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CORRELATIONS AND PATH COEFFICIENT ANALYSIS FOR SEED YIELD TRAITS IN SUNFLOWER (*Helianthus annuus L.*)

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SUMMARY

Correlation studies revealed that seed yield per plant was highly and significantly associated with number of seeds per head, head diameter, 100-seed weight, filled seed (%), plant height and stem diameter. Path coefficient analysis indicated that number of seeds per head, 100-seed weight and head diameter were most important traits of seed yield per plant.

Key words: Sunflower, correlation coefficient, path coefficient analysis, hybrids.

INTRODUCTION

Seed yield in sunflower is a quantitative character and is largely dependent on its own component characters. Such interdependence of contributory characters, as well as the characters of economic importance often misleads and thus makes correlation coefficient by and large unreliable during selection, more particularly in crop like sunflower, which is highly cross pollinated and heterozygous and envisages enormous variability in succeeding generation. The present study was undertaken to know the causal components of relationship among various traits by using path coefficient analysis. Such an analysis would be of immense practical utility in sunflower breeding programmes.

MATERIAL AND METHOD

The present investigation consisted of a total of 63 genotypes involving 45 F_1 cross hybrids (9 single cross, 18 double cross and 18 three way cross hybrids), their 15 parents and 3 standard checks viz. APSH-11, MSFH-8 and EC 68415C. All these genotypes were grown in 2 rows of 3 m length with spacing 60x30 cm in a randomized block design (R.B.D.) with three replications at the experimental farm of Department of Plant Breeding, CCS Haryana Agricultural University, Hisar during the year 1992-93. All of the recommended practices were followed to raise the crop. Data were recorded on 5 randomly selected plants on the following eleven characters viz. days to flowering, days to 50 percent flowering, maturity (days), plant height (cm), stem diameter (cm), head diameter (cm), unfilled seeds (%), 100-seed weight (g), number of seeds per head, oil content (%) and seed yield per plant (g). The percent oil content of the oven-dried seeds was determined by nuclear magnetic resonance (N.M.R.).

Table 1: Phenotypic, genotypic and environmental correlation for yield and other characters.

Character		Flowering (days)	50% flowering (days)	Maturity (days)	Plant height (cm)	Unfilled seeds (%)	Stem diam. (cm)	Head diam. (cm)	Oil content (%)	100-seed weight (g)	Number of seed/ head	Seed yield/ plant (g)
		1	2	3	4	5	6	7	8	9	10	11
Flowering (days)	P		0.9124**	0.6481**	0.3376**	0.0644	0.4022**	0.2347	0.1012	-0.0803	0.1308	0.0658
	G		0.9692	0.6674	0.4097	0.0698	0.4745	0.2763	0.2055	-0.1156	0.1805	0.0978
	E		0.7592**	0.7541**	0.0925	0.2123	0.0795	0.0554	-0.0341	0.0020	-0.0013	0.0265
50% flowering (days)	P			0.6185**	0.3137**	0.0928	0.4126**	0.2220	0.0978	-0.0814	0.0907	0.0461
	G			0.6203	0.3632	0.0972	0.4618	0.2467	0.1605	-0.1183	0.1189	0.0532
	E			0.6444**	-0.9774**	0.0762	0.1258	0.0891	0.0105	0.0209	0.0002	0.0218
Maturity	P				0.1884	-0.0286	0.3072**	0.2642*	-0.0092	0.0437	0.1306	0.1052
	G				0.2387	-0.1047	0.3756	0.3287	0.0308	0.0483	0.1591	0.1175
	E				0.0019	-0.1644	0.1340	0.1034	-0.0558	0.0349	0.0705	0.0798
Plant height (cm)	P					-0.4034**	0.6060**	0.7225**	0.1194	0.4246**	0.6402**	0.5733**
	G					-0.4491	0.6165	0.7355	0.1918	0.5157	0.7434	0.6571
	E					-0.1018	0.0384	0.1625	-0.0794	-0.0062	0.0669	0.0448
Unfilled seeds (%)	P						-0.2677**	-0.6189**	0.1361	-0.5624**	-0.5640**	-0.5085**
	G						-0.3054	-0.6889	0.1773	-0.7198	-0.7411	-0.6790
	E						0.0249	-0.0804	0.0923	-0.1171	0.0259	0.0978
Stem diameter (cm)	P							0.6207**	0.0760	0.3659**	0.4541**	0.4508**
	G							0.6385	0.1287	0.4455	0.5360	0.5267
	E							0.0507	-0.0738	0.0068	-0.0333	-0.6261**
Head diameter (cm)	P								-0.0285	0.6569**	0.7076**	0.7204**
	G								-0.0878	0.7984	0.8489	0.8392
	E								0.4227**	0.0408	-0.1019	-0.0238
Oil content (%)	P									-0.0285	0.0013	0.0003
	G									-0.0878	-0.0598	0.0090
	E									0.4227**	-0.9317	-0.0135
100-seed weight (g)	P										0.6265**	0.7154**
	G										0.7758	0.9125
	E										0.2538**	0.1973
Number of seeds/head	P											0.9155**
	G											0.9428
	E											0.8334

