J. Agric. Sci. Mansoura Univ., 29 (12): 7157 - 7166, 2004

INDUCED MUTATIONAL VARIABILITY BY GAMMA-RADIATION OR ETHYLMETHANE SULPHONATE AND THEIR COMBINATIONS IN PEA *Pisum sativum* L.

El-Gazar, T.M.*; E.I. Metwally**; A.S. El-Gamal* and A.M. Fayad*
* Vegetable and Floriculture Dept., Fac. Agric., Mansoura Univ.
** Horticulture Department, Fac. Agric., Kafr El-Sheikh, Tanta Univ.

ABSTRACT

Seeds of the pea cultivar Master B were irradiated with different doses of gamma-rays (0, 2.5, 5, 10, 15, 20, 25 and 30 KR), another portions of the seeds were treated with different levels of EMS (0.0, 0.025, 0.05, 0.1%). Also, there were combined treatments using the two mutagenic agents. The results of this investigation showed that the M_2-plants exhibited different degrees of reduction in growth in comparison with those of the untreated control plants. In M_2, the mutagenic doses significantly increased the mean value for plant height, number of pods per plant and seed yield per plant. However, the results did not show additional variation for number of branches per plant and number of seeds per pod. In M_2-generation, 107 different mutant lines were selected.

INTRODUCTION

Plant breeding is nothing more than controlled selection. The degree to which selection could be controlled by plant breeder is depednent upon the amount and kind of genetic variation available in the breeding population. Theoretically, this limitation could be overcome either by inducing mutations, or outcrossing, or by a combination of both techniques. The effects of mutagenic agents be measured more readily in homozygous population. Mutants could be used directly to establish a new variety. This appraoch is time-saving as compared with the other breeding methods (Gaul, 1966). Selection of mutants could start from the M_2-generation. Selection in M_2-generation is preferable, since it will imply the highest chance to find the desired mutation among the small irradiated population.

Gamma-rays and ethylemethane sulphonate (EMS) have been used to improve plant characters and increasing genetic variability in several varieties of pea by many investigators such as Balint (1968), Hussein *et al.* (1974) and Kumar *et al.* (1981).

Therefore, the present study was under taken to evaluate the effects of different gamma-rays and EMS doses on the M_2-generation in inducing new variability for some important traits in pea. These information may help in the planning of more efficient breeding programs. It is important to mention that pea is a self-pollinating plant and has a narrow spectrum of natural phenotypic variation.

MATERIALS AND METHODS

Pea seeds *Pisum sativum* L. from Master B cultivar were exposed to different doses of gamma-rays, i.e., 2.5, 5, 10, 15, 20, 25 and 30 KR.

Gamma-rays used in this study was generated from the cobalt-60 source at the Middle Eastern Regional Radioisotope Center of the Arab Countries, Dokki, Cairo, Egypt. Dry seeds of pea cultivar were treated with freshly prepared aqueous solution of ethylmethane sulphonate (EMS). The concentrations at which the mutagen was applied to the seeds were 0.0, 0.025, 0.05 and 0.1% for 12 hours at room temperature. Irradiated seeds in the three doses 25, 5 and 10 KR of gamma-rays were divided into three portions, each one was soaked for 12 hours in 0.025, 0.05 and 0.1% of EMS. While irradiated seeds at high doses of gamma-rays (15, 20, 25 and 30 KR) were not treated by EMS. Treated and non-treated seeds (control) were sown in four replications using a randomized complete blocks design. These planted treated plant have been named M_1-plants which gave the M_2-seeds at the end of the season.

M_2 seeds from the individual M_1-plants from each treatment were sown as a family on November 1st 2000/01 and 2001/02 seasons under field conditions, as well as one row of untreated seeds as a control for each ten families of treated seeds.

During the growth period, macromutations such as dwarf, vigorous plants, early or late mature plants, and other morphological changes were harvested separately to give rise to M_3-families.

