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SELECTION WITHIN F2 THROUGH F4 FOR EARLINESS AND PRODUCTIVITY IN FABA BEAN (*Vicia faba L.*)

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ABSTRACT

This work was conducted in the Experimental Farm of Mattana Agricultural Research Station, Agricultural Research Center, Egypt, during two successive winter seasons of 2008/2009 and 2009/2010 to study the responses to two cycles of selection from the offspring of three crosses among local cultivars with variable levels of earliness and high yielding ability. Four cultivars of faba bean i.e. Giza-716, Giza-843, Sakha-1 and Triple White were crossed to attain the goal of this study. In the first season of 2008/2009, mean performances of the four parents and their offspring of F_2 generation for seed yield per plant and number of days from sowing to maturity were measured in order to make the best choices of populations of high yielding ability and earliness. The results showed that three of six populations attained the best results of the critical traits i.e. Sakha-1 × Giza-843, Sakha-1 × Giza-716 and Giza-843 × Triple White. In the first season of 2008/2009, the responses to selection were measured at the levels of six out of eight traits because there were insignificant differences between the bulk and the selected populations for both numbers of days from sowing to flowering and maturity of the selected F_3 families. Plant height insignificantly varied among the 3 populations and ranged from 109.1 to 119.1 cm. and number of branches per plant from 4.47 to 7.07 branches. However number of pods per plant insignificantly varied among the 3 populations and ranged from 36.7 to 53.9 pods and number of seeds per plant from 95.7 to 100.8 seeds. Although the analysis of variance indicated insignificant variations among the 3 populations selected of F_3 for number of pods and seeds/plant, the responses to selection for both traits were very high. Weight of seeds (g) per plant of the selected F3 families considerably varied among the 3 populations and ranged from 59.16 to 105.13 g and also the response to selection was so high and reached a convenient level to continue for further cycles of selection. Weight of 100 seeds relatively varied among the 3 populations from 62.1 to 80.9 g. In the second season of 2009/2010, the means of all eight traits of the selected F_4 families were calculated and the responses to selection were measured with similar results as those of the selected F_3 families. The population Giza-843 × Triple White has achieved the goal of the research as it exhibited high productivity with good level of earliness indicating the importance of proper choice for the germplasms selected in breeding programs. The results obtained encouraged the team work to continue the research on the three selected populations in advanced cycles of selection to improve the performance of faba bean plants.

INTRODUCTION

Faba bean is one of the most important plant protein sources in Egypt. Much work has been directed to increase its productivity by developing high yield varieties and using traditional agricultural practices. Selection is considered to be the most important way to maximize crop productivity and it has long been successful attempts for improving faba bean productivity in Egypt. Egyptians are securing an adequate supply of protein in their diet through consumption of faba bean. There was success in breeding efforts for

faba bean cultivars combining both earliness and high yield in one genotype in Egypt such as Giza 716, Sakha1 and others. Segregating generations were variable and allow efficient selection (Abdalla, 1977; Khalil, 1977; Ali *et al*., 1978; Khalil and Nassib, 1982; Khalil *et al*., 1982; Abdalla and Metwally, 1983; El-Menoufy, 1983; El-Gamal *et al*, 1990). Abdalla and Darwish, 1974, 1996 a and 1996 b found that selection in naturally intercrossed populations offers valuable genotypes. Selection in early segregating populations gave higher yields than cultivated varieties because of the heterosis and transgressive segregation (Abdalla and Metwally, 1983). Selection within local and exotic populations may result in improving faba bean performance (Abdalla, 1976). Bakheit and Mahdy (1988) found that the family selection for two generations in Giza-2 was effective in producing some families exceeding the base population. Omar (1989) noticed that both pod and seed sets had a great influence on improving seed yield. He found that bulk method attained higher genetic variation and the number of superior families relative to other breeding methods. Ibrahim *et al*. (1979); Nassib *et al*, (1979) and Nassib and Khalil (1982) recommended using mass selection for improving commercial varieties. Ahmed (1987) practiced selection within segregating generations of 8 crosses for shedding and leaf minor infestation and measured the obtained gain in yield components. He also reported that the procedure used attained good chane for actual gain in yield and its components. El-Refaey and El-Keredy (1992) found that the effectiveness of selection between and within segregating generations varied from case to another. Ragheb (1994) found that the selection with Aquadolse (a major stock) for two cycles of selection was effective. Breeding efforts have been employed for combining genes for adaptability and high yield from elite faba bean genotypes with those for earliness (Bekheit, 2007). However, information on genetics of earliness and high yield is scant and the nature of the genetic system involved is far from clear which might account for the rather limited number of early maturing and high yield cultivars released through breeding. The objective of this study is to develop faba bean genotypes through selection of high yield and good level of earliness.

