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Genetic variability and character association among quantitative traits in gerbera

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ABSTRACT

Ten gerbera genotypes were evaluated for 13 quantitative traits during 2011-12 and 2012-13 in RBD with three replications and pooled data were analysed. Different measures of variability, heritability and correlation and path coefficient were worked out to identify promising traits based on which selection could be made. High heritability coupled with high genetic advance as per cent of mean was observed for number of leaves/ plant, leaf breadth, number of suckers/plant, disc diameter, flower stalk length and number of flowers/ plant, indicating presence of additive gene action and consequently a distinct possibility of improving these traits through selection. The number of flowers per plant was highly significant and positively correlated with leaf length, days to bud burst, days to first flower opening and flower stalk length.

Key words: Correlation coefficient, gerbera, genetic variability, heritability.

INTRODUCTION

Gerbera (*Gerbera jamesonii* Bolus ex Hooker F., 2n = 50) of the family Asteraceae, is an important cut flower grown for domestic as well as for export market. Investigations have examined various gerbera flower traits using quantitative genetic approaches (Harding *et al.*, 1). An effective breeding programme for developing improved quality varieties requires preliminary information on the nature and magnitude of genetic variability, degree of transmission of traits and their inter-relationship. Hence, it is important to have knowledge of association of vegetative and floral traits among themselves (Panwar *et al.*, 2). Correlation coefficient studies are useful in selecting superior cultivars from their phenotypic and genotypic expression. Hence, the present study was conducted to ascertain the extent of genotypic variability, heritability, genetic advance and correlation among quantitative traits to identify potential economic traits for selection.

MATERIALS AND METHODS

The experiment was laid out with 10 gerbera genotypes, *viz.,* Arianna, Figaro, Kyllian, Laurance, Manizales, Pasto, Pocho, Renee, Soleada and Vilassar in randomized block design with three replications under naturally ventilated polyhouse at the Division of Ornamental Crops, IIHR, Hessaraghatta, Bengaluru during 2011-12 and 2012-13. Tissue-cultured plants of all the genotypes were planted at 40 cm x 30 cm spacing accommodating 6 plants/ m^2. Uniform cultural practices were followed. The data were recorded on six plants from each genotype per replication for 13 quantitative traits, *viz.,* number of leaves/plant, leaf length (cm), leaf breadth (cm), plant spread (E-W) (cm), plant spread (N-S) (cm), number of suckers/plant/year, days to bud burst, days to first flower opening, flower diameter (cm), disc diameter (cm), flower stalk length (cm), flower stalk diameter (mm) and number of flowers/plant/month. The data of both the years were pooled and analysis of variance was performed following the standard procedure. The genotypic and phenotypic coefficient of correlation was estimated (Al-Jibouri *et al.*, 3). Statistical package 'Biostat IIHR, version 1.0' was used for statistical analysis of data.

RESULTS AND DISCUSSION

The extent of variability measured in terms of range, mean, GCV and PCV along with per cent of heritability (h^2) and genetic advance as per cent mean are presented in Table 1. PCV was higher than GCV for all the characters, indicating the role of environment in the expression of genotypes. Higher PCV than GCV has also been reported for various traits in gerbera (Kumari *et al.*, 5; Kumar *et al.*, 6). However, there was close correspondence between GCV and PCV for number of leaves/plant, leaf length, flower diameter, disc diameter, flower stalk length, flower stalk diameter and number of flowers per plant, indicating little influence of environment on expression of these characters. The estimates

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Table 1. Estimates of genotypic and phenotypic coefficient of variation, heritability and genetic advance as per cent of mean for different traits in gerbera.

