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RESPONSE TO SELECTION FOR SEED YIELD AND ITS COMPONENTS IN ONE POPULATION OF FABA BEAN (*Vicia Faba* L.)

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ABSTRACT

One population (16 F_7 families) of faba bean (*Vicia faba L.*) derived from a cross Giza 429 x Assiut 215 was made for pedigree selection by two selection criteria i.e., number of pods/plant and seed yield/plant during 2012/2013 growing season. The results manifested highly significant differences among genotypes (selected families, parents and check variety) for all studied traits. Mean of seed yield/plant of the selected families was increased from F_6 to F_7. Also, mean performance of the families surpassed the check cultivar for all studied traits, except days to maturity. Pedigree selection decreased the genetic variability measured as a genotypic coefficient of variability of the two selection criteria and other studied traits. Significant positive phenotypic and genotypic correlations were found between seed yield/plant and number of pods/plant.

INTRODUCTION

Faba bean (*Vicia faba L.*) is one among the most important nutritive seed legumes and widely considered as a good source of protein for human and animal nutrition. In addition, faba bean is one of the most efficient fixers of atmospheric nitrogen and, hence, can contribute to sustainability or enhancement of the total soil nitrogen fertility through biological N_2-fixation (Lindemann and Glover, 2003).

Pedigree selection method is a preferable method for improvement yielding ability in faba bean (Ahmed *et al,* 2008).

Heritability estimates provide values of relative importance of genetic components to phenotypic variation and is useful in predicting the expected genetic advance from selection in segregating population. Seed yield is a complex trait that is quantitatively inherited with low heritability value (Bond, 1966; Kambal, 1969 and Yassin, 1973). The low heritability and consequent limited genetic advance for yield in response to selection had led many scientists to search for characters which are associated with yield but which are more highly heritable (De Pace, 1979).

Correlation between traits can be useful in developing selection criteria (Kloth, 1998). Falconer, 1989 reported that if two traits are associated and one is easier to assess and select, selection pressures should be applied to this trait to improve the other. Genotypic and phenotypic correlations are widely used to standard the nature of complex interrelationships among traits and to identify the source of variation. For the genotypic correlation, the interrelationships might be quite different in other materials in which different gene associations exist in the parental of the segregating population (Miller *et al,* 1958).

This investigation was aimed to study the efficiency of pedigree selection to improve seed yield of 16 F_7 families.

MATERIALS AND METHODS

The present investigation was performed during 2012/2013 growing season at Experimental Farm, Faculty of Agriculture, Al-Azhar University, Assiut Branch, Egypt. The work aimed to study the efficiency of pedigree selection by two selection criteria i.e., number of pods/plant and seed yield/plant on improving seed yield of one population of faba bean. The basic materials in this study consisted of 16 F_7 families which traced back to F_6 families from cross Giza 429 x Assiut 215. Giza 429 was obtained from Legume Crops Section, Field Crops Research Institute, Agriculture Research Center, Giza, Egypt. While, Assiut 215: A breeding line in the ninth generation, provided

by Prof. Dr. E. A. Waly, Horticultural Dep. Faculty of Agriculture Assiut University. The 16 F_7 families, parents and the check cultivar Giza 674 were sown on 20th of October in two separated experiments (one experiment for each selection criterion) in a randomized complete block design with three replications. Each family was single ridge 3 m long, 60 cm wide and 20 cm between hills. The recommended cultural practices for faba bean production were applied at the proper time. Data in the each experiment were collected on ten random plants from each family, parents and the check for days to maturity, plant height, number of branches/plant, number of pods/plant, 100-seed weight and seed yield/plant.

Statistical Analysis: Analysis of mean squares with randomized complete block design to compute the significant for genotypes was made according to Snedecor and Cochran, 1980.

Table 1: Analysis of variance and expected mean squares.

Source of variance	D.F	M.S	E.M.S
Replications	r-1	m_3	$\sigma^2 e + g\sigma^2 r$
Genotypes	g-1	m_2	$\sigma^2 e + r\sigma^2 g$
Error	(r-1) (g-1)	m_1	$\sigma^2 e$

Estimates of phenotypic and genotypic variances ($\sigma^2 ph$ and $\sigma^2 g$) and heritability were calculated from the partitioning mean squares expectation (E.M.S) of variance components of the selected families (Table 1) according to Al-Jibouri *et al*, 1958 as follows:

- The genotypic variance $\sigma^2 g = (m_2 - m_1)/r$
- The phenotypic variance $\sigma^2 ph = \sigma^2 g + \sigma^2 e$

  Where $\sigma^2 e = m_1$

Broad sense heritability ($H^2 b$) was calculated as the ratio of genotypic variance ($\sigma^2 g$) to the phenotypic variance ($\sigma^2 ph$) according to **Fehr, 1987** as follows:

$H^2 b = (\sigma^2 g/\sigma^2 p) \times 100$

The phenotypic (P.C.V %) and genotypic (G.C.V %) coefficients of variability were estimated according to Burton, 1952 as follows:

- P.C.V % $= (\sigma p/x)100$
- G.C.V % $= (\sigma g/x)100$

Where: σp and σg are the phenotypic and genotypic standard deviations of the family mean and x is the family mean for a given trait.

