Selection for Yield and Its Components in Okra (*Abelmoschus Esculentus* L. Moench)

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ABSTRACT

A breeding work was carried out at Sabahia Horticultural Research Station, Alexandria, Egypt. This breeding program started in 1995 summer season to improve and meet the need of new cultivars of okra for fresh consumption. Individual plants selection accompanied by self-pollination were conducted for three successive generations in 2002, 2003, and 2004 summer seasons. The selection based on days to first flower; pod; length, diameter, weight, color, spines, net weight percentage and total yield/plant. Five lines were selected i.e., L_3 had early flowers and the pods were tall, thin, and mild-green; L_5 had early flowers and the pods were short, thick, and relatively dark-green; L_6 had early flowers with tall, thin, and dark-green pods; L_{10} had late flowers with; mild-tall, thick, and relatively dark-green pods, and L_{12} had late flower with short, thick, and dark-green pods. All lines gave tall plants and smooth pods, with high values for net weight percentage, number of pods and total yield/plant. More work should be done for more improvement of these lines.

INTRODUCTION

One of the major goals of okra breeding is to improve yield and its components. The dominant breeding program usually involves selection in local populations and in segregating generations following inter-varietals crosses. This must be accompanied by testing the selected materials for the performance of yield and its components. To achieve this goal, the breeder has the option of selecting desirable genotypes in early generations or delaying intense selection to advanced generations, when progenies become nearly homozygous and depending on preliminary accepted yield traits. The selection criteria for improved production may be total yield and one or more of the morphological components of yield. In 2001, an experiment with 45 genotypes of okra (10 F_1+10 F_2 and 20 backcross families with 5 parents) were tested to get information about the phenotypic and genotypic variability, heritability, genetic advance of some important traits of okra (Mansour, 2004). He found that plant height, number of branches/plant, pod length, number of pods/plant, total yield/plant and Spines had high genotypic and phenotypic co-efficient of variation, heritability and genetic advance were high as well. These findings were confirmed by Martin et al. (1981); Patil et al. (1996); Panda and Singh (1997); Paiva and Costa (1998). Therefore, these traits can be improved by selection through segregating generations.

The present investigation was carried out to determine the performance of some advanced breeding lines of okra to compare them with their parents regarding yield and its components to select one line or more to be officially listed in Egypt.

MATERIALS AND METHODS

The present study was carried out during the three successive seasons of 2002, 2003 and 2004 at Sabahia Horticultural Research Station, Alexandria, Egypt. Plant materials of this study established with 5 local varieties, of diverse origin, and 14 breeding lines of okra. The varieties, presented in Table 1, were used as parents. The lines were originated from a breeding program, started in the summer season of 1995 (Mansour 1997 and 2000). Six segregates of the crosses among the five local varieties of okra represented these lines in the study. The hybridization and repeated selfing and individual plant selection and selection within families to the F_5 generation was done for the six lines were followed. These lines are; L_1 {$P_1 \times P_3$}, L_2 {$P_1 \times P_4$}, L_3 {$P_2 \times P_3$}, L_4 {$P_2 \times P_4$}, L_5 {$P_2 \times P_5$} and L_6 {$P_3 \times P_4$}. The remained eight lines were developed by backcrossing F_1 plants to one of their parents and repeated selfing, individual plant selection and selection within families up to the 4^{th} generation. These lines are; L_7 {$P_1 \times (P_1 \times P_2)$}, L_8 {$P_2 \times (P_1 \times P_2)$}, L_9 {$P_4 \times (P_1 \times P_4)$}, L_{10} {$P_2 \times (P_2 \times P_3)$}, L_{11} {$P_4 \times (P_2 \times P_4)$}, L_{12} { $P_2 \times (P_2 \times P_5)$}, L_{13} {$P_5 \times (P_2 \times P_5)$}, and L_{14} {$(P_4 \times (P_3 \times P_4)$}.

It worth mentioning, that the first six breeding lines were selected from 20 F_2 crosses originated from a half diallel cross, while the other eight lines were selected from 20 backcrosses developed by crossing each of the 10 F_1 crosses to each of their parents (Mansour, 2004). Selection was practiced for number of days to first flower, pod length, diameter, weight, color, spines, neck/pod ratio and total yield/plant.

Table 1: Sources and main characters of local okra varieties.

