INTERCHARACTER ASSOCIATION AND PATH COEFFICIENT ANALYSIS IN SUNFLOWER (*HELIANTHUS ANNUUS* L.)

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ABSTRACT

One hundred ninety six germplasm accessions of sunflower were included in this study which revealed that seed yield had highest correlation with number of filled seeds per plant, followed by seed filling percentage and head diameter. Oil yield was highly and positively correlated with seed yield per plant and number of filled seeds per plant. Number of filled seeds per plant had maximum direct effect on seed yield. Head diameter also had considerable effect on seed yield. The present study brings out the importance of seeds per plant, head diameter and 1000-seed weight for yield improvement.

Association of a particular character in relation to other traits contributing to seed yield will be of great importance in planning a successful breeding programme in any crop plant. Path coefficient analysis is helpful in partitioning the correlation coefficients into its direct and indirect effects, so that the relative contribution of each component character to yield could be assessed. The present study has been undertaken with the twin objectives of estimating the genotypic and phenotypic correlation between different quantitative traits and to work out the path coefficients to know the direct and indirect contribution of important yield parameters.

MATERIALS AND METHODS

One hundred ninety six germplasm accessions of sunflower were grown in 14 x 14 simple lattice design with two replications. Each germplasm entry was sown in a single row of 3 m length with 60 cm spacing between the rows and 30 cm between plants. Observations were recorded on five random plants for plant height, stem diameter, head diameter, days to 50% flowering, leaves per plant, 1000-seed weight, seed yield per plant, number of filled

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seeds per plant, seed filling per cent, and oil content. Oil content was estimated on dry seed basis using nuclear magnetic resonance (NMR) spectrometer. Oil yield was computed by multiplying seed yield with oil content. All observations except days to 50% flowering were computed as per Weber and Moorthy [1]. Path coefficient analysis was carried out as per Wright [2] and illustrated by Dewey and Lu [3].

RESULTS AND DISCUSSION

CORRELATION STUDIES

At genotypic and phenotypic levels, significant positive correlations were observed for seed yield with plant height (r = 0.620 and 0.461, respectively), stem diameter (0.623 and 0.364), head diameter (r = 0.486 and 0.460), test weight (r = 0.302 and 0.286), and seed filling percentage (r = 0.406 and 0.327). However, seed yield had strongest correlation (r = 0.832 and 0.799 respectively) with number of filled seeds per plant both at genotypic and phenotypic levels (Table 1). Lakshmaniah [4] and Anand and Chandra [5] also reported that number of filled seeds and seed filling percentage were highly correlated with seed yield.

Plant height showed significant positive correlation with all the characters studied except seed filling. Plant height was highly correlated with seed yield (r = 0.620). Similar results were reported by Vanishree et al. [6]. Plant height had strong correlation with leaves per plant, followed by head diameter and stem diameter. When the plant height is more, obviously the number of leaves will be more providing greater fixation of carbon leading to more accumulation of dry matter. This may lead to increase in stem weight and size, head diameter and head weight, resulting in higher yields.

Nonsignificant correlation of seed filling with all the characters under study except yield and seeds per plant suggests that yields could be enhanced by increasing the total number of seeds and their filling. The earlier report by Niranjanmurthy and Shambulingappa [7] also contained similar results.

In the present investigation, oil content was negatively correlated with seed yield at genotypic level (r = − 0.142). This is in conformity with the results of [8, 9].

It can be inferred from these results head diameter, number of filled seeds per plant, 1000-seed weight, and seed filling percentage are highly correlated with seed yield and could be directly used for selection.

Table 1. Genotypic (upper values) and phenotypic (lower values) correlation coefficients for quantitative characters in sunflower

Characters	Stem dia-meter	Head dia-meter	Days to flower-ing	Leaves per plant	1000-seed weight	Seed yield	Filled seeds per plant	Seed filling %	Oil con-tent	Oil yield
Plant height	0.592**	0.608**	0.421**	0.645**	0.348**	0.620**	0.423**	0.081	-0.098	0.371**
	0.562**	0.583**	0.349**	0.626**	0.334**	0.461**	0.408**	0.074	-0.081	0.362**
Stem diameter		0.656**	0.499**	0.607**	0.200**	0.632**	0.384**	0.163	-0.082	0.269**
		0.654**	0.406**	0.497**	0.205**	0.364**	0.372**	0.134	-0.069	0.264**
Head diameter			0.374**	0.474**	0.339**	0.486**	0.432**	0.095	-0.057	0.382**
			0.316**	0.449**	0.235**	0.460	0.418**	0.093	-0.040	0.359**
Days to flowering				0.367**	0.125	0.241**	0.172*	0.096	0.023	0.108
				0.288**	0.097	0.151*	0.150*	0.094	-0.019	0.107
Leaves per plant					0.398**	0.468**	0.416**	0.082	-0.122	0.372**
					0.393**	0.445**	0.406**	0.074	-0.118	0.369**
1000-seed weight						0.302**	0.278**	0.081	-0.132	0.258**
						0.286**	0.225**	0.043	-0.098	0.254**
Seed yield							0.832**	0.406**	-0.142*	0.651**
							0.799**	0.327**	-0.126	0.643**
Filled seeds/plant								0.462**	-0.068	0.532**
								0.454**	-0.047	0.530**
Seed filling %									-0.039	0.221**
									-0.028	0.210**
Oil content										0.102
										0.064

*,**Significant at 5% and 1% levels, respectively.

PATH COEFFICIENT ANALYSIS

Out of the eight characters listed in Table 2, the number of filled seeds per plant had maximum direct effect on seed yield. This is also supported by the fact that indirect effects of all other traits through this character were high and positive. Head diameter was second best in its direct and indirect effects on seed yield. This is in agreement with the results of Pathak [10], who reported that achenes per plant had the highest direct effect on yield. Hence, selection based on these two traits will be effective in improving yield levels. Vanozzi et al. [11] also reported high direct effect of head diameter on seed yield.

