

## IMPROVEMENT OF SOME ECONOMIC CHARACTERS THROUGH VARIATION INDUCED VIA MUTAGENESIS IN SUMMER SQUASH

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### ABSTRACT

This work was carried out at the Experimental Farm of Faculty of Agriculture, Ain Shams University, at Shalakan, in the fall and summer seasons of 2004/2005 and 2005/2006. The aim of this experiment was to study the mutagenesis effect of both gamma irradiation (at doses 10, 20, 30, and 40 kr) and EMS (at concentrations 0.025, 0.05, 0.1, and 0.2 %) on two summer squash cultivars, Eskandarani and Gabla, as an attempt to induce mutations of valuable productivity. Three mutant generations were carried out after treating with the two mutagenesis and the results indicated that in M1 generation the values of most studied traits was decreased at the high doses and high concentrations of gamma-rays and EMS, respectively, compared with control plants. In M2-generation, five types of mutant were selected, these mutants were different from their control plant. In M3-generation, four type mutants, namely early flowering, node position of first pistillate flower, high number of pistillate flower and large fruit selected from the M2-generation, were raised to study their behavior compared to the control plants. The progeny test of these mutants revealed that all the mutants in M3 retained the behavior they show in the M2-generation. These mutants were superior to their control plant in these economic characters.

**Keywords:** summer squash, gamma rays, EMS, mutants, mutagenesis

### INTRODUCTION

Summer squash (*Cucurbita pepo*. L.) is one of the most popular vegetable crops in most Arab countries. However, there are only two local cultivars of squash in Egypt. Balady, which is lately discarded for its prostrate growth habit and low yield and Eskandarani, which is highly yielding and satisfies both the producer and consumer. There are little studies on using mutagenesis to induce mutation in summer squash or *Cucurbitaceae* family, therefore literature concerning other crops will be reviewed. Shalaby *et al.* (1983) soaked cloves of Egyptian garlic with EMS solution at concentrations of 0.0, 0.025, 0.05, 0.1 or 0.2% for 12, 24, 48 and 72 hours. The result showed that, in the M1-generation, both higher concentrations and longer periods of soaking had inhibitory effect on bulb diameter, bulb weight, number of cloves per bulb, average clove weight and total yield. Saxena and Solanki (1986) irradiated seeds of tomato cv. Pusa Ruby to different doses of gamma-rays, i.e., 5, 10, 15, 20 and 25 Kr. They stated that doses lower than 20 Kr induced early flowering and fruiting with an appreciable effect in 5 Kr doses. Tickoo (1987) studied the effect of EMS for inducing mutations in mung bean (*Vigna radiate* L.). In M2-generation, macromutations identified

were dwarf, many pods, large pods, long pods, white pods, large seeds and seed coat color. The mutants bred true in the M3-generation. Nofal (1989) studied the effect of gamma-ray doses (5, 10 and 20 Kr) on two pea cultivars. It was found that all doses significantly reduced the mean number of pods per plant of both cultivars in M1-generation. Hassan (1991) treated seeds of lupine with EMS at concentration of 0.1, 0.15, 0.2 and 0.25%. It was reported that the variability of such trait as indicated by C.V.% values showed elevation above that of the control. Greater variability in number of pods per plant compared with control was showed by Ahmad and Yagoob(1993). Kumar and Mishra (1999) found in *Vigna radiate* L. that dry seeds treated with varying doses of gamma-rays ( 10, 20, 30 and 40 Kr) gave reduced number of leaves per plant, but increased the number of days to flowering, on mung bean with 10 to 30 Kr gamma-rays. Srivastava and Singh (1996) studied the effect of different EMS concentrations (0.1, 0.2, and 0.3%) on two pigeon pea cultivars. They isolated two kind of mutants; high yield and high protein content in M2-generation. These mutants were further taken to M3 and M4 generations where they were found to be bred true.

The aim of this experiment was to study the mutagenesis effect of both gamma irradiation and EMS on two summer squash cultivars, Eskandarani and Gabla, as an attempt to induce mutations of valuable productivity.

