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STUDIES ON THE VARIABILITY AND THE CORRELATION BETWEEN YIELD AND ITS COMPONENTS IN SESAME (*Sesamum indicum* L.)

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ABSTRACT

Evaluation of 17 sesame genotypes were carried out at two locations (Mallawi and Shandaweel Research Stations, ARC) in two successive seasons (1998 and 1999). Combined analysis was done for the four experiments for some characters. The results revealed highly significant differences among genotypes, and years for all studied characters. The same trend was observed for locations effect except for number of branches/plant. The first and second interactions were highly significant for all studied characters.

Wide range of genotypic and phenotypic coefficient of variations were noticed in characters. Heritability estimates for plant height, first capsule height and number of branches per plant were high. The expected genetic advance from selection appeared to be effective, these results proved that phenotypic selection may be useful for these characters. Correlation coefficient between seed yield/plant and other characters was positive and highly significant except for first capsule height. Also, the correlations were positive and highly significant between plant height and all yield components. Results indicated that selection for the studied characters resulted in yield improvement.

INTRODUCTION

Sesame (*Sesamum indicum* L.) is one of the important oilseed crops grown in the world as well as in Egypt. Inspite of intensive efforts to increase the productivity of this crop, the total production remains more or less static for the last decade. The prime reason that the yield is a complex polygenic character greatly influenced by environment (Thangavelu and Sridharan, 1988). Hence, selection of superior genotypes based on yield is not likely to be effective. So, information on the variability and character associations are absolutely necessary to formulate an effective breeding strategy (Hexing, 1988). Evaluation is an important and necessary step in the development of improved sesame cultivars. Because of genotype x environment interaction, the evaluation of the promising breeding strains requires repeated testing in both seasons and locations. Also, study of association of important characters with yield over a number of seasons assumes special significance in deciding the basis for identifying the high yielding genotypes (Houli *et al.*, 1961).

The objective of this investigation was to study the genetic variability and the performance of 17 cultivars of sesame at two locations for two seasons. Also, gain information regarding phenotypic and genotypic coefficient of variability, broad sense heritability and genetic advance were estimated. In addition, the correlation between some economic characters were determined. These genetic parameters would give a more dependable information on choice of character for selection.

MATERIALS AND METHODS

This study was carried out at the Agricultural Research Stations, Mallawi and Shandaweel, Agric. Res. Center during 1998 and 1999 seasons. The material used in this study were obtained from the Oil Crop Research Section, FCRI, ARC, composed of 17 cultivars and strains of sesame (*Sesamum indicum* L.) and presented in (Table 2).

A randomized complete block design with four replications was used, plot size was 6 rows, 4 m. long and 50 cm. apart. The recommended distances between hills were 20 cm. After full emergence, the seedlings were singled, and the recommended cultural practices of sesame were adopted throughout the growing season.

The data for the following six important economic characters were collected at maturity on 10 random guarded plants in each plot.

1- Plant height cm.
2- First capsule height cm.
3- Number of branches per plant.
4- Number of capsules per plant.
5- Length of fruiting zone.
6- Seed yield per plant.

Means were compared using the N.L.S.D. test as mentioned by Waller and Duncan (1969). To study the (genotype x environment) interaction a combined analysis of variance was made for each trait over the two years following Cochran and Cox (1957), and Steel and Torrie (1980).

Genetic estimates of the studied characters were calculated using the components of variances from the expected mean square as described by Johnson *et al*. (1955). The genotypic and phenotypic coefficient of variability were estimated according Burton (1952). The heritability coefficient, in the broad sense, was calculated using the formula given by Rasmusson and Glass (1967), while the genetic advance (GA) was estimated according to Fehr (1987). The correlation coefficient were calculated as indicated by Miller *et al*. (1958).

