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GENETICAL STUDIES FOR IMPROVMENT OF FRUIT QUALITY AND YIELD OF SWEET MELON (ISMAILAWY).

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ABSTRACT

In the present investigation, the first (S_1) and second (S_2) selective generations were produced by selection from Ismailawy sweet melon population, S_1 and S_2 were planted under the two planting methods drep irrigation and balee. The genotypic and phenotypic coefficient of variability and the narrow sense heritability and the expected gain under selection were estimated. Partial and multiple linear correlations were also calculated between some important traits. The results showed that the genotypic and phenotypic coefficient of variability were nearly equal for fruit diameter, fruit shape index and fruit flesh thickness in S_1 and for fruit length and fruit flesh thickness in S_2. Narrow sense heritability was high for number of fruits / plant, total yield / plant and total soluble solids of fruit Highly significant and positive correlations were detected between number of fruit/plant and total yield/plant, fruit weight and total soluble solids of flesh, fruit length and fruit flesh thickness.

These results may help in selecting the proper breeding program for improving Ismailawy sweet melon.

INTRODUCTION

Ismailawy sweet melon belongs to *(Cucumis melo* var *aegyptiacus).* This spice also includes all the varieties cultivated in upper Egypt and the Nile delta, Egypt is a primary center of origin of sweet melon, as per definition of Vavilov 1951, where it has tremendous diversity in sweet melon; specially, oblong and oval types. Ismailawy sweet melon had originated in upper Egypt, it was introduced to Ismailia (indigenous introduction) in the early part of the 20^{th} century. Ismailawy sweet melon was the most famous and popular cultivated vegetable crop in Egypt for many years.

Twenty years ago depression in the important quality traits of Ismailawy sweet melon took place, specially in sweetness trait. Therefore, production of Ismailawy sweet melon decreased fowled by cultivated area.

Rare researches on local cultivars or land varieties of sweet melon were done, if compared with muskmelon cultivars. This investigation is an attempt to identify the genetic behavior of Ismailawy sweet melon traits. Narrow sense heritability and correlation coefficient for yield and quality traits in (*Cucumis melon*) were described by some investigators. (Abd El-Raheem *et al*., 1986; Abd El-Raheem and El-Mighawry, 1991; Awny., 1992; Lee *et al.*, 1996 and El-Mighawry, 1998).

MATERIALS AND METHODS

The present study was carried out on Ismailawy sweet melon population, which had grown in private farm at El-Kantara district Ismailia governortate.

In July 1999, 50 fruits were selected from the whole field on the basis of appearance (Ismailawy type) and sweetness the seeds of that fruits were mixed together and regarded as the first selective generation seeds (S_1). In March 2000, the seeds (S_1) was divided into two parts. The first part was planted by drep irrigation method while the other was planted by locality planting method using the under ground water irrigation (balee). The Ismailawy sweet melon has adapted on balee planting method for many years.

The two methods of plantings were in the same of experimental field, each experiment consist of three replication, each replicate contains 70 plants. In July 2000, four fruits were selected from each replicate based on fruit shape and sweetness to introduce (S_2). In March 2001, the seeds of (S_2) which harvested from balee method were planted by balee too, the same in the drep irrigation method. The statistical analysis and genetics studies were computed among the first and second selective generation plants S_1,S_2 analysis of variance was used for each of the growing season (2000-2001), to compare the effects of both planting methods on yield and quality.

Data were recorded on the follow traits.

1. Number of fruits/plant. (No.F./P)
2. Fruit weight (kg) (F.W.)
3. Total yield /plant (kg). (T.Y./P)
4. Fruit length (cm). (F.L.)
5. Fruit diameter (cm). (F.D.)
6. Fruit shape index (Length/Diameter) (F.S.I)
7. Fruit flesh thickness. (cm) (F.F.Th.)
8. Total soluble solids of flesh (%) (T.S.S.)

Percent soluble solids was determined by Refractometer

Coefficient of variability values were estimated depends on phenotypic (P.C.V) and genotypic (G.C.V) variances using the next equations:

$$P.C.V.\% = \sqrt{\frac{V_{pH}}{\overline{x}}} \times 100$$

$$G.C.V.\% = \sqrt{\frac{V_G}{\overline{x}}} \times 100$$

Where:

V_{pH}=phenotypic variance of population

V_G =genotypic variance of population

$\overline{x}$ =Population mean

Analysis of variance were computed among the both of planting methods (balee and drep irrigation), according to Snedecor and Cochron (1967).

