Asian Journal of
Plant Sciences

Variability and Correlations Study in Different Newly Developed Sunflower Hybrids

Asif Khan, [1]Ihsan Ullah, S.Bilal Murtaza and [1]M. Yousaf Khan
NWFP Agricultural University, Peshawar, Pakistan
[1]National Agricultural Research Center, Islamabad, Pakistan

Abstract: A study was conducted to evaluate the performance of different local hybrids developed by NARC, Oilseed Research Programme. Analysis of variance, LSD test and correlation coefficients were performed to check the differences among hybrids and correlations of grain yield (GY) with different traits like days to flower initiation (DFI), days to flower completion (DFC), plant height (PH), head diameter (HD), days to physiological maturity (DPM), number of grains per head (NGPH), number of filled grains per head (NFGPH), 100-grain weight (100-GW) and oil content (OC). Highly significant differences for DFI, DFC, PH, DPM and GY while significant differences for 100-GW and non-significant differences for HD, NGPH, NFGPH and OC were observed among the hybrids. Hybrid Hysun-33 showed the highest yield of 2128 kg ha^{-1} followed by SF-187 with 2040 kg ha^{-1} while SMH-2002-4 and SMH-2002-19 ranked third and fourth in terms of yield with 1908 kg ha^{-1} and 1862 kg ha^{-1} respectively. Correlation of HD with DPM and 100-GW was highly significant and positive and non-significant with NFGPH, GY and OC. DPM were significantly and positively correlated with DFI, DFC, HD, 100-GW and OC and non-significantly correlated with PH and GY. NGPH were significantly correlated with NFGPH and had negative and non-significant correlations with DFI, HD and OC. Correlation of NFGPH with NGPH, PH, GY and 100-GW was significantly positive. 100-GW was significantly and positively correlated with DFI, DFC, HD, DPM, NFGPH and GY while non-significantly correlated with PH, NGPH and OC. Grain yield was significantly and positively correlated with DFI, DFC, PH, NFGPH and 100-GW. Correlation data indicate that selection for days to flower completion, plant height, number of filled grains per head and 100-grain weight will be effective for higher grain yield.

Key words: Sunflower local hybrids evaluation yield parameters

Introduction

In Pakistan the consumption of edible oil and ghee is very high as compared to its production and to meet the domestic needs, a large amount of edible oil has to be imported annually draining a large amount of foreign exchange. Pakistan paid 10 billion rupees in 1991-92 for import of 1 million tons, 14.7 billion rupees in 1993-94 for 1.13 million tons and more than 30 billion in 1994-95 for the import of 1.389 million tons of edible oil (Oilseed Development Strategy, 1995). The available option to save this foreign exchange is to increase local oilseed production through the evolution of hybrids/varieties having good adaptability to our climatic conditions.

Sunflower is an international crop grown on 16 m ha in 50 countries. It is a major oilseed crop but its use as oilseed crop is recent as compared to many other crop species. It is the second most important oilseed crop, extensively grown in different countries of the world for oil production. The largest sunflower producers in the world are Soviet Union, Argentina, U.S.A., China, France, Spain, Romania, Turkey and Hungry etc. (Skoric, 1988). The popularity of sunflower is increasing day by day among the farmers and consumers due to its more oil contents, high quality oil and moderate production requirements. In addition it provides 20% protein contents in the seed. It is a non-conventional oilseed crop, having shown a great promise under agro-climatic conditions of Pakistan and established itself as a cash crop. Pakistan has a unique agricultural environment where raising of two sunflower crops (spring and summer seasons) in a year is possible. Being a short duration crop, it has the potential to solve the edible oil shortage problem by growing two crops per year.

Mostly sunflower hybrid seed is imported form outside, which is too much expensive, leading to increase in cost of production and thus pushing the farmers away from sunflower cultivation. The objectives of this study were to evaluate the different types of sunflower hybrids produced locally at National Agricultural Research Center, Islamabad to screen out high yielding and early maturing hybrids adaptable to our local environmental conditions. Moreover, domestic hybrid seed production will bring prices of hybrid down and ensure the timely availability of quality seed to the farmers.

Materials and Methods

Twenty Sunflower hybrids were grown at the experimental area of National Agricultural Research Center, Islamabad

during autumn season of 2002. Experimental was planted on 31st of July, 2002 with Randomized Complete Block design, having four replications and plot size of 5m x 3m (15 m²). Each plot had four rows distanced 75 cm apart with 25 cm plant to plant gap.

Sixteen newly developed hybrids were used in this study having being developed at NARC while four hybrids, SMH-9706 (NARC), SF-187 (Mansanto), SF-177 (Mansanto) and Hysun-33 (ICI) were used as checks.

