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NEW STRAINS OF BROAD BEAN

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ABSTRACT

This research was carried out at El-Baramoon Horticulture Research Farm, Dakahlia Governorate, Egypt, during the winter seasons for four years. Sixteen broad bean genotypes, including 15 selected lines and El-Kassasien 1 cultivar were grown in randomized complete blocks design with three replications. These inbred lines obtained from El-Khobrosy cultivar after four generations of inbreeding and selection and were evaluated. The differences among means of most tested lines appeared significance. The results indicated that the strains 8, 7, 3, 11, 12, 4 and 2, respectively were superior than check cultivar (El-Kassasien 1) for the qualitative and quantitative traits of broad bean crop. The results revealed that the selection pure line within El-Khobrosy cultivar proved to be effective in separating new promising lines superior of yield and quality. A correlation study indicated that the existence of high positive correlations between total yield and each of No. of pods per plant, and pod weight. On the other hand, total yield gave negative correlation with No. of first pod node in both seasons. All the studied traits, except No. of first pod node were positively correlated with total yield at the two seasons.

INTRODUCTION

Broad bean (*Vicia faba,* L.) is one of the most popular vegetable crops as the source of protein in the Arab Republic of Egypt, but the cultivated area with green broad bean was limited and great demands have increased as a result of the continuous rise in the Egyptian population and, in turn, the prices have also increased. So, the improvement of broad bean production through breeding methods, such as pure line selection and mass selection or introducing high yielding line considered of national interest.

Breeding study by pure line selection of broad been was carried out by Luminis (1999). Other breeding studies were carried out by many breeders; Bond and Crofton (1999), Bozzini and Chiaretti (1999 a&b), Duc *et al.* (1999), Filippetti *et al.* (1999), Jingdi (1999) and Madlouf *et al.* (1999).

Evaluation studies of broad bean genotypes were conducted by several investigators, such as Yousef *et al.* (1999) and Link *et al.* (1999). They reported that the important role of selection methods to improve quantity and quality of broad bean crop.

Correlation coefficients were known to be used to estimate the relationship between various pairs of traits and whether the trait was more effective or correlated with yield. This study presented herein was undertaken in an attempt to evaluate and compare fifteen broad bean pure lines that they released from the El-Khobrosy cultivar through pure line selection method.

MATERIALS AND METHODS

Pure line selection program, continued for four years at El-Baramoon Horticultural Research Farm, Dakahlia Governorate, Egypt. Fifteen different

lines were developed through selection individual plants among the original population of El-Khobrosy cultivar depend on growth, yield and quality. The program was as follows: a) Selection of Nemours individual plants. b) Growing of selected plants separately in single rows to select among rows after year. c) Evaluation of the best fifteen inbred lines.

Evaluation work was made at the same Horticultural Research Farm to evaluate these selected lines during the two successive winter seasons 2000/2001 and 2001/2002, comparing with the local variety (Kassasien 1). Randomized complete blocks design with three replications was used. Each plot consisted of three rows, 4.5 m long, 70 cm wide, so the plot area was 9.45 m^2. Broad bean seeds were planted on October 1st, three seeds were grown per hill, and after germination seedlings were thinned at two seedlings per hill. The seeds were grown at 25 cm spacing.

Normal cultural practices of irrigation, fertilization and pest control were followed wherever they were necessary.

Vegetative samples were taken at the rate of three plants randomly from each plot after 110 days from sowing. While yield and yield component were determined when the pods reached to the green harvest stage, by random choosing 30 pods of each plot. Seed index (dry weight of 100 seeds) was determined for two samples obtained from the seeds of each plot in all replications.

Data recorded were plant height, No. of tillers per plant, No. of first pod node, plant dry weight, No. of pods per plant, pod length, pod width, pod weight, No. of seeds per pod, TSS, seed index, green yield per plant and total green yield per feddan.

All recorded data were subjected to statistical analysis, for each year separately, as illustrated by Al-Rawi and Khalf-Allah (1980). Differences among means were compared using Duncan's Multiple Range Test (Duncan, 1955)..

