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YIELD PERFORMANCE, HERITABILITY AND INTERRELATIONSHIP IN SOME QUANTITATIVE TRAITS IN SUNFLOWER

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SUMMARY

Yield performance, heritability and trait correlation were studied in 20 sunflower genotypes. Hybrid SF-100 produced the highest seed yield of 3669 kg ha^{-1} followed by NK-265 and Gloriasol with 3289 and 3264 kg ha^{-1}, respectively. Heritability (broad sense) values ranged from -5.58% in seed per capitulum to 98.72 for 50% flower. 100-achene weight, 1st flower, complete flowering, maturity, and oil content showed high heritability values of 98.65%, 98.56%, 98.38%, 96.03% and 95.72%, respectively. Seed yield was positively correlated with all traits studied. Path coefficient analysis revealed that first flower had the highest positive direct effect on seed yield followed by seed per capitulum, 100-achene weight complete flower, and head diameter, while 50% flower had the greatest negative direct effect on seed yield.

Key words: yield, heritability, correlation, path coefficient, sunflower

INTRODUCTION

Sunflower (*Helianthus annuus* L.) is a potential oilseed crop that is widely adaptabed and photo-insensitive. Grain yield is the product of several interrelated factors which are highly susceptible to environment fluctuation. Therefore, estimation of yield basised on yield component is of considerable importance. Marinković (1992) reported that correlation coefficients between head diameter, seed $head^{-1}$, 1000-seed weight and seed yield were positive and highly significant. The highest direct positive effects on seed yield were exhibited by 1000-seed weight and head diameter, while oil content had a direct negative effect on seed yield. Singh and Labana (1990) revealed that the seed yield was positively correlated with days to maturity, plant height, head dimeter and 1000-seed weight. Path coefficient analysis indicated that head diameter and 1000-seed weight had the greatest direct effect on seed yield followed by days to maturity and plant height. Khan *et al.* (1983) reported heritability values ranging from 30.62% to 95.55% for seed pod^{-1} and pods $plant^{-1}$ in *Cicer arietinum*. While values for 100-achene weight, and seed yield

were 56.58%, 76.87% and 52.86%, respectively. Seed yield was positively correlated with all characters. Khair *et al.* (1992) reported that broad sense heritabilities were high for head diameter (97.47%), plant height (78.10%), 100-achene weight (76.39%), oil content (74.83%) and seed yield (67.74%). Aslam *et al.* (1992) concluded that pods plant^{-1}, pod height, and days to maturity had negative association as well as direct negative path toward yield in soybean. Khan *et al.* (1992) reported that yield in sunflower was positively correlated with all plant characters *i.e.*, days to maturity, plant height, head size and 100 achene weight, whereas path coefficient analysis revealed that head diameter (0.7281) had the greatest direct effect on seed yield followed by 100 achene weight (0.6295), plant height (0.3422) and days to maturity (0.2834). Sheriff *et al.* (1986) concluded that plant height and head diameter showed highly positive correlations with sunflower seed yield. However, path coefficient analysis showed that head diameter had highest direct effect on seed yield. Lakshmanaiah (1980) and Rao (1983) reported that head diameter and 100 seed weight influnce seed yield both directly and indirectly, whereas days to maturity had the greatest negative direct effect on seed yield. Therefore, the present study was undertaken to assess genetic variation (heritability), correlation, path coefficient analysis and to explore the possibility of selection for high yielding sunflower genotypes.

MATERIALS AND METHODS

The plant materials consisted of 20 sunflower genotypes (AH-Extra, SH-3322, SH-222, SE-187, C-206, IS-3312, SF-100, IS-3107, NK-212, SySun 33, P-6480, NSH-54, NSH-101, NSH-104, NK-265, NSH-160, IS-3107, NSH-45, Agrisol and Gloriasol) of diverse origin (USA, Australia, Yugoslavia, Spain, Italy and France) planted in a RCB design with three replications at Agriculture Research Station (ARS) Mingora Swat during the spring of 1991. Plots were 5 x 2.5 m with inter and intra row space of 75 cm and 20 cm, respectively. Seeds were planted on the top ridges. All plots were grown using standard agronomic practices. At physiological maturity, ten plants were randomly selected from each plot for observation. However, data on 1st flower, 50% flower, complete flower, maturity duration, plant height, head diameter, seed capitulum, 100-achene weight, oil content and seed yield were recorded at the appropriate time. Analysis of variance, broad sense heritability was estimated according to the formula used by Burton and De Vanes (1953). Coefficient of correlation and path coefficient analysis were carried out as described by Steel and Torrie (1960) and Dewey and Lu (1959), respectively.

