Simple Recurrent Selection and Selfing with Selection as Two Breeding Methods for Improving Pumpkin[*Cucurbita moschata*,Duchesne (Poire)] Plants

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ABSTRACT

The present investigation was carried out during the three successive summer seasons of 2004, 2005 and 2006, in order to compare the efficiency of one cycle of simple recurrent selection with selfing and selection for two generations, as two breeding methods for some important characters of pumpkin.The estimated coefficients of variation (C.V.%) values for the characters; main stem length, number of leaves/plant, number of branches/plant, fruit weight, fruit polar diameter, fruit equatorial diameter, fruit shape index, fruit flesh thickness, flesh dry matter, total soluble solids and carotene contents in a relatively large population of the "Local" cultivar of pumpkin reflected generally enough variability for the purposes of selection and improvement. Generally, the results indicated that all the studied characters were improved through the two practiced breeding methods, simple recurrent selection and selfing with selection, but with different magnitudes among the characters and the used breeding methods. Variability magnitudes within the studied characters declined as a result of practicing the two breeding systems, but with more severe reductions in the second selfed progenies, relative to those of simple recurrent selection population. The estimated values of the correlation coefficients among the various pairs of the studied characters illustrated generally that forty one out of the possible fifty five relationships, appeared to be significant and desirable for the objectives of selection in the present study.

INTRODUCTION

Pumpkin "butternut" or calabaza (*Cucurbita moschata,* Duchesne (Poire), 2n=40) is one of the important vegetable crops belonging to family Cucurbitaceae. It is considered as one of the most important and popular food crops in many tropical and sub-tropical countries in the world for its contents carbohydrates, protein, vitamins A, C and E; carotene, fibers and some minerals (Marek *et al.*, 2008).Moreover, pumpkin is ,also, one of the vegetables that well-know of nutritional source for its contents of carotenoids; which are precursors for an essential vitamin for vision (Wessel-Beaver *et al.*, 2006), and as antioxidants (Pandey *et al.*, 2003), that reduce the risk of certain cancers (Rock, 1997).

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In Egypt, it is noticed that the devoted area and the average production per faddan of pumpkin are extremely limited, which were estimated by 282 faddan, with an average production of 6.96 tons/fad*. Notably, no serious attempts have so for been made to purify and to upgrade the productivity and acceptability of this crop. Moreover, the grower's seeds are not usually produced by specialists. Therefore, this could be due to using old local cultivar of pumpkin, which have a relatively low productive capacity with a noticeable deterioration of quality characters, as well as, it is characterized with a great amount of variability in most of its traits presented among the individual plants.

Accordingly, it is important to open an immense scope to plan effective breeding programs for pumpkin improvement depending on selection procedures, leading to the identification of superior genotypes. Recurrent selection is one of the efficient selection's methods that is usually used for improving open-pollinated crops. This method allows to maintain genetic variability, consequently, natural vigor of cross pollinated crops; while, at the same time, allows for the concentration of desirable alleles and increase the frequency of superior recombinations in successive populations. Several investigators indicated the effectiveness of recurrent selection in increasing genetic improvement by raising the gene frequencies of the desirable alleles for various economical characters of cucurbits such as Simon and Navazia (1997), Mitiady *et al.* (2005), Cardoso(2007), Hazara (2007) ,and Gwanama *et al.*(2008) on pumpkin; Narayan *et al.* (1996) on bottlegourd; Staub *et al.* (2004) on melon; Lertat and Lower (1984), Wehner (1989) , Wehner and Cramer (1996) on cucumber .Generally, such researchers illustrated also that the studied characters of the different cucurbits plants can be improved by using recurrent selection method.

Inbreeding is the mating of closely related individuals in a population. Successive inbreeding increases the homozygosity by bringing together identical alleles at a locus which is usually associated with inbreeding depression on vigor and other characters, in cross-pollinated crops, but with various degrees. However, in many cases, inbreeding with selection increases the effectiveness of selection and the amount of genetic improvement in a breeding program by increasing the frequency of the desirable alleles. Some investigators studied the effect of inbreeding and/ or selfing with selection on some important characters of cucurbits such as Borghi *et al.* (1973) and Cardoso (2004) on squash; Chekalina (1976),Damarany(1989),and Hazara (2007) on pumpkin, and Godoy *et al.*(2005) on cucumber.

