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Phenotypic and Genotypic Variability in a Set of Sesame (*Sesamum indicum* L.) Genotypes

Ismail M. Bedawy# and Naheif E. Mohamed
Agronomy Department, Faculty of Agriculture, Sohag University, Sohag, Egypt.

TOTALLY, 86 sesame (*Sesamum indicum* L.) genotypes were used for the study of phenotypic and genotypic variability in summer seasons of 2015 and 2016. They were differed significantly values for all studied traits in both seasons. The genotypes mean ranged widely around the general mean in the studied traits. 67.4, 40.7, 46.5 and 48.8% of the genotypes were raised than the average for plant height (159.05cm), capsule length (2.56cm), thousand seed weight (3.65g) and seed yield per plant (14.38g). While 51.2% of genotypes were higher than the average of first capsule height, length of fruiting zone and capsules number per plant in the first season. The higher phenotypic values than overall mean observed as 53.5, 51.2, 52.3, 54.7, 40.7, 48.8 and 48.8% for the plant height, the first capsule height, the fruiting zone length, the capsule number per plant, the capsule length, the thousand seed weight and the seed yield per plant in the second year, respectively. Also, high values (>20%) of phenotypic coefficient variations (PCV) and genotypic coefficients of variations (GCV) were recorded in the first capsule height in both seasons. However, moderate values of genetic advance (GA) were observed for the plant height (18.49) in both seasons and (17.52 & 16.94) for the fruiting zone length in the first and second seasons coupled with high heritability. Higher heritability coupled with high genetic advance estimates (>20) were recorded for the first capsule height (26.05 and 25.85) and the capsules number per plant (22.55 and 26.11) in both seasons. This is indicates that these traits controlled by additive gene action and mostly which is very useful for selection efficiency.

Keywords: Sesame (*Sesamum indicum* L.), Genetic variability, Phenotypic coefficient of variation (PCV), Genotypic coefficient of variation (GCV), Heritability.

Introduction

Sesame (*Sesamum indicum* L.) is one of the oldest crops cultivated and widely grown in tropical and subtropical zones from 40°N to 40°S latitude. The cultivated sesame area mostly occurs in the developing countries such as India, Myanmar, China, Sudan and Nigeria (Hassan, 2013 and Hamza & Abd El-Salam, 2015).

In Egypt, there is a big gap between the total production and consumption of edible oils, whereas the self-sufficient is about 10% and 90% imported. Similarly, its plant is characterized by low nitrogen content and water requirements, and seeds are rich in oil seed (50–60%) and some of the essential amino acids such as linoleic acid, which is a source of vitamin E, calcium and phosphorous minerals (Weiss, 2000 and Hamza & Abd El-Salam, 2015). In addition to them, it is being reported that this plant could be grown at the reclaimed soils (Boureima et al., 2016). Despite of all these advantages, the local production of sesame is 45 thousand tonnes, harvested from a small cultivated area of 32 thousand ha (FAOSTAT, 2016). The limited area is due to the low yielding capacity of the plant compared to other crop plants, its susceptibility to diseases, seed shattering, indeterminate growth habit and asynchronous capsule ripening (Ashri, 1998 and Yol & Uzun, 2012). To minimize the edible oil gap, Egypt needs to create a national program for

#Corresponding author email: ismail_bedawy@yahoo.com
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expanding the cultivated sesame area, especially in the reclaimed desert lands. In parallel with a strong breeding program effective for developed high yielding genotypes under the abiotic stress in the reclaimed soil. Herein, Boureima et al. (2016) reported that genetic and breeding improvement efforts in the sesame have been limited, making the results of such efforts slow to emerge. Effective selection criteria and additional genetic information for breeders are insufficient. So would be used effectiveness selection methods in which associated criteria with the sesame yield. Wide information on phenotypic and genotypic variability would be available for a plant breeder. Hika et al. (2015) stated that using the germplasm in the improvement program is considered a great opportunity for the genotype selection of high yielding productivity. The higher PCV rather than the GCV indicates that trait expression is highly affected by environmental effects. Broad sense heritability refers to the percentage of genetic sharing for the trait expressions. Sabiel et al. (2015) found the highest GCV for seed yield and high the heritability for days to flowering (>85%) in their studied genetic variation of sesame. Spandana et al. (2011) found the high PCV and GCV for the seed yield per plant. Also, highly values of the PCV and the GCV were reported by Gidey et al. (2012) for the first capsule height, the seed yield, the number of seeds per capsule and the day to 50% flowering. They also reported the high heritability value for the first capsule height and the days to 50% flowering. Similarly, Mahdy et al. (2005 a and b) were observed high heritability for the plant height, the first capsule height, the days to 50% blooming, the capsules per plant, the capsule length, the seed yield per plant and the thousand seed weight.

The broad sense heritability estimated alone is not reliable, because these estimations values are might be affected by the environmental and plant material changes. Using high broad sense heritability (H_b) coupled with higher genetic advance (GA) is more preferred and helpful in prediction gain under selection due to the additive gene action, reported by El Soury et al. (2016) and Patil & Lokesha (2018). Also, Abate et al. (2015) observed moderate to high genetic advance in the number capsules, biomass and harvest index and the thousand seed weight coupled with the moderate heritability and these traits were controlled by the additive and non-additive genes.

The current investigation aimed to: (1) Study the phenotypic and genotypic variability in the seed yield and related traits of the used sesame genotypes, (2) Identify the traits which highly expressed by genetic rather than the environmental effects and (3) Observe the traits which controlled by the additive gene action for using efficiently selection methods.