Narrow-sense heritability (h_N^2 %) was estimated from the regression of second selective generation (S_2) on first selective generation (S_1). The regression coefficients were adjusted for inhreeding (Luciano *et. al.*, 1965). Ahmed and Dermot (1989) estimated narrow sense heritability from the regression of F_3 family means on individual F_2 plants. The genetic advances under selection were calculated as follows

Genetic advance = $K \times \sqrt{VP} \times h^2$ *(Chaudhary 1989)* where k, $\sqrt{VP}$ and h^2 represent selection differential, phenotypic standard deviation, and narrow sense heritability, respectively. Here, when, K=2.06 when five % of plants were selected correlation coefficient for any pair of traits was calculated using the following equation.

$$r = \frac{\sum xy - (\sum x \sum y)/n}{\sqrt{(\sum x^2 - (\sum x)^2/n)(\sum y^2 - (\sum y)^2/s)}}$$

(Sendecor, 1956)

The standard error of the correlation coefficient was determined by the formula:

$$S_r = \sqrt{\frac{1-r^2}{n-2}}$$

Where S_r is the error of the correlation coefficient, r is the correlation coefficient; n is the sample size, i.e. number of paired values from which the sample correlation coefficient is derived. The null hypothesis was tested by use of t whose sample value is:

$$t_r = \frac{r}{s_r}$$

The coefficient of determination (r2) was estimated by square correlation coefficient, according to *Dospekhov (1984)*.

The estimates of partial (rxyz) and multiple (Rxyz) coefficient correlation were done according to method described by *Dospekhov (1984)* as follow:

Partial $$(r_{xyz}) = \frac{r_{xy} - r_{xz} r_{yz}}{\sqrt{(1-r_{xy}^2)(1-r_{yz}^3)}}$$

Where rxy, rxz and ryz are the paired coefficient of correlation. The error and t of the partial correlation are determined by the same formulas as for the paired correlation:

$$S_{r_{xyz}} = \sqrt{\frac{1-r_{xyz}^2}{n-2}}; t = \frac{r}{s_r}$$

- Multiple $$(R_{xyz}) = \sqrt{\frac{r_{xy}^2 + r_{xz}^2 - 2r_{xy} r_{xz} r_{yz}}{1-r_{yz}^2}}$$

the squared coefficient of multiple correlation (R^2) is termed the coefficient of multiple determination. The F test estimates the significance of multiple correlation :

$$F = \frac{R^2}{1-R^2}\left(\frac{n-k}{k-1}\right)$$

where n is the sample size, k is the number of variables with degree of freedom k-1 and n-k.

RESULTS AND DISCUSSION

This investigation was carried out to study the possibility to improving Ismailawy sweet melon, through selection program.

Table (1): Mean values of all studied traits under the two planting methods at the two seasons

Traits	No. F./P		F.W (kg)		T.Y./P (kg)		F.L (cm)		F. D. (cm)		F.S.I		F.F.Th (cm)		T.S.S %	
Seasons	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001
Balee	3.2	3.7	3.7	4.8	11.9	17.7	25.4	25.4	15.1	15.1	1.7	1.7	3.8	3.7	7.4	7.4
Drip irrigation	2.5	3.4	2.9	4.4	7.3	14.9	23.7	28.7	9.4	16.1	2.5	1.8	3.5	4.4	8.3	7.9

The variance due to balee and drep irrigation planting methods effects (Table 2) were non-significant for most studied traits in both of growing seasons (2000-2001), except fruit diameter and fruit shape index traits which were significant in only 2000 growing season with regard to flesh fruit thickness trait the variance due to planting methods effects were significant in both growing season. The results indicates that the advancing of Ismailawy sweet melon under any of the both methods of planting will be possible, specially the importance traits i.e. fruits number, fruit weight, total yield and total soluble solids.

1- Coefficient of Variability:

The coefficients of genotypic (G.C.V), and phenotypic (P.C.V) variability may serve as reference points for breeders try to detect genotypic difference with respect to the most important economic traits in plants belonging to hybrid and mutant populations. It also make selection of forms with valuable genotypes more effective (Guzhov, 1984).