Parents		**Sources**	**Pod characters**
Fallahi	(P_1)	The local market near Alexandria.	Medium green with red spots, thin and medium spiny.
Assuiti	(P_2)	Fac. Agric., Assiuti Univ.	Dark green, thick and non-spiny.
Eskandrani	(P_3)	The local market near Alexandria.	Medium to light green, thick and semi spiny.
Roomi	(P_4)	A foreign cv. adapted in Alexandria.	Light green, tall and non-spiny.
Baladi	(P_5)	The local market in Assiuti.	Dark green, thick and heavy spiny.

On the first of May 2002, fourteen selected breeding lines (six F_3 self-pollinated families and eight F_2 backcross lines), along with their 5 parental lines (which were multiplied by controlled sib-mating), were hand sown in a randomized complete block design of three replicates experiment. Each sergeant was planted in 2 rows-plot in each replicate. The rows were 4 m. long, 60 cm. apart and seeds were sown in hills spaced 40 cm. apart. After emergence the hills were thinned to one plant per hill. Cultural practices were carried out as recommended for okra production in Alexandria area. Selection was made between and within the 14 breeding lines.

In 2003, summer season, eight lines (six F_4 self-pollinated pedigree lines and two F_3 backcross lines, namely, L_{10} and L_{12}) which were originated from the previous generation by selfing and single plant selection within families with their five parental lines, were planted in the same date and manner as done in 2002 summer season. Selection was made between and within the 8 breeding lines.

In 2004, summer season, 5 lines (three F_5 self-pollinated pedigree lines i.e., L_3 , L_5 and L_6 and two F_4 backcross lines i.e., L_{10} and L_{12}) along with their parental lines, were planted in the same date and manner as it was 2002 and 2003 summer seasons.

Days to first flower was measured as number of days from seeding to first flower anthesis. Plant height and number of branches/plant were taken after the last picking of pods. The following traits were recorded, as an average data of 50 mature pods per plot; pod length and diameter (cm), weight (g), spines (scored from 1 to 3, where 1 denotes the smoothest pod, 2 to medium spiny and 3 to the heavy spiny), and pod color; determined visually and ranged 1 to 3, where 1 for light, 2 to mild, and 3 dark green pods. Net weight percentage of pods expressed as pod weight without neck (g) x 100/total pod weight (g). Edible pod yield (g) and number of pods/plant were taken on the inner 10 plants within row for 25 picking at three days period after anthesis.

The obtained data were tabulated and statistically analyzed according to Dospekhov (1984) and the differences were detected by the revised L.S.D at 0.05 level of probability.

RESULTS AND DISCUSSION

Mean values ±standard error of six F_3 self-pollinated pedigree lines and eight F_2 backcrossed lines compared with their parents showed significant differences for all of the studied traits (Table 2). Days to first flower, L_{12} followed by L_1, L_{11}, L_4 and L_{10} were the earliest flowering. On the other hand, L_8 and L_{14} were the latest. These results show the importance of L_{12}, L_1, L_{11}, L_4 and L_{10} lines in the improvement of early okra yield. Earliness of

okra yield is desired for both marketing and growing okra under less favorable environmental conditions. However, early flowering and fruiting in okra are desired by Shalaby (1975). Korla and Rastogl (1978) pointed that the improvement by selecting early flowering of okra types will reflect a large number of fruit. Also, earliness in okra was suggested by Erickson and Couto (1963) to have a dominant nature.

Line 6 plants exhibited the tallest ones, the numerous branches and longest pods, while L_7 gave the opposite results of these characters in the experiment. Lines 3 and 11 gave thin pods, while L_{13} gave thick pods. These pods are preferred by Upper Egypt citizens, while most of Egyptians prefer the thin ones. Lines 4, 11, 5 and 8 gave the lowest pod weight. The lighted weight okra pods are desired by most the Egyptians in Lower Egypt. Whereas L_{14} gave the highest ones. Line 14 had light green color pods; Lines 1, 12, 2, 8 and 10 had mild green color pods; Lines 3, 4, 5, 9, 6 and 13 had dark green color ones. This diversity of pod color will meet the desire of wide range of consumers. As pod Spines, most lines showed relatively smooth pods, whereas L_{13} and L_7 possessed relatively heavy pods. Spines of okra pods is undesired by the picker and processor.

