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POPULATION AND SINGLE PLANT-DERIVED INBRED LINE ANALYSES FOR SEX EXPRESSION IN SUMMER SQUASH (*CUCURBITA PEPO* L.) CV 'ESKANDRANI'

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ABSTRACT:

Literature have shown large agreement on the notion that enhanced formation of pistillate flowers increases the yield of immature fruits in summer squash (*Cucurbita pepo* L.). However, selection scheme to improve sex expression is not adequately clarified in our local favorable cv 'Eskandrani'. Our initial assessment in an open pollinated population grown in summer and winter seasons showed the existence of discrete group of phenotypes that is largely influenced by environmental factors. The χ^2 test of phenotypic distribution in open pollinated population suggested fitness to 2 dominant major genes controlling sex expression. Based on progeny test in the first selfed generation, one line homozygous for maleness was obtained and four heterozygous balanced monoecious lines were identified. The latter lines showed 3: 1 segregation ratio for balanced monoecious phenotype and predominant pistillate flower producing phenotype, respectively. These lines consistently behaved as heterozygous balanced monoecious phenotype up to the third generation. Increasing tendency to femininity was associated with lowered node of the first female flower and reduced stem length and number of leaves. Immature fruit yield trial conducted during summer and winter seasons indicated superiority of the four balanced monoecious lines to the open pollinated population and the inferiority of the line producing predominantly staminate flowers. This study suggests the feasibility of complete elimination of maleness phenotype in summer squash cv 'Eskandrani' by line breeding and the significance of correlated response with improved sex expression to enhance crop earliness and elevate immature fruit yield.

INTRODUCTION:

'Eskandrani' is the main zucchini-type summer squash cultivar grown in Egypt. This cultivar has been reported to show adaptability over wide range of culture conditions as compared to exotic cultivars and hybrids (Damarany *et al*., 1995; Hassan, 1988; Waly and Nassar 1978). Assessment of sex expression in open pollinated 'Eskandrani' summer squash cultivar (Mohamed 1996) indicated an existence of three discrete phenotypes. These are plants predominantly form staminate flowers, balanced monoecious plants and plants predominantly develop pistillate flowers. Plants predominantly form staminate flowers give the first female flower starting at least on the 11th

leaf axils. Over 45-55% of the population failed in this sex expression group. Balanced monoecious plants (interchangeably develop pistillate and staminate flowers on different but almost consecutive leaf axils) form their first pistillate flower starting on the 7^{th} to 10^{th} leaf axils. Plants predominantly develop pistillate flowers form the first pistillate flower starting on the 5^{th} to 7^{th} leaf axils and they present only around 5% of whole population.

The frequency distribution polygons for an open pollinated population of summer squash cv 'Eskandrani' suggested major gene(s) with appreciable environmental influence (Brewbaker, 1964; Mohamed, 1996) controlling the flower sex expression. Recessive genes seemed to influence femininity tendency, number of fruits/plant and earliness (El-Tahawy, 2007). Significant association was detected between increased formation of female flowers and both number and weight of immature harvested fruits (Mohamed, 1996; Refaei, 2001). Selection against predominant staminate flower formation was effective in increasing quantity of early and total immature fruit yield and enhancing population homogeneity for these traits (Mohamed, 1996; Refaei, 2001). 'Eskandrani' summer squash cultivar showed tolerance to inbreeding (Refaei, 2001; Mohamed *et al*., 2003) and a scheme of pedigree selection yielded superior inbred lines. No serious depression was detected in other squash cultivar as well (Robinson, 1999) when an inbred line breeding scheme was followed. Heterosis over better parent for number of fruits/plant and earliness was found to be insignificant in the genetic analysis studies on summer squash cv 'Eskandrani' conducted by Metwally *et al*. (1988) and Abd El-Hadi *et al*. (2005). In practice, balanced monoecious plants are preferable to the two other groups (Mohamed, 1996). It carries the female and male flowers interchangeably on different consecutive leaf axils providing available source of pollen for fertilization and the plants grow vigor enough before fruiting enabling support to fruit development. Delay in fruit harvest inflict a reduced risk on development of successive fruits as compared to plants predominantly develop pistillate flowers.