From studying of G.C.V and P.C.V (Table 3), it was found that the values of G.C.V and P.C.V were nearly equal for F.D, F.S.I and F.F.Th traits in the first selective generation, indicating that these traits were not affected by environmental conditions the same trend of results were showed for F.L and F.F.Th traits in the second selective generation. The differences between G.C.V and P.C.V values were low for F.W. and T.Y./P traits in the first selective generation and F.W., F.D and T.S.S traits in the second selective generation, indicating that the environmental effects on these traits can be neglected. The difference between G.C.V and P.C.V was large for T.Y./P trait in the second selective generation, indicating that these trait had be affect by environmental conditions. The difference in the values of G.C.V and P.C.V from a generation to the other for same studied traits due to the experiment conditions in both seasons (2000-2001). On the other hand, the both of G.C.V and P.C.V values were significant for (F.W, F.D, F.S.I) and (No. F./P, T.Y./P, F.L) in the first and second selective generations, respectively. The both value were moderate for (T.Y./P, F.F.Th) and (F.S.I, T.S.S) in the first and second selective generations, respectively. With the expiation of F.F.Th trait which was insignificant in the second selective generation.

Whereas, the effectiveness of selection according to quantitative traits is largely dependent on the ratio between the levels of their genotypic and phenotypic variability within the population, (Guzhov 1984), thereby each of these traits that appeared equal or approximate ratios for G.C.V and P.C.V values, selection according to such traits is effective. Figures 1 and 2 illustrates the levels of genotypic and phenotypic variability of all studied traits in first and second selective generations.

The presented data suggest that levels of G.C.V and P.C.V are equal for (F.D., F.S.I.,F.F.Th) and (F.F.Th) traits in first and second generations, respectively. The comparison between G.C.V and P.C.V are quite near for (F.W., T.Y./P) and (F.L., F.D., T.S.S) traits in first and second selective generations, respectively.

2- Heritability Coefficient:-

. The narrow sense heritability for F.W; F.S.I and F.F. Th traits was low indicating that response due to selection would be slow (Table 4), the high (77% , 56% , 50 %) and intermediate (49%, 35%) narrow sense heritability indicate a large of the additive genetic variance and low influence of the environment, suggest that selection based on early selective generations would be relatively effective for T.S.S., T.Y./P, No.F./P, F.D and F.L traits, but otherwise the selection will be effective in late selective generations F.W; F.S.I and F.F.Th traits.

3- Gain of selection:-

Predicted selection gains were in the favorable direction and were larger in the second selective generation than in the first selective generation for No. F./ P, F.w; T.Y./P F.L and F.F.Th traits (Table 4). Predicted gains in the first and second selective generations were identical for F.S.I trait and approximated for T.S.S trait, from results of gain selection. A rapid progress in improvement of that traits, specially which explain high narrow sense heritability is expected.

Table (2): Analysis of variance for Ismailawy sweet melon under the two planting methods

Traits S.O.V		No. F./P		F.W		T.Y./P		F.L		F. D.		F.S.I		F.F.Th		T.S.S %	
	d.f	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001
Replicates	2	0.27	0.13	0.13	0.003	6.52	2.43	0.55	4.76	0.09	046	0.02	0.01	0.03	0.05.	1.01	0.14
Planting methods	1	0.63	1.51	0.88	0.26	32.7	11.52	0.43	16.34	49.3x	1.71	1.04xx	0.02	0.14x	0.74x	1.22	0.67
Error	2	0.31	0.56	0.10	0.18	3.27	18.2	3	1.08	0.115	0.8	0.02	0.04	0.001	0.02	1.55	0.3

x.xx significant at 5% and 1 % levels of probability , respectively

Table (3): Genotypic (G.C.V) and phenotypic (P.C.V) coefficient of variability for all studied traits.

Generations	Traits	No. F./P	F.W	T.Y./P	F.L	F. D.	F.S.I	F.F.Th	T.S.S
S_1	G.C.V %	19.48	28.0	17.23	13.2	115.5	19.5	11.03	13.8
	P.C.V %	26.91	29.6	18.5	24.1	115.5	20	11.15	22.78
S_2	G.C.V %	29.8	8.08	36.9	43.38	13.87	10.99	5.93	13.0
	P.C.V %	37.3	13.99	48.5	44.89	19.61	18.57	6.17	17.6

Variability is insignificant if its coefficient < 10 percent, moderate if the coefficient ranges from 10 to 20 percent and significant if the coefficient > 20 percent. (Guzhov 1984)