Materials and Methods

A population of 6 sesame varieties and 80 sesame lines were used in this study. (Developed in the previous breeding program for high yielding and resistant to wilt diseases (Mahdy et al., 2005 a and b). This experiment was carried out at the Research Farm of Faculty Agric., Sohag University at El-Kawthar during the summer seasons of 2015 and 2016 to study the phenotypic and genotypic variability. A randomized complete block design (RCBD) with 3 replicates was used. Seeds were sown in rows of 4m long, 60cm apart and 20cm between hills within rows (two rows for one genotype). At harvest 20 guarded plants were chosen randomly from each genotype, then the following traits were recorded as average: (1) The plant height (cm), (2) The first capsule height (cm), (3) The fruiting zone length (cm), (4) The capsules number per plant, (5) The capsule length (cm), (6) The thousand seed weight (g) and (7) The seed yield per plant (g).

The recorded data were statistically analyzed in SAS statistical software (SAS ver. 9.2, SAS Institute, 2008). The revised LSD at 5% and 1% significant levels were calculated according to Petersen (1985), for comparing the genotypes mean values of the studied traits. In addition, the parameters for the phenotypic and genotypic variability were calculated according to Burton (1952) and Al-Jibouri et al. (1958) as follow:

1- Genotypic variance (Vg)= (MSg–MSe)/r

where, MSg is the genotype mean square, MSe is the mean square of experimental error and r is the number of replicates.

2- Phenotypic variance (Vp)= Vg+MSe

3- Phenotypic coefficient of variation

$$(PCV)= \sqrt{\frac{Vp}{\bar{x}}} * 100$$

4- Genotypic coefficient of variation

$$(GCV) = \sqrt{\frac{Vg}{\bar{x}}} *100$$

5- Broad sense heritability (H) = (Vg/Vp)*100

6- Genetic Advance (GA) = k*H*$\sqrt{Vp}$

where, k is the intensity of selection (k =2.06 at 5% selection intensity).

7- Genetic advance over mean (GAM) = (GA/ $\bar{x}$)*100

Results and Discussion

Phenotypic parameters

The sesame genotypes differed significantly at 5% and 1% levels in all studied traits in both seasons. Results were indicated that genetic variability is existing among–sesame genotypes in terms of investigated traits (Table 1). So, this variation could be a good chance for improving these traits under selection process. These results are in agreement with those obtained by Saha et al. (2012), Begum et al. (2017), Aye et al. (2018) and Patil & Lokesha (2018). On the other hand, the phenotypic values (Tables 2 & 3 and Fig. 1 & 2) were also ranged widely around the mean values and represented 67.4, 40.7, 46.5 and 48.8% of the genotypes above the average for the plant height, the capsule length, the thousand seed weight and the seed yield per plant, while 51.2% of genotypes were higher than the average for the both of first capsule height, the length of fruiting zoon and the capsules number per plant in the first season, respectively. The higher phenotypic values of the genotypes than overall mean were 53.5, 51.2, 52.3, 54.7, and 40.7% for the plant height, the first capsule height, the fruiting zoon length, the capsules number per plant, the capsule length and 48.8% for the both of thousand seed weight and the seed yield per plant in the second season, respectively. The maximum values of studied traits were observed in the genotypes number 3 (175cm), 9 (86cm), 41 (123.67cm), 40 (161.33capsule), 86 (3.16cm), 34 (4.7g) and 6 (18.31g) for the plant height, the first capsule height, the length of fruiting zoon and the capsules number per plant, the capsule length, the thousand seed weight and the seed yield per plant in the first season, respectively. Furthermore, the genotype number 66 exhibited values above the mean in all studied traits (Tables 2 and 3).

Regarding to the second season, the highest values (178.33cm, 86cm, 124cm, 163.67capsules, 3.17cm, 4.86g and 16.64g) were obtained from the genotypes number 2, 9, 44, 70, 86, 34 and 6 for the plant height, the first capsule height, the fruiting zoon length, the capsules number per plant, the capsule length, the thousand seed weight and the seed yield per plant in the second season, respectively. While the genotypes of number 54 and 66 were exhibited the higher values in all studied characters. These results as similar to those obtained by Hika et al. (2015). They were found highly significant differences intra 64 populations for seed yield and its components and stated that 52 and 40.63% of the populations were higher than the mean of thousand seed weight and the seed yield, respectively.

Genotypic parameters

The phenotypic and genotypic variability plays an important role in sesame breeding program across hybridization and selection (Begum & Dasgupta, 2014; Begum et al., 2017 and Aye et al., 2018). The presented data in Table1 and Fig. 3 show that the PCV and GCV are close together for most studied traits in both seasons, indicating the minimum environmental effects on the genetic expression of studied traits, herein the selection based on phenotypic values will not be so difficult. These results confirmed by Patil & Lokesha (2018). They reported that the PCV was higher than the GCV for the yield and its attributes with low difference interpreted environmental effect which was low and the genetic factors controlling variability in these traits. Results in the Table 1 showed high values of the PCV and the GCV (>20%) were recorded in the first capsule height (25.64 and 25.45cm) and (25.52 and 25.31cm) in the first and second seasons, respectively. The fruiting zone length, the capsules number per plant, the thousand seed weight and the seed yield per plant were moderate (10–20%) values of the PCV and the GCV in both seasons. In the same line, Hika et al. (2015) found moderate values of the PCV and the GCV for the seed yield (18.31 and 18.30%), low values for the plant height (6.27 and 6.14) and the thousand seed weight (11.56 and 7.57%). Similar results were obtained by Khan et al. (2007). They concluded that maximum percentage of the GCV and the PCV (33.58% and 34.26%) were observed for the seed yield per m^2 followed by 26.80% and 29.17% for the seed yield per plant. On the other hand, low values of the PCV and the GCV (<10%) were found with the plant height and the capsule length in both seasons (Table 1). This means that these traits are highly affected by environmental conditions. These results are in line with those obtained by Shekhawat et al. (2013), Bharathi et al. (2014), Aristya et al. (2017) and Saxena & Bisen (2017). Broad sense heritability is significant to the breeding programs, in regards to the percentage of genetic expressing the character phenotype. In the current study, Heritability in broad sense estimations (Table 1) were high for all studied traits and ranged from 87.58 % for capsules number per plant to 98.5% for the first capsule height and from 89.24% for the fruiting zone length to 98.43% for the first capsule height in the first and second seasons, respectively. This indicates that small contribution of the environment in the phenotype expression. These results are in agreement with those obtained by Hika et al. (2015). They found that broad sense heritability values were more than 80% for all traits except the thousand seed weight (45.13%). The highest heritability percentages (91.40, 88.70 and 86.20%) were recorded for the seed yield per plant, the plant height and the capsules number per plant, respectively (Begum et al., 2017). Also, Khan et al. (2007) observed the low difference among the GCV and the PCV and coupled with high broad sense heritability for all the characters in their study. They added that selection would be effective for the yield and its components.