Concerning the magnitude of variability among pumpkin and some other cucurbits genotypes for some economic and important traits, several investigators estimated the phenotypic and/or genotypic variability coefficients such as Doijode and Sulladmath (1986), Wessel-Beaver (1998), Maynard (2005), Mohanty (2000) , Pandey *et al.*(2003), and Mitiady *et al.* (2005) on pumpkin; Narayan *et al.* (1996) on bottllegourd; Rahman *et al.* (2002) on snake gourd;and Gabriele and Wehner (2007) on watermelon. Their results illustrated generally that estimates of variability among genotypes for the different studied characters appeared to be high with a wide range, which reflected the high potential for effective selection in breeding programs to improve the characteristics of this crop.

Studies on correlation coefficients between pairs of characters enable the breeders to know the mutual relationship between various characters and determine the component characters on which selection can be used for genetic improvement. In this respect, positive and significant phenotypic correlation coefficients (directs effects) between some pairs of pumpkin characters; i.e., vegetative, and yield and its components; were estimated by many workers such as Doijode and Sulladmath (1986), Damarany (1989), Damarany and Farag (1994), Gwanama *et al.* (1998), Kumaran *et al.* (1998), Gwanama and Nichterlein (2005), Mohanty (2001), and Camacho *et al.* (2006). On the other hand, negative correlations (indirect effects) were evident between fruit weight and each of fruit diameter and fruit dry matter percentages (Damarany, 1989).

The main objective of this study was to estimate and compare the efficiency of one cycle of simple recurrent selection method with that of selfing with selection for two generations as two breeding methods, on the improvement of some important traits of pumpkin. The phenotypic correlation coefficients among the various studied traits were, also, estimated to assist pumpkin's breeders in their selection programs.

MATERIALS AND METHODS

This investigation was carried out during the three successive summer seasons from 2004 till 2006, at the Experimental Station Farm of the Faculty of Agriculture at Abies, Alexandria University, through the following steps:

2004 Summer Season

Growing of original population

The used original genetic material in this breeding program was the common commercial "Local" cultivar of pumpkin. Seeds were sown on May 5, 2004. The experimental area included 120 ridges, 4.5m long and

280cm wide, and the spacing between hills within ridges was 90 cm. The common cultural practices; such as fertilization, irrigation and pests control; were performed as usually recommended for pumpkin's commercial production whenever they appeared necessary.

Data recorded and variability estimations

The studied characters; that were measured on the basis of individual plants; included: main stem length (cm), number of leaves per plant,number of branches per plant, fruit weight (kg), fruit polar diameter (P, cm),fruit equatorial diameter (E, cm), shape index (E/P), fruit flesh thickness(cm), fruit dry matter content (%), total soluble solids content (T.S.S.%), and carotene content (mg/g.d.w). After harvesting of fully mature fruits, samples from each flesh fruits were, randomly, bulked, cut into small and thin slices, then, 30 grams of flesh samples were dried in a forced air oven at the temperature of 105°C for 48 hours, then at 70°C for 24 hours till a constant weight was accomplished, therefore, the samples reweighed to estimate the percentages of flesh dry matter content. The dried fruits samples were taken, grounded to determine carotene content according to Davies (1976). Flesh samples were also juiced to determine total soluble solids content (T.S.S. %) using a refractometer.

The recorded data were used to calculate the statistical variability parameters: ranges, means and coefficients of variations (C.V. %) for each character.

Initial selection and production of the first selfed generation

At the beginning of flowering stage, the best 70 plants from the growing population (about 1050 plants) were primarily selected on the basis of the general performances of their visual vegetative growth characteristics; i.e., main stem length, number of leaves per plant, and number of branches per plant. The selection criteria used in the primary selection were based on the following desirable characters; long stem , more number of leaves per plant and more number of branches per plant. Then, each of the selected plants was selfed by hand pollination, using pollen grains, which collected from mature anthers of just opened flowers that were bagged before by a paper bags. After the completion of the hand pollination that was always done on the early morning, the pollinated flowers were, also ,re-bagged till the assurance of fruit setting.

At fruit maturity; a second and more severe selection practice was conducted, according to the following desirable fruit's characters; a heavy fruit's weight; a long polar diameter, a wide equatorial diameter; having oblong –and/or cylindrical -shape; a thick flesh thickness. A third and more severe selection cycle was done on the basis of high dry matter content, high total soluble solids, and high carotene content. Then, the seeds of each selected plants were separately extracted, dried and stored to be used it in the next generation. The number of the final selected plants came out to be only 30 ones.

