

INDUCED MUTATION BY GAMMA RAYS IN FABA BEAN

(*Vicia faba* L.)

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ABSTRACT

This investigation was carried out during the two seasons , 2000 / 2001 and 2001/2002 to study the effect of gamma irradiation on two faba bean varieties Misr 1 and Giza 461 using doses of 3.0 , 6.0 , 9.0 , 12.0 and 15.0 K.R. of gamma-rays.

Results revealed significant differences among treatments for all studied characters in M_1 and M_2 generations except number of seeds per pod in M_1 generation and seed index in M_2 generation. In the M_2 generation germination percentage was affected by increase doses of gamma-rays. A drastic reduction in the pod-bearing plants % in all treatments was obtained, especially at 15 K.R. for variety Misr 1 in M_1 generation. The mutagen treatments 3 and 6 K.R. gave the highest values of plant height, 100 and 111 cm. for variety Misr 1, 108 and 120 cm. for Giza 461 in M_1 and M_2 generations respectively, while the high doses 12 and 15 K.R. gave the lowest plant height and height of first pod in both seasons. The dose of 15 K.R. resulted in 3 –7 days in flowering, 4 –7 days in maturity earlier in both varieties more than the control. Number of branches per plant was affected by gamma – rays , however the low doses 3 , 6 and 9 K.R. were relatively superior over the high doses 12 and 15 K.R. as well as the control. Number of pods , seeds and seed yield per plant increased by low doses , however the highest value of seed yield per plant was obtained by dose 3 K.R. 56.30 and 52.87 g. comparing to 41.97g. and 42.78g. of control Misr 1 in M_1 and M_2 generations respectively , while dose 6 K.R. resulted 51.57 g. compared to 38.33 g. and dose 3 K.R. 55.64 g. compared to 38.38 g. for Giza 461 in M_1 and M_2 generations respectively. Seed index slightly increased for Misr 1 in M_2 generation by dose 12 K.R. , while the dose 15 K.R. gave 94.63 compared to 75.73 g. of control in M_1 generation and 84.74 compared to 69.28 g. in M_2 generation for variety Giza 461. Number of seeds per pod was not affected by gamma- rays in both seasons. Pod length increased by dose 12 and 15 K.R. (9.1 and 9.0 cm.) in both seasons for variety Misr 1 , while the doses 3 and 6 K.R. gave the highest values of pod length (9.8 and 12.3 cm.) compared to 7.0 cm. of control in M_1 generation for Giza 461.

High heritability coupled with high genetic advance observed for plant height, height of first pod, number of pods , seeds , seed yield per plant and seed index , while it was moderate to low for other characters.

Highly significant positive correlation was recorded between seed yield/plant and each of plant height, number of pods/plant and number of seeds/plant in M₁ generation, while it was highly significant and positive between number of branches/plant and number of seeds/plant in M₂ generation.

Key words: *Faba bean , Gamma irradiation, Significant of variances, Yield and its components, Variability, Genetic parameters. Simple correlation coefficient.*

INTRODUCTION

Faba bean in Egypt is one of the most important food legume crops. Its importance is due to high protein seed nutritionally that complement cereal grain in the human diet and its ability to fix atmospheric nitrogen.

Mutation technique has been used to induce genetic variability in high yielding cultivars and select recombinants characterized by early maturity, high level of resistance and high yielding ability (Abdalla and Hussein 1977). Selection for increasing seed yield of the Egyptian faba bean varieties alone would not be effective (Haggag *et al* 1980), but Abdalla (1964) proved that effective selection could be practiced in land races. Crossing Egyptian parents, mutations and introduced theses could increase genetic variability. The breeder should know the type of gene action of the quantitative traits because this is the main determination in the choice of selection and breeding procedures. The success of breeding program depends mainly upon the genetic variability produced among the genotypes to permit effective selection. Mutation breeding has been considered a very useful tool for generating genetic variability in many plant species, especially the self pollinated ones. Hussein and Abdalla (1974,1977, 1978 and 1979) induced mutations by gamma rays in *Vicia faba* L. Abdalla (1982) summarized the work done on mutation studies in faba beans by rays, EMS, MMS, EI, DES and combination of mutagens. In particular focus was made on mutations of immediate use to faba bean breeders in the fields of vegetative and generative characters, seed and yield traits and protein content and quality. In addition the author outlined the future areas of mutation research in this crop.

The purpose of this investigation was to study the effect of gamma – ray doses on the production of some useful mutants for early maturing, high yielding and resistance to some diseases.

MATERIALS AND METHODS

Dry seeds of two local cultivars of *Vicia faba* L. (Misr 1 and Giza 461) were subjected to 3, 6, 9, 12 and 15 K.R. of gamma-rays (60^{Co} source available at the National Center for Research and Radiation Technology, Nasr-City, Cairo, Egypt. The field experiments were conducted at Gemmiza Agricultural Research Station of A.R.C. located in Gharbia, Governorate during the two successive seasons of 2000/ 2001 and 2001/ 2002. The treated and (untreated) seeds were planted after exposing the seeds by 24 hr.