The phenotypic (rp_{xy}) and genotypic (rg_{xy}) correlations were estimated according to Johanson *et al*, 1955 as follows:

$rp_{xy} = Covp_{xy} / (\sigma p_x . \sigma p_y)$

$rg_{xy} = Covg_{xy} / (\sigma g_x . \sigma g_y)$.

where: $Covp_{xy}$ is the phenotypic covariance of two variable x and y.

$Covg_{xy}$ is the genotypic covariance of two variables x and y.

RESULTS AND DISSCUSION

One cycle of pedigree selection method was achievement in F_7 generation of one faba bean population (*Vicia faba L.)* stemmed from a cross between Giza 429 x Assiut 215. Direct pedigree selection by two selection criteria i.e., number of pods/plant and seed yield/plant was applied in two separated experiments (one experiment for each selection criterion).

Description of the base population (F_6 generation)

Mean performance, phenotypic variance (σ^2ph) and coefficient of variation (CV %) of a base population (F_6 generation) which originated from the crossing of Giza 429 x Assiut 215 are presented in Table 2.

Table 2: Mean, phenotypic variance (σ^2ph) and coefficient of variation (CV %) of base population (F_6 generation) for days to maturity, plant height, number of branches/plant, number of pods/plant, 100-seed weight and seed yield/plant.

Items		days to maturity	plant height	No. of branches/plant	No. of pods/plant	100-seed weight	seed yield/plant
F6- population mean		167.19	143.22	4.73	50.82	53.55	79.09
σ^2ph		950.52	657.12	0.27	58.08	75.00	147
CV %		18.14	17.90	13.93	18.67	16.17	15.34
Parents	Giza 429	150.88	135.90	5.20	52.98	49.55	90.94
	Assiut 215	168.20	151.11	4.51	50.09	55.55	76.21

The obtained results revealed that the values of the mean, σ^2ph and CV % for days to maturity were 167.19 days, 950.52 and 18.14 %, respectively as well as for plant height were 143.22 cm, 657.12 and 17.90 %, respectively. For number of branches/plant the values of the mean, σ^2ph and CV % were 4.73, 0.27 and 13.93 %, respectively as well as for number of pods/plant were 50.82, 58.08 and 18.67 %, respectively. For 100-seed weight the values of the mean, σ^2ph and CV % were 53.55 gm, 75 and 16.17 %, respectively as well as for seed yield/plant were 79.09 gm, 147 and 15.34 %, respectively.

Pedigree selection

The pedigree selection was practiced in F_7 generation by two selection criteria i.e., number of pods/plant and seed yield/plant on one population of faba bean consisted of 16 families.

Analysis of variance: Analysis of variance for the selected 16 families along with the parents and the check cultivar Giza 674 for the six studied traits in F_7 generation at the two selection criteria is presented in Table 3. The obtained results revealed highly significant differences among genotypes for all studied traits at the two selection criteria. This result was in agreement with these obtained by Abd-El-Haleem and Mohamed 2011 and Yassien *et al* 2012.

Table 3: mean squares for the selected families along with the parents and the check cultivar in F_7 generation at the two selection criteria.

Items	D.f	Mean squares					
		No. of pods/plant	seed yield/plant	No. of pods/plant	seed yield/plant	No. of pods/plant	seed yield/plant
		Days to maturity		Plant height		No. of branches/plant	
Genotypes	18	95.45**	82.95**	151.33**	148.12**	17.16**	19.33**
Error	36	7.23	7.99	25.45	24.45	4.33	4.44
		No. of pods/plant		100-seed weight		seed yield/plant	
Genotypes	18	82.54**	91.85**	144.56**	147.88**	131.55**	129.25**
Error	36	16.77	15.85	27.54	26.18	12.32	11.96

Mean performance and Genetic parameters: Mean performance of the selected families, parents and the check cultivar, as well as phenotypic (PCV %) and genotypic (GCV %) coefficients of variability and heritability in broad sense (H.B.S %) at the two selection criteria are presented in Table 4.

Table 4: Mean performance, phenotypic (PCV %) and genotypic (GCV %) coefficients of variability and heritability in broad sense (H.B.S %) at the two selection criteria.