2005 Summer Season

Seed production of the first cycle of recurrent selection (C_1) and of the second selfed progenies (S_2's)

Seeds of the first selfed progenies (S_1's) were separately sown on May 10, 2005. Selection, on the same foregoing basis, was again practiced within-and between-the selfed progenies of the selected plants to maintain the six most promising progenies for the next cycle of self-pollination. At flowering stage, some of the developing floral buds were selfed to produce the seeds of the second selfed progenies (S_2's); whereas, all other flowers were left for open-pollination to produce the seeds of the first cycle (C_1) of the simple recurrent selection.

2006 Summer Season

Evaluation of the derived populations (C_1) and (S_2's)

Seeds of the original population (C_0) and those of the first recurrent selection cycle population (C_1), as well as those of the six second selfed progenies (S_2's) of the six selected populations were sown on May 17, 2006. In this experiment a randomized complete blocks design (R.C.B.D.), with four replicates was used. Each plot consisted of four ridges; 5m long and 280 cm wide; and the plants were allowed to grow at 90 cm spacings. All recommended cultural practices for commercial pumpkin production were followed.

Statistical Analyses

Data of the previously mentioned characters were recorded, statistically analyzed as illustrated by Al-Rawi and Khalf-Allah (1980), using Co-State Software (2004), computer program for statistics. The differences among the various means were tested, using Duncan's multiple range test (L.S.R.). The phenotypic correlation coefficients between the different pairs of characters were also estimated as described by Mather and Jinks (1971). Also, the statistical parameters of variability; i.e.; ranges and coefficients of variation (C.V. %) for each studied characters were calculated.

RESULTS AND DISCUSSION

Table 1 shows the results of the estimated values for the statistical parameters; means, ranges and coefficients of variation (C.V.%); for all studied characters of the original population (C_0) of the pumpkin "Local" cultivar. The results of the estimated values of coefficients of variation, clearly, indicated that the original population (C_0) was characterized with a high variabilities, which ranged from 27.11% for fruit polar diameter up to 48% for fruit weight. The results showed also that the ranges of the various studied characters in the original population were generally found to be wide. Such obtained results seemed to be due to the oldness of this cultivar and its growing, commercially, for a long period without any purification and improvement. Moreover, the highest detected extreme values noticed in the reflected wide ranges by most of the studied characters, which reached more than double of the population mean in particular characters, clearly, suggested the high potentialities for improving such characters in pumpkin. Also, the tremendous variation reflected by most investigated characters of the original population supported the high possibilities of conducting successful and efficient selection to introduce new cultivar, with better general performances than the original population. Such an opinion agreed, completely, with the ideas of Mitiady *et al.* (2005), who found that the local types of pumpkin were considered as a rich source of variation and could be used as a main selection material in breeding programs to improve the characteristics of this crop. Also, some researchers such as Doijode and Sulladmath (1982), Maynard (2005), and Mohanty (2000) found wide ranges of variation in most of the studied characters in pumpkin and concluded that their studied characters could be improved through selection.

Accordingly, it was expected that all studied characters could be improved through selection and selfing; using a recurrent selection method; but, with varying degrees, depending on the amount of variation presented in the population, the selection intensity, and the heritability of the concerned character.

Table 1: Means ($\bar{X}$), ranges and coefficients of variations (C.V.%) for all studied characters of the original population of "Local" cultivar of pumpkin in 2004 season.

Characters \ Parameters	$\bar{X}$	Range	C.V. %
Main stem length (m)	4.11	2-8	44.63
No. of leaves / plant	152.13	82-237	35.42
No. of branches / plant	4.12	2-8	42.62
Fruit weight (kg)	4.21	0.530-8.50	48.00
Fruit polar diameter (P, cm)	31.19	16-56	27.11
Fruit equatorial diameter (E, cm)	24.32	10-49	28.16
Fruit shape index (E/P)	0.72	0.38-1.44	31.86
Fruit flesh thickness (cm)	2.75	1.50-5.00	30.22
Flesh dry matter content (%)	8.50	7.00-20.00	29.00
Total soluble solids (T.S.S %)	5.71	4-11	28.32
Carotene content ($mg.g.d.w^{-1}$)	0.44	0.22-0.80	39.42

The results of the comparisons among the different statistical parameters; means, ranges and coefficients of variations; of the different studied characters of the eight different evaluated populations; original population (C_0), population derived from the first cycle of recurrent selection (C_1) and second selfed progenies of the six individual selection [S_2-1, S_2-2, S_2-3, S_2-4, S_2-5 and S_2-6] are listed in Tables 2,3 and 4.

