

Growth Performance, Heritability and Inter Relationship in Some Quantitative Traits in Sunflower

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Abstract: Growth performance, heritability and characters correlation were studied in 20 sunflower genotypes. Hybrid SF-100 produced significantly highest seed yield (3669 Kg ha⁻¹) followed by NK-265, Gloriasol with respective seed yield of 3289 and 3264 Kg ha⁻¹. Heritability values ranged from -5.58 % in seed capitulum⁻¹ to 98.72 in 50% flower. 100-achene weight, 1st flower, complete flower, maturity, and oil content showed high heritability values of 98.65%, 98.56, 98.38, 96.03 and 95.72%, respectively. Seed yield was positively correlated with all traits studied. Path coefficient analysis revealed that first flower had the highest positive direct effect on seed yield followed by seed capitulum⁻¹, 100 achene weight, complete flower and head diameter while 50% flower had the maximum negative direct effect on seed yield.

Key words: Heritability, correlation, path coefficient, sunflower, inter-relationship

Introduction

Sunflower (*Helianthus annuus* L.) is gaining popularity among the farming community mainly due to its high level of polyunsaturated fatty acid content and thus contributing to low cholesterol diet. It has wide adaptability, photo-insensitive nature, short season crop and can be accommodated in the existing cropping system. The average yield obtained in the country is far below the yield recorded in other sunflower growing countries of the world. There is a need for further improvement in productivity to meet the growing edible oil demands of our country. Grain yield is a product of an organized interplay of several factors which are highly susceptible to environment fluctuation. Marinkovic (1992) and Singh and Labana (1990) revealed that the seed yield was positively correlated with days to maturity, plant height, head diameter and 1000-seed weight while path co-efficient analysis indicated that head diameter and 1000-seed weight had the greatest direct effect on seed yield followed by days to maturity and plant height. Khan *et al.* (1983a) reported heritability values ranges 30.62% to 95.55% for seed pod⁻¹ and pods plant⁻¹. While values for 100-achene weight, and seed yield were 56.58%, 76.87% and 52.86%, respectively. Seed yield was positively correlated with all characters. Khair *et al.* (1992) reported that the heritability were high for head diameter (97.47%), plant height (78.10%), 100-achene weight (76.39%), oil content (74.83%) and seed yield (67.74%). Aslam *et al.* (1992) concluded that pods plant⁻¹, pod height, and days to maturity had negative association as well as direct negative path toward yield. Khan *et al.* (1992b) reported that the yield was positively correlated with all plant characters i.e., days to maturity, plant height, head size and 100 achene weight whereas path coefficient analysis revealed that head diameter (0.7281) had strong direct effect on seed yield followed by 100 achene weight (0.6295), plant height (0.3422) and days to maturity (0.2834). Sheriff *et al.* (1986) concluded that plant height and head diameter showed highly positive correlation with seed yield. However, path coefficient analysis showed that head diameter had highest direct effect on seed yield. Lakshmanaiah (1980) and Rao (1983) reported that capitulum diameter and 100 seed weight influence the seed yield both directly and indirectly whereas days to maturity had the greatest negative direct effect on seed yield.

Therefore, this experiment was undertaken to assess genetic variation (heritability), correlation, path coefficient analysis and to explore the possibility of selection for high yielding sunflower genotypes.

Materials and Methods

Twenty sunflower genotypes of diverse origin were planted in RCB design at Sugarcane Breeding Station Dargai, Malakand Agency, during spring, 1999. Plot size measures 5 x 2.5 m² with inter and intra row space of 75 cm and 20 cm, respectively. Sowing was done on ridges by dibbling method. All agronomic practices were raised uniformly for all plots. At physiological maturity ten competitive plants were randomly selected from each plot. However, data on 1st flower, 50% flower, complete flower, maturity duration, plant height, head diameter, seed capitulum⁻¹, 100-achene weight, oil content and seed yield were recorded. Analysis of variance, heritability was estimated from the results of variance analysis according to the formula used by Burton and De Vane (1953), coefficient of correlation and path coefficient analysis were also estimated by Steel and Torrie (1960) and Dewey and Lu (1959), respectively.

