATERIAL AND METHODS

The experiment was carried out during October 2011 - May 2012 to study the performance of 15 gladiolus cultivars, namely, 'Anglia', 'Bis-Bis', 'Chandini', 'Delhi Pink', 'Dhanvantari', 'G.S.-2', 'Gunjan', 'IIHR-G-11', 'IIHR-G-12', 'Jyotsna', 'Punjab Dawn', 'Punjab Morning', 'Pusa Kiran', 'Shabnam' and 'Urmil' in Randomized Block Design, with 3 replications, at AICRP on Floriculture Project, Horticulture Farm, RCA Campus, Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan situated at 24º35' North latitude, 24º42' East longitude and at 579.5m above MSL altitude. Mean maximum (40.1°C) and minimum (23.3°C) temperature, and relative humidity of maximum (73.75%) and minimum (34.30%), were

recorded during the experiment. Corms of gladiolus cultivars were collected from IARI, Pusa, New Delhi; IIHR, Bangalore, and AICRP on Floriculture Project Centre, MPUAT, Udaipur. Healthy and uniform sized corms of 3-4 cm diameter were planted in the fourth week of October at a spacing of 30cm x 20cm at 6cm depth. Twenty corms of each cultivar per replication were planted on the ridge in each plot. The soil was clay loam in texture, with pH 7.34 and EC 0.54 dSm^{-1} under irrigated condition. Well-decomposed 2.5kg / m^2 farm yard manure was incorporated into all the plots two weeks prior to planting. A basal fertilizer dose comprising 150kg N, 200kg P_2O_5 and 200kg K_2O ha^{-1} was applied at planting and the remaining 150kg of N was applied 45 days after planting (Arora *et al*, 2002). Uniform cultural practices were followed throughout the experiment. Corms were harvested at 45 days after complete flowering for recording corm and cormels parameters. Data on vegetative growth, flowering, corm and cormels production were recorded in five randomly selected plants, and mean values were analyzed statistically.

RESULTS AND DISCUSSION

A. Vegetative parameters

Table 1 shows that cultivars significantly differed in their vegetative growth characters. Among the different cultivars studied, maximum plant height was recorded in 'IIHR-G-12' (108.32cm), followed by 'IIHR-G-11' (105.64cm), whereas, minimum plant height was recorded in 'Anglia' (67.53cm). Number of leaves per plant was highest in 'Dhanvantari' (9.60), which was statistically at par with 'Gunjan' and 'Pusa Kiran' (9.27 and 9.23, respectively). However, least number of leaves was seen in 'Anglia' (8.13). Broadest leaf was recorded in 'Pusa Kiran' (3.28 cm), while, the narrowest in 'Punjab Morning' (1.61cm). Longest leaf was observed in cv. 'Dhanvantari' (44.50cm), whereas, leaf was shortest in 'Pusa Kiran' (34.04cm). Significantly high number of tillers per plant was recorded in 'Punjab Dawn' (2.7), followed by 'IIHR-G-12' (2.60), while minimum number of tillers were seen in 'Dhanvantari' and 'Bis-Bis'(1.53). Variations found in vegetative characters in different cultivars may be due to their genetic make-up and prevailing environmental conditions prevalent during crop growth period. Similar trend was reported by Shaukat *et al* (2013) and Saleem *et al* (2013).

B. Flower parameters

Gladiolus cultivars significantly differ in their flowering characters. Cultivar IIHR-G-12 was found to be the earliest in heading (65.87 days), spike emergence (70.43 days), first floret showing colour (82.93 days) and basal floret opening (85.60 days), while, cv. Urmil was observed to be very late in heading (91.27 days), spike emergence (96.73 days), first flower showing colour (112.93 days) and basal floret opening (116.10 days). Planting of early and late varieties in a judicious manner can prolong the duration of flowering. Similar variation in gladiolus cultivars has also been reported by Kumar (2009), Rajan *et al* (2010) and Choudhary *et al* (2011). Longest spike was recorded in 'IIHR-G-12' (76.43cm), followed by 'Punjab Morning' (73.80cm) and 'IIHR-G-11' (72.13cm), while, 'Punjab Dawn' produced the shortest spike (42.20cm). Longest rachis was noticed in 'IIHR-G-12' (58.27cm), followed by 'IIHR-G-11' (53.20cm); shortest rachis was seen in 'Punjab Dawn' (29.47cm). Number of spikes produced per plant was highest in 'IIHR-G-12' (2.5), followed by 'Punjab Dawn' (2.35), whereas, lowest number was seen in cv. 'Urmil' (1.33). Maximum number of florets per spike was observed in 'IIHR-G-12 (14.9), which was statistically at par with 'IIHR-G-11', 'G.S.-2' and 'Pusa Kiran' (14.77, 14.40, and 13.92, respectively), and minimum in 'Urmil' (9.93). Kumar and Yadav (2005) and Horo *et al* (2009) also noticed significant difference in number of florets different cultivars. Longest durability of spike (16.2 days) and duration of flowering (38.2 days) was recorded in 'IIHR-G-12', whereas, 'Urmil' exhibited the least durability (10.97 days) and duration of flowering (20.53 days). Similar results were reported by Kumar *et al* (2009) and Choudhary *et al* (2011).