Trait	GV	PV	GCV (%)	PCV (%)	Heritability (%)	Genetic Advance	Genetic advance as per cent of mean
No. of leaves per plant	3.88	4.84	14.33	15.39	86.75	3.52	25.60
Leaf length (cm)	7.49	8.72	7.40	7.99	85.82	4.84	13.09
Leaf breadth (cm)	7.17	7.81	16.82	17.55	91.82	5.07	31.85
Plant spread (E-W) (cm)	20.46	23.03	6.98	7.40	88.83	8.28	12.77
Plant spread (N-W) (cm)	30.96	35.47	6.58	9.18	87.30	10.01	15.44
No. of suckers per plant	0.11	0.13	12.52	13.56	85.22	0.58	21.97
Days to bud burst	26.84	31.55	7.52	8.15	85.06	9.08	13.17
Days to first flower opening	23.72	47.23	6.57	9.26	50.21	5.04	6.79
Flower diameter (cm)	0.22	0.23	4.56	4.67	95.62	0.92	8.94
Disc diameter (cm)	0.18	0.18	16.16	16.25	98.89	0.85	32.82
Flower stalk length (cm)	45.94	47.13	11.90	12.02	97.48	13.61	23.89
Flower stalk diameter (cm)	0.27	0.30	9.97	9.42	90.65	0.98	16.78
No. of flowers per plant	0.15	0.16	12.52	12.79	95.73	0.76	24.68

GV : Genotypic Variance; PV : Phenotypic Variance; GCV : Genotypic Coefficient of Variation; PCV : Phenotypic Coefficient of Variation

of heritability in broad sense give a measure of transmission of characters from one generation to another, thus giving an idea of heritable portion of variability and enable the plant breeder in isolating the elite selection in the crop. Heritability and genetic advance increase the efficiency of the selection by assessing the influence of environmental factors and additive gene action. High heritability (>60%) was observed for all the quantitative traits except days to first flower opening, indicating the possible role of additive gene action. The magnitude of heritable variability is the most important aspect of genetic constitution of the genotype which has close bearing on the response to selection (Panse, 7). Similar results were also reported by Chobe *et al.* (8), and Kumari *et al.* (5). Heritability in broad sense ranged from 50.21% (days to first flower opening) to 98.89% (disc diameter).

General combining ability and heritability (broad sense) are not sufficient to determine the amount of variation which is heritable (Burton, 9). Heritable variation can be determined with greater accuracy when heritability along with genetic advance is studied. Heritability along with genetic gain is more useful criterion in predicting the resultant effects of selecting the best individual (Johnson *et al.,* 10). High heritability with high genetic advance suggests that the character is governed by additive gene action (Kumar *et al*., 5). In the present study, high heritability coupled with high genetic advance as per cent of mean was observed for number of leaves per plant, leaf breadth, number of suckers per plant, disc diameter, flower stalk length and number of flowers per plant, indicating presence of additive gene action and consequently a distinct possibility of improving these traits through selection. Thus, selection on the basis of these traits would be more effective for further breeding programme. High heritability and high genetic advance for number of leaves per plant (Anirban and Dastidar, 11; Dewey and Lu, 4), leaf breadth (Kumar *et al*., 6), and disc diameter and stalk length (Anuradha and Gowda, 12) have also been reported.

All possible phenotypic and genotypic correlation studies were carried out to reveal the nature of relationship between various growth and flowering related traits (Table 2). The correlation involving cut flower yield along with flower diameter, stalk length, stalk thickness and vase life deserve special attention as these traits are of primary interest in gerbera breeding. The number of leaves per plant was highly significant and positively correlated with number of suckers per plant. Leaf length was highly significant and positively correlated with leaf breadth, plant spread (E-W and N-S), days to bud burst, days to first flower opening, flower stalk length, flower stalk diameter and number of flowers per plant. Leaf breadth was highly significant and positively correlated with leaf length, plant spread (E-W and N-S), flower stalk length and flower stalk diameter.

Table 2. Estimates of phenotypic (r_p) and genotypic (r_g) correlation coefficients among 13 quantitative traits in gerbera.