Table 1: Average and analysis of variance for ten traits in 20 sunflower genotypes at Agriculture Research Station Mingora, Swat

S.V	D.F	Mean Square									
		1st flower	50% flower	Complete flower	Maturity duration	Plant height	Head di-ameter	Seed per capitulum	100-achene weight	Oil content	Seed yield
Repeat	2	3.389	0.50	0.09	0.79	525.51	15.04	114482.4	0.02	0.01	6420422.1
Genotype	19	94.22 **	87.10 **	49.55 **	35.82 **	1572.28 **	19.09 **	45788.7 *	1.54 **	16.28 **	1513911.8 *
Error	38	0.461	0.384	0.271	0.487	188.383	4.187	54342.77	0.007	0.240	764616.57

*significant at $P < 0.05$
**significant at $P < 0.01$

Table 2: Character means, heritability, genotypic coefficient of variation for ten traits of sunflower at Agriculture Research Station Mingora, Swat

Parameter	Means	Heritability	GCV (%)
1st flower (days)	69.61	98.56	0.0803
50% flower (days)	73.00	98.72	0.0736
Complete flower (days)	75.35	98.38	0.0537
Maturity (days)	106.13	96.03	0.0323
Plant height (cm)	203.61	71.00	0.1054
Head diameter (cm)	19.88	54.27	0.1121
Seed per capitulum	1714.21	-5.58	ERR
100-achene weight (g)	5.988	98.65	0.1196
Oil content (%)	40.217	95.72	0.574
Seed yield (kg ha^{-1})	2888.08	24.62	0.1730

Table 3: Correlation coefficient for ten traits in sunflower planted at Agriculture Research Station Mingora, Swat

	50% flower	Complete flower	Maturity duration	Plant height	Head diameter	Seed per capitulum	100-achene weight	Oil content	Seed yield
1st flower	0.997**	0.990**	0.929**	0.826**	0.798**	0.844**	0.768**	0.881**	0.470*
50% flower		0.995**	0.935**	0.818**	0.797**	0.852**	0.778**	0.891**	0.477*
Complete flower			0.961	0.843**	0.815**	0.885**	0.818**	0.921**	0.505*
Maturity duration				0.903**	0.833**	0.942**	0.867**	0.955**	0.592**
Plant height					0.788**	0.887**	0.812**	0.856**	0.618**
Head diameter						0.838**	0.720**	0.746**	0.637**
Seed per capitulum							0.831**	0.92**	0.646**
100-achene weight								0.848**	0.525**
Oil content									0.533**

* Significant at $P < 0.05$, ** Significant at $P < 0.01$

Table 4: Path coefficient analysis showing direct and indirect effects of nine traits on seed yield in sunflower

	1st flower	50% flower	Complete flower	Maturity duration	Plant height	Head diameter	Seed per capitulum	100-achene weight	Oil content	TC
1st flower	(0.67)	-0.836	0.181	0.211	0.056	0.120	0.463	-0.356	-0.627	0.467
50% flower	0.657	(-0.89)	0.247	-0.219	0.056	0.120	0.468	0.361	-0.634	0.166
Complete flower	0.610	-0.800	(0.314)	-0.253	0.057	0.123	0.486	-0.379	-0.656	0.502
Maturity duration	0.603	-0.727	0.795	(-0.304)	0.061	0.126	0.517	-0.402	-0.679	0.99
Plant height	0.515	-0.634	0.215	-0.178	(0.068)	0.119	0.487	-0.377	-0.609	0.606
Head diameter	0.328	-0.258	0.843	-0.086	0.054	(0.151)	0.460	-0.334	-0.531	0.627
Seed per capitulum	0.635	-0.242	0.774	-0.229	0.060	0.127	(0.549)	-0.386	-0.655	0.633
100-achene weight	0.128	-0.918	0.891	-0.131	0.055	0.090	0.456	(0.464)	-0.604	0.522
Oil content	0.882	-0.939	0.262	-0.245	0.058	0.113	0.505	-0.393	(-0.712)	0.533

Residual effect (R) = 0.71
TC= Total correlation with yield

RESULTS AND DISCUSSION

The analysis of variance revealed significant differences among genotypes for all the characters studied at 5% level of probability. Hybrid SF-100 produced highest seed yields of 3669 kg ha^{-1} followed by NK-265, Gloriasol and SF-187 with 3387, 3289 and 3264 kg ha^{-1}, respectively, while IS-3107 produced the lowest seed yield of 1190 kg ha^{-1}. However, the remaining hybrids had yield in the range of 1744 to 3189 kg ha^{-1} (data not shown).