On the other hand, net weight percentage ranged from 71.5 % followed by 71.6 % for L_8 and L_{14}, respectively, to 82.5 % for L_3. The lowest values for number of pods and total yield/plant were obtained from L_{14} and L_{11}, respectively, and L_{12} was the highest. Six self-pollinated pedigree lines (F_4) and two backcrossed lines of okra (F_3) were selected on the basis of their pod color and spines and other quality traits. The lines 7, 8, 9, 11, 13 and 14 were rejected.

The results of six F_4 self-pollinated pedigree lines and two backcrossed lines of okra (Table 3) showed that all studied traits exhibited significant differences except that of pod spines. Days to first flower showed wide range of variation, it ranged from 47.8 days in L_3 to 57.0 days in L_{12}. Concerning Plant height, L_2 was the shortest, while L_{12} were the tallest plants. Both of L_5 and L_{12} gave short and thick pods; while L_3 followed by line L_6, had the longest and thinner pods. Pod weight ranged from 43.0 gm in L_5 to 55.3 gm in L_6. Wide range of variation was found among lines in pod color, it ranged from light green to dark green in L_1 and L_4, respectively. Net weight percentage ranged from 82.0 % of the pod in L_2 to 85.4% in L_3. such result is desired by the processor and the home wife, because of the net weight percentage increased, the end resulting material of food will increase. It also will reduce the cast price of the product. Regarding number of pods and total yield/plant, L_{12} and L_1 had the lowest values, respectively, whereas L_3 and L_6 gave the highest values,

respectively. This result is expected, as the number of okra pods per plant is increased, the total weight of pods will consequently increase.

A noticeable improvement was detected in all studied characters in the experiment except that of pod color and net weight percentage in the self-pollinated pedigree lines for the changes from F_3 to F_4. Also, the improvement in the backcrossed lines for the changes from F_2 to F_3 was clear in all studied traits except that of days to first flower, pod diameter and spines. This improvement was confirmed by the attained overall changes in Table 5. The lines L_3, L_5, L_6, L_{10} and L_{12} were selected according to their high performance of days to first flower, plant height, pod spines and other quality traits.

Differences were significant among the three F_5 selfing pedigree lines and two F_4 backcrossed lines of okra regarding all studied traits except that of number of branches/plant and pod spines (Table 4). Line 3 was early flower with tall, thin, and mild-green pods, $L_5$was early flowering with short, thick, relatively dark-green pods; L_6 had early flowers with tall, thin, and dark-green pods; L_{10} was late flowering with semi-tall, thick, relatively dark-green pods; L_{12} had late flowers with short, thick, dark-green pods. All lines gave tall plants, smooth pods, high values for net weight percentage, number of pods and total yield/plant. Some traits tended to be improved from F_4 to F_5, i.e., plant height, pod length, pod color and total yield/plant in the three completely selfing pedigree lines while pod color, spines and number of pods/plant were improved in the two backcrossed lines from F_3 to F_4. In this regard, Chandra et al. (1996) showed that the selection for number of pods/plant, length of pod and plant height is important to evolve high yielding varieties of okra. Also, in another study, Veeraragavathatham and Irulappan (1991) found that, after selfing for 6 generations, the parents Punjab Padmin (P_1), AE974 (P_2), AE138 (P_3), Pusa Sawani (P_4), AE142 (P_5), AE180 (P_6) and AE824PS.11 (P_7) were crossed a full diallel to give 21 direct and 21 reciprocal hybrids. The crosses P2 x P_6, P_2 x P_1 and P_2 x P_4. P_2 x P_4 were preferred. High yielding (317 g/plant) were combined with a high number of fruits/plant (21.8) and reduced fruit length (15.8 cm).

Table 2: Mean ± S.E. of some economic characters for the studied six F_3 selfed pedigree lines, and the eight F_2 backcrossed lines of okra, compared with their parents grown in 2002.