Respecting the vegetative growth characters; main stem length, number of leaves per plant and number of branches per plant; the comparisons among the means of the eight different populations (Table 2) indicated generally that all selected populations were characterized with long main stems, more numbers of leaves and branches per plant, than those of the original population (C_0). The differences among the mean values of each studied character for all selected populations appeared to be significant, but with different magnitudes, compared to those of the original population. The results showed also that the values of coefficients of variations (C.V. %) and ranges of the derived population ,were found to be lower and narrower, relative to those of the (C_0). These results indicated clearly that the practiced recurrent selection cycle was able to increase, significantly, the characters of main stem length, number of leaves per plant and number of branches per plant from 3.85 m, 147.42 and 4.25 in the original population (C_0) up to 4.76 m, 191.52 and 4.93 in the population of the first recurrent selection cycle, respectively. These results reflected desirable increments in the means values of these three characters; main stem length, number of leaves per plant and number of branches per plant; which were estimated by 23.64%, 29.91 % and 16%, respectively. These results seemed to accord with the findings of Doijode *et al.* (1982) on vine length; Gwanama and Nichterlein (2005) on vine length, numbers of branches and leaves per plant; and Maheswari and Haribabu (2005) on vine length and number of branches per plant, who found significant differences among their studied genotypes of pumpkin.

In the case of the progenies of selfing with selection, the increments in the characters of main stem length, number of leaves per plant and number of branches per plant were noticed to be within the ranges of 3.38% - 35.06%; 30.51% - 45.04%, and 4.47% - 34.59%, respectively. These results might be expected, since these characters seemed to be simply inherited. So, the successful selection for long stem, more numbers of leaves and branches could be related to the type of gene action involved in the inheritance of these characters, that seemed to be additive, as reported by Maheswari and Haribabu (2005). However, Sirohi and Behera (2000) noticed that dominant gene effect was greater than additive in the inheritance of vine length of pumpkin.

Table 2: Means ($\bar{x}$), ranges and coefficients of variations(C.V.%) for main stem length ,number of leaves / plant, and number of branches/ plant for the different populations of pumpkin.

Characters	Main stem length (m)			No. of leaves / plant			No. of branches/ plant		
Parameters / Populations	$\bar{x}$	Range	C.V.%	$\bar{x}$	Range	C.V %	$\bar{x}$	Range	C.V.%
C_o	3.85 c	1.45-5.60	42.60	147.42 c	79-233	36.17	4.25 d	2-8	45.09
C_1	4.76 b	2.50-5.00	29.81	191.52 b	98-220	21.17	4.93 bc	3-8	28.11
S_2-1	4.19 c	3.20-5.00	27.01	25.83 ab	110-220	20.81	4.44 bc	3-7	20.60
S_2-2	5.19 a	3.50-6.00	19.70	209.23 ab	110-225	17.09	5.72 a	3-7	18.01
S_2-3	4.24 c	3.00-5.50	20.23	192.40 b	110-220	19.11	4.78 bc	3-8	23.11
S_2-4	5.20 a	3.50-6.00	18.50	213.82 a	119-235	16.33	5.28 ab	4-8	17.83
S_2-5	4.01 c	3.00-5.00	21.83	196.14 b	120-225	20.91	5.10 b	3-8	21.70
S_2-6	3.98 c	3.10-5.00	22.97	194.76 b	115-215	22.60	4.50 cd	4-7	21.60

Values having similar alphabetical letter(s) do not significantly differ, using Duncan's multiples range test (L.S.R.) at 0.05 level of probability.

Co= Original population C₁= Population of the first recurrent selection cycle
S_2 (1)-S_2 (6) =Progenies of the second selfed generation of six individual selections.

The results illustrated also that the first recurrent selection cycle (C_1) reduced the (C.V.) values from 42.60% in (C_0) to 29.81% in (C_1) for main stem length; from 36.17% in Co to 21.17% in (C_1) for number of leaves per plant; and from 45.09% in (C_0) to 28.11% in (C_1) for number of branches per plant. Whereas, in the six second selfed progenies; S_2-1, S_2-2, S_2-3, S_2-4, S_2-5 and S_2-6;the reductions were greater, and the estimated (C.V.) values were found to be in the range from 18.50% to 27.01% for main stem length; from 17.09% to 22.60% for the number of leaves per plant and from 17.83% up to 23.11% for the number of branches per plant. Likewise, the detected positive relationships between main stem length with each of number of leaves per plant and number of branches per plant, in Table (5), contributed also for the improvement of these characters, since the selection for long stem would be associated with more numbers of leaves and branches per plant. Such improvements attained in these characters, through the two selection methods, indicated that both methods were efficient in concentrating the genes of long main stem, more numbers of leaves and branches per plant in the selected plants.

