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Correlation and path analysis in sunflower (*Helianthus annus L.*)

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Abstract

A study on genetic correlation and inter-relationship of seed yield and associated characters under irrigated conditions was carried out by using forty eight diverse sunflower genotypes. The correlation studies indicated that genotypic correlation coefficients were higher than phenotypic correlation coefficients for most of the traits. The trait seed yield per plant exhibited highly significant and positive correlation with days to 50 percent flowering, days to maturity, number of leaves per plant, stem girth, head diameter, 100 seed weight, seeds per head, filled seeds per head and harvest index at genotypic and phenotypic levels. On the contrary, it expressed negative and highly significant genotypic and phenotypic association with oil content with seed yield per plant. Path coefficient analysis revealed that head diameter, plant height, days to 50 percent flowering and seeds per head exhibited high and positive direct effects on seed yield per plant, whereas, days to maturity and oil content showed moderate to low positive direct effects.

Keywords: Sunflower, correlation, path co-efficient, yield, yield components

Introduction

Yield is the most economic character in almost all of the crops. Yield is a complex entity and inheritance of yield depends upon a number of characters which are often polygenic in nature and are highly affected by environmental factors. Knowledge of genetic system controlling yield and its components is useful in understanding the prepotency of the parents and thus help to select parents possessing in-built genetic potential. For efficient selection, programme, interrelationship between yield and its components is inevitable and mutual association of plant characters, which is determined by correlation coefficient and is used to find out the degree (strength), mutual relationship between various plant characters and the component character on which selection can be relied upon the genetic improvement of yield. But information on the relative importance of direct and indirect effects of each component characters towards yield is not provided by such studies. Path coefficient is helpful in partitioning the correlation into direct and indirect effects so that relative contribution of each component character to the yield could be assessed. In other words, path analysis measures the direct and indirect contribution of various independent characters on a dependent character. Therefore, the present investigation was undertaken to determine the mutual association among different traits in sunflower and their direct and indirect effects on yield by using path coefficient analysis.

Material and Methods

The experiment was conducted with forty eight diverse genotypes under irrigated condition during *Rabi* 2016-17 at Niger Research Station, Vanarasi, Navsari Agricultural University, Navsari (Gujarat). The material was grown in a randomized block design with three replications. The seeds were sown at 60 cm between rows and 30 cm between plants within the row. The experiment was laid out with one row of 3.6 m length of each genotype surrounded by two guard rows to avoid damage and border effects. Normal crop raised following all recommended cultural practices and plant protection measures. Five plants from each replication were selected at random and observations were recorded on thirteen characters *viz.*, days to 50% flowering, days to maturity, plant height (cm), head diameter (cm), stem girth (cm), number of leaves per plant, leaf area (cm²), seeds per head, filled seeds per head, 100 seed weight (g), oil content (%), harvest index (%) and seed yield per plant (g).

The observation on days to 50% flowering was recorded on plot basis. The mean over replication of each character was subjected to statistical analysis. The genotypic and phenotypic correlations were calculated using the formulae suggested by Fisher and Yates (1967) [3], while the direct and indirect contribution of each character for grain yield was estimated by path co-efficient analysis suggested by Wright (1921) [17].

Results and Discussion

The genotypic and phenotypic correlations for yield and yield components are presented in table 1. The results on correlation coefficients revealed that both genotypic and phenotypic correlations followed the same trend but the genotypic correlations were generally higher than the phenotypic correlations indicating that the phenotypic expression of correlations is reduced under the influence of environment. A perusal of these results revealed that seed yield per plant exhibited highly significant and positive correlation with days to 50 percent flowering, days to maturity, number of leaves per plant, stem girth, head diameter, 100 seed weight, seeds per head, filled seeds per head and harvest index at genotypic and phenotypic levels indicating an increase in seed yield with strong selections of these characters. Therefore, priority should be given to these traits, while making selection for yield improvement. The findings are in agreement with the reports of Godwa (1994) [4], Manjula (1997) [8], Rao *et al.* (2003) [12], Sridhar *et al.* (2005) [14], Machikowa and Saetang (2008) [7], Tyagi and Tyagi (2010) [15], Pandya *et al.* (2015) [10]. Furthermore, it expressed negative and highly significant genotypic and phenotypic association with oil content with seed yield per plant. A negative association between seed yield with oil

content were finding similar Krishna Manjula (1997) [8], Vidhyavathi *et al.* (2005) [16], Habib *et al.* (2007) [5], Arshad *et al.* (2010) [2].

