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Original Research Article

Character Association and Path Analysis for Yield and Yield Attributes in Sunflower (*Helianthus annuus* L.) Restorer Lines

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A B S T R A C T

Correlation and path analysis was studied in sunflower restorer lines. 116 lines comprising 113 restorer lines and 3 local checks were selected to access the character association and path analysis between yield and its contributing traits. Observations were recorded on 10 traits viz., days to 50% flowering, days to maturity, plant height(cm), head diameter(cm), seed filling percent, hull content percent, oil content percent, 100 seed weight (g), volume weight (g/ml) and seed yield per plant. Randomized block design was followed with two replications. Results revealed that Seed yield had significant positively correlated with volume weight, seed filling per cent, hundred seed weight, head diameter, plant height and days to maturity. Path coefficient analysis indicated that highest direct effects on seed yield were observed in the traits volume weight, hundred seed weight, seed filling percent, head diameter and hence emphasis can be laid out on these traits during selection for further improvement in seed yield in sunflower.

Keywords

Agronomic traits, Correlation, Path analysis, Sunflower

Introduction

Sunflower (*Helianthus annuus* L.) is an annual oil seed crop belongs to the family *Asteraceae* and it is highly cross pollinated. It is taking prime position in the oil seed economy both at national and global level, mainly because of quality oil and poly unsaturated fatty acid. In India sunflower is being grown over an area of 0.55 million hectares production of 0.41 million tonnes with productivity of 752 kg/ha^{-1}. Presently Karnataka is the leading state in the country contributing 63.76 per cent and 53.70 per cent of total area and production, respectively. Its adaptability to a wide range of soil and climatic conditions are the oft-cited phenomenon which makes its cultivation possible during any part of the year in the tropical and subtropical regions of the country (Anonymous, 2015). Sunflower is the second major oilseed crop having a potential source of vegetable oil and protein. The crop is grown under diverse agro-production situations, crossing climatic and geographic boundaries. Though the crop is considered as thermo and photo insensitive (Kavi *et al.*, 1994) but the productivity of sunflower in the country is one of the low in the world.

Yield is a complex character and influenced by several yield component characters. The knowledge on the association of several characters with yield and interrelationship among these characters is essential for

planning a successful plant breeding program. Correlation studies enable breeders to know the strength of the relationship between various characters as well as direction of changes expected during selection.

The path coefficient analysis provides a more realistic picture of the relationship as it considers direct as well as indirect effects of the variables by partitioning the correlation coefficients. An attempt was made in the present investigation to assess the variability, heritability and genetic advance of some quantitative characters and understand the relationship between these characters and their contribution to yield in a set of genotypes.

Materials and Methods

In the present study 116 restorer lines (113 restorers and three local checks) were sown in randomized complete block design (RCBD) with two replications at Oilseeds Research Station, Latur. Each restorer lines was raised in plot size 3.0m x 1.2m with spacing of 60 X 30 cm. Recommended agronomic practices were followed to raise a good crop. At field maturity of the crop, all the heads were harvested separately, seeds were cleaned, dried and analyzed for other traits. Observations were recorded on 10 morphological traits viz., days to 50% flowering, days to maturity, plant height (cm), head diameter(cm), seed filling percent, hull content percent, oil content percent, 100 seed weight (g), volume weight (g/ml) and seed yield per plant. The data were recorded on five randomly selected plants in each entry in each replication. The mean values were used for analysis of variance. The correlation coefficients and path analysis were carried out following the Methods of Johnson *et al.*, (1955b) and Dewey and Lu (1959) respectively.

Results and Discussion

Seed yield is a complex character and it is the end product of action and interaction among number of traits, hence it is important to understand the association of different characters with seed yield. Plant breeder has to find simple correlations and the extent of direct and indirect effects of attributes with seed yield that could be useful to predict the superior cross combinations and to identify traits for ideal plant type and aid in indirect selection. The present study revealed the phenotypic and genotypic correlations between several characters and seed yield. In general, genotypic correlation were higher in magnitude than their respective phenotypic correlations, indicating that selection for the correlated characters could give a better yield response than would be expected on the basis of phenotypic correlations. The present results were in agreement with Tyagi and Khan (2013).

Seed yield/plant exhibited significant and higher genotypic and phenotypic correlations in the positive direction with volume weight (0.8393 and 0.7938), seed filling percent (0.7301and 0.7090), 100 seed weight (0.7201 and 0.6617), head diameter (0.6520 and 0.6237), plant height (0.3319 and 0.3115) and days to maturity (0.2611 and 0.3319).

