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Assessment of Genetic Variability and Heritability in Gerbera (*Gerbera jamesonii* L.) Cultivars

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ABSTRACT: An attempt was made to study the extent of genetic variability, heritability, genetic advance and genetic gain for vegetative and floral characters of Gerbera (*Gerbera jamesonii* L.) under naturally ventilated polyhouse. Varieties namely Balance, Stanza, Savannah, Dana Ellen, Goliath, Primerose, Helix, Liberty, Sabrina and Montenegro were selected for their evaluation. Consumers desire characteristics such as good blooming quality and a long vase life since they enhance value and are more likely to make a good and lasting impression on the gift recipient. Hence, there is need to study their performance in different growing medium and conditions for the development of production technology for better yield and quality of the produce round the year. Notable variations were registered for twenty parameters studied in a layout of randomized block design with three replications during 2015–2016. The range of variation was high for duration of flowering from 238.33 to 266.13 followed by leaf area ranged from 123.93 to 197.92. Analogy of genotypic and phenotypic co-efficient of variation for distinct characters indicated that the value of PCV wasfound to be higher than GCV due to influence of environment. The higher GCV and PCV estimates registered for number of ray florets per flower (41.27% and 41.92% respectively) followed by number of suckers per plant (19.72 and 26.45 respectively). Heritability in the broad sense ranged from 96.89 for ray florets to 55.56 for suckers' number per plant. However, high heritability was associated with high genetic advance was recorded for number of ray florets per flower (76.15) followed by leaf area (51.68) indicating existence of adequate genetic variability for selection in these traits. Great heritability accompanied with low genetic advance for the characters days to first flower opening, 50% flowering and duration of flowering implies that non-additive gene action.

Keywords: Heritability, genetic advance, genetic gain, gerbera, genetic variability.

INTRODUCTION

Gerbera (*Gerbera jamesonii* L.) is a very attractive and high value cut flower, connected to close family Asteraceae; a well-known cut flower grown all over the world in a varied meteorological condition. It is famously known as 'Barberton daisy' or 'Transvaal daisy'. The daisy ranks fourth in the worlds cut flower trade and a popular cut flower in Holland, Germany and USA (Sridhar and Biradar 2016). With its huge, brilliant flowers and stemless perennial nature, gerbera has gained favour among those who enjoy flowers. This flower comes in a very wide range of variations. The freshness and long lasting characteristics of this flower used as decorative flower in parties, functions and flower bouquet.

The daisy-like flowers grow in a wide range of colors including yellow, orange, cream-white, pink, brick red, scarlet, maroon, terracotta and various other intermediate shades. The center floral disk can range from a yellowish to light-bronze to black in color.

In the recent years, floriculture is quickly growing as highly competitive, commercial and economic industry with the potential to generate significant foreign exchange aided by liberalization of economy and import policy. As a result, several adventures and enthusiastic entrepreneurs and nursery men are taking advantage of this opportunity and bringing the newest and improved gerbera cultivars from abroad for cultivation in the state and elsewhere. Additionally, a number of reputable companies here in the country have begun supplying improved plant materials multiplied through tissue culture techniques.

The consumer preferences changes with time and longevity of cut flowers. Hence crop improvement is necessary right now in order to maintain the supply of desirable cultivars Improvement through selection is dependent on the variability present in the genotypes that are now accessible, which may be caused by variations in the genetic constitution of cultivars or in the growing environments. Gerbera is a vegetative propagated crop through suckers on commercial scale and selection is an easy method for varietal improvement in it. Selection is successful only when the observed variability in the population is heritable in nature. Genetic variance, heritability and other genetic factors are reported to be subject to fluctuations with changing environments (Lal *et al.,* 1985).

As the profitable cultivation of gerbera is obtaining importance, introduction and popularization of high yielding varieties and better quality is necessary. Thus, it is important to investigate morphological variation and genotypes performance in a new environment to enhance the efficiency of a breeding programme. It is crucial to estimate the heritability and genetic advance of the significant yield attributing traits in a crop as well as the nature and extent of genetic variability in the germplasm for a successful breeding programme. Therefore, the current investigation was carried out to comprehend the heterogeneity within the ten gerbera cultivars and their respective performance.