RESULTS AND DISCUSSION

Analysis of variance data presented in Table (1) to the first season and Table (2) to the second one, cleared the presence of significant differences between all tested lines means as well as Kassasien 1 as a check. These results indicated that the selection within El-Khobrosy cultivar proved to be effective in separating new lines, by pure line program used. It was concluded that there was enough scope for improvement the quantitative and qualititative characters in broad bean by simple breeding method, pure line selection (Filippetti *et al.*, 1999 and Luminis, 1999).

The data presented in Tables (1 and 2) were summarized as follows:-

1. Plant height:

The tallest line in the first and second season was line 9 (145.3 and 146.7 cm) followed by the lines 7, 8 and 11, respectively. All new lines were significantly taller plants than the check cultivar.

Table 1: Comparisons among the means of traits of the 15 broad bean pure lines and Kassasein 1 as a check during 2000/2001 season.

Lines	Plant height (cm)	No. of tillers / plant	No. of first pod node	Plant dry weight (g)	No. of pods / plant	Pod length (cm)	Pod width (cm)	Pod weight (g)	No. of seeds / pod	TSS (%)	Seed index	Total yield / plant (Kg)	Total yield / fed. (Ton)
1	113.3gh	8.4 f	2.3 c	145.0cde	40.7 h	14.3 e	2.2 a	21.3 d	4.0 ef	11.3 b	114.4 i	0.9 fg	17.3 fg
2	120.3 f	38.0 a	2.7 bc	131.0 e	150.0a	13.3ef	1.6def	11.5 h	5.0bcd	6.8 h	73.8 n	1.7 d	34.5 d
3	114.3 g	15.0 e	2.7 bc	192.7bcd	103.0c	24.3 a	1.9 bc	24.1 c	6.0 a	12.0 a	128.5d	2.5 a	49.6 a
4	103.3 i	22.0bc	93.7 ab	196.7bcd	72.7 e	18.3cd	1.7cde	25.8 b	4.7cde	9.8 d	124.0 f	1.9 cd	37.5 cd
5	111.3 h	16.0de	4.3 a	202.7bcd	49.7fg	17.3 d	2..1 ab	20.5 d	4.0 ef	10.0 d	120.0h	1.0efg	20.3efg
6	124.3 e	10.7 f	3.0 bc	145.0 de	76.7 e	14.3 e	1.9 bc	15.4 g	4.7cde	5.3 j	107.1 j	1.2 e	23.6 e
7	145.3 a	15.3 e	2.0 c	313.3 a	78.0 e	20.3 b	2.3 a	33.6 a	5.7 ab	9.3 e	132.6c	2.6 a	52.7 a
8	138.3 b	18.7cde	2.7 bc	347.0 a	152.7a	14.3 e	2.2 a	17.6 f	3.7 f	7.5 g	128.7d	2.7 a	53.9 a
9	145.3 a	18.0de	2.7 bc	313.3 a	99.0c	13.3ef	1.8 cd	9.3 i	5.0bcd	8.8 f	78.1 m	1.0efg	19.1efg
10	129.3cd	18.0de	2.7 bc	213.0 bc	55.0 f	9.3 h	1.9 bc	8.0 j	4.3def	7.8 g	101.4k	0.4 i	8.8 i
11	131.3 c	9.0 f	2.3 c	245.7 b	101.0c	19.3bc	1.7cde	21.3 d	5.3abc	9.8 d	149.3a	2.2 b	43.0 b
12	127.3 d	18.7cde	2.7 bc	329.7 a	92.0 d	14.7 e	1.4 f	21.3 d	5.0bcd	8.8 f	133.8b	2.0 bc	39.3 bc
13	111.3gh	23.0b	2.7 bc	155.0 de	45.7gh	18.3cd	2.1 ab	23.7 c	5.3abc	11.8 a	127.1e	1.1 ef	21.7 ef
14	96.3 j	18.3cde	2.7 bc	204.0bcd	31.7 i	19.3bc	2.3 a	18.9 e	4.7cde	9.7 de	121.0h	0.6 hi	12.0 hi
15	93.3 k	19.7bcd	2.7 bc	231.3 b	73.7 e	12.3fg	1.5ef	11.0 h	2.7 g	10.7 c	122.6g	0.8 gh	16.1 gh
Check	127.7 d	10.3 f	3.0 bc	302.3 a	121.7b	11.3 g	1.5ef	9.7 i	3.7 f	6.0 i	97.5 l	1.2 e	23.7 e

Means having the same letter in the same column do not significantly differ using Duncan's Multiple Range Test.

