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Assessment of genetic variability, heritability and genetic advance of Chrysanthemum

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ABSTRACT

An experiment was conducted to study genetic variability, heritability and genetic advance among twenty varieties of chrysanthemum (*Chrysanthemum morifolium* Ramat.) at the College Farm, College of Horticulture, Department of Floriculture and Landscape Architecture, SDAU, Jagudan during 2020-21. A wide variation in performance of the varieties were recorded for various growth, flowering, yield and quality parameters and results shows that magnitude of the phenotypic coefficient of variation (PCV) was higher than genetic coefficient of variance (GCV). High GCV and PCV was recorded for fresh weight of flower followed by number of leaves per plant, number of flowers per plant, number of primary branches, shelf life, yield of flowers per plant and yield of flowers per plot. High heritability along with high genetic advance as per cent of mean was observed for number of leaves per plant, days to full bloom, number of flowers per plant, yield of flowers per plant and yield of flowers per ha. Further, these characters could be exploited for improvement through breeding programme.

Keywords: Chrysanthemum, genetic variability, heritability and genetic advance

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INTRODUCTION

Chrysanthemum is a versatile flower among all other decorative flowers. Chrysanthemum (*Chrysanthemum morifolium* Ramat. Syn. *Dendranthema grandiflora* Tzvelev.) belongs to family Asteraceae and is native of the northern hemisphere mainly Europe and Asia. It is the most beautiful flowering plant which is commonly known as "Queen of East" and is the symbol of royalty in Japan. The demand of chrysanthemum is increasing day by day due to the wide range of shapes and sizes of flowers, bewitching colour tones, long lasting flower life and diversity in height as well as growth habit of the plant. It is gaining popularity as cut flower, pot plant and loose flower crop.

Presently, large numbers of chrysanthemum cultivars are available for commercial cultivation and new cultivars are being continuously added to the existing ones. The efficiency of selection depends on the identification of genetic variability from phenotypic expression of different characters. Assessment of nature and magnitude of variability present in existing material is prerequisite for any breeding programme. For effective breeding programme, knowledge of the mean performance, magnitude of genetic variability, heritability and genetic advance as per cent of mean is essential.

Genotypic and phenotypic coefficients of variation are useful in detecting amount of variability present in genotypes (Kumar, 2014). Crop improvement depends upon the magnitude of genetic variability and the extent to which the desirable characters are heritable. It becomes very difficult to judge how much of the variability is heritable and how much is non- heritable. Heritability along with genetic advance increases the efficiency of selection in a breeding programme by assessing the influence of environmental factors and additive gene action (Vishnupriy *et al*. 2015). Therefore, present investigation was carried out with the aim to study the variability, heritability with genetic advance among twenty different varieties of chrysanthemum.

MATERIALS AND METHOD

The field experiment was conducted at College Farm, College of Horticulture, S. D. Agricultural University, Jagudan, Dist. Mehsana, Gujarat during August, 2020 to January, 2021.The experiment was laid out in a Randomized Block Design using twenty varieties *viz*. Ajina Purple, Autumn Joy, Basanti, Deep Red, Dolly Orange, Geetanjali, Jaya, Karnal Pink, Lal Pari, Little Pink, NC Pink, Pusa Aditya, Pusa Centenary, Pusa Chitraksha, Pusa Guldasta, Pusa Shwet, Ratlam Selection, Ravi Kiran, Red Star and Royal White, which were replicated thrice in open field condition. Transplanting of healthy and uniform rooted cuttings was done at 30 cm x 30 cm. The observations were recorded on five randomly selected plants per replication for each variety on seventeen characters like plant height at 60 days after transplanting and at full bloom (cm), number of primary branches, plant spread in North to South and East to West directions (cm), number of leaves per plant, stem girth (cm),days to bud initiation, days to 50% flowering, days to full bloom, flower diameter (cm),fresh weight of individual flower (g),number of flowers per plant, yield of flowers per plant (g), yield of flowers per plot (kg), yield of flowers per hectare (q) and shelf life. Phenotypic and genotypic coefficients of variation (PCV and GCV) were obtained by the method suggested by Burton (1952). Heritability, genetic advance (GA) and genetic advance as

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percent of mean (GAM) were estimated as per the formula described by Hanson *et al.* (1956).