## MATERIALS AND METHODS

This work was carried out at the Experimental Farm of Faculty of Agriculture, Ain Shams University, at Shalakan, in the fall and summer seasons of 2004-2005 and 2005-2006. Seeds of two cultivars (pure line) of summer squash (*Cucurbita pepo* L.), namely Eskandarani and Gabla, were exposed to different doses of gamma rays, i.e., 0, 10, 20, 30 and 40 Kr, from a cobalt-60 source at the Middle Eastern Regional Radioisotope Center of the Arab Countries, Dokki, Cairo, Egypt. Dose rate was 3.80 and 4.21 rad/sec, in the first and second season, respectively. Dry seeds of the two summer squash cultivars were treated with freshly prepared aqueous solution of ethylmethane sulphonate (EMS) at the concentrations 0.0, 0.025, 0.05, 0.1 and 0.2% for 12 hours at room temperature. The soaked seeds were thoroughly washed in running water to remove the mutagen. Immediately after the treatment, the seeds were sown in field. Seeds soaked in a tap water under the above mentioned conditions were used as control. The treatments with two mutagenesis were done on August 2 and 3 in 2004 and 2005 seasons, respectively.

### **M1-generation:**

Treated and non-treated seeds (control) from the two cultivars were sown in four replications and the complete randomized block design was used in M1-generation.

Each experimental plot consisted of four rows with 5 meter length and 0.7 meter width. Two seeds were planted in each hill, a distance of 50 cm was maintained between the plants, and the field was then irrigated. The plants were thinned to a single seedling per hill two weeks after germination.

All replications received similar treatments as regards to cultivation, manuring, irrigation, pest and disease control, and other agricultural practices as commonly followed in the district. The following data were recorded :

- 1- Number of days from sowing till the first pistillate flower opening.
- 2- Number of staminate flower per plant.
- 3- Number of pistillate flowers per plant.
- 4- Sex ratio
- 5- Early and total yield: Fruits were harvested at two-day intervals. Early and total yields were calculated, as fruit weight per plot and number of fruits per plant. Fruits harvested during 15 days from the beginning of harvest were considered as early yield.

**M2-generation:**

Random seeds from the individual M1-plant of each treatment were planted as a family on February 15, 2005. Seeds of Every family were planted in 15 rows with 5 meter long and 70 cm wide and 50 cm apart, beside two rows of untreated seeds as a control for each treatment.

During the growth period, macromutations such as dwarf, vigorous plants, number of days to first pistillate flower, number of nodes to first pistillate flower, fruit length, fruit diameter and other morphological abnormalities or any plant showing chimeras were recorded.

Data recorded:

1. Number of days from sowing till the first pistillate flower opening.
2. Number of nodes till first pistillate flower.
3. Number of pistillate flowers per plant.
4. Average fruit weight without fruit neck.
5. Number of fruits per plant.

Seeds of each fertile mutant plant were kept separately in paper bag for sowing in next season (2006) to raise M3-generation.

**M3-generation:**

Seeds of the best mutant plants, which were selected from M2-generation, were sown on 15<sup>th</sup> of February, 2006, to provide the experimental plant materials of M3-generation. The progeny of each M2-deviant plant was grown as a single family in three rows each one considered as replicate, the length of row was 7 meter and the width was 70 cm and 50 cm apart between plants. Control seeds were, also, sown in the same designs.

From each replicate 4 plants were determined and the following data were recorded:

1. Stem length: the plants were picked at the end of season and the average of stem length was measured.
2. Average number of leaves per plant: The plants were dug out at the end of season and the leaf number was counted.
3. Number of days from sowing till the first pistillate flower opening.
4. Number of nodes till first pistillate flower.
5. Number of staminate flowers per plant.
6. Number of pistillate flowers per plant.
7. Average fruit length was measured without fruit neck
8. Average fruit diameter was measured at the middle of fruit.
9. Average fruit weight was measured without neck.

10. Number of fruits per plant.

11. Weight of 100 seeds.

**Statistical analysis:**

**M1 and M3 generations**

Data were statistically analyzed according to the regular analysis of variance of complete randomized block design. Duncan's multiple range test was used for the comparison between treatment means (Waller and Duncan, 1960)

**M2-generation**

Data on M2-micro-mutation were statistically analyzed by calculating minimum value, maximum value (range of variability), the means of treatment (X), variance (S<sup>2</sup>), standard error (S.E), coefficient variation (CV %) for each treatment.