C. Vase-life parameters

Significant variation in vase-life was recorded in different cultivars (Table 2). Highest cut-spike diameter was observed in 'Pusa Kiran' (0.82cm), which was at par with 'IIHR-G-12', and minimum was seen in 'Chandini' (0.48). Moreover, highest spike weight was produced by 'Pusa Kiran' (36.8g), followed by 'Bis-Bis' (35.05g), while it was the lowest in 'Chandini' (23.94g). 'Gunjan' gave the largest first-floret diameter (10.39cm), followed by 'Shabnam' (10.21cm), whereas, the smallest was seen in 'Urmil' (8.48cm). Maximum number of florets open at a time per spike was observed in 'IIHR-G-12' (3.63), followed by 'Shabnam' (3.33), and the least was seen in 'Dhanvantari' (2.22). Varieties producing higher number of early-opening florets are suitable for display in exhibitions. Maximum open-floret longevity was observed in 'IIHR-G-12' (4.57 days), which was statistically at par with 'Chandini', 'G.S.-2', 'Shabnam' and 'Jyotsna', while, the lowest was seen in

Table 1. Performance of gladiolus cultivars for vegetative and flowering parameters

Cultivar	Plant height (cm)	No. of leaves / plant	Leaf width (cm)	Leaf length (cm)	No. of tillers per plant	Days taken to heading	Spike emergence (days)	Appearance of first floret showed (days)	Basal floret opening (days)	No. of florets per spike	Spike length (cm)	Rachis length (cm)	No. of spikes per plant	Field durability of spike (days)	Flowering duration (days)
Anglia	67.53	8.13	2.76	34.44	2.27	75.59	79.67	86.47	89.47	11.20	45.20	34.73	2.27	11.98	29.53
Bis-Bis	73.47	8.73	1.83	40.26	1.53	89.47	94.47	110.53	112.87	10.80	49.27	38.33	1.40	13.03	25.47
Chandini	72.73	8.27	1.81	39.88	2.50	76.53	82.60	93.00	95.00	11.07	42.33	31.13	1.93	14.33	35.82
Delhi Pink	86.40	8.27	1.68	37.24	1.67	89.40	93.87	106.87	110.13	10.83	53.13	40.20	1.67	12.85	26.13
Dhanvantari	78.87	9.60	2.74	44.50	1.53	86.50	91.83	105.53	107.70	13.13	49.67	34.93	1.40	12.98	34.28
G.S.-2	92.53	8.73	2.31	39.95	2.20	77.86	82.27	90.20	93.03	14.40	60.73	44.20	1.38	14.75	35.47
Gunjan	81.95	9.27	2.71	40.41	1.60	79.83	84.33	92.93	95.93	12.20	54.13	36.30	1.47	13.97	28.58
IIHR-G-11	105.64	8.27	2.22	37.70	1.93	68.70	73.93	85.40	88.23	14.77	72.13	53.20	1.73	14.12	36.93
IIHR-G-12	108.32	8.87	3.13	38.51	2.60	65.87	70.43	82.93	85.60	14.90	76.43	58.27	2.50	16.20	38.20
Jyotsna	81.00	8.33	2.18	38.18	1.70	76.33	81.27	90.93	92.93	11.70	49.87	37.00	1.73	13.20	35.03
Punjab Dawn	73.80	8.33	1.90	38.64	2.70	76.87	81.80	88.33	90.33	12.17	42.20	29.47	2.35	12.36	33.67
Punjab Morning	101.00	8.67	1.61	35.37	2.00	77.67	82.80	93.73	96.07	12.63	73.80	48.60	1.47	14.33	32.93
Pusa Kiran	99.07	9.23	3.28	34.04	1.80	82.47	87.80	96.93	99.27	13.92	64.13	48.43	1.80	13.70	26.47
Shabnam	92.13	8.20	1.84	36.61	2.14	76.77	82.13	90.93	93.43	13.40	60.47	45.33	1.67	13.43	34.20
Urmil	74.60	8.50	2.16	38.91	2.00	91.27	96.73	112.93	116.10	9.93	48.53	36.20	1.33	10.97	20.53
SEm ±	2.55	0.18	0.04	0.79	0.08	0.72	0.74	0.68	0.80	0.38	1.67	1.80	0.08	0.23	1.04
CD *(P=0.05)*	7.38	0.53	0.12	2.29	0.23	2.10	2.15	1.91	2.27	1.06	4.83	5.22	0.21	0.64	2.95
	5.14	3.68	3.27	3.57	7.07	1.58	1.53	1.23	1.42	5.21	5.15	7.59	7.45	2.93	5.72

Table 2. Performance of gladiolus cultivars for vase life and corm parameters

Cultivar	Cut-spike diameter (cm)	Fresh weight of spike (g)	Floret diameter (cm)	No. of florets open at a time	Floret longevity (days)	No. of opened florets (%)	Vase life (days)	No. of corms per plant	No. of cormels per plant	Corm diameter (cm)	Cormel diameter (cm)	Corm fresh weight (g)	Cormel fresh weight (g)
Anglia	0.71	25.94	8.73	2.79	2.89	72.05	9.98	2.34	30.44	4.23	0.78	29.66	6.80
Bis-Bis	0.62	35.05	9.03	2.81	2.45	78.06	11.67	1.33	16.62	4.37	1.13	36.62	19.30
Chandini	0.48	23.94	9.03	2.51	3.3	87.35	12.70	2.40	26.68	3.47	0.58	22.3	3.53
Delhi Pink	0.70	26.44	9.05	2.99	2.66	84.67	10.85	1.30	11.33	4.98	1.91	43.52	21.72
Dhanvantari	0.67	24.64	8.95	2.22	3.01	74.40	10.98	1.61	17.13	4.38	0.71	34.74	3.19
G.S.-2	0.69	24.11	9.18	2.27	3.26	81.04	13.22	2.33	21.33	4.2	0.69	28.62	5.20
Gunjan	0.71	25.51	10.39	2.42	3.15	77.05	12.10	1.62	60.76	4.65	0.90	48.28	24.50
IIHR-G-11	0.72	27.20	9.92	3.04	3.1	89.84	12.12	1.95	26.71	4.38	0.64	31.28	2.70
IIHR-G-12	0.77	27.87	9.75	3.63	3.39	93.29	14.20	2.55	54.38	6.13	1.02	68.49	29.42
Jyotsna	0.63	25.03	10.17	2.87	3.22	88.89	11.87	1.74	15.70	4.15	0.62	27.35	3.74
Punjab Dawn	0.65	26.70	8.54	2.29	2.95	76.75	10.36	2.45	36.33	4.05	0.80	30.61	7.76
Punjab Morning	0.65	26.99	10.17	2.95	3.2	91.05	13.00	2.20	11.67	3.86	0.72	29.74	2.48
Pusa Kiran	0.82	36.80	8.56	3.07	3.07	82.61	12.20	1.98	18.09	5.95	0.98	70.24	12.28
Shabnam	0.66	29.77	10.21	3.33	3.22	80.60	11.76	1.33	11.33	4.27	0.66	29.31	2.48
Urmil	0.62	24.74	8.48	3.15	2.28	70.19	8.97	1.54	9.67	3.83	0.78	28.51	3.49
SEm ±	0.02	0.52	0.18	0.14	0.08	1.53	0.13	0.07	0.62	0.23	0.04	0.89	0.36
CD *(P=0.05)*	0.06	1.50	0.52	0.41	0.22	4.33	0.36	0.19	1.74	0.64	0.11	2.52	1.01
CV %	5.37	3.28	3.38	8.83	3.17	3.25	1.90	6.01	4.34	8.77	7.66	4.14	6.24

Table 3. Relative economics of 15 gladiolus cultivars

Cultivar	Yield ha^{-1}					
	Number of Spike	Numbers of Corms	Weight of Cormels (kg)	Gross return (Rs / ha)	Net return (Rs / ha)	B : Cratio
Anglia	378331.82	389998.44	1133.33	1977492	1250714	1.72
Bis-Bis	233332.40	221665.78	3216.65	1298328	571550	0.79
Chandini	321665.38	399998.40	588.33	1833576	1106798	1.52
Delhi Pink	278332.22	216665.80	3619.99	1418495	691717	0.95
Dhanvantari	233332.40	268332.26	531.66	1280745	553967	0.76
G.S.-2	229999.08	256665.64	866.66	1259995	533217	0.73
Gunjan	244999.02	269998.92	4083.33	1491661	764883	1.05
IIHR-G-11	288332.18	324998.70	449.10	1555782	829004	1.14
IIHR-G-12	416665.00	424998.30	4903.31	2349324	1622546	2.23
Jyotsna	288332.18	289998.84	623.33	1476994	750216	1.03
Punjab Dawn	391665.10	408331.70	1293.33	2064659	1337881	1.84
Punjab Morning	244999.02	366665.20	413.33	1549827	823049	1.13
Pusa Kiran	299998.80	329998.68	2046.66	1677327	950549	1.31
Shabnam	278332.22	221665.78	413.33	1270662	543884	0.75
Urmil	221665.78	256665.64	581.66	1224912	498134	0.69

*Production cost - Rs. 726778, *Selling price of spike/ corm – Rs. 2.50/- , *Selling price of cormels – Rs. 50.0 kg^{-1}

'Urmil' (3.46 days). Maximum number of open florets in the vase was noticed in 'IIHR-G-12' (93.29%), followed by 'Punjab Morning' (91.05%), whereas, this was minimum in 'Urmil' (70.19%). Vase-life was longest in 'IIHR-G-12' (14.2days), followed by 'G.S.-2' (13.22days), 'Punjab Morning' (13.0days) and 'Chandini', (12.7days), while it was shortest in 'Urmil' (8.97 days). High longevity and vase-life are desirable traits. Similar results for vase-life were recorded by Horo *et al* (2009) and Choudhary *et al* (2011).

D. Corms and cormels: parameters

Corms and cormels harvested from different cultivars showed significant variation in number per plant, size and weight. Highest numbers of corms per plant were recorded in 'IIHR-G-12' (2.55), which was statistically at par with 'Punjab Dawn' and 'Chandini'. However, 'Delhi Pink' (1.3) recorded lowest number of corms per plant. Although maximum number of cormels per plant was recorded in 'Gunjan' (60.76), followed by 'IIHR-G-12' (54.38), minimum number was seen in 'Urmil' (9.67). Largest corm diameter was observed in 'IIHR-G-12' (6.13cm), which was statistically at par with 'Pusa Kiran' (5.95cm). This was lowest in 'Chandini' (3.47cm). Maximum cormel diameter was noticed in 'Delhi Pink' (1.91cm), followed by 'Bis-Bis' (1.13) and 'IIHR-G-12' (1.02), while minimum cormel diameter was recorded in 'Chandini' (0.58cm). Heaviest corms were produced by 'Pusa Kiran' (70.24g), which was statistically at par with 'IIHR-G-12' (68.49g), while, the lightest corms were seen in 'Chandini' (22.30g). Cultivar IIHR-G-12 gave highest cormel weight per plant (29.42g), followed by 'Gunjan' (24.50g). Minimum cormel weight was recorded in cvs. Shabnam and Punjab Morning (2.48g). Larger and heavier corms are one of the important criteria for selecting of quality corms obtains quality spikes. Variation in traits of corms and cormels may be primarily due to genetic constitution of the cultivars which may get further modified owing to the prevailing environmental conditions. Wide variation for yield was observed by Kumar (2009) and Shaukat *et al* (2013)

E. Economic parameters

The relative economics of the various cultivars were calculated on the basis of formula (Table 3). Whereas, the data from economic parameters were indicated that cv. 'IIHR-G-12' recorded highest gross returns (Rs. 23,49,324), along with spike (4,16,665), corms (4,24,998) and cormels yield (4903.31kg) production ha^{-1}. The produce obtained was sold @ Rs. 2.50 per spike, corm and cormels @ Rs. 50/kg. Thus the maximum net returns of Rs. 1622546 ha^{-1} were obtained in 'IIHR-G-12', where the cost of cultivation was Rs. 726778 ha^{-1}. Among various cultivars, returns per rupee invested (B:C ratio = Net returns / Total cost of cultivation) was maximum in 'IIHR-G-12'(Rs. 2.23), while, it was minimum in 'Urmil' (Rs. 0.69).

It is evident from the results that cultivar IIHR-G-12 was early to flower, recorded higher spike yield, net returns and B/C ratio, and was the best among 15 cultivars of gladiolus tested under sub-humid southern plains of Rajasthan.

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