As per frequency distribution polygons study conducted by Mohamed (1996) for plants in open pollinated 'Eskandrani' summer squash cultivar, it is suggested that 2 dominant independent major genes govern sex expression. Accordingly, complete elimination of plant phenotype predominantly express maleness can be attained by line breeding from individual selections of balance monoecious plant. The present study was conducted to test this prospect and its subsequent influence on yield performance of immature fruits.

MATERIALS AND METHODS:

The present study was conducted during the summer and winter growing seasons in the period from 2005 to 2007 at Assiut Research Station, Arab El-Awammer. Seeds of open pollinated summer squash (*Cucurbita pepo* L.) cv 'Eskandrani' produced by Egyptian Agricultural Organization were planted in summer March 15 and winter Sept. 15, 2005. Planting was 40 cm apart on the northern side of 4 m long and 80 cm wide rows. Data were recorded per individual plant for number of male and female flower buds 35-days after planting (Mohamed, 1996). Frequency distribution of individual plant for femininity tendency (number of female flowers divided by sum of male and female flower buds multiplied by 100) was conducted as described by Steel and Torrie (1980). Number of plants in different phenotypic classes was examined for fitness to

fixed digenetic ratio by χ^2 test (Gomez and Gomez, 1984). Self pollination was conducted in summer season 2005 for selected plants representing femininity tendency in the range of 50%–60% (Mohamed, 1996). Seeds from mature fruits were extracted as recommended by George (1985) and Hassan (1994). Extracted seeds were planted in winter season 2005 to study femininity tendency performance of S_1 lines. In winter season 2005, self pollination was conducted for plants within S_1 to produce S_2 generation. The produced seeds were planted in summer season 2006 to study femininity tendency performance of S_2 and to produce S_3 lines. During selfing, selection for long fruits with reduced diameter was conducted. Femininity tendencies in S_1, S_2 and S_3 were examined for fitness to fixed monogenic segregations using χ^2 test.

Field trials were conducted during summer and winter seasons in 2007 to evaluate growth, flowering and immature fruit yield of 13 S_3 lines along with the original open pollinated population. The experiment for field trials was randomized complete-blocks with 4 replicates. One 3.5 long and 70 cm wide row per plot was used for S_3 lines while 12 rows were assigned for the open pollinated population. Plants were spaced at 30 cm within-row. Data were recorded per individual plant for the following growth and flowering traits: 1) node of the first female flower 35-days after planting, 2) number of male and female flower buds 35 and 70 days after planting; expressed as femininity tendency, 3) main stem length of 35 and 70-day-old plants and 4) number of leaves per individual 35 and 70-day-old plants. The following crop yield traits were determined: 1) average fruit length and diameter 3-4 days after anthesis, 2) number of fruits produced per plant, 3) fruit yield (kg) per plant, 4) fruit yield (kg) per feddan, and 5) early yield (first 3 harvests, kg) per feddan. Data from field trials were used for analysis of variance relevant to the experiment design used and means were separated by the "Least Significant Test" ($LSD_{0.05}$) (Gomez and Gomez, 1984). Simple correlation coefficients (r) were calculated for association between femininity tendency and all other studied growth and yield traits.

RESULTS AND DISCUSSION:

As shown in Figure (1) three peaks are well demonstrated in the diagrammatic presentation of frequency distribution for femininity tendency expressed by 317 and 321 plants in summer and winter seasons, respectively. Meanwhile, two threshold drop points are clearly shown differentiating three distinct phenotypic classes. These phenotypes were plants predominately produce staminate flowers, balanced monoecious plants and predominately pistillate flower forming plants. The first class had femininity tendencies between 6% and 26% in the summer season and between 6% and 38% in the winter season. The second class showed femininity tendencies between >26% and 75% in summer season and between >38% and 70% in winter season. The third class produced femininity tendencys >75% in summer season and >70% in winter season. Closely similar results were reported by Mohamed (1996) in summer squash cv 'Eskandrani', suggesting major gene(s) directing femininity tendency expression. We additionally here show results support that a simple model of 2 independent genes governs this trait (Table 1). Conducting χ^2 test for fixed ratio using our data indicated no significant deviation for the number of plants in each of the three aforementioned phenotypic classes from 9 :6:1 in both summer and winter seasons.