The results of path analysis revealed that the head diameter, plant height, days to 50 percent flowering and seeds per head had strong positive direct effects on seed yield per plant (table 2) this may indicate that direct selection of these characters is likely to be effective in increasing seed yield. Similar results obtained by Nehru and Manjunath (2003) [9], Sridhar *et al.* (2005) [14], Vidhyavathi *et al.* (2005) [16], Arshad *et al.* (2010) [2], Sowmya *et al.* (2010) [13], Kholghi *et al.* (2011) [6], Patil (2011) [11], Neelima *et al.* (2012), Whereas, days to maturity and oil content showed moderate to low positive direct effects. On the contrary, negative and low to negligible direct effects were observed for number of leaves per plant, stem girth, leaf area, 100 seed weight, filled seeds per head and harvest index. The indirect effects of head diameter, plant height, days to 50 percent flowering, seeds per head and days to maturity were higher and positive for most of the characters, which were identified as the most important yield components. These findings suggested that, selection pressure should be given to head diameter, plant height, days to 50 percent flowering and seeds per head would be effective for improvement of seed yield in sunflower.

Table 1: Genotypic (r_g) and phenotypic (r_p) correlation coefficients of different characters in sunflower

Character	C	X ₁	X ₂	X ₃	X ₄	X ₅	X ₆	X ₇	X ₈	X ₉	X ₁₀	X ₁₁	X ₁₂	X ₁₃
X ₁	r_g	1	0.674**	0.078	0.345**	0.039	0.713**	-0.556**	-0.121	0.303**	0.733**	0.808**	0.645**	0.750**
	r_p	1	0.486**	0.098	0.268**	0.039	0.570**	-0.466**	-0.049	0.283**	0.587**	0.654**	0.498**	0.641**
X ₂	r_g		1	-0.106	0.357**	0.031	0.358**	-0.242**	0.119	0.231**	0.352**	0.519**	0.445**	0.408**
	r_p		1	-0.100	0.243**	0.010	0.289**	-0.178*	0.124	0.163*	0.285**	0.371**	0.280**	0.296**
X ₃	r_g			1	0.172*	-0.310**	0.359**	-0.302**	0.091	0.178*	0.389**	0.334**	0.387**	0.383**
	r_p			1	0.084	-0.250**	0.247**	-0.225**	0.035	0.140	0.273**	0.240**	0.225**	0.284**
X ₄	r_g				1	0.374**	0.368**	-0.409**	0.512**	0.089	0.303**	0.326**	0.324**	0.367**
	r_p				1	0.266**	0.267**	-0.347**	0.351**	0.066	0.233**	0.278**	0.272**	0.291**
X ₅	r_g					1	0.012	-0.020	0.557**	0.105	0.031	-0.026	0.077	0.026
	r_p					1	-0.022	-0.015	0.415**	0.103	0.007	-0.029	0.048	0.028
X ₆	r_g						1	-0.789**	-0.186*	0.528**	0.918**	0.926**	0.780**	0.967**
	r_p						1	-0.740	-0.145	0.468**	0.853**	0.840**	0.652**	0.869**
X ₇	r_g							1	-0.034	-0.406**	-0.731**	-0.690**	-0.660**	-0.842**
	r_p							1	-0.032	-0.376**	-0.693**	-0.650**	-0.571**	-0.799**
X ₈	r_g								1	0.136	-0.109	-0.106	0.088	-0.030
	r_p								1	0.094	-0.089	-0.098	0.067	-0.010
X ₉	r_g									1	0.444**	0.494**	0.418**	0.520**
	r_p									1	0.388**	0.450**	0.338**	0.478**
X ₁₀	r_g										1	0.941**	0.752**	0.930**
	r_p										1	0.868**	0.617**	0.855**
X ₁₁	r_g											1	0.738**	0.930**
	r_p											1	0.613**	0.858**
X ₁₂	r_g												1	0.806**
	r_p												1	0.688**
X ₁₃	r_g													1
	r_p													1