Results and Discussion

The analysis of variance revealed significant differences among genotypes for all the characters studied at 5% level of probability. Hybrid SF-100 obtained significantly the highest seed yield of 3669 Kg ha⁻¹ followed by NK-265, Gloriasol and SF-187 with seed yield of 3387, 3289 and 3264 Kg ha⁻¹, respectively (Table 1) while IS-3107 produced significantly Lowest seed yield (1190 Kg ha⁻¹). However, the rest of the hybrids were in the range of 1744-3189 Kg ha⁻¹.

Seeds capitulum⁻¹ had the lowest heritability value (-5.58) among the parameters studied (Table. 2). The highest heritability values of 98.72, 98.65, 98.56 and 98.36% were observed for 50% flowers, 100-achene weight, 1st flower, and complete flowers, respectively. Maturity duration had exhibited the second highest heritability value of 96.03% followed by oil content with 95.72%. While plant height and head diameter showed moderate heritability value of 71.00% and 54.27%, respectively. Such variation in heritability is also reported by Khair *et al.* (1992) and Khan *et al.* (1983a). However, seed yield had the second lowest heritability values.

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Table 1: Average and analysis of variance for ten characters in 20 Sunflower hybrids trial.

Hybrid	Days to				Plant height (cm)	Head diameter (cm)	Seed capitulum ⁻¹	100-achene wt: (gm)	Oil content (%)	Seed yield Kg ha ⁻¹	
	1st flower	50% flower	complete flower	maturity							
AH. Extra	60.3	63	68	101	208	21	1746	5.86	40.10	2787	
SH-3322 60.7	65	69	103	228	17	1733	5.90	42.56	3035		
SH-222	60.3	64	68	108	222	20	1583	5.67	38.72	2643	
SE-187	64.3	69	72	109	169	20	1734	5.18	41.94	3264	
C-206	66.0	72	74	107	197	19	1832	4.75	39.89	2883	
IS-3312	69.0	74	76	103	196	16	1549	6.75	39.99	2708	
SF-100	61.0	64	69	105	207	21	1969	6.76	44.53	3669	
IS-3107	69.7	74	76	99	159	17	1634	5.26	40.97	1190	
NK-212	60.3	63	70	106	173	18	1700	6.97	38.58	2919	
SySun 33	72.3	76	77	108	195	19	1613	6.32	38.80	2805	
P-6480	77.0	79	81	110	215	17	1661	5.70	39.31	1914	
NSH-54	73.3	76	78	109	232	20	1766	7.05	43.57	3051	
NSH-101 71.7	74	76	107	199	17	1554	6.14	39.83	3189		
NSH-104 75.3	78	79	112	245	19	4803	6.64	42.06	2782		
NK-265	70.0	76	75	106	195	22	1747	6.70	37.32	3387	
NSH-160 76.0	79	80	100	173	20	1377	5.32	41.01	2493		
IS-3107	73.3	80	79	101	166	20	1665	4.90	37.62	2954	
NSH-45	75.3	78	79	103	209	25	1803	6.24	38.58	3143	
Agrisol	73.3	76	77	107	223	24	1729	5.05	35.50	3005	
Gloriasol	69.7	73	75	109	226	26	1780	6.47	37.30	3289	
Lsd _{0.05}	2.34	1.3	2.7	NS	45.18	1.1	188	1.15	15.3	273	
S.V	D.F	Mean Square									
		1st flower	50% flower	Complete flower	Maturity (day)	Plant height (cm)	Head diameter (cm)	Seed capitulum ⁻¹	100-achene wt (gm)	Oil content (%)	Seed yield Kg ha ⁻¹
Repeat	2	3.389	0.50	0.09	0.79	525.51	15.04	114482.4	0.02	0.01	6420422.1
Hybrid	19	94.22 **	15.139	87.10 **		49.55 **	35.82 **	1572.28 **	19.09 **	4.5788	7 *
Error	38	0.461	0.384	0.271	0.487	188.383	4.187	54342.77	0.007	0.240	764616.57

* Significant at P < 0.05, ** Significant at P < 0.01, NS= Non significant

Table 2: Character means, heritability, genotypic coefficient of variation for ten parameters of *Helianthus annuus* L.