In 2000/ 2001 season the treated and untreated seeds of the two varieties were planted on 25 Nov. in a split plot design with three replications. The two varieties and doses of gamma-rays were arranged randomly in main plots and sub plots, respectively. Each plot was 9 m² (3x3), each comprised 5 ridges, 3 m long and 60 cm a part (30 seeds / ridge). Seeds were hand planted at one side of the ridge in double-seed hills spaced 20 cm. All the normal cultural practices were applied. Data of germination percentage was recorded after emergence (15 days from sowing), pod-bearing plants %, i.e., the number of plants producing seeds for the recorded at the time of maturity. The number of days from sowing to 50% flowering and 95% maturity were recorded on plot basis. At harvest sixty plants were randomly chosen from each treatment (20 plants from each plot) for study plant height, height of first pod , number of branches/plant, number of pods and seeds, seed weight/plant, seed index , number of seeds/pod and pod length .

In the second season (M₂ generation) a high yield of thirty six plants which were chosen from each treatment of M₁ generation (12plants / plot) were separated and planted in M₂ generation. Every plant was randomly sown in one row 3m. long and 60 cm. apart in a split plot design in three replications. Seeds were hand planted at one side of the ridge in double-seed hills spaced 20cm on 22 Nov. 2001/ 2002. Common cultural practices as usually followed in faba bean fields were carried out. The same data were recorded as in previous season. The data were statistically analyzed according to Snedecor and Cochran (1980). Treatment means were compared by L.S.D. at 5% level probability.

Genotypic and phenotypic variance as well as heritability in the broad sense were calculated according to Burton (1952), expected genetic advance (at 0.05) from selection according to Johanson *et al* (1955).

The correlation coefficient between pairs of traits were calculated to find out the relationship between the different studied characters.

RESULTS AND DISCUSSION

Significance of variance

Table (1) and (2) showed that, two varieties mean squares were significant in M_1 and M_2 generations for all characters studied except number of branches, seed weight/plant and number of seeds per pod in M_1 generation, flowering date, plant height, number of seeds/pod and pod length in M_2 generation. All treatments of irradiation mean squares were significant for all characters studied in both seasons except number of seeds/pod in M_1 generation and seed index in M_2 generation. Mean square for the interactions between varieties and doses of irradiation were significant for all characters studied in M_1 generation except germination and pod-bearing percentages, whereas it was significant for plant height, height of first pod and number of branches/plant

Table 1. Mean squares for the studied characters in M_1 plants of the two faba bean varieties treated with gamma-ray doses.

Trait	df	Rep	Varieties (A)	Doses (B)	A x B	Error
		2	1	5	5	22
Emergence %		4.778	560.11**	448.91**	1.44	7.08
Pod-bearing plants %		9	729.0**	465.27**	5.93	9.64
Flowering date, d		2.111	462.25**	11.36**	2.38*	0.808
Maturity date d		0.361	386.78**	26.78**	3.84*	1.18
Plant height, cm		24.19	1144.7**	635.96**	57.16**	8.33
Height of first pod, cm		6.86	245.44**	48.91**	13.04	9.95
No. of branches/plant		0.465	0.007	2.174*	2.674*	0.715
No. of pods/Plant		20.007	354.69**	372.24**	29.83*	10.48
No. of seeds/plant		4.021	729.0**	1982.1**	395.13**	56.96
Seed weight/Plant, g		8.581	27.21	674.99**	112.24**	24.96
Seed index, g		6.244	1217.7**	303.73**	357.14**	67.73
No. of seeds/pod		0.048	0.163	0.118	0.356*	0.11
Pod length, cm		0.422	17.8**	5.94**	0.53**	0.477

* and ** indicate significant variance at 5% and 1%, respectively.

Table 2. Mean squares for the studied characters in M_2 plants of the two faba bean varieties grown from the treated seeds by gamma-ray doses.

Trait	df	Rep	Varieties (A)	Doses (B)	A x B	Error
		2	1	5	5	22
Flowering date, d		3.694	0.111	21.91**	6.78	4.85
Maturity date d		2.33	17.36**	18.65**	0.294	3.273
Plant height, cm		42.58	42.25	826.12**	278.12**	19.19
Height of first pod, cm		2.57	109.55**	25.88*	33.53**	7.03
No. of branches/plant		0.023	1.247*	1.493**	1.106**	0.182
No. of pods/Plant		4.146	370.56**	222.47**	25.477	13.957
No. of seeds/plant		41.45	1509.32**	1525.52**	110.99	76.38
Seed weight/Plant, g		11.62	116.20*	513.67**	37.52	27.76
Seed index, g		27.05	662.38**	76.72	102.54	41.05
No. of seeds/pod		0.072	0.219	0.210	0.025	0.064
Pod length, cm		0.448	1.36	5.61*	0.396	0.51

* and ** indicate significant variance at 5% and 1%, respectively.