Sex expression has long been known to be greatly affected by environmental factors (Shifriss, 1985; Hassan, 1988; NeSmith, *et al*., 1994). This is shown in the present data (Fig. 1) by the range of variation in each class and by diagram shape pattern of each class. In spite of class separation by threshold turn drops, the classes are not completely separated in either season. Summer conditions are in favor of stimulating male flower production (Hassan, 1988; NeSmith, *et al*., 1994; Mohamed, 1996). Such modifying effects are apparent in the diagrammatic of all classes as a sharp skew towards low femininity tendencies in summer grown plants. Therefore, sex expression is considered a trait controlled by major gene(s) with existence of appreciable environmental influence (Brewbaker, 1964; Mohamed, 1996).

According to the presumed genetic model of the sex expression in this study, predominant male flower formation is controlled by dominant genes (Brewbaker, 1964; Hassan, 1991) simultaneously existing whether homozygous or heterozygous in both of the two independent loci and also if homozygous in one locus and heterozygous in the other locus. Two recessive homozygous genes are needed to develop plants with high tendency towards femaleness. Dominant gene homozygosity or heterozygoisty in one locus can then led to development of balanced monoecious phenotypes. Hence, inbred of balanced monoecious genotypes would either show no segregations or compose of both balanced monoecious phenotype and plants with high tendency towards femaleness in the 3:1 ratio. Among selfed plants produced in the present study, four S_1 inbred lines showed fitness to 3:1 segregations ratio while one inbred line was homozygous predominant male flower forming genotype (Table 2). The latter inbred showed consistent true breeding behavior in all derived inbred sub-families up to the S_3 generation (Table 3). Except in S_2 grown in summer 2006 (Table 2), all derived S_3 sub-families of selfed balanced monoecious phenotype fitted segregation ratio of 3:1 (Table 3). We speculate that the production of only monoecious phenotype segregates of S_2 grown in summer 2006 was, therefore, most likely due to unintentionally occurred culture stresses unfavorable for femaleness. In either case, however, the most important come out result is that complete elimination of predominant male flower producing plants is feasible through inbred line breeding.

Predominant formation of pistillate flowers mutually enhances production of immature fruit yield in summer squash (Hassan, 1988; Damarany *et al*., 1995). Shifriss, (1985) reported that selection is effective to enhance plant tendency toward femininity. In summer squash (*Cucurbita pepo* L.) cv 'Eskandrani', former assessments (Refaei, *et al*., 2001; Mohamed, *et al*., 2003) have suggested that bulk selection in open pollinated summer squash population against predominate staminate flower forming plants before blooming can effectively decreasing the frequency of undesirable alleles. The authors followed a scheme of culling out plants that did not develop female flowers 30-35 days after planting. Their results showed a significant enhanced early and total yield of immature fruits. The method is simple and can be practiced in seed production field to produce elite seed stocks (George, 1985.). However, it is noticeable that the plants predominantly forming male flower formation can be originated from crosses among plants within different genotypes of balanced monoecious genotypes. Thus this method if not practiced continuously would lead to restoring gene equilibrium status of original population after

few generation of open pollination (Falconer, 1981).

Tables (4 A and B) present means of original open pollinated summer squash population (S_0) and 13 S_3 inbred lines grown in summer (3A) and winter (3B) for node of the first female flower, femininity tendency, main stem length and number of leaves per plant. The lines 8-1-1, 8-2-1 and 8-2-2 predominantly produced male flowers. They, in general, expressed lower femininity tendency and had greater number of nodes to first female flower than the original population. They also tended to produce larger number of leaves per plant and longer stem. Comparing to the original population, the opposite was almost true for the other ten lines which contained only balanced monoecious phenotype and plants predominantly produced female flowers. As shown in Table (5 A & B), lines 8-1-1, 8-2-1 and 8-2-2, in general, produced reduced number of fruits per plant, early and total fruit yield comparing with the original population. The vice versa was found for other ten lines when compared to the original population. Results obtained for growth and yield indicate more suitability of these ten lines to intensive production system in time and space as they characterized by shorter stems and enhanced early and total yield. Calculated total correlation coefficients (r) substantiate the significance of correlated responses to female flower improvement found in growth and crop yield (Table 4A&B; Table 5A & B). Further, the strong associations between measurements of femininity tendency, node of the first female flower bud, stem length and number of leaves per plant at 35 and 70 days indicate that early assessment based on these criterions would be effective in differentiating desirable plants expressing high tendency towards femininity. Regardless of line performance for sex expression, selection for fruits shape while conducting selfing was effective in developing lines producing longer and thinner fruits than those of the original population (Table 5A & B).