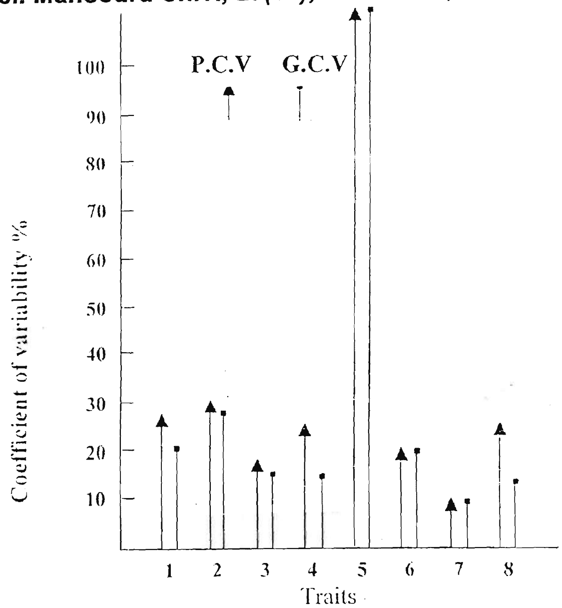

Fig: 1 Genotypic and phenotypic variabilities of all studied traits in S_1: 1-No. F./p; 2-F.w; 3-T.y./p; 4-F.L; 5-F.D; 6-F.S.I; 7- F.F.th; 8-T.S.S.

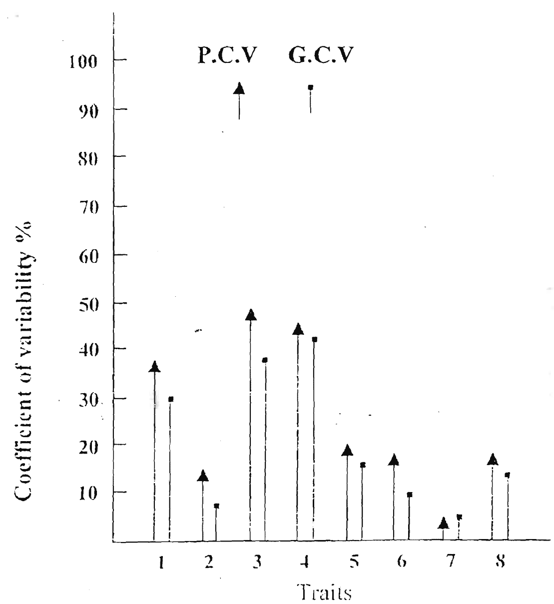

Fig: 2 Genotypic and phenotypic variabilities of all studied traits in S_2: 1-No. F./p; 2-F.W; 3-T.Y./p; 4-F.L; 5-F.D; 6-F.S.I; 7- F.F. Th; 8-T.S.S.

Table (4):Narrow sense heritability (h2N%) and the expected gain under selection (GS) for all studied traits

Traits	No. F./P	F.W	T.Y./P	F.L	F. D.	F.S.I	F.F.Th	T.S.S
(h^2_N %)	50	7	56	35	49	28	30	77
S_1	0.47	0.08	1.05	0.9	4.1	0.08	0.13	1.02
S_2	0.73	4.33	2.3	1.8	1.1	0.08	0.32	0.75

4- Correlation coefficient: -

Correlation coefficients were computed in the second selective generation among mean No.-F./P; F.w; T.Y./P; F.L; F.D; F.F.Th. and T.S.S, (Table 5). Correlation coefficients represent the degree to which respective traits are correlated. Consequently, correlation coefficients have predictive value in selection.

Table (5): Coefficient of correlation (r) and determination (r2) between pairs and some studied traits.