## RESULTS AND DISCUSSION

**M1-generation**

**Number of days for first pistillate flower:**

Data presented in Table (1) show that in both cultivars the low dose of gamma rays (10 Kr) decreased the period from sowing to flowering. While, the high doses of two mutagenesis (30 and 40 Kr) or (0.1 and 0.2% EMS) increased such period. In both cultivars the lowest values for number of days for first pistillate flower was at 10 Kr of gamma-rays. Early flowering could be attributed to that low doses of irradiation, generally stimulate cell growth, increase the rate of growth and produce early flowering in specific case and at some growing stage according to radiation type and dose as well as to plant species (Abd El-Maksoud, 1980). Also, it can be explained as a result of delaying or inhibiting the synthesis of florigens which resulted in delaying flowering under the external environmental conditions because induction of flowering can be affected by many factors, either internal or external. These results are in agreement with those of Saxena and Solanki (1986) and Kumar and Mishra (1999).

**Number of pistillate and staminate flowers and sex ratio:**

From Table (1) we can notice that in Eskandarani cultivar high doses of gamma-rays decreased the number of staminate and pistillate flowers and increased the sex ratio, while the low dose 1 Kr increased the number of pistillate flowers and decreased the sex ratio. In the same cultivar, EMS caused more decreasing in number of pistillate flowers and more increasing in sex ratio compared with gamma-rays. On the other hand, in Gabla cultivar all concentrations of EMS and high doses of gamma-rays increased the number of staminate flowers and sex ratio, while 10 Kr of gamma-rays increased the number of pistillate flowers and decreased the sex ratio. The changing in number of flowers and sex ratio due to some treatments may be returned to the stimulation effect of these treatments on plant growth and growth regulator in the plant.

**Yield and yield components:**

Results presented in Table (2) showed that the low and medium doses of EMS did not affect the early and total yield of the two cultivars in the both seasons, while the high doses of EMS (0.1, 0.2) caused high significant

decrease in the early and total yield of two cultivars in both seasons. The 10 Kr dose of gamma-rays caused increasing in early and total yield in both cultivars, while the higher doses of gamma-rays caused significant decrease in early and total yield. The increasing in early and total yield at 10 Kr dose may be returned to the increasing in vegetative growth, earlier in flowering, number of pistillate flowers and fruit weight at this dose as we showed previously. While the decreasing in early and total yield at high doses of two mutagenesis maybe returned to the decreasing in plant growth, number of pistillate flower and fruit weight at these doses. These results are confirmed with those of Shalaby *et al.* (1983) and Nofal 1989.

**Table (1): Effect of gamma rays and EMS on some flowering traits of two summer squash cultivars in M1- generation in 2004 and 2005 seasons.**

Treatments	No. of days for first pistillate flower	No. of staminate flowers/ plant	No. of pistillate flowers/ plant	Sex ratio	No. of days for first pistillate flower	No. of staminate flowers/ plant	No. of pistillate flowers/ plant	Sex ratio
<b>2004</b>								
<b>2005</b>								
Eskandarani								
Control	45.10 H	10.11 DEF	11.40 E	0.88 EFG	42.58 FGH	9.36 BCD	10.97 DE	0.86 FGH
0.025 %	46.38 FG	11.06 BCD	11.94 DE	1.03 CD	43.75 EFG	9.55 BCD	9.77FGGH	0.97 DEF
0.05 %	47.97 E	11.53 ABC	9.95 FG	1.14 B	44.55 EF	9.72 BCD	8.50 HI	1.15 CD
0.1 %	51.93 D	10.56 CDE	8.70 I	1.21 B	47.99 CD	9.08 CDE	7.09 J	1.27 BC
0.2 %	54.91 C	10.52 CDE	7.68 J	1.36 A	51.47 B	8.34 CDEF	5.45 K	1.68 A
10 Kr	40.66 K	9.75 DEFG	13.36 B	0.72 HI	39.58 IJ	9.23 BCDE	12.70 BC	0.72 GHI
20 Kr	47.54 EF	9.48 DEF	11.54 E	0.85 FG	45.89 DE	8.91 CDEF	9.91 EF	0.90EFG
30 Kr	56.50 B	8.37 GH	9.19 HI	0.92 DEF	53.97 A	7.74 DEF	8.54 GHI	0.98 DEF
40 Kr	58.81 A	7.69 H	7.02 K	1.12 BC	55.42 A	6.95 F	6.78 J	1.12 CD
Gabla								
Control	40.64 K	8.90 FGH	13.65 B	0.64 I	37.89 J	9.05 CDE	14.54 A	0.61 IJ
0.025 %	41.74 JK	12.84 A	13.35 B	0.95 DEF	41.45 GHI	12.31 A	12.77 BC	0.97 DEF
0.05 %	44.75 H	12.38 AB	12.73 C	0.96 DE	43.46 EFG	13.14 A	11.78 CD	1.10 CDE
0.1 %	46.72 FG	11.69 ABC	10.41 F	1.10 BC	45.56 E	12.11 A	9.82 EFG	1.23 BC
0.2 %	51.81 D	11.62 ABC	9.52 GH	1.21 B	50.22 BC	11.20 AB	8.00 IJ	1.40 B
10 Kr	36.10 L	7.72 H	14.72 A	0.52 J	34.28 K	7.43 EF	15.45 A	0.47 J
20 Kr	42.08 J	9.84 DEF	12.43 CD	0.78 GH	40.77 HI	9.23 BCDE	13.06 B	0.70 HI
30 Kr	43.57 I	9.35 EFG	9.82 FG	0.94 DEF	42.75 FGH	10.09 BC	11.07 DE	0.91 EFG
40 Kr	45.80 GH	9.28 EFG	8.08 J	1.14 B	43.62 FGH	8.63 CDEF	9.24 FGHI	0.99 DEF