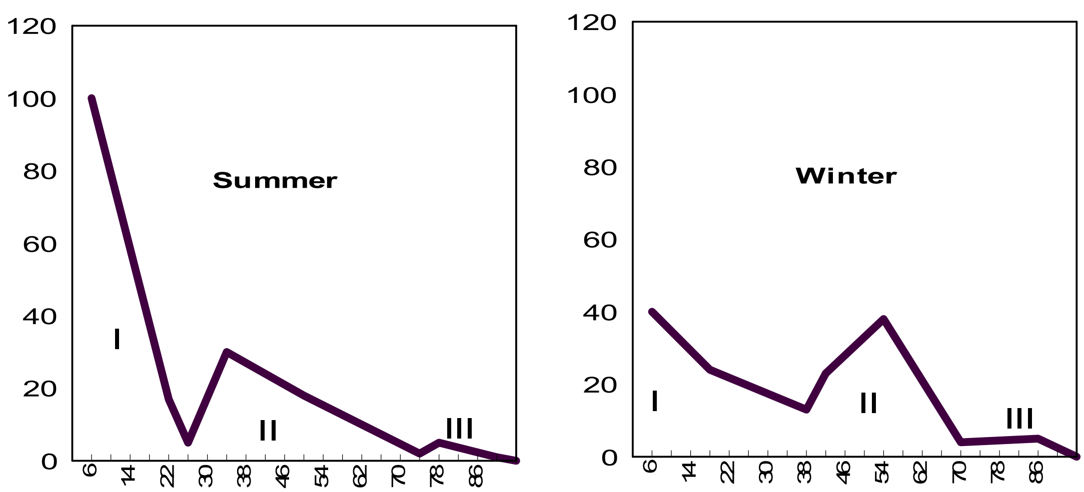

Fig. (1): Diagrammatic presentation of frequency distribution for femininity tendency expressed by 314 and 317 summer squash plants in open pollinated population grown in summer and winter

seasons 2005, respectively, showing well marked peaks and threshold turn drop points differentiating three distinct phenotypic classes; predominate staminate flower producing plants (I), balanced monoecious plants (II) and predominate pistillate flower forming plants (III).

Table (1): Fixed ratio χ^2 test for the number of plants in each of three phenotypic classes present predominate staminate flower producing plants (PS), balanced monoecious plants (BM) and predominate pistillate flower forming plants (PP) in an open pollinated summer squash population of 314 and 317 plants grown in summer and winter seasons 2005, respectively

Entry	Observed			Test Ratio	χ2 (P< 0.05)
	PS	BM	PP		
Open pollinated population (summer season, 2005)	171	131	12	9 : 6 : 1	5.1 ns
Open pollinated population (winter season, 2005)	160	138	19	9 : 6 : 1	4.9 ns

ns = not significant

Table (2): Fixed ratio χ^2 test for segregation in first generation (S_1) inbred lines and of second generation (S_2) sub-families derived from selfed balanced monoecious plants (BM) (lines 1, 3, 4 and 6) and predominate staminate flower producing plants (PS) (line 8) in summer squash.

Entry	Observed[1]			Test Ratio	χ^2
	PS	BM	PP		
(A) Inbred lines (first generation, S_1) Winter 2005					
1	-	9	1	3:1	1.73 ns
3	-	7	3	3:1	0.13 ns
4	-	7	3	3:1	0.13 ns
6	-	8	2	3:1	0.40 ns
8	10	-	-	-	-
(B) Inbred lines (second generation, S_2) Summer 2006					
1-1	-	10	-	-	-
1-2	-	10	-	-	-
1-3	-	10	-	-	-
3-1	-	10	-	-	-
4-1	-	10	-	-	-
4-2	-	10	-	-	-
6-1	-	10	-	-	-
8-1	10		-	-	
8-2	10	-	-	-	-

(1) (PS) = predominate staminate flower producing plants

(BM) = balanced monoecious plants (BM).
(PP) = predominate pistillate flower forming plants.
ns = not significant.