	F.W	T.Y./p	F.l.	F.D	F.F.Th	T.S.S	
No. F./P	-0.238 ± 0.486 0.057	0.935 ± ^{x} 0.177 0.874	0.457± 0.445 0.209	0.722 ± 0.346 0.521	-0.756 ± 0.327 0.572	-0.286 ± 0.479 0.082	r sr r^2
F.W		0.113 ± 0.497 0.013	-0.095 0.498 0.009	0.564 ± 0.413 0.318	-0.222 ± 0.488 0.049	0.545 ± ^{x} 0.176 0.297	r sr r^2
T.Y./p			-0.538 ± 0.422 0.289	-0.546 ± 0.419 0.298	-0.868 ± ^{x} 0.248 0.753	-0.061 ± 0.0499 0.004	r sr r^2
F.L.				0.260 ± 0.480 0.068	0.820 ± ^{x} 0.286 0.672	0.086 ± 0.248 0.007	r sr r^2
F.D.					0.187 ± 0.491 0.035	0.184 ± 0.242 0.034	r sr r^2
F.F.Th						0.048 ± 0.499 0.002	r sr r^2

x Significant of 5 % level of probability when r < 0.3 the correlation between variables is said to be weak; when r = 0.3 –0.7 medium; and 0.7 strong.

There were a positive and significant correlation r = 0.935, 0.545 and 0.820 between (T.Y./p and No. F./P) , (F.W and T.S.S) and (F.L and F.F. Th), respectively, suggesting that selection should be practiced for high yielding, sweetness and fruit thickness based on number of fruits, fruit weight and fruit length, respectively. The coefficient of determinations r^2 (table 5) appear that 87% of the variability of T.Y/P is attributable to the variability of No. F./P r^2 = 0.874, also 30% of the variability of T.S.S is attributable to the F.W r^2 = 0.297, and 67% of the variability of F.F.Th accounts for the variability of the F.L r^2=0.672 .

The correlation coefficient between F.W and both of F.F.Th and F.D were (-0.222) and (0.564), respectively, indicating that selection for F.W trait should be based on F.D trait. The positive and medium relationship r =0.722

between No.F/P and F.D indicates that both traits could be improved simultaneously. There was a negative and weak correlation r =-0.238 between F.W and No.F./P indicating that fruit weight will be decreased with increasing of number of fruits/plant, the coefficient of determination, indicates that 6% only of the variability of F.W is attributable to the variability of No.F./P.

Yield and sweetness improvement are of utmost importance in Ismailawy sweet melon, therefore, high yielding with high sweetness should result from successive generations of selection based on number of fruits / plant and fruit weight traits. El-Mighawry (1998) found significant positive correlations between total yield and each of fruit weight and number of fruits / plant on muskmelon.

5- Partial and multiple correlations:

The partial correlations coefficient is a measure of the contingency of two variables while the third remains constant. In this investigation, partial correlation was done by yield and its components (Number of fruits / plant and fruit weight), also between total soluble solids, fruit weight and fruit flesh thickness. The results of table (6) showed that the partial correlation between T.Y./P and No.F./P with the F.W being constant are non-significant but negative (r_{xyz}=-0.568), this differ significantly from the total correlation coefficient (r_{xy}=0.935), table (5), indicating that if we select plants with fruits of an identical weight, the relation between T.Y./P and No.F./P will be very weak, for an essential part of the interrelationship is the variation in the fruit weight. Same result with partial correlation between T.S.S, F.W and F.F.Th, (table 6).

Table (6): Partial and multiple linear correlation and coefficient of multiple determination

Partial and multiple coefficient correlation between total yield (x) , fruit number (y) and fruit weight (z) and coefficient of multiple determination R^2			Partial and multiple coefficient correlation between T.S.S (x) fruit weight (y) and flesh thickness (z) and coefficient of multiple determination R^2		
r_{xyz}	R_{xyz}	R^2_{XYZ}	r_{xyz}	R_{xyz}	R^2_{XYZ}
-0.568	0.996	˙0.99	-0.134	0.505	0.26

x , significant of 5% level of probability

The multiple correlation coefficients between T.Y./P, No.F./P, F.W and also, between T.S.S, F.W, F.F.Th were tabulated at (table 6). It was clear that it was significant R_{xyz}=0.996 and non-significant R=0.505, respectively. Coefficient R always lies between 0 and 1. As R tends to unity, the degree of linear relation of three variables increases. (Dospekhov 1984). As judged by the coefficient of multiple determination (table 6), R^2_{xyz}=0.99 indicating that 99% of the variation in the yield of Ismailawy sweet melon is attributed to the No.F/P and F.W traits, while 1% of the variation (1-R^2) cannot be attributed to their effect. On the other hand 26% of the variation in the T.S.S is attributed to the F.W and F.F.Th traits and 74% of the variation is attributed to other factors.