* Significant at 5%

** Significant at 1%

Correlation coefficients at phenotypic, genotypic and environmental level were calculated according to Johnson et al., (1955) and path coefficient analyses were carried out as per the procedure given by Dewey and Lu (1959).

RESULTS AND DISCUSSION

Seed yield per plant was positively and significantly correlated (Table 1) with the following characters viz. plant height (0.6571**), stem diameter (0.5267**), head diameter (0.8392**), 100 seed weight (0.9125**) and number of seeds per head (0.9428**). However, it was negatively and significantly associated with unfilled seed percentage (-0.6790**) i.e., percentage of filled seed per head is also an important component of seed yield. These results supports the earlier findings of Putt, 1943; Pathak, 1974; Škorić, 1974; Varshney et al., 1977; Alba and Greco 1979; Giriraj et al., 1979; Ivanov et al., 1980; and Marinković, 1992. Contrary to this Alba et al., (1979) reported a negative correlation between seed yield and head diameter and a positive but non-significant correlation between seed yield and 1000 seed weight. Moreover some researchers could not find correlation between seed yield and head diameter (Varshney et al., 1977).

As a matter of fact, the plants with a large number of flowers had a large number of seeds as illustrated by the very high significant positive correlation between seed yield per plant and number of seeds per head (0.9428**). Both 100-seed weight and number of seeds per head were significantly positively associated with plant height, stem diameter and head diameter and between themselves and significantly negatively associated with percentage of unfilled seed. Maturity was positively significantly associated with days to flowering and days to 50 percent flowering. However, oil content was not at all correlated with any of the characters studied, indicating that it is entirely independent of all the characters studied including seed yield. Therefore oil content can be improved along with other seed yield components without any compromise.

Table 2. Analysis of direct and indirect effect of six characters on seed yield per sunflower plant

Character	Direct effect	Indirect effect via						
		Plant height (cm)	Unfilled seed (%)	Stem diameter (cm)	Head diameter (cm)	100-seed weight (g)	Number of seeds/ head	Total
Plant height (cm)	-0.0911	1	-0.0489	0.0019	0.1066	0.0961	0.5086	0.5733
Unfilled seed (%)	0.1212	0.0367	1	-0.0008	-0.0902	-0.1274	-0.4481	-0.5085
Stem diameter (cm)	0.0031	-0.0552	-0.0324	1	0.0916	0.0828	0.3607	0.4507
Head diameter (cm)	0.1476	-0.0658	-0.0740	0.0019	1	0.1486	0.5621	0.7204
100-seed weight (g)	0.2265	-0.0386	-0.0682	0.0011	0.0968	1	0.4977	0.7153
Number of seed/head	0.7944	-0.0583	-0.0683	0.0014	0.1044	0.1419	1	0.9155

Residual effect 0.1166

Since cause and effect relationship could not be established based on phenotypic, genotype and environmental correlations coefficient between the examined yield com-

ponents and seed yield per plant, data were processed for path coefficient analysis which enabled the partitioning of the direct and indirect effects of individual yield components and identification of yield components applicable as selection criteria in sunflower breeding (Table 2).