Items	Selection criterion					
	No. of pods/plant	seed yield/plant	No. of pods/plant	seed yield/plant	No. of pods/plant	seed yield/plant
	Days to maturity		Plant height		No. of branches/plant	
P_1	158.45	159.33	154.09	155.25	4.30	4.52
P_2	158.77	160.02	155.66	155.01	4.22	4.44
Check G.674	158.08	158.55	155.84	155.02	3.21	3.30
Selected family	156.88	157.35	157.04	156.22	4.33	4.55
PCV %	3.60	3.34	4.52	4.50	55.23	55.79
GCV %	3.46	3.18	4.13	4.11	47.76	48.96
H.B.S %	92.43	90.37	83.18	83.49	74.77	77.03
	No. of pods/plant		seed index		seed yield/plant	
P_1	46.66	56.63	65.12	65.09	79.12	79.02
P_2	46.55	46.52	65.25	65.22	78.45	78.42
Check G.674	47.12	47.05	65.45	65.39	78.77	78.75
Selected family	47.25	47.16	65.78	65.71	79.82	79.89
PCV %	11.10	11.73	10.55	10.69	8.29	8.22
GCV %	9.91	10.67	9.50	9.69	7.89	7.83
H.B.S %	79.68	82.74	80.95	82.30	90.64	90.75

The obtained results revealed that mean performance of the families surpassed the check cultivar for all studied traits, except days to maturity. Also, mean of seed yield/plant of the selected families was increased from F_6 to F_7. The values of phenotypic and genotypic coefficients of variability among of the selected families showed small differences between them for all studied traits, indicating the environment has not a major role to influence variation among families. These results were in agreement with those obtained by

Mahmoud 2001, Lithy and Abdel-Aal 2004, Abd-El-Haleem and Mohamed 2011 and Yassien *et al* 2012. Genotypic coefficient of variability had small values in all studied traits, indicating pedigree selection decreased the genetic variability measured as genotypic coefficient of variability. Falconer 1989 stated that selection reduces genotypic variance of the next generation. Broad sense heritability values were high for all studied traits, indicating that selection could be practiced in population successfully. These results are supported with the findings of El-Shazly 1993, Haridy 2009, Abd-El-Haleem and Mohamed 2011 and Yassien *et al* 2012.

Phenotypic and genotypic correlations: Results of phenotypic and genotypic correlations between seed yield/plant and other studied traits at the two selection criteria are presented in Table 5. The obtained results cleared significant positive phenotypic and genotypic correlations between seed yield/plant and number of pods/plant at the two selection criteria. This is an indication that plants bearing more number of pods/plant produce more seed yield. Thus, selection for number of pods/plant could be considered as a good selection criterion for higher seed yield/plant in faba bean. These results were in agreement with those obtained by Ulukan *et al* (2003), Alghamdi and Ali (2004), Abdelmula and Abuanja 2007, Alghamdi 2007, Tadaesse *et al* 2011 and Yassien *et al* 2012.

Table 5: Phenotypic (rp) and genotypic (rg) correlations between seed yield/plant and each of other traits for selected families in F_7 generation at two selection criteria.

Characters		No. of pods/plant	seed yield/plant
		seed yield/plant	
Days to maturity	rp	- 0.75**	- 0.33
	rg	- 0.71*	- 0.27
Plant height	rp	0.15	0.71*
	rg	0.11	0.49
No. of branches/plant	rp	0.49	0.57*
	rg	0.35	0.49
No. of pods/plant	rp	0.57*	0.79**
	rg	0.55*	0.75**
seed index	rp	0.42	0.49
	rg	0.35	0.39

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الاستجابة للانتخاب للمحصول ومكوناته فى عشيرة من الفول البلدى

ابراهيم نجاح عبد الظاهر
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أجريت هذه الدراسه فى موسم ٢٠١٢-٢٠١٣ بمزرعه كليه الزراعه بجامعه الأزهر بأسيوط وذلك بهدف تقدير الاستجابه المباشره للانتخاب المنسب للمحصول ومكوناته باستخدام معيارين انتخابيين هما عدد قرون النبات ومحصول النبات كلا فى تجربه مستقله وذلك لعشيره من الفول البلدى مكونه من ١٦عائله فى الجيل السابع والمنتخبه من العشيره (اسيوط ٢١٥ x جيزه ٤٢٩).

وكانت الصفات التى تم دراستها عدد الايام حتى النضج،طول النبات(سم)،عدد الأفرع/نبات،عدد القرون/نبات،وزن ١٠٠ بذره (جم) ومحصول بذور النبات (جم)

اظهر تحليل التباين وجود اختلافات عاليه المعنويه بين العائلات المنتخبه لكل الصفات المدروسه فى التجربتين مما يدل على ان الانتخاب داخل العشيره يكون فعالا. زاد متوسط محصول النبات للعائلات المنتخبه فى الجيل السابع عن الجيل السادس كما تفوقت العائلات المنتخبه فى محصولها على صنف المقارنه. تقاربت قيم التباين الوراثى والمظهرى مما يدل على اهميه التباين الوراثى فى توريث الصفات المدروسه. اظهر تقدير الارتباط المظهرى والوراثى بين المحصول والصفات المدروسه وجود ارتباط موجب ومعنوى بين محصول النبات وعدد قرون النبات.