TABLE 1. Analysis of variance, means, ranges, phenotypic (PCV), genotypic (GCV) coefficients of variation and heritability in a broad sense (H) for examined traits.

Item		Plant height (cm)	First capsule height (cm)	Fruiting zone length (cm)	Capsules per plant	Capsule length (cm)	Thousand seed weight (g)	Seed yield/ plant (g)
S.O.V	**DF**	**Mean square at 2015 season**						
Replication	2	33.878*	5.236	0.457	59.468	0.0015	0.0382	0.239
Genotypes	85	269.37**	494.33**	254.18**	466.74**	0.0518**	0.262**	9.365**
Error	170	7.37	3.746	10.14	30.884	0.00179	0.0113	0.532
Mean		159.05	61.54	97.51	137.05	2.56	3.65	14.38
Range		128-175	28.67 - 86	80.67 - 123.67	107.3-161.33	2.34-3.16	2.98-4.7	10.98-18.31
PCV		7.40	25.64	11.79	11.51	6.40	10.12	15.46
GCV		7.20	25.45	11.33	10.77	6.18	9.69	14.61
H		94.67	98.50	92.33	87.59	93.32	91.73	89.25
GA		18.49	26.05	17.52	22.55	0.25	0.56	3.25
GAM		11.62	42.32	17.97	16.45	9.87	15.30	22.61
		Moderate	High	Moderate	Moderate	Low	Moderate	High
S.O.V	**DF**	**Mean square at 2016 season**						
Replication	2	2.794	5.306	0.399	14.84	0.0012	0.00108	0.473
Genotypes	85	283.637**	487.61**	254.022**	559.35**	0.0526**	0.25031**	10.99**
Error	170	11.445	3.86	14.442	21.045	0.00102	0.01111	0.551
Mean		160.50	61.44	99.07	138.05	2.57	3.68	14.76
Range		128-178.33	28.67-86	80-124	103.33-163.67	2.37-3.17	2.99-4.86	11.12-18.94
PCV		7.57	25.52	11.70	12.34	6.37	9.81	16.27
GCV		7.27	25.31	11.05	11.88	6.25	9.39	15.48
H		92.24	98.43	89.24	92.75	96.20	91.50	90.45
GA		18.49	25.85	16.94	26.11	0.26	0.54	3.57
GAM		11.52	42.08	17.10	18.91	10.21	14.79	24.19
		Moderate	High	Moderate	Moderate	Moderate	Moderate	High

DF: Degrees of freedom; *,** Significant and highly significant, respectively; GA: Genetic advance and GAM: Genetic advance over mean.

TABLE 2. Means of studied traits for the 86 sesame genotypes in 2015 season.