Germination and pod-bearing percentages.

The data in Table (3) indicated that Misr 1 and Giza 461 showed a progressive decrease in germination percentage with the increase of the dosage. In this respect, they had almost the same sensitivity to gamma irradiation. The pod-bearing (%) were reduced with increasing dosage in all mutagenic treatments, especially in variety Giza 461. A drastic reduction in the pod-bearing occurred in all treatments, especially at 15 Kr. for Misr 1 (63.3 %) and Giza 461 (54.3 %). These results in general agreement with those of Sinha and Choudhary (1987), Vandana and Dubey (1988) Sushil and Dubey (1993) and Abada (1995).

Flowering and maturity date.

Results of M_1 and M_2 generations had narrowest range for number of days to 50 % flowering (3-5 days) and number of days to maturity (3-7 days) (Tables 3 and 4). The mutagen treatment 15 K.r. gave the earliest maturity (5-7 days) for variety Giza 461 and (4-6 days) for variety Misr 1 in both M_1 and M_2 generations. Similar results were obtained by Hanna (1969), El-Hosary (1977), Hassan (1977), Tolba (1980), Abdalla (1982a), Abd El - Mohsen (1988).

Plant height and height of first pod.

Effect of Gamma-ray on plant height and height of first pod for the two varieties showed different responses to these treatments. The doses 3, 6 and 9 K.R. gave the highest values of plant height and height of first pod for variety Misr 1 and Giza 461 in M_1 and M_2 generations comparing to the control and other treatments. Increasing the doses from 9 up 15 K.R. caused considerable decrease in plant height and height of first pod. The dose 15 K.R. gave the lowest value of plant height and height of first pod for the two varieties in both M_1 and M_2 generations. Sinha and Choudhary (1987) isolated a tall mutant in faba bean compared to its parent (75.6 vs. 42.4 cm.). Abd El-Mohsen (1988) decided that by increasing doses of gamma ray at 40 K.R. decreased plant height in soybean.

Number of branches/plant.

The mean number of branches per plant (Tables 3 and 4) of the two varieties was affected by gamma-ray doses, however the lowest doses (3, 6 and 9 K.R.) were relatively superior over the highest doses (12 and 15K.R.) as well as the control. The dose of 12 K.R. gave the lowest number of branches per plant for Misr 1 (2.3 and 2.5) in M_1 and M_2 generations respectively, while it was by dose 15 K.R. for Giza 461 (3.0 and 2.9) in M_1 and M_2 generations respectively. These results are in agreement with

Table 3. Performance of the two faba bean varieties in M₁ generation.

Treatments	Emergence %	Pod-bearing plants %	Flowering date, d	Maturity date, d	Plant height, cm	Height of first pod, cm	No. of branches / plant	No. of pods/ plant	No. of seeds/ plant	Seed weight/ Plant, g	Seed index, g	No. of seeds/p od	Pod length, cm
Misir 1													
Control	89.3	86.3	62.0	146.7	85.7	19.0	4.0	22.2	63.0	41.97	65.18	2.95	6.2
3 K.R.	89.0	84.3	62.0	146.0	100.7	24.0	5.7	31.0	88.0	56.30	63.59	2.82	7.8
6 K.R.	83.3	80.3	62.3	148.0	100.0	21.7	4.3	40.0	70.7	45.30	61.10	2.21	6.7
9 K.R.	79.7	73.0	64.0	147.3	86.0	21.0	3.7	35.7	83.7	52.80	61.95	2.43	7.2
12 K.R.	70.7	66.7	65.3	145.3	77.7	17.7	2.3	17.7	42.0	24.23	54.88	2.37	9.1
15 K.R.	68.3	63.3	65.7	142.0	73.0	19.3	3.0	18.7	49.7	25.77	54.94	2.77	9.0
Mean	75.7	75.7	63.6	145.9	87.2	20.4	3.8	27.5	66.2	41.06	60.28	2.59	7.7
Giza 461													
Control	81.7	74.7	55.0	142.3	100.7	26.7	4.3	17.5	50.7	38.33	75.73	2.89	7.0
3 K.R.	83.3	75.0	55.3	141.0	103.3	28.3	3.7	27.3	65.3	48.13	79.98	2.43	9.8
6 K.R.	75.0	70.0	56.0	140.0	108.3	27.3	4.0	31.3	91.7	51.67	57.95	2.93	12.3
9 K.R.	72.0	65.3	57.7	139.3	106.7	30.0	3.7	21.3	64.0	37.97	62.21	3.0	8.5
12 K.R.	65.3	60.7	58.3	137.7	86.7	21.7	4.5	14.3	39.0	30.57	60.94	2.73	8.0
15 K.R.	60.0	54.3	56.0	135.7	85.0	20.0	3.0	15.7	32.3	29.37	94.63	2.37	8.6
Mean	67.8	66.7	56.4	139.3	98.4	25.7	3.9	21.3	57.2	39.32	71.91	2.73	9.1
L.S.D. .05 A	1.84	2.15	0.62	0.75	1.98	2.18	N.S.	2.24	5.22	N.S.	5.69	N.S.	0.48
B	3.19	3.72	1.076	1.30	3.43	3.78	1.01	3.88	9.04	5.98	9.85	N.S.	0.83
AxB	N.S.	N.S.	1.52	1.84	4.86	N.S.	1.43	5.48	12.78	8.46	13.94	0.56	1.17
C.V.	3.71	4.36	1.50	0.67	3.09	13.68	3.9	13.27	12.24	12.43	12.45	12.49	8.27

