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Investigation of genetic variability in annual chrysanthemum for yield and it's contributing characters

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Abstract
Annual chrysanthemum, botanically known as *Chrysanthemum coronarium* L., is an annual under the chrysanthemum group of flowers. The experiment was conducted during 2019-2020 at NARP, Ganeshkhind, Pune in Randomized Block Design with 18 genotypes as treatments and two replications of Annual Chrysanthemum. There were 14 genotypes and four checks in the experiment. The main objective was to study the extent of variability in available genotype of annual Chrysanthemum.
It was observed that genotypic coefficient of variation (GCV) was lower than phenotypic coefficient of variation (PCV) for all the traits under study. The highest value of genotypic and phenotypic coefficient of variation was recorded for the character number of ray florets (57.21), (57.57) respectively. The estimates of GCV and PCV were of high magnitude in number of branches per plant, number of ray florets, number of flowers per plant, weight of 10 flowers, yield of flowers per plant, yield of flowers per plot and yield of flowers per hectare. The estimate of heritability ranged between Plant spread in N-S direction (58.60%) to Number of ray florets (98.80%). High estimate of heritability (98.80%) was recorded for Number of ray florets. The range of genetic advance was from 0.38 to 12067.69. The character, Yield of flowers per hectare exhibited highest genetic advance (12067.69%), followed by Yield of flowers per plant (203.40%), followed by Yield of flowers per plot (150.69%). The lowest value of genetic advance was reported for character disc diameter (0.38%). Therefore, these characters should be given top priority during selection breeding in annual Chrysanthemum.

Keywords: Annual chrysanthemum, GCV, PCV, heritability and genetic advance

Introduction
Annual chrysanthemum, botanically known as *Chrysanthemum coronarium* L., is an annual under the chrysanthemum group of flowers. It is different from plurannual or florist chrysanthemum in many aspects. The crop is relatively short duration and less photosensitive; thus capable of coming up throughout the year. It grows very well under mild or slightly cold climates, but will go quickly into premature flowering in warm summer conditions. It produces large sized attractive blooms for making garlands and for decoration during religious functions. The plant is fast growing and used as a background to a broad flower border. It is hardier, vigorous and grows taller. Its flowers are in various shades of yellow, white having single or double forms. They are hermaphrodite. The plant is self-fertile and seed propagated. The species is also referred as *Leucanthemum coronarium* and *Glebioni scoronoria*. It is a native of the Mediterranean region distributed throughout Europe, Northern Africa and Asia (FAO, 2007). Though the recent and authentic data on area and production of chrysanthemums are not available, they contributed nearly 27 per cent share in commercial flower production and 12 per cent share in the area under flower crops during the year 1995-96 (Gajanana and Sudha, 1998) [3] reflecting a tremendous increase in per capita availability of flowers in the country. The increase in per capita demand and consumption of floricultural products was attributed to the globalization of economy.
Genetic variability in a population can be partitioned into heritable and non-heritable variation with the aid of genetic parameters such as variance, genotypic coefficient of variation, heritability and genetic advance, which serves as basis for selection of some outstanding genotypes from existing ones. The study of genetic variability is the prerequisite for any crop improvement programme. Success in recombination breeding depend on suitable exploitation

of genotypes as parent of obtaining high heterotic crosses and transgressive segregants or the presence of genetic variability in base population is essential (Allarad, 1960) [1]. The study of genetic variability reveals about the presence of variation in their genetic constitution and it is all most important as it provide the basis of effective selection. The main objective of the present investigation was to study the extent of variability in available genotype of annual Chrysanthemum.

Materials and methods

The experiment was conducted during 2019-2020 at NARP, Ganeshkhind, Pune in Randomized Block Design with 18 genotypes as treatments and two replications. There were 14 genotypes and four checks were involved in the experiment. The raised beds of size 1m x 0.90 x 0.15 m were prepared for raising seedlings of annual chrysanthemum of different genotypes. Sufficient amount of FYM was added in the soil. Captan fungicide was applied to the beds to avoid the fungal incidence. Seeds were sown and then covered with fine soil. Water was applied immediately after sowing with rose water can. Daily water was applied in morning and afternoon as per need of crop. Seedlings were drenched with fungicidal solution to avoid damping off. Seedlings were ready for transplanting after 40-45 days of sowing. Seedling transplanting was done at the spacing of 45 cm between the rows and 30 cm between the plants on ridges and furrows. Recommended dose of 10-15 t/ha was applied during field preparation. The fertilizer dose 180: 60:60 Kg NPK /ha of which 90:60:60 kg/ha was applied as basal dose and 90 kg/ha N was applied as top dressing 40 days after transplanting. Recommended plant protection measures were followed.

The phenotypic and genotypic variances were calculated as suggested by (Johnson *et al.* 1955) [6]. The genotypic and phenotypic coefficients of variation were calculated as suggested by Burton and Devane (1953) [2]. Heritability in broad sense was estimated as suggested by Hanson *et al.*, (1956). The high, medium and low heritability estimates were classified on the basis of values given by Robinson H.F. (1966) [10]. The Genetic advance (at 5% selection intensity) was calculated as suggested by Allard (1960) [1].

Observations for all thirty plants were recorded for growth characters such as, plant height (cm), plant spread (cm), number of branches per plant. To assess the performance of different genotypes for flowering characters, the observations were recorded on flower head diameter (cm), number of ray florets per flower and disc diameter (cm).Observations on yield characters such as number of flowers per plant, weight of flowers per plant (g), yield of flower per plant (g), yield of flowers per plot (kg) and yield of flowers per hectare (kg) were recorded for each plant.

Table 1: List of Annual Chrysanthemum genotypes used in experiment

S. No.	Code or Symbol	Source
1	HCP-B-1	Banglore-I (Check)
2	HCP-B-2	Banglore-II (Check)
3	HCP-B-3	PDKV Akola Bijali Super (Check)
4	HCP-B-4	Nimgaon-I
5	HCP-B-5	Nimgaon-II
6	HCP-B-6	DFR, Pune (Check)
7	HCP-B-7	Ballalwadi-I
8	HCP-B-8	Dhalewadi-I
9	HCP-B-9	Yenere
10	HCP-B-10	Nirgude
11	HCP-B-11	Kusur
12	HCP-B-12	Nimdari
13	HCP-B-13	Narayangaon
14	HCP-B-14	Dhalewadi-II
15	HCP-B-15	Nagpur
16	HCP-B-16	Ballalwadi-II
17	HCP-B-17	Shiroli B.K.
18	HCP-B-18	Tejewadi

Results and discussion

Genetic variability

The parameters of genetic variability viz., mean, range, genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability (broad sense), genetic advance and genetic advance expressed as per cent mean are presented in (Table 2). It was observed that genotypic coefficient of variation (GCV) was lower than phenotypic coefficient of variation (PCV) for all the traits under study. The highest value of genotypic coefficient of variation was recorded for the character number of ray florets (57.21), followed by yield of flowers per plot (kg) and yield of flowers per hectare (kg) i.e. (39.92), followed by yield of flowers per plant (39.86. The rest of traits recorded GCV in the range of plant height (8.78) to Weight of 10 flowers (32.95 g). The inherent phenotypic variability is expressed by the genotypic coefficient of variation. Highest values for phenotypic coefficient variation (PCV) was recorded for the character number of ray florets (57.57), followed by Yield of flowers per plot (Kg) and yield of flowers per hectare (Kg) i.e. (40.70), followed by Yield of flowers per plant (40.65). The rest of traits recorded PCV in the range of plant height (10.43) to weight of 10 flowers (33.35 g). Genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) are categorized as low (less than 10%), moderate (10-20%) and high (more than 20%).

The estimates of GCV and PCV were of high magnitude in no. of branches per plant, No. of ray florets, No. of flowers per plant, Weight of 10 flowers, Yield of flowers per plant, Yield of flowers per plot and Yield of flowers per hectare. The estimates of GCV and PCV were medium for Plant Spread E-W, Flower Head diameter, Disc Diameter. The characters viz., plant height, plant spread N-S reported low GCV and medium value for PCV.

Phenotypic coefficient of variation (PCV) was higher than the genotypic coefficient of variation (GCV) for all the traits indicating that environmental factors were influencing their expression. Wide difference between phenotypic and genotypic coefficient of variations indicated their sensitiveness to environmental fluctuations whereas narrow difference showed less environmental interference on the expression of these traits. The traits which showed high phenotypic and genotypic coefficient of variations are of economic importance and there is scope for improvement of these traits through selection. Present finding are in agreement with Latha and Dharmatti (2018) [7].

Table 2: Estimates of variability parameters for different characters of Annual Chrysanthemum

S. No.	Characters	Range	Mean	GCV (%)	PCV (%)	Heritability (h^2) (b.s.) (%)	Genetic Advance (at 5% K)	GA as % of Mean (at 5% K)
1	Plant Height (cm)	77.06-113.72	98.52	8.785	10.431	0.709	15.014	15.240
2	Plant Spread N-S (cm)	36.19-58.42	42.64	8.854	11.571	0.586	5.951	13.957
3	Plant Spread E-W (cm)	37.01-57.64	42.47	10.230	11.534	0.787	7.938	18.692
4	No. of branches per plant	22.06-61.91	33.75	24.904	25.788	0.933	16.723	49.544
5	Flower Head diameter (cm)	4.88-7.37	6.40	11.147	11.468	0.945	1.429	22.319
6	No. of ray florets	19.69-231.78	102.29	57.218	57.578	0.988	119.812	117.131
7	Disc Diameter (cm)	1.4-2.3	1.73	11.869	12.934	0.842	0.388	22.437
8	No. of flowers per plant	55.02-183.10	89.91	30.464	32.034	0.904	53.660	59.680
9	Weight of 10 flowers (g)	14.13-45.54	29.31	32.952	33.351	0.976	19.655	67.069
10	Yield of flowers per plant (g)	73.96-399.75	252.57	39.866	40.652	0.962	203.409	80.536
11	Yield of flowers per plot (Kg)	54.73-295.82	186.82	39.926	40.709	0.962	150.695	80.665
12	Yield of flowers per hectare (Kg)	4382.60-23688.95	14968.72	39.926	40.709	0.962	12067.697	80.666

Heritability percentage (broad sense)

The estimate of heritability ranged between plant spread in N-Sdirection (58.60%) to number of ray florets (98.80%). High estimate of heritability (98.80%) was recorded for number of ray florets; followed by weight of 10 flowers (97.60%), followed by yield characters viz., yield of flowers per plant, yield of flowers per plot and Yield of flowers per hectare which reported heritability (96.20%). Lowest value of heritability (58.60%) was reported for Plant spread in N-S direction. Heritability estimate provide the information regarding the amount of transmissible genetic variation to total variation and determine genetic improvement and response to selection. These results are in conformity with Ghimiray and Sarkar (2015) [4], Singh *et al*. (2015), Latha and Dharmatti (2018) [7] and Patel *et al*. (2019) [9]

Genetic advance

The range of genetic advance was from 0.38 to 12067.69. The character, yield of flowers per hectare exhibited highest genetic advance (12067.69%), followed by yield of flowers per plant (203.40%), followed by yield of flowers per plot (150.69%). The lowest value of genetic advance was reported for character disc diameter (0.38%). The estimate of genetic advance as percent of mean varied between (13.95 to 117.13%). High value of genetic advance as percent of mean was observed for number of ray florets (117.131%), followed by yield of flowers per hectare (80.66%), followed by yield of flowers per plot (80.66%). Lowest value of genetic advance as percent of mean (13.95%) was reported for plant spread for N-S direction.

Heritability estimate along genetic advance are normally more useful in predicting the gain under selection than that of heritability alone. However, it is not necessary that a character showing high heritability will also exhibit high genetic advance (Johnson *et al.* 1955) [6]. Similar results were reported by Sahu (2016) [11] Gobade *et al.* (2017) [5], Telem *et al* (2017) [12] and Patel *et al.* (2019) [9]. They also reported that high heritability coupled with high genetic gain suggests that the gene action is mostly of additive type and therefore, direct selection of such trait will be rewarding.

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