Genotype No.	Code	Plant height (cm)	First capsule height (cm)	Fruiting zone length (cm)	Number of capsules per plant	Capsule length (cm)	Thousand seed weight (g)	Seed yield (g)
1	1_1_1	171.83	67.67	104.17	139.67	2.37	3.53	13.24
2	1_1_2	169.00	69.67	99.33	139.67	2.48	3.51	13.99
3	5_1_1	175.33	76.67	98.67	142.00	2.46	3.47	16.47
4	5_1_2	170.67	77.00	93.67	141.00	2.65	3.40	16.58
5	9_1_1	173.33	76.33	97.00	154.67	2.63	3.71	16.61
6	9_1_2	171.33	75.00	96.33	160.33	2.57	3.85	18.31
7	9_2_1	167.33	79.67	87.67	139.33	2.50	4.25	13.59
8	9_2_2	168.00	80.00	88.00	136.00	2.51	3.95	14.22
9	10_1	167.33	86.00	81.33	134.67	2.52	3.63	15.41
10	10_2	166.33	84.00	82.33	132.67	2.57	3.93	15.16
11	11_2_1	165.33	73.67	91.67	159.67	2.45	3.64	16.69
12	11_2_2	162.33	75.00	87.33	157.00	2.44	4.14	16.75
13	266_1	157.67	64.33	93.33	145.33	2.35	3.80	14.86
14	266_2	155.33	62.67	92.67	143.33	2.38	3.96	14.86
15	216_1	158.00	61.67	96.33	142.33	2.46	3.79	14.62
16	216_2	158.33	64.33	94.00	142.33	2.39	3.60	15.37
17	257_1	152.67	56.67	96.00	133.33	2.38	3.40	11.23
18	257_2	160.33	58.67	101.67	131.33	2.61	3.70	12.59
19	44_1	169.00	64.67	104.33	124.00	2.50	3.30	12.65
20	44_2	170.33	70.67	99.67	128.00	2.43	3.16	12.44
21	34_2_1	170.67	72.33	98.33	138.33	2.63	3.16	15.91
22	34_2_2	173.00	70.67	102.33	137.67	2.68	3.06	15.70
23	59_1_1	154.67	46.00	108.67	137.00	2.57	4.05	14.43
24	59_1_2	158.00	52.00	106.00	137.00	2.63	3.43	13.69
25	110_12_1	154.67	60.67	94.00	114.00	2.60	3.49	12.48
26	110_12_2	152.67	59.00	93.67	136.33	2.77	3.54	12.22
27	58_3_1	145.67	60.67	85.00	135.67	2.53	3.02	13.49
28	58_3_2	151.67	56.33	95.33	135.67	2.68	3.41	14.41
29	58_1	158.33	55.67	102.67	146.00	2.75	3.87	17.37
30	58_2	157.67	60.00	97.67	147.00	2.68	3.90	16.99
31	167_1_1	153.00	40.67	112.33	120.33	2.48	3.52	12.13
32	167_1_2	160.00	43.00	117.00	121.00	2.37	3.72	12.59
33	148_1	148.67	48.33	100.33	140.33	2.53	4.02	16.93
34	148_2	154.33	48.67	105.67	143.67	2.69	4.70	16.92
35	65_1	141.33	38.67	102.67	117.00	2.61	4.14	12.68
36	65_2	149.00	45.00	104.00	117.33	2.48	3.70	13.23
37	76_1	166.33	79.00	87.33	139.33	2.49	3.77	14.68
38	76_2	165.33	83.67	81.67	138.33	2.43	3.63	14.79
39	1_1	155.00	54.67	100.33	155.67	2.55	2.99	16.55
40	1_2	157.67	53.00	104.67	161.33	2.54	3.28	17.24
41	2_4_1	161.67	38.00	123.67	142.67	2.47	3.35	15.24
42	2_4_2	159.67	44.33	115.33	143.33	2.49	3.47	12.21
43	3_1	172.67	53.67	119.00	137.00	2.49	3.68	14.14
44	3_2	168.00	46.67	121.33	140.67	2.47	3.82	13.52

TABLE 2. Cont.

Genotype No.	Code	Plant height (cm)	First capsule height (cm)	Fruiting zone length (cm)	Number of capsules per plant	Capsule length (cm)	Thousand seed weight (g)	Seed yield (g)
45	58_1	163.00	75.33	87.67	142.00	2.53	3.57	14.30
46	58_2	162.33	71.33	91.00	145.67	2.54	3.39	13.93
47	125_1	149.67	39.67	110.00	125.00	2.53	3.41	11.56
48	125_2	153.33	45.33	108.00	124.33	2.52	3.53	12.13
49	133_1	168.00	82.00	86.00	151.00	2.41	3.19	16.96
50	133_2	164.33	81.33	83.00	152.67	2.49	3.40	15.96
51	2_1_1	159.33	59.67	99.67	129.67	2.46	3.33	10.98
52	2_1_2	161.00	60.33	100.67	128.33	2.39	3.52	13.00
53	11_1_1	160.00	68.00	92.00	146.33	2.56	3.92	15.93
54	11_1_2	164.67	67.33	97.33	148.00	2.60	3.79	16.59
55	9_1_1	162.00	60.67	101.33	135.33	2.61	3.69	13.28
56	9_1_2	162.00	62.00	100.00	132.00	2.56	3.67	15.40
57	15_1_1	165.67	59.33	106.33	129.33	2.51	3.74	13.74
58	15_1_2	162.67	59.67	103.00	129.33	2.61	3.98	11.85
59	259_1	162.67	70.00	92.67	119.67	2.59	3.81	11.86
60	259_2	166.33	70.33	96.00	127.00	2.65	3.68	13.03
61	10_1	157.67	65.33	92.33	142.33	2.55	3.46	14.45
62	10_2	160.33	60.00	100.33	142.00	2.52	3.53	12.97
63	17_2_1	158.00	72.00	86.00	140.33	2.66	3.95	12.57
64	17_2_2	162.00	72.00	90.00	143.67	2.67	4.15	13.82
65	20_1	167.67	63.00	104.67	153.00	2.52	3.74	16.59
66	20_2	170.33	64.67	105.67	156.67	2.60	4.02	15.75
67	23_1	156.33	53.00	103.33	151.67	2.49	3.53	17.37
68	23_2	155.00	51.33	103.67	153.00	2.39	3.46	17.37
69	63_1	165.67	67.33	98.33	155.67	2.54	3.73	15.59
70	63_2	167.33	71.67	95.67	158.00	2.57	3.62	15.15
71	90_1	153.67	66.67	87.00	112.33	2.80	3.77	13.15
72	90_2	152.67	63.00	89.67	110.67	2.76	3.94	13.86
73	124_1	146.33	45.67	100.67	129.33	2.61	3.45	15.89
74	124_2	141.33	45.67	95.67	133.67	2.53	3.65	14.74
75	126_1	147.00	46.67	100.33	147.00	2.48	3.77	15.83
76	126_2	149.00	47.33	101.67	146.33	2.56	3.61	15.28
77	169_1	158.00	77.33	80.67	122.33	2.59	3.49	12.01
78	169_2	158.00	74.67	83.33	126.33	2.55	3.64	12.08
79	55_2_1	164.67	66.33	98.33	133.33	2.75	3.34	14.26
80	55_2_2	168.00	67.33	100.67	127.33	2.65	3.47	14.85
81	Intr. No. 153515	143.67	56.00	87.67	125.67	2.43	3.55	13.25
82	Intr. No. 158071	143.67	60.33	83.33	128.67	2.70	3.61	11.68
83	Giza25	143.67	57.67	86.00	127.00	2.72	3.72	12.97
84	Giza32	141.67	50.00	91.67	129.00	2.50	3.58	12.67
85	Shandweil3	128.00	31.67	96.33	107.33	3.01	4.04	13.54
86	Toshka1	132.00	28.67	103.33	108.67	3.17	4.31	13.72
	$RLSD_{.05}$	6.68	4.76	7.97	14.38	0.104	0.266	1.89
	$RLSD_{.01}$	8.64	6.16	10.40	18.78	0.135	0.347	2.47

RLSD.05 and RLSD.01, Revised L.S.D at 0.05 and 0.01, respectively.