RESULTS AND DISCUSSION

1.Plant height:

The data of combined analysis of variances are presented in (Table 1). The years main effect was highly significant for this character, also highly significantly affected by locations. Data showed highly significant effect for years and locations, this indicates that there were variations in the environmental conditions throughout the experimentation period. There were also highly significant differences among the genotypes. The first and second order interactions were highly significant. The genotype H. 102 recorded the tallest plants 231.8 cm (Table 2). The average of plant height was 197.9 and 206.15 cm. at Mallawi and Shandaweel locations, respectively (Table 3). These results are in agreement with the results obtained by El-Shimy and El-Hifny (1989) and Woldemariam *et al*. (1993).

2.First capsule height:

The data of combined analysis of variances are presented in (Table 1). Highly significant differences were obtained between years, locations and genotypes. The first and second order interactions were highly significant. The genotype Int. 1-A5 showed the lowest height to the first capsule (48.40 cm), while H102 recorded the highest first capsule (101.90 cm) (Table 2). The overall mean of Mallawi was higher (82.46 cm) than that of Shandaweel (76.54 cm) for this character. This could be due to differences in edaphic and climatic conditions prevailing in these locations. These results are coincidence with those reported by El-Shimy and El-Hifny (1989).

3.Number of branches/plant:

The combined analysis of variances are presented in (Table 1). Highly significant differences were obtained between years and genotypes, while insignificant was found between locations. Genotypes x locations and genotypes x years x locations interactions mean squares were highly significant, indicating differences in different years and locations. The highly significant first order interaction indicated that there were changes in the relative rankings or magnitudes of differences among genotypes over locations. The genotype H102-F_{13} followed by Int. 1-A22 recorded the higher number of branches (4.706 and 4.625, respectively) (Table 2). No difference between overall mean of Mallawi and Shandaweel (Table 3). These results are in agreement with those obtained by Osman and Khidir (1974), Solanki and Paliwal (1981) and Abdul-Khader and Nair (1984).

Table (1): Combined analysis of variance and mean squares for the studied characters in sesame after evaluation at two locations in two seasons.

Source ofvariation	d.F.	Mean squares					
		Plant height	First capsule height	No. of branches per plant	No. of capsules per plant	Length of fruiting zone	Seed yield per plant
Years (Y)	1	41802.882**	1629.252**	5.649**	140286.029**	27244.218**	5.868**
Locations (L)	1	4595.309**	2374.756**	0.099	256013.555**	13805.259**	2654.938**
Y x L	1	32780.132**	680.728**	51.018**	139360.978**	24316.558**	2270.442**
Y x L x Rep.	12	213.752**	99.305	1.413**	65.459	82.761	1.242
Genotypes (G)	16	3087.934**	4561.647**	11.575**	6870.331**	2224.445**	28.676**
Y x G	16	811.445**	1145.319**	3.329**	5934.153**	473.432**	58.625**
L x G	16	1795.621**	846.803**	1.744**	9994.380**	1763.506**	45.741**
Y x L x G	16	1575.570**	1038.039**	2.878**	4939.460**	586.485**	40.244**
Error	192	65.662	83.839	0.461	115.239	56.066	3.307

*** = Significant at 0.05 level. ** = Significant at 0.01 level.**

4.Number of capsules/plant:

The results of combined analysis of variance are presented in (Table 1). Highly significant differences were obtained between years, location and genotypes. With respect to the effect of years x locations interaction it showed highly significant differences. The first and second order interactions revealed that the genotypes responded differently from year to year and from location to another.

The genotypes Int. 1-A9, H55 F7 and Int. 289-1 showed the highest number of capsules 144.9, 141.4 and 140.9, respectively (Table 2). The mean of number of capsules/plant of Shandaweel was higher 142.25 than that of Mallawi 80.91 (Table 3). This could be due to differences in both edaphic and climatic conditions prevailing in these locations. These results are in line with those reported by Murugesan *et al*. (1979) and Chandramony and Nayar (1985).

