Madras Agric. J., 96 (7-12): 286-288, December 2009
https://doi.org/10.29321/MAJ.10.100487

Adaptability of Sunflower Hybrids for Seed and Oil Yield

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An investigation was made to test the adaptability of nine high yielding sunflower heterotic hybrids along with three check hybrids for seed yield per plant, oil content and oil yield per plant over three environments *viz.*, *rabi*, 2005 - 2006(E1), *kharif'* 2006 (E_2) and *rabi / summer*, 2006 - 2007 (E_3). Genotype x environment interaction was significant for seed yield and oil yield indicating different genotypes responded differently to changing environments. The environmental indices revealed that *kharif,* 2006 (E_2 environment) was found to be favorable environment for expression of characters *viz.,* seed yield, oil content and oil yield. Considering the stability parameter, all hybrids and checks recorded non-significant squared deviation from regression. Among the superior oil yielding hybrids, CSFH 6045 and CSFH 6039 recorded unity regression coefficient and had average responsiveness to environment . The hybrids CSFH 6008 and CSFH 6009 and check hybrids KBSH 44, TCSH 1 and Sunbred 275 recorded above unity regression coefficient and were above average responsive hybrids. The study on phenotypic stability parameters *viz.,* mean, regression co-efficient and deviation from regression indicated that the hybrids *viz.,* CSFH 6008, CSFH 6037, CSFH 6039, CSFH 6045 and CSFH 6058 were stable over environments for seed yield and oil yield. Among these hybrids, CSFH 6045 was found superior.

Key words*:* Sunflower, hybrids, G x E interaction, seed yield, oil yield

Sunflower is an important edible oilseed crop of the world. The crop is grown under diverse agro-production situations, crossing climatic and geographic boundaries which necessitated the development of more productive hybrids of diverse duration. Development of hybrid is of much value for increasing the production of sunflower.It is commonly observed that the relative performance of different genotypes varies in different environments i.e. there exists G x E interactions. An understanding of the causes of genotype x environment interaction can help in identifying traits and environments for better cultivar evaluation.The genotype x environment interaction plays an important role in the performance of genotypes. Numerous methods have been used in the search for an understanding of the causes of G x E interaction (Van *et al*.1996). Stability analysis helps in understanding the adaptability of crop varieties over a wide range of environmental conditions. Hence identifying hybrid with good adaptability is essential. Considering the view, an attempt was made to evaluate the nature and magnitude of G x E interaction and adaptability of nine sunflower hybrids for seed yield, oil yield and oil content over three seasons.

Materials and Methods

The present study was undertaken to test the adaptability of new heterotic hybrid combinations in sunflower. The experiment was conducted at Department of Oilseeds, Centre for Plant Breeding and Genetics (CPBG), Tamil Nadu Agricultural University (TNAU), Coimbatore. The experiment was carried out in two trials. The first trial comprised 10 testers *viz.,* CSFI 5014, CSFI 5118, CSFI 5169, CSFI 5274, CSFI 5325, CSFI 5414, CSFI 5418, CSFI 5434, CSFI 5435, CSFI 5436 and three CMS lines *viz*., 17A, 234A and 851A. The second trial included 10 testers *viz.*, CSFI 5013, CSFI 5048, CSFI 5068, CSFI 5156, CSFI 5159, CSFI 5168, CSFI 5412, CSFI 5415, CSFI 5419, CSFI 5428 and three CMS lines *viz.*, 17A, 47A and 851A. All the three CMS lines and 10 testers of two different trials were raised in a crossing block during *kharif*, 2005 and the second crossing block during *rabi*, 2005-2006. Crossing was done in a line x tester fashion. A total of 60 hybrids were raised along with their 24 parents and check hybrids *viz*., KBSH 44, TCSH 1 and Sunbred 275 during two seasons *viz*., *rabi*, 2005-2006 and *kharif,* 2006. The experiment was laid out in a randomized block design with two replications. Each entry was raised in one row of 3 m length adopting a spacing of 60 cm between rows and 30 cm between plants. The standard agronomic practices were followed throughout the period of crop growth. Among the 60 hybrids evaluated in two seasons, nine best hybrids were identified based on heterotic performance. The nine best hybrids along with three check hybrids *viz.*, KBSH 44, TCSH 1 and Sunbred 275 were raised during *rabi*, 2006-2007 to assess its stability. At the

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time of flowering, five plants in each of the hybrids were selected at random and tagged. Observations were recorded on five randomly selected plants from each hybrid combination per replication for the traits *viz*., seed yield, oil content and oil yield. The data were subjected to stability analysis as per the method of Eberhart and Russell (1966) in order to estimate the three parameters of stability *viz*., mean, regression coefficient (b_i) and mean squared deviation ($s d^2$) for each genotype.