TABLE 3. Means of studied traits for the 86 sesame genotypes in 2016 season.

Genotype No.	Code	Plant height (cm)	First capsule height (cm)	Fruiting zone length (cm)	Number of capsules per plant	Capsule length (cm)	Thousand seed weight (g)	Seed yield (g)
1	1_1_1	175.33	65.67	109.67	146.00	2.39	3.54	13.00
2	1_1_2	178.33	67.67	110.67	145.67	2.50	3.50	15.28
3	5_1_1	178.00	74.33	103.67	148.00	2.47	3.61	16.34
4	5_1_2	173.67	74.33	99.33	148.00	2.63	3.47	15.87
5	9_1_1	174.67	76.33	98.33	153.67	2.65	3.86	16.78
6	9_1_2	173.33	75.00	98.33	158.00	2.59	3.75	18.94
7	9_2_1	167.67	79.67	88.00	141.33	2.52	4.22	13.17
8	9_2_2	168.33	80.00	88.33	138.67	2.52	3.87	14.98
9	10_1	168.00	86.00	82.00	140.33	2.53	3.76	15.62
10	10_2	169.67	84.00	85.67	132.33	2.57	3.88	16.11
11	11_2_1	167.33	73.67	93.67	161.00	2.49	3.83	16.58
12	11_2_2	166.00	75.00	91.00	162.67	2.46	4.23	17.58
13	266_1	156.67	64.33	92.33	152.33	2.37	3.87	15.82
14	266_2	156.67	62.67	94.00	149.67	2.40	3.95	15.06
15	216_1	159.67	61.67	98.00	146.00	2.45	3.92	15.34
16	216_2	160.67	64.33	96.33	148.33	2.42	3.71	15.63
17	257_1	156.33	56.67	99.67	138.67	2.40	3.52	11.79
18	257_2	162.00	58.67	103.33	128.67	2.59	3.66	12.37
19	44_1	170.67	64.67	106.00	126.00	2.49	3.37	12.91
20	44_2	171.67	70.67	101.00	123.67	2.41	3.23	13.09
21	34_2_1	171.33	72.33	99.00	137.00	2.65	3.19	16.95
22	34_2_2	173.67	70.67	103.00	139.33	2.69	3.13	16.35
23	59_1_1	158.33	46.00	112.33	139.00	2.58	4.01	14.49
24	59_1_2	158.67	52.00	106.67	139.67	2.65	3.51	14.67
25	110_12_1	155.00	60.67	94.33	107.33	2.62	3.61	12.40
26	110_12_2	155.33	59.00	96.33	129.33	2.77	3.60	12.03
27	58_3_1	148.00	60.67	87.33	138.00	2.57	3.11	14.13
28	58_3_2	153.67	56.33	97.33	141.33	2.70	3.34	14.25
29	58_1	160.67	55.67	105.00	143.67	2.76	3.88	17.62
30	58_2	158.00	60.00	98.00	140.67	2.71	3.91	17.41
31	167_1_1	154.33	40.67	113.67	122.00	2.46	3.46	11.78
32	167_1_2	160.67	43.00	117.67	119.00	2.41	3.65	12.31
33	148_1	151.00	48.33	102.67	146.67	2.55	4.19	18.04
34	148_2	154.67	48.67	106.00	151.33	2.70	4.87	16.98
35	65_1	141.67	38.67	103.00	112.67	2.59	4.12	12.90
36	65_2	152.33	45.00	107.33	115.00	2.50	3.76	12.28
37	76_1	167.33	79.00	88.33	144.67	2.47	3.84	14.71
38	76_2	166.33	83.67	82.67	142.33	2.44	3.73	15.79
39	1_1	155.67	54.67	101.00	153.00	2.56	2.99	17.53
40	1_2	159.00	53.00	106.00	155.67	2.55	3.43	17.12
41	2_4_1	161.67	38.00	123.67	138.00	2.49	3.37	14.85
42	2_4_2	159.67	44.33	115.33	138.00	2.51	3.48	13.03
43	3_1	173.33	53.67	119.67	133.67	2.50	3.73	14.84
44	3_2	170.67	46.67	124.00	134.67	2.49	3.79	14.48

TABLE 3. Cont.

