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Full Length Research Paper

Correlation and path coefficient analyses in sunflower

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Correlation and path coefficient analyses were studied in twenty four diverse genotypes of sunflower in order to understand the relationship and contribution on eight characters towards the grain yield. The yield kg per plant exhibits highly significant and positive correlation with number of seeds per head, head length in diameter and 1000-seed weight at both genotypic and phenotypic level. Path coefficient analysis revealed that number of seeds per head, 1000-seed weight and head length in diameter had the highest and positive direct effect with yield kg per plant. Hence, the study revealed the importance of number of seeds per head, head length in diameter and 1000-seed weight as selection criteria for improvement of yield in sunflower.

Key words: Correlation, path coefficient, genotypes, *Helianthus annuus*, genetic interaction.

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 (Nadarajan and Gunasekaran, 2005). 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 (Singh and Narayanam, 2007). 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 eight selected traits in sunflower and their direct and indirect effects on yield by using path coefficient analysis.

MATERIALS AND METHODS

The materials for the present study consisted of 24 genotypes of sunflower which were introduced from Uttar Pradesh Council of Agriculture Research (UPCAR). Table 1 reveals detailed information about the 24 genotypes used in the present study. The field experiment (3 × 2.4 m) was laid out in randomized block design with three replications at Experimental Center, College of Agriculture, Allahabad Agricultural Institute (Deemed University) Allahabad. Geographically Allahabad Agricultural Institute-Deemed University, Allahabad is situated at 25.35°N latitude, 82.25°E longitude and at an altitude of 78 m above sea level. This region has sub-tropical climate with extreme summer and winter both. During winter season especially in the month of December and January, the temperature drops down as low as 1 - 2°C, while during summer the temperature reaches up to 44 - 46°C. Out of the recommended dose of fertilizers (40:50:40 kg of NPK ha^{-1}), 50% of N and entire dose of P and K were applied at the time of sowing and 2 - 3 seeds were dibbed per hill following a spacing of 60 x 30 cm. After 14 days of sowing, the excess seedlings were thinned out, retaining only one healthy seedling/hill. Five competitive plants were tagged at random in each treatment and in each replication for recording

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Table 1. List of 24 genotypes of sunflower.

S. no	Accession number	Status	Introduced from	Genetic characteristics	S. no	Accession number	Status	Introduction from	*Genetic characteristics*
1	ASF-1	Germplasm	UPCAR	Tall, large head, more number of seed per head and high yielding	13	ASF-13	Germplasm	UPCAR	*Semi-tall, large head, more number of seeds per head and high yielding*
2	ASF-2	Germplasm	UPCAR	Tall, high 1000-seed weight and large leaf area	14	ASF-14	Germplasm	UPCAR	*Semi-dwarf and large head*
3	ASF-3	Germplasm	UPCAR	Semi-dwarf, large head, more no. of seeds per head, large leaf area and high yielding	15	ASF-15	Germplasm	UPCAR	*Tall, more number of leaves and large leaf area*
4	ASF-4	Germplasm	UPCAR	Tall, large head, high 1000-seed weight, Large leaf area, more number of seed per head and high yielding	16	ASF-16	Germplasm	UPCAR	*Semi-tall, large head, high 1000-seed weight and large leaf area*
5	ASF-5	Germplasm	UPCAR	Semi-Tall, Large head, more number of seeds per head and high yielding	17	ASF-17	Germplasm	UPCAR	*Semi-dwarf, large head, more number of seed per head and high yielding*
6	ASF-6	Germplasm	UPCAR	Semi-dwarf, large head and disease resistant	18	ASF-18	Germplasm	UPCAR	*Semi-tall, more no. of Leaves, large leaf area and high 1000-seed weight*
7	ASF-7	Germplasm	UPCAR	Semi-dwarf and high 1000-seed weight	19	ASF-19	Germplasm	UPCAR	*Tall, large head, high 1000-seed weight, large leaf area, more number of seed per head and high yielding*
8	ASF-8	Germplasm	UPCAR	Semi-dwarf, large head, more no. of seeds per head, high 1000-seed weight and high yielding	20	ASF-20	Germplasm	UPCAR	*Semi-tall, large head, more number of seeds per head and high yielding*
9	ASF-9	Germplasm	UPCAR	Semi-tall, large head, high 1000-seed weight and large leaf area	21	ASF-21	Germplasm	UPCAR	*Tall, more number of leaves and large leaf area*
10	ASF-10	Germplasm	UPCAR	Tall, more number of leaves and large leaf area	22	ASF-22	Germplasm	UPCAR	*Semi-dwarf and large head*
11	ASF-11	Germplasm	UPCAR	Tall, more number of leaves, high 1000-seed weight	23	ASF-23	Germplasm	UPCAR	*Semi-dwarf and high 1000-seed weight*
12	*ASF-12*	*Germplasm*	*UPCAR*	*Dwarf, large leaf area, large head and more number of seeds per head*	*24*	*ASF-24*	*Germplasm*	*UPCAR*	*Semi-dwarf and large head*