The study of direct effects on seed yield showed that number of seeds per head had highest direct effect (0.7944) followed by 100-seed weight (0.2265). Similar results were also reported by Alba et al., 1979; Giriraj et al., 1979 and Varshney et al., 1977. Beside this, head diameter also had direct positive effect (0.1476) on seed yield. The other characters positively associated with seed yield on the basis of correlation coefficients

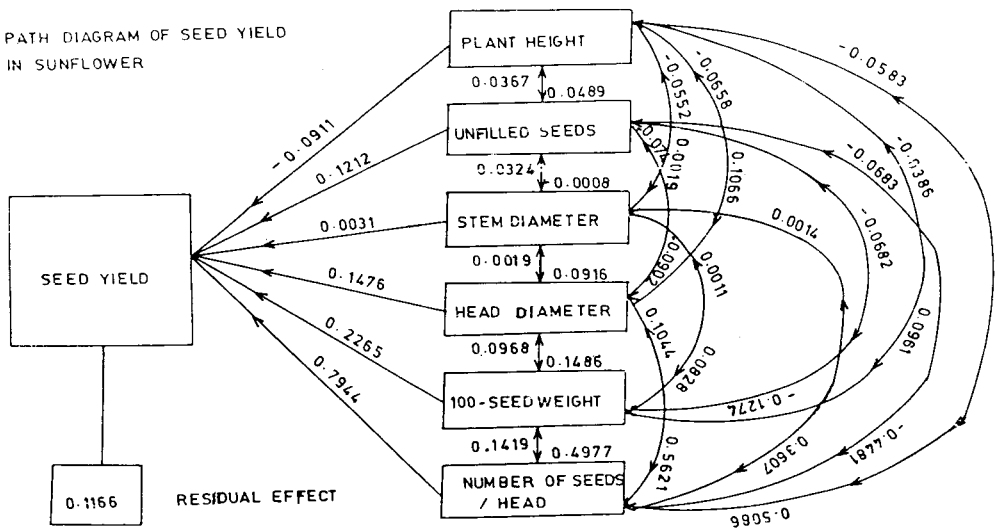

Figure 1. Path diagram of seed yield in sunflower

like plant height, head diameter and stem diameter were found to influence the seed yield indirectly via number of seeds per head and 100-seed weight (Figure 1).

From the ongoing results, it can be concluded that number of seeds per head and 100-seed weight are the main seed yield components. Our results are in accordance with the earlier findings of Singh and Labana, 1990; Visic, 1991 and Marinković, 1992. Hence, these two characters viz. number of seeds per head and 100 seed weight, should get due attention in sunflower breeding programmes along with head diameter, plant height and stem diameter which indirectly contribute to seed yield through the former characters.

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ANALISIS DE CORRELACION Y COEFICIENTES DE SENDERO PARA CARACTERES DE RENDIMIENTO DE SEMILLA EN GIRASOL

RESUMEN

Los estudios de correlación revelaron que el rendimiento de semilla por planta fue alto y significativamente asociado con el número de semillas por planta, diámetro del capítulo, peso de 100 semillas, porcentaje de semilla llena, altura de la planta y diámetro del tallo. El análisis de coeficiente de sendero indicó que el número de semillas por capítulo, el peso de 100 semillas y el diámetro del capítulo fueron los caracteres mas importantes para el rendimiento de semilla de la planta.

CORRELATION ET ANALYSE DU COEFFICIENT DE CORRELATION POUR LES CARACTÉRES RELATIFS AU RENDEMENT EN GRAIN CHEZ LE TOURNESOL

RÉSUMÉ

Des études de correlation rélévent que le rendement en grain par plante est significativement associé au nombre de graines par capitule, au diamétre des capitules, au poids de mille grains, au pourcentage d'akènes remplis, à la hauteur des plantes et au diamétre des tiges. L'analyse du coefficient de corrélation indique que le nombre de graines par capitule, le poids de mille grains et le diamétre du capitule étaient les caractéres les plus importants du rendement en grain par plantes.