Since Ismailawy sweet melon is cross-pollinated crop. Therefore the mass selection program will be useful in improvement of the important traits. The improvement will be rapid in the early selective generations for traits which appear high values of narrow sense heritability, good predicted gains and the lowest influence by environmental conditions, but the enhancement become slow in the later selective generation with inverse results.

REFERENCES

Abd El-Raheem, A.A; F.A. Omar; A. E. Abdel-Moneam and S. A. Baha El-Din (1986). Genetical Studies of some morphological and yield characters in cantaloupe and melon (*Cucumis mole* L.) J. Agric. Res. Tanta Univ., 12 (4): 88 – 108.

Abd El-Raheem A.A. and A. El-Mighawry (1991). Genetic analysis of yield and earliness in an intervarietal cross of melon (*Cucumis mole* L.) J. Agric. Res. Tanta Univ., 17 (1): 91-102.

Ahmed R. Aggour and Dermot P. Coyne (1989). Heritability, Phenotypic correlations, and associations of the common blight disease reactions in beans. J. Amer. Soc. Hort. Sci., 114 (5): 828-833.

Awny, S. (1992). Genetic behaviour of yield and quality traits of muskmelon (*Cucumis mole* L.): J. Agric. Sci. Mansoura Univ., 17 (2): 393-400.

Chaudhary R.C. (1989) Introduction to plant breeding. New Delhi: Oxford and IBM Publ.

Dospekhov, B.A. (1984). Field Experimentation. Mir Publisher. English translation. P.P. 311-318. Moscow.

El-Mighawry A. (1998) Type of gene action, combining ability and correlation of some yield and quality characters in muskmelon (*Cucumis mole* L.) Egypt. J. Appl. Sci., 13 (4): 167-182.

Guzhov, Y.U. (1984) Genetics and plant breeding for agriculture. Mir Publisher. English translation. Moscow.

Lee, T.; J. Cheonsoon; K. Il seop and Y. Keunchang (1996). Comparative analysis for characteristics off, hybrids between sweet and less-sweet lines of muskmelon in warm season. J. of the Korean Society for Hort. Sci. 37 (6) 751- 757 (C.F. plant Breed. Abst., 67 (6): 6156.)

Luciano, A.; M.L. Kinman and J. D. smith (1965). Heritability of self-incompatibility in the sunflower (*Helianthus annus*). Crop Sci., 5 : 529 – 532.

Sendecor, G.W. (1956). Statistical methods applied to experiments in agriculture and biology, 5th ed., Iowa state college press.

Sendecor, G.W. and W.G. Cochran (1967). Statistical methods. Oxford and IBH. Publishing Co. 6th ed. PP. 299-312.

Vavilov, N.I. (1951). the origin of variation, immunity and breeding of cultivated plants. Chronica Bot., 13 (1): – 364 .

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دراسات وراثية لتحسين صفات الجودة والمحصول في الشمام الإسماعيلاوي

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استخدم في هذا البحث الأجيال الانتخابية الأول والثاني الناتجة من عشيرة شمام اسماعيلاوي بالانتخاب وقد زرعت الأجيال الانتخابية الأول والثاني تحت نظامين من طرق الزراعة ري بالتنقيط وزراعة بعليه وقد تم في هذا البحث دراسة معامل التباين الوراثي والمظهري ومعامل التوريث بمعناه الضيق والتحسين المتوقع بالانتخاب. وأيضاً تم دراسة معامل الارتباط وايضاً معامل الارتباط الجزئي والمتعدد بين بعض الصفات الهامة وقد أوضحت النتائج أن معامل التباين الوراثي والمظهري كان تقريباً متساوي لصفات قطر الثمرة ومعامل شكل الثمرة وسمك لحم الثمرة في الجيل الانتخابي الأول وصفات طول الثمرة وسمك لحم الثمرة في الجيل الانتخابي الثاني.

معامل التوريث بمعناه الضيق كان عالي لصفات عدد الثمار / نبات والمحصول الكلي / نبات ونسبة المواد الصلبة الذائبة أيضاً.

وقد وجد أن هناك ارتباط معنوي موجب بين عدد الثمار / نبات مع المحصول الكلي / نبات وأيضاً بين وزن الثمرة مع نسبة المواد الصلبة الذائبة وكذلك بين طول الثمرة وسمك لحم الثمرة.

وهذه النتائج قد تساعد في اختيار برنامج التربية المناسب لتحسين الشمام الاسماعيلاوي .