At harvest, seed yield and its components were measured for every plant from each family to discover the occurrence of M_2-micromutations. Data were recorded on plant height (cm), number of branches, pods and seed yield per plant and number of seeds per pod. The statistically analyzed by calculating minimum value, maximum value (range of variability), the man of treatment (X) variance (S^2), standard error (S.E), coefficient of variation (C.V.%), the ratio of coefficient of variation of treatment and the control (C.V. % of treatment /C.V.% of control) to determine the relative variability induced by gamma-rays and ethylmethane sulphonate.

RESULTS AND DISCUSSION

Plant height

As shown in Table 1, plant height was reduced as the dose of gamma-rays or EMS concentrations was increased. On the other hand, most treatments of both mutagens induced variability higher than the control. The measurements of variation (range of variability and coefficient of variation) in the treated plants were higher than those of the control plants.

From the above results, it is clear that both gamma-rays and EMS concentrations were able to create and extend an additional variation in plant height of the M_2-generation. With regard to the control, the present variability could be due to environmental conditions (Hussein *et al.*, 1974). Therefore, the increments in variability in the M_2-irradiated generation could be due to genetical variation affecting the plant height. This means more opportunities for the selection of the desirable plant height.

Number of branches/plant

Data presented in Table 2 show that the estimates for number of branches per plant under the doses of gamma-rays and EMS were not isignificantly variable in spit of the appearance of some differences among the treatments means for this trait.

This response of number of branches per plant to radiation, might be the balance between the stimulating effect of the lower doses of mutagens and inhibiting effect of the higher doses (Badr *et al.*, 2000). Also, the depression effect of the high mutagen doses on vegetative traits may be attributed to the active disturbances of some enzyme involved in the synthesis of growth (Abd El-Rahman, 2000).

Number of pods per plant:

Data presented in Table 3 show that in the cultivar Master B in the first season for number of pods per plant was unaffected by the different mutagenic treatments in M_2-generation. The range of variability for the mutagenic plants appeared similar to that of the control. In the second season the concentration of 0.1% EMS produced the highest (11.0), range of variability for the mutagenic treatments which was wider than the control.

This result is in agreement with that reported by Omar (1995) who found, on *Gomphrena globosa* L. that in M_2-generation of two seasons the differences among the different doses (0, 5, 10, 15, 25 and 30 KR) of gamma-rays were not significant considering number of inflorescences per plant.

Number of seeds/pod:

Data concerning the number of seeds per pod in Table 4 show hat the single mutagenic treatments did not change the number of seeds per pod in both seasons. Therefore, all treatment means had nearly the same value of the number of seeds per pod, and the ranges of variability for irradiated plants were similar to that of the control plants.

This result is in agreement with that reported by Marwan ***et al.*** (1974) who found that number of pods/plant, seeds/pod and 100-seed weight were positively correlated with seed yield in M_2-generation after the irradiation of the pea seeds with gamma-rays.

Seed yield

The response of seed yield per plant to mutagenic treatments was somewhat differed in the cultivar Master B. In the first season, seed yield per plant was decreased with the increasing of mutagenic doses. But in the second season, all plants derived from all doses produced similar values of seed yield. Only the dose of 5 KR was able to increase the range of variability in the M_2-generation compared with the other treatments as presentd in Table 5.

Table 1: Effect of single and combined treatments of gamma-rays and EMS on micromutation in M_2 -generation on plant height of pea cultivar Master B in 2000/01 and 2001/02 seasons.