MATERIAL AND METHODS

The polyhouse trail was carried out at division of Floriculture and Landscape Architecture, College of Horticulture at Sri Konda Laxman Telangana State Horticultural University, Rajendranagar, Hyderabad, during 2015-2016. The leaves and roots were cut off, and the healthy suckers were separated from the clump. Thereafter, the suckers were then planted taking extreme care to avoid burying the crown under soil. A 30 x 30 cm space between the suckers was used to plant about 16 plants in each plotin double row zig-zag pattern in completely randomized system with three replicationscomprising of ten different cultivars *viz.,* Balance, Dana Ellen, Goliath, Helix, Liberty, Montenegro, Primerose, Sabrina, Savannah and Stanza.

In the early morning, planting was done immediately, and then irrigation water was applied. Manual weeding was used to keep the plots free of weeds throughout the growth season. Numerous cross-cultural practices, including irrigation, earthing up, removing dried leaves and blossoms, etc., were carried out on a regular basis to ensure optimal plant growth and development. In each replication, five selected plants from each cultivar were measured onplant height, number of leaves per plant, leaf length, leaf breadth, leaf area, leaf area index, number of suckers per plant per year, chlorophyll content, first flowering, flower diameter, flower stalk diameter, length of the flower stalk, number of ray florets, disc diameter, days take to flower 50%, duration of flowering, field life, number of flowers per plant, fresh weight and dry weight of flowers.

The Singh and Chaudhary (1985) technique was used to compute the genotypic and phenotypic coefficients of variation. Parameters of variability were estimated as per formula provided by Burton (1952). Heritability in broad sense was determined according to the methodology given by Allard (1960). From the heritability estimates the genetic advance and predicted genetic gain were calculated by using formula given by Johnson *et al.* (1955).

RESULTS AND DISCUSSION

In ten daisy cultivars, the degree of variability with regard to twenty quantitative characters were calculated in terms of mean performance, phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV), heritability, genetic advance, and genetic gain are shown in Table 1. The range of variation was high for duration of flowering from 238.33 to 266.13followed by leaf area ranged from 123.93 to 197.92. While leaf area index showed lowest range was recorded from 0.14 to 0.21.

For all the traits under study, the phenotypic coefficient of variation (PCV) was greater than genotypic coefficient of variation (GCV), indicating how environment affect the expression of cultivar. Rajiv Kumar *et al.* (2012) also reported higher PCV than GCV for various traits. It was indicating the importance and influence of interaction of environment expression of the characters. The differences between the PCV and GCV were relatively very small which indicated that large amount of variability was contributed by genetic component and less by environmental influence. However, close correspondence was seen between GCV and PCV for some characters like leaf area, leaf area index, first flower opening, number of ray florets, days taken to flower for 50% and flowering duration, noticing little influence of environment on these characters. But, Anand *et al.* (2014) was also seen a close correspondence between GCV and PCV for certain characters like plant height, leaf length, number of suckers plant, stalk length and numbers of flowers per clump per year indicating little influence of environment on these characters.

The highest genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) were found for number of ray florets per flower (41.27% and 41.92% respectively) followed by number of suckers per plant (19.72 and 26.45 respectively), number of leaves (23.88 and 25.33), dry weight flower (22.70 and 27.06) and flower count per plant (20.29 and 21.83) suggesting that these characters are under genetic control. Hence, these characters greater scope for further improvement. Chobe *et al.* (2010) reported same results observed for number of ray florets flower^{-1} and Anand *et al.* (2013) obtained for number of leaves, number of suckers and number flowers per plant. Senapati *et al*. (2013) reported the highest GCV and PCV were recorded for number of leaves per plant, followed by number of clumps per plant, leaf area index and hollowness of the stalk, indicating high variation in these characters, predicting greater scope for improvement of these four characters. The low estimate of GCV and PCV were recorded for duration of flowering (3.90 and 4.11) after days taken for 50% blooming (4.96 and 5.34). This implied that there was little variance in these traits amongst cultivars. The lesser number of genotypes evaluated might be the probable reason attributed for low variability.