Table 4. Performance of the two faba bean varieties in M₂ generation

Treatments	Flowering date, d	Maturity date, d	Plant height, cm	Height of first pod, cm	No. of branches/plant	No. of pods/Plant	No. of seeds/plant	Seed weight/Plant, g	Seed index, g	No. of seeds/pod	Pod length, cm
Misir 1											
Control	61.66	149.0	91.7	24.0	4.3	27.9	64.5	42.78	66.38	2.48	6.6
3 K.R.	62.0	146.3	111.3	24.7	4.5	33.5	87.8	52.87	60.08	2.73	8.5
6 K.R.	63.66	146.3	111.7	23.7	4.7	34.2	82.3	50.84	63.16	2.44	7.5
9 K.R.	65.0	146.3	105.7	23.0	4.0	31.6	73.9	46.10	64.42	2.34	7.6
12 K.R.	66.33	145.7	106.3	27.5	2.5	20.5	46.4	29.25	68.51	2.33	9.2
15 K.R.	64.33	143.7	97.3	21.3	3.5	25.2	68.0	41.61	60.44	2.70	8.5
Mean	63.8	146.2	104.0	24.02	3.91	28.8	70.49	43.91	63.83	2.5	7.99
Giza 461											
Control	61.66	150.0	90.0	24.7	3.3	24.7	55.5	38.38	69.28	2.48	6.8
3 K.R.	63.66	148.0	120.3	29.3	3.9	29.1	80.4	55.64	69.80	2.79	9.4
6 K.R.	65.33	148.0	116.0	29.3	4.1	31.9	78.7	50.13	64.42	2.54	7.8
9 K.R.	66.0	148.0	116.0	33.7	3.1	19.1	50.0	34.02	70.81	2.58	8.0
12 K.R.	66.66	147.3	80.7	24.3	3.9	14.5	36.2	27.03	75.41	2.52	8.8
15 K.R.	60.33	144.3	88.0	23.7	2.9	14.9	44.5	36.68	84.74	3.05	9.5
Mean	63.9	147.6	101.8	27.51	3.54	22.3	57.54	40.32	72.41	2.66	8.38
L.S.D. .05 A	N.S	N.S	1.83	0.29	2.58	6.04	3.64	4.43	N.S	N.S	1.25
B	0.85	5.25	3.17	0.51	4.47	10.47	6.31	N.S	N.S	2.64	2.17
AxB	N.S	7.42	4.49	0.72	N.S	N.S	N.S	N.S	0.43	N.S	N.S
C.V.	3.45	1.23	4.26	10.29	11.45	14.60	13.65	12.51	9.41	9.78	8.72

those obtained by El - Hosary (1977), Mohamed (1981), Hussein (1982), Dawwam *et al* (1986) and Atia and Battah (1996),

Yield and its components

Number of pods, seeds and seed weight / plant (Tables 3 and 4) for variety Misr 1 increased by the doses 3 , 6 and 9 K.R. in both M₁ and M₂ generations , however the highest value of seed yield per plant were obtained by 3 K.R. 56.30 and 52.87g. for same variety in M₁ and M₂ generations respectively. For variety Giza 461 the number of pods, seeds and seed yield / plant increased by doses 3 and 6 K.R. comparing with the other doses under study and control in both M₁ and M₂ generations. The highest value of seed yield / plant was obtained by dose 6 K.R. (51.67 g. compared to 38.38 g. of control) in M₁ generation and by dose 3 K.R. (55.64 g. compared to 38.38 g. of control) in M₂ generation.

The means of seed index of the two varieties were affected by gamma-ray (Tables 3 and 4). The dose 12 K.R. gave the highest value of seed index for variety Misr 1 in M₂ generation (68.51 g.), while the high doses 12 and 15 K.R. gave the lowest values of seed index in M₁ generation for the same variety (54.88 and 54.94 g. respectively). The dose 15 K.R. of gamma - ray gave the highest value of seed index (94.63 g.) compared to 75.73 g. of the control for variety Giza 461 in M₁ generation. Meanwhile the doses 12 and 15 K.R. gave the highest values of seed index 75.41 and 84.74 g. compared to 69.28 g. of control for the same variety Giza 461 in M₂ generation. These results in general were in agreement with that obtained by Ismail *et al* (1976), El - Hosary (1977), El-Kady (1978), Nagl (1978), Khalil and Nassib (1982), El-Shouny and El-Hosary (1983 a,b), Filippetti and Pace (1986), Dawwam *et al* (1988) and Vandana and Dubey (1993).

