Minufiya J. Agric. Res. Vol. 28 No. 3: 965 – 971 (2003)

A STUDY ON SELECTION FOR SEED YIELD AND SOME OF ITS COMPONENTS AMONG SELFED POPULATIONS OF THE COMMON BEAN (*PHASEOLUS VULGARIS* L.).

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(Received : Feb., 1, 2003)

ABSTRACT: *Eight parents of common bean, and their 12 F_3, F_4 and F_5 generations were evaluated in two successive seasons, i.e. 2000 and 2001. Mean seed yield per plant of seven F_3, F_4 and F_5 offsprings were higher than the yield of their mid-parents. Four of the 6 studied characters exhibited positive correlation coefficient among the mid-parent, F_3, F_4 and F_5. Heritability ranged from 0.47 to 0.51 for seed yield per plant, 0.55 to 0.62 for number of seeds per plant, 0.56 to 0.64 for seed index (1000 seed weight) and 0.30 to 0.52 for protein content. Values of the expected genetic gains for the same previously mentioned characters ranged from 3.19 to 3.41, 2.62 to 3.01, 59.64 to 71.78 and 0.90 to 1.66 respectively. The results support the idea of using early generation tests and selection among populations in breeding of the common bean cultivars.*

Key words: *common bean, seed yield, Phaseolus vulgaris, early generations, correlation, heritability, genetic gain.*

INTRODUCTION

The importance of a crop puts it in an intensive and focus work of improvement programs. That is the case with the self-pollinated crop, common bean (*Phaseolus vulgaris* L.). It is in continuous need to improve and produce new varieties to meet the demand of markets, producers and consumers. Besides, it is important for the breeders, farmers and exporters to increase the genetic base and introduce new improved cultivars as the consumers preference is changeable from time to time. In the mean time, several previous results have been reported on possibility of using early generations of selfed populations in selection for yield and its components (Ntare et al., 1984; Singh et al., 1990; Singh and Urrea, 1994 and Martin and Geraldi, 2002). Additionally, a positive correlation between yield of the parents and F_3, F_4 and F_5 generations derived from their crosses in the common bean was also reported by other researchers (Roupakias et al., 1997), which can be useful in selection programs. In recent years, it is noticed that several introduced cultivars are being imported to the local market and that can make more expenses which cause problems to Egypt's budget. Thus, it is quite important to produce and gain local varieties and reasonable germplasm. Therefore, the aim of this study was to obtain and

select the best entries based on the performance of mid-parents and offsprings of early generations in common bean (*Phaseolus vulgaris* L.).

MATERIALS AND METHODS

In the current study eight parents namely Serbo (1), Giza 6 (2), Giza 3 (3), Bronco (4), HAB53 (5), HAB20 (6), Helda (7) and Limka (8); and 12 F_3, F_4 and F_5 generations derived from their crosses were evaluated at Kaha Vegetable Research farm, Kalubia governorate in a randomized complete block design using three replications. Each plot consisted of two rows with 4 m long and 60 cm in width. Seeds were sown 10 cm apart in summer seasons of March 2000 and 2001. Data were recorded for number of days to 50% flowering, number of days to seed harvesting, seed index (1000 seed weight), number of seeds per plant, seed yield per plant and protein content. Data for each year were analyzed separately. Heritability based on the regression of F_4 on F_3 and F_5 on F_4 has been estimated according to Smith and Kinman (1965). Expected genetic gains in F_4 and F_5 at 10% selection intensity were estimated according to Singh and Chaudhary (1977).

RESULTS AND DISCUSSION

Differences among parents, F_3, F_4 and F_5 populations were significant for all studied characters, except for protein content and number of days to seed harvesting in both seasons of 2000 and 2001. The mean performance values of mid-parents, F_3, F_4 and F_5 generations are shown in Table (1 and 2) while the mean squares are shown in Table (3). Correlation coefficients between the mid-parents, F_3, F_4 and F_5 were positive for all combinations and all studied characters in both first and second seasons except for number of days to 50% flowering and number of days to seed harvesting (Table 4). Values of correlation coefficients were generally highest for seed index (1000 seed weight), followed by number of seeds per plant. Protein content tended to show lower values. Similar results were reported for the common bean by Hamblin and Evans (1976), Singh et al. (1990) and Singh and Urrea (1994). This is consistent with the predominance of additive genetic variance (Nienhuis and Singh, 1986; Nienhuis and Singh 1988 and Singh et al., 1990) and occurrence of moderate high heritability values for most of these characters in common bean (Table 5).