Results and Discussion

The phenotypic stability of the nine hybrids had been worked out to identify genotypes for their adoption over environments and to establish the interaction between the genotypes and the different environments in which they were grown so that besides recognizing genotypes that were stable over environments those suitable for favorable environments and poor environments could be differentiated. Whatever, be the adaptability of the genotypes under different environments, the primary requirement of a good variety or hybrid will be their superior mean performance. In measuring phenotypic stability, the regression coefficient was considered a measure of response to varying environment (Langer *et al.,* 1979)

The results of the environmental index for seed yield per plant calculated as the deviation of the mean of all varieties at a particular environment from grand mean revealed that *kharif,* 2006 (E_2) recorded substantial increase in values of environmental index (Table 1). proving to be the best environment to realize increased seed yield per plant which was accompanied by increased values in the environmental index for oil yield and oil content. On the other hand *rabi*, 2006-2007 (E_3) recorded considerable increase in environmental index for 100 seed weight and volume weight.

Table 1. Environmental indices for différent traits of sunflower hybrids

Character	Environmental indices		
	E 1	E 2	E 3
Days to 50 per cent flowering	0.181	0.389	-0.569
Plant height (cm)	24.553	-36.606	12.053
Head diameter (cm)	0.218	-0.486	0.268
Volume weight (g)	-0.476	-0.472	0.949
Hundred seed weight (g)	-0.336	-0.266	0.602
Seed yield (g/plant)	-2.396	2.951	-0.556
Oil content (%)	-0.458	0.354	0.104
Oil Yield (g)	-1.096	1.233	-0.138

E_1 -rabi, 2005-06; E_2- kharif 2006; E_3- rabi, 2006-07

The analysis of variance revealed significant differences for all the characters due to genotypes and significant differences for seed yield per plant and oil content due to genotype x environment interaction component (Table 2). In considering the stability of genotypes, the three stability parameter *viz.*, grand mean over environment, the regression coefficient and the squared deviation from the regression are considered to be important. The regression coefficient around unity and deviation from regression around zero indicate. That the genotypes possessing these attributes are stable over environments. (Sivaram, 1981).

Table 2. Analysis of variance for phenotypic stability for seed yield and oil yield in sunflower hybrids

Source	Degrees of freedom	Seed yield (g)	Oil Yield (g)	Oil content (%)
Replication within Environment	3	59.20**	0.45	4.77**
Genotype(G)	11	121.38**	20.27**	24.57**
Environment + (Gx E)	24	34.35**	0.45	4.46**
Environment (E)	2	88.54**	2.07	16.44**
Genotype x Environment	22	29.43**	0.31	3.37**
Environment (Linear)	1	177.08	4.15	32.88
Genotype x Environment (Linear)	11	52.50**	0.39	5.47**
Pooled deviation	12	5.83**	0.20	1.16
Pooled error	33	23.09	1.02	2.65
Non Linear: Linear		1:9.01	1:1.91	1:4.71

*-Significance of P at 5 % level **-Significance of P at 1 % level

Among the stability parameters the most important parameter appears to be the potential of a genotype to express greater mean over environments, since the regression coefficient and the deviation mean square may not be of any practical utility if the genotype is potentially weak. In the present study, most of the hybrids recorded mean values exceeding the best check mean plus critical difference (CD) for all the characters (Table 3). Among the hybrids, CSFH 6045 (22.45g), CSFH 6039 (22.05g) and CSFH 6008 (21.03g) and CSFH 6058 (20.58g) recorded significantly superior oil yield per plant than the best check Sunbred 275 (19.14g). Considering the stability parameter, all hybrids and checks recorded non-significant squared deviation from regression and hence stable. Among the superior oil yielding hybrids, CSFH 6045 and CSFH 6039 recorded unity regression coefficient and had average responsiveness to environments (Table 3). These two hybrids could be recommended to all environments. However, the hybrids CSFH 6008 and CSFH 6009 and check hybrids KBSH 44, TCSH 1 and Sunbred 275 recorded above unity regression coefficient and were above average responsive hybrids. These checks and hybrids could be recommended for highly favorable environment only.

