SHORT COMMUNICATION

Variability Studies in Some Quantitative Characters in Sunflower (*Helianthus annuus* l.)

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Twenty-two genotypes of sunflower were evaluated for sixteen different quantitative characters, revealed considerable amount of variability for all the characters. Variation at genotypic level was also quite high for most of the traits indicating sufficient scope for selection. The magnitude of GCV and PCV were comparatively higher for seed yield per plant leaf area, total weight of head and number of seeds per head as compared to other characters. The characters such as days to 50% flowering and oil content were less affected by environment showing a close correspondence between GCV and PCV, while characters such as leaf area, total weight of head, seed yield/plant and head diameter of sterile area were the most effected. High heritability estimates with low genetic advance was observed for days to 50% flowering implying less genetic gain if selected upon, while selection for seed yield per plant, leaf area, total weight of head and number of seeds per head possessing high GCV, moderate h^2 and high genetic advance as percent of mean in the material under study is expected to result in considerable genetic gains. Lowest values of GCV, h^2 and GA were observed for oil content, suggesting that this character can not be improved effectively by selection.

Key Words : Genetic advance, Genetic variability, Heritability

The exploitation of sunflower (*Helianthus annus* L.) as a source of edible oil in India is receiving considerable thought for increasing the quantity of oil in the seeds of some promising strains after their successful introduction into this country from the Soviet Union. A need for improving and stabilizing the yield of this crop was felt by the breeders. Selection of superior varieties will be possible only when adequate variability exists in the gene pool. Therefore, an attempt was made in the present study to estimate genetic variability with the aid of genetic parameters such as genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability (h^2) and genetic advance as % of mean (GA).

Seeds of twenty two genotypes of sunflower viz., PZ-1570, EC370, PZ-1351, PC-317, PC-1569, PZ-D1603, PC-B1382, CMS-339B, PC-381, CMS-339A, EC336, PZ-1571, PCF-1604, PCA-1173, PZB-1141, PC-1520, PCB-1603, PZ-1040, PZ-1572, PC-160, PC-1603 and local selections were collected from the Division of Genetics, Indian Agricultural Research Institute (IARI), New Delhi. The material was evaluated in a Randomized Block Design experiment with three replications during rainy season 2005 at research farm of Kisan (PG) College, Simbhaoli, Ghaziabad (UP). Each genotype was assigned to two row plots of 3 m length with inter and intra row spacing of 75 cm and 30 cm, respectively. Recommended cultural practices were followed to raise a healthy crop. The data was recorded on five randomly selected plants from each treatment on sixteen distinct morphological characters mentioned in Table 1. Data were subjected to analysis of variance (Panse and Sukhatme, 1967). GCV and PCV were estimated using the method suggested by Burton and Devane (1953). Genetic advance as percent of mean at 5%. Selection intensity was estimated according to the formula suggested by Allard (1960).

The analysis of variance revealed highly significant differences among the cultivars for all the characters (Table 1) which indicated the presence of considerable amount of diversity in the material selected for the study. The range of variation was maximum for leaf area (257.57–50.73), number of seeds per head (213.33–82.33), total weight of head (192.50–32.67) and plant height (131.90–69.70), while it was lowest in the case of stem diameter at top height (3.40–1.93), stem diameter at mid height (4.30–2.53) and head diameter of sterile area (3.87–1.10). Though, the comparison between characters is uncalled for, the results would apparently remain same

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Table 1. Analysis of variance (ANOVA) for sixteen quantitative characters recorded on 22 genotypes of sunflower

Source of variation	d.f.	D.F. 50 %	NL/P	PH	SDTH	SDMH	HD	HDSA	TWH	NS/H	PFS	100SW	SY/P	OC %	LL	LB	LA
Replication	2	13.921	35.503	605.000	0.246	0.951	4.432	2.972	3606.843	2664.750	64.734	22.753	55.156	5.546	3.648	6.378	1886.062
Treatment	21	44.470**	19.909**	773.797**	0.392**	0.913**	5.776**	1.468**	5653.013**	4748.363**	82.856*	17.535**	102.518**	28.674**	22.342**	16.506**	6726.274**
Error	42	4.333	5.079	165.584	0.149	0.292	1.987	0.351	1048.463	826.285	42.216	2.952	12.69	3.955	4.016	3.104	1198.708

** = Significant at p = 0.01 level

Character Code :
D.F. 50 % = Days to 50 % flowering
NL/P = Number of leaves/plant
PH = Plant height
SDTH = Stem diameter top height
SDMH = Stem diameter at mid height
HD = Head diameter
HDSA = Head diameter of sterile area
TWH = Total weight of head
NS/H = Number of seeds per head
PFS = Per cent filled seed
100 SW = 100 Seed weight
SY/P = Seed yield/Plant
OC % = Oil content percentage
LL = Leaf length
LB = Leaf breadth
LA = Leaf area

even after standardization with the corresponding means. It leads to say that there exists an association between mean values and the range. In other words, higher mean was associated with high range. It means, there is better scope for selection for number of seeds/head and total weight of head compared to others. The magnitude of PCV was higher than the GCV for all the characters studied which suggested that the apparent variation is not only due to the genotype but also due to the influence of environment. High PCV and GCV were observed for seed yield per plant (59.46 and 49.83) followed by leaf area (54.72 and 42.59), total weight of head (51.91 and 40.01) and number of seeds/head (34.71 and 27.17) which suggested greater genetic diversity among the genotypes and responsiveness of the attributes for making further improvement by selection. These characters also showed narrow differences between PCV and GCV which indicated their relative resistance to environmental variation. Genetic factors were predominantly responsible for the expression of these attributes and selection could be made effectively on the basis of phenotypic performance. Saravanan *et al.* (1996) and Patil *et al.* (1996) reported similar results. The lowest PCV and GCV values were observed for oil content (7.38 and 6.06) and percent filled seeds (10.28 and 5.07) which indicated low variability for these traits. A marked difference between PCV and GCV was observed for leaf area, total weight of head, seed yield/plant, head diameter of sterile area and head diameter suggesting the predominance of GXE interactions and genetic role of environment on the expression of these traits. This is in agreement with the earlier reports of Chaudhary and Anand (1987).

However, high variance values alone are not the determining factors of the expected progress that could be made in respect of quantitative traits (Falconer, 1981). It was suggested that the GCV together with the high h^2 estimates would give a better picture of the extent of genetic gain to be expected under selection. In the present study, high h^2 estimates was obtained for days to 50% flowering (76%). Similar results have been reported by Patil *et al.* (1996). However, in general, characters with high h^2 did not possess greater variability (high GCV). In other words, characters with high GCV showed moderate h^2. Incidentally these characters also showed higher genetic advance as per cent of mean. Johnson *et al.* (1955) suggested that h^2 considered together with GA is more reliable in predicting the effect of selection than h^2 alone. Therefore, selection for seed yield/plant, leaf area, total

Table 2. Estimates of genetic constraints (for variability) for 16 characters in 22 genotype of sunflower

Characters	Range	Heritability (bs)	Genetic advance	Genetic advance over mean	Coefficient variability		Difference PCV-GCV
					GCV	PCV	
D.F. 50 %	50.83–64.67	0.76	6.55	11.90	6.65	7.65	1.00
NL/P	13.67–23.83	0.49	3.22	17.12	11.82	16.84	5.02
PH	69.70–131.90	0.55	21.76	22.64	14.81	19.97	5.16
SDTH	1.93–3.40	0.35	0.35	12.86	10.46	17.62	7.16
SDMH	2.53–4.30	0.42	0.60	17.91	13.58	21.08	7.50
HD	5.60–10.47	0.39	1.44	18.34	14.31	22.95	8.64
HDSA	1.10–3.87	0.51	0.90	35.43	23.99	33.45	9.46
TWH	32.67–192.50	0.59	62.21	63.54	40.01	51.91	11.90
NS/H	82.33–213.33	0.61	58.30	43.81	27.17	34.71	7.54
PFS	62.10–80.73	0.24	3.74	5.15	5.07	10.28	5.21
100SW	8.17–16.33	0.62	3.58	28.66	17.65	22.38	4.73
SY/P	4.00–22.90	0.72	9.45	86.06	49.83	59.46	9.63
OC %	43.37–54.43	0.68	4.86	10.26	6.06	7.38	1.32
LL	10.53–22.63	0.60	3.95	27.39	17.13	22.06	4.93
LB	6.43–16.17	0.59	3.34	35.34	22.37	29.12	6.75
LA	50.73–257.57	0.61	68.83	68.29	42.59	54.72	12.13

Table 3. Potent genetic donors in sunflower identified for seed yield and its component traits

Characters	Promising genotypes
Seed Yield/plant (g)>10.98	PCB-114, PC-1520, PZ-1569, PZ-381
100 seed weight (g)> 12.49	PZ-1572, PZ-1570, PZA-1173, PZ-1040
Total weight of head(g)> 97.91	PCB-114, PZB-1603, PCB-520, PZ-1569
Head Diameter >7.85	PZB-1603, PZ-381, PZ-1520
Oil Content(%) > 47.35	PZ-1570, PZ-1569, PZ-160, PZ-1603
Days to 50% flowering < 55.02	PZ-1040, PZ-1572, PCB-1382, PC-1351, PZ-1570

weight of head and number of seeds/head which possessed high GCV, moderate h^2 and high GA over mean in the material under study is expected to result in considerable genetic gains. While selection for days to 50% flowering where only h^2 was high is not expected to result in maximum genetic gains. Lowest values of GCV, h^2 and GA were observed for oil content suggesting that this character can not be improved effectively by selection.

Potent genetic donors were identified (Table 3) for high yielding potentials, bold seed size, total weight of heads, head diameter, high oil content and early flowering in nature. These genotypes can also be utilized for general cultivation and in breeding programme for their useful traits.

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