Treatment	2000/01						2001/02					
	No. of plants	Min.	Max.	X ± S.E.	C.V.%	C.V. treat / cv. cont.	No. of plants	Min.	Max.	X ± S.E.	C.V.%	C.V. treat / cv. cont.
2.5 KR	381	30	65	46.6±0.39	6.14	0.85	405	39	77	55.7±0.39	5.07	0.83
5 KR	330	30	75	44.5±0.43	6.75	0.93	360	35	76	57.3±0.53	5.44	0.89
10 KR	295	30	70	43.0±0.42	7.30	1.01	391	42	75	54.7±0.43	5.33	0.87
15 KR	276	20	70	45.5±0.45	6.92	0.96	294	35	75	54.6±0.33	5.12	0.84
20 KR	173	20	75	44.7±0.45	7.79	1.08	182	30	85	56.8±0.49	5.94	0.94
25 KR	46	20	65	43.1±0.39	7.35	1.02	52	30	85	58.0±0.42	6.45	1.06
30 KR	37	25	65	42.6±0.41	7.49	1.03	47	35	74	56.0±0.45	5.24	0.86
0.025 % EMS	358	20	70	42.5±0.43	7.42	1.02	319	15	80	52.8±0.65	7.08	1.16
0.05 % EMS	354	30	70	41.1±0.40	7.30	1.01	362	40	92	62.1±0.49	5.37	0.88
0.1% EMS	315	20	60	43.9±0.42	7.07	0.98	323	42	97	60.9±0.61	5.83	0.96
2.5 KR+0.025% EMS	392	10	75	45.1±0.47	7.93	1.10	410	35	88	57.6±0.39	6.27	1.03
2.5 KR+0.05% EMS	432	20	70	43.0±0.43	5.67	0.78	412	31	81	54.5±0.33	6.07	1.00
2.5KR+0.1% EMS	460	20	70	47.0±0.40	6.23	0.86	423	22	75	55.3±0.38	5.98	0.98
5KR+0.025%EMS	419	30	70	46.4±0.38	6.21	0.86	430	32	80	65.0±0.30	5.18	0.85
5KR+0.05%EMS	388	25	60	47.0±0.35	5.69	0.79	376	42	83	57.7±0.43	5.48	0.90
5KR+0.1%EMS	422	15	70	44.6±0.41	7.51	1.04	385	32	92	58.0±0.34	5.70	0.93
10KR+0.025%EMS	281	25	70	42.8±0.38	7.19	0.99	364	37	95	56.1±0.40	5.87	0.96
10KR+0.05%EMS	265	30	70	44.9±0.46	8.38	1.16	342	31	70	54.5±0.46	5.50	0.90
10KR+0.1%EMS	243	25	70	46.4±0.41	7.19	0.99	276	25	76	56.2±0.36	5.35	0.88
Control	365	15	60	41.7±0.40	7.24	1.00	354	42	79	54.1±0.42	6.10	1.00

Table 2: Effect of single and combined treatments of gamma-rays and EMS on micromutation in M_2 -generation on number of branches per plant of pea cultivar Master B in 2000/01 and 2001/02 seasons.

Treatment	2000/01						2001/02					
	No. of plants	Min.	Max.	X ± S.E.	C.V.%	C.V. treat / cv. cont.	No. of plants	Min.	Max.	X ± S.E.	C.V.%	C.V. treat / cv. cont.
2.5 KR	381	0	4	0.2±0.11	409.01	1.02	405	0	3	1.0±0.13	96.38	0.58
5 KR	330	0	2	0.1±0.09	606.38	1.52	360	0	3	1.0±0.16	94.38	0.57
10 KR	295	0	6	0.5±0.15	225.74	0.56	391	0	3	0.8±0.14	118.16	0.71
15 KR	276	0	7	0.4±0.16	281.61	0.70	294	0	5	0.9±0.13	116.39	0.70
20 KR	173	0	3	0.2±0.10	386.00	0.97	182	0	2	0.9±0.12	95.52	0.57
25 KR	46	0	4	0.3±0.10	283.26	0.71	52	0	4	0.8±0.12	128.66	0.78
30 KR	37	0	4	0.2±0.10	403.34	1.01	47	0	4	1.0±0.17	108.06	0.65
0.025 % EMS	358	0	2	0.2±0.90	341.25	0.85	319	0	2	0.6±0.15	140.28	0.84
0.05 % EMS	354	0	3	0.2±0.10	379.38	0.95	362	0	2	0.5±0.12	157.89	0.95
0.1% EMS	315	0	3	0.2±0.10	378.31	0.95	323	0	3	0.7±0.14	118.15	0.71
2.5 KR+0.025% EMS	392	0	4	0.2±0.10	393.94	0.99	410	0	6	1.1±0.12	100.63	0.60
2.5 KR+0.05% EMS	432	0	3	0.2±0.10	386.69	0.97	412	0	4	0.9±0.10	107.50	0.64
2.5KR+0.1% EMS	460	0	3	0.1±0.10	723.99	1.81	423	0	6	0.8±0.12	130.38	0.78
5KR+0.025%EMS	419	0	3	0.2±0.10	388.19	0.97	430	0	4	0.6±0.09	147.38	0.88
5KR+0.05%EMS	388	0	2	0.1±0.80	647.09	1.62	376	0	3	0.8±0.12	107.85	0.65
5KR+0.1%EMS	422	0	3	0.2±0.10	393.87	0.99	385	0	3	0.6±0.09	144.93	0.87
10KR+0.025%EMS	281	0	3	0.2±0.09	375.69	0.94	364	0	4	0.7±0.12	134.94	0.81
10KR+0.05%EMS	265	0	3	0.2±0.09	377.99	0.95	342	0	2	0.7±0.13	117.83	0.71
10KR+0.1%EMS	243	0	3	0.2±0.09	377.10	0.94	276	0	7	1.1±0.13	96.31	0.58
Control	365	0	4	0.2±0.11	399.74	1.00	354	0	3	0.5±0.11	166.9	1.00