However, it was negatively correlated with hull content percent (-0.6392 and -0.6006) at genotypic and phenotypic level and oil content percent (-0.0114) at genotypic level. Days to 50% flowering had significant positive correlation at genotypic and phenotypic level with days to maturity (0.2920 and 0.2685) and plant height (0.2374 and 0.2198), while negatively significant correlated with oil content percent (-0.1573 and -0.1534).

Table.1 Estimates of genotypic (G) and phenotypic (P) correlation for ten characters in sunflower

Sr. No	Characters		Days to 50% flowering	Days to maturity	Plant height (cm)	Head diameter (cm)	Seed filling %	Hull content %	Oil content %	100 seed weight (g)	Volume weight (g/100 ml)	Seed yield/plant (g)
1	**Days to 50 % flowering**	G	**1.000**	0.2920**	0.2374**	-0.0371	-0.0227	-0.0117	-0.1573*	0.0604	-0.0344	0.0093
		P	**1.000**	0.2685**	0.2198**	-0.0291	-0.0284	-0.0203	-0.1534*	0.0554	-0.0298	0.0055
2	**Day to maturity**	G		**1.000**	0.8104**	0.1671*	0.3390**	-0.3419**	-0.1879**	0.1319*	0.1212	0.2611**
		P		**1.000**	0.7359**	0.1454*	0.3275**	-0.3007**	-0.1770**	0.1156	0.1113	0.3319**
3	**Plant height**	G			**1.000**	0.2655**	0.2779**	-0.3516**	-0.0920	0.2157**	0.1931**	0.3319**
		P			**1.000**	0.2415**	0.2625**	-0.3198**	-0.0844	0.2002**	0.1699**	0.3115**
4	**Head diameter**	G				**1.000**	0.4913**	-0.5341**	0.0253	0.5320**	0.5551**	0.6520**
		P				**1.000**	0.4714**	-0.5105**	0.0218	0.5069**	0.5435**	0.6237**
5	**Seed filling %**	G					**1.000**	-0.5971**	0.1356*	0.5350**	0.7006**	0.7301**
		P					**1.000**	-0.5733**	0.1336*	0.4998**	0.6708**	0.7090**
6	**Hull content %**	G						**1.000**	-0.1672*	-0.5847**	-0.4983**	-0.6392**
		P						**1.000**	-0.1511*	-0.5482**	-0.4683**	-0.6006**
7	**Oil content %**	G							**1.000**	0.1709**	0.0801	-0.0114
		P							**1.000**	0.1639*	0.0768	0.0003
8	**100 seed weight**	G								**1.000**	0.5931**	0.7201**
		P								**1.000**	0.5701**	0.6617**
9	**Volume weight**	G									**1.000**	0.8393**
		P									**1.000**	0.7938**
10	**Seed yield per plant**	G										**1.000**
		P										**1.000**

*, ** significant at 5% and 1% level, respectively

Table.2 Estimates of genotypic (G) and phenotypic (P) path coefficients in sunflower

Sr. no	Characters		Plant height (cm)	100 seed weight (g)	Oil content (%)	Days to 50 % flowering	Days to maturity	Head diameter (cm)	Seed filling (%)	Husk content (%)	Volume weight (g/100 ml)	Correlated yield (r)
1	**Plant height**	G	**0.0601**	0.0130	-0.0055	0.0143	0.0487	0.0160	0.0167	-0.0211	0.0116	0.3319
		P	**0.0706**	0.0141	-0.0060	0.0155	0.0520	0.0171	0.0185	-0.0226	0.0120	0.3115
2	**100 seed weight**	G	0.0505	**0.2340**	0.0400	0.0141	0.0309	0.1245	0.1252	-0.1368	0.1388	0.7201
		P	0.0380	**0.1898**	0.0311	0.0105	0.0220	0.0962	0.0949	-0.1041	0.1082	0.6617
3	**Oil content (%)**	G	0.0106	-0.0197	**-0.1154**	0.0182	0.0217	-0.0029	-0.0156	0.0193	-0.0092	-0.0114
		P	0.0084	-0.0164	**-0.0999**	0.0153	0.0177	-0.0022	-0.0133	0.0151	-0.0077	0.0003
4	**Days to 50 % flowering**	G	-0.0067	-0.0017	0.0044	**-0.0282**	-0.0082	0.0010	0.0006	0.0003	0.0010	0.0093
		P	-0.0044	-0.0011	0.0031	**-0.0201**	-0.0054	0.0006	0.0006	0.0004	0.0006	0.0055
5	**Days to maturity**	G	0.0198	0.0032	-0.0046	0.0071	**0.0244**	0.0041	0.0083	-0.0083	0.0030	0.2827
		P	0.0044	0.0007	-0.0011	0.0016	**0.0060**	0.0009	0.0020	-0.0018	0.0007	0.2611
6	**Head diameter**	G	0.0277	0.0556	0.0026	-0.0039	0.0175	**0.1044**	0.0513	-0.0558	0.0580	0.6502
		P	0.0292	0.0613	0.0026	-0.0035	0.0176	**0.1210**	0.0571	-0.0618	0.0658	0.6237
7	**Seed filling (%)**	G	0.0331	0.0637	0.0161	-0.0027	0.0404	0.0585	**0.1191**	-0.0711	0.0834	0.7301
		P	0.0498	0.0948	0.0253	-0.0054	0.0621	0.0894	**0.1896**	-0.1087	0.1272	0.7090
8	**Husk content (%)**	G	0.0416	0.0692	0.0198	0.0014	0.0404	0.0632	0.0706	**-0.1183**	0.0589	-0.6392
		P	0.0357	0.0612	0.0169	0.0023	0.0336	0.0570	0.0640	**-0.1117**	0.0523	0.6006
9	**Volume weight**	G	0.0953	0.2926	0.0395	-0.0170	0.0598	0.2738	0.3457	-0.2458	**0.4934**	0.8393
		P	0.0734	0.2462	0.0332	-0.0129	0.0480	0.2347	0.2897	-0.2022	**0.4318**	0.7938