Pertaining the fruit characteristics of pumpkin; i.e., fruit weight, fruit polar and equatorial diameters, and shape index; results Table 3 illustrated that using one cycle of recurrent selection reflected significant increases in the population of C_1 ,compared to the original population (C_0) for these characters. This result was noticed from the comparisons among the mean values of the four fruit characters of the (C_0), with those of the four fruit characters of the (C_1), which appeared to be significant. Similarly, Mitiady *et al.* (2006) on fruit weight, and Wessel-Beaver *et al.*(2005) on fruit weight, fruit diameter, fruit length and shape index reported that recurrent selection method was used to improve these characters in pumpkin. The estimated values of the ranges and coefficients of variations (C.V. %) reflected additionally lower variability magnitudes after the first cycle of recurrent selection. Since, the (C.V. %) values in the original population were 48.16% for fruit weight; 28% for fruit polar diameter; 31% for fruit equatorial diameter; and 32.16% for fruit shape index; which were noticed to be reduced by 31.09%, 21.91, 22.13% and 23.17% for the four fruit characters, respectively, after the first recurrent selection cycle . The obtained results, generally, seemed to cope with those reported by Maynard (2000) on fruit weight and fruit shape of pumpkin. The same author reported that unimproved genotypes of pumpkin varied in their characters.

As for reducing effects on variabilities in the case of selfing with selection appeared to be more pronounced, since the (C.V.%) values of all selfed progenies were, severely, reduced to reach the range from 22.31% to 28.11% for fruit weight; from 17.11% to 21.31% for fruit polar diameter; from 17.50% to 21.11% for fruit equatorial diameter, and from 16.09% to 21.61% for fruit shape index. Such achieved improvements might be related to, the relatively, high amounts of variability in the original population. Also, selfing with selection resulted in concentrating the desirable genes of these characters, which cooperated in realizing the obtained results. In this respect, the successful selection for fruit weight character could be related to the type of gene action involved in the inheritance of this character that was reported to be mostly additive, as illustrated by Hazara (2007). The obtained results, in the present investigation, were generally in accordance with those obtained by Damarany (1989), who reported that using inbreeding with selection for three generations, improved with increasing effects for the characters fruit weight, fruit diameter and fruit length .

With reference to the characters of fruit flesh thickness, flesh dry matter content, total soluble solids and carotene contents, the results concerning these characters in Table 4 reflected, generally, some improvements in these four characters after only one cycle of recurrent selection as well as for selfing with selection for two successive generations. The comparisons among the mean values of these four characters illustrated generally that the mean values of the characters fruit thickness, flesh dry matter, total soluble solids, and carotene contents were significantly increased,and the increments as a percentage relative to the C_0 mean were estimated by 16.25%, 17.91%, 17.61% and 28.91%, respectively, after one cycle of recurrent selection(C_1),over those of the original population (C_0).The detected positive relationships among these four characters (Table 5) contributed ,also, for the improvements in these characters, since the selection for one of these character would lead also to same improvements in the other, which helped in achieving the objectives of the present study. The selfing with selection increased also the mean values of these four characters, which were estimated as percentages of the C_0 in their progenies, with about 30.39% to 49.12% for fruit flesh thickness; 33.50% to 64.91% for flesh dry matter content ;17.78% to 62.39% for total soluble solids content, and 28.19% to 79.75% for carotene content, relative to the original population means. Moreover, the results indicated that the great variability magnitudes in the original population offered good opportunity to improve these characters. Furthermore, the successful selection for improving of the two characters; i.e., total soluble solids and flesh thickness of pumpkincould be related to the type of gene action involved in the inheritance of these characters, which were reported by Mohanty (2000) for fruit flesh thickness, and Gwanama *et al.* (2008) for soluble solids content, who found that both the additive and non-additive gene effects were important in the inheritance of these two characters, though the additive gene effect was noticed to begreater than the non- additive gene effects. They reported, also, that these two characters could be improved by recurrent selection. The ranges and coefficients of variation values, generally, indicated that the variability estimates were reduced, with different magnitudes in all derived populations; compared to the original population as appears in Table 4.These results reflected the efficiency of the two practiced selection methods to improve these characters. Similar results were obtained by Pandey *et al.* (2003) on carotene content, and Marek *et al.* (2008) on soluble solids and carotene contents , who reported that their different evaluated genotypes of pumpkin varied in their contents of these two characters, and that some of them appeared to have superior and favorable values for the carotene and soluble solids contents. Concerning the flesh dry matter content, Damarany (1989) found slight decreases in dry matter content of pumpkin after inbreeding with selection.