Genotypes	Days to first flower	Plant height (cm)	No. of branches /plant	Pod length (cm)	Pod diameter (cm)	Pod weight (g)	Pod color	Spines	Net weight (%)	No. of pods / plant	Total yield/ plant (g)
Parents											
P_1	50.9±0.34 f*	168.4±1.10 ef	7.5±0.32 g	7.5±0.23 j	3.6±0.03 b	39.2±1.58 fg	2.2±0.03 de	3.0±0.00 a	70.4±0.54 g	45.5±0.36 b	183.1 ±1.0 b
P_2	61.7±0.31 a	154.1±0.85 ef	6.7±0.27 h	8.1±0.14 i	3.4±0.06 bc	37.4±1.00 gh	3.0±0.00 a	1.0±0.00 f	66.9±0.44 h	38.4±0.33 f	153.2 ±1.0 c
P_3	62.6±0.25 a	133.5±1.09 g	9.7±0.23 d	10.8±0.32 g	3.0±0.08 df	41.5±1.08 f	2.1±0.03 e	1.8±0.06 c	79.5±0.32 c	37.1±0.49 g	137.3 ±1.3 d
P_4	61.1±0.38 ab	179.1±0.99 d	9.2± 0.18 e	17.9±0.49 b	2.3±0.08 i	40.8±1.60 f	1.6±0.03 f	1.0±0.00 f	79.7±0.22 c	34.3±0.43 h	122.8 ±1.3 de
P_5	62.8±0.20 a	180.8±1.12 d	10.8±0.15 bc	9.0 ±0.12 h	3.5±0.06 b	40.5±1.00 f	3.0±0.00 a	3.0±0.00 a	76.4±0.60 de	28.7±0.17 j	119.7 ±0.5 e
Lines:											
L_1	52.6±1.68 de	173.8±1.68 de	8.0 ± 0.58 f	13.5 ± 0.85 d	2.8±0.44 fg	47.0±1.83 cd	2.1±0.55 e	1.4±0.22 de	79.7±1.80 c	43.4±1.01 d	177.6±3.3 bc
L_2	56.2±1.58 c	122.2±1.46 g	8.7 ± 0.44 e	10.5 ± 0.65 g	3.3±0.26 c	46.9±3.01 d	2.2±0.20 de	1.6±0.20 c	78.6±1.44 cd	40.6±1.61 e	197.6±4.9 b
L_3	54.0±1.57 d	172.9±1.33 de	10.6 ± 0.46 c	12.4 ± 1.21 e	2.6±0.35 g	40.8±2 97 f	2.5±0.17 c	1.3±0.23 e	82.5±1.61 a	45.2±0.89 b	199.8±2.7 b
L_4	52.8±1.25 de	231.7±1.50 b	9.7 ± 0.32 d	11.5 ± 1.07 f	3.1±0.38 df	35.7±1.93 i	2.5±0.23 c	1.6±0.23 c	80.5±1.93 bc	43.4±1.26 d	186.8±3.2 b
L_5	54.1±1.12 d	155.6±1.63 ef	10.5 ± 0.47 c	10.3 ± 0.76 g	3.0±0.32 df	38.7±1.71 g	2.5±0.23 c	1.2±0.27 ef	81.6±1.72 b	43.0±0.98 d	202.7±3.5 ab
L_6	55.5±1.33 cd	257.9±1.80 a	11.1 ± 0.43 b	19.9 ± 0.81 a	3.0±0.35 df	44.0±2.13 e	2.7±0.02 b	1.4±0.18 de	81.8±1.82 b	38.7±0.86 f	146.8±3.0 d
L_7	53.7±1.53 d	116.2±1.05 gh	6.5 ± 0.55 h	9.2 ± 0.88 h	3.7±0.43 b	45.0±1.80 de	2.4±0.20 cd	2.1±0.29 b	74.2±1.76 f	38.2±0.89 f	177.4±3.6 bc
L_8	57.4±1.79 c	153.7±1.53 ef	7.2 ± 0.65 g	10.2 ± 0.66 g	3.3±0.38 c	38.9±2.48 g	2.3±0.23 d	1.3±0.32 e	71.5±2.02 g	36.5±1.02 g	178.0±3.0 bc
L_9	53.4±1.44 d	163.2±1.84 e	12.9 ± 0.47 a	15.7 ± 0.90 c	2.9±0.26 f	55.0±2.57 a	2.6±0.26 bc	1.3±0.40 e	81.3±1.70 b	39.7±1.25 f	176.5±4.0 c
L_{10}	52.8±1.48 de	201.9±1.98 c	8.9 ± 0.49 ef	10.2 ± 1.17 g	3.1±0.41 d	46.4±1.69 cd	2.3±0.28 d	1.3±0.16 e	78.2±1.82 cd	44.4±0.98 c	202.6±3.4 ab
L_{11}	52.7±1.79 de	164.2±2.39 e	9.3 ± 0.44 de	13.8 ± 1.01 d	2.6±0.29 g	38.6±2.05 gh	1.8±0.20 f	1.3±0.37 e	78.0±1.53 d	36.5±1.02 g	135.3±2.8 d
L_{12}	52.3±1.80 e	238.0±2.34 b	8.6 ± 0.38 ef	10.9 ± 1.10 g	3.4±0.26 bc	47.7±2.08 c	2.1±0.20 de	1.1±0.06 f	77.9±2.10 d	48.5±1.06 a	214.7±3.1 a
L_{13}	55.9±1.81 cd	135.7±1.20 g	9.5 ± 0.35 d	9.6 ± 0.69 h	4.0±0.38 a	39.7±2.29 fg	2.7±0.28 b	2.0±0.26 b	77.5±1.56 d	34.6±0.98 h	148.4±2.9 d
L_{14}	57.7±1.35 c	105.9±2.0 h	8.3 ± 0.35 f	13.1 ± 1.13 d	3.2±0.41 cd	52.8±2.02 b	1.6±0.26 f	1.5±0.38 d	71.6±1.63 g	33.3±1.21 i	144.3±2.8 d