Estimates of heritability in a wide sense give a measure of transmission of characters from one generation to another. Thus, giving an idea about the heritable portion of variability which enables the plant breeder to isolate elite selections in the crop. Heritability and genetic advance increase efficiency of selection in a breeding programme by assessing influence of the environmental factors and additive gene action.High heritability was observed for all the vegetative and floral characters under study. Sunil Kumar (2014) also suggested high heritability for most of the quantitative traits in gerbera.

When heritability is studied along with genetic advancement, the determination of heritable variation becomes more accurate. In the current study, ray florets showed high heritability associated with high genetic advance (96.89 and 76.15) followed by leaf area (92.32 and 51.68) indicating the possible role of additive gene action in their inheritance. As a result, these characteristics are found suitable for selection. Therefore, response to selection could be anticipated in improving the yield.

High heritability with low genetic advance recorded for number of leaves per plant, first flower opening, Length of the flower stalk, Days taken for 50% flowering, Duration of flowering. Similar findings obtained by Ghimiray and Sarkar (2015) for circumference of plant, days to visibility, days to full bloom and days to opening of flower buds had low estimates of genetic advance but high heritability indicating greater contribution of non-additive gene effect in controlling these characters as was also observed by Chobe *et al.* (2010) for days to first flowering, vase life and number of flowers/ plant/year. The high heritability is being exhibited due to favourable influence of environment rather than genotype. Medium heritability with low genetic advance exhibited in plant height, leaf length, leaf breadth, diameter of flower, diameter of flower stalk and flower dry weight.

Greater heritability (>60%) accompanied with high genetic advance as percentage of mean (GAM >20%) was obtained in almost all characters except chlorophyll content, days to take flower for 50% and duration of flowering indicating contribution of additive gene effects in the expression of these traits and proving more useful for efficient character improvement through simple selection. Similar results have been reported by Raj Narayan *et al.* (2016), Rajiv Kumar (2013) and Rajiv Kumar (2015) stated that greater heritability paired with high genetic advance as per cent of mean was recorded for leaf count per plant, leaf breadth, suckers' number per plant.

Among the flower characters, the traits that determine the earliness specifically days taken for first flower opening, 50% flowering and duration of flowering recorded a very high heritability (94, 86 and 90%) but a low genetic advance (9.51, 8.08 and 19.42) with low genetic advance as percentage of mean (13.05, 9.49 and 7.64 %) which indicates non-additive gene action. The high heritability is being showed due to suitable environment instead of genotype, selection for these traits may not be rewarding. Anujaand Jahnavi (2012) reported same results for days taken to flower 50% and duration of flowering in French Marigold.

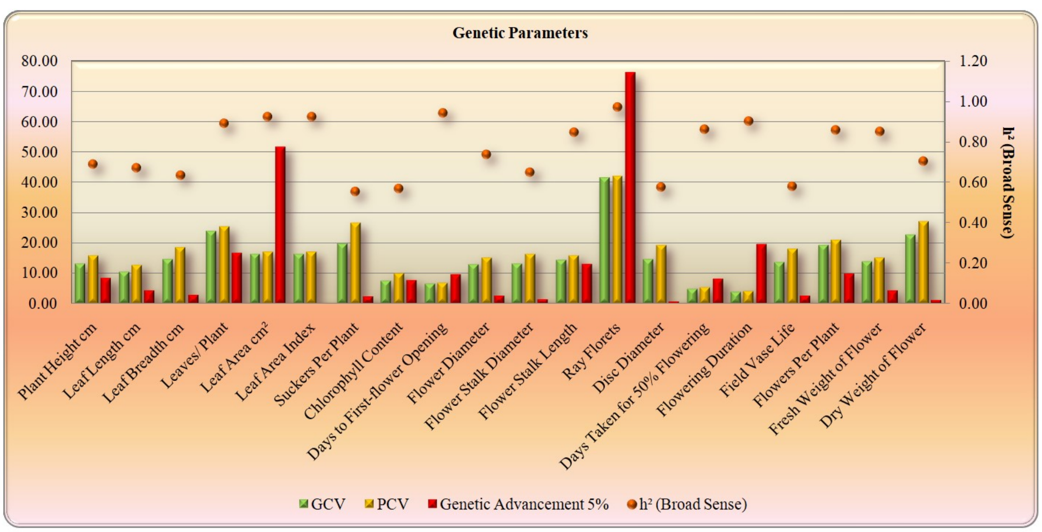

Fig. 1. PCV, GCV, Heritability (%) and Genetic advance as per cent of mean for different characters of gerbera.