Seeds per capitulum had the lowest heritability value (-5.537) among the parameters studied (Table 2). The highest heritability values of 98.72%, 98.65%, 98.56%, and 98.36% were observed for 50% flowers, 100-achene weight, 1st flower, and complete flowering, respectively. Maturity duration had the next highest heritability value of 96.03%, followed by oil content with 95.72%. Plant height and head diameter had moderate heritability values of 71.00% and 54.27%, respectively. Such variation in heritability was also reported by Khair *et al.* (1992) and Khan *et al.* (1983). However, seed yield had the second lowest heritability estimate. High genotypic coefficient of variation (GCV) and heritability for traits were an indication of additive gene action of these parameters.

Seed yield kg ha^{-1} had a highly significant positive correlation with all parameters studied except complete flower with days to maturity (Table 3). The results are in agreement with the findings of Khan *et al*. (1992) and Sheriff *et al.* (1986).

Path coefficient analysis revealed that first flowering had the highest positive direct effect on seed yield followed by seeds per capitulum, 100-achene weight, complete flower (100%) and head diameter (Table 3), while oil content had highest negative direct influnce (-0.712) with seed yield followed by 50% flower (-0.89) and maturity (-0.304). Similar results head diameter having a strong effect on seed yield were also observed by Khan *et al.* (1992) and Sheriff *et al*. (1986). Moreover, 50% flowering negatively affected seed yield *via* others characters *viz*., maturity and 100-achene weight. Thus this study concluded that complete flowering, 1st flowering, seeds per capitulum, head diameter, and plant height had a significant role in enhancing the seed yield, but a compromise should also be made with other characters because of their indirect effects on seed yield.

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RENDIMIENTO, HEREDABILIDAD Y LAS INTERRELACIONES DE CIERTAS CARACTERISTICAS CUANTITATIVAS DEL GIRASOL

RESUMEN

El rendimiento, la heredabilidad y las interrelaciones de caracteristicas cuantitativas en 20 genotipos de girasol. El hibrido SF-100 es el mas alto rendimiento de 3669 kg ha^{-1}, pues siguen los hibridos NK-265 y Gloriasol con 3289 y 3264 kg ha^{-1}. Los valores de heredabilidad (en el sentido mas amplio) variaban de -5,58% para el numero de semillas por cabeza hasta 98,72 para 50% de florescencia. Las caracteristicas del peso de 100 semillas, el tiempo de aparicion de primera flor, florescencia, madurez y contenido de aceite tenian altos valores de heredabilidad de 98,65%, 98,56%, 98,38%, 96,03% y 95,72%, respectivamente. El rendimiento de semillas era en la correlacion positiva con todas las caracteristicas estudiadas. El analisis de coeficientes de camino mostraron que el tiempo de aparicion de la flor tenia el mas grande efecto directo sobre el rendimiento de semillas, y pues el numero de semillas por cabeza, peso de 100 semillas, tiempo de la florescencia completa y el diametro de la cabeza. El tiempo de hasta 50% de florescencia tenia el mas grande efecto directo negativo sobre el rendimiento de semillas.

RENDEMENT, HÉRIDITÉ ET INTERRELATIONS DE CERTAINS TRAITS QUANTITATIFS DU TOURNESOL

RÉSUMÉ

Le rendement, l'hérédité et les interrelations de certains quantitatifs du tournesol ont été étudiés dans 20 génotypes de tournesol. L'hybride SF-100 a fourni le plus grand rendement avec 3669 kg ha^{-1}, il était suivi des hybrides NK-265 et Gloriasol qui ont fourni 3289 et 3264 kg ha^{-1}. Les valeurs d'hérédité (dans le sens large) variaient de -5.58% à 98.72% pour le nombre de graines par capitule pour 50% de la floraison. Le poids de 100 akènes, le temps de l'apparition de la première fleur, la floraison complète, la maturité et le contenu en huile ont montré des valeurs d'hérédité supérieures de 98.65%, 98.56%, 98.38%, 96.03% et 95.72%. Le rendement en graines était en corrélation positive avec toutes les caractéristiques étudiées. L'analyse du coefficient de l'orbite a montré que le temps de l'apparition de la première fleur avait la plus grande influence positive directe sur le rendement en semences, puis le nombre de graines par capitule, le poids de 100 akènes, le temps de la floraison complète et la diamètre du capitule. La période de 50% de la floraison avait l'influence directe la plus négative sur le rendement en semences.