Any means within the same column followed by the same letter are not statistically different at the 5% level (Duncan's multiple range test).

### **M 2-generation**

#### **Number of days for first pistillate flower:**

It is cleared from Table (3) that the mean values of all doses were nearly from control value in two cultivars. Range of distribution in all treatment progenies in M2-generation were mostly wider than that of the control. Coefficient of variation values in both cultivars for all treatment progenies were higher than the respective control. These results are in agreement with that those of Hassan (1991)

**Table (2): Effect of gamma rays and EMS on some yield traits of two summer squash cultivars in M1- generation in 2004 and 2005 seasons.**

Treatments	Early yield / plant ( fruit number)	Early yield/ plot (kg)	Total yield/ plant (fruit number)	Total yield / plot (kg)	Early yield / plant ( fruit number)	Early yield/ plot (kg)	Total yield/ plant (fruit number)	Total yield / plot (kg)
	2004				2005			
Eskandarani								
Control	4.50 E	8.21 AB	11.27 DE	20.63 AB	4.14 DE	7.74 B	10.71 CD	20.00 B
0.025 %	4.31 EF	7.55 BC	10.30 EF	18.04 BCD	4.00 DEF	7.05 BC	9.41 DE	16.55 C
0.05 %	3.90 GHI	6.65 CDE	9.01 GH	15.22 DEF	3.85 EFG	6.74 C	7.57 EF	13.80 DE
0.1 %	3.22 K	5.07 FGH	7.49 IJ	12.52 FG	3.25 HI	5.21 DEF	6.00 FGH	10.51 FG
0.2 %	2.99 K	4.05 I	6.00 K	8.83 HIJ	3.02 I	4.65 FG	4.41 H	7.62 H
10 Kr	5.21 BC	9.04 A	13.01 B	22.98 A	4.98 B	8.97 A	12.50 BC	22.55 A
20 Kr	4.09 FGH	6.83 CD	10.30 EF	17.06 CD	4.15 DE	7.14 BC	9.33 DE	16.03 CD
30 Kr	3.67 IJ	5.63 EFG	8.24 GHI	12.62 FG	3.25 HI	5.48 DE	7.44 EFG	13.41 E
40 Kr	3.12 K	4.57 HI	4.39 L	8.29 IJ	2.96 I	4.62 FG	5.46 GH	9.10 GH
Gabla								
Control	5.49 B	7.47 BC	13.49 AB	15.97 CDE	5.01 B	7.16 BC	14.14 AB	20.18 B
0.025 %	5.08 C	6.69 CD	12.66 BC	16.73 CDE	4.86 B	6.52 C	12.23 C	16.65 C
0.05 %	4.58 DE	5.99 DEF	12.35 BCD	15.11 DEF	4.51 C	5.73 D	11.04 CD	13.88 DE
0.1 %	4.02 Fghi	5.58 EFG	9.23 FG	11.14 GH	3.98 EF	4.72 EFG	6.24 FGH	10.30 FG
0.2 %	3.34 JK	4.38 HI	7.85 HIJ	6.74 J	3.52 GH	4.09 G	5.95 FGH	7.57 H
10 Kr	5.97 A	7.32 BC	14.45 A	18.59 BC	5.54 A	7.80 B	15.23 A	21.40 AB
20 Kr	4.90 CD	6.07 DEF	11.66 CD	13.93 EFG	4.37 CD	5.72 D	12.13 C	15.79 CD
30 Kr	4.25 EFG	4.73 GHI	8.71 GHI	9.70 HI	3.96 EF	4.86 EFG	9.16 DE	12.10 EF
40 Kr	3.37 HI	3.95 I	6.80 JK	7.15 IJ	3.71 FG	4.11 G	7.18 FG	8.95 GH

Any means within the same column followed by the same letter are not statistically different at the 5% level (Duncan's multiple range test).

