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Identification of Stable Populations Derived By Various Population Improvement Schemes in Different Locations in Sunflower (*Helianthus Annus* L.)

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ABSTRACT

The present investigation was carried out at Regional Agricultural Research Station, Nandyal, Andhra Pradesh. The study was aimed at to find out stability of populations/characters over different locations and dates of sowing. The Morden open pollinated population was chosen for imposing population schemes like Mass selection, Bulk sib, half sib, full sib selection and selfed progeny selection schemes. In the present study environment was treated only in terms of its total effect over different locations in the same year or season and over different dates of sowing in the same location. The progenies derived through different selections i.e. mass selection, bulk selection, half-sib, full-sib, selfed progenies as well as Morden variety and MSFH-17 hybrids were enhanced over the five locations as well as over five different dates of sowing representative of late *Rabi* and early *summer* environments.

Key words : Improvement schemes, Populations derived, Stable, Sunflower.

The present investigations, Morden variety was chosen for imposing various population improvement selection schemes as this variety is the most stable, early, short stature and dependable variety grown with varying managerial skills and input capacities of the farmers in different environments.

Thus the present investigation aimed at in open pollinated Morden Variety with the following objective.

To find out stable populations derived by various population improvement schemes in different locations.

MATERIALS AND METHODS

The kharif 1999 seed material of MS_2, BS_2, HS_2, FS_2, S_2 were used to study genotype X environmental interaction along with Morden and MSFH-17 in different locations.

Experiment – 1

The kharif 1999 seed material of MS_2, BS_2, HS_2, FS_2, S_2 and checks morden and MSFH-17 were raised in a randomized block design with five replications at five locations i.e. Nandyal and Sirivella (Kurnool District), Badvel (Cuddapah district). Penukond and Mundla Mothukapalli (Anatapur district) during November, 1999. The data was recorded at all locations in all the treatments at maturity and subjected for analysis.

Stability analysis studies:

The data obtained on eight quantitative traits from 5 populations and two checks over five locations in one experiment were subjected to as per the model suggested by Eberhart and Russell (1966).

RESULTS AND DISCUSSION

Genotype X Environment Interaction And Stability Analysis

Genotype x environment interaction continues to be a challenging issue among plant breeders, geneticists and production agronomists who are involved in crop performance trials across diverse environments. Stability of performance is considered as an important aspect of yield trials. Plant breeders have recognized variability among crop varieties and populations across a range of environments. Development of populations with stable performance over a range of environmental conditions would allow a population to be useful and productive in a larger region. Population improvement methods applicable to sunflower included mass selection, S_1 selection, half sib progeny selection, full sib progeny selection and bulk selections etc.

All the improved populations which were derived through various selection schemes are adapted to a different range of environment. In the past the term "stable genotype" often has been used to mean a variety / genotype / hybrid / population that does relatively better over a wide range of environments. The phenomenon of component compensation in imparting homeostasis to complex character has also been stressed by Griffing (1956).

Against pooled error which revealed differential behavior of populations to varying environments for seed yield and its components except for stem thickness. The populations also differed significantly for their linear response to environmental effects and also for the deviations from the linearity which suggested that both the linear regressions and the deviations from the linearity were the major components for differences in stability for seed yield and its components in these populations.

A comparison of the effect of five locations on performance of populations indicated that Sirivella centre was superior to Nandyal and Badvel locations for yield, oil per cent and early maturity while Nandyal location favoured for 100-grain weight and plant height. On contrary, Badvel centre was found to be superior for seed yield and for late maturity. However, the remaining centers viz., Penukonda and Mundlamothukapalli locations were favoured for head diameter and stem thickness. This indicates that the differences among five locations were not from the cultural operations but from unpredictable sources.

Linear regression represents definite and measurable response to environments (Breeze, 1969). However, the variance due to deviations from linear function which is primarily due to unpredictable causes depends on the environments sampled for testing the material. In the present study environment was treated only in terms of its total effect over different locations in the same year or season. The progenies derived through different selections i.e. mass selection, bulk selection, half-sib, full-sib, selfed progenies as well as Morden variety and MSFH-17 hybrids were enhanced over the five locations (environments).