The response of two varieties to gamma-ray doses was specific , however the number of seeds per pod of Giza 461 was slightly increased by the dose of 9 K.R.in M₁ generation and 15 K.R. in M₂ generation compared with the other doses as well as the control (Tables 3 and 4). Generally the number of seeds per pod was reduced with Gamma irradiation. Hana (1969) showed that the doses ranged from 1 to 30 K.R. of Gamma irradiation reduced the number of seeds per pod of faba bean compared with the control.

It is known that yield is a function of different metabolic processes occurring during different stages of plant growth, and consequently the differences in the yield or its components due to seed treatment with

Gamma irradiation is attributed to the difference in metabolic processes occurring at the different stages of plant development Abo-Hegazi (1978).

Regarding to the pod length cm. of the two varieties a significantly increase was obtained by different Gamma-ray doses in both M_1 and M_2 generations. The doses 12 and 15 K.R. gave the highest values (9.1 and 9.0 cm. /pod) in M_1 generation (9.2 and 8.5 cm./pod) in M_2 generation for Misr 1. For the variety Giza 461 the dose 3 and 6 K.R. gave the highest value of pod length (9.8 and 12.3 cm. /pod) in M_1 generation and by dose 3 and 15 K.R. (9.4 and 9.5 cm./pod) in M_2 generation.

Genetic parameters.

The phenotypic and genotypic variance, heritability estimates in broad sense and expected genetic advance of selection were determined for days to 50 % flowering, days to maturity and yield and its components in M_2 generation (Table 5). The results demonstrated that the magnitude of the genetic parameters were mostly greater for all the studied characters except number of seeds per pod for two varieties under studied. In general plant height, height of first pod number of branches, number of pods, seeds, seed yield/plant, seed index and pod length exhibited the largest amount of genotypic and phenotypic variance. On the contrary days to 50 % flowering and days to maturity showed low amount of genotypic and phenotypic variance. These results were similar to those previously reported by Ibrahim (1963), Abdalla (1964), Abdalla and Hussein (1977) and El-Kady (1978).

In general, the heritability values in broad sense were high above (78.90) for plant height, number of branches per plant, number of pods, seeds and seed yield per plant. The characters days to maturity, height of first pod, seed index, number of seeds per pod and pod length had fairly high heritability. High heritability values for yield and its components have been reported by Vandana and Dub (1993) and El-Kady (1978).

The expected genetic advance from selection was relatively high for plant height, number of pods, seeds, seed yield per plant and seed index, while it was fairly high for height of first pod. Days to 50% flowering, days to maturity, number of branches per plant, number of seeds per pod and pod length showed low values of genetic advance. The present findings revealed that selection for characters which have high heritability and genetic advance should be effective and satisfactory for practical purpose. Vandana and Dubey (1993) obtained high values of genetic advance coupled with high heritability for many of these traits in induced mutants of faba bean.

Table 5. Variability, heritability and expected genetic advance for yield and its components in M₂ generation.

Parameters	Flowering date, d		Maturity date, d		Plant height, cm		Height of first pod, cm		No. of branches/Plant		No. of pods/plant		No. of seeds/plant		Seed weight /plant, gm		Seed index, gra		No. of seeds/pod		Pod length, Cm	
	Misr 1	Giza 461	Misr 1	Giza 461	Misr 1	Giza 461	Misr 1	Giza 461	Misr 1	Giza 461	Misr 1	Giza 461	Misr 1	Giza 461	Misr 1	Giza 461	Misr 1	Giza 461	Misr 1	Giza 461	Misr 1	Giza 461
Mean	63.8	63.9	146.2	147.	104	101.8	24.0	27.5	3.91	3.54	28.8	22.4	70.5	57.5	43.9	40.3	63.8	72.4	2.5	2.66	7.99	8.38
Range																						
Min	61.7	60.3	143.7	144.	91.7	80.7	21.3	23.7	3.47	2.93	20.5	14.5	46.4	36.2	41.6	27.0	60.1	64.4	2.34	2.48	6.57	6.77
Max	66.3	66.7	149.	150.	111	120.3	27.5	33.7	4.67	4.13	34.2	31.9	87.8	80.4	52.9	55.6	68.5	84.7	2.73	3.05	9.23	9.53
C ² ph	4.6	8.22	3.34	4.22	70.9	311.1	5.03	19.7	0.71	0.29	31.8	60.1	236.	361.	83.1	119.	21.5	66.4	0.04	0.07	1.09	1.29
C ² g	1.78	4.53	2.5	2.58	56.0	298.1	3.25	11.7	0.56	0.18	25.1	48.4	193.	300.	58.7	106.	0.32	31.3	0.02	0.03	0.71	0.93
P.C.V.	3.36	4.48	1.25	1.39	8.10	17.3	9.33	16.1	21.5	15.1	19.6	34.6	21.8	33.0	20.8	27.1	7.26	11.3	8.20	9.80	13.1	13.5
G.C.V.	2.09	3.33	1.08	1.09	7.20	16.96	7.50	12.4	19.1	12.0	17.4	31.1	19.7	30.1	17.5	25.6	0.88	7.72	5.37	6.29	10.5	11.5
h ² %	38.7	55.1	74.9	61.2	78.9	95.84	64.6	59.2	79.2	63.1	78.9	80.6	81.8	83.1	70.6	88.8	1.48	47.1	42.9	41.2	65.1	72.3
Ga %	1.71	3.25	2.82	2.59	13.7	34.82	2.98	5.41	1.37	0.70	9.17	12.9	25.9	32.5	13.3	20.0	1.42	7.91	0.18	0.22	1.40	1.69