RESULTS AND DISCUSSION

The extent of variability present in the chrysanthemum varieties was measured for various traits in terms of mean, range, phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV), heritability, genetic advance and genetic advance as percent of mean (Table 1). Significant difference was observed among all the varieties for all the seventeen characters. Wide range of variation was reported for the characters *viz*. number of leaves per plant (49.27-676.87), yield of flowers per ha (q) (38.29-277.22) and number of flowers per plant (18.33-235.87). Highest genotypic coefficient of variation was recorded for fresh weight of flower (67.39%) followed by number of leaves per plant (60.19%), number of flowers per plant (53.99%), number of primary branches (41.60%), shelf life (37.35%), yield of flowers per plant (30.63%) and yield of flowers per plot (27.32%) which indicates that greater amount of variability was present among genotypes. Moderate genotypic coefficient of variation was observed for plant spread in both direction (N-S and E-W 18.61% and 16.41%, respectively) followed by plant height at full bloom (16.74%) and plant height at 60 days after transplanting (14.92%). Low coefficient of variation was recorded for stem girth (6.29%) character.

High phenotypic coefficient of variation was observed in fresh weight of flower (85.11%), followed by number of leaves per plant (60.36%), number of flowers per plant (57.16%), yield of flowers per plant (55.21%) and yield of flowers per ha (49.23%). Moderate phenotypic coefficient of variation was noticed in plant height at 60 days after transplanting (19.41%) followed by plant height at full bloom stage (19.11%) and plant spread in North to South direction (18.92%) whereas, days to full bloom (9.21%) was recorded low phenotypic coefficient of variation.

The maximum difference between PCV and GCV values was noticed for stem girth (8.16%) followed by plant spread in East to West direction (5.51%), number of flowers per plant (5.29%) and plant height at 60 days after transplanting (4.49%). The minimum difference was observed for days to bud initiation (0.09%) followed by number of primary branches (0.13%), number of leaves per plant (0.17%), days to full bloom (0.18%), shelf life (0.35) and days to 50% flowering (0.64%).

The estimate of phenotypic coefficient of variation was higher than genotypic coefficient of variation for all the characters,

Table 1: Estimates of genetic parameters of seventeen characters in chrysanthemum

Sr. No	Characters	Range		Components of variance					
		Max.	Min.	Mean	σ^2_e	σ^2_g	σ^2_p	GCV%	PCV%
1	Plant height at 60 days after transplanting (cm)	42.81	19.79	32.88	16.63	24.07	40.71	14.92	19.41
2	Plant height at full bloom (cm)	64.91	34.09	49.04	16.32	71.38	87.70	16.74	19.11
3	Number of primary branches	27.53	4.93	13.26	35.36	29.84	30.03	41.20	41.33
4	Plant spread (N-S) (cm)	47.24	22.85	35.36	11.10	33.65	44.74	16.41	18.92
5	Plant spread (E-W) (cm)	44.87	20.20	31.29	23.01	33.92	56.93	18.61	24.12
6	Number of leaves per plant	676.87	49.27	300.84	187.91	32783.78	32971.69	60.19	60.36
7	Stem girth (cm)	1.18	0.77	1.01	0.01	0.004	0.02	6.29	14.45
8	Days to bud initiation	95.70	60.70	77.24	1.31	78.31	79.62	11.46	11.55
9	Days to 50% flowering	123.6	85.30	104.66	5.99	92.83	98.82	8.97	9.61
10	Days to full bloom	131.10	95.00	111.11	4.04	100.66	104.70	9.03	9.21
12	Flower diameter (cm)	9.14	3.80	5.55	0.31	2.30	2.61	27.46	29.32
11	Fresh weight of flower (g)	6.03	0.67	1.78	0.19	1.44	1.64	67.39	71.77
13	Number of flowers per plant	235.87	18.33	113.98	88.30	3786.45	3874.75	53.99	54.62
14	Yield of flowers per plant (g)	304.87	85.27	155.22	96.55	2260.61	2357.16	30.63	31.28
15	Yield of flowers per plot (kg)	4.99	0.70	3.26	0.11	0.79	0.90	27.32	29.06
16	Yield of flowers per ha (q)	277.22	38.29	181.21	332.93	2439.36	2772.29	27.25	29.10
17	Shelf life (days)	9.33	2.80	6.22	0.10	5.39	5.50	37.35	37.70

Where,

σ^2_g, σ^2_p and σ^2_e are the genotypic, phenotypic and environmental variance, respectively.

GCV (%) and PCV (%) are genotypic and phenotypic coefficient of variance, respectively.

which indicates the role of environmental factors for the expression of these characters. However, less difference between the phenotypic and genotypic coefficient of variation for days to bud initiation followed by number of primary branches, number of leaves per plant, days to full bloom, shelf life and days to 50% flowering was recorded which indicates that these characters are not much influenced by environmental factors. These results are in close conformity with the findings of Verma and Sahukla (2018), Suresh (2019), Patil *et al.* (2019) and Negi *et al.* (2020) in chrysanthemum.

The estimates of heritability, genetic advance and genetic advance as per cent of mean in chrysanthemum genotypes obtained from the study are presented in Table 2. High heritability was reported for number of leaves per plant (99.43%) followed by number of primary branches (99.37%), days to bud initiation (98.35%), shelf life (98.15%) and number of flowers per plant (97.72%).

Estimates of genetic advance help in understanding the gene action involved in the expression of various characters. The highest estimate of genetic advance was noted for number of leaves per plant (371.93) followed by number of flowers per plant (125.30), yield of flowers per ha (99.43) and yield of flowers per plant (95.92) while, least estimates of genetic advance was noticed for stem girth (0.06).The data related to highest estimates of genetic advance as per cent of mean was observed for fresh weight of flower (130.37%), number of leaves per plant (123.63%), yield of flowers per plant (109.94%) while, the lowest estimate was observed for stem girth (5.65%).

An estimate of high heritability coupled with high genetic advance was observed for number of leaves per plant, days to full bloom, number of flowers per plant, yield of flowers per plant and yield of flowers per ha which indicates lesser influence of environment in expression of these characters and prevalence of additive gene action in their inheritance, hence selection for these traits will be effective. These results are in close conformity with the findings of Hebbal *et al.* (2018) and Negi *et al.* (2020). Whereas, high heritability coupled with moderate genetic advance for plant height at full bloom, number of primary branches, plant spread in North to South direction, days to bud initiation and days to 50% flowering indicates ample scope of improvement in these traits through selection. High heritability with low genetic advance for characters *viz.*, plant height at 60 days after transplanting, plant spread in East to West direction, flower diameter, fresh weight of flower, yield of flowers per plot and shelf life denotes non additive gene action. Similar findings were obtained by Kumar and Dewan (2017), Narayan *et al.* (2016) and Hebbal *et al.* (2018) in chrysanthemum.

Table 2: Estimates of genetic parameters of seventeen characters in chrysanthemum

Sr. No.	Characters	h^2 (%)	GA	GAM (%)
1	Plant height at 60 days after transplanting (cm)	59.14	7.77	23.64
2	Plant height at full bloom (cm)	76.78	14.79	30.23
3	Number of primary branches	99.37	11.22	84.60
4	Plant spread (N-S) (cm)	75.20	10.36	29.31
5	Plant spread (E-W) (cm)	59.58	9.26	29.60
6	Number of leaves per plant	99.43	371.93	123.63
7	Stem girth (cm)	18.96	0.06	5.65
8	Days to bud initiation	98.35	18.08	23.41
9	Days to 50% flowering	87.23	18.04	17.27
10	Days to full bloom	96.14	20.27	18.24
12	Flower diameter (cm)	87.75	2.94	53.00
11	Fresh weight of flower (g)	88.18	2.32	130.37
13	Number of flowers per plant	97.72	125.30	109.94
14	Yield of flowers per plant (g)	95.90	95.92	61.80
15	Yield of flowers per plot (kg)	87.78	1.71	52.45
16	Yield of flowers per ha (q)	87.99	99.43	52.66
17	Shelf life (days)	98.15	4.74	76.22

Where,
h^2(%), GA and GAM are heritability, genetic advance and genetic advance expressed as per cent of mean, respectively.

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