MATERIALS AND METHODS

Four faba bean (*Vicia faba* L.) varieties i.e. Sakha-1, Giza-843, Giza-716 and Triple White were used. They represent wide range of agronomic traits as well as different levels of high yield and earliness (Table 1). In 2007/2008 growing season, a field experiment was conducted in order to select the highest yield and earlier matured populations of F_2 families. Selection differential was measured for each population as the deviation of the mean of selected F_2 plants from the F_2 population mean. Response to selection was expressed as percentage of change in the mean of the selected families from that of bulked plants of each population. Three populations attained this goal i.e. Sakha-1 × Giza-843, Sakha-1 × Giza-716 and Giza-843 × Triple White. In 2008/2009 growing season, seeds of ten selected F_3 plants of each of the 3 crosses were sown on 1st November 2009 as yield trial compared to the F_3 bulk of each cross. In 2009/2010 growing

season, seeds of ten selected F_4 plants of each of the three crosses were sown on 1st November in the field compared to the F_4 bulk of each cross. A randomized complete block design with three replications was used. In each block, a plot of five ridges was assigned to each of the three entries; five ridges for the plants of each of F_3 selected families and the plants of each of F_4 selected families. The four parents were also represented by a plot of one ridge for each parent in each block. Each ridge was 2-m long, 60-cm wide and contained 10 plants spaced 20 cm from each other. The characters of plant height, number of branches, number of days to 50% flowering, number of days to 95% maturity, seed yield per plant (g), number of pods and seeds per plant and weight of 100 seeds were measured on individual plant basis throughout the different experiments.

Table (1). The description of the four parental varieties of faba bean (*Vicia faba* L.)

Parent	Pedigree	Seed index	Plant height	Maturity
Giza-716	461/442/83 × 503/453/83	90 - 95 g	140 – 145 cm	moderate
Giza-843	561/2076/85 × 461/845/83	60 – 65 g	150 – 160 cm	moderate
Sakha-1	716/724/83 × 620/283/85	85 – 89 g	150 – 155 cm	moderate
Triple White	Mutant of individual Sudan plant	54 – 55 g	130 – 135 cm	Early

RESULTS AND DISCUSSION

The means of eight characters studied for four parents and three of their F_2 populations that were selected in 2007/2008 season are presented in Table (2). Three populations attained the goal of this research i.e. Sakha-1 × Giza-843, Sakha-1 × Giza-716 and Giza-843 × Triple White which attained the best results of the critical traits of seed yield and maturity.

Table 2. Means of days to flowering and maturity, plant height, number of branches/plant, number of pods, seeds/plant, weight of seeds/plant and 100 seeds weight (seed index) for parents and 3 F_2 populations.

Types	Studied characters							
	Flower.	Matur.	p.height	n.bran.	n.pods	n.seeds	Seedw/p	S. index
Parents : Giza-716	45.7	144.3	140.7	3.6	17.3	48.9	42.7	89.3
Giza-843	49.0	142.7	150.7	3.7	28.4	67.8	59.3	87.4
Sakha-1	46.7	141.3	151.0	3. 7	28.4	76.3	64.3	84.6
Triple White	40.3	134.7	126.3	2.0	36.1	88. 7	47.2	53.3
F_2 generation								
Sakha-1 × Giza-843	45.5	136.4	140.4	4.1	48.2	128.0	76.2	59.8
Sakha-1 × Giza-716	47.5	137.9	134.5	4.5	45.0	119.7	75.0	63.0
Triple White × Giza-843	46.4	136.6	133.2	4.6	49.7	138.5	71.4	51.9
LSD 0.05	NS	NS	1.12	0.1	0.57	1.4	0.97	1.05

The differences between the three populations in both flowering and maturity were not significant**.** The differences between the three populations selected were not significant in both flowering and maturity while the measures of the responses to selection for plant height, number of branches,

pods and seeds per plant and both weights of seeds per plant and 100 seeds (seed index) were significant and the results obtained encourage the team work to continue the research on the three populations selected for advanced cycles of selection to improve the performance of faba bean plants. The results are in agreement with those of Mahmoud (1968), El-Hosary (1982 and 1983), and Khalil *et al*. (1982).