Considering the performance for yield component characters, hybrid CSFH 6045 performed superior mean for seed yield per plant than the best checks. It also showed average responsiveness for seed yield per plant.The sunflower hybrids studied by Seetharam *et al*. (1980) had greater specificity of adaptability of favorable environments based on mean yield and unit regression coefficient.The hybrid

Table 3. Estimates of stability parameters in sunflower hybrids

Hybrids	Seed yield per plant (g.)			Oil content (%)			Oil yield per plant (g.)		
	Mean	Regression co efficient (b_i)	Deviation from regression ($ó^2di$)	Mean	Regression co efficient (b_i)	Deviation from regression ($ó^2di$)	Mean	Regression co efficient (b_i)	Deviation from regression ($ó^2di$)
CSFH 6008	59.23 **	1.05 **	-26.08	35.45	2.22 *	-0.74	21.03 **	1.36 **	-2.79
CSFH 6009	58.38 **	3.28 **	-15.77	34.10	0.84	-0.90	19.92	2.66 **	-1.40
CSFH 6025	56.75 **	0.30	-25.29	35.12	2.35 *	-0.67	19.93	0.77 **	-2.78
CSFH 6037	56.79 **	-1.24	-16.96	32.03	0.23	-0.61	18.11	-0.85	-0.84
CSFH 6039	61.21 **	-1.49	-14.67	36.12	1.52 **	-0.96	22.05 **	-0.87	-0.57
CSFH 6042	55.64	-0.15	-23.78	33.36	2.85	-0.30	18.54	0.56 *	-2.70
CSFH 6045	60.25 **	-0.31	-23.06	37.20	1.11**	-0.95	22.45 **	-0.04	-2.05
CSFH 6050	55.16	-0.37	-22.74	33.77	1.18 **	-0.96	18.60	-0.04	-2.17
CSFH 6058	57.26 **	1.18 **	-26.00	35.82	-0.30	-0.19	20.53 **	0.76 **	-2.77
KBSH 44	42.02	2.83 **	-20.71	28.34	0.00	-0.97	11.87	1.83 **	-2.04
Sunbred 275	53.06	2.51 **	-22.54	36.07	0.00	-0.97	19.14	2.05 **	-1.96
TCSH 1	42.13	4.42 **	-5.66	38.10	0.00	-0.97	16.05	3.82 **	2.07
Popln mean		54.82			34.62			19.01	
SEd mean		1.71			0.32			0.76	
SEd bi		0.62			0.76			0.65	
CD		3.35			0.63			1.38	

* - Significance of P at 5 % level **- Significance of P at 1 % level

CSFH 6008 recorded superior mean performance for seed yield than checks and above average responsiveness to environment. The hybrid CSFH 6039 showed superior *per se* for oil yield alone than check hybrid. The hybrid CSFH 6058 recorded superior mean for days to fifty per cent flowering, plant height, volume weight and seed yield per plant than checks and above average responsiveness to environment (Table 3).

The phenotypic stability parameters *viz*., mean, regression co-efficient and deviation from regression indicated that the hybrids *viz.*, CSFH 6008, CSFH 6037, CSFH 6039, CSFH 6045 and CSFH 6058 were stable over environments for seed yield and oil yield. Among these hybrids, CSFH 6045 was found superior.

References

Eberhart, S.A. and Russell, W.A. 1966. Stability parameters for comparing varieties. *Crop Sci.,* **6**: 36-40.

Langer, S., Frey, K.J. and Bailey, T. 1979. Association among productivity, production response and stability index in oat varieties. *Euphytica*, **28**: 17-24

Seetharam, A., Giriraj, K. and Kumar, P.K. 1980. Phenotypic stability of seed yield in sunflower hybrids. *Indian J. Genet.,* **40**: 102-104.

Sivaram, M.R. 1981. Genetic and stability analysis in sunflower. Haryana Agrl. Univ.Thesis Abs, **8**: 256-257.

Van Eeuvijk, F.A., Denis, J.B. and Kang, M.S. 1996. Incorporate additional information on genotype and environment tables. In: *Genotype by Environment Interaction*. CRC Press, Boca Raton, p.15-49.

Received: May 30, 2008; Revised: September 30, 2009; Accepted: November 20, 2009