Table 3: Effect of single and combined treatments of gamma-rays and EMS on micromutation in M_2 -generation on number of pods per plant of pea cultivar Master B in 2000/01 and 2001/02 seasons.

Treatment	2000/01						2001/02					
	No. of plants	Min.	Max.	$X \pm$ S.E.	C.V.%	C.V. treat / cv. cont.	No. of plants	Min.	Max.	$X \pm$ S.E.	C.V.%	C.V. treat / cv. cont.
2.5 KR	381	2	10	3.9±0.19	34.82	1.03	405	3	14	6.9±0.24	25.08	0.96
5 KR	330	1	23	3.6±0.25	49.09	1.45	360	1	17	7.9±0.33	25.00	0.95
10 KR	295	1	14	3.5±0.21	44.35	1.31	391	2	14	6.4±0.25	26.51	1.01
15 KR	276	1	14	3.5±0.22	43.81	1.29	294	3	15	6.8±0.21	25.39	0.97
20 KR	173	1	10	3.3±0.15	36.80	1.09	182	2	15	6.1±0.25	27.99	1.07
25 KR	46	2	11	3.3±0.14	34.33	1.01	52	2	18	6.5±0.21	29.30	1.12
30 KR	37	1	18	3.4±0.19	43.18	1.27	47	2	15	6.5±0.30	29.66	1.13
0.025 % EMS	358	1	5	2.9±0.12	29.32	0.87	319	1	12	4.7±0.28	34.16	1.30
0.05 % EMS	354	1	7	3.2±0.13	29.57	0.87	362	2	16	5.6±0.24	29.41	1.12
0.1% EMS	315	2	12	3.5±0.16	34.41	1.02	323	3	16	11.0±0.64	31.18	1.19
2.5 KR+0.025% EMS	392	1	10	3.8±0.19	38.70	1.14	410	3	30	7.3±0.23	29.13	1.11
2.5 KR+0.05% EMS	432	1	12	3.7±0.19	38.44	1.13	412	2	18	6.5±0.19	29.71	1.13
2.5KR+0.1% EMS	460	2	10	4.2±0.18	31.15	0.92	423	1	13	6.6±0.21	27.27	1.04
5KR+0.025%EMS	419	1	11	3.9±0.17	33.47	0.99	430	2	15	6.3±0.18	27.78	1.06
5KR+0.05%EMS	388	2	12	4.3±0.18	32.43	0.96	376	2	17	7.0±0.24	25.12	0.96
5KR+0.1%EMS	422	1	8	3.1±0.13	32.89	0.97	385	2	18	6.2±0.18	27.88	1.06
10KR+0.025%EMS	281	1	6	3.0±0.12	31.64	0.93	364	1	24	6.0±0.22	30.32	1.16
10KR+0.05%EMS	265	1	6	3.1±0.12	32.19	0.95	342	1	12	5.4±0.24	29.55	1.13
10KR+0.1%EMS	243	1	6	3.1±0.12	31.70	0.94	276	1	14	7.2±0.22	25.27	0.97
Control	365	1	5	3.2±0.14	33.88	1.00	354	2	8	4.7±0.16	26.18	1.00

Table 4: Effect of single and combined treatments of gamma-rays and EMS on micromutation in M_2 -generation on number of seeds per pod of pea cultivar Master B in 2000/01 and 2001/02 seasons.