1st Cycle of selection – F_3 generation:

The response to selection :

The means of eight characters studied for four parents and three populations of F_3 generations that were selected in 2008/2009 season are presented in Table (3). These three populations attained the best results of seed yield and maturity traits. The differences between the three populations were high except for flowering and maturity. However, the responses to selection for maturity were promising with negative values that stand for earlier matured populations in the future. The other six traits of plant height, number of branches, pods and seeds per plant and both weights of seeds per plant and 100 seeds which had a special attention in this study and the results obtained encourage the staff to continue the research on the three populations selected for advanced cycles of selection in order to improve the performance of faba bean plants.

Positive responses were obtained for plant height in all of the 3 populations which were not significant in 3 populations as revealed by the analysis of variance. The responses ranging from 4.1 to 8.2 % with an average of 6.5 % of the population mean. Plant height of the selected F_3 families varied considerably among the 3 populations that ranged from 109.1 to 119.1 cm. The most outstanding F_3 selections of two crosses involved the tallest parental cultivars Saka-1 and Giza-843, namely population 1 (Sakha-1 × Giza-843), with a mean plant height of 119.1 cm and population 2 (Sakha-1 × Giza-716), with a mean of 109.1 cm. Meanwhile, the analysis also indicated that there were insignificant variations among the F_3 selected families in all populations.

For number of branches, positive responses were obtained in all of the 3 populations which were significant in 3 populations. The responses ranging from 27.7 to 38.6 % with an average of 33.17 % of the population mean. Number of branches per plant of the selected F3 families varied considerably among the 3 populations that ranged from 4.47 to 7.07 branches. The most outstanding F_3 selections of two crosses involved the most branched parental cultivar Giza-843, namely population 2 (Sakha-1 × Giza-716), with a mean of 7.07 branches. Meanwhile, the analysis also indicated that there were significant variations among the F_3 selected families in all populations which permit for further response to another cycle of selection.

Positive responses were obtained from number of pods per plant in all of the 3 populations which were significant in 3 populations. The responses ranging from 62.4 to 150 % with an average of 111.1 % of the population mean. Number of pods per plant of the selected F_3 families varied considerably among the 3 populations that ranged from 36.7 to 53.9 pods.

In terms of number of seeds per plant, positive responses were obtained in all of the 3 populations which were significant in 3 populations. The responses ranging from 63.6 to 77.2 % with an average of 71.03 % of the population mean. Number of seeds per plant of the selected F_3 families varied considerably among the 3 populations that ranged from 95.7 to 100.8 seeds. The most outstanding F_3 selections of two crosses involved the highest seed number parental cultivar Sakha-1, namely populations (Sakha-1 × Giza-843) with a mean of 100.8 seeds and (Sakha-1 × Giza-716), with a mean of 138.5 seeds. Although the analysis indicated insignificant variations among the F_3 selected families in all populations for number of seeds, the responses to selection for this trait were very high.

Table 3. Means of the days to 50% flowering, 95% maturity, plant height (cm), number of branches, number of pods and seeds/plant, weight of seeds/plant (g) and 100 seeds (g) for 4 parents and 3 crosses of their F_3 generation.

Types	Studied characters							
	Flower.	Matur.	p.height	n.bran.	n.pods	n.seeds	Seedw/p	S. index
Parents : Giza-716	46.67	144.3	139.7	3.43	17.40	49.00	43.20	88.17
Giza-843	44.67	143.0	146.3	3.57	30.93	69.73	58.97	77.90
Sakha-1	44.00	142.3	147.7	3.63	28.50	73.67	65.70	89.30
Triple White	39.33	131.7	127.3	1.90	36.30	89.17	47.17	52.90
F_3 generation	**1. (Sakha-1 × Giza-843)**							
bulk	42.33	142.3	111.1	3.47	24.13	61.57	48.67	79.10
Selected	45.50	136.4	119.1	4.47	53.30	100.8	80.78	80.90
Response%	28.8%	-4.2%	7.2%	27.7%	12.1%	63.6%	65.9%	2.27%
2. (Sakha-1 × Giza-716)								
bulk	43.00	144.0	100.8	5.07	33.30	80.40	61.20	76.13
Selected	46.50	138.9	109.1	7.07	53.90	138.5	105.1	77.90
Response%	8.14%	-3.5%	8.2%	38.6%	62.4%	72.3%	71.7%	2.37%
3. (Triple White × Giza-843)								
bulk	38.33	139.3	109.0	3.43	23.97	54.02	34.27	63.40
Selected	42.45	137.6	113.5	4.53	36.70	95.7	59.16	62.10
Response%	10.8%	-1.2%	4.1%	33.2%	15.0%	77.2%	72.5	-2.1%
LSD 0.05	0.49	0.63	2.67	0.07	1.12	3.71	2.55	4.39