With respect to phenotypic correlation coefficients; the estimated correlation coefficients among all possible pairs of the studied characters, in Table 5, illustrated that forty one out of the possible fifty five relationships appeared to be desirable for the objective of the present study, and highly correlated. Whereas, their estimated values were found to be either significant or, even, highly significant. On the other side, the other values of correlation coefficients (14 relationships) were found to be insignificant.

The desirable positive and significant correlations were detected between main stem length with each of number of leaves per plant, number of branched per plant, fruit weight; fruit equatorial diameter, total soluble solids and carotene content. These results indicated that selection for a long plant (a desirable form) would lead, spontaneously, for the improvement of the other six characters; more number of leaves and branches per plant, heavier fruit, wider fruit diameter, high contents of total soluble solids and carotene. Number of leaves per plant appeared to be positively correlated with each of number of branches per plant, fruit weight, fruit equatorial diameter, fruit shape index, fruit flesh thickness, flesh dry matter, total soluble solids and carotene contents. Number of branches per plant showed positive correlation with each of fruit weight, fruit equatorial diameter, fruit shape index, fruit flesh thickness, flesh dry matter, T.S.S. and carotene contents. These desirable relationships suggested, clearly, that selection for each of more number of leaves per plant and/or more number of branches per plant would subsequently resulted in increasing the fruit weight, fruit equatorial diameter, fruit shape index, fruit flesh thickness, flesh dry matter, total soluble solids and carotene contents.

Fruit weight was found to be correlated with each of fruit equatorial diameter, fruit shape index, fruit flesh thickness, flesh dry matter, T.S.S. and carotene contents. The estimated relationship between fruit weight and fruit equatorial diameter agreed with that reported by Damarany (1989). Also, positive correlations between fruit weight with each of fruit flesh thickness and fruit diameter were in accordance with those obtained by Damarany and Farag (1994). On the other hand, Damarany (1989) found a negative correlation between fruit weight and fruit dry matter, so, which disagreed with that noticed in the present study. The results of correlation coefficients indicated also that there were positive relationships among all possible pairs of the characters fruit equatorial diameter, fruit shape index, fruit flesh thickness, flesh dry matter, total soluble solids and carotene contents. These results seemed to agree with those reported by Doijode and Sulladmath (1986), Gwanama *et al.* (1998), Kumaran *et al.*(1998), and Mohanty (2001). Those investigators reported that positive and significant correlations among total yield and its components characters were detected inpumpkin.

Table 3: Means($\bar{x}$), ranges and coefficients of variations (C.V. %) for fruit weight (kg), fruit polar diameter (P, cm), fruit equatorial diameter (E, cm),and fruit shape index (E/P) for the different populations of pumpkin.

Characters	Fruit weight (kg)			Fruit polar diameter (P, cm)			Fruit equatorial diameter (E, cm)			Fruit shape index (E/P)		
Parameters / Populations	$\bar{X}$	Range	C.V. %	$\bar{X}$	Range	C.V. %	$\bar{X}$	Range	C.V. %	$\bar{X}$	Range	C.V. %
C_o	3.95f	0.65-8.82	48.16	30.95d	17-57	28.00	22.99d	10-47	31.00	0.69d	0.39-1.31	32.16
C_1	4.58e	1.30-7.50	31.09	40.99ab	19-52	21.91	29.68c	16-45	22.13	0.66c	0.41-1.20	23.17
S_2-1	5.10d	2.20-7.50	28.50	39.15bc	19-50	20.12	30.13bc	18-40	20.71	0.88bc	0.40-0.95	20.33
S_2-2	6.21b	2.80-7.70	26.51	41.55ab	20-48	15.33	37.78a	18-42	18.08	1.01a-c	0.40-1.00	18.91
S_2-3	5.51c	2.10-7.50	24.16	39.97a-c	19-48	21.31	31.59a-c	17-39	21.11	0.96a-c	0.40-1.20	20.19
S2-4	7.16a	2.80-7.80	22.31	43.01a	21-46	17.11	33.32ab	18-40	17.50	1.059a	0. 51-1.20	16.09
S_2-5	4.89d	2.10-8.00	26.14	37.15c	18-48	20.31	29.48c	18-39	20.63	0.97a c	0. 51-1. 30	21.61
S_2-6	5.96b	2.60-8.00	28.11	40.28a-c	20-50	19.92	31.79a-c	16-40	19.71	1.02ab	0.45-1.20	21.50

Values having similar alphabetical letter (s) do not significantly differ, using Duncan's multiples range test (L.S.R.) at 0.05 level of probability.

Co= Original population C_1= Population of the first recurrent selection cycle
S_2 (1)-S_2 (6) =Progenies of the second selfed generation of six individual selections.

Table 4: Means(x), ranges and coefficients of variations (C.V %) for fruit flesh thickness (cm), flesh dry matter content (%), total soluble solids (T.S.S. %),and carotene content (mg. g. d.w^{-1}.) for the different populations of pumpkin.

Characters	Fruit flesh thickness (cm)			Flesh dry matter content (%)			Total soluble solids content (T.S.S. %)			Carotene content (mg/g.d.w)		
Parameters / Populations	$\bar{X}$	Rang	C.V. %	$\bar{X}$	Range	C.V. %	$\bar{X}$	Range	C.V. %	$\bar{X}$	Range	C.V %
Co	2.83d	1.50-5.00	31.11	5.15e	7.22-20.49	29.36	5.85d	3-12	29.39	0.415d	0.08-0.77	42.11
C_1	3.29c	1.80-5.00	21.33	9.61d	8.20-17.41	26.29	6.88c	5-9	20.11	0.535c	0.210.72	29.31
S_2-1	3.69b	2.50-5.00	17.62	12.26a-c	9.22-18.12	18.18	7.27c	5-10	17.63	0.601b	0.25-0.75	23.11
S_2-2	4.22a	2.30-5.00	15.51	13.44a	10.31-17.90	14.51	9.50a	6-11	15.11	0.702a	0.30-0.75	20.20
S_2-3	4.00ab	2.00-5.00	17.13	11.67bc	10.10-17.11	16.33	7.79b	5-10	18.52	0.618b	0.30-0.70	21.00
S_2-4	3.67ab	2.21-5.00	14.22	12.96ab	10.50-16.50	13.32	8.97a	6-11	15.13	0.746a	0.35-0.80	17.50
S_2-5	3.92ab	2.00-4.50	18.60	10.88cd	9.22-17.11	19.17	8.16b	5-10	17.33	0.532c	0.35-0.65	19.00
S_2-6	3.79b	2.00-4.50	19.01	12.43ab	10.11-17.51	18.11	6.89c	5-10	19.16	0.534c	0.30-0.72	21.11

Values having similar alphabetical letter(s) do not significantly differ, using Duncan's multiples range test (L.S.R.) at 0.05 levels of probability.

Co= Original population C_1= Population of the first recurrent selection cycle
S_2 (1)-S_2 (6) =Progenies of the second selfed generation of six individual selection

Table 5: Phenotypic correlation coefficients among the studied characters of pumpkin "Local" cultivar.

characters	No. of leaves/ plant	No. of branches plant	Fruit weight (kg)	Fruit polar diameter (P, cm)	Fruit equatorial diameter (E, cm)	Fruit shape index (E/P)	Fruit flesh thickness (cm)	Flesh dry matter content (%)	Total soluble solids content (TS.S. %)	Carotene content (mg/g.d.w)
Main stem length (cm)	0.538**	0.627**	0.534**	-0.074	0.579**	0.224	0.312	0.382	0.632**	0.698**
No. of leaves /plant		0.746**	0.679**	-0.082	0.771**	0.161**	0.753**	0.722**	0.703**	0.793**
No. of branches / plant			0.593**	-0.203	0.612**	0.474*	0.612**	0.583**	0.77**	0.662**
Fruit weight (kg)				0.055	0.719**	0.502	0.692**	0.836**	0.744**	0.837**
Fruit polar diameter (P, cm)					0.217	0.103	0.077	0.094	0.115	0.020
Fruit equatorial diameter(E, cm)						0.698**	0.760**	0.759**	0.723**	0.756**
Fruit shape index (E/P)							0.653**	0.562**	0.568**	0.469*
Fruit flesh thickness (cm)								0.787**	0.766**	0.727**
Flesh dry matter content (%)									0.752**	0.785**
Total soluble solids(T.S.S.%)										0.839**

* = Significant at 0.05 of probability level. ** = Highly significant at 0.1 of operability level.