*Values with alphabetical letter, within a comparable group of means, do not differ significantly from one another using LSD Test at 0.05 level of probability

Table 3: Mean ± S.E. of some economic characters for the studied six F_4 selfed pedigree lines, and two F_3 backcrossed lines of okra, compared with their parents grown in 2003.

Genotypes	Days to first flower	Plant height (cm)	No. of branches /plant	Pod length (cm)	Pod diameter (cm)	Pod weight (g)	Pod color	Spines	Net weight (%)	No. of pods / plant	Total yield/ plant (g)
Parents:											
P_1	50.1±0.58 e*	168.3±0.99 de	7.6±0.20 f	7.6±0.10 i	3.6±0.03 a	39.4±0.69 h	2.3±0.03 f	3.0±0.00 a	70.4±0.54 f	43.6±0.23 c	181.2±1.1 b
P_2	61.9±0.33 ab	154.2±0.58 e	6.9±0.12 g	8.1±0.12 h	3.4±0.06 ab	37.9±0.28 i	3.0±0.00 a	1.0±0.00 a	66.9±0.44 g	35.3±0.53 h	153.1±0.5 c
P_3	62.6±0.35 a	134.0±0.69 f	9.8±0.22 c	10.5±0.20 f	3.0±0.08 bc	42.3±0.26 f	2.3±0.06 f	1.8±0.07 a	79.5±0.32 d	34.3±0.52 i	138.4±1.1 cd
P_4	61.1±0.31 b	178.9±0.97 d	8.9±0.12 d	18.3±0.23 c	2.3±0.08 e	40.8±0.52 g	1.4±0.03 h	1.0±0.00 a	79.7±0.22 d	32.4±0.47 j	123.8±0.7 d
P_5	62.5±0.32 a	160.5±0.93 d	11.1±0.41 b	9.0±0.12 g	3.5±0.08 a	40.6±0.55 g	3.0±0.00 a	3.0±0.00 a	76.4±0.61 e	31.5±0.26 k	120.7±1.1 d
Lines:											
L_1	53.5± 0.96 d	181.1±1.45 d	9.8±0.26 c	13.9±0.83 d	2.9±0.25 c	49.8±1.31 d	1.7±0.09 g	1.3±0.08 a	82.7±1.37 c	43.8±0.72 c	175.3±2.5 bc
L_2	53.2±1.45 d	166.1±1.20 de	9.1±0.29 d	13.2±0.38 d	3.2±0.20 b	52.9±1.51 b	2.6±0.12 cd	1.4±0.12 a	82.0±1.25 c	44.2±0.93 b	195.6±3.0 b
L_3	47.8±1.22 f	226.4±1.31 b	7.1±0.32 g	21.4±0.61 a	2.6±0.26 d	43.2±1.18 f	2.3±0.12 f	1.0±0.00 a	85.4±0.90 a	46.6±0.68 a	212.9±2.0 a
L_4	48.1±1.15 f	215.9±1.59 bc	12.3±0.32 a	13.0±0.31 d	3.0±0.21 bc	50.9±1.13 c	2.4±0.08 ef	1.0±0.00 a	82.1±1.40 c	40.4±0.86 e	183.7±3.1 b
L_5	50.8±0.90 e	230.9±0.64 ab	9.7±0.30 c	11.8±0.39 e	3.4±0.26 ab	43.0±1.48 f	2.5±0.12 de	1.1±0.06 a	83.2±1.07 b	41.0±0.95 d	206.0±1.7 ab
L_6	48.9±1.39 f	245.4±1.54 a	8.9±0.31 d	20.9±0.45 b	2.8±0.28 c	55.3±0.99 a	2.8±0.12 b	1.0±0.00 a	83.2±1.34 b	39.2±0.73 f	220.7±2.0 a
L_{10}	52.8±1.18 d	212.0±0.96 bc	8.8±0.31 d	13.6±0.55 d	3.3±0.29 b	45.9±1.24 e	2.5±0.10 de	1.0±0.00 a	82.9±1.52 c	44.2±0.67 b	211.5±3.1 ab
L_{12}	57.0±1.40 c	257.6±1.78 a	8.5±0.32 e	11.8±0.24 e	3.5±0.26 a	43.1±1.11 f	2.7±0.14 bc	1.1±0.03 a	83.7±0.95 b	37.2±0.73 g	216.2±1.7 ab