From the means of weight of seeds there were clear positive responses were obtained in all of the 3 populations which were significant in 3 populations. The responses ranging from 65.9 to 72.5 % with an average of 70.03 % of the population mean. Weight of seeds (g) per plant of the selected F_3 families varied considerably among the 3 populations that ranged from 59.16 to 105.13 grams of seed. The most outstanding F_3 selections of two crosses involved the most seed weighed parental cultivar Sakha-1, namely populations (Sakha-1 × Giza-843) with a mean of 80.78 grams of seeds and 2 (Sakha-1 × Giza-716), with a mean of 105.13 grams of seeds. Meanwhile, the analysis also indicated that there were significant variations among the F_3 selected families in all populations and the responses to selection were also very high which permit for further response to another cycle of selection.

Two positive responses versus to one negative response were obtained from Weight of 100 seeds (g) in all of the 3 populations which were

significant in 3 populations as revealed by the analysis of variance. The responses ranging from -2.05 to 2.37 % with an average of 0.86 % of the population mean. Weight of 100 seeds (g) of the selected F_3 families varied considerably among the 3 populations that ranged from 62.1 to 80.9 g. The most outstanding F_3 selections of two crosses involved the heaviest seed index parental cultivar Sakha-1, namely populations (Sakha-1 × Giza-843) with a mean of 80.9 grams and (Sakha-1 × Giza-716), with a mean of 77.9 grams. Meanwhile, the analysis also indicated that there were significant variations among the F_3 selected families in all populations which permit for further response to another cycle The results are in agreement with those of Mahmoud (1968), El-Hosary (1982 and 1983), and Khalil *et al*. (1982).

2nd cycle of selection - F_4 Generation:

Number of days to flowering and maturity:

The negative values of the responses to selection for both flowering and maturity are considered to be a good index for earlier populations in the future in which two populations of Sakha-1 × Giza-716 and Giza.843 × Triple White gave negative values of responses for flowering – 0.42 and – 0.44% respectively, while Sakha-1 × Giza-843 and Giza.843 × Giza-716 gave negative values of responses for maturity – 0.68 and – 1.99%, respectively. These results reveal that the population Sakha-1 × Giza-716 has two advantages of earliness of both flowering and maturity, (Table 4).

Table 4. Means of the flowering and maturity in 3 crosses of F_4 generation for selected, bulk and parents populations.

Populations	Flowering			Maturity		
	S-1× G-843	S-1 × G-716	G.843 × T.W	S-1 × G-843	S-1 × G-716	G.843 × T.W
Selected	46.43	47.47	45.47	136.40	137.87	136.6
Bulk	44.67	47.67	45.67	137.33	140.67	134.7
Response %	3.94%	-0.42%	-0.44%	-0.68%	-1.99%	1.41%
P_1	45.33	44.67	46.67	141.00	141.33	140.3
P_2	40.33	45.67	49.00	142.67	144.33	134.7
LSD 0.05	0.57	0.55	0.49	0.46	0.50	0.43

Plant height and number of branches:

The results represented in Table (5) show positive responses to selection in plant height in 2 out of the 3 populations Sakha-1 × Giza-843 and Giza.843 × Triple White which gave values of 0.29 (not significant) and 15.83%. (highly significant) while the population Sakha-1 × Giza-716 gave a highly significant negative value – 11.04 of response to selection for this trait. Plant height of the selected F_4 families varied considerably among the 3 populations that ranged from 133.2 to 140.4 cm. The most outstanding F_4 selections of two crosses involved the tallest parental cultivars Sakha-1 and Giza-843, namely population (Sakha-1 × Giza-843), with a mean plant height of 140.0 cm and population (Sakha-1 × Giza-716), with a mean of 151.2 cm. Meanwhile, the analysis also indicated that there were insignificant variations among the F_4 selected families in all populations. The results are in agreement with those of Mahmoud (1968), El-Hosary (1982 and 1983) and Khalil *et al*. (1982).