**Table (3): Statistical parameter of number of days for first pistillate flower M2-generation for two summer squash cultivars.**

cultivar	treatment	No. of plants	Classes						Range	X+ S.E	C.V%	
			25-30	31-35	36-40	41-45	46-50	51-55				56-60
	Control 0.00	120				87	33		42-47	44.70 +- 0.11	2.63	
Eskandarani	Camma irradiation doses											
	10 Kr	100		6		58	33	3	32-53	44.28 +- 0.35	7.90	
	20Kr	120		8	1	98	10	3	31-54	43.51 +- 0.32	8.04	
	30Kr	140	3	8	1	80	42	4	2	30-57	44.21 +- 0.38	10.04
	40Kr	120			4	54	42	15	5	39-57	46.17 +- 0.36	8.53
	EMS concentration											
	0.025 %	140			13	76	51			38-48	44.44 +- 0.19	5.17
	0.05 %	150	1	6		119	22	2		30-53	43.39 +- 0.26	7.39
	0.1 %	120	3	9	13	57	38			30-49	42.56 +- 0.40	10.33
	0.2 %	140			11	89	32	2	6	38-59	44.28 +- 0.31	8.42
	Control 0.00	140			19	121			40-45	42.00 +- 0.11	2.67	
Gabla	Camma irradiation doses											
	10 Kr	120	6	3		111				27-45	41.30 +- 0.32	8.49
	20Kr	100	3		31	66				28-44	40.85 +- 0.24	5.80
	30Kr	130	11		33	86				25-44	40.14 +- 0.34	9.69
	40Kr	140	2	2	30	101	4	1		30-51	41.47 +- 0.22	6.39
	EMS concentration											
	0.025 %	120				115	5			41-49	42.56 +- 0.16	4.08
	0.05 %	140			40	95	5			37-48	42.26 +- 0.22	6.19
	0.1 %	120	6	3	32	76	3			25-49	40.64 +- 0.33	8.95
	0.2 %	150	4		17	127	2			26-47	42.53 +- 0.25	7.12

**Number of nodes to first pistillate flower:**

Data presented in Table (4) showed that there were little differences among all treatments and control in the two cultivars. The range of most treatments was wider than that of the control of two cultivars. The widest range was at 10 Kr and 0.05% EMS (3-8) for Eskandarani cultivar and it was at 40 Kr for Gabla cultivar (4-8). Coefficient of variation values in both

cultivars for all treatment progenies were higher than the respective control. The maximum values of CV% was obtained at 40 Kr in Eskandarani cultivar (14.40%) and at 0.2% EMS in Gabla cultivar (14.35).

**Table (4):Statistical parameter of number of nodes for first pistillate flowers in M2- generation for two summer squash cultivars.**

cultivar	treatment	No. of plants	Classes						Range	X ± S.E	C.V%	
			2	3	4	5	6	7				8
	Control 0.00	120				21	99			5-6	5.83 +- 0.034	6.51
Eskandarani	Camma irradiation doses											
	10 Kr	100		5		64	29	1	1	3-8	5.24 +- 0.075	14.31
	20Kr	120				26	94			5-6	5.78 +- 0.037	7.09
	30Kr	140				36	104			5-6	5.74 +- 0.037	7.66
	40Kr	120		7		42	70	1		3-7	5.48 +- 0.072	14.41
	EMS concentration											
	0.025 %	140				62	78			5-6	5.56 +- 0.042	8.99
	0.05 %	150		2	6	71	70		1	3-8	5.42 +- 0.54	12.36
0.1 %	120			1	25	94			4-6	5.78 +- 0.040	7.61	
0.2 %	140	3	4		114	19			2-6	5.01 +- 0.056	13.37	
	Control 0.00	140			60	80				4-5	4.57 +- 0.42	10.94
Gabla	Camma irradiation doses											
	10 Kr	120	7		4	115		1		4-7	4.98 +- 0.23	5.22
	20Kr	100		4	31	58				2-5	4.40 +- 0.086	17.04
	30Kr	130		5	95	30				3-5	4.19 +- 0.042	11.45
	40Kr	140			60	78		1	1	4-8	4.61 +- 0.051	13.23
	EMS concentration											
	0.025 %	120	3		26	93		1		4-7	4.80 +- 0.042	9.58
	0.05 %	140			54	83				2-5	4.55 +- 0.052	13.61
0.1 %	120	4		84	36				4-5	4.30 +- 0.042	10.69	
0.2 %	150	4	2	97	47				2-5	4.25 +- 0.050	14.35	