ANOVA for stability among populations of sunflower over five locations revealed that mean squares due to populations were highly significant for all the characters except for oil yield indicating that each population differed significantly from one another for yield and most of its components thus giving scope for selection. In respect of environments, significant differences were observed for two traits viz., head diameter and 100-seed weight where as for all the remaining characters it was non-significant indicating stability of all the characters across environments. The population x environment interaction was also highly significant when tested irregularities for a particular population may be less in one sample of environment and reverse may the case in another sample of environments. This may be one of the reasons which no definite trend for deviation mean squares could be observed in any population over the environments. On the basis of these results all the three stability parameters seem to be equally important.

The populations which showed stability for different characters were half-sibs, MSFH-17, selfed progenies and Morden for plant height, Morden, half-sibs and full-sibs for days to maturity, full-sibs and selfed progenies for head diameter, bulk sibs and half-sibs for stem thickness, mass selection for 100-seed weight and selfed progenies for seed yield.

The average performance of the populations over five locations revealed that maximum yielding populations i.e. full-sibs and half-sibs for seed yield were least stable. The same populations also revealed superiority for head diameter, stem thickness, and oil yield, however, they were found to be least stable. Characters like head diameter, stem thickness, 100-grain weight and oil yield appear to be greatly affected due to environments, whereas plant height, maturity, seed yield and oil per cent appear to be least affected.

The results of pooled deviation of regression from zero indicated that almost all the

Table 1. Analysis of variance for 8 characters of 7 populations of sunflower over 5 environments (5 locations)

S. No	Source of variations	df	Plant height	Head diameter	Stem thickness	Days to maturity	100-secd Wight	Oil per cent	Oil yield	Seed yield / plot
1.	Replications within environments	20	13.46	0.308	0.01	0.37	0.01	0.02	0.03	0.10
2.	Populations	6	372.58**	46.12**	0.48**	13.66**	1.78**	60.27**	26.73**	22.55**
3.	Environments	4	26.04	11.67**	0.05	1.76	0.36**	0.74	9.75	3.70
4.	Populations X Envt	24	55.33	1.95	0.07	2.16	0.07	0.75	5.99	4.23
5.	Envt. + (popln + Envt)	28	51.14	3.34	0.07	2.11	0.11	0.75	6.53	4.15
6.	Env. (Linear)	1	104.16**	46.70**	0.22*	7.05**	1.45**	2.97**	39.00**	14.82*
7.	Popln X Env. (Linear)	6	86.83**	2.06**	0.03	1.59*	0.05*	1.67**	10.03**	2.15**
8.	Pooled deviation	21	38.42**	1.64**	0.07**	20.02**	0.06**	0.37**	3.98**	4.21**
Populations										
9.	Mass selection	3	51.08**	1.87**	0.09**	6.84**	0.016	0.31**	4.33**	9.89**
10.	Bulk Sib	3	27.82*	2.54**	0.02**	4.14**	0.05**	0.05**	4.22**	2.78**
11.	Half Sib	3	17.16**	2.05**	0.02**	0.28	0.03*	0.39**	6.82**	5.15**
12.	Full Sib	3	146.32**	0.44	0.15**	0.24**	0.04**	0.32**	2.40**	4.32**
13.	Selfed progeny	3	11.97*	0.36**	0.08**	0.93**	0.05**	0.34**	0.68**	0.20**
14.	Morden	3	0.49	3.15**	0.05**	0.46**	0.23**	0.70**	8.1**	5.00**
15.	MSFH-17	3	14.12	1.03**	0.06**	1.23**	0.03*	0.06*	1.27**	2.17**
16.	Pooled error	120	10.24	0.25	0.01	0.29	0.01	0.02	0.03	0.10
17.	Total	34	107.87	10.89	0.14	4.15	0.40	11.25	10.09	7.40

*,** Significant at 5 and 1 per cent levels when tested against pooled error

population recorded significant deviation from zero for characters except selfed progenies for seed yield, bulk sibs and half sibs for stem thickness, full sibs and selfed progenies for head diameter, half sibs, full sibs, and Morden for maturity, mass selection for 100-seed weight and half sibs, selfed progenies, Morden and MSFH-17 for plant height. Where the later characters showed non-significant deviation from zero for the respective characters.