In terms of number of branches/plant, positive responses to selection were obtained in all of the 3 populations Sakha-1 × Giza-843 and Sakha-1 × Giza-716 which got values of 35.66% (significant) and 9.5% (not significant) and the population Giza.843 × Triple White got a highly significant positive value 42.28% of response to selection for this trait. Number of branches per plant of the selected F_4 families varied considerably among the 3 populations that ranged from 4.28 to 5.06 branches. The most outstanding F_4 selections of two crosses involved the most branched parental cultivar Giza-843, namely populations (Sakha-1 × Giza-843) and (Giza.843 × Triple White) with means of 3.73 and 7.97 branches, respectively. Meanwhile, the analysis also indicated that there were significant variations among the F_4 selected families in all populations which permit for further response to another cycle of selection, (Table 5). The results are in agreement with those of Mahmoud (1968), El-Hosary (1982 and 1983) and Khalil *et al*. (1982).

Table 5. Means of plant height, number of branches, in 3 crosses of F4 generation for selected, bulk and parents populations.

	Plant height (cm)			Number of branches		
Populations	**S-1 × G-843**	**S-1 × G-716**	**G.843 × T.W**	**S-1 × G-843**	**S-1 × G-716**	**G.843 × T.W**
Selected	140.40	134.50	133.2	5.06	4.38	7.97
Bulk	140.00	151.20	115.0	3.73	4.00	4.60
Response %	0.29%	-11.04%	15.83%	35.66%	9.50%	42.28%
P_1	151.00	146.00	150.0	3.67	3.73	3.70
P_2	150.67	140.67	126.3	3.70	3.57	2.03
LSD 0.05	1.52	0.87	0.65	0.96	0.13	0.08

Number of pods and number of seeds/plant:

The results represented in Table (6) reveal the mean values of number of pods and seeds/plant and show negative responses to selection in all of the 3 populations Sakha-1 × Giza-843, Sakha-1 × Giza-716 and Giza.843 × Triple White which gave values of 14.21%, 2.17% (not significant), and 42.66% from the population that gave a highly significant positive value of response to selection for this trait and clarifying the transmission of the property of independent vascular supply of the genotype Triple White to its offspring individuals.

Table 6: Means of number of pods and seeds/plant in 3 crosses of F_4 generation for selected, bulk and parents populations.

	Number of pods			Number of seeds		
Populations	**S-1 × G-843**	**S-1 × G-716**	**G.843 × T.W**	**S-1 × G-843**	**S-1 × G-716**	**G.843 × T.W**
Selected	48.23	46.00	86.63	128.0	119.7	263.7
Bulk	42.23	45.00	49.67	119.7	108.5	138.5
Response %	14.21%	2.17%	42.66%	6.93%	10.32%	47.48%
P_1	28.37	28.37	30.83	76.30	75.60	69.57
P_2	30.37	17.33	36.07	67.80	48.93	88.67
LSD 0.05	0.95	0.91	1.47	1.21	1.72	1.30

The large flower and young pod drop in faba bean has been attributed to physiological interactions among flowers and pods in the same raceme

and the use of the IVS mutant with independent vascular supply traces to each flower has been suggested to circumvent this (Gates *et al.,* 1983). Lines with this trait are effective semi-determinates with a heavy pod set over the first five to six flowering nodes, providing a strong sink for assimilates, which leads to the early death of the vegetative apex. This result in yield being limited by the ability of the plant to supply assimilates, rather than by sink capacity, which is the usual case for faba bean (McEwen, 1972). This is a less pronounced modification than with determinates and would allow a more flexible response to favorable environments in regard to photosynthetic area. Number of pods of the selected F_4 families varied considerably among the 3 populations that ranged from 46.0 to 86.63 pods.

The most outstanding F_4 selections of two crosses involved the highest number of pods involved parental cultivars Triple White and Giza-843, namely population 1 (Sakha-1 × Giza-843), with a mean number of pods of 42.23 pods and population 3 (Giza-843 × Triple White), with a mean of 49.67 pods. Meanwhile, the analysis also indicated that there were significant variations among the F_4 selected families in all populations which permit for further response to another cycle of selection. The results are in agreement with those of Mahmoud (1968), El-Hosary (1982 and 1983) and Khalil *et al*. (1982).