**Number of pistillate flowers per plant:**

As shown in Table (5), the number of pistillate flowers per plant recorded a little increase in all treatments compared with control of two cultivars. The range of most treatments was wider than that of the control. The coefficient of variation values in both cultivars for most treatments were higher than the respective control. Some treatments recorded lower CV% values than the control, this case may be attributed to environmental conditions.

**Fruit weight:**

A significant difference between control and most treatments was observed in both cultivars (Table 6). All treatments produced lower weight of fruit compared to control. The maximum decrease was achieved by using 40 Kr of gamma-rays in both cultivars, it was 77.62 and 60.62 g for Eskandarani and Gabla cultivars, respectively. From the same Table it is clear that there were no differences between the effect of gamma-rays and EMS concentration. The SE (standard error) values were increased by increasing the doses of two mutagenesis. Concerning variation in fruit weight, all populations of M2 recorded relatively high CV % values indicating high degree of heterogeneity in this respect. Moreover, the coefficient of variation of each mutagenized progenies was higher than the control. The maximum increase in variability of fruit weight was achieved at 30 and 40 Kr gamma-

rays for Eskandarani and Gabla cultivar, respectively. These results are similar to that found by Tickoo (1987).

**Table (5): Statistical parameter of number of pistillate flowers / plant in M2- generation for two summer squash cultivars.**

cultivar	treatment	No. of plants	Classes				Range	X+ S.E	C.V%
			5-8	9-12	13-16	17-20			
Eskandrani	Control 0.00	60	7	42	11		6-14	10.66 +- 0.25	18.75
	Camma irradiation doses								
	10 Kr	50	3	37	9	2	8-19	11.38 +-0.31	19.24
	20Kr	60	2	37	18	3	8-19	12.03 +- 0.27	17.70
	30Kr	70	5	40	24	1	8-18	11.75 +- 0.27	19.23
	40Kr	60	5	40	14	1	7-17	11.48 +- 0.24	16.55
	EMS concentration								
	0.025 %	70	2	52	12	4	8-18	11.58 +- 0.26	18.91
	0.05 %	75	6	35	33	1	5-17	12.30 +- 0.28	20.00
	0.1 %	60	2	52	6		6-14	10.96 +- 0.18	12.95
0.2 %	70		50	20		9-14	11.82 +- 0.17	12.43	
Control 0.00	70		35	34	1	9-17	12.98 +- 0.20	13.09	
Gabla	Camma irradiation doses								
	10 Kr	60	7	13	37	3	5-20	12.95 +- 0.37	22.70
	20Kr	50	1	14	33	2	8-21	13.48 +- 0.29	15.43
	30Kr	65		20	42	3	10-20	13.76 +- 0.23	13.51
	40Kr	70	4	41	23	2	5-17	11.90 +- 0.28	20.00
	EMS concentration								
	0.025 %	60	1	51	8		8-15	10.93 +- 018	12.90
	0.05 %	70	4	49	16	1	6-19	11.71 +- 0.25	18.44
	0.1 %	60	8	35	16	1	5-19	11.25 +- 0.36	24.88
	0.2 %	75	5	43	25	2	6-17	12.05 +- 0.26	19.00

**Number of fruits per plant:**

It is clear from Table (7) that all treatments recorded higher mean values compared with control of two cultivars. The highest value was recorded at 0.05% EMS in Eskandrani cultivar (11.44 fruit) and it was at 30 Kr in Gabla cultivar (12.49 fruit). Range of distribution of progenies of all treatments for both cultivars was slightly wider than that of the control. Coefficient of variation values in all progenies of most treatments within each cultivar were higher than the respective control value. The highest variation was found at 0.05% EMS and 30 Kr in Eskandarani cultivar and it was at 0.1% EMS and 10 Kr in Gabla cultivar. Similar results were found by Hassan (1991), Ahmad and Yagoob (1993) and Srivastava and Singh (1996).

