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RELATIONSHIP OF AUTOGAMY AND SELF FERTILITY WITH SEED YIELD AND YIELD COMPONENTS IN SUNFLOWER (*Helianthus annuus* L.)

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SUMMARY

Interrelations of eight biomorpohological characteristics such as plant height, days to 50 percent flowering, days to maturity, stem girth, head diameter, seed set, 100-seed weight, oil content and their correlations with autogamy, self fertility and seed yield per plant were examined in a study that included 47 genotypes. The head diameter followed by 100-seed weight, plant height and stem girth showed significant positive association with seed yield. The strongest association was with head diameter which was also revealed in the path coefficient analysis with the highest positive direct effect. Autogamy and self fertility showed significant negative correlation with seed yield. Days to 50 percent flowering also showed direct negative effects. The positive effect of plant height was through head diameter. Autogamy also showed highly negative association with important yiled-contributing characters such as head diameter, stem girth, plant height and 100-seed weight suggesting such negative associations are to be broken for achieving high yielding genotypes with high autogamy.

Key words: **Sunflower (*Helianthus annuus* L.), autogamy, self fertility, self compability, correlation, path analysis.**

INTRODUCTION

Yield is an important and extremely complex character which may be regarded as the end product of interrelated attributes. Yield is such a low heritable character that there are no genes as such for yield but it is manifested through indirect selection for one or more of its component characters. The correlation between two yield component characters is not a simple relationship but is rather an interaction of several charactes. The mutual association becomes more and more complex as

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more and more variables are included. In sunflower (*Helianthus annuus* L.), along with high yield, development of superior self compatible hybrids/varieties is also important. Improvement of seed yield together with self fertility can be brought about only by understanding the grain yield and its components through autogamy and self fertility. Therefore, in the present study, association of eight important characters with autogamy, self fertility and seed yield was studied at the phenotypic level. Further, the relative importance of these characters was measured by path coeffecient analysis.

MATERIAL AND METHODS

A total of 47 genotypes involving 11 hybrids, 31 inbreds and 5 populations (Table 1) were grown during the rainy season of 1994 in a randomized complete block design with three replications. Each genotype was grown in two rows of 4.2 m length with a spacing of 60 cm x 30 cm. All the recommended practices were followed to raise the crop.

From each genotype 15 plants per replication were randomly selected for recording observations and imposing treatments. Ten plants were covered with cloth bags soon after first ray florets opened in the capitulum. Remaining 5 plants were left for open pollination. Among 10 bagged heads five were selected for manual self pollination (each morning heads were rubbed through the bag by hand till flowering was completed). The percent seed set, autogamy, (George et al., 1980) and self fertility were determined as given below:

$$\text{Seed set (\%)} = \frac{\text{Number of filled seeds}}{\text{Total seeds}} \times 100$$

$$\text{Autogamy (\%)} = \frac{\text{\% Seed set under autogamous pollination}}{\text{\% Seed set under open pollination}} \times 100$$

$$\text{Self fertility (\%)} = \frac{\text{\% Seed set under manual pollination}}{\text{\% Seed set under open pollination}} \times 100$$

The other quantitative characters such as plant height, days to 50 percent flowering, days to maturity, stem girth, head diameter, seed set, 100-seed weight, oil content, and seed yield were recorded on selected 5 plants left for open pollination.

The phenotypic correlation coefficients were computed accordint to Al Jibouri *et al.*, (1959) and path coefficient analysis was carried out as per the procedure given by De Wey and Lu (1959) to estimate the direct and indirect effects of the yield components on seed yield.

RESULTS AND DISCUSSION

Table 1: List of entries grown during kharif 1994 summer

Sl. No	Hybrid	Inbred	Population
1	BSH-1	RLC-2	EC-68414
2	ISFH-306	DSF-2	1210
3	DSH-1	4546-B	EC-68415
4	DSFH-17	R-274	MODERN
5	DSH-4	R-857	1222
6	DSH-36	NDRLOS-2	
7	DSH-38	IV 83 (NB)	
8	MSFH-1117	234-B	
9	DSH-39	NDROLOS-1	
10	KBSH-1	RLC-4	
11	DSH-11	RLC-1-1	
12		R-265	
13		NDBLOS-4-8	
14		RR-1	
15		822-B	
16		IB-49	
17		NDBLOS-4-1	
18		IB-41	
19		R-298	
20		NDRLOS-6	
21		Br-1-56-89	
22		V-60	
23		M-151	
24		M-150	
25		M-132	
26		M-103	
27		M-161	
28		M-107	
29		M-133	
30		M-129	
31		M-148	