Treatment	2000/01						2001/02					
	No. of plants	Min.	Max.	X ± S.E.	C.V.%	C.V. treat / cv. cont.	No. of plants	Min.	Max.	X ± S.E.	C.V.%	C.V. treat / cv. cont.
2.5 KR	381	3	9	7.4±0.21	20.18	1.41	405	3	9	5.8±0.17	20.69	0.95
5 KR	330	2	9	7.3±0.23	22.43	1.57	360	2	9	5.8±0.23	23.93	1.10
10 KR	295	3	8	6.3±0.22	25.44	1.78	391	3	8	6.3±0.18	18.91	0.87
15 KR	276	2	9	6.8±0.22	22.49	1.57	294	3	8	5.6±0.17	24.95	1.15
20 KR	173	2	8	6.6±0.18	21.71	1.52	182	2	8	5.8±0.19	22.58	1.04
25 KR	46	2	8	7.8±0.15	15.42	1.08	52	2	8	5.7±0.15	23.47	1.08
30 KR	37	2	8	8.0±0.14	13.44	0.94	47	3	8	5.0±0.18	22.78	1.05
0.025 % EMS	358	3	9	7.9±0.19	17.64	1.24	319	2	8	5.2±0.29	25.29	1.16
0.05 % EMS	354	3	9	7.7±0.17	16.46	1.15	362	3	9	6.3±0.18	19.68	0.91
0.1% EMS	315	3	9	8.0±0.16	14.50	1.02	323	4	8	5.7±0.21	21.22	0.98
2.5 KR+0.025% EMS	392	2	9	7.3±0.19	20.14	1.41	410	2	9	5.9±0.23	24.45	1.13
2.5 KR+0.05% EMS	432	2	8	6.7±0.21	24.19	1.69	412	2	8	5.8±0.18	21.37	0.98
2.5KR+0.1% EMS	460	2	9	7.4±0.20	19.80	1.39	423	4	9	5.4±0.19	23.67	1.09
5KR+0.025%EMS	419	2	8	7.7±0.17	16.31	1.14	430	1	8	6.4±0.16	17.17	0.79
5KR+0.05%EMS	388	2	8	7.8±0.18	17.76	1.24	376	3	8	5.1±0.18	25.09	1.18
5KR+0.1%EMS	422	3	9	6.8±0.16	19.61	1.37	385	3	8	6.0±0.17	20.20	0.93
10KR+0.025%EMS	281	3	9	7.5±0.17	18.63	1.30	364	3	8	6.3±0.16	20.38	0.94
10KR+0.05%EMS	265	2	8	7.4±0.17	18.36	1.29	342	3	8	5.5±0.15	24.91	1.15
10KR+0.1%EMS	243	3	9	7.5±0.14	15.49	1.08	276	3	9	5.4±0.15	23.51	1.08
Control	365	5	9	8.2±0.16	14.28	1.00	354	5	9	5.8±0.16	21.71	1.00

Table 5: Effect of single and combined treatments of gamma-rays and EMS on micromutation in M_2 -generation on seed yield per plant of pea cultivar Master B in 2000/01 and 2001/02 seasons.