Genotype No.	Code	Plant height (cm)	The first capsule heigh (cm)	Fruiting zone length (cm)	Number of capsules per plant	Capsule length (cm)	Thousand seed weight (g)	Seed yield (g)
45	58_1	162.33	75.33	87.00	141.00	2.56	3.60	14.65
46	58_2	161.33	71.33	90.00	139.67	2.55	3.37	14.64
47	125_1	150.00	39.67	110.33	126.33	2.53	3.46	11.13
48	125_2	155.00	45.33	109.67	125.67	2.53	3.58	12.35
49	133_1	170.00	82.00	88.00	154.00	2.44	3.19	17.65
50	133_2	167.67	81.33	86.33	155.33	2.49	3.52	16.54
51	2_1_1	160.67	59.67	101.00	121.67	2.45	3.34	11.21
52	2_1_2	160.33	60.33	100.00	123.00	2.40	3.57	12.91
53	11_1_1	163.33	68.00	95.33	149.33	2.57	3.91	16.85
54	11_1_2	166.67	67.33	99.33	149.00	2.60	3.79	17.18
55	9_1_1	162.33	60.67	101.67	137.67	2.59	3.70	14.33
56	9_1_2	163.00	62.00	101.00	140.00	2.55	3.73	15.64
57	15_1_1	164.33	59.33	105.00	126.33	2.54	3.75	14.55
58	15_1_2	165.00	59.67	105.33	127.00	2.61	3.92	11.87
59	259_1	164.00	70.00	94.00	126.67	2.62	3.85	12.05
60	259_2	168.00	70.33	97.67	134.00	2.67	3.66	13.25
61	10_1	160.00	65.33	94.67	138.33	2.55	3.58	14.48
62	10_2	163.33	60.00	103.33	140.67	2.53	3.53	13.94
63	17_2_1	159.00	72.00	87.00	147.33	2.69	3.94	12.92
64	17_2_2	164.00	72.00	92.00	148.67	2.70	4.04	13.99
65	20_1	168.67	63.00	105.67	155.00	2.55	3.76	16.93
66	20_2	171.00	64.67	106.33	158.67	2.60	4.02	16.35
67	23_1	157.33	53.00	104.33	150.33	2.47	3.58	17.96
68	23_2	155.33	51.33	104.00	150.67	2.41	3.46	18.35
69	63_1	167.67	67.33	100.33	161.00	2.57	3.75	15.88
70	63_2	164.33	71.67	92.67	163.67	2.59	3.62	15.98
71	90_1	155.00	66.67	88.33	106.67	2.82	3.81	13.00
72	90_2	153.67	63.00	90.67	103.33	2.80	3.94	13.14
73	124_1	148.33	45.67	102.67	130.67	2.62	3.53	15.98
74	124_2	143.33	45.67	97.67	131.33	2.56	3.70	15.56
75	126_1	148.67	46.67	102.00	150.00	2.49	3.80	15.55
76	126_2	152.33	47.33	105.00	148.33	2.53	3.62	16.75
77	169_1	157.33	77.33	80.00	129.67	2.60	3.47	13.02
78	169_2	160.33	74.67	85.67	127.67	2.58	3.63	12.38
79	55_2_1	167.00	66.33	100.67	133.33	2.76	3.35	13.88
80	55_2_2	167.00	67.33	99.67	124.67	2.66	3.44	15.77
81	Intr. No. 153515	144.33	56.00	88.33	122.67	2.43	3.60	12.93
82	Intr. No. 158071	149.67	60.33	89.33	135.33	2.71	3.60	12.12
83	Giza25	145.67	57.67	88.00	129.67	2.73	3.75	13.67
84	Giza32	143.67	50.00	93.67	132.33	2.50	3.66	13.63
85	Shandweil3	128.67	31.67	97.00	111.00	3.05	4.12	14.63
86	Toshka1	128.00	28.67	99.33	113.67	3.18	4.15	14.78
	$RLSD_{.05}$	8.47	4.83	9.51	11.48	0.079	0.264	1.92
	$RLSD_{.01}$	11.05	6.25	12.84	14.99	0.102	0.344	2.51

RLSD.05, RLSD.01, Revised L.S.D at 0.05 and 0.01, respectively

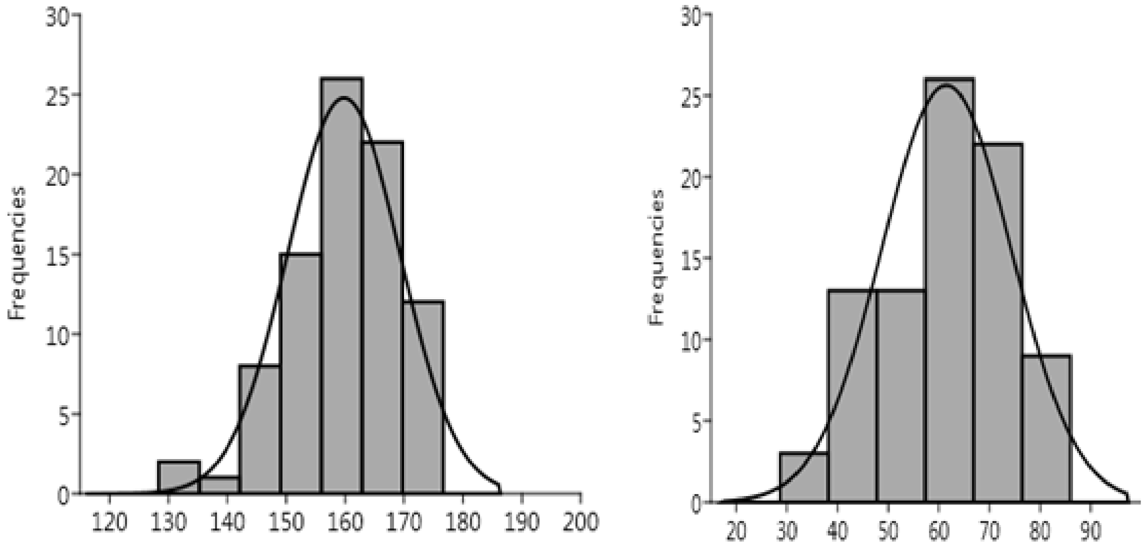

Fig. 1. Frequency distribution of sesame lines means over two years for (on the left) the plant height (cm) and (on the right) the first capsule height (cm).