Hybrids tested in the study

Name of Hybrid	Source
SMH-2002-1	NARC.
SMH-2002-3	NARC
SMH-2002-4	NARC.
SMH-2002-5	NARC.
SMH-2002-6	NARC.
SMH-2002-7	NARC.
SMH-2002-8	NARC.
SMH-2002-9	NARC.
SMH-2002-11	NARC.
SMH-2002-12	NARC.
SMH-2002-13	NARC.
SMH-2002-14	NARC.
SMH-2002-15	NARC.
SMH-2002-16	NARC.
SMH-2002-18	NARC.
SMH-2002-19	NARC.
SMH-9706	NARC.
SF-177	Monsanto.
SF-187	Monsanto.
Hysun-33	ICI.

The data were collected on Days to flower initiation (DFI), Days to flower completion (DFC), Plant height (PH), Head diameter (HD), Days to physiological maturity (DPM), Number of grains per head (NGPH), Number of filled grains per head (NFGPH), 100-grain weight (100-GW), Grain Yield (GY), Oil content (OC). The data were analyzed using standard analysis of variance for all characteristics as given by Steel and Torrie (1980). For individual comparison of hybrids, Least Significance Test (LSD) at 5% level of probability was used. Correlation coefficients for all possible pairs of the traits were estimated by using MSTATC.

Results and Discussion
The data taken on various traits were analyzed for ANOVA, LSD and correlation coefficients. The results are discussed below:

Days to flower initiation: Data regarding days to flower initiation showed highly significant differences, (P<0.01) among the hybrid (Table 1). SMH-2002-19 took maximum (62) days to flower initiation followed by hybrid Hysun-33 with (60.50) days. Hybrid SMH-2002-11 took minimum 53.50 days. Highly significant and positive correlation of days to flower initiation was observed with grain yield, days to flower completion and 100 grain weight as supported by the findings of Thomboro and Joshi (1982). Correlations of days to flower initiation with plant height and head diameter were also significant and positive while non-significant with number of filled grains/head and oil content (%). Negative and non-significant correlation was observed with number of grains/head.

Plant height (cm): Plant height data showed significant differences among hybrid for plant height (Table 1) as supported by Cruz and Dela (1986), Tariq *et al.* (1992) and Epinosa *et al.* (1992). The mean data for plant height ranged between 110.5-163 cm. Hysun-33 showed maximum height of 163 cm followed by SMH-2002-19 showing 148.8 cm plant height. Hybrid SMH-2002-8 attained minimum plant height of 110.5 cm followed by SF-187 with 117.5 cm. Hybrids SMH-9706 and SF-177 showed 148.6 and 145.5 cm of plant height, respectively.

Plant height was also positively and significantly correlated with yield (Chaudhry and Anand, 1993; Vanisree *et al.* 1988, Ashok *et al.*, 2000, Epinosa *et al.*, 1992 and Yusuf *et al.*, 1985) (Table 2).

Head diameter (cm): Non-significant differences were observed among the hybrids for head diameter (Table 1). As supported by Caylak and Emiroglu (1984). The mean data ranged from 12.80 to 17 cm for head diameter (Table 2). Possible reason could be the uniform genetic background of inbred lines. Correlation of head diameter (cm) with days to physiological maturity was highly significant and positive. Head diameter (cm) showed non-significant correlations with yield as reported by Caylak and Emiroglu (1984), Yusuf *et al.* (1985), Chaudhary and Anand (1985) and Ashok *et al.* (2000).

Days to physiological maturity: Proper maturity period is an important consideration in crop varieties to fit into multiple cropping systems. Highly significant differences (P<0.01) were observed among the hybrids for days to physiological maturity (Table 1). The mean values of hybrids for days to physiological maturity ranged between 86.75 and 94 days. Hybrid SMH-2002-1 took minimum 86.75 days followed by SMH-2002-11, with 87 days. Maximum 94 days to physiological maturity were taken by hybrid SMH-2002-19 followed by SMH-2002-14 taking 91.50 days. While commercial hybrids SMH-9706, SF-177, SF-187 and Hysun-33 recorded 88.50, 88, 87.75 and 90.50 days respectively. Correlation of days to physiological maturity with plant height (cm) and grain yield (kg ha⁻¹) was non-significant as reported by Tanimu

and Ado 1988 (Table 2).