Table 2: Comparisons among the means of traits of the 15 broad bean pure lines and Kassasein 1 as a check during 2001/2002 season.

Lines	Plant height (cm)	No. of tillers / plant	No. of first pod node	Plant dry weight (g)	No. of pods / plant	Pod length (cm)	Pod width (cm)	Pod weight (g)	No. of seeds / pod	TSS (%)	Seed index	Total yield / plant (Kg)	Total yield / fed. (Ton)
1	114.3 h	8.3 g	2.0 c	155.3 j	39.3 h	14.7 f	2.3 ab	20.6 d	4.3 fg	11.2 c	115.6 i	0.8 hi	16.2 h
2	121.3 g	37.0 a	2.7 bc	131.3 k	145.3a	13.7 g	1.7 ef	11.1 i	5.3 cde	6.7 j	74.6 n	1.6 e	32.3 e
3	115.3 h	14.7 f	2.3 c	197.0 i	100.0c	24.7 a	1.9 c	23.3 c	7.3 a	12.0 a	129.8d	2.3 b	46.7 b
4	104.3 j	21.7bc	4.0 a	196.3 i	70.3 e	18.7 d	1.8 de	25.1 b	4.7 efg	9.7 f	125.3 f	1.7 d	35.3 d
5	112.3 i	15.7ef	3.7 ab	201.0hi	48.0fg	17.7 e	2.1 b	19.9 e	5.3 cde	10.0 e	121.8h	1.0 gh	19.1 g
6	125.3 f	10.3 g	2.7 bc	145.7 j	74.3 e	14.7 f	1.9 c	14.9 h	5.0 def	5.2 l	108.2 j	1.1 f	22.2 f
7	146.7 a	15.0ef	2.0 c	317.3 c	75.7 e	21.0 b	2.3 a	32.6 a	6.0 bc	9.2 g	133.9 c	2.5 ab	49.4 a
8	139.7 b	18.3de	2.3 c	337.3 b	148.0a	14.7 f	2.3 ab	17.1 g	4.0 gh	7.7 i	130.1d	2.5 a	50.7 a
9	146.7 a	17.7def	2.3 c	303.0 d	96.0 c	14.0 fg	1.8 cd	9.3 j	5.3 cde	8.7 h	78.9 m	0.9 ghi	17.9gh
10	130.7 d	17.7def	3.0abc	213.7 g	53.0 f	9.7 j	1.9 c	7.7 k	6.3 b	7.7 i	102.4 k	0.4 k	8.3 j
11	132.7 c	8.7 g	2.3 c	238.0 e	98.0 c	19.7 c	1.7 de	20.7 d	5.7 bcd	9.7 ef	150.8a	2.0 c	40.5 c
12	128.7 e	18.3 de	2.7 bc	464.3 a	89.3 d	14.7 f	1.4 g	20.7 d	5.3 cde	8.7 h	135.2b	1.8 d	36.9 d
13	112.3 i	22.7 b	2.7 bc	155.7 j	44.3gh	18.7 d	2.1 b	22.9 c	5.7 bcd	11.7 b	128.4e	1.0 fg	20.3 fg
14	97.3 k	18.0 de	2.7 bc	205.3 h	30.7 i	19.7 c	2.3 a	18.3 f	5.0 def	9.3 fg	122.2h	0.6 j	11.3 i
15	94.3 l	19.3 cd	3.0abc	230.0 f	71.3 e	12.7 h	1.5 fg	10.6 i	3.0 i	10.3 d	123.8g	0.8 i	15.1 h
Check	132.0cd	10.0 g	3.0abc	304.0 d	118.0b	11.7 i	1.5 g	9.4 j	3.3 hi	6.2 k	98.5 l	1.1 f	22.1 f

2. Number of tillers / plant:

The highest number of tillers derived from the line 2 (38 and 37) followed by the lines 13, 4 and 15 in the two seasons of study, respectively. Those and others were considerably of great tillering potentiality than the check cultivar.

3. Number of first pod node:

The best performing genotype for earliness was line 7 (2 and 2) followed by the lines 1, 11 and 8 in the two seasons of study, respectively. This trait considered as actual indicator for pod yield earliness and also yield, lines which set their pods at the lowest node were of the significant highest pods number and yield.