Simple correlation coefficient.

Data of simple correlation coefficient matrix, and means over two M_1 and M_2 generations are shown in Tables (6) and (7). Data clearly showed that days to 50 % flowering with days to maturity, days to maturity with number of pods/plant, plant height with height of first pod and plant height with seed yield/plant were significantly positive correlated with r values of 0.651, 0.590, 0.750 and 0.625 respectively In M_1 generation. Another positive correlation worthy of some attention is that between number of pods per plant and number of seeds/plant ($r = 0.808$), number of pods/plant with seed yield/plant ($r = 0.786$) and number of seeds/plant with seed yield/plant per ($r = 0.892$). in M_1 generation. On the other hand, highly significant negative correlation was recorded between days to 50 % flowering with plant height cm., ($r = - 0.630$). In the second season Table (7) a highly significant positive correlation was recorded between plant height with number of seeds/plant ($r = 0.600$), number of branches/plant with number of pods/plant, number of seeds/plant with seed yield/plant ($r = 0.658$, 0.681 and 0.682 respectively), number of pods/plant with number of seeds/plant ($r = 0.0.900$) and number of seeds/plant with seed yield/plant ($r = 0.935$) On the other hand a highly significant negative correlation was found between number of pods/plant and seed index ($r = - 0.678$) and number of seeds/plant with seed index ($r = 0.663$). These results are in agreement with those obtained by Khalil and Nassib (1982) and Sushil and Dubey (1993).

Generally, used irradiation by gamma-ray exhibited different genetic variability such as, tall plants, dwarf plants, early maturing, high yield, small and large seeds. These genetic variability important to used it directly in breeding programs of faba bean by selection in the next generations or by hybridization with commercial varieties.

Table 6. Simple correlation coefficients and mean of faba bean in M₁ generation.

Characters	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(y)
Flowering date (1)											
Maturity date (2)	0.651 *										
Plant height cm(3)	-0.630 *	-0.083									
Height of first pod (4)	-0.548	-0.246	0.750 **								
No. of branches/plant (5)	-0.176	0.199	0.410	0.211							
No. of pods/plant (6)	0.177	0.590 *	0.410	0.155	0.345						
No. of seeds/plant (7)	0.062	0.474	0.549	0.391	0.459	0.808 **					
Seed index (8)	-0.584	-0.382	0.132	0.038	0.047	-0.174	-0.274				
No. of seeds/pod (9)	-0.199	-0.176	0.195	0.093	0.093	-0.235	0.225	-0.209			
Pod length, cm (10)	-0.293	-0.476	0.213	0.309	-0.243	-0.025	0.144	-0.053	0.130		
Seed yield/plant gm (y)	-0.150	0.401	0.625 *	0.384	0.561	0.786 **	0.892 **	0.079	0.033	0.012	

* and ** significant at 0.05 and 0.01 level of significance, respectively

Table 7. Simple correlation coefficients and mean of faba bean in M₂ generation.

Characters	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(y)
Flowering date (1)											
Maturity date (2)	-0.101										
Plant height cm(3)	0.110	0.062									
Height of first pod (4)	0.201	0.305	0.552								
No. of branches/plant (5)	0.028	0.287	0.121	-0.264							
No. of pods/plant (6)	-0.152	0.189	0.555	-0.052	0.658 *						
No. of seeds/plant (7)	-0.137	0.139	0.600 *	-0.116	0.681 *	0.900 **					
Seed index (8)	0.006	-0.086	-0.377	0.148	-0.402	-0.678 *	-0.663 *				
No. of seeds/pod (9)	-0.227	0.106	0.049	-0.223	0.049	-0.243	0.135	0.198			
Pod length, cm (10)	0.154	-0.464	0.067	0.136	-0.353	-0.421	-0.252	0.490	0.333		
Seed yield/plant gm (y)	-0.174	0.161	0.551	-0.080	0.682 *	0.799	0.935 **	-0.389	0.227	-0.116	