*Values with alphabetical letter, within a comparable group of means, do not differ significantly from one another using LSD Test at 0.05 level of probability.

Table 4: Mean ± S.E. of some economic characters for the studied three F_5 selfed pedigree lines,and two F_4 backcrossed lines of okra, compared with their parents grown in 2004.

Genotypes	Days to first flower	Plant height (cm)	No. of branches /plant	Pod length (cm)	Pod diameter (cm)	Pod weight (g)	Pod color	Spines	Net weight (%)	No. of pods / plant	Total yield/ plant (g)
Parents											
P_1	60.6±0.23 d#	155.3± 0.64 d	7.5 ±0.23 a	8.2±0.12 i	3.5±0.06 a	38.1±0.23 f	3.0±0.00 a	1.0 ±0.00 a	69.2 ±0.41 f	43.5 ±0.49 c	178.8±0.96 b
P_2	61.8±0.14 c	133.9± 0.84 e	9.8 ±0.14 a	10.6±0.12 g	3.2±0.08 a	42.2±0.32 d	2.3±0.04 d	1.9 ±0.06 a	80.0 ±0.37 b	36.6 ±0.35 e	136.2±1.21 c
P_3	52.4±0.20 f	181.8± 0.91 c	9.0 ±0.12 a	18.8±0.21 c	2.4±0.06 c	40.6±0.37 e	1.4±0.06 f	1.0 ±0.00 a	79.3 ±0.31 c	31.3 ±0.35 f	122.2±0.95 c
P_4	62.0±0.17 a	183.1± 0.58 c	11.1±0.23 a	9.4±0.23 h	3.5±0.06 a	40.9±0.35 e	3.0±0.00 a	3.0 ±0.00 a	74.9 ±0.35 e	29.9 ±0.35 g	118.3±0.93 c
P_5	62.7±0.26 b	180.7±1.03 c	11.0±0.28 a	9.0±0.12 h	3.5±0.07 a	40.6±0.78 e	3.0±0.00 a	3.0±0.00 a	76.4±0.61 d	30.1±0.22 g	120.2±0.80 c
Lines											
L_3	49.3±0.74 h	230.3±0.71 b	7.3 ±0.26 a	21.8±0.35 a	2.6±0.17 b	44.3±0.92 c	2.2±0.06 e	1.0 ±0.00 a	83.8 ±0.59 a	46.4 ±0.56 a	216.3±1.11a
L_5	50.6±0.61 g	235.9±0.84 b	8.8 ±0.28 a	11.2±0.23 f	3.5±0.20 a	42.5±0.93 d	2.6±0.04 b	1.1 ±0.03 a	82.1 ±0.95 a	41.0 ±0.66 d	208.7±1.31 a
L_6	48.3±0.66 i	267.4±1.27 a	8.3 ±0.12 a	20.9±0.23 b	2.9±0.17 b	54.9±0.69 a	3.0±0.04 a	1.0 ±0.00 a	81.1 ±0.78 ab	40.2 ±0.50 d	224.5±1.31 a
L_{10}	52.6±0.61 f	225.7±0.90 b	8.3 ±0.21 a	13.9±0.24 d	3.4±0.17 a	46.0±0.91 b	2.5±0.04 c	1.0 ±0.00 a	80.6 ±0.88 b	44.9 ±0.43 b	215.0±1.32 a
L_{12}	56.3±0.66 e	257.5±0.85 a	7.0 ±0.25 a	12.0±0.23 e	3.6±0.20 a	44.4±0.79 c	3.0±0.00 a	1.0±0.00 a	82.3 ±0.65 a	40.0 ±0.52 d	220.7±1.35 a

Values with alphabetical letter, within a comparable group of means, do not differ significantly from one another using LSD Test at 0.05 level of probability.