4. Plant dry weight:

The biggest plant dry weight was given by the lines 8 and 12 in the first season or 12 and 2in the second one, respectively. Also, it was evident that lines of higher capacity to accumulate and translocate dry matter, extended such physiological potentiality to fruiting and yielding processes.

5. Number of pods / plant:

The highest number of pods was obtained from the lines 8 and 2 in the two seasons of study, respectively, followed by check cultivar (El-Kassasien 1). While, the lowest number of pods gave by the lines 14 and 1. It was clear from the data that such lines had the highest record of tillers number per plant.

6. Pod length:

The tallest pod in the two seasons was given by the lines 3, 7, 14 and 11, respectively. While, the shortest pod was given by the lines 10 and 16.

7. Pod width:

The biggest pod width was given by the lines 7, 14, 1 and 8. While, the smallest pod width was given by the lines 12 and 15 in the two seasons of study, respectively.

8. Average pod weight:

The highest average pod weight was obtained from the lines 7, 4, 3 and 13. While, the lowest average pod weight was obtained from the lines 10 and 9 followed by the check cultivar in the two seasons of study, respectively. Herein, it could be suggested that such lines of the highest pod weight might be activity accumulated and translocated more bioassimilates into their pods and seeds, as well as activity of setting more seeds per their pods compared with check.

9. Number of seeds / pod:

The highest number of seeds per pod was given by the line 3. While, the lowest number of seeds was given by the line 15 followed by the check cultivar.

10. Total soluble solids (TSS):

The highest total soluble solids was obtained from the lines 3, 13, 1 and 15. While, the lowest TSS was given from the line 5 followed by the check cultivar. This is indicator to high nutrient value to the lines 3, 13, 1 and 15 compared to the check cultivar.

11. Seed index (weight of 100 seeds):

The highest seed index in both seasons was obtained from the lines 11, 12, 7, 8 and 3. While, the lowest record was given by the lines 2 and 9 followed by the check cultivar, respectively.

12. Total green yield:

Data presented in this study revealed that the maximum total yield per plant and total yield per feddan was obtained from the lines 8, 7, 3, 11, 12, 4 and 2 compared to check cultivar. While, the minimum total yield per plant and total yield per feddan was obtained from the lines 10, 14, and 15 in the two seasons of study, respectively. It was obvious from the same data that such superiority in yield of these lines could be associated to their superiority in growth (tillering and dry matter accumulation), as well as in pods and seeds setting and weight (number and weight). This reflected physiological and genetical superiority.

Generally, the lines 8, 7, 3, 11, 12, 4 and 2 appeared to be deit strains and had a superior for the qualitative and quantitative characters of broad bean crop.

A correlation study was carried out to determine the relationship between yield and eleven other traits. Data presented in Table (3) cleared that the existence of high positive correlation between total yield and each of No. of pods per plant and pod weight. On the other hand, all the studied traits, except No. of first pod node were positively correlated with total yield at the two seasons of study.

Table 3 : Correlation coefficient values of yield and 11 traits of broad bean strains as well as the check cultivar during the seasons of 2000/2001 and 2001/2002.

Traits	Total yield / fed.	
	2000/2001	2001/2002
Plant height	0.42	0.41
No. of tillers / plant	0.05	0.04
No. of first pod node	-0.19	-0.20
Plant dry weight	0.33	0.38
No. of pods / plant	0.61	0.61
Pod length	0.50	0.50
Pod width	0.02	0.02
Pod weight	0.58	0.58
No. of seeds / pod	0.39	0.25
TSS	0.02	0.05
Seed index	0.44	0.44

Finally, it must be concluded that such new selected superior lines could be utilized commercially as a new promising cultivars or inbreeding programs to be utilized from some promising traits as tillering and fruiting potentiality.

REFERENCES

Al-Rawi, K.M. and Khalf-Allah, A.M. (1980). Design and analysis of agriculture experiments. Text Book, El-Mousel Univ. Press, Ninawa, Iraq, 487p.

Bond, D.A. and Crofton, G.R.A. (1999). History of winter beans (*Vicia faba*) in the UK J. of the Royal Agric. Soc. of England, 160:200-209.