Table (3): Fixed ratio χ^2 test for segregation in third inbred generation (S_3) sub-families derived from second inbred generation (S_2) of balanced monoecious plants (BM) (sub-families of lines 1, 3, 4 and 6) and predominate staminate flower producing plants (PS) (sub-families of line 8) in summer squash grown during (A) the summer and (B) the winter seasons, 2007

Entry	Observed[1]			Test Ratio	χ^2
	PS	BM	PP		
(A)- Inbred lines (third generation, S_3) Summer, 2007					
1-1-1	-	26	4	3:1	2.53 ns
1-1-2	-	18	12	3:1	3.24 ns
1-2-1	-	21	9	3:1	0.31 ns
1-2-2	-	26	4	3:1	2.53 ns
1-3-1	-	18	12	3:1	3.24 ns
1-3-2	-	21	9	3:1	0.31 ns
3-1-1	-	21	9	3:1	0.31 ns
4-1-1	-	18	12	3:1	3.24 ns
4-2-1	-	18	12	3:1	3.24 ns
6-1-1	-	18	12	3:1	3.24 ns
8-1-1	30	-	-	-	-
8-2-1	30	-	-	-	-
8-2-2	30	-	-	-	-
(B)- Inbred lines (third generation, S_3) Winter, 2007					
1-1-1	-	26	4	3:1	2.53 ns
1-1-2	-	18	12	3:1	3.24 ns
1-2-1	-	24	6	3:1	0.58 ns
1-2-2	-	24	6	3:1	0.58 ns
1-3-1	-	18	12	3:1	3.24 ns
1-3-2	-	18	12	3:1	3.24 ns
3-1-1	-	21	9	3:1	0.31 ns
4-1-1	-	18	12	3:1	3.24 ns
4-2-1	-	18	12	3:1	3.24 ns
6-1-1	-	18	12	3:1	3.24 ns
8-1-1	30	-	-	-	-
8-2-1	30	-	-	-	-
8-2-2	30	-	-	-	-

[1](PS) = predominate staminate flower producing plants
(BM) = balanced monoecious plants (BM).
(PP) = predominate pistillate flower forming plants.

ns = not significant.

Table (4): Means of node of the first female flower, femininity tendency, main stem length and number of leaves per plant in original open pollinated summer squash population (S_0) and in 13 S_3 inbred lines grown in (A) summer and (B) winter seasons, 2007