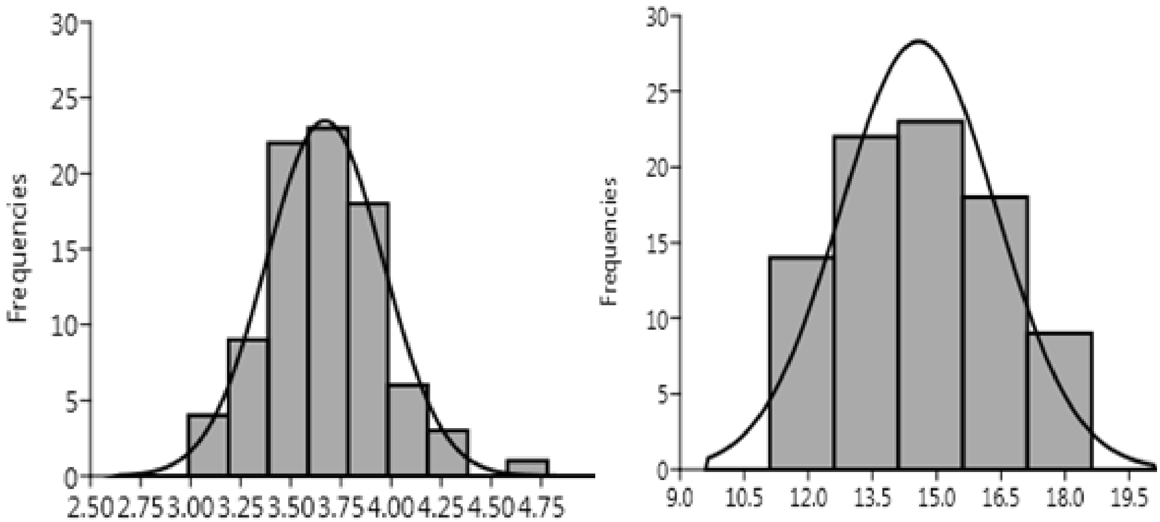

Fig. 2. Frequency distribution of sesame lines means over two years for (on the left) the thousand seeds weight (g) and (on the right) the seed yield per plant (g).

The heritability estimated in broad sense solo is not reliable, because these estimations values are might be altered with any changes of environment and plant materials. Patil & Lokesha (2018) said that using high broad sense heritability coupled with higher genetic advance is more preferred and helpful in prediction gain under the selection.

The data in the Table 1 represent a low genetic advance for the capsule length (0.25 and 0.26), the thousand seed weight (0.56 and 0.54) and the seed yield per plant (3.25 and 3.57) coupled with high heritability estimations in the first and second seasons, respectively. Obtained results due to the capsule length, the thousand seed weight and the seed yield per plant are controlled by multi genes, complex nature and much affected by the environment. Moderate values of genetic advance were observed for plant height (18.49) in both seasons and (17.52 and 16.94) for the fruiting zone length in the first and second seasons, respectively coupled with high heritability. These results refer to the presence of additive and non-additive genes. While, the high heritability coupled with high genetic advance values were recorded for the first capsule height (26.05 and 25.85) and the capsules number per plant (22.55 and 26.11) in the first and second seasons, respectively. These traits might be controlled by the additive gene action mostly which is very useful for selection efficiency. Similar results were reported by El Soury et al. (2016) and Patil & Lokesha (2018).

The genetic advance represented in the Table 1 as a percent of means (GAM) was moderate (10–20%) for the plant height, the fruiting zone length, the capsules number per plant, the capsule length and the thousand seed weight in both seasons. The GAM of first capsule height (42.32 and 42.08 %) and the seed yield per plant (22.61 and 24.19%) were high percentages (>20%) in the first and second season respectively, coupled with high heritability and low differences between the PCV and the GCV (Fig. 3). That is meaning simple selection based on the phenotypes after a cycle of selection at 5% intensity for the first capsule height and the seed yield per plant would be effective. Hika et al. (2015) observed the higher GAM estimates (>30%) for the seed yield per ha, biomass yield per ha and the harvest index. In the current study, the genetic variability estimations of studied traits revealed that the first capsule height, the seed yield per plant, fruiting zone length and the capsules number per plant was the highest GAM coupled with high heritability. So, this phenomenon suggests that the additive gene action model controls these traits and the mass selection would be effective for the sesame productivity improvement.