Treatment	2000/01						2001/02					
	No. of plants	Min.	Max.	X ± S.E.	C.V.%	C.V. treat / cv. cont.	No. of plants	Min.	Max.	X ± S.E.	C.V.%	C.V. treat / cv. cont.
2.5 KR	381	1.11	7.29	3.7±0.17	33.09	1.00	405	0.9	19.2	6.0±0.22	27.09	0.94
5 KR	330	0.16	6.49	3.0±0.18	42.48	1.28	360	1.0	15.0	7.4±0.36	29.08	1.01
10 KR	295	0.00	5.54	2.5±0.16	48.37	1.46	391	0.8	24.4	6.1±0.23	25.08	0.87
15 KR	276	0.00	5.23	2.9±0.17	39.92	1.20	294	1.0	13.5	5.9±0.21	29.86	1.04
20 KR	173	0.32	6.34	2.8±0.14	37.90	1.14	182	1.4	25.0	5.5±0.24	29.99	1.04
25 KR	46	1.11	7.29	3.4±0.13	30.91	0.93	52	0.8	19.6	5.8±0.22	32.79	1.14
30 KR	37	1.11	7.13	3.4±0.15	34.16	1.03	47	1.6	22.2	5.1±0.27	35.13	1.22
0.025 % EMS	358	0.32	5.86	3.2±0.15	34.19	1.03	319	1.6	25.5	4.0±0.28	40.89	1.42
0.05 % EMS	354	0.32	6.81	3.3±0.14	32.83	0.99	362	0.3	13.3	5.5±0.25	30.14	1.04
0.1% EMS	315	0.79	8.40	3.5±0.16	33.64	1.01	323	1.3	26.1	6.0±0.29	28.24	0.98
2.5 KR+0.025% EMS	392	0.95	10.77	3.0±0.17	42.78	1.29	410	1.0	14.3	6.0±0.31	32.59	1.13
2.5 KR+0.05% EMS	432	0.16	6.65	3.7±0.13	26.97	0.81	412	2.1	10.9	5.4±0.25	30.88	1.07
2.5KR+0.1% EMS	460	0.79	8.87	4.1±0.19	34.80	1.05	423	0.3	18.9	4.7±0.46	34.76	1.2
5KR+0.025%EMS	419	1.27	9.82	3.6±0.16	32.79	0.99	430	1.6	27.7	6.1±0.26	28.28	0.98
5KR+0.05%EMS	388	1.42	6.65	3.5±0.19	40.55	1.22	376	1.0	15.1	5.4±0.21	28.27	0.98
5KR+0.1%EMS	422	0.16	4.44	2.7±0.12	36.42	1.10	385	1.0	16.3	6.2±0.24	27.43	0.95
10KR+0.025%EMS	281	0.79	5.70	8.9±0.85	76.75	2.32	364	1.1	14.3	6.0±0.22	30.57	1.06
10KR+0.05%EMS	265	1.11	6.49	6.0±0.06	80.03	2.41	342	1.9	19.0	5.0±0.23	30.94	1.07
10KR+0.1%EMS	243	1.42	6.34	3.2±0.13	33.57	1.01	276	0.8	11.9	6.0±0.20	27.40	0.95
Control	365	0.63	6.34	3.7±0.17	33.15	1.00	354	0.9	11.4	4.4±0.16	28.85	1.00

This results is agreement with Mehandjiev (1970) on pea who found that the combined effects of irradiation and chemical mutagens exceeded the additive effects on mutation rate gave less common mutations than those obtained by treatment with the physical or chemical mutagens alone and also yielded a wider spectra of economically useful mutation. Sanaev *et al.* (1976) on pea found that treated with gamma-rays (5-10 KR) and soaked 0.05-0.1% solutions of cyclophosphane after irradiated with gamma rays the highest percentage of mutants in the M_2-generation was obtained after treatment with 10 KR and 0.1% cyclophosphane and selected three mutants with more seeds per pod, larger seeds and plant height than the initial form. Moustafa (1987) on cowpea found that irradiation with gamma-rays at doses of 0, 2.5, 5, 7.5, 10 and 15 KR in M_2-generation 2.5 KR and 5 KR increased the yield and most of its components.

REFERENCES

Abd El-Rahman, M.M. (2000). Inducing genetic variability in *Citrullus colocynthis* by using gamma-irradiation. J. Agric. Sci. Res. Mansoura Univ., 25(1): 193-199.