Residual (G): 0.3837 Residual (P): 0.4709

Days to maturity had significant positive correlation with plant height (0.8104 and 0.7359), head diameter (0.1671 and 0.1454), seed filling percent (0.3390 and 0.3275) at genotypic and phenotypic level, 100 seed weight (0.1319) at genotypic level and negatively significant correlated with hull content percent (-0.3419 and -0.3007) and oil content percent (-0.1879 and 0.1770) at both levels. Plant height had positive significant correlation with head diameter (0.2655 and 0.2415), seed filling percent (0.2779 and 0.2625), 100 seed weight (0.2157 and 0.2002) and volume weight (0.1931 and 0.1699), whereas negatively significant correlation with hull content percent (0.3419 and 0.3007) at both levels. Head diameter had positive significant correlation with seed filling percent (0.4913 and 0.4714), 100 seed weight (0.2157 and 0.2002) at both levels. Seed filling percent had positive significant correlation with oil content percent (0.1356 and 0.1336), 100 seed weight (0.5350 and 0.4998) and volume weight (0.7006 and 0.6708) and negatively significant correlated with hull content percent (-0.5971 and -0.5733) at both levels. Oil content percent positively significant correlated with 100 seed weight (0.1709 and 0.1639) at both levels. 100 seed weight positively significant correlated with volume weight (0.5931 and 0.5701) at both levels. Volume weight positively significant correlated with seed yield/plant (0.8393 and 0.7938) at both levels. Head diameter and 100 seed weight were positively associated with each other, and both the characters had significant positive correlation with seed filling percent.100 seed weight showed significant and negative association with hull content percent only however, the association was positive with all other characters.

A comparison of direct and indirect effects of different traits on seed yield revealed that the change in nature and degree of association among the yield components were accompanied by the change in their direct and indirect effects. Path analysis a standardized partial regression, permits separation of correlations into measure of direct and indirect effects. The cause and effect relationship between different pairs of characters is given by the combination of correlations and path analysis. The direct effect of volume weight, 100 seed weight, seed filling percent and head diameter on the seed yield is in conformity with earlier reports (Tecklewold *et al.,* 2000, Dagustu 2002, Nehru and Manjunath 2003 and Rao *et al.,* 2003).

The hull content though had direct negative effect on seed yield, their correlation with yield were positive and significant at genotypic level due to positive indirect effect on seed yield through other associated characters. The plant height showed low positive direct effect on seed yield which is in conformity with the findings of Patil *et al.,* (1996). Oil content showed negative direct effect on seed yield which is in conformity with the results of Rao *et al.,* (2003).

Maximum direct effects of volume weight, 100 seed weight, seed filling percent and head diameter were observed on seed yield. Hence it may be concluded that these traits contributed maximum to higher seed yield compared to other characters, thus simultaneous selection for these characters is expected to improve seed yield in sunflower.

It was concluded that seed filling percentage, test weight, head diameter and volume weight had significant association with each other indicating that simultaneous selection for these traits might brought an improvement in seed yield. The path

coefficient analysis revealed that volume weight followed by 100 seed weight, seed filling percentage and head diameter had direct positive effect on seed yield which could be used as good selection criteria for selecting high yielding genotypes in sunflower.

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