For number of seeds, positive responses to selection were obtained in all of the 3 populations Sakha-1 × Giza-843, Sakha-1 × Giza-716 and Giza-843 × Triple White which gave values of 6.93% (not significant), 10.32%, and 47.48% from the population that gave a highly significant positive value of response to selection for this trait that clarifying the transmission of desired genes from the genotype Triple White to its offspring. Number of seeds of the selected F4 families varied considerably among the 3 populations that ranged from 119.7 to 263.7 seeds. The most outstanding F_4 selections of two crosses involved the highest number of pods involved parental cultivars Triple White and Giza-843, namely population 1 (Sakha-1 × Giza-843), with a mean number of pods of 119.7 seeds and population 3 (Giza-843 × Triple White), with a mean of 138.5 seeds. Meanwhile, the analysis also indicated that there were significant variations among the F_4 selected families in all populations which permit for further response to another cycle of selection, (Table 6). The results are in agreement with those of Mahmoud (1968), El-Hosary (1982 and 1983) and Khalil *et al*. (1982).

Weight of seeds per plant and weight of 100 seeds (g):

The results shown in Table (7) reveal the mean values of weight of seeds per plant and show positive responses to selection in all of the 3 populations Sakha-1 × Giza-843, Sakha-1 × Giza-716 and Giza.843 × Triple White which got values of 4.51%, 9.77% and 26.10% from population that gave a highly significant positive value of response to selection for this trait that clarifies the transmission of the property of independent vascular supply of the genotype Triple White to its offspring. Weight of seeds per plant of the selected F_4 families varied considerably among the 3 populations that ranged from 71.39 to 79.20 grams.

Table 7: Means of weight of seeds/plant and weight of 100 seeds in 3 crosses of F_4 generation for selected, bulk and parents populations.

Populations	Weight of seeds/plant			Seed index		
	S-1 × G-843	S-1 × G-716	G.843 × T.W	S-1 × G-843	S-1 × G-716	G.843 × T.W
Selected	79.20	74.97	71.37	59.80	63.03	51.90
Bulk	76.80	68.30	56.6	66.80	62.93	59.40
Response %	4.51%	9.77%	26.10%	-10.48%	0.16%	-12.63%
P_1	64.33	65.20	58.37	84.33	86.20	83.93
P_2	59.30	46.70	47.23	87.40	89.30	53.27
LSD 0.05	1.4	4.10	1.35	1.1	1.51	1.64

The most outstanding F_4 selections of two crosses involved the highest weight of seeds per plant invlved parental cultivars Triple White and Giza-843, namely population (Sakha-1 × Giza-843), with a mean weight of seeds per plant (g) of 76.80 grams and population (Giza-843 × Triple White), with a mean of 56.6 grams. Meanwhile, the analysis also indicated that there were significant variations among the F_4 selected families in all populations which permit for further response to another cycle of selection. The results are in agreement with those of Mahmoud (1968), El-Hosary (1982 and 1983) and Khalil *et al*. (1982).

As to the weight of 100 seeds g, positive responses to selection were obtained in 1 out of 3 populations Sakha-1 × Giza-716 and on the other hand, two negative responses to selection were obtained from population Sakha-1 × Giza-843 (-10.48%) and population Giza.843 × Triple White which gave a value of (-12.63%) indicating that the higher number of seeds attained the less seed index resulted. Weight of 100 seeds of the selected F_4 families varied considerably among the 3 populations that ranged from 51.90 to 63.03 grams. The most outstanding F_4 selections of two crosses involved the highest weight of 100 seeds involved parental cultivar Giza-843, namely population (Sakha-1 × Giza-843) with a mean weight of 100 seeds of 66.80 grams and population 3 (Giza-843 × Triple White) with a mean of 59.40 grams. Meanwhile, the results also indicated that there were significant variations among the F_4 selected families in all populations which permit for further response to another cycle of selection, (Table 6). The results are in agreement with those of Mahmoud (1968), El-Hosary (1982 and 1983) and Khalil *et al*. (1982).