UPCAR = Uttar Pradesh Council of Agricultural Research, Lucknow.

Table 2. Genotypic and phenotypic correlation coefficient for nine characters in sunflower.

Characters	r	Plant height (cm)	Leaf length (cm)	Leaf breadth	Leaf area (cm^2)	No. of leaves per plant	Head length in diameter	No. of seeds per head	1000-seed weight	Yield kg/ Plant$^-$
Plant height	rg	1.000	0.032	0.482*	0.418*	0.117	0.495*	-0.001	0.097	0.004
	rp	1.000	0.091	0.278	0.252	-0.102	0.286	0.053	-0.059	0.009
Leaf length (cm)	rg			0.435*	0.765**	0.303	-0.068	-0.199	-0.462**	-0.110
	rp			0.178	0.641**	0.111	-0.078	0.051	-0.173	-0.038
Leaf breadth (cm)	rg				0.968**	0.424*	-0.343	-0.585**	0.009	-0.311
	rp				0.750**	0.266	-0.010	-0.321	0.101	-0.154
Leaf area (cm^2)	rg					0.629**	0.192	-0.460*	-0.352	0.245
	rp					0.252	0.054	-0.141	-0.003	0.109
No. of leaves per plant	rg						0.068	-0.311	-0.640**	0.297
	rp						0.064	-0.209	-0.010	-0.195
Head length in diameter	rg							-0.251	-0.031	0.488**
	rp							0.170	0.071	0.749**
No. of seeds per head	rg								-0.195	0.603**
	rp								0.009	0.718**
1000-seed weight	rg									0.643**
	rp									0.423**

*Significant at 5% probability level; **Significant at probability 1% level. rg = genotypic correlation; rp = phenotypic correlation.

detailed observations. The observations were recorded on nine quantitative characters viz., plant height, leaf length, leaf breadth, leaf area (leaf area was worked by using the factor 0.695, Llie and Tonev, 2000), number of leaves per plant, head diameter, number of seeds per head, test weight and yield per plant. Mean values were subjected to different statistical and biometrical analysis. Correlation coefficient at genotypic and phenotypic levels were estimated from the analysis of variance and according to the procedure of Singh and Chaudhary (1977) and path coefficient analysis were done as according to Dewey and Lu (1959).

RESULTS AND DISCUSSION

In the present investigation, the genotypic correlation coefficients in general were higher than the phenotypic correlation coefficients (Table 2). This could be due to relative stability of the genotypes since the majority of them have been subjected to a certain amount of selection. Yieldper plant showed significant and positive correlation with number of seeds per head, head length in diameter and 1000-seed weight at both genotypic and phenotypic level. These findings are in close agreement with those of Jaksimovic et al. (1998), Dagustu (2002) in sunflower. The correlation coefficients between the character plant height with leaf breadth, leaf area and head

Table 3. Direct and indirect effect at genotypic and phenotypic levels of different quantitative characters on yield kg per plant of sunflower (*H. annuus* L.).

