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Research article

ASSOCIATION ANALYSIS IN SUNFLOWER (*Helianthus annuus* L.)

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ABSTRACT: Sunflower is one of the most important annual crops grown for vegetable and industrial oils in the world. Yield is a complex character influenced by several other characters known as yield contributing characters. To understand the association of various characters, a field experiment was conducted with 94 genotypes including three checks to study the genotypic and phenotypic correlation coefficients and path effects of yield attributing traits on grain yield. Grain yield had significant and positive association with head diameter, number filled seeds per head, test weight, plant height, number of leaves per plant, oil content and days to maturity and these are major yield contributing traits to be given selection pressure for improving yield. Path analysis revealed higher magnitude of positive direct effect of number of filled seeds per head followed by test weight and plant height on seed yield.

Key words: Sunflower, Correlations, Path analysis

INTRODUCTION

Sunflower (Helianthus annuus L.) has become an important oil crop in the world with annual production of 20 to 25 million hectares worldwide in the present decade. Its adaptability to a wide range of soil and climatic conditions, which makes its cultivation possible during any part of the year in the tropical and sub tropical regions of the country (Reddy and Kumar, 1996). Sunflower 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. Breeders focus their entire attention in developing sunflower genotypes with higher oil yield. Higher oil yield is an ultimate objective of sunflower researchers. Oil yield is affected by many other plant characteristics. Plant traits like days to 50 % flowering, days to maturity, plant height, 100-seed weight, volume weight per 100 ml and oil content are very important in connection with oil yield. Earlier Fick *et al*., (1974), Skoric *et al*.,(1974), Green (1980) and Joksimovic *et al*., (1999) used simple correlation analysis to study the relationships between oil yield on one side and the other sunflower plant traits on the other side. Before initiating any breeding programme, it is essential to obtain information regarding the interrelationship between various yield attributing characters with seed yield. Knowledge on association between yield and yield components will serve to make simultaneous selection for various characters. The cultivated sunflower emerged as one of the major edible oil seed crops in the world. In sunflower breeding strategies worldwide, attempts are being made to break the yield barrier. The grain yield is a complex character dependent on many component characters. To develop elite genotypes, knowledge on interrelationship among yield and its component characters and direct and indirect contribution towards yield is important. The path coefficient analysis,
which is a standardized partial regression analysis, permits further separation of correlation coefficients to measure direct and indirect effects. Hence, the present study was undertaken to study the association among the seed yield and its component characters and direct and indirect effects of various characters on yield in sunflower.

MATERIALS AND METHODS

The experiment consists of 94 genotypes including three checks were sown in randomized complete block design (RBD) with two replications at agricultural college farm, Hyderabad during *Kharif*, 2007. Each genotype was raised in 5m length with spacing of 60 x 30 cm. Recommended agronomic practices were followed to raise good crop.

Observations were recorded on days to 50% flowering, days to maturity, plant height(cm), number of leaves per plant, head diameter(cm), number of filled seeds per head, number of unfilled seeds per head, test weight(g) and seed yield per plant(g). 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 Al-Jibouri *et al.*, (1958) and Dewey and Lu (1959), respectively.

RESULTS AND DISCUSSION

The analysis of variation revealed highly significant differences among the genotypes for all the characters studied, indicating the existence of considerable genetic variation in the experimental material. Seed yield is a complex character governed by several contributing traits. Hence, it is important to understand the association of different characters with seed yield for enhancing the usefulness of selection criterion to be followed while developing varieties. In the present investigation the genotypic and phenotypic correlations are on par with each other suggesting the less influence of environment (Table 1). Invariably seed yield was positively correlated with head diameter, number filled seeds per head, test weight, plant height, number of leaves per plant, oil content and days to maturity. Non significant positive association of seed yield noticed with days to 50 per cent flowering. However, negative association with number of unfilled seeds per head was observed. Similar findings were reported by Lakshmanaiah(1980) and Tekelwold *et al.*, (2000).

Inter correlation among yield components reveled days to 50% flowering has significant positive association with days to maturity, plant height, number of leaves per plant, oil content, head diameter and test weight. Days to maturity has significant positive association with plant height, number of leaves per plant, oil content, head diameter and test weight. Plant height has significant positive association with number of leaves per plant, head diameter, oil content, test weight and number of filled seeds per head. Number of leaves per plant has significant positive association with head diameter, test weight, number of filled seeds per head and oil content. Head diameter has significant positive association with test weight, number of filled seeds per head and oil content. Number of filled seeds per head has significant positive association with oil content. Test weight has significant positive association with oil content

Table 1 Phenotypic and Genotypic correlations between seed yield and yield components in Sunflower