Parameter	Means	Heritability (%)	GCV (%)
1st flower (days)	69.61	98.56	0.0803
50% flower (days)	73.00	98.72	0.0736
Complete flower (days)	75.35	98.38	0.0537
Maturity (days)	106.13	96.03	0.0323
Plant height (cm)	203.61	71.00	0.1054
Head diameter (cm)	19.88	54.27	0.1121
Seed capitulum ⁻¹	1714.21	-5.58	ERR
100-achene weight (gm)	5.988	98.65	0.1196
Oil contents (%)	40.217	95.72	0.574
Seed yield (Kg ha ⁻¹)	2888.08	24.62	0.1730

Table 3: Correlation coefficient for ten traits in sunflower

	Days to			Plant height (cm)	Head diameter (cm)	Seed capitulum ⁻¹ wt: (gm)	100-Achene (%)	Oil content Kg ha ⁻¹	Seed yield
	50% flower	Complete flower	Maturity						
1st flower (day)	0.997 **	0.990 **	0.929 **	0.826 **	0.798 **	0.844 **	0.768 **	0.881 **	0.470 *
50% flower (day)		0.995 **	0.935 **	0.818 **	0.797 **	0.852 **	0.778 **	0.891 **	0.477 *
Complete flower (day)			0.961	0.843 **	0.815 **	0.885 **	0.818 **	0.921 **	0.505 *
Maturity (day)				0.903 **	0.833 **	0.942 **	0.867 **	0.955 **	0.592 **
Plant height (cm)					0.788 **	0.887 **	0.812 **	0.856 **	0.618 **
Head diameter (cm)						0.838 **	0.720 **	0.637 **	
Seed capitulum ⁻¹							0.831 **	0.92 **	0.646 **
100-achene wt (gm)								0.848 **	0.525 **
Oil content (%)									0.533 **

* Significant at P < 0.05, ** Significant at P < 0.01

Table 4: Path co-efficient analysis showing direct (bold) and indirect effects of nine traits in sunflower

	Days to				Plant height (cm)	Head diameter (cm)	Seed capitulum ¹ wt: (gm)	100-achene (%)	Oil content	TC
	1st flower	50% flower	Complete flower	Maturity						
1st flower (day)	(0.67)	-0.836	0.181	0.211	0.056	0.120	0.463	-0.356	-0.627	0.467
50% flower (day)	0.657	(-0.89)	0.247	-0.219	0.056	0.120	0.468	0.361	-0.634	0.166
Complete flower (day)	0.610	-0.800	(0.314)	-0.253	0.057	0.123	0.486	-0.379	-0.656	0.502
Maturity (day)	0.603	-0.727	0.795	(-0.304)	0.061	0.126	0.517	-0.402	-0.679	0.99
Plant height (cm)	0.515	-0.634	0.215	-0.178	(0.068)	0.119	0.487	-0.377	-0.609	0.606
Head diameter (cm)	0.328	-0.258	0.843	-0.086	0.054	(0.151)	0.460	-0.334	-0.531	0.627
Seed capitulum ⁻¹	0.635	-0.242	0.774	-0.229	0.060	0.127	(0.549)		-0.386	-0.655
100-achene wt (gm)	0.128	-0.918	0.891	-0.131	0.055	0.090	0.456	(0.464)	-0.604	0.522
Oil content (%)	0.882	-0.939	0.262	-0.245	0.058	0.113	0.505	-0.393	(-0.712)	0.533

Residual effect (R) = 0.71

TC = Total correlation with yield

High genotypic coefficient of variation (GCV) and heritability for captioned traits were indication of additive gene action on these parameters. Seed yield (Kg ha^{-1}) had a highly significant positive correlation with all parameters studied except complete flower with days to maturity (Table 3). The results are in agreement with the findings of Khan *et al.* (1992b) and Sheriff *et al.* (1986). Path coefficient analysis concealed that first flowering had the highest positive direct effect on seed yield followed by seeds capitulum⁻¹, 100-achene weight, complete flower (100%) and head diameter (Table.3) while oil content had highest negative direct influence of (-0.712) with seed yield followed by 50% flower (-0.89) and maturity (-0.304). Similar results i.e., head diameter had strong effect on seed yield were also observed by Khan *et al.* (1992b) and Sheriff *et al.* (1986). Moreover, 50% flowering affected seed yield negatively via others characters viz. maturity and 100-achene weight. Thus this study concluded that complete flowering, 1st flowering, seeds capitulum⁻¹, head diameter, and plant height had a significant role in enhancing the seed yield, but at the same time a compromise should also be made with other characters because of their indirect effects on seed yield.

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