Table 2. Direct (in bold) and indirect effects of yield components on seed yield at phenotypic level

Characters	Plant height	Stem dia- meter	Head dia- meter	Days to flower- ing	No. of leaves per plant	1000- seed weight	No. of seeds per plant	Seed filling %	Phenotypic correlation with yield
Plant height	**0.0847**	– 0.032	0.0691	– 0.0078	0.0407	0.0201	0.2868	– 0.0005	0.461
Stem diameter	0.0476	**– 0.0574**	0.0776	– 0.0089	0.0324	0.0124	0.2714	– 0.0009	0.364
Head diameter	0.0493	– 0.0375	**0.1187**	– 0.0069	0.0292	0.0142	0.0294	– 0.0006	0.460
Days to flowering	0.0295	– 0.0233	0.0375	**– 0.0220**	0.0187	0.0058	0.1053	– 0.0006	0.151
No. of leaves/plant	0.0530	– 0.0285	0.0532	– 0.0063	**0.0651**	0.0237	0.2852	– 0.0005	0.445
1000-seed weight	0.0282	– 0.0117	0.0278	– 0.0021	0.0255	**0.0603**	0.1580	– 0.0002	0.286
No. of seeds/plant	0.0345	– 0.0213	0.0496	– 0.0033	0.0264	0.0135	**0.7026**	– 0.0031	0.799
Seed filling %	0.0062	– 0.0076	0.0110	– 0.0020	0.0048	0.0026	0.3190	**– 0.0069**	0.327

R = 0.3252.

Path analysis for oil yield (Table 3) revealed that, seed yield had the highest direct effect on oil yield (1.496), followed by seed filling percentage (0.698), oil content and head diameter. Number of filled seeds per plant had the highest indirect effect via seed yield per plant (1.195). The other characters, i.e. plant height, stem diameter, head diameter and

Table 3. Direct (in bold) and indirect effects of different characters on oil yield at phenotypic level

Characters	Plant height	Stem dia- meter	Head dia- meter	1000- seed weight	Yield per plant	Seeds per plant	Seed filling %	Oil con- tent	Phenotypic correlation with yield
Plant height	**0.1438**	0.0160	0.0708	0.0286	0.6898	– 0.6086	0.0517	0.0306	0.3620
Stem diameter	0.0808	**0.0285**	0.0794	0.0176	0.5447	– 0.5549	0.0936	– 0.0259	0.2640
Head diameter	0.0838	0.0186	**0.1214**	0.0202	0.6883	0.6235	0.0650	– 0.0150	0.3590
1000-seed weight	0.0480	0.0058	0.0285	**0.0858**	0.4279	– 0.3356	0.0301	– 0.0367	0.2540
Seed yield/plant	0.0663	0.0104	0.0559	0.0246	**1.4960**	– 1.1910	0.2286	– 0.0472	0.6430
No. of seeds/plant	0.0587	0.0106	0.0507	0.0193	1.1950	**– 1.4910**	0.3173	– 0.0176	0.1430
Seed filling %	0.0106	0.0038	0.0112	0.0036	0.4890	– 0.6779	**0.6989**	– 0.0104	0.5300
Oil content	– 0.0116	– 0.0019	– 0.0048	– 0.0084	– 0.1885	0.0701	– 0.0195	**0.3749**	0.2100

R = 0.3231.

1000-seed weight had greater indirect effect via seed yield. The residual effect was 0.3231, suggesting that the number of characters considered for path analysis were appropriate. From these results it can be inferred that selection for seed yield directly increases oil yield.

REFERENCES

1. C. R. Weber and B. R. Murthy. 1952. Heritable and nonheritable relationship and variability of oil content and agronomic characters in the F_2 generation of soybean crosses. Agron. J., **44**: 202–209.

2. S. Wright. 1921. Correlation and causation. J. Agric. Res., **20**: 557–585.

3. D. R. Dewey and K. H. Lu. 1957. A correlation and path coefficient analysis of components of crested wheat grass seed production. Agron. J., **51**: 515–518.

4. V. H. Lakshmaniah. 1978. Genetic Variability and Association of Morphological Characters with Seed Yield and Oil Content in Sunflower. M. Sc. (Ag.) Thesis. University of Agricultural Sciences, Bangalore.

5. I. J. Anand and S. Chandra. 1980. Genetic diversity and interrelationships of oil yielding traits in sunflower. Sunflower Newsl., **3**(1): 5–8.

6. G. Vanishree, K. Ananthasayana, G. V. S. Nagabhushanam and C. A. Jagadish. 1988. Correlation and path coefficient analysis in sunflower. J. Oilseeds Res., **5**(2): 46–51.

7. Niranjanmurthy and K. G. Shambulingappa. 1989. Path analysis for seed yield in sunflower. J. Oilseeds Res., **6**(1): 22–25.

8. A. A. Zali, B. Y. Samadi and M. C. Amirshahi. 1977. Multiple regression analysis for different quantitative characters in sunflower. Agron. J., **18**: 78.

9. K. Srinivas. 1982. Inheritance of Fertility Restoration and Oil Content in Sunflower (*Helianthus annuus* L.). M. Sc. (Ag.) Thesis. University of Agricultural Sciences, Bangalore.

10. A. R. Pathak, M. U. Kukadia and B. A. Kunadra. 1983. Path coefficient analysis in sunflower. Indian J. agric. Sci., **53**(7): 607–608.

11. G. P. Vanozzi, P. Belloni and F. Martorana. 1986. Correlations among yield components in sunflower. Somenti Elitte, **32**(6): 25–31.