5.Length of fruiting zone:

The combined analysis of variance revealed highly significant differences among years and locations, (Table 1). Highly significant differences among genotypes were also observed. There were highly significant effects due to the interaction of years and locations. Results also showed the important role of each of genotypes x years and genotypes x locations. The second order interaction of genotypes x locations x years were highly significant. It mean that genotypes, locations and years acted dependently on this character. The genotypes Int. 1-A5 and H55 F7 were superior in length of fruiting zone 141.2 and 143.6, respectively (Table 2). The average of length of fruiting zone was 115.45 and 129.70 cm. at Mallawi an Shandaweel locations, respectively (Table 3). The difference between the genotypes may be due to the difference in the genetical make up. These results are in agreement with those obtained by Chandramony and Nayar (1985) and El-Shimy and El-Hifny (1989).

Table (2): Means of agronomical characters for studied genotypes of sesame at two locations in two successive seasons.

No.	C.V.	Plant height	First capsule height	No. of branches per plant	No. of capsules per plant	Length of fruiting zone	Seed yield per plant
1	Giza 32	206.9 CD	83.23 D	3.044 DE	101.90 D	123.6 DE	14.84 DEF
2	H102	231.8 A	101.90 A	3.612 BC	78.64 G	129.9 BC	12.51 H
3	Int. 574	206.9 CD	93.99 C	3.400 CD	88.07 F	113.9 G	15.78 BCDE
4	Int. 1-A_5	189.6 G	48.40 H	1.837 F	113.20 C	141.2 A	16.23 ABCD
5	Int. 1-A_{32}	203.8 CD	76.78 E	3.769 BC	113.70 C	127.0 CD	15.15 CDEF
6	Int. 1-A_9	192.8 FG	58.05 G	1.881 F	144.90 A	134.8 B	14.28 FG
7	Int. 1-A_{22}	197.6 EF	82.88 D	4.625 A	89.89 EF	114.8 G	14.33 FG
8	H 102 F_{15}	168.4 I	47.69 H	3.669 BC	121.00 C	120.7 EF	13.93 FG
9	H 102 F_{46}	210.3 BC	82.42 D	4.106 B	118.10 C	127.9 CD	17.43 A
10	H 46	210.1 BC	85.14 D	3.050 DE	85.11 FG	124.9 CDE	16.32 ABC
11	H53 F_7	183.3 H	67.65 F	3.612 BC	119.40 C	115.6 FG	15.14 CDEF
12	H_{55} F_7	209.6 BC	65.93 F	2.150 F	141.40 A	143.6 A	14.49 EF
13	H 102 F_{13}	213.3 B	98.16 B	4.706 A	133.10 B	115.2 FG	16.56 ABC
14	H 106 F_8	205.2 CD	83.07 D	3.775 BC	113.70 C	122.1 DE	16.68 AB
15	Int. 261	207.2 BCD	91.16 C	3.825 BC	96.92 DE	116.0 FG	14.18 FG
16	H 77	202.9 DE	83.13 D	2.662 E	96.58 DE	119.7 EFG	13.04 GH
17	Int. 289-1	194.8 FG	101.9 A	3.787 BC	140.90 A	92.9 H	15.79 BCDE

Values followed by the same alphabetical letter (s) is (are) insignificant at 0.05 level of probability.

6.Seed yield/plant:

The combined analysis of variances are presented in (Table (1). Highly significant differences were obtained between years. Highly significant differences among locations. The first order interactions revealed that performance of genotypes differ from year to year and from location to location. The second order interaction of genotypes x locations x years were highly significant. These results emphasized that the expression of certain genotype regarding seed yield/plant, would depend on the year and location as well as environmental conditions of growing where all the interaction sources of variation were highly significant (Table 1). The tested genotypes differed highly significantly in this character, the genotypes H102 F46, H106F8 and H108F13 produced the highest seed yield/plant (17.43, 16.68 and 16.56, respectively), while H102 was the lowest genotype in seed yield/plant (21.51), as shown in (Table 2). The highest seed yield/plant was obtained at Shandaweel location 18.22 (Table 3). These results are in agreement with those obtained by Osman and Khidir (1974), Abdul-Khader and Nair (1984) and El-Shimy and El-Hifny (1989).

