STABILITY OF SUNFLOWER GENOTYPES FOR SEED YIELD

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SUMMARY

A set of fifteen sunflower genotypes comprising inbreds, populations, single, three-way and double crosses were evaluated in replicated trial for stability of seed yield over four environments manipulated by adopting spacings (60 x 30 cm; 45 x 20 cm) and raised over irrigated and non-irrigated (rainfed) conditions. The mean performance of genotypes was comparatively high under low plant density. All the genotypes recorded high seed yield under irrigated condition. Over four environments, a three-way hybrid, viz., (F-89 x Morden) RHA-265 performed better than other genotypes. Of the three single cross hybrids, the performance of presently cultivated sunflower hybrid BSH-1 was superior. Inbreds recorded lower seed yield in all the environments. The phenotypic stability of a genotype was measured by considering three parameters, viz., the mean seed yield, the linear regression (bi) and the deviation from regression function (S^2d). Armaviriski-3497 with comparatively high seed yield and low linear and non-linear components of the genotype-environment interaction was the most stable population. BSH-1 single cross hybrid, (F-89 x Morden) RHA-265; (CMS-234 x Morden) RHA-274 and a double-cross hybrid viz., (CMS-234 x PR-1) (F-97 x RHA-274) were found to be specially adapted to favourable environments. Mean values of inbreds, populations, single, three-way and double-cross hybrids over four environments were also used to compute stability parameters. Based on the results obtained, it was concluded that populations followed by three-way crosses were comparatively more stable in comparison to inbreds, single and double-cross.

INTRODUCTION

In India, large scale cultivation of sunflower began in early eighties. It is a fast developing oilseed crop. During 1986-87, sunflower was cropped over an area of about one million hectares. It is grown over wide range of environmental conditions. Open pollinated varieties and single cross hybrids are raised under rainfed and irrigated conditions in three distinct seasons, viz; early monsoon (June-July), winter (September-October) and summer season (January-early February). The performance of genotypes differ under variable environment and management conditions. In breeding programmes, there is urgent need to identify varieties which give high seed yield over variable environments. Information on genotype-environment interaction and stability of genotypes is scanty in case of sunflower which has now established as the potential edible oilseed crop. In the present study, therefore, an attempt has been made to assess the stability of fifteen genotypes for seed yield over four environments.

MATERIALS AND METHODS

Fifteen genotypes comprised three each of inbreds, populations single cross hybrids, three-way cross hybrids and double cross hybrids as detailed below along with the code word listed in Table-2.

Inbreds: RHA-822, RHA-290 and RHA-265, coded as I-1, I-2 and I-3 respectively.

Open pollinated varieties: Morden (Cernianka-66), CGP-1 and Armaviritski-3497 (EC-68415); coded as OPV-1, OPV-2 and OPV-3 respectively.

Single-cross hybrids: F-89 x PR-1, CMS-234 x RHA-274 (BSH-1) and CMS-301 x RHA-801 coded as SH-1, SH-2 and SH-3 respectively.

Three-way cross hybrids: (F-89 x Morden) RHA-265, (CMS-234 x Morden) RHA -274 and (CMS-302 x CGP-70) RHA-801 coded as TH-1, TH-2 and TH-3 respectively.

Double-cross hybrids: (CMS-290 x RHA-265) (CMS-302 x RHA-801), (CMS-234 x RHA-274) (F-89 x PR-1) and (CMS-234 x PR-1) (F-97 x RHA-274) coded as DH-1, DH-2 and DH-3 respectively.

All the genotypes were evaluated in 1986 over four environments created by manipulating plant population (60 x 30 cm and 45 x 20 cm) under irrigated and rained (no irrigation) conditions.

Environment-I : irrigated; 60 x 30 cm spacing - (E-I)
Environment-II : rainfed; 60 x 30 cm spacing - (E-II)
Environment-III : irrigated; 45 x 20 cm spacing - (E-III)
Environment-IV : rainfed; 45 x 20 cm spacing - (E-IV)

Each genotype was planted in two rows of 4.5 m length in a simple randomised block design, replicated three times. At the time of sowing, the irrigated crop was fertilized with 60N-75P_2O_5-60K_2O per ha while the rainfed crop received fertilizer dose of 40N-P_2O_5-40K_2O kg/ha. Seed yield (gm) was recorded on five competitive random plants in each replication and the mean values were used to calculate stability parameters according to the method proposed by Eberhart and Russell (1966).

RESULTS AND DISCUSSION

Pooled analysis of variance (Table-1) revealed that the genotypes included in the study differed significantly for seed yield.