100-Grain weight (g): Hybrids showed significant differences for 100-grain weight. (Table 1). Cruz and Dela (1986), Caylak and Emiroglu (1984) recorded similar significant differences for 100-grain weight. The highest 100-grains weight (7.03 g) was recorded by hybrid SMH-2002-16 followed by Hysun-33 with 6.70 gram. Correlations of 100-grain weight with grain yield was significantly positive as supported by Buttar and Uppal (1998), Caylak and Emiroglu (1984). Shabana (1974) concluded that breeding for high 100-grain weight is an important character in development of superior inbred lines, which may be used for high yielding hybrid development. 100-grain weight should be given priority in breeding programmes for high yield.

Grain yield (kg ha^{-1}): Yield is the major goal toward which all efforts are directed. Analysis of variance regarding grain yield (kg ha^{-1}), indicated that hybrids were significantly different among themselves for grain yield as supported by Epinosa *et al.* (1992), Cruz and Dela (1986), Tariq *et al.* (1992) and Yusaf *et al.* (1985). Highest mean grain yield of 2128 kg ha^{-1} was recorded by Hysun-33 followed by SF-187 (2040 kg ha^{-1}) and SMH-2002-4 (1908 kg ha^{-1}), respectively. The least mean value for grain yield (744 kg ha^{-1}) was obtained from the hybrid SMH-2002-15 while, SF-177, SMH-9706 and SMH-2002-19 yielded 1839, 1569 and 1862 kg ha^{-1} respectively (Table 1). Data regarding yield showed positive correlation with days to flower initiation, days to flower completion and plant height as reported by Chaudhary and Anand (1993), Vanisree *et al.* (1988), Ashok *et al* (2000), Epinosa *et al.* (1992) and Yusuf *et al.* (1985). Correlations of grain yield with head diameter and days to physiological maturity were non-significant. Tanimu and Ado (1988) also reported similar results. Number of filled grains per head was significantly correlated with grain yield. Significant and positive correlations of grain yield with 100-grain weight were found in this study which is supported by Buttar and Uppal (1998), Caylak and Emiroglu (1984).

Table 1: Mean values for different traits studied of sunflower local and commercial hybrids evaluated at National Agricultural Research Center Islamabad, during autumn 2002

Hybrids	Days to flower initiation	Days to flower completion	Plant height	Head diameter	Days to Physiolo - gical maturity	Number of grain/head	No. of filled grains/Head	100-grain weight	Grain yield	Oil content
1 SMH-2002-1	53.50	57.25	127.8	12.80	86.75	614.50	458.25	5.490	1555	38.98
2 SMH-2002-3	55.00	59.50	130.8	13.85	88.50	639.43	507.75	6.188	1155	38.15
3 SMH-2002-4	58.00	62.25	127.5	15.05	90.25	545.50	441.70	6.653	1908	39.85
4 SMH-2002-5	55.50	59.25	142.0	15.25	90.75	506.11	418.25	5.775	1233	40.71
5 SMH-2002-6	59.00	63.75	129.1	15.85	90.00	565.31	462.75	6.582	1833	37.41
6 SMH-2002-7	55.75	59.25	144.3	14.35	87.75	505.75	406.17	5.645	1355	41.10
7 SMH-2002-8	55.00	58.00	110.5	12.70	87.25	450.25	369.75	5.802	890	37.33
8 SMH-2002-9	57.50	61.75	139.5	16.30	90.25	487.87	416.75	6.260	1813	40.81
9 SMH-2002-11	53.50	57.00	139.0	14.30	87.00	515.75	468.55	5.757	798	40.14
10 SMH-2002-12	55.75	58.75	128.8	14.75	90.00	485.25	401.75	6.205	1026	38.82
11 SMH-2002-13	54.50	57.75	130.0	15.85	89.75	530.75	436.15	6.162	1295	38.11
12 SMH-2002-14	55.75	58.50	137.5	17	91.50	475.78	390	6.238	1332	41.19
13 SMH-2002-15	57.00	58.00	119.5	14.20	90.75	422.50	352.12	5.415	744	40
14 SMH-2002-16	55.50	58.75	135.5	16.50	90.75	588.10	480	7.038	1504	40.42
15 SMH-2002-18	55.00	58.00	118.5	13.65	87.75	527.25	452.50	5.835	1136	37.34
16 SMH-2002-19	62.00	64.75	148.8	15.35	94.00	536	459.75	6.642	1862	43.68
17 SMH-9706	56.50	59.75	148.6	14.95	88.50	563.50	473.50	5.960	1569	39.84
18 SF-177	55.75	61.50	145.5	14.60	88.00	502.21	488.75	5.923	1839	37.89
19 SF-187	55.50	58.50	117.5	14.45	87.75	516	429.75	5.928	2040	36.69
20 Hysun-33	60.50	63.50	163.0	15.05	90.50	544	487	6.705	2128	37.97
LSD value at 5 %	2.527	1.598	18.03	NS	1.22	NS	NS	0.814	464.2	NS