**M3-generation:**

The best mutations were selected depended on some commercial characters as early and high yield and data in Tables (8 and 9) show that each mutant was superior in one character comparative with control and other genotypes. EPF1 and GPF2 mutants are superior in number of pistillate flowers, EDN3 and GDN5 mutants were earlier than control and other genotypes, ENN4 and GNN5 mutants recorded the lowest number of nodes



to first pistillate flower and EFW1 and GFW1 had the highest fruit weight. It can be concluded that these mutants have good and important characters and they are very important for breeding programs.

**Table (6): Statistical parameter of average of fruit weight (g) in M2-generation for two summer squash cultivars.**

cultivar	treatment	No. of plants	Classes								Range	X± S.E	C.V%
			40-50	51-60	61-70	71-80	81-90	91-100	101-110	111-120			
Eskandrani	Control 0.00	60				2	29	29			78-99	90.76 ± 0.69	5.66
	Camma irradiation doses												
	10 Kr	50				3	34	12		1	80-120	88.42 ± 1.00	8.00
	20Kr	60			2	14	32	11		1	70-117	85.45 ± 1.04	9.50
	30Kr	70			5	45	13	7			65-96	79.60 ± 0.64	9.92
	40Kr	60		10	11	16	14	9			55-99	77.62 ± 1.68	16.73
	EMS concentration												
	0.025 %	70				6	36	28			71-100	89.69 ± 0.76	7.16
	0.05 %	75			3	15	27	8			67-98	84.46 ± 0.72	7.43
Gabra	Control 0.00	70			44	26					62-76	68.98 ± 0.55	6.75
	Camma irradiation doses												
	10 Kr	60		7	42	10		1			60-95	67.17 ± 0.68	7.87
	20Kr	50	1	13	36						50-70	63.72 ± 0.73	8.12
	30Kr	65	7	13	41	4					48-73	62.81 ± 0.87	11.22
	40Kr	70	17	10	42	1					45-71	60.62 ± 1.08	14.89
	EMS concentration												
	0.025 %	60			51	9					62-73	67.32 ± 0.37	4.27
	0.05 %	70		6	60	4					53-73	66.02 ± 0.51	6.52
0.1 %	60	7	12	37	4					48-72	62.84 ± 0.93	11.55	
0.2 %	75	12	7	51	5					42-72	62.21 ± 0.93	13.05	

**Table (7): Statistical parameter of number of fruits / plant in M2-generation for two summer squash cultivars.**

cultivar	treatment	No. of plants	Classes					Range	X ± S.E	C.V%
			3-6	7-10	11-13	14-17	18-21			
	Control 0.00	60	4	33	23			6-13	9.90 +- 0.21	16.76
Eskandrani	Gamma irradiation doses									
	10 Kr	50		28	19	3		7-16	10.44 +- 0.26	17.81
	20Kr	60		27	29	4		7-17	10.86 +- 0.22	15.93
	30Kr	70	2	30	30	8		6-17	10.77 +- 0.26	20.42
	40Kr	60	3	25	30	2		6-16	10.66 +- 0.26	18.94
	EMS concentration									
	0.025 %	70		41	22	7		7-17	10.67 +- 0.26	20.52
	0.05 %	75	1	26	31	17		3-16	11.44 +- 0.28	21.67
	0.1 %	60	2	37	21			4-13	10.08 +- 0.18	14.48
0.2 %	70		35	33	2		7-14	10.68 +- 0.17	13.57	
	Control 0.00	70		7	49	14		9-16	12.14 +- 0.18	12.16
Gabra	Gamma irradiation doses									
	10 Kr	60	3	13	30	13	1	3-18	11.61 +- 0.36	24.03
	20Kr	50		7	28	14	1	8-19	12.38 +- 0.28	16.23
	30Kr	65		11	32	21	1	8-18	12.49 +- 0.23	15.37
	40Kr	70	2	32	27	9		4-16	10.47 +- 0.26	20.76
	EMS concentration									
	0.025 %	60		34	17			7-13	9.51 +- 0.18	14.93
	0.05 %	70	2	38	22	8		4-15	10.47 +- 0.26	20.72
	0.1 %	60	8	19	26	7		4-15	10.28 +- 0.35	26.55
0.2 %	75	3	32	27	13		5-16	10.97 +- 0.27	21.69	