The strongest positive association of seed yield was with head diameter (0.475) followed by plant height (0.451), 100-seed weight (0.409) and stem girth (0.299) (Table 2). These characters also showed positive direct effect on seed yield. Similar observations were also made by Choudhary and Anand, (1993) and Punia and Gill, (1994). As head diameter and 100-seed weight along with plant hight recorded largest direct effects on seed yield, enough weight must be accorded to these charactes in breeding programmes. Autogamy and self fertility percent recorded significant negative association with seed yield. Self fertility also showed a negative and direct

Table 2: Correlation coefficient for different quantitative characters under open pollination during rainy season

	Plant hight (cm)	Days to 50% flowering	Days to maturity	Stem girth (cm)	Head diamater (cm)	Seed set (%)	100 seed weight (g)	Oil content (%)	Autogamy (%)	Self fertility (%)	Seed yeld (g)
Plant height	1.000	0.4239**	0.4315**	0.6209**	0.6781**	-0.2482	0.3818**	0.1046	-0.5899**	-0.4223**	0.4509**
Days to 50% flowering		1.000	0.9451**	0.3606**	0.2746	-0.3238**	-0.1284	-0.3296**	-0.2675	-0.2776**	0.0580
Days to maturity			1.000	0.3081*	0.2746	-0.2520	-0.0732	-0.1989	-0.2644	-0.2952*	0.0801
Stem girth				1.000	0.7307**	-0.0593	0.2675	0.0497	-04340**	-0.3222	0.2985*
Head diameter					1.000	-0.0327	0.5528**	0.2388	-0.4879**	0.2659	0.4746**
Seed set						1.000	0.0988	0.4687**	0.3926**	0.0688	-0.1217
100-seed weight							1.000	0.4345**	-0.2880*	-0.1510	0.4084**
Oil content								1.000	0.1489	0.0052	0.1144
Autogamy									1.000	0.7808**	-0.4415**
Self fertiliti										1.000	-0.3454**
Seed yield											1.000

* and ** - significant at the 0.05 and 0.01 probability level

Table 3: Path cefficient analysis showing direct and indirect effects of 10 quantitative characters on seed yield per plant (g) under open polination during rainy season

	Plant hight (cm)	Days to 50% flowering	Stem girth (cm)	Head diemater (cm)	Seed set (%)	100 seed weight (g)	Oil content (%)	Autogamy (%)	Self fertility (%)	Days to maturity	Correla-tion with seed yield/ plant
Plant height	0.1947	-0.0526	-0.0859	0.2351	0.0248	0.0626	-0.0056	0.0117	0.1021	-0.0125	0.4509
Days to 50% flowering	0.0825	-0.1241	-0.0499	0.0860	0.0323	-0.0211	0.0178	-0.0053	0.0671	-0.0273	0.0580
Stem girth	0.1209	-0.0448	-0.1384	0.2533	0.0059	0.0439	-0.0027	-0.0086	0.0779	-0.0089	0.2985
Head diameter	0.1320	-0.0308	-0.1011	0.3487	0.0033	0.0907	-0.0128	-0.0097	0.0643	-0.0079	0.4746
Seed set	-0.0483	0.0402	0.0082	-0.0113	-0.0999	0.0182	-0.0253	0.0078	-0.0166	0.0073	-0.1217
100-seed weight	0.0743	0.0159	-0.0370	0.1916	-0.0099	0.1640	-0.0234	-0.0057	0.0365	0.0021	0.4084
Oil content	0.0204	0.0409	-0.0069	0.0821	-0.0468	0.0713	-0.0539	0.0029	-0.0013	0.0057	0.1144
Autogamy	-0.1148	0.0332	0.0601	-0.1891	-0.0392	-0.0472	-0.0080	0.0198	-0.1839	0.0076	-0.4415
Self fertiliti	-0.0822	0.0345	0.0446	-0.0922	-0.0069	-0.0246	-0.0003	0.0151	-0.2417	0.0085	-0.3454
Days to maturity	0.0840	-0.1173	-0.0426	0.0952	0.0252	-0.0120	0.0107	-0.0052	0.0711	-0.0289	0.0801

* and ** - significant at the 0.05 and 0.01 probability level

effect on seed yield. There was a significant positive association between atuogamy and self fertility, this suggesting selection for either self fertility or autogamy would be equal. Further, self fertility is also negatively associated with some of the important yield components such as plant height, stem girth and 100-seed weight which have direct positive effect on seed yield. In such situations selection for self fertility or seed yield alone is unlikely to give desirable effect because of undesirable associations of seed yield and self fertility on one hand and self fertility and yield components on the other. Therefore, simultaneous selection for self fertility and seed yield is necessary. In such situations, understanding the association of other characters with seed yield and self fertility is important.