Trait		1	2	3	4	5	6	7	8	9	10	11	12	13
1.	r_p	1.00	0.28	0.29	0.23	0.27	0.42*	-0.07	-0.22	-0.16	0.41*	0.28	0.01	0.15
	r_g	1.00	0.32	0.31	0.29	0.32	0.57**	-0.07	-0.42*	0.17	0.41*	0.31	-0.02	0.15
2.	r_p		1.00	0.73**	0.77**	0.77**	0.11	0.40*	0.34	0.06	0.08	0.55**	0.54**	0.54**
	r_g		1.00	0.73**	0.80**	0.80**	0.15	0.47**	0.58**	0.05	0.09	0.62**	0.60**	0.64**
3.	r_p			1.00	0.68**	0.77**	0.09	0.02	0.02	0.28	0.05	0.54**	0.51**	0.17
	r_g			1.00	0.69**	0.77**	0.11	0.01	0.08	0.29	0.05	0.59**	0.55**	0.21
4.	r_p				1.00	0.92**	-0.03	0.17	0.09	-0.09	0.24	0.16	0.26	0.18
	r_g				1.00	0.96**	-0.04	0.21	0.27	-0.12	0.25	0.18	0.26	0.23
5.	r_p					1.00	-0.04	0.18	0.10	0.06	0.29	0.19	0.31	0.15
	r_g					1.00	0.02	0.21	0.27	0.05	0.31	0.22	0.36*	0.19
6.	r_p						1.00	0.23	-0.03	0.46**	0.37*	0.43*	0.31	0.22
	r_g						1.00	0.31	0.20	0.54**	0.43*	0.46**	0.38*	0.26
7.	r_p							1.00	0.84**	0.11	-0.21	0.20	0.15	0.79**
	r_g							1.00	1.01**	0.08	-0.23	0.23	0.14	0.88**
8.	r_p								1.00	0.07	-0.25	0.18	0.19	0.67**
	r_g								1.00	0.08	0.37*	0.30	0.20	0.91**
9.	r_p									1.00	0.49**	0.62**	0.20	0.03
	r_g									1.00	0.50**	0.66**	0.19	0.04
10.	r_p										1.00	0.20	0.05	-0.34
	r_g										1.00	0.20	0.04	-0.35
11.	r_p											1.00	0.51**	0.47**
	r_g											1.00	0.55**	0.48**
12.	r_p												1.00	0.25
	r_g												1.00	0.29
13.	r_p													1.00
	r_g													1.00

*, **Significant at 5 and 1%, respectively. 1. No. of leaves per plant, 2. Leaf length (cm), 3. Leaf breadth (cm), 4. Plant spread (E-W) (cm), 5. Plant spread (N-S) (cm), 6. Number of suckers per plant, 7. Days to bud burst, 8. Days to first flower opening, 9. Flower diameter (cm), 10. Disc diameter (cm), 11. Flower stalk length (cm), 12. Flower stalk diameter (cm), 13. Number of flowers per plant

Plant spread (E-W) was positive and highly significant with leaf length, leaf breath and plant spread (N-S). Plant spread (N-S) was positive and highly significant with leaf length, leaf breadth and plant spread (E-W). Number of suckers per plant was positive and highly significant with number of leaves per plant, flower diameter and flower stalk length.

Days to bud burst were positive and highly significant with leaf length, days to first flower opening and number of flowers per plant. Days to first flower opening were positive and highly significant with leaf length, days to bud burst and number of flowers per plant. Flower diameter was positive and highly significant with number of suckers per plant and flower stalk length. A positive correlation of flower diameter with flower stalk length has also been reported (Kumar *et al*., 6). Flower stalk length was highly significant and positively correlated with leaf length, leaf breadth, number of suckers per plant, flower diameter, flower stalk diameter and number of flowers per plant. Flower stalk diameter was highly significant and positively correlated with leaf breadth, plant spread (E-W) and flower stalk length. Number of flowers per plant was highly significant and positively correlated with leaf length, days to bud burst, days to first flower opening and flower stalk length. Association among different quantitative traits in gerbera has also been reported by Kumar *et al.* (6).

With the above findings, it may be concluded that improvement in the characters like leaf length, days to bud burst, days to first flower opening, leaf breadth and flower stalk length will help in improving the number of flowers per plant in gerbera.

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