Table 5: Overall changes % for some important characters of okra three F_5 self-pollinated pedigree lines from F_3 to F_4 and F_4 to F_5, and two F_4 backcrossed lines from F_2 to F_3 and F_3 to F_4 generations.

Characters	self-pollinated pedigree lines		Backcrossed lines	
	F_3 - F_4	F_4 - F_5	F_2 - F_3	F_3 - F_4
Days to first flower	7.0	1.6	- 0.7	0.7
Plant height (cm)	- 13.6	- 15.9	- 46.8	- 2.9
No. of branches /plant.	3.1	14.7	-7.4	11.5
Pod length (cm)	- 20.8	- 14.6	- 9.4	- 2.4
Pod diameter (cm)	- 20.0	0.0	8.0	- 2.9
Pod weight (g)	- 16.6	4.1	2.2	- 1.6
Pod color	0.0	- 8.3	- 18.2	- 7.9
Pod Spines	31.3	9.1	35.3	9.1
Net weight (%)	- 2.8	1.0	- 9.2	2.2
No. of pods/plant	- 5.4	- 1.8	- 4.4	- 4.4
Total yield/plant (g)	- 7.5	- 8.8	- 24.2	- 1.9

In general, all characters tended to be improved, but the rate of improvement was higher in F_5 than that in F_4 lines, regarding the self-pollinated pedigree lines (Table 5). On the contrary, the improvement in days to first flower, pod length and Spines and number of pods/plant were less in F_5 than F_4 lines. The changes in pod weight were barely stopped from F_4 to F_5. Regarding backcrossed lines, the rate of improvement was higher in F_3 than F_4 in plant height, pod length, color and Spines and total yield/ plant. The change in pod diameter and net weight was stopped from F_3 to F_4 lines.

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الملخص العربى

الانتخاب للمحصول ومكوناته فى الباميا

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من خلال برنامج تربية بدأ بمحطة بحوث البساتين بالصبحية بالإسكندرية فى الموسم الصيفى ١٩٩٥ ، تم أنتاج ٥ سلالات جديدة من الباميا عن طريق الانتخاب ، وقد أجرى الانتخاب المصحوب بالتربية الذاتية للأفراد المنتخبة لثلاثة أجيال متتالية؛ بدأ بأفراد الجيل الثالث حتى الجيل الخامس لمدة ٣ مواسم صيفية متتالية ناجحة هى ٢٠٠٢ ، ٢٠٠٣ ، ٢٠٠٤ وذلك لإنتاج أصناف محلية متباينة فى الصفات ، وتصلح للاستهلاك الطازج . وقد تميزت هذه السلالات بالآتى :

١ – السلالة الأولى ($P_2 \times P_3$) كانت مبكرة النضج، وذات قرون طويلة، ورفيعة، وناعمة الملمس، ولونها أخضر متوسط .

٢ – السلالة الثانية ($P_2 \times P_5$) كانت مبكرة النضج، وذات قرون قصيرة ، وسميكة ، وناعمة الملمس ، لونها أخضر متوسط.

٣ – السلالة الثالثة ($P_3 \times P4$) كانت مبكرة النضج، وذات قرون طويلة، ومتوسطة السمك، وناعمة الملمس، ولونها أخضر داكن.

٤ – السلالة الرابعة ($P_2 \times (P_2 \times P_3)$) كانت متأخرة النضج، وذات قرون متوسطة الطول ، وسميكة ، وناعمة الملمس ، ولونها أخضر متوسط .

٥ – السلالة الخامسة ($P_2 \times (P_2 \times P_5)$) كانت متأخرة النضج، وذات قرون قصيرة ، سميكة ، ناعمة الملمس ، و لونها أخضر داكن .

كما تميزت جميع السلالات بطول النباتات ، وارتفاع فى كل من نسبة تصافى القرون، ووزن وعدد القرون لكل نبات. ويحتاج الأمر إلى مزيد من العمل لإجراء مزيد من التحسين فى هذه السلالات.