Table-1 : Stability analysis of variance for seed yield

Source of variation	d.f.	Sum of squares	Mean square
Genotypes	14	3198.93	228.50**
Genotype x environment	42	2851.25	67.89**
Environment (linear)	1	2069.00	2069.00**
Genotype x environment (linear)	14	389.04	27.79*
Pooled deviation	30	393.21	13.11
Pooled error	120	1245.60	10.38

* Significant at 5% level
** Significant at 1% level

Highly significant mean squares due to genotype x environment component showed that the genotypes interacted considerably with environmental conditions that

existed. The component environment (linear) being highly significant indicated that creation of the different environment by manipulating irrigation and spacing was effective. The significant genotype-environment (linear) interaction indicated that the differences among the regression coefficients pertaining to various genotypes on the environmental means were real. However, variance due to pooled deviation was not significant which indicates that the major component for differences in stability for seed yield was due to the linear regression and not the deviations from the linear function.

In the present study, stability of the genotypes was measured by three parameters, viz., mean performance over environments, the linear regression and the deviations from regression function. The data presented in Table-2 reveal that, in general, the genotypes recorded higher seed yield under irrigated and low plant density (E - I) followed by E - II, E - III and E - IV environments.

Table-2 : Mean seed yield (gm) of genotypes over four environments and stability parameters.

Genotypes	Environments				Mean yield (gm)	bi	S^2di
	E-I	E-II	E-III	E-IV			
I-1	28	12	12	11	15.75	0.92**	31.74
I-2	17	13	12	10	13.00	0.41	-8.93
I-3	25	25	29	18	24.25	0.32	14.00
OPV-1	34	27	28	20	27.25	0.76	0.70
OPV-2	42	34	36	25	34.25	0.90**	7.84
OPV-3	40	41	37	24	35.50	1.01**	11.98
SH-1	40	39	31	22	33.00	1.20**	-4.63
SH-2	47	40	31	25	35.75	1.43**	-9.87
SH-3	37	33	22	20	28.00	1.19**	-5.41
TH-1	48	40	32	35	38.75	0.89**	8.57
TH-2	44	44	32	29	37.25	1.11**	-2.38
TH-3	39	38	28	22	31.75	1.18**	-6.37
DH-1	50	43	24	18	33.75	2.21**	-1.49
DH-2	28	31	23	19	25.25	0.70*	-1.65
[illegible]	[illegible]	37	25	29	32.25	0.77*	8.26
Mean	37.13	33.13	26.80	21.80	29.72	-	-
C.D. 5%	9	10	12	7	-	-	-

Considering the stability parameters along with mean seed yield, it is clear that none of the inbreds possessed stability for seed yield over different environments. Amongst open pollinated varieties, OPV-3 (Armaviriski-3497) which is under commercial cultivation in some parts of India recorded highest mean seed yield with bi=1.01. Hence, it is the most desirable variety for seed yield under favourable environments. Pathak and Dixit (1984); Rangaswamy et al (1984) also obtained similar results. However, Sharma and Chopde (1979) opined that Armaviriski-3497

has specificity towards unfavourable environment. Absence of genotype-environment interactions was recorded for OPV-1 (Morden). Considering all the three stability parameters, Morden may be considered a highly homeostatic variety. Presently, it is grown on large areas in all the sunflower growing regions of the country because of its early maturity and dwarf stature. Of the three hybrids, SH-2 (BSH-1) appears to be adapted to favourable environments. The results are in agreement with the earlier report of Seetharam et al (1980). Hybrid sunflowers are preferred over open pollinated varieties for cultivation under irrigated conditions and assured rainfall tracts for realising higher seed yield potential of single cross hybrids. Although three-way and double-cross hybrids in sunflower are not presently under commercial cultivation, they will be of commercial value only when specific characteristics like disease resistance, high oil content, earliness, dwarf stature etc., are to be incorporated. The results of the present study showed that three-way (TH-1 and TH-2) and double cross hybrids (DH-1) are most suited to favourable environmental conditions.

The mean values of inbreds, populations, single, three-way and double cross hybrids for seed yield were used to calculate stability parameters and the data obtained is given below:

Group of genotypes	Seed yield (gm) over Environments				Mean	bi	S^2di
	E-I	E-II	E-III	E-IV			
Inbreds	24	17	18	13	18	0.51	2.99
Populations	39	34	34	23	33	0.91**	1.70
Single cross	41	37	28	22	32	1.31**	2.24
3-way cross	43	40	31	29	36	1.07**	0.24
Double cross	39	37	24	23	31	1.19**	5.74

The foregoing results further substantiated that the inbreds are low in stability while populations have high level of stability and wider adaptability. The performance of single-cross hybrids and double cross hybrids over environments was almost same and both perform superior under favourable environments. Three way hybrids with high mean seed yield and regression value being equal to unity and with least deviation around the regression line may be considered as the most stable group for seed yield.

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