It is clear from the results obtained that the effectiveness of selection between generations varied from trait to another with the improvement of earliness where number of days to maturity had been decreased from 142.3 days for the F_3 plants selected from population 1 (Sakha-1 × Giza-843) to 136.4 days for its F_4 plants and from 138.9 days for the F_3 plants selected from population 2 (Sakha-1 × Giza-716) to 137.87 days for its F_4 plants and also the population 3 (Giza-843 × Triple White), its F_4 plants came to maturity one day earlier than its F_3 plants. The improvement of seed yield trait was clear in the population 3 (Giza-843 × Triple White) where its average weight of seeds per plant had increased from 59.16 grams for its F_3 selected plants to 91.37 grams for its F_4 selected plants indicating the importance of proper choice for the germplasms selected in breeding programs.

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الإنتخاب في الأجيال من الثاني الى الرابع للتبكير والإنتاجية العالية في الفول البلدي

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أجرى هذا البحث فى المزرعة البحثية لمحطة البحوث الزراعية بالمطاعنة, محافظة قنا جنوب مصرخلال الموسم الشتوي لأعوام ٢٠٠٨/٢٠٠٩ و ٢٠٠٩/٢٠١٠ لدراسة استجابة نسل اربعة آباء من الفول البلدي للإنتخاب تحت ظروف مصر العليا وقد اختيرت الاربعه طرز من الفول البلدي لتمثل مستويات مختلفة من التبكير و الإنتاجية العالية وهي Giza-716, Sakha-1 ,Giza-843 ثم Triple White ابكر الأصناف المستخدمة في هذه الدراسة وهجنت الآباء الأربعة فيما بينها لإنتخاب أفضل العائلات الناتجة منها تبكيراً وإنتاجية. تم قياس متوسطات اداء الآباء ونسلها في موسم الإنتخاب الاول لنباتات الجيل الثاني لصفتي التبكير و الإنتاجية العالية الممثلين في عدد الأيام من الزراعة حتى نضج ٩٥% من النباتات ووزن بذور النبات الفردي. وقد أظهرت النتائج تفوق ثلاثة عشائر في الصفات الهامة موضع الدراسة والتي تم اختيارها لتمثل الجيل الثالث في دورة الإنتخاب الثانية والعشائر الثلاثة المنتخبة هي Sakha-1 × Giza-843 و Sakha-1 × Giza-716 اللتان حققتا تفوقاً محصولياً عالياً ثم Giza-843 × Triple White.

في الموسم الأول ٢٠٠٨/٢٠٠٩ تم تقدير الإستجابة للإنتخاب في ستة من الصفات الهلمة وقد أظهرت النتائج استجابة موجبة للإنتخاب لصفة طول النبات مع اختلافات غير معنوية بين العشائر الثلاثة على عكس عدد فروع النبات الفردي التي حقق الإنتخاب فيها إستجابة معنوية موجبة مع اختلافات معنوية بين العشائر الثلاثة لهذه الصفة وبالنسبة لصفتي عدد قرون وبذور النبات الفردي فقد حققتا إستجابات عالية جداً للإنتخاب برغم عدم وجود اختلافات معنوية بين العشائر الثلاثة لهاتين الصفتين. حقق الإنتخاب لمحصول النبات الفردي من البذور إستجابة موجبة وعالية المعنوية مع اختلافات جوهرية بين العشائر الثلاثة لهذه الصفة والتي تمثل الهدف الاهم وتبرر الإستجابة العالية للإنتخاب لهذه الصفة ضرورة الإستمرار لدورات إنتخاب متقدمة لزيادة التحسين الوراثي في عائلات الفول البلدي المبشرة مستقبلاً. إختلفت الإستجابات لوزن ١٠٠ بذره ما بين سلبية وإيجالبية مع اختلافات معنوية بين العشائر الثلاثة لهذه الصفة.

أظهرت النتائج المتحصل عليها من الإنتخاب في الجيل الرابع في الموسم الثاني ٢٠٠٩/٢٠١٠ تشابه لتلك المتحصل عليها في الجيل الثالث وقد حققت العشيرة Giza-843 × Triple White الهدف من البحث في زيادة محصولية مع التبكير مما يدل على اهمية إختيار مواد التربية المناسبة لتحقيق الهدف المنشود منها. تفيد التائج المتحصل عليها في ضرورة الإستمرار في برنامج التربية لتحقيق الهدف المرجو للوصول إلى سلالات ثابتة في صفات التبكير في النضج و الإنتاجية العالية.

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