**Table (8): Stem length, No. of leaves per plant, No. of staminate flowers/ plant, No. of pistillate flowers/ plant, No. of nodes to first pistillate flower and No. of days to first pistillate flower for 8 mutant lines of summer squash for Eskandarani and Gabla cultivars and their original cultivars in M3-generation**

genotype	Stem length (cm)	No. of leaves/ plant	No. of staminate flowers/ plant	No. of pistillate flowers/ plant	No. of nodes to first pistillate flower	No. of days to first pistillate flower
<b>Eskandarani</b>						
Control	84.36	21.65	14.07	11.35	5.22	45.67
EPF1	84.00	21.00	7.33	18.74	4.00	39.68
EDN3	81.33	18.33	9.65	13.00	4.66	30.03
ENN4	83.33	19.67	12.64	15.67	2.40	35.00
EFW1	92.33	23.00	12.60	11.60	5.03	44.31
L.S.D 5%	2.87	1.85	1.70	1.59	0.60	1.88
<b>Gabla</b>						
control	71.35	17.11	14.02	11.32	4.15	41.65
GPF2	74.00	13.69	17.60	6.12	4.00	39.00
GDN5	68.00	20.22	17.00	5.28	3.66	27.03
GNN5	70.00	17.23	14.63	7.00	2.19	42.00
GFW1	76058	16.33	14.33	9.66	4.33	40.00
LSD 5%	2.692	1.425	1.402	1.544	0.540	1.799

DN = Early flowering mutant

NN= node position mutant

PF = high number of pistillate flowers mutant

FW = Large and small fruit mutant

**Table (9): Fruit length, diameter, weight, and number per plant and 100 seed weight for 8 mutant lines of summer squash cv. Eskandarani and Gabla cultivars and their original cultivars in M3-generation.**

genotype	Fruit length (cm)	Fruit diameter (cm)	Average fruit weight (g)	Fruit number / plant	100 seeds weight (g)
<b>Eskandarani</b>					
Control	13.33	2.65	88.35	10.33	17.87
EPF1	13.30	2.36	84.00	17.00	17.00
EDN3	14.12	2.73	85.00	12.67	12.12
ENN4	11.00	2.80	87.00	14.67	17.67
EFW1	15.33	3.33	117.60	11.00	17.26
L.S.D 5%	1.26	0.19	1.55	2.11	1.59
<b>Gabla</b>					
control	7.66	3.20	70.45	13.67	15.37
GPF2	9.14	3.40	71.60	16.67	16.67
GDN5	7.57	3.13	67.00	15.33	14.00
GNN5	6.33	3.46	58.67	13.00	13.67
GFW1	9.66	3.33	94.56	13.67	16.00
LSD 5%	1.038	0.197	1.813	1.476	1.366

DN = Early flowering mutant

NN= node position mutant

PF = high number of pistillate flowers mutant

FW = Large and small fruit mutant

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تحسين بعض الصفات الإقتصادية من خلال التباين المستحدث عن طريق المطفرات في قرع الكوسة  
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أجري هذا البحث في وحدة البحوث والتجارب الزراعية - كلية الزراعة - جامعة عين شمس (شلقان) في خريف وصيف موسمي ٢٠٠٤/٢٠٠٥، ٢٠٠٥/٢٠٠٦، وكان الهدف من هذه الدراسة دراسة تأثير أشعة جاما (بجرعات ١٠، ٢٠، ٣٠ و ٤٠ كيلو راد) ومادة إيثايل ميثان سلفونيت (بتراكيز ٠،٠٢٥، ٠،٠٥، ٠،١ و ٠،٢ %) على صنفين من قرع الكوسة هما الإسكندراني وجبلة في محاولة لاستحداث تغيرات وراثية وانتخاب تراكيب وراثية جديدة، حيث تم دراسة الجيل الطافر الأول والثاني والثالث وقد اشارت النتائج في الجيل الاول أن معظم قيم الصفات المدروسة انخفضت مع ارتفاع الجرعات من كلا المطفرين مقارنة مع نباتات الكونترول أما في الجيل الثاني فقد تم التعرف على خمسة أنماط من الطفرات ذات صفات اقتصادية هامة و كانت نباتاتها مختلفة في بعض مواصفاتها عن نباتات الكونترول وفي الجيل الثالث تم متابعة اربع أنماط من الطفرات التي ظهرت في الجيل الثاني وهي مبكرة الإزهار، قليلة عدد العقد حتى أول زهرة مؤنثة، كثيرة عدد الأزهار المؤنثة و كبيرة الثمار، وقد أظهرت هذه الطفرات نفس السلوك التي أظهرته في الجيل الثاني وتوقفت على نباتات الكونترول في الصفات الهامة التي انتخبت على اساسها وبالتالي يمكن اعتبارها ذات أهمية كبيرة في برامج التربية.