* and ** significant at 0.05 and 0.01 level of significance, respectively

REFERENCES

- Abada, K.A. (1995). Induced mutation by gamma rays for rust resistance in Faba bean. Bulletin of Faculty of Agric. Univ. of Cairo 46 (2) : 299 – 310.
- Abdalla, M.M.F. (1964). Variation of some agronomic characters in different collections of *Vicia faba* L. M.Sc. Thesis, Fac. Agric., Cairo University.
- Abdalla, M.M.F. and H.A.S. Hussein (1977). Effect of single and combined treatments of gamma-rays and EMS on M₂ –quantitative variation in *Vicia faba* L.Z. Pflanzenzuchtg. 78: 57-64.
- Abdalla, M.M.F. (1982a). Mutation breeding in faba beans. In: G. Hawtin and C.Webb (Eds). Faba bean improvement. 83-90. Martinus Nijhoff (Netherlands) ICARDA/IFAD (N.V.P.).
- Abd El-Mohsen , M.I. (1988). Studies the effect of gamma – rays on some agricultural and chemical characteristic in soybean. M.Sc. Thesis Fac. Agric Al – Azhar Univ. Egypt.
- Abo-Hegazi, A.M.T.(1978). High protein lines in field beans *Vicia faba* resulted from a breeding programme by the use of gamma-rays. I. Seed yield and heritability of seed protein. IAEA Inter. Symp on Seed Protein Improvement in Cereals and Grain Legumes. Neuherberge, Germany.Sept. 78.
- Atia, Z.M.A. and N.S. Battah (1996). Effect of gamma irradiation on field bean. *Vicia faba* characteristics. Zagazig J. Agric. Res. Vol. 23 (5): 723-735.
- Burton. G.W. (1952). Quantitative in Grasses. Proc. 6 th intern. Grass land Confr. 1: 227-283.
- Dawwam, H.A., A.A. El-Hosary and S.M. Abdel-Aal (1986). Effect of some chemical mutagens on yield and its components of the M₁ plants in some varieties of field beans (*Vicia faba* L.). Minufiya J. Agric. Res. II (1): 63-80.
- Dawwam, H.A., F.A.. Hendawy and A.A. El-Hosary (1988). Effect of some chemical mutagens on some characters of the M₂ and M₃ plants in field beans. Minufiya J. Agric. Res. 13(1): 71-84.
- El-Hosary, A.A.,(1977).Effect of some chemical and physical mutagens on *Vicia faba*. M.Sc. Thesis Fac. Agric. Ain Shams University.
- El-Kady, M.A.(1978). Induced variability of yield and yield components in two Egyptian broad bean cultivars by gamma radiation. Res. Bull. Ain Shams Univ., 820: PP 12.
- El-Shouny, K.A.and A.A. El-Hosary (1983a). Effect of some chemical and physical mutagens on *Vicia faba* L. III. Effect of Ea, DES, gamma rays and some combinations of them on frequency and spectrum of morphological and phisological mutations in M₂ and M₃. Proc 1st Conf. Agron.,1: 73-83.

- El-Shouny, K.A. and A.A. El-Hosary (1983b).** Effect of some chemical and physical mutagens on *Vicia faba* L. IV. Spectrum of chlorophyll mutations induced in M2 and M3 generations. Proc. 1st Conf. Agron., Ain Shams Univ., Egypt I: 85-92.
- Johnson, H.W., H.F. Robinson and R.E. Comstock (1955).** Estimates of genetic and environmental variability in soybeans. Agron., J. 47: 314-318.
- Haggag, M.E.A., A.I.El-Agamy, G.A. Morshed, A.M. Okaz, A.M.T. Abo Hegazi and A. Tolba (1980).** Response of field beans to gamma irradiation. Res. Bull., Fac. Agric., Al-Azhar Univ. Vol. 17: 1-12.
- Hassan, H.F.(1977).** Mutation studies on *Vicia faba*. M. Sc. Thesis, Fac. Agric. Al-Azhar Univ. Egypt.
- Hussein, H.A.S.(1982).** A mutation breeding program for improving some grain legume crops in Egypt. IAEA. TECDOC-260:19-27.
- Hussein, H.A.S. and M.M.F. Abdalla (1974).** Effect of single and combined treatments of gamma-rays and EMS on the M₁-fertility and M₂-chlorophyll mutations in *Vicia faba* L. Egypt. J. Genet. Cytol. 3:246-258.
- Hussein, H.A.S. and M.M.F. Abdalla (1977).** Protein and yield traits of field bean mutants induced with gamma-rays. EMS and their combinations. Seed protein improvement by Nuclear Techniques. Proc. Symp. Vienna. IAEA. 1977.
- Hussein, H.A.S. and M.M.F. Abdalla (1978).** Protein and yield traits of field bean mutants induced with gamma-rays. EMS and their combinations. Seed protein improvement by Nuclear Techniques, IAEA Vienna 253-264.
- Hussein, H.A.S. and M.M.F. Abdalla (1979).** Gamma -ray and EMS induced mutations in *Vicia faba* L. Evaluation of yield and protein traits of mutants in the M4 and M5 generations. Seed Protein Improvement in Cereals and Grain Legumes. IAEA, Vienna Vol. II 23-31.
- Ismail, M.A., M.Y. Heakel and A. Fayed (1976).** Improvement of yield through induced mutagenesis in broad beans. Indian J. Genet. And Plant Breed. Vol. 36: 347-350.
- Burton. G.W. (1952).** Quantitative in Grasses. Proc. 6th Intern. Grass Land Conf. 1 : 227 - 283.
- Khalil, S.A. and A.M. Nassib (1982).** Behaviour of some morphological characteristics in two crosses of faba bean (*Vicia faba* L.). II Yield and yield components and correlation between characters. Proceed . Egypt. Bot. Soc. 3. 1982 (Mansoura Conf.): 726-747.
- Mohamed, K.I. (1981).** Cytological and genetical studies on some mutation types obtained in *Vicia faba* after treatment with radiation and chemicals. Ph.D. Thesis, Fac. Agric., Ain shams University.

