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Varietal assessment and variability study of gerbera (*Gerbera jamesonii* Bolus.) in controlled condition

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Abstract

The field investigation was laid out in Surastra condition to evaluate of eight varieties of gerbera viz., 1314, Pertired, Alcochete, Petitamarel, Setubal, Caiman, Helena and 1133. In this experiment variability was assessed on the morphological and different pigment content. The observations on growth, flowering and yield characters were recorded as morphological markers and analyzed separately. Among the morphological characters, vigorous growth in terms of leaf area and plant height were obtained significantly superior in variety Pertired (V₂). Variety Pertired (V₂) also formed maximum number suckers per plant. With respect to flowering characters, earliness in flower bud initiation was registered in variety Pertired (V₂). Consequently the flower quality in respect of flower diameter and number of petals per flower were significantly higher in variety Pertired (V₂). However, significantly maximum A – grade quality flowers were recorded in variety Pertired (V₂) while variety Helena (V₇) produced highest flowers with respect to B – grade. Setubal (V₅) produced maximum flowers of C – grade. D – Grade flowers were obtained significantly maximum in variety Petitamarel (V₄). Significantly highest yield per plant per year was obtained in variety Pertired (V₂) which was followed by variety 1314 (V₁). Superiority with respect to shelf life and vase life were found significantly maximum in variety Pertired (V₂) which was statistically at par with variety 1314 (V₁). With respect to flower color variety Pertired (V₂) was observed significantly strongest flower color. According to the pigment analysis variety Caiman (V₆) was highest in total flavonoid content, while variety Setubal (V₅) was highest in total anthocyanins content.

Keywords: Gerbera, varietal evolution

Introduction

Gerbera, commonly known as Transvaal Daisy, Barberton Daisy or African Daisy is cultivated throughout the world under a wide range of climatic conditions for its attractive flowers. It is highly suitable for beds, borders, pots and rock gardens. The wide range of colours and the attractive shape of flowers suit very well in flower arrangements. The cut blooms have long vase life (Singh, 2006 a) [21]. Today gerbera is known as an important commercial flower crop and belong to the most important plant species in the world, together with the rose, chrysanthemum, carnation and tulip. Gerbera is grown commercially in India for export as well as for the domestic market.

The genus Gerbera was named in the honour of German botanist /naturalist, Traugott Gerber who travelled in Russia in 1743 and started first botanical garden in Moscow. However, for species, *G. jamesonii*, it is a matter of different opinion. *G. jamesonii* was named for Dr. L. S. Jamesson, a British colonial statesman in South Africa who was one of the discoverer of the species. The first official description of the South African species, *Gerbera jamesonii* was made by J. D. Hooker in Curt's Botanical Magazine (Singh, 2006 b) [22]. This genus is native to South African and Asiatic regions. The Gerbera species belong to Asteraceae, which is the largest family of plants. The genus Gerbera consists of about fourty species of hardy and perennial flowering plants, of which *Gerbera jamesonii* Bolus is only under cultivation. The other species are *G. asplenifolia*, *G. kunzeana*, *G. viridifolia*, etc. In India, it is distributed in the temperate Himalayas from Kashmir to Nepal at altitude of 1,300 to 3,200 meters (Bhattacharjee and De, 2003 a). It is mainly cultivated in West Bengal, North Eastern States, Maharashtra, Andhra Pradesh, Karnataka and Tamil Nadu. In Gujarat, the area under gerbera cultivation is concentrated around Surat, Navsari, Valsad, Vadodara and Ahmadabad districts. Recently many growers and corporate are taking up projects on gerbera around Pune and Bangalore to produce high quality cut flowers for domestic and export markets Bhayani, 2005a) [3].

Materials and Methods

Experiment were conducted at Hi-tech Horticulture Park (Greenhouse Unit-4), Department of Horticulture, College of Agriculture, Junagadh Agricultural University, Junagadh during the year 2015-16 and 2016-17. The present experiment was laid out in Completely Randomized Design (CRD) with three replications and eight varieties of gerbera viz., 1314, Pertired, Alcochete, Petitamarel, Setubal, Caiman, Helena and 1133.

Pigment profiling

Plant Material

Petals of eight gerbera varieties in different colors including 1314 (Red), Pertired (Red), Alcochete (Red), Petitamarel (Pink), Setubal (Red), Caiman (Yellow), Helena (Purple) and 1133 (Orange) that were grown in a greenhouse under standard and identical condition, collected at time of full bloom. The collected samples were kept in liquid N until used time. It should be mentioned that only ray florets studied in this study.