The other characters such as days to 50 percent flowering, days to maturity and oil content did not show any significant association with seed yield. Similarly Punia and Gill (1994) reported no association of oil content and other charactes with seed yield. However, in the present study, oil content showed significant positive association with seed set (0.469) and 100-seed weight (0.435). The oil content had negative direct effect on yield (Table 3) in this study. But, Choudhary and Anand (1993) observed positive association of oil content with seed yield. However, oil content has a positive indirect effect through plant height which has a direct positive effect on seed yield.

From these results it can be concluded thath plants that are tall, with thick stem, larger head size and 100-seed weight are more likely to give higher seed yield. Our results are in accordance with Tyagi (1985), Laksham Rao (1985), Visic (1991), Marinković (1992), Badwal (1993) and Punia and Gill (1994). Hence, 100-seed weight, head diameter and plant height should get due attention in sunflower breeding programmes for higher yield. However, these parameters are negatively associated with self fertility. Hence, breeding high yielding genotypes with high self compatability would be rather difficult. High self fertility coupled with higher yield will be possible if negative associations of self fertility with important yield components are broken. Biparental mating systems and population improvement for both characters simultaneousy through recurrent selection are to be resorted to break such undesirable linkages in sunflower.

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RELACIÓN ENTRE LA AUTOGAMIA Y LA AUTOFERTILIDAD CON EL RENDIMIENTO EN SEMILLA Y COMPONENTES DE RENDIMIENTO EN GIRASOL (*Helianthus annuus* L.)

RESUMEN

La interrelación entre ocho características biomorfológicas tales como altura de la planta, días a 50 por ciento floración, días a maduración, circunferencia del tallo, diámetro del capítulo, llenado de semilla, peso de 100 semillas contenido de aceite y sus correlaciones con autogamia, autofertilidad y rendimiento en semilla por planta fueron examinados en un estudio que incluyó 47 genotipos. El diámetro del capítulo seguido por el peso de 100 semillas, altura de la planta y circunferencia del tallo mostró una asociación positiva significativa con el rendimiento en semilla. La asociación más fuerte fue con el diámetro del capítulo el cual fue también identificado en el análisis del coeficiente de sendero como el del mayor efecto positivo directo. La autogamia y la autofertilidad mostraron una correlación negativa y significativa con el rendimiento en semilla. Los días a 50 por ciento de floración también mostraron una asociación altamente negativa con caracteres importantes que contribuyen al rendimiento tales como diámetro del capítulo, circunferencia del tallo, altura de la planta y peso de 100 semillas sugiriendo que tales asociaciones negativas deben ser rotas para alcanzar genotipos con alto rendimiento y con autogamia.

RELATIONS ENTRE AUTOGAMIE ET AUTOFERTILITÉ AVEC LE RENDEMENT EN GRAINS ET LES COMPOSANTES DU RENDEMENT CHEZ LE TOURNESOL (*Helianthus annuus* L.)

RÉSUMÉ

Les relations entre huit caractères biomorphologiques tels que la hauteur de la plante, le nombre de jours à 50% de floraison, le nombre de jours à maturité, la circonférence de la tige, le diamètre du capitule, le nombre de graines, le poids de 100 graines, la teneur en huile, et leurs corrélations avec l'autogamie, l'autofertilité et le rendement en grains par plante ont été analysées dans une étude comportant 47 génotypes. Le diamètre du capitule puis respectivement le poids de 100 grains, la hauteur de la plante et la circonférence de la tige montrent une relation positive avec le rendement. L'association la plus étroite concerne le diamètre du capitule dont l'analyse par le "Path coeffîcient" révèle l'effet positif direct le plus fort. L'autogamie et l'autofertilité ont présenté des corrélations négatives significatives avec le rendement en grains. Le nombre de jours nécessaires à 50% de floraison est soumis également à des effets négatifs directs. L'effet positif de la taille de la plante est relié au diamètre du capitule. L'autogamie présente aussi une association fortement négative avec les caractéristiques liées au rendement telles que le diamètre du capitule, la circonférence de la tige, la hauteur de la plante et le poids de 100 grains, suggérant que de telles associations négatives doivent être rompues pour l'obtention de génotypes à forte autogamie et a rendement élevé.