*,** Significant at P=5% level and P=1% level

X ₁ = Days to 50% flowering	X ₄ = Stem girth (cm)	X ₇ = Oil content (%)	X ₁₁ = Filled seeds per head
X ₂ = Days to maturity	X ₅ = Leaf area (cm ²)	X ₈ = Plant Height (cm)	X ₁₂ = Harvest index (%)
X ₃ = No. of leaves per plant	X ₆ = Head diameter (cm)	X ₉ = 100 seed weight (g)	X ₁₃ = Seed Yield per plant (g)

Table 2: Path coefficient analysis showing direct and indirect effects of different characters on seed yield per plant of sunflower

Characters	X ₁	X ₂	X ₃	X ₄	X ₅	X ₆	X ₇	X ₈	X ₉	X ₁₀	X ₁₁	X ₁₂
X ₁	0.2766	0.1865	0.0216	0.0954	0.0108	0.1975	-0.1539	-0.0335	0.0841	0.2028	0.2235	0.1785
X ₂	0.0657	0.0975	-0.0104	0.0349	0.0030	0.0350	-0.0236	0.0117	0.0225	0.0344	0.0506	0.0434
X ₃	-0.0031	0.0043	-0.0399	-0.0069	0.0124	-0.0143	0.0121	-0.0036	-0.0071	-0.0156	-0.0133	-0.0155
X ₄	-0.1336	-0.1386	-0.0699	-0.3874	-0.1449	-0.1427	0.1586	-0.1987	-0.0345	-0.1177	-0.1263	-0.1256
X ₅	-0.0087	-0.0069	0.0694	-0.0835	-0.2233	-0.0028	0.0046	-0.1246	-0.0235	-0.0069	0.0060	-0.0172
X ₆	1.2507	0.6286	0.6292	0.6452	0.0223	1.7520	-1.3833	-0.3263	0.9260	1.6084	1.6229	1.3682

X ₇	-0.0059	-0.0026	-0.0032	-0.0044	-0.0002	-0.0084	0.0106	-0.0004	-0.0043	-0.0078	-0.0074	-0.0070
X ₈	-0.0781	0.0772	0.0589	0.3308	0.3599	-0.1202	-0.0223	0.6452	0.0878	-0.0707	-0.0686	0.0574
X ₉	-0.0553	-0.0421	-0.0325	-0.0162	-0.0192	-0.0962	0.0740	-0.0248	-0.1820	-0.0810	-0.0900	-0.0762
X ₁₀	0.1744	0.0839	0.0926	0.0723	0.0074	0.2184	-0.1739	-0.0261	0.1058	0.2378	0.2238	0.1790
X ₁₁	-0.5610	-0.3607	-0.2320	-0.2264	0.0186	-0.6431	0.4794	0.0738	-0.3434	-0.6533	-0.6943	-0.5130
X ₁₂	-0.1713	-0.1183	-0.1028	-0.0861	-0.0205	-0.2073	0.1754	-0.0236	-0.1112	-0.1999	-0.1962	-0.2655
Correlation with SY	0.7502**	0.4088**	0.3839**	0.3677**	0.0263	0.9677**	-0.8422**	-0.0309	0.5201**	0.9306**	0.9307**	0.8064**

*, ** Significant at P =5% and 1% level respectively Residual effect =0.1284 Bold figures show direct effect

X ₁	=	Days to 50% flowering	X ₅	=	Leaf area (cm ²)	X ₉	=	100 seed weight (g)
X ₂	=	Days to maturity	X ₆	=	Head diameter (cm)	X ₁₀	=	Seeds per head
X ₃	=	No. of leaves per plant	X ₇	=	Oil content (%)	X ₁₁	=	Filled seeds per head
X ₄	=	Stem girth (cm)	X ₈	=	Plant height (cm)	X ₁₂	=	Harvest index (%)
SY	=	Seed yield per plant (g)						

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