Determination of flower colour

Flower color was estimated with the collection of fresh outer ray florets three gram of each variety of gerbera and mixed acetone 4 ml then crush with mortar and pestle. A colorimetric instrument (Lovibond Tintometer) was used to measure the color of fresh petals from flowers of each variety, immediately after collection. Color was expressed according to the Commission International de l'Éclairage (CIE) $L^*a^*b^*$ color-space coordinates.

Determination of the total Flavonoid content

Total "flavonoid" content were determined using the spectrophotometric method based on formation of complex with aluminum (Ordon *et al.*, 2006) [16]. A volume of 0.5 ml of 2% $AlCl_3$ methanol solution was added to 0.5 ml sample solution. After one hour at room temperature, the absorbance was by a PG Instrument T80 spectrophotometer. Total "flavonoid" content was calculated using the equation based on the calibration curve.

Determination of the total Anthocyanins content

Plant material was ground in liquid N and freeze-dried for 2 day. 10mg of the powder was extracted with 1 ml of extraction solvent (70 ml methanol + 20 ml water + 10 ml 1 M HCL) at 4° C for 20 h, and centrifuged (7826 g for 20 min at 4° C). There were three replication for each sample. The absorbance of the supernatants was measured at 530 nm. The anthocyanin content was calculated based on cyaniding chloride (sigma) as a standard (Laitinen *et al.*, 2008) [11].

Result and Discussion

Leaf area (cm²)

The leaf area was found significantly highest (163.66 cm² and 161.00 cm²) in variety Pertired (V₂), which was statistically at par with Petitamarel - V₄ (152 cm² and 157.33 cm²) whereas the variety Setubal (V₅) recorded lowest leaf area (121.33 cm² and 116.66 cm²) during the year 2015-16 and 2016-17, respectively. In pooled data, leaf area was found highest (162.33 cm²) in Pertired (V₂) and noted lowest (119.00 cm²) in variety Setubal (V₅).

Plant height

It is evident from the data presented in Table 4.3 that the tallest plant height was observed significantly superior in variety Pertired (V₂) and which was statistically at par with

varieties 1314 (V₁), Setubal (V₅) and Helena (V₇) being 36.70 cm, 36.26 cm and 37.41 cm, respectively, while the lowest plant height (31.14 cm) was noted in Petitamarel (V₄) during the year 2015-16. Similarly during second year i.e. 2016-17, the tallest plant (37.48 cm) was also recorded in Pertired (V₂) but which was statistically at par with varieties Setubal (V₅), Caiman (V₆) and Helena (V₇) being 35.17 cm, 36.96 cm and 36.27 cm, respectively, whereas smallest plant (31.17 cm) was again produced by Petitamarel (V₄) variety.

In pooled analysis, the tallest plant (37.55 cm) was observed in Pertired (V₂) which was statistically at par with V₇ – Helena (36.84 cm). However, the smallest plant (31.46 cm) was obtained in variety Petitamarel (V₄). Similar variation in plant height due to cultivars was also noticed previously in gerbera by Dhane *et al.*, (2003) [5] & Sarakar and Ghimiray (2004) [20]. The findings of the present investigation conform well with result reported by Bhayani *et al.*, (2005) [3] & Kumar and Yadav (2005) [10].

Number of suckers per plant

The data indicated that the number of suckers per plant was formed significantly higher in variety Pertired (V₂) being 7.55, 7.81 and 7.68 suckers/plant in the year 2015-16, 2016-17 and pooled data, respectively, however the lowest number of suckers per plant was noted in variety Helena (V₇) being 5.62 and 5.78 suckers/plant during the year 2015-16 and pooled data, respectively. Variation in sucker production per plant has also been reported by Kumar and Yadav (2005) [10], Kandpal *et al.*, (2003) [9], Naik *et al.*, (2006) [14] and Magar *et al.*, (2010) [13] in gerbera.

Flowering parameter

Days taken to flower bud initiation

The statistical analysis of the data revealed that the minimum days required for first flower bud initiation being 90.40 days in variety Pertired (V₂) which was statistically at par with V₁ (1314), V₇ (Helena) and V₈ (1133) i.e. 92.09 days, 94.31 days and 94.66 days, respectively. While, the maximum days taken for first flower bud initiation (103.07 days) were observed in variety Alcochete (V₃). This might be due to genetic differences. These results are in accordance with Nair and Medhi (2002) [15] and Naik *et al.*, (2006) [14] and Bhayani *et al.* (2008) [4] in gerbera.

Quality attribute

Diameter of flower (cm)

Significantly highest flower diameter (12.48 cm, 12.37 cm and 12.42 cm) was observed in variety Pertired (V₂). While lowest flower diameter (6.40 cm, 6.37 cm and 6.38 cm) was found in variety Caiman (V₆) during the year 2015-16, 2016-17 and pooled analysis, respectively. This could be mainly due to genetic makeup. The results confirmed the report of Nair and Medhi (2002) [15] at the Bay Islands, Bhayani *et al.*, (2008) and Patil *et al.*, (2010) [15, 19] in gerbera.

Flower stalk grading (%)

With respect to A – grade quality, maximum flowers (61.10 %, 60.90% and 61.00%) were reported in Pertired (V₂) variety during 2015-16, 2016-17 and pooled data, respectively.

Variety Helena (V₇) was produced highest flower (42.23 %, 41.79 % and 42.01%) with respect to B – grade during 2015-16, 2016-17 and pooled data, respectively. However, variety Setubal (V₅) attained the least flower (14.19 %, 13.69 % and 13.94 %) of B – grade during 2015-16, 2016-17 and pooled, respectively.

It is evident from the data presented in Table – 11 that the Setubal (V₅) obtained highest flower of C – grade (65.33 %, 67.40 % and 66.37) during 2015-16, 2016-17 and pooled, respectively, whereas variety Pertired (V₂) attained least flower of C – grade (10.11 %, 9.33 % and 9.72 %) during 2015-16, 2016-17 and pooled, respectively.

D – grade flower were obtained significantly maximum in variety Petitamarel (V₄) i.e. 30.20 %, 29.64 % and 29.92 % during the year 2015-16, 2016-17 and pooled, respectively. Although, variety Pertired (V₂) formed the least flower (6.78 %, 5.47 % and 6.13 %) of D – grade. Variation in different floral characters might be attributed to the divergence in these genotypes or wide range in nature of growth. These results were also in accordance of Nair and Medhi (2002) ^[15], Kandpal *et al.*, (2003) ^[9] and Naik *et al.*, (2006) ^[14] and Magar *et al.*, (2010) ^[13] in gerbera.

Number of petals per flower

It is evident from the data presented in that the throughout both the year in peak flowering phase, the overall average number of petals per flower were produced significantly maximum in variety Pertired (V₂) being 59.04, 56.92 and 57.98 during 2015-16, 2016-17 and pooled data, respectively. However, the lowest number of petals was produced by Setubal (V₅) i.e. 25.44, 27.11 during 2015-16 and pooled data, respectively. On the other hand variety Caiman (V₆) produced lowest number of petals (28.64) followed by Setubal - V₅ (28.78) during the year 2016-17. This might be due to genetic difference in the cultivars and growing condition provided. These results are in accordance with Dipal (2011) ^[6] in gerbera.

Yield attribute

Number of flowers per plant per year

It is evident from the data presented in Table 4.16 that the significantly superior yield was recorded in variety Pertired (V₂) being 32.60, 33.90 and 33.25 flowers/plant/year in year 2015-16, 2016-17 and pooled data, respectively, which was statistically at par with variety 1314 (V₂) in 2015-16. However, the least number of flowers per plant per year i.e. 25.80, 23.07 and 24.43 flowers/plant/year was observed in variety Helena (V₇) during both the experimental year and pooled data, correspondingly.

Flower longevity

Shelf life of flower (days)

The gerbera varieties exhibited the moderate range of variation with respect to flower shelf life. The data in Table 4.17 clearly indicated that the overall average shelf life was obtained significantly highest (11.41 days, 11.44 days and 11.42 days) in variety Pertired (V₂), which was statistically at par with variety 1314 (V₁) during the year 2015-16, 2016-17 and pooled data. Whereas, the lowest shelf life (6.79 days, 6.70 days and 6.74 days) was recorded in variety 1133 (V₈) during both the experimental year and pooled analysis. Thomas *et al.*, (2004) ^[23] and Bhayani *et al.*, (2005) ^[3] also observed similar results in gerbera. The cut stem of variety Pertired was straight and thicker which supported for longer shelf life and vase life of flowers. Further, the cut stem of var. Pertired was enough stiff and it had higher photosynthetic accumulation in flower head resulting cut flower showed less incidence of stem bending may be helpful in regulating water potential of tissues ultimately to flower head for maintenance of turgidity, as evidenced by higher absorption of water in cut stem. These findings are in agreement with respect of Fisher

et al. (1982) ^[7], Parthasarthy and Nagaraju (2003) ^[18] and Paraneetha (2006) ^[17] in gerbera. They stated that variation in post harvest life of flowers depends on genetical variations among the varieties.

Vase life of flower (days)

Varieties under investigation show the moderate range of variation with respect to vase life. The data presented in Table 4.19 clearly showed that the overall average vase life was found significantly highest in Pertired (V₂) being 11.61 days, 11.07 days and 11.62 days and which was statistically at par with variety 1314 (V₁) in both the experimental year, respectively. However, shortest vase life (6.70 days, 6.47 days and 6.58 days) was recorded in variety 1133 (V₈) during both the experimental year as well as in pooled data. Thomas *et al.*, (2004) ^[23] and Bhayani *et al.*, (2005) ^[3] also observed similar results in gerbera. The cut stem of variety Pertired was straight and thicker which supported for longer shelf life and vase life of flowers. Further, the cut stem of var. Pertired was enough stiff and it had higher photosynthetic accumulation in flower head resulting cut flower showed less incidence of stem bending may be helpful in regulating water potential of tissues ultimately to flower head for maintenance of turgidity, as evidenced by higher absorption of water in cut stem. These findings are in agreement with respect of Fisher *et al.* (1982) ^[7], Parthasarthy and Nagaraju (2003) ^[18] and Paraneetha (2006) ^[17] in gerbera. They stated that variation in post harvest life of flowers depends on genetical variations among the varieties.

The cultivars showed significant variation in different traits related to keeping quality (on the plant and off the plant). It seems that variation in different variety of gerbera with respect to flower diameter and weight of flower might be due to difference in senescence behavior through the production of ACC, ethylene forming enzymes or might be due to genetic makeup (Madhubala *et al.*, 2008) ^[12]. Similar results were reported by Nair and Medhi (2002) ^[15], Kandpal *et al.*, (2003) ^[3] and Paraneetha (2006) ^[17], Magar *et al.*, (2010) ^[13] and Patil *et al.*, (2010) ^[19] in gerbera.

Pigment profiling

Varieties under investigation display the wide range of variation with respect to flower color and different pigment content in gerbera flowers.

Determination of the total flavanoid content

The overall average of total flavanoid was significantly highest (30.25 mg/g, 29.81 mg/g and 30.03 mg/g) in variety Caiman (V₆) which is yellow color during both the experimental year 2015-16, 2016-17 and pooled data, respectively. However variety 1314 (V₁) which is red color recorded lowest (15.02 mg/g, 15.08 mg/g and 15.05 mg/g) during both the experimental year 2015-16, 2016-17 as well as pooled data, respectively. This is might be due to flavonoid are usually colourless or yellow and derived from dihydroflavonols through enzymatic conservation by flavonol synthase and may affect flower color being yellow (Honton *et al.*, 1993) ^[8].

Determination of the total Anthocynins content

The overall average of total anthocynins content was significantly highest (58.44 g/100g, 58.11 g/100g and 58.28 g/100g) in variety Setubal (V₅) which is red color. However variety Caiman (V₆) which is yellow color recorded lowest (2.65 g/100g, 2.99 g/100g and 2.82 g/100g) total anthocynins

during both the experimental year 2015-16, 2016-17 as well as pooled data, respectively. This is due to dark red color flower petals synthesize more anthocynins than other color flower petals (Honton *et al.*, 1993) [8].

Determination of flower color

The the flower color distribution on color space (or CIELAB) was as followed; the L^* values limited from 86.12 in 'Caiman' to 44.92 in 'Setubal', a^* values between 46.11 in 'Setubal' and 0.02 'Caiman', b^* values from 117.30 in 'Caiman', to 18.46 'Helena', C^* values from 118.88 'Caiman' to 19.95 'Helena', h^0 values between 96.43 'Caiman', and 48.21 'Setubal'.

Flower Color distribution on color space (or CIELAB) variety Caiman (V_6) showed highest L^* (Lighestness), C^* (Croma) and h^0 (Hue angle) and lowest a^* b^* (Cromatic component) due to presence of total flavones and flavonols content (Table 4.21) than other variety. Therefore variety Caiman (V_6) found

characteristics of strong color. These results are in accordance with Akabari *et al.* (2012) in gerbera.