- Nagl, K. (1978).** Breeding value of radio-induced mutants of *Vicia faba* var. minor. Seed protein Improvement by Nuclear Techniques, IAEA, Vienna, 243-252.
- Tolba, A.M. (1980).** Studies on characters of gamma irradiated faba bean. M.Sc. Thesis. Fac. Agric., Al-Azhar University.
- El - Hosary , A.M. (1977).** Effect of some chemical and physical mutagens on *Vicia faba* L. M.Sc.Thesis Fac. Agric. Ain Sharns Univ. Egypt.
- Filippetti, A. and C.D.Pace (1986).** Improvement of seed yield in *Vicia faba* L. by using experimental mutagenesis. II comparison of gamma - radiation and ethyl - methane - sulphonate (EMS) in production of morphological mutants. Euphtica 35 (1) 49 - 59.
- Hanna , E.M. (1969).** Studies of Co⁶⁰ gamma radiation on *Vicia faba* L. M.Sc. Thesis . Fac. Science Cairo Univ.
- Ibrahim , A. A. (1963).** A genetic analysis of some Egyptian and imported varieties of bean (*Vicia faba* L.). Thesis , Cairo Univ. Egypt.
- Sinha , R.P. and S.K. Choudhary (1987).** Isolation and evaluation of a bold - seeded of *Vicia faba* var. minor. FABIS - Newsletter , Faba bean Information Service, ICARDA (18) 9 - 10.
- Snedecor , G.W. and W.G.Cochran (1980).** Statistical Methods. Seventh Edition. Iowa State Univ. Press , Amcs , Iowa USA.
- Sushil Kumar, Vandana and D.k. Dubey (1993).** Studies on the effect of Gamma Rays and Diethyl Sulfate (DES) on germination , growth , fertility and yield in Faba bean. FABIS Newsletter (32) : 15- 18.
- Vandana and D.K. Dubey (1988).** Effect of ethyl methane sulphonate (EMS) and diethyl sulphate (DES) on germination, growth fertility and yield of *Vicia Faba* L. FABIS Newsletter 20 : 25 - 29.
- Vandana and D.K. Dubey (1993).** Path analysis in faba bean . FABIS Newsletter - ICARDA (32) 23 - 24.

استحداث طفرات في الفول البلدي باستعمال أشعة جاما

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أجري هذا البحث بمحطة البحوث الزراعية بالجميزة خلال موسمي الزراعة ٢٠٠٠/٢٠٠١ ، ٢٠٠١/٢٠٠٢ لدراسة تأثير أشعة جاما بجرعات مختلفة هي صفر ، ٣ ، ٦ ، ٩ ، ١٢ ، ١٥ كيلو راد على سنفي الفول البلدي مصر ١ ، جيزة ٤٦١ لاستحداث طفرات قد تكون ذات قيمة اقتصادية مثل التبيكير في النضج وزيادة المحصول ومكوناته واستخدامه في لدراسة تصميم القطاعات المنشقة في ثلاث مكررات حيث وضعت الأصناف في القطع الرئيسية ومعاملات الإشعاع في القطع الشقية وكان أهم النتائج المتحصل عليها هي :-

- ١- أثرت معاملات الإشعاع على كل الصفات المدروسة في الجيل الطفري الأول فيما عدا صفة عدد بذور القرون أما في الجيل الثاني فإن تأثير تلك الجرعات الإشعاعية كانت معنوية التأثير لكل الصفات فيما عدا معامل البذرة وكان لجرعات الإشعاع العالية تأثير واضح في انخفاض نسبة الظهور وعدد النباتات المتبقية عند الحصاد.
- ٢- كان تباين التفاعل بين الأصناف والجرعات معنويا لكل الصفات في الجيل الأول فيما عدا النسبة المعنوية لظهور البادرات ونسبة النباتات المتبقية وارتفاع أول قرن بينما كان ذلك التفاعل معنويا في الجيل الطفري الثاني فقط لصفات ارتفاع النبات وارتفاع أول قرن وعدد أفرع النبات.
- ٣- زاