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Genetic variability for quantitative traits in China aster [*Callistephus chinensis* (L.) Nees]

Gayatri Khangjarakpam[1], Rajiv Kumar, G.K. Seetharamu[1], T. Manjunatha Rao, M.V. Dhananjaya, R. Venugopalan[2] and K. Padmini[3]
Division of Ornamental Crops, ICAR-Indian Institute of Horticultural Research
Hessaraghatta Lake Post, Bengaluru - 560 089, India
E-mail : flori_rajiv@yahoo.co.in

ABSTRACT

A field study was conducted to estimate genetic variability, heritability and genetic advance in 20 genotypes of China aster for 15 traits during the year 2012-13 in Randomized Complete Block Design, with three replications. Results revealed that the magnitude of phenotypic co-efficient of variation (PCV) was higher than genotypic co-efficient of variation (GCV) for all the traits studied. Narrow differences between GCV and PCV were recorded in all the characters except flowering duration, vase-life and shelf-life, indicating little environmental influence on expression of these characters. High (>20%) GCV and PCV were recorded for plant height, number of branches and leaves per plant, flower diameter, number of ray and disc florets/flower head, stalk length, and, number and weight of flowers/plant. Heritability estimates ranged from 28.30% (flowering duration) to 99.54% (flower diameter). High heritability (>60%) was observed for all the traits except flowering duration. High heritability, coupled with high genetic advance as per cent mean, was recorded for flower diameter, stalk-length, number of branches/plant, weight of flowers/plant, days to first flower opening, days to 50 per cent flowering, plant height, number of leaves/plant, number of ray and disc florets/flower head, number of flowers/plant, indicating a possible role of additive gene action. Thus, these traits can be improved through selection and breeding.

Key words: China aster, genetic variability, heritability, genetic advance

INTRODUCTION

China aster [*Callistephus chinensis* (L.) Nees], belonging to the family Asteraceae, is a very popular annual flowering plant grown throughout the world. In India, it is grown traditionally for loose flower, cut flower, vase arrangement, floral decorations, for making garlands and *venis* for hair decoration. It is extensively grown in Karnataka, Tamil Nadu, West Bengal and Maharashtra by marginal and small farmers. Dwarf cultivars are used as potted plants suitable for hedges and window boxes (Rao *et al*, 2012). The genus *Callistephus* has only a single species, *chinensis*, with diploid (2n) chromosome number 18 (Huziwara, 1954).

Information on nature and magnitude of variability among traits in a germplasm is the pre-requisite for improving a desired flower trait. Genotypic and phenotypic co-efficient of variability are useful in detecting amount of variability present in the genotype. The main purpose of estimating heritability and genetic parameters, that compose heritability estimate, is to compare expected gains from selection based on alternative selection strategies (Holland *et al*, 2003). Several flower traits in China aster have been studied using quantitative genetic approaches (Rao, 1982; Negi *et al*, 1983; Ravikumar and Patil, 2003). The present study was conducted to ascertain the extent of genotypic variability, heritability and genetic advance to identify potential economic traits for selection.

MATERIAL AND METHODS

The study was carried out at an experimental field of Division of Ornamental Crops, ICAR-Indian Institute of Horticultural Research, Bengaluru, during the year 2012-13 in Randomized Complete Block Design, with three replications. Experimental material comprised of 20 genotypes, viz., Kamini, Poornima, Shashank, Violet Cushion, Phule Ganesh Pink, Phule Ganesh White, Phule Ganesh Purple, Matsumoto Apricot, Matsumoto Red,

[1]Department of Floriculture, Medicinal and Aromatic Plants, Uttar Banga Krishi Viswavidyalaya, Koch Vihar, West Bengal.
[2]Section of Economics and Statistics, [3]Section of Seed Science and Technology, IIHR, Bengaluru

Matsumoto Rose, Matsumoto Scarlet, Matsumoto Pink, Matsumoto White, Matsumoto Yellow, Local White, IIHR-H13A, IIHR-C 1, IIHR-H 3, IIHR-I 1 and IIHR-G 13. Thirty two plants per genotype per replication were planted at a spacing of 30cm x 30cm during the second week of October 2012. Uniform cultural practices were imposed on all the genotypes. Five uniformly-grown plants per replication were tagged for recording various biometric observations. Genotypic and phenotypic coefficients of variation were estimated according to Burton and Dewane (1953) based on an estimate of genotypic and phenotypic variance. Broad sense heritability (h^2) was estimated as per Weber and Moorthy (1952). Genetic advance as per cent mean was worked out as per Johnson *et al* (1955). Statistical package 'Biostat IIHR, Version 1.0' was used for statistical analysis of data.

Table 1. Mean, range and coefficient of variation for various traits in China aster

Trait	Mean±SEm	Range		Coefficient of Variation (%)
		Minimum	Maximum	
Plant height (cm)	44.96 ± 1.24	29.06	60.77	4.78
Number of branches/plant	13.92 ± 0.23	11.13	22.86	2.91
Number of leaves/plant	186.28 ± 4.70	128.86	258.33	4.37
Plant spread (cm)	27.67 ± 0.42	23.9	33.45	1.89
Days to first flower opening	69.42 ± 0.88	55.60	87.66	2.20
Days to 50% flowering	78.04 ± 1.12	62.11	97.00	2.48
Flower diameter (cm)	5.24 ± 0.05	3.75	8.19	1.70
Number of ray florets/flower head	111.00 ± 3.40	40.33	149.06	5.31
Number of disc florets/flower head	184.35 ± 4.79	123.13	255.06	4.50
Flower stalk length (cm)	27.03 ± 0.67	16.00	58.05	4.35
Flowering duration (days)	28.04 ± 1.48	23.44	32.11	9.17
Vase life (days)	7.15 ± 0.25	5.83	8.66	6.13
Shelf life (days)	3.59 ± 0.16	2.93	4.66	7.95
Number of flowers/plant	49.74 ± 3.22	22.44	81.89	11.22
Weight of flowers/plant (g)	106.68 ± 3.79	34.66	178.16	6.15

RESULTS AND DISCUSSION

Genetic variability

Analysis of variance showed significant differences among genotypes for all the traits studied (Table 1). Extent of variability was measured in terms of variance, genotypic co-efficient of variation (GCV), phenotypic co-efficient of variation (PCV), along with per cent heritability (h^2) and genetic advance as per cent mean (Table 2).

Phenotypic co-efficient of variation was higher than genotypic co-efficient of variation for all the characters, which indicated greater genotype X environment interaction. Ravikumar and Patil (2003) also reported higher PCV than GCV for various traits in China aster. However, narrow differences between GCV and PCV were observed for all the characters excepting flowering duration, vase life and shelf life, indicating minimal environmental influence on expression of these characters.

Table 2. Estimate of genotypic and phenotypic coefficient of variation, heritability and genetic advance for various traits in China aster

Trait	GV	PV	GCV (%)	PCV (%)	Heritability (%)	Genetic Advance	Genetic Advance as per cent mean
Plant height (cm)	108.75	113.38	23.19	23.68	95.92	20.61	45.84
Number of branches/plant	10.55	10.71	23.32	23.51	98.46	6.59	47.34
Number of leaves/plant	2599.79	2666.13	27.37	27.71	97.51	102.42	54.98
Plant spread (cm)	6.46	6.74	9.19	9.38	95.92	5.03	18.17
Days to first flower opening	103.22	105.55	14.63	14.79	97.79	20.47	29.48
Days to 50% flowering	132.95	136.73	14.77	14.98	97.24	23.10	29.60
Flower diameter (cm)	1.73	1.74	25.10	25.15	99.54	2.70	51.52
Number of ray florets/flower head	767.84	802.64	24.96	25.52	95.66	54.61	49.19
Number of disc florets/flower head	1421.67	1490.74	20.45	20.94	95.37	74.07	40.17
Flower stalk length (cm)	136.78	138.16	43.25	43.47	99.00	23.85	88.23
Flowering duration (days)	2.61	9.24	5.76	10.84	28.30	0.94	3.35
Vase life (days)	0.61	0.81	10.98	12.58	76.24	1.24	17.34
Shelf life (days)	0.17	0.25	11.59	14.05	67.99	0.58	16.15
Number of flowers/plant	468.25	499.41	43.50	44.92	93.76	41.80	84.03
Weight of flowers/plant (g)	2362.33	2405.44	45.55	45.97	98.21	98.33	92.17

GV: Genotypic variance; PV: Phenotypic variance; GCV: Genotypic coefficient of variation; PCV: Phenotypic coefficient of variation

High genotypic and phenotypic co-efficient of variation were recorded for weight of flowers/plant, number of flowers/plant, flower stalk length, number of leaves/plant, flower diameter, number of ray florets/flower head, number of branches/plant, plant height and number of disc florets/ flower head, indicating the presence of maximum variability among the genotypes studied. Negi *et al* (1983) also reported high GCV and PCV for plant height, number of flowers/ plant, stalk length and flower weight in China aster. Moderate genotypic co-efficient was recorded for days to 50% flowering, days to first flowering, shelf-life and vase-life. Low genotypic co-efficient of variation was recorded for plant spread and duration of flowering. Low GCV for plant spread in gerbera has been reported by Kumar *et al* (2012).

Traits like plant height, number of branches and leaves/plant, flower diameter, number of ray florets/flower head, number of disc florets/flower head, flower stalk length and weight of flowers/plant showed high genotypic co-efficient of variation, coupled with a narrow difference between genotypic and phenotypic co-efficients of variation. Hence, these traits can prove to be effective in improving the crop through selection and breeding. Such a high genotypic co-efficient of variation, together with heritability estimates, would be useful in arriving at the amount of advancement to be achieved through selection (Burton, 1952).

Heritability and Genetic Advance

Magnitude of heritable variability is the most important aspect having a close bearing on response to selection (Panse, 1957). In the present experiment, heritability estimates ranged from 28.30% (flowering duration) to 99.54% (flower diameter). Magnitude of heritability in broad sense was high for all the characters except flowering duration. Patil and Rane (1995) and Ravikumar and Patil (2003) also reported high heritability for most of the quantitative traits in China aster. Such high heritability estimates are helpful in making a selection for superior genotypes on the basis of phenotypic performance of quantitative traits.

Heritability and genetic advance increase the efficiency of selection in a breeding programme by assessing the influence of environmental factors and the nature of gene action. Johnson *et al* (1955) suggested that heritability, along with genetic advance was more useful in predicting selection of the best individuals. In the present study, high heritability, coupled with high genetic advance as per cent mean was recorded for flower diameter, flower stalk length, number of branches/plant, weight of flower/plant, days to first flower opening, days to 50% flowering, plant height, number of leaves/plant, number of ray florets/head, number of disc florets/head and number of flowers/plant indicating, that, these traits are controlled by additive gene action. Therefore, these traits can be improved through pure-line selection and breeding.

High heritability, coupled with high genetic advance as per cent, mean has also been reported for flower diameter and number of ray florets/flower head (Raghava and Negi, 1994), plant height, number of branches/plant, flower stalk length (Aswath and Parthasarathy, 1993) and weight of flowers/plant (Rao, 1982; Negi *et al*, 1983; Ravikumar and Patil, 2003) in China aster. High heritability, associated with high genetic advance, is more useful for improvement of a character through selection.

High heritability, with moderate genetic advance was recorded for plant spread, vase-life and shelf-life, which are attributed to the presence of both additive and non-additive gene effects indicating, that, these characters can be improved through hybridization and selection in later generations. High heritability and moderate genetic advance has been reported for plant spread (Rao, 1982) and vase-life (Kumar *et al*, 2012) in China aster and gerbera, respectively.

The present study revealed that traits like plant height, number and leaves/plant, flower diameter, number of ray and disc florets/flower head, flower stalk length, and, number and weight of flowers/plant showed high genotypic coefficient of variation, heritability and genetic advance as per cent of mean, which may be attributed to additive gene effects. Thus, these characters can prove useful for selection and breeding in China aster.

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