Characters	Plant height (cm)	Leaf length (cm)	Leaf breadth (cm)	Leaf area (cm)	No. of leaves per plant	Head length in diameter	No. of seeds per head	1000-seed weight (g)	Genotypic/phenotypic correlation coefficient with yield
Plant height	0.009	-0.001	-0.005	0.001	0.002	0.001	0.001	0.001	0.004
	0.025	-0.001	-0.005	0.003	-0.001	-0.003	0.002	0.001	0.009
Leaf length	0.001	-0.034	-0.005	0.021	-0.005	0.001	-0.007	-0.001	-0.110
	0.002	-0.012	-0.003	0.008	0.001	0.001	0.002	-0.003	-0.038
Leaf breadth	0.004	-0.015	-0.011	0.026	-0.007	0.001	-0.022	0.001	-0.311
	0.007	-0.002	-0.017	0.009	0.002	0.001	-0.010	0.017	-0.154
Leaf area	0.004	-0.026	-0.010	0.027	-0.010	0.001	-0.017	-0.001	0.245
	0.006	-0.007	0.013	0.012	0.002	0.001	-0.004	0.001	0.109
No. of leaves	-0.001	-0.010	-0.005	0.017	-0.016	0.001	-0.012	-0.001	0.297
per plant	-0.003	-0.001	0.005	0.003	0.008	-0.001	-0.007	0.012	-0.195
Head length in	0.004	0.002	0.004	0.005	-0.001	0.202	-0.009	0.291	0.488**
diameter	0.007	0.097	0.215	-0.001	0.001	0.221	-0.005	0.214	0.749**
No. of seeds	0.001	0.007	0.006	0.013	0.005	0.248	0.337	0.001	0.603**
per head	0.001	0.007	0.006	-0.002	-0.002	0.171	0.232	0.305	0.718**
1000-seed	-0.001	0.016	0.001	0.010	0.010	0.233	-0.007	0.392	0.643**
weight	-0.001	0.002	-0.002	0.001	0.001	-0.001	0.208	0.215	0.423*

Residual = 0.0011 (genotypic), residual = 0.0046 (phenotypic), bold number = direct effect.

length in diameter were positively significant. Similar relationship was reported by Singh and Labana (1990). A tall plant supporting many leaves could increase total biomass production through increased carbon fixation, which can ultimately be portioned to reproductive organs. Thus, the total number of internodes, which are the sites of leaf initiation, should remain constant during breeding for short plant type. It was found that at genotypic level, leaf length showed positive and significant correlation with leaf breadth but negative and significant correlation with 1000-seed weight. This trait showed positive and significant correlation with leaf area both at genotypic and phenotypic level. At genotypic and phenotypic level, leaf breadth showed positive and significant correlation with leaf area. This trait showed positive and significant correlation with number of leaves per plant but negative and significant correlation with number of seeds per head at genotypic level. Leaf area showed positive and significant correlation with number of leaves per plant and negative significant correlation with number of seeds per head at genotypic level. Similar observation was also confirmed by Rajan (1976). The genotypic and phenotypic correlation coefficient of yield with its contributing components were portioned into direct and indirect effects through path coefficient analysis (Table 3) in order to formulate a sound basis for selection of the important contributing characters to the yield in sunflower. Thus, the correlation in conjugation with path coefficient can

give a better insight into the cause and effect relationship between the different pairs of characters. Path analysis revealed that all the characters except number of seeds per head, head length in diameter and 1000-seed weight had small positive/negative direct effect on yield per plant. Plant height and leaf area had positive small direct effect on yield per plant, while leaf length, leaf breadth and number of leaves per plant had negative small direct effect on yield per plant. The characters number of seeds per head, head length in diameter and 1000-seed weight exhibited positive and significant association with yield per plant both at genotypic and phenotypic level and on partitioning the correlation, it was observed that these traits showed positive and high direct effect on yield per plant. These results are in agreement with that of Patil et al. (1996); Dagustu (2002). As expected, the number of seeds per head, head length in diameter and 1000-seed weight showed positive and significant association with yield as well as these traits also exhibit positive and high direct effect on yield. Hence, selection for all the above traits would be more effective to bring about simultaneous improvement for yield and other yield components in sunflower.

Conclusion

It is concluded from the present investigation that, yield has positive and significant association with number of seeds per head, head length in diameter and 1000-seed weight at both genotypic and phenotypic level. Path coefficient analysis indicates that number of seeds per head, 1000-seed weight and head length in diameter have maximum positive direct effect with yield. The selection of these traits would be more effective to bring about simultaneous improvement for yield in sunflower.

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