Entry	Nodes to the first female flower (no.)	Femininity tendency (female/male and female flowers) X100		Leaves/plant (No.)		Main stem length (cm)	
		35 d	70 d	35 d	70 d	35 d	70 d
(A) Summer, 2007							
S0	10.5	33.2	35.2	25.0	37.3	33.17	73.50
S3 1-1-1	8.9	51.3	51.8	16.7	28.4	29.30	51.30
S3 1-1-2	8.8	65.0	59.5	19.2	28.5	32.43	54.60
S3 1-2-1	8.8	63.2	56.9	19.3	29.3	30.20	49.70
S3 1-2-2	9.5	55.8	56.6	16.7	28.0	30.00	47.40
S31-3-1	8.8	75.9	70.7	19.9	29.4	33.20	49.50
S31-3-2	8.3	69.6	69.3	19.7	29.6	30.90	48.67
S3 3-1-1	8.3	75.0	70.7	20.0	27.4	33.07	50.57
S3 4-1-1	8.7	81.8	75.3	18.2	27.8	29.00	47.47
S3 4-2-1	7.7	68.9	75.7	18.3	27.9	30.40	49.60
S3 6-1-1	8.9	68.0	67.8	23.2	31.4	57.00	78.00
S3 8-1-1	18.9	9.4	13.2	26.4	37.0	70.87	97.20
S3 8-2-1	19.3	10.9	15.9	25.7	36.5	72.00	100.00
S3 8-2-2	19.8	12.5	13.5	26.5	36.3	81.30	116.00
L.S.D 0.05	0.3	1.5	3.4	0.4	0.4	1.27	0.575
(r) of 35d and 70d in S0	-------	0.112**		0.562**		0.599**	
(r) of 35d and 70d in S3	-------	0.566**		0.946**		0.995**	
(r) with 35d femininity tendency in S0	- 0.822**	-------	-------	-0.475**	-------	-0.532**	-------
(r) with 35d femininity tendency in S3	- 0.959**	-------	-------	-0.916**	-------	-0.885**	-------
(B) Winter, 2007							
S0	11.3	39.43	40.87	25.3	43.50	37.0	77.33
S3 1-1-1	8. 3	55.3	56.5	17.7	30.33	30.0	56.00
S3 1-1-2	8.2	67.5	61.9	19.0	31.00	32.0	60.00
S3 1-2-1	8.1	67.2	64.8	19.0	30.00	29.7	53.50
S3 1-2-2	8.5	62.5	60.8	16.0	30.00	30.0	51.20
S31-3-1	8.1	79.7	70.8	20.6	30.50	33.5	52.60
S31-3-2	8.5	70.4	70.0	19.0	31.00	31.6	52.00
S3 3-1-1	7.9	73.0	71.5	20.0	29.5	29.8	53.3
S3 4-1-1	7.8	76.1	73.3	18.7	32.0	29.5	52.8
S3 4-2-1	7.3	72.9	74.3	18.3	27.9	30.4	50.4
S3 6-1-1	9.1	67.2	68.7	25.4	34.80	52.5	81.50
S3 8-1-1	17.5	17.7	16.2	24.0	39.00	71.0	104.00
S3 8-2-1	16.7	18.0	18.6	24.0	39.33	68.0	107.00
S3 8-2-2	16.2	17.9	16.6	22.0	40.84	69.0	108.00
L.S.D 0.05	0.29	0.86	0.89	1.3	0.365	0.97	1.84
(r) of 35d and 70d in S0	-------	0.211*		0.443**		0.758**	
(r) of 35d and 70d in S3	-------	0.992**		0.764**		0.991**	
(r) with 35d femininity tendency in S0	-0.806**	-------	-------	-0.287**	-------	-0.408**	-------
(r) with 35d femininity	-0.959**	-------	-------	-0.899**	-------	-0.668*	-------

tendency in S3							

* and ** = significant at 0.05 and 0.01 probability levels, respectively.

Table (5): Means of fruit length and diameter, number and weight of fruits per plant and total and early yield per feddan in original open pollinated summer squash population (S_0) and in 13 S_3 inbred lines grown in (A) summer and (B) winter seasons, 2007

Entry	Avg. fruit Length (cm)	Fruit diameter (cm)	Fruit/ Plant (no.)	Fruit/ Plant (Wt., g)	Total Yield (ton/Feddan)	Early yield (ton/Feddan)
(A) Summer, 2007						
S_0	11.5	4.0	4.3	0.468	5.871	1.617
S_3 1-1-1	11.8	2.4	5.9	0.611	7.755	2.500
S_3 1-1-2	13.1	2.7	6.5	0.674	8.425	2.590
S_3 1-2-1	13.5	3.0	7.1	0.753	9.410	2.650
S_3 1-2-2	13.5	3.0	6.2	0.632	7.900	2.450
$S_3$1-3-1	12.0	3.0	8.4	0.857	10.713	2.850
$S_3$1-3-2	14.0	3.3	7.8	0.819	10.243	2.750
S_3 3-1-1	15.0	3.5	7.9	0.777	9.710	2.500
S_3 4-1-1	12.0	3.2	8.6	0.980	12.257	3.300
S_3 4-2-1	16.7	3.5	8.2	0.951	11.893	3.000
S_3 6-1-1	15.0	3.2	8.9	0.961	12.013	3.400
S_3 8-1-1	12.0	2.8	2.1	0.227	2.842	0.000
S_3 8-2-1	12.0	2.8	2.4	0.273	3.411	0.000
S_3 8-2-2	15.0	3.2	2.3	0.262	3.271	0.000
$L.S.D_{0.05}$	1.0	0.2	0.4	0.036	0.363	0.102
(r) with 35d femininity tendency in S_3	0.211	0.385	0.980**	0.959**	0.959**	0.966**
(B) Winter, 2007						
S_0	12.67	4.0	5.3	0.553	6.458	2.033
S_3 1-1-1	12.5	2.9	7.0	0.742	9.274	2.650
S_3 1-1-2	13.0	3.0	8.4	0.865	10.813	2.750
S_3 1-2-1	13.3	3.1	8.6	0.912	11.400	2.817
S_3 1-2-2	13.8	3.2	8.0	0.856	10.700	2.790
$S_3$1-3-1	14.0	3.4	9.1	1.004	12.510	3.100
$S_3$1-3-2	14.7	3.5	9.0	0.990	12.373	2.950
S_3 3-1-1	12.3	2.8	7.9	0.789	9.733	2.488
S_3 4-1-1	15.8	3.5	8.3	0.962	12.020	3.138
S_3 4-2-1	15.5	3.5	8.3	0.958	11.975	3.130
S_3 6-1-1	12.1	2.8	11.0	1.177	14.710	3.867
S_3 8-1-1	17.2	3.0	3.1	0.344	4.300	0.000
S_3 8-2-1	16.6	3.1	3.4	0.388	4.846	0.000
S_3 8-2-2	17.9	3.2	3.1	0.341	4.263	0.000
$L.S.D_{0.05}$	1.0	0.2	0.4	0.040	0.530	0.080
(r) with 35d femininity tendency in S_3	-0.696**	0.250	0.932**	0.932**	0.929**	0.952**