Badr, M.; O. El-Shennawy; M. Mostafa and F. El-Tony (2000). Effect of gamma irradiation, methylmethan sulphone and their combinations on growth, flowering and induced variability in *Tagetes erecta* L. Agric. Sci. Mansoura univ., 25(6); 3587-2604.

Balint, A.; D. Dutits and J. Sutka (1968). Study of quantitative characters of pea in a mutant population. Novenytermeles 1968. 17 : 187–196. [C. F. Pl. Breed. Abst., 39 (3) 5911].

Gul, H.; K. Bender; K. Ulonska and M. State (1966). EMS-induced genetic variability in barley. The problem of EMS induced sterility in "Mutation in Plant Breeding". Symp. FAO/IAEA. Vienna 17:17-21,Jan.pp. 63-84.

Hussein, H.A.S.; A.R. Selim and I.I.S. El-Shawaf (1974). EMS and gamma-rays induced mutations in *Pisum sativum* L. I- Effects on the frequency and spectrum of M_2 chlorophyll mutations. Egypt. J. Genet. Cytol. 3 (1) : 106–116.

Kumar, S. and P.K. Gupta (1981). Mutagenic effects of gamma-rays in two varieties of *Pisum sativum* L. II- Chlorophyll mutations. Indian Sci. Meerut Univ. (3) : 379–384 [C. F. Pl. Breed. Abst., 52 : 08082]

Marawan, M.A.; K.A. Okasha; M. Abdel-Maksoud and O. El-Gibaly (1974). Pigment responses in peas *Pisum sativum* L. to different gamma-radiation doses. J. Agric. Sci. Ain Shams Univ., Cairo, Egypt, 49(2): 155-159.

Mehandjiev, A. and N. Nicoloff (1970). Effect of combined treatment of ethylmethane sulphonate and gamma-rays on the chromosome aberrations in peas *Pisum sativum* L. CR Acad. Sci. Agric. Bulg. 3 (1) : 63–68 . [C. F. Pl. Breed. Abst., 41 (4) 9325].

Moustafa, R.A.K.; A.M.T. Abo-Hegazi and Z.M.A. Atia (1987). A study on the effect of acute gamma irradiation on some quantitative characters of cowpea in M_2-generation. J. Agric. Res. Sci. 13 (3) : 1559–1571.

Omar, S.S. (1995). Effect of gamma-radiation on growth, flowering and induced variability in *Gomphrena globosa* L. M.Sc. Thesis, Fac. Agric. Alex Univ., ARE.

Sanaev, N.F. and L.P. Egrova (1976). Inheritance of changes in garden pea induced by physical and chemical mutagens. [C. F. Pl. Breed. Abst., 1976 (48) : 06105].

اختلافات طفورية ومستحدثة بأشعة جاما والإيثيل ميثان سلفونيت والتفاعل المشترك بينهم في نبات البسلة

طه محمد الجزار [١]، المهدى إبراهيم متولى [٢]، أحمد سعد الجمل [١]، وعاطف محمد فياض [١]

[١]قسم الخضر والزينة – كلية الزراعة – جامعة المنصورة.

[٢]قسم البساتين – كلية الزراعة بكفرالشيخ – جامعة طنطا.

أجرى هذا البحث خلال موسمين متتاليين ٢٠٠١/٢٠٠٠) ، (٢٠٠٢/٢٠٠١ بمزرعة كلية الزراعة بكفرالشيخ بهدف دراسة تأثير أشعة جاما والمطفر الكيماوى أيثايل ميثان سلفونيت على نبات البسلة صنف ماستر بى على نباتات الجيل الثانى.

ويمكن تلخيص أهم النتائج المتحصل عليها كما يلى:

١-أظهرت معظم المعاملات المستخدمة من أشعة جاما والمطفر الكيماوى إختلاف فى كل من طول النبات ، عدد القرون للنبات ، المحصول البذرى للنبات عن الكنترول فى كلا الموسمين.

٢ -لم تحدث إختلافات وراثية فى صفة عدد الافروع للنبات وعدد البذور للقرن نتيجة المعاملات المستخدمة فى كلا الموسمين.