Heritability values, based on the regression of F_4 on F_3 and F_5 on F_4 were the highest for seed index (1000 seed weight) in both first and second seasons (Table 5). In general, heritability values were moderatly high for most of the studied characters. Expected gains from selection (at 10% selection pressure) were the highest for seed index (1000 seed weight) in both seasons of 2000 and 2001 followed by number of days to seed harvesting (Table 5), while, protein content had the lowest values in this respect. This could be a consequence of reduced variation available among populations for these characters. The results obtained herein were in agreement with those reported by Singh et al., 1990.

Table (1): Mean values for seed yield and other characters of common bean mid-parents (p), F_3, F_4 and F5 bulk populations grown in season of 2000.

	Number of days to 50% flowering				Number of days to seed harvesting				Seed index (1000 seed weight)				Number of seeds per plant				Seed yield per plant (g)				Protein content (%)			
	P	F_3	F_4	F_5	P	F_3	F_4	F_5	P	F_3	F_4	F_5	P	F_3	F_4	F_5	P	F_3	F_4	F_5	P	F_3	F_4	F_5
1x4	40.72	47.96	40.17	40.45	94.83	91.63	93.23	94.03	283.04	308.05	293.04	285.54	66.19	58.95	62.57	64.38	17.58	15.22	16.24	16.41	21.33	23.09	22.87	22.77
1x5	37.84	45.38	38.44	38.14	95.06	95.46	95.26	95.16	315.53	324.01	319.77	317.65	52.33	53.50	52.92	52.62	15.82	17.92	16.37	16.09	23.19	23.97	23.74	23.63
1x6	37.39	45.37	37.72	37.55	92.72	93.04	92.88	92.80	329.27	348.90	339.08	334.18	50.33	43.78	47.05	46.69	15.77	14.28	15.02	16.39	21.71	22.52	22.37	22.29
2x5	37.89	45.25	38.24	38.07	95.17	94.21	94.69	94.93	393.67	415.61	404.64	399.15	33.53	29.53	31.53	32.53	11.47	10.72	10.10	11.28	24.21	23.76	23.91	23.98
2x6	37.44	45.25	37.51	37.48	92.83	92.48	92.65	92.74	407.40	427.37	417.38	412.39	31.53	33.40	32.47	32.00	11.42	13.42	12.42	12.59	22.73	22.49	22.61	22.67
2x7	41.28	46.12	40.70	40.99	95.83	94.38	95.10	95.47	531.23	505.82	518.43	524.63	28.03	35.49	31.76	29.89	14.26	16.87	14.57	14.91	22.22	24.04	23.71	23.55
3x6	39.17	45.71	39.10	39.14	90.87	92.83	91.75	91.21	359.12	379.69	371.90	366.01	32.15	34.84	33.49	32.82	10.84	12.74	12.48	11.31	22.29	23.45	22.87	22.58
3x7	43.00	47.42	42.38	42.69	93.67	93.67	93.67	93.67	482.95	462.46	475.20	481.57	28.65	31.66	30.17	29.41	13.87	14.19	13.93	13.80	21.78	23.07	23.01	22.98
3x8	44.58	44.67	43.61	44.08	93.50	90.88	92.19	92.84	387.87	365.08	383.98	363.42	35.13	34.71	34.92	35.02	11.79	12.62	12.54	12.50	22.16	22.87	22.68	22.59
4x7	44.28	46.12	43.53	43.91	95.78	94.00	94.89	95.33	424.81	416.21	417.41	416.51	54.14	51.28	52.71	53.43	16.49	15.83	15.66	16.74	20.74	22.45	22.60	22.67
4x8	45.83	44.83	45.08	45.45	95.61	94.21	94.91	95.26	309.54	319.67	307.10	300.82	60.62	59.29	59.96	60.29	18.61	17.94	18.27	15.61	21.13	23.40	22.85	22.57
5x8	42.95	45.96	41.96	42.45	95.83	91.21	93.52	94.68	342.03	361.96	346.99	339.51	46.78	48.23	47.49	47.12	14.84	15.05	15.94	15.39	22.99	24.00	23.56	23.37

Table (2): Mean values for seed yield and other characters of common bean mid-parents (p), F_3, F_4 and F5 bulk populations grown in season of 2001.