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الملخص العربي

الانتخاب المتكرر البسيط والتربية الذاتية مع الانتخاب كطريقتي تربية لتحسين نباتات القرع العسلي

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أجريت هذه الدراسة في محطة البحوث الزراعية بأبيس – التابعة لكلية الزراعة – جامعة الإسكندرية وذلك خلال المواسم الصيفية لأعوام ٢٠٠٤، ٢٠٠٥، ٢٠٠٦ ، وذلك بغرض تقييم كفاءة دورة من الانتخاب الدوري المتكرر و التربية الذاتية مع الانتخاب لمدة جيلين فى تحسين بعض الصفات الهامة في الصنف المحلي للقرع العسلي ، بالإضافة إلي تقدير معامل الارتباط المظهري بين أزواج الصفات الهامة موضع الدراسة، و اشتملت الصفات المدروسة والتي تم الانتخاب علي أساسها الساق الرئيسية الطويلة، عدد الأوراق الكثيرة، عدد الأفرع الكثيرة، زيادة وزن الثمرة، الثمرة الأكثر طولا وقطرا، والأعلى في قيمة دليل شكل الرأس (الشكل البيضاوي والمائل للاستطالة) ، الثمرة ذات اللحم السميك، وزيادة كل من المادة الجافة للحم الثمار والمواد الصلبة الذائبة الكلية و محتوي الكاروتين.

تمت زراعة العشيرة الأصلية في الموسم الصيفي الأول لعام٢٠٠٤و ذلك لتقدير مقدار وحجم الاختلافات في الصفات المدروسة بين النباتات الفردية وذلك من خلال تقدير معامل الاختلاف والمدي بالاضافة إلي تقدير المتوسط ، حيث تبين وجود اختلافات كبيرة وكافية بين النباتات وذلك بالنسبة لجميع ا لصفات المدروسة والتي عكست أهمية إجراء الانتخاب والتحسين لمواصفات هذا المحصول.

وبناء علي ذلك أجري الانتخاب بين النباتات علي أساس الصفات السابق تحديدها، وعند الإزهار تم اجراء التلقيح الذاتي لعدد كاف من البراعم الزهرية من كل نبات منتخب وتم الحصول علي بذور النسل الذاتي الاول، والتي زرعت في الموسم الصيفي لعام ٢٠٠٥ في صورة عائلات منفصلة ، ثم تم الانتخاب المظهري لافضل النباتات من داخل كل عائلة من نسل الجيل الذاتي الاول وتركت للتلقيح المفتوح للحصول علي بذور ناتج الدورة الأولي من الانتخاب المتكرر بالإضافة إلي اجراء التلقيح الذاتي لبعض أزهار النباتات المنتخبة (٦ نباتات) للحصول علي بذور التلقيح الذاتي الثاني.

تم تقييم كفاءة كل من دورة الانتخاب المتكرر والتلقيح الذاتي مع الانتخاب علي تحسين الصفات المدروسة وذلك في الموسم الصيفي لعام ٢٠٠٦ باستخدام تصميم القطاعات العشوائية الكاملة وذلك

لمقارنة العشائر المنتخبة وهي عشيرة دورة الانتخاب المتكرر الأول ، ست عشائر ناتجة من التلقيح الذاتي الثاني مع الانتخاب بالإضافة إلي العشيرة الأصلية للمقارنة.

وأظهرت النتائج بصفة عامة أن استخدام كل من طريقتي التربية المستخدمتين أدي إلي تحسين ملحوظ ومعنوي في كل الصفات المدروسة مقارنة بالعشيرة الأصلية، كما حدث انخفاض بدرجات مختلفة في مقدار الاختلافات فى العشائر المنتخبة بالنسبة لجميع الصفات مقارنة بالعشيرة الأصلية ولكن الانخفاض كان أكثر وضوحا في عشائر التلقيح الذاتي الثاني بالمقارنة بعشيرة الانتخاب المتكرر وهذه النتيجة توضح أن الانتخاب المتكرر يتيح الفرصة للاستمرار في الانتخاب والتحسين بالمقارنة بالتلقيح الذاتي مع الانتخاب.

أوضحت دراسة معامل الارتباط المظهري بين أزواج الصفات المدروسة وجود واحد وأربعين علاقة ارتباط معنوية ومرغوبة من بين خمس وخمسون علاقة ممكنة ، مما يتيح الفرصة للاستفادة منها في برامج التربية بالانتخاب وذلك للاستعانة في انتخاب صفة معقدة أو صعبة القياس بآخري سهلة القياس ومرتبطة معها بصورة مرغوبة.