Mean in the vertical columns followed by different letters are significantly different at 5 % level of probability, using LSD test, NS= Non significant

Table 2: Correlation coefficients among different parameters of 20 sunflower local and commercial hybrids tested and NARC, Islamabad during Autumn 2002

	DFC	PH (cm)	HD (cm)	DPM	NGPH	NFGPH	100 GW (g)	GY (kg ha^{-1})	OC (%)
DFI	0.909**	0.459*	0.367*	0.725**	0.032	0.108	0.586**	0.579**	0.332
DFC		0.524**	0.371	0.568**	0.157	0.345	0.634**	0.722**	0.219
PH (cm)			0.424	0.354	0.210	0.471*	0.338	0.451*	0.465*
HD (cm)				0.690**	-0.040	0.049	0.642**	0.353	0.417
DPM					0.132	-0.106	0.602**	0.238	0.609**
NGPH						0.825**	0.358	0.351	-0.106
NFGPH							0.430*	0.467*	-0.147
100 GW (g)								0.545*	0.149
GY (kg ha^{-1})									-0.016

*= Significant (P< 0.05), **= highly significant (P< 0.01)

Oil content (%): Non-significant differences were observed for oil content (%) among the hybrids. These results are in contrast with those of Caylak and Emiroglu (1984), who observed significant differences for oil content. Oil content (%) means ranged from 36.69 to 43.68 %. Highest mean value (43.68 %) was recorded in hybrid SMH-2002-19 while lowest means value 36.69%0 in SF-187 (Table 1). Highly significant and positive correlation of oil content was observed with days to physiological maturity and plant height and non-significant and negative correlation with number of filled grains per head (Table-2).

References

Ashok, S., N.M. Sheriff and S.I. Narayanan, 2000. Character association and path coefficient analysis in sunflower. Crop Res. Hisar., 20: 104-114.

Buttar, G.S and H.S. Uppal, 1998. Correlation and path coefficient studies in sunflower. Annals of Arid Zone, 37: 83-87.

Caylak, B. and V.S.H. Emiroglu, 1984. Correlations among some agronomic and exchnological characters in sunflower. Pl. Br. Abst. !988. Vol. 058, Abst. No. 00705.

Chaudhary, S.K. and I.J. Anand, 1985. Influence of various characters on yield of sunflower. Pl. Br. Abst. 1987, Vol. 057, Abst. No. 03141.

Chaudhary, S.K. and I.J. Anand, 1993. Correlation and path coefficient analysis in F1 and F2 generations in sunflower. International J. Trop Agric., 11: 204-208.

Cruz, V.G and R. Dela, 1986. Heterosis and combining ability for yield and yield components in sunflower (*Helianthus annuus* L.). Crop Sci., 2: 171-174.

Epinosa, Z.C., P.E. Sevilla and V.L. Quilantan, 1992. Characterization and evaluation per se of low plant sunflower lines in Mexico. Proceedings of the 13th International Sunflower Conference Volume 2, Pisa, Italy, 7-11 September 1992. pp: 1030-1036.

Oilseeds development strategy, 1995. National Oilseeds Development Programme.

Shabana, M.R., 1974. Number of seeds perhead and seed size in sunflower. Sunflower J. Edible Oil Industry, Yogoslavia, 25: 16.

Skoric, D.,1988. Sunflower breeding. Uljarstov, 25: 3.

Steel, R.G.D. and J.H. Torrie, 1980.Principles and procedures of statistics. MC graw HILL book Co., New York.

Tariq, M., G. Idrees and A. Tahir, 1992. Genetic variability and correlation studies in sunflower. Sarhad J. Agric., 8: 659-663.

Tanimu, B. and S.C. Ado, 1988. Relationships between yield and yield components in forty populations of sunflower. Helia 988: 17-19.

Thomboro, M.V. and B.P. Joshi, 1982. Correlation and path analysis in sunflower varieties. Pl. Br. Abst., 52: 882.

Vinisree, G., K. Ananthasayana., G.V.S. Nagabhusnanam and C.A. Jagadish, 1988. Correlation and path coefficient analysis in sunflower. J. Oilseeds Res., 2: 46-51.

Yusuf, M.A., M.A. Rana and B. Akhtar, 1985. Evaluation of sunflower cultivars under rainfed conditions. Sarhad J. Agric., 5: 73-76.