	Number of days to 50% flowering				Number of days to seed harvesting				Seed index (1000 seed weight)				Number of seeds per plant				Seed yield per plant (g)				Protein content (%)			
	P	F_3	F_4	F_5	P	F_3	F_4	F_5	P	F_3	F_4	F_5	P	F_3	F_4	F_5	P	F_3	F_4	F_5	P	F_3	F_4	F_5
1x4	48.67	47.58	40.79	40.90	92.00	91.96	93.23	94.53	272.97	308.56	293.76	288.36	64.71	58.75	62.40	64.22	16.32	15.73	16.02	16.17	21.44	23.08	22.80	22.85
1x5	46.33	45.67	38.33	38.50	92.44	95.67	95.72	95.58	303.66	324.33	319.60	317.74	56.14	53.15	52.81	52.48	15.96	17.56	16.76	16.36	23.57	23.39	23.40	23.57
1x6	46.67	45.83	37.25	37.46	90.89	93.25	92.74	92.65	306.97	346.81	339.06	331.18	59.17	43.75	47.96	48.07	16.43	14.77	15.60	16.02	21.40	22.11	22.84	22.04
2x5	45.67	45.08	36.71	36.85	94.06	94.46	94.76	94.24	373.57	415.34	404.46	399.01	37.84	29.70	31.00	32.49	11.85	10.26	10.96	11.30	24.87	23.51	23.69	23.28
2x6	48.00	45.67	37.17	37.92	92.50	92.71	92.60	92.39	376.86	427.16	417.08	412.53	38.67	33.32	33.00	32.00	12.13	13.81	12.97	12.85	22.71	22.36	22.71	22.71
2x7	45.39	46.37	40.65	40.97	94.44	94.46	95.20	95.24	477.46	505.16	516.32	524.55	32.96	35.66	31.31	29.47	13.84	16.02	14.83	14.23	22.25	24.45	23.85	23.39
3x6	46.33	45.75	39.04	39.52	91.39	92.71	91.38	91.22	352.99	379.49	371.07	366.37	38.70	34.96	33.33	32.65	11.81	12.86	12.24	11.92	22.37	23.39	22.71	22.87
3x7	45.72	47.87	42.47	42.93	93.33	93.96	93.73	93.95	453.79	462.17	475.31	481.38	32.99	31.62	30.57	29.61	13.12	14.17	13.84	13.38	21.91	23.44	23.35	22.96
3x8	44.33	44.58	43.79	44.40	95.67	90.33	92.17	92.75	371.62	365.53	363.18	363.33	38.09	34.92	34.67	35.21	12.24	12.24	12.24	12.24	22.54	22.96	22.42	22.64
4x7	46.06	46.21	43.13	43.43	94.17	94.96	94.90	95.20	394.13	415.10	417.62	416.86	49.79	51.42	52.94	53.53	16.12	15.67	15.89	16.01	20.87	22.56	22.71	22.27
4x8	44.67	44.25	45.13	46.56	96.50	94.83	94.42	95.86	312.17	319.96	307.23	301.70	54.89	59.74	59.31	60.60	18.25	17.30	18.27	15.76	21.30	23.06	22.77	22.62
5x8	44.33	45.75	41.71	42.59	96.94	91.54	93.58	94.26	343.06	361.06	346.57	339.33	46.32	48.57	47.95	47.84	14.88	16.58	15.73	15.31	23.42	24.32	23.84	23.15

Table (3): Mean squares of six characters of common bean parents, F_3, F_4 and F_5 grown in seasons of 2000 and 2001.

Sv	Df	Number of days to 50% flowering		Number of days to seed harvesting		Seed index (1000 seed weight)		Number of seeds per plant		Seed yield per plant (g)		Protein content (%)	
		2000	2001	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001
Genotypes	43	35.09*	31.11*	7.28	9.11	15950.75*	14165.72*	477.44*	434.37*	18.70*	15.46*	2.11	2.64
Error	86	8.52	8.57	7.02	7.18	78.48	78.16	18.21	18.59	2.57	2.38	3.67	3.13

* Significant at 5% level.

Table (4): Correlation coefficients among early generations of common bean populations grown in seasons of 2000 and 2001.

Generations	Number of days to 50% flowering		Number of days to seed harvesting		Seed index (1000 seed weight)		Number of seeds per plant		Seed yield per plant (g)		Protein content (%)	
	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001
Mid-parent and F_3	0.032	0.509	0.286	-0.113	0.984*	0.963*	0.958*	0.877*	0.725*	0.777*	0.557	0.441
Mid-parent and F_4	0.996*	-0.659*	0.832*	0.288	0.995*	0.975*	0.991*	0.934*	0.872*	0.935*	0.710*	0.576*
Mid-parent and F_5	0.999*	-0.707*	0.969*	0.463	0.997*	0.980*	0.998*	0.934*	0.953*	0.983*	0.741*	0.708*
F_3 and F_4	-0.009	-0.122	0.769*	0.783*	0.996*	0.996*	0.987*	0.984*	0.900*	0.950*	0.910*	0.747*
F_3 and F_5	0.013	-0.139	0.515	0.608*	0.991*	0.991*	0.974*	0.974*	0.793*	0.878*	0.787*	0.798*
F_4 and F_5	0.999*	0.995*	0.944*	0.906*	0.999*	0.999*	0.998*	0.997*	0.927*	0.984*	0.972*	0.729*

* Significant at 5% level.