Table 1: Estimates of GCV, PCV, Heritability, GA and GA as per cent of mean for different traits in gerbera.

S. No.	Character	Mean	Range		Genotypic Variance	Phenotypic Variance	GCV	PCV	Heritability (%)	GA	G A as % of mean
			Minimum	Maximum							
1.	Plant height (cm)	36.85	27.82	45.46	23.56	34.22	13.17	15.87	68.85	8.30	22.51
2.	Leaf length (cm)	23.23	19.41	26.31	5.87	8.75	10.43	12.73	67.16	4.09	76.61
3.	Leaf breadth (cm)	11.60	9.32	14.90	2.91	4.57	14.70	18.44	63.53	2.80	24.14
4.	Number of leaves per plant	35.70	22.00	50.16	72.67	81.76	23.88	25.33	88.88	16.55	46.37
5.	Leaf area (cm^2)	159.88	123.93	197.92	68.59	738.25	16.33	16.99	92.32	51.68	32.32
6.	Leaf area index	0.18	0.14	0.21	0.00	0.00	16.28	16.93	92.41	0.06	32.23
7.	Number of suckers per plant	6.95	4.20	9.20	1.88	3.38	19.72	26.45	55.56	2.10	30.27
8.	Chlorophyll content	65.28	58.97	75.96	23.88	41.91	7.49	9.92	56.98	7.60	11.64
9.	First flower opening (Days)	72.89	66.30	80.10	22.65	24.08	6.53	6.73	94.09	9.51	13.05
10.	Flower diameter (cm)	10.38	8.60	13.70	1.82	2.46	12.98	15.11	73.75	2.38	22.96
11.	Flower stalk diameter (mm)	5.89	4.90	7.68	0.59	0.91	13.08	16.22	64.99	1.28	21.72
12.	Length of the flower stalk	47.30	38.16	60.20	46.74	55.20	14.45	15.71	84.68	12.96	27.40
13.	Number of ray florets	91.00	62.23	176.16	1410.28	1455.47	41.27	41.92	96.89	76.15	83.68
14.	Disc diameter(cm)	2.08	1.60	2.60	0.09	0.16	14.61	19.26	57.57	0.48	22.84
15.	Days taken for 50% flowering	85.22	78.10	92.50	17.85	20.68	4.96	5.34	86.30	8.08	9.49
16.	Duration of flowering (Days)	254.11	238.33	266.10	98.45	109.07	3.90	4.11	90.26	19.42	7.64
17.	Field life (Days)	11.40	8.76	14.16	2.45	4.23	13.74	18.05	57.97	2.46	21.56
18.	Number of flowers per plant	26.48	16.00	32.80	26.10	30.44	20.29	21.83	85.74	9.74	36.80
19.	Fresh weight of flower (g)	15.84	12.15	18.33	4.81	5.66	13.85	15.02	85.02	4.17	26.31
20.	Dry weight of flower (g)	2.56	1.54	3.35	0.34	0.48	22.70	27.06	70.38	1.00	39.23

PCV = Phenotypic coefficient of variation
GCV= Genotypic coefficient of variation
PCV, GCV & GA Scales: >10-Low; 10-20 Moderate; >20-High
Heritability Scales (Broad sense): Up to 30-Low; 30-60 Moderate; >60-High

CONCLUSION

Yield attributes can be obtained through effective selection based on heritability and genetic advance estimates. The results from high heritability accompanied with low genetic advance for the characters days taken to first flower opening, 50% flowering and duration of flowering implies that there is no additive gene action. More number of ray florets, leaf count per plant and number of flowers per plant which exhibited high heritability along with greater genetic gain which implies that these traits could be used to select genotypes for a significant improvement in cultivation, especially under polyhouse conditions.

FUTURE SCOPE

Individual plant selection based on vegetative and floral characteristics of leaf area and ray florets respectively which exhibited high heritability coupled with high genetic gain, may thus be effective for crop improvement. This suggests that there is a substantial additive gene effect governing these traits and that phenotypic selection will be useful in improving these traits. Therefore, the genotypes with variation identified in the present study could be used for the future breeding programme.

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Conflict of Interest. None.

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