Bozzini, A. and Chalretti, D. (1999a). The genetic improvement of the Mediterranean faba bean (*Vicia faba*, L.). II.Transfer into Mediterranean lines of progressive traits found in other genetic pools: Seed quality associated with pure white flower. J. Genet., 53(3):201-206.

Bozzini, A. and Chalretti, D. (1999b). The genetic improvement of the Mediterranean faba bean (*Vicia faba*, L.). III. Development of obligate self fertile lines. J. Genet., 53(3):207-213.

Duc, G.; Moussy, F.; Zong, X. and Ding, G. (1999). Single gene mutation for green cotyledons as a marker for the embryonic genotype in faba bean, *Vicia faba*. Plant Breed., 118(6):577-578.

Duncan, B.D. (1955). Multiple range and multiple F-test. Biometrics, 11:1-42.

Filippetti, A.; Azadegan, G.H., and Pace, C.D.E. (1999). Breeding strategies for seed protein content and trypsin inhibitors inferred from combining ability and heterosis in test-crosses of *Vicia faba*. Plant Breed., 118(5):411-416.

Link, W.; Abd El-mula, A.A.; Kittlitz, E. Von; Bruns, S.; Riemer, H., and Stelling, D. (1999). Genotypic variation for drought tolerance in *Vicia faba*. Plant Breed., 118(6):477-483.

Luminis, L.T.D. (1999). Australia, grains research and development corporation variety. Fiesta VF' Application No. 97/327. Plant Varieties J., 12(2):28-29.

Maalauf, F.S.; Suso, M.J., and Moreno, M.T. (1999). Choice of methods and indices for identifying the best parentals for synthetic varieties in faba bean. Agronomie, 19(8):705-712.

Jingdi, M.; Bangchuan, P. and Xuejun, W. *et al.* (1999). Study on measurement of natural cross-pollination percentage in broad bean and its utilization. Jiangsu Agric. Sci., 4:40-42.

Yousef, S.A.; AL-Saadawy, I.S. and Alla, A.Y.N. (1999). Nitrate reductase activity in 21 genotypes of broad bean *Vicia faba*, L. Dirasat. Agric. Sci., 26(3):411-416.

سلالات جديدة من الفول الرومى

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تم إنتخاب ١٥ سلالة جديدة من الفول الرومى من الصنف القبرصى والذى لوحظ أنه يشتمل على خلط وراثى بين نباتاته وذلك من خلال برنامج تربية إستمر لمدة ٤ سنوات فى المزرعة البحثية بالبرامون – محافظة الدقهلية. وتم تقييم هذه السلالات فى موسمى شتاء ٢٠٠٠ / ٢٠٠١ ، ٢٠٠١ / ٢٠٠٢ بنفس المزرعة للمقارنة بينهم وبين الصنف القياسى قصاصين ١ .
وقد بينت النتائج أن السلالات المختبرة أظهرت إختلافات إحصائية فيما بينها لمعظم الصفات المدروسة والمتعلقة بالنمو الخضرى والمحصول والجودة وهى إرتفاع النبات وعدد الخلفات للنبات ورقم عقدة أو قرن والوزن الجاف للنبات وعدد القرون على النبات وطول القرن وعرض القرن ومتوسط وزن القرن وعدد البذور فى القرن والمواد الصلبة الذائبة الكلية ومتوسط وزن ١٠٠ بذرة جافة والإنتاج الكلى للنبات والإنتاج الكلى للفدان من المحصول الأخضر للقرون.
وقد أظهرت السلالات رقم ٨ ، ٧ ، ٣ ، ١١ ، ١٢ ، ٤ ، ٢ على الترتيب معنوية عالية لكل الصفات المدروسة بالنسبة لصنف المقارنة قصاصين ١ مما يدل على فاعلية الإنتخاب فى الصنف القبرصى والمستخدم فى الزراعة المحلية منذ فترة طويلة مما ترتب عليه وجود إختلافات مظهرية ووراثية بسبب الطفرات والخلط الميكانيكى والوراثى. ويوجد إرتباط قوى موجب بين الإنتاج الكلى للفدان وصفة كل من عدد القرون على النبات ومتوسط وزن القرن ، ويوجد أيضا إرتباط سالب بين الإنتاج الكلى للفدان ورقم عقدة أول قرن مما يدل على أن السلالات المنتخبة مبكرة عن الصنف المقارن.