Table (3): Means of studied agronomical characters at two locations in two successive seasons.

Treatment		Loc. 1 Mallawi	Loc. 2 Shandaweel	Overall mean
Plant height	Season 1	196.5	182.8	189.65
	Season 2	199.3	229.5	214.4
	Overall mean	197.9	206.15	202.025
First capsule height	Season 1	81.59	72.51	77.05
	Season 2	83.32	80.57	81.95
	Overall mean	82.46	76.54	79.50
No. of branches/plant	Season 1	3.691	2.878	3.239
	Season 2	3.113	3.941	3.527
	Overall mean	3.402	3.364	3.383
No. of capsules/plant	Season 1	80.81	96.90	88.86
	Season 2	81.00	187.60	134.30
	Overall mean	80.91	142.25	111.58
Length of fruiting zone	Season 1	114.90	110.20	112.55
	Season 2	116.00	149.20	132.60
	Overall mean	115.45	129.70	122.58
Seed yield/plant	Season 1	14.717	15.187	14.952
	Season 2	9.232	21.259	15.246
	Overall mean	11.975	18.223	15.099

Estimates of phenotypic and genotypic of variability, broad sense heritability and genetic advance:

Estimates of phenotypic and genotypic coefficient of variability (P.C.V. and G.C.V.), heritability (broad sense) and expected genetic advance for the studied characters are given in Table (4). A wide range of phenotypic variation was noticed in characters like plant height, number of branches/plant and seed yield/plant, whereas characters like first capsule height and number of capsule/plant showed comparatively lower range of phenotypic variation. All the studied characters manifested high phenotypic coefficient of variability except plant height. The genotypic coefficient of variability (G.C.V.) for the studied characters ranged between 4.89 and 22.63%. The relatively high genotypic coefficient of variability for number of branches/plant and first capsule height indicated that these characters might be more genotypically predominant and it would be possible to achieve further improvement in them. On the other hand, negative estimate, were obtained for number of capsule and seed yield.

Table (4): Means, genotypic and phenotypic variances, genotypic and phenotypic coefficient of variability (G.C.V. and P.C.V.), heritability and genetic advance for the studied characters.

Characters	Mean	Variance		Coefficient of variability		Herita-bility %	Genetic advance G.A.	R%, genetic Advance %
		Geno-typic	Pheno-typic	Geno-typic	Pheno-typic			
1.Plant height	202.025	128.53	192.997	5.61	6.88	66.6	19.056	9.43
2.First capsule height	79.50	225.473	285.103	18.89	21.24	79.09	27.51	34.60
3.No. of branches/plant	3.383	0.586	0.723	22.63	25.13	81.05	1.42	41.97
4.No. of capsule/plant	111.58	-257.42	429.399	-	18.57	-	-	-
5.Length of fruiting zone	122.58	35.875	139.023	4.89	9.62	25.81	6.27	5.11
6.Seed yield/plant	15.099	-2.215	1.794	-	8.91	-	-	-

The heritability estimates and genetic advance are presented in (Table 4). Plant height, first capsule height and number of branches/plant had higher heritability estimates of 66.6-81.05% indicating that they are less influenced by the environment in contrast to length of fruiting zone. Negative estimates of heritability were observed for No. of capsule/plant and seed yield/plant indicating that they are complex in nature because of they being highly susceptible to environmental influence. Warner (1952) indicated that estimates of heritability (greater than the theoretical limit, i.e., 100%) may be due to several causes: sampling errors, differential responses of the generations to the environments and non-allelic interactions. Also, negative estimates of heritability may be due to differential responses of generations to the environmental effects, or to the small additive portion which may be masked by the environmental effects for such characters. Negative estimates of heritability for number of branches/plant and seed yield/plant was reported by El-Mahdy and Bakheit (1988). For other characters, these results are in agreement with Ibrahim *et al.* (1983b).