* and ** = significant at 0.05 and 0.01 probability levels, respectively.

CONCLUSION:

Our study introduces a selection scheme that could be utilized as an efficient breeding strategy to completely eliminate plants having strong tendency towards maleness in the summer squash cv. 'Eskandrani'. Obtaining desirable fruit characteristics can be simultaneously, accomplished while conducting

inbreeding. Compact growth and improved early and total yield would occur unprompted as correlated responses to enhancing tendency towards femininity.

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تحليل التعبير الجنسى فى عشيرة مفتوحة التلقيح وسلالات مرباه داخليا فى قرع الكوسة صنف الاسكندرانى

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أجريت هذه الدراسة بمزرعة البحوث الزراعية بعرب العوامر بأسيوط التابعة لمركز البحوث الزراعية، وذلك خلال الفترة من عام 2005 إلى عام 2007 وذلك بغرض إجراء تحليل وراثى للتعبير الجنسى فى سلالات مرباة داخلياً وتأثيرها على المحصول والتبكير فى الكوسة الاسكندرانى. تم زراعة عشيرة مفتوحة التلقيح من الكوسة فى العروة الصيفية 2005.وتم تسجيل البيانات على النسبة الجنسية لإجراء تلقيح ذاتى لإنتاج سلالات الجيل الأول من نباتات منتخبة، وفى شتاء 2005 تم دراسة العشيرة مرة أخرى مع تقييم نسل الجيل الأول من السلالات الذاتية وانتخاب نباتات الجيل الثانى منها وفى صيف 2006 تم دراسة التعبير الجنسى فى سلالات الجيل الذاتى الثانى، لإنتاج نباتات الجيل الثالث منها، وفى صيف وشتاء 2007تم تقييم الجيل الثالث المربى داخلياً ، وكان عددها 13 سلالة مع العشير الاصلية.

وقد أظهر تحليل البيانات أن النسبة الجنسية فى العشيرة الأصلية يحكمها زوج من الجينات السائدة المستقلة كما أظهر أن السلالات المرباة داخلياً تتوزع فى ثلاث فئات رئيسية الأولى يسود فيها إنتاج الأزهار المذكرة، والثانية متوازنة فى الأزهار المزكرة والمؤنثة، والثالثة تسود فيها الأزهار المؤنثة ويحكمها زوج من الجينات السائدة المستقلة، كما أظهر أن السلالات المرباة داخلياً تعطى انعزالات متطابقة مع النسبة المندلية لجين رئيسى سائد. وقد تفوقت السلالات المرباة داخلياً ذات النسبة الجنسية المرتفعة على العشيرة الأصلية بينما كانت السلالات ذات النسبة الجنسية المنخفضة أقل إنتاجية عن العشيرة الاصلية. وقد وجد أن الاتجاه نحو إنتاج الأزهار المؤنثة قد أدى إلى إنتاج نباتات قصيرة الساق،ويتكون أزهارها المؤنثة على عقد منخفضة على الساق. وقد أمكن استنتاج أنه يمكن التخلص التام من وجود النباتات المذكرة بطريقة بسيطة مما يسهل تربية وتحسين صنف الكوسة الاسكندرانى.