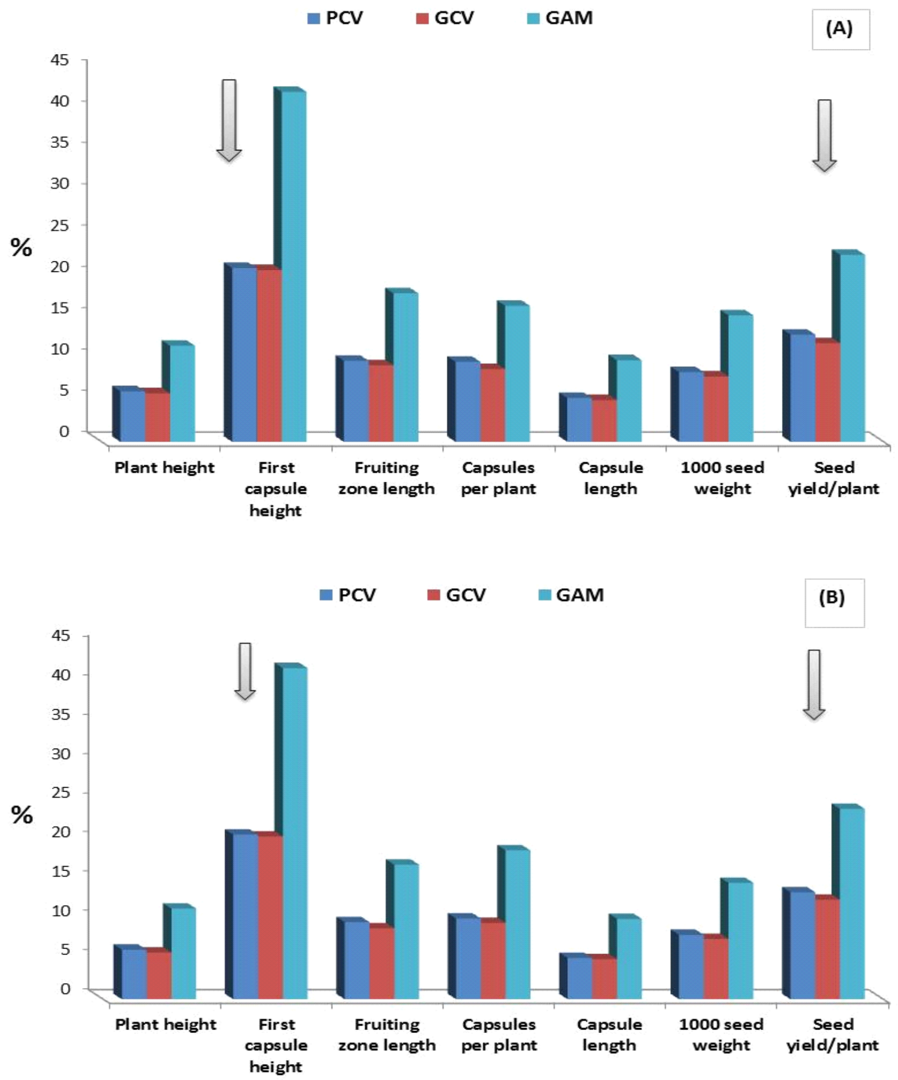

Fig. 3. Estimations of the PCV, the GCV and the genetic advance as percent of means in the first season (A) and second season (B).

Conclusion

In the current study, the genetic variability estimations of studied traits revealed that the first capsule height, the seed yield per plant, fruiting zone length and the capsules number per plant was the highest GAM coupled with high heritability. So, this phenomenon suggests that the additive gene action model controls these traits and the mass selection would be effective for the sesame productivity improvement.

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الإختلافات المظهرية والوراثية في مجموعة من التراكيب الوراثية للسمسم

إسماعيل محمود أحمد بديوي و نحيف أبراهيم محمد محمد
قسم المحاصيل – كلية الزراعة – جامعة سوهاج – سوهاج – مصر.

اجريت هذه الدراسة خلال الموسم الصيفى لعامى 2015 , 2016 لدراسة الإختلافات المظهرية و الوراثية فى مزرعة كلية الزراعة بحى الكوثر جامعة سوهاج. و ذلك باستخدام عدد 86 تركيب وراثى من محصول السمسم و كانت النتائج كالاتى:-

اظهرت نتائج التحليل الاحصائى وجود اختلافات معنوية عند مستوى معنوية 1% بين التراكيب الوراثية لجميع الصفات المدروسة فى كلا الموسمين.

الموسم الأول: اختلفت متوسطات التراكيب عن المتوسط العام فى مدى عريض حيث تفوق 67.4، 40.7، 46.5، 48.8% من هذه التراكيب عن المتوسط العام فى صفات طول النبات، طول الكبسولة، وزن الألف بذرة و محصول النبات على التوالى. بينما تفوق 51.2% لصفات ارتفاع أول كبسولة، طول المنطقة الثمرية، عدد كبسولات النبات فى الموسم الأول.

اما بالنسبة إلى الموسم الثانى: اشارت النتائج إلى تفوق 53.5، 51.2، 52.3، 54.7، 40.7% من التراكيب الوراثية فى صفات طول النبات، ارتفاع اول كبسولة، طول المنطقة الثمرية، عدد كبسولات النبات، طول الكبسولة على التولى، 48.8% فى صفتى وزن الألف بذرة و محصول النبات.

اظهرت النتائج بوجود فارق صغير بين قيمة معامل الأختلاف المظهرى و معامل الأختلاف الوراثى لكل صفة من الصفات المدروسة فى كلا الموسمين مما يدل على التأثيرالبيئى على التعبير الجينى لهذه الصفات قليل. تراوحت قيم معامل الأختلاف المظهرى و الوراثى ما بين عالى (اكبر من 20%) لصفة ارتفاع أول كبسولة، متوسط (10–20%) لصفات طول المنطقة الثمرية، عدد كبسولات النبات، وزن الألف بذرة، محصول البذور. على الجانب الأخر وجدت قيم منخفضة لمعامل الإختلاف الوراثى و المظهرى (اقل من 10%) لصفات طول النبات و طول الكبسولة.

أظهرت النتائج درجة توريث عالية (اكبر من 85%) لجميع الصفات المدروسة فى كلا الموسمين، كما أن درجة التوريث العالية اقترنت بقيم عالية لدرجة التقدم الوراثى الراجع للإنتخاب فى صفات أرتفاع أول كبسولة و عدد كبسولات النبات مما يدل على أن تاثير فعل الجين الإضافى هو المتحكم فى هذه الصفات مما يسهل عملية الإنتخاب لها. أقتران درجة التوريث العالية بدرجة تقدم وراثى متوسط لصفات طول النبات و طول المنطقة الثمرية يشير إلى فعل الجين الإضافى و الغير إضافى هو المتحكم فى توريث هذه الصفات.

ارتفاع درجة التقدم الوراثى كنسبة مئوية من المتوسط (اكبر من 20%) مع اقترانه بدرجة التوريث العالية لصفات ارتفاع أول كبسولة و محصول البذور للنبات مع تقارب معامل الإختلاف الوراثى و المظهرى لهذه الصفات مما يشير إلى إمكانية تحسين مثل هذه الصفات بالإنتخاب البسيط عند شدة انتخاب 5%.