Character		DF	DM	PH	NL	HD	NFS	NUS	TW	OC	Seed yield/plant
Days to 50% flowering(DF)	P	1.0000	0.9495**	0.6729**	0.4640**	0.2634**	0.0697	0.0882	0.2041	0.4068**	0.1864
	G	1.0000	0.9715**	0.6985**	0.4994**	0.2763**	0.0755	0.0941	0.2134*	0.4203**	0.1973
Days to maturity(DM)	P		1.0000	0.6729**	0.5086**	0.2724**	0.0531	0.1132	0.2570*	0.3850**	0.2231*
	G		1.0000	0.6922**	0.5382**	0.2887**	0.0581	0.1161	0.2641*	0.3955**	0.2224*
Plant height(PH)	P			1.0000	0.5962**	0.5036**	0.3735**	0.0830	0.4182*	0.4799**	0.5891**
	G			1.0000	0.6317**	0.5312**	0.3781**	0.0838	0.4244*	0.4856**	0.5979**
No of leaves per plant(NL)	P				1.0000	0.5261**	0.2356**	0.0303	0.4982**	0.2060*	0.5127**
	G				1.0000	0.5888**	0.2512**	0.0440	0.5196**	0.2145*	0.5406**
Head diameter(HD)	P					1.0000	0.4593**	-0.0352	0.5640**	0.3331*	0.7574**
	G					1.0000	0.4836**	-0.0333	0.6034**	0.3490*	0.7992**
No of filled seeds/head(NFS)	P						1.0000	-0.1188	-0.1364	0.2180*	0.6595**
	G						1.0000	-0.1173	-0.1347	0.2213*	0.6652**
No of unfilled seeds/head(NUS)	P							1.0000	0.0141	-0.0330	-0.0639
	G							1.0000	0.0158	-0.0346	-0.0659
Test weight(TW)	P								1.0000	0.3014**	0.6223**
	G								1.0000	0.3082*	0.6326**
Oil Content(OC)	P									1.0000	0.3777**
	G									1.0000	0.3830**

**** Significant at 1 per cent level, * Significant at 5 per cent level**

The correlation values denote only the nature and degree of association present between the pairs of characters. A dependent character like seed yield is controlled by several mutually associated characters. If correlations between dependent and independent characters arise due to direct effect of character, it reflects a true association between them. Selection can be practiced for such character to improve the dependent character.

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The direct and indirect effects of different yield components on seed yield at phenotypic and genotypic level are presented in Table 2. Among the yield components the highest direct positive effect of number of filled seeds was followed by test weight and plant height was observed on seed yield. Hence, a direct selection criterion should be followed for these traits for improvement of the seed yield. The results are in consonance with earlier reports (Lawrence and Mohmmad, 1993; Suma and virupakshappa, 1994 and Teklewold *et al.*, 2000).

Table 2 Direct (diagnol) and indirect effects of yield contributing characters in sunflower

Character		DF	DM	PH	NL	HD	NFS	NUS	TW	OC	Seed yield/plant
Days to 50% flowering(DF)	P	-0.0302	0.0107	0.0289	-0.0245	0.0030	0.0528	0.0014	0.1500	-0.0056	0.1864
	G	-0.0187	0.0143	0.0244	-0.0329	-0.0078	0.0600	0.0012	0.1672	-0.0106	0.1973
Days to maturity(DM)	P	-0.0287	0.0113	0.0289	-0.0269	0.0031	0.0402	0.0018	0.1888	-0.0053	0.2231*
	G	-0.0179	0.0150	0.0242	-0.0354	-0.0081	0.0462	0.0015	0.2070	-0.0100	0.2224*
Plant height(PH)	P	-0.0203	0.0076	0.0429	-0.0315	0.0057	0.2828	0.0013	0.3072	-0.0066	0.5891**
	G	-0.0131	0.0104	0.0349	-0.0456	-0.0149	0.3008	0.0011	0.3326	-0.0122	0.5979**
No of leaves per plant(NL)	P	-0.0140	0.0057	0.0256	-0.0528	0.0060	0.1784	0.0006	0.3660	-0.0028	0.5127**
	G	-0.0094	0.0081	0.0221	-0.0658	-0.0165	0.1998	0.0006	0.4072	-0.0054	0.5406**
Head diameter(HD)	P	-0.0080	0.0031	0.0216	-0.0278	0.0114	0.3478	-0.0005	0.4144	-0.0046	0.7574**
	G	-0.0052	0.0043	0.0185	-0.0388	-0.0281	0.3847	-0.0004	0.4729	-0.0088	0.7992**
No of filled seeds/head(NFS)	P	-0.0021	0.0006	0.0160	-0.0124	0.0052	0.7573	-0.0018	-0.1002	-0.0030	0.6595**
	G	-0.0014	0.0009	0.0132	-0.0165	-0.0136	0.7954	-0.0015	-0.1056	-0.0056	0.6652**
No of unfilled seeds/head(NUS)	P	-0.0027	0.0013	0.0036	-0.0020	0.0004	-0.0899	0.0155	0.0103	-0.0005	-0.0639
	G	-0.0018	0.0017	0.0029	-0.0029	-0.0009	-0.0933	0.0132	0.0124	-0.0009	-0.0659
Test weight(TW)	P	-0.0062	0.0029	0.0180	-0.0263	0.0064	-0.1033	0.0002	0.7347	-0.0042	0.6223**
	G	-0.0040	0.0040	0.0148	-0.0342	-0.0169	-0.1072	0.0002	0.7837	-0.0078	0.6326**
Oil Content(OC)	P	-0.0123	0.0043	0.0206	-0.0109	0.0038	0.1651	-0.0005	0.2215	-0.0138	0.3777**
	G	-0.0079	0.0059	0.0173	-0.0141	-0.0098	0.1760	-0.0005	0.2415	-0.0252	0.3830**

Residual effect (P) = 0.2145 Residual effect (G) = 0.1522 P=Phenotypic G=Genotypic

Days to maturity showed direct positive effect on seed yield. It is indirectly contributed through plant height, number of filled seeds and test weight. These results are similar with earlier report of Mishra *et al.*, (1985). Head diameter showed direct positive effect (phenotypically) on seed yield. It is similar to earlier findings of Doddamini *et al.*, (1997). In contrast days to 50%flowering showed negative effect. It is similar with results of Ayub khan (2001) and oil content showed negative direct effect on seed yield. Such trends are observed by Niranjana murthy and Shambulingappa(1989).

From this study it can be concluded that number of filled seeds per head, test weight, plant height and head diameter were the major yield contributing traits through which high yielding genotypes of sunflower may be selected.

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