Table (5): Heritability and expected genetic gain from selection for seed yield and other characters in early generation populations of common bean in seasons of 2000 and 2001.

	Number of days to 50% flowering		Number of day to seed harvesting		Seed index (1000 seed weight)		Number of seeds per plant		Seed yield per plant (g)		Protein content (%)	
	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001
Heritability[1]: F_4 on F_3	-0.014	-0.173	0.380	0.373	0.641	0.643	0.619	0.618	0.466	0.481	0.454	0.296
F_5 on F_4	0.583	0.545	0.562	0.526	0.564	0.565	0.560	0.546	0.498	0.514	0.522	0.359
Expected gain[2]: F_4 on F_3	-0.636	-0.722	7.714	7.259	71.781	67.886	2898	3.009	3.191	3.192	1.446	0.903
F_5 on F_4	2.636	2.278	11.411	10.256	63.174	59.643	2.623	2.657	3.413	3.410	1.662	1.096

[1]Obtained from the regression of F_4 on F_3 and F_5 on F_4 according to Smith and Kinman (1965).
[2]Calculated at 10% selection pressure.

Values for correlation coefficient among generations were high for most of the studied characters and heritability values were moderatly high, which could be due to more diverse parents and the use of single-cross populations in the current study. This was in accordance with that reported by Singh and Urrea, 1994. However, data on yield and its components, evaluation and selection for these characters in early segregating generations are very important and this practice needs to be critically examined. It is suggested, according to the current study, that in common bean, all potential parents to be used in crossing should be tested for yield and its components in replicated trials and in different environments. That should be followed by selection for hybridization of parents having high yield and other desirable characters. Besides, F_3, F_4 and F_5 populations should be tested in the same way and undesirable populations have to be discarded. Because of positive associations between the mid-parent values and F_3, F_4 and F_5 occur, the evaluation for yield and other characters of early generation populations is required. If reliable yield data on parents is available, the need to yield test of early generation populations is reduced. It is better to test and identify promising early generation populations and families and discard the undesirable, low yielding and inferior populations as early as possible. Thereafter, further evaluation and selection of desirable recombinations and fixation of characters should be concentrated within promising populations and families.

Results obtained herein suggest that the most promising offsprings that could be involved in next generations in advanced selection program were (2 x 5) for seed index (1000 seed weight); (2 x 6), (3 x 6) and (3 x 8) for number of days to seed harvesting; (1 x 4) and (3 x 6) for number of days to 50% flowering; (1 x 5) and (3 x 7) for protein content and (1 x 5) for seed yield per plant.

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دراسة عن الانتخاب لمحصول البذور و بعض مكوناته بين عشائر الفاصوليا الملقحة ذاتيا

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الملخص العربي

تـم إجراء الدراسة الحالية على ثمانية آباء من الفاصوليا و ١٢ جيل ثالث و ١٢ جيل رابع و ١٢ جـيل خـامس المشـتقة من نسل هجن هذه الآباء. و قد قيمت تلك المواد الوراثية في موسـمين ناجحين خلال عامى ٢٠٠٠ و ٢٠٠١. و قد كان متوسط محصول النبات من البذور الجافـة مـرتفع قليلا عن محصول متوسط آبائهم. و قد أظهرت ٤ من الصفات الستة التي تم دراستها ارتباط موجب بين متوسط الآباء من جهة و الجيل الثالث و الرابع و الخامس من جهة أخـرى. و قد تراوحت درجة التوريث من ٠,٤٧ إلى ٠,٥٤ بالنسبة لصفة محصول النبات من البذور الجافة و ٠,٥٥ إلى ٠,٦٢ بالنسبة لصفة عدد بذور النبات و ٠,٥٦ إلى ٠,٦٤ بالنسبة لصـفة وزن ١٠٠٠ بـذرة و ٠,٣ إلى ٠,٥٢ بالنسبة لصفة محتوى البروتين. وتراوحت قيم المـردود الوراثـي المـتوقع لنفس الصفات السابقة الذكر من ٣,١٩ إلى ٣,٤١ و ٢,٦٢ إلى ٣,٠١ و ٥٩,٦٤ إلـى ٧١,٧٨ و ٠,٩ إلـى ١,٦٦ علـى التوالي. وتؤيد تلك النتائج أهمية الاستفادة من اختبار الآباء و الأجيال المبكرة لهجن هذه الآباء ومدى ارتباطهم ببعضهم البعض في الانتخاب داخل وبين عشائر محصول الفاصوليا.