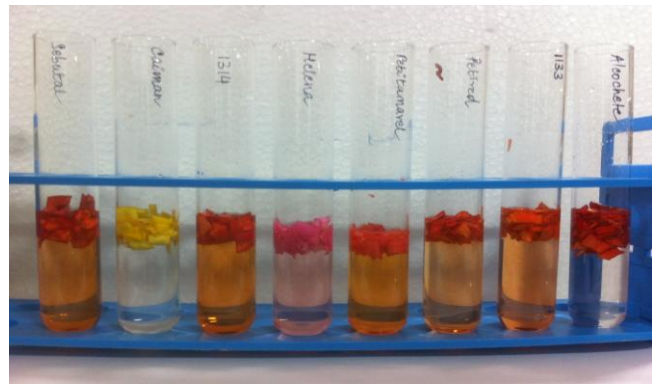


Fig 1: Colour Extraction from Petals of gerbera Flower

Table 1: Variation in leaf area, plant height, number of suckers per plant, days taken to flower bud initiation, diameter of flower and flower stalk grading (%).

Treatment	Leaf Area (cm ²)	Plant height (cm)	Number of suckers per plant	Days taken to flower bud initiation	Diameter of flower (cm)	Flower stalk grading (%)			
						A grade >65 cm stalk length	B grade 55-65 cm stalk length	C grade 45-55 cm stalk length	D grade 35-45 cm stalk length
	Pooled	Pooled	Pooled		Pooled	Pooled	Pooled	Pooled	Pooled
V1	147.00	35.71	6.51	92.09	11.22	39.25	40.01	13.73	7.02
V2	162.33	37.55	7.68	90.40	12.42	61.00	23.16	9.72	6.13
V3	139.66	32.34	6.33	103.07	9.47	1.44	19.66	53.26	25.65
V4	154.66	31.46	5.92	97.96	8.39	2.16	21.73	46.20	29.92
V5	119.00	35.72	5.92	99.80	9.38	0.00	13.94	66.37	19.70
V6	137.33	35.72	6.29	97.73	6.38	5.62	30.39	37.30	26.70
V7	141.00	36.84	5.78	94.31	10.50	24.66	42.01	19.86	13.47
V8	141.66	33.41	6.13	94.66	8.48	33.08	39.75	10.40	16.86
Mean	142.83	34.84	6.32	96.25	9.53	20.90	28.83	32.10	18.18
S.Em.±	6.53	0.54	0.12	2.22	0.15	0.27	0.38	0.65	0.25
C.D. at 5 %	3.89	1.58	0.34	6.65	0.43	0.79	1.10	2.19	0.72

Table 2: Variation in number of petals per flower, number of flowers per plant per year, shelf life of flower, vase life of flower, total flavonoid content, total anthocynins content, petal color parameter.

Treatment	Number of petals per flower	Number of flowers per plant per year	Shelf life of flower (days)	Vase life of flower (days)	Total flavonoid content (mg/g)	Total anthocynins content (g/100g)	Petal color parameters				
							L^*	a^*	b^*	C^*	h^0
	Pooled	Pooled	Pooled	Pooled	Pooled	Pooled					
V1	42.94	31.02	11.06	11.13	15.05	23.58	47.99	36.85	70.23	79.14	62.25
V2	57.98	33.25	11.42	11.62	16.75	21.78	64.48	18.47	86.97	88.98	78.02
V3	44.13	29.93	8.60	8.68	16.72	22.49	59.55	25.54	82.21	85.86	72.70
V4	38.88	26.57	8.71	8.71	16.37	33.99	82.66	4.47	23.36	24.94	79.68
V5	27.11	29.14	7.48	7.51	22.86	58.28	44.92	46.11	52.78	68.86	48.21
V6	29.23	28.90	9.19	9.23	30.03	2.82	86.12	0.02	18.46	118.88	96.43
V7	35.31	24.43	7.57	7.34	26.44	6.29	82.45	0.18	117.3	19.95	89.48
V8	40.90	29.33	6.74	6.58	18.02	13.35	74.81	5.49	99.19	100.07	86.85
Mean	39.56	29.07	8.84	8.85	20.28	22.82	67.87	17.14	68.81	73.34	76.70
S.Em.±	0.61	0.52	0.17	0.15	0.25	0.17	0.90	0.35	0.66	1.19	1.15
C.D. at 5 %	1.77	1.50	0.50	0.44	0.74	0.48	2.72	1.06	2.00	3.58	3.46

L^* : lightness; a^* , b^* : chromatic components; C^* Croma; h^0 Hue angle

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