Heritability estimates along with genetic gain is more important than heritability alone. In the present investigation, number of branches/plant and first capsule height had higher heritability estimates coupled with high genetic advance as percentage of mean which might be due to additive genetic action. Hence phenotypic selection may be practiced to increase or decrease these characters.

Association among characters:

Estimates of correlation coefficients among some characters are presented in (Table 5). Since high seed yield is an important selection criterion in the improvement of sesame, therefore information on the correlation of seed yield with other characters is useful to determine whether there are any association that could either impede or aid materially in selecting for high seed yield. So in this part an attempt was made to obtained information on the association of seed yield/plant with other characters. Data from (Table 5), showed that correlation between seed yield/plant and each of other characters indicated that the highest positive correlation (0.566) was between yield and No. of capsules/plant followed by length of fruiting zone (0.465), plant height (0.383) and No. of branches/plant (0.208). These results

Table (5): Estimates of correlation coefficient among some economic characters.

Characters	1	2	3	4	5	6
1. First capsule height	-	0.346**	0.565**	-0.210**	-0.294**	-0.023
2. No.of ranches/plant		-	0.300**	0.085	0.018	0.208**
3. Plant height			-	0.210**	0.621**	0.383**
4. No.of capsules/plant				-	0.441**	0.566**
5. length of fru. zone.					-	0.465**
6. Seed yield/plant						-

are in agreement with Angarta (1962), Depral (1967), Sharma and Chauhan (1984), Thangavelu and Sridharan (1988) and El-Shimy and El-Hifny (1989).

Correlation between first capsule height and number of branches/ plant and plant height were positive and high, whereas negative correlation were obtained for other characters. For number of branches/plant positive correlations were detected with other characters, the same trend was also noticed for the correlations between plant height and other characters. For number of capsules/plant correlation coefficient gave high estimate for this character, indicating that seed yield/plant might principally depend on number of capsules/plant, in the present study. These results indicated that the important characters which were positively correlated with seed yield/plant were: number of branches/plant, plant height, number of capsules/plant and length of fruiting zone. These characters should be considered in any program for yield in such materials. Considering G.C.V, heritability, genetic advance and correlation estimates it was observed that selection for plant height, first capsule height and number of branches per plant would result in yield improvement. Selection based on these characters would result in selection of tall plants with more branches, capsules, seeds and higher yield. So, in selection experiments in sesame, greater emphasis should be laid on selection of genotypes with more branches and seeds.

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دراسات على الأختلافات وعلاقات الأرتباط بين المحصول ومكوناته فى السمسم

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أجريت هذه الدراسة فى محطتى ملوى وشندويل خلال المواسم الزراعية 1998 ، 1999 بهدف توضيح الأختلافات الصنفية ودراسة التلازم بين صفات المحصول ومكوناته وزرعت هذه السلالات فى تجربة فى نظام القطاعات الكاملة العشوائية فى أربع مكررات.

أوضحت الدراسة أن الاختلافات الصنفية معنوية لكل الصفات التى تمت دراستها وكذلك تأثير المواسم والمواقع. أظهرت الدراسة أن تأثيرات التفاعل من الدرجة الأولى والثانية لكل الصفات كان معنويا ، وقد كان المكافئ الوراثى والتحسين الوراثى المتوقع عاليا لصفات طول النبات وإرتفاع أول قرن وعدد الفروع لكل نبات.

وأوضحت النتائج أن صفة المحصول موجبة التلازم ومعنوية مع كل الصفات التى تم دراستها ماعدا صفة إرتفاع أول قرن ، وقد تميزت صفات طول النبات وعدد الفروع للنبات بكبر معامل إرتباطها بالمحصول علاوة على كبر معامل التوريث لها مما يمكن من الإعتماد عليها للتراكيب الوراثية للمحصول العالى والإستفادة منها فى برامج الإنتخاب والتربية لتحسين صفة المحصول.