The results indicated that half sibs was found regression value more than one. On contrary, full sibs and MSFH-17 were found to be suitable for low yielding and stress environments as they have higher mean and regression values were negative or approaching zero. However, in all the above populations the yield is unpredictable owing to their significant deviation from zero (S^2_{di}). (Table 2).

The populations exhibited considerable differences among them for all the characters under the study. The populations, Morden and the hybrid MSFH-17 for plant height, full sibs for head diameter, half sibs and Morden for stem thickness, full sibs for late maturity, selfed progenies for seed yield, bulk sibs, full sibs and self progenies for oil yield showed significant deviation of regression from unity (bi=1). On contrary, none of the populations expressed significant deviation of regression from unity for 100-seed weight indicating the stability of this trait in all the populations.

The analysis of *per se* performance of individual population for all the characters revealed that full sibs recorded the highest mean performance (desirable) for seed yield, oil yield, head diameter, stem thickness and 100-grain weight and had undesirable trait performance for maturity, oil per cent and plant height. However, its regression co-efficients were negatively lesser than one for seed yield, oil per cent, oil yield and maturity, and were positively more than one for 100-seed weight, head diameter, stem thickness indicating its undesirability from the point of cultivation in large areas part of which could be low or undesirable environments.

Estimates of stability parameters for plant height reveled that selfed progenies, and mass selection population were dwarf and selfed progenies were highly negative to favourable environmental changes (bi > 1) whereas mass selection and Morden populations were responsive to unfavourable environments. Populations also exhibited non-significant selfed progenies and Morden mean share deviations thus indicated their good stability under respective environments. Similarly for head diameter and full sibs progenies were suitable for favourable environment and response is predictable in nature. Whereas, half-sibs population expressed suitability for favourable environment but response was unpredictable in nature. Similar kind of unpredictable response and adaptation to poor environment. In general all the population was expressed by MSFH-17 hybrid population for head diameter.

Stability of population for stem thickness indicated that half sibs, an bulk sibs were found to be highly adaptable to favourable and poor environments, respectively and were stable whereas full sib population had adaptation to average environment but with unpredictable response as it had significant mean square deviation from zero. Among all the populations, selfed progenies were earliest in maturity and had adaptation to unfavourable environment with greater stability. Similarly, mass selection population was also early in maturity but it showed highly responsiveness to favourable environment with greater deviations in response to environmental changes. Contrary to this MSFH-17 hybrid was latest in maturity and exhibited highly unpredictable response to poor environment. In general, all the populations expressed earliness in maturity when compared to MSFH-17 hybrid population and most of the genotypes had general adaptation to poorer environment with greater stability.

For 100-seed weight full sibs and half sibs showed unstable performance under favourable environment. Whereas, mass selected population had stable performance under unfavourable environment. The genotypes exhibited high range of variability in respect of oil per cent being it was highest in selfed progenies followed by morden and full sibs with unstable performance having general adaptation to poor environment. Similar kind of adaptation of genotypes to unfavourable environment with stable performance was expressed with bulk sib population for oil per cent.

None of the genotypes expressed stable performance for oil yield. However, only two populations viz., full sibs and half sibs had high oil yield but with unstable performance. Among these, full sibs were highly adapted poor environment whereas half sib population had general adaptation to average environment for this important trait. All the remaining genotypes were found to be oil yields with unstable performance having specific adaptation to either poor or average or favourable environments.

From the foregoing discussion, it is clear that none of the populations were found to be constant in ranking for all the characters under study except full sibs and half sibs which were found to be relatively most desirable for all the characters except maturity and oil per cent. In the present study, it is to conclude that the characters in the populations were highly unstable over environments and recorded a decrease in their performance under different locations. However, certain populations viz., full sibs, half sibs, selfed progenies and bulk sibs expressed stability for specific characters like, head diameter, stem thickness, maturity and plant height and showed increase in the performance of respective characters. Chaudhary (1978) also observed considerable stable performance of characters viz., head diameter, seed yield and 100-seed weight in sunflower genotypes over different environments similar kind of general adaptation and stability of sunflower varieties was also revealed by Sharma and Chopde (1979), and Kandalkar (1997). Though similar kind of results have been observed in the present investigation with different populations, it is suggested that selection strategies may be formulated in order to capitalize maximum exploitation of the available variability as well as to generate new variability in the stable populations identified for specific characters viz., full sibs populations for head diameter, mass selection for seed weight, bulk-sibs for oil per cent and stem thickness.

Further multi-location testing of these populations over a range of diverse agro-climatic regions is warranted in order to gather more information on the stability and adaptation of these genotypes.

Table 2. Mean performance and stability parameters of 7 genotypes over five environments (locations).

Populations	Plant height (cm)			Head diameter			Stem thickness			Days to maturity		
	$\overline{X}$	*bi*	S^2_{di}	$\overline{X}$	*bi*	S^2_{di}	$\overline{X}$	*bi*	S^2_{di}	$\overline{X}$	*bi*	S^2_{di}
Mass selection	73.00	-2.518	40.38**	10.36	1.39*	1.61**	1.08	0.74	0.084**	79.52	3.17	6.53**
Bulk Sib	80.29	1.845	17.11**	13.21	0.72	2.29**	1.62	0.68*	0.010	80.4	1.77	3.83**
Half Sib	82.27	1.241	6.46	15.02	1.23	1.79**	1.78	2.41**	0.013	81.0	1.44*	-0.019
Full Sib	89.90	0.461	135.62**	17.22	1.84**	0.18	1.88	1.21	0.145**	80.64	-0.31	-0.060
Selfed progeny	70.67	1.3512	1.26	7.96	0.59*	0.10	1.10	1.75**	0.077**	77.64	0.91	0.627*
Morden	76.46	-0.794**	-10.20	11.57	1.04	2.89**	1.45	-0.44	0.039**	79.92	-0.31	0.150
MSFH-17	94.21	5.253**	3.41	13.10	0.16	0.77**	1.53	0.63	0.054**	83.12	0.31	0.931**

Populations	100 seed weight (g)			Seed yield/plot (kg)			Oil per cent			Oil yield /plant (g)		
	$\overline{X}$	*bi*	S^2_{di}	$\overline{X}$	*bi*	S^2_{di}	$\overline{X}$	*bi*	S^2_{di}	$\overline{X}$	*bi*	S^2_{di}
Mass selection	3.864	0.424	0.0037	6.32	1.7	9.79**	30.06	2.69*	0.29**	6.98	2.253*	4.3080**
Bulk Sib	3.300	0.736	0.036**	7.88	0.252	2.68**	34.58	3.60**	0.48	10.21	-0.477	4.19**
Half Sib	3.860	1.271*	0.019*	9.76	1.185	5.05**	31.97	2.30	0.38**	10.95	1.417	6.79**
Full Sib	4.748	1.978**	0.03**	10.61	-0.814	4.22**	33.88	-2.08	0.30**	13.28	-1.299	2.37**
Selfed progeny	2.856	0.31	0.005**	4.36	2.135**	0.1	39.11	0.76	0.32**	6.70	1.944**	0.65**
Morden	3.384	0.716	0.22**	6.70	1.65	4.90**	34.78	-0.181	0.69**	8.50	1.692	8.07**
MSFH-17	3.504	1.057*	0.02*	8.24	0.88	2.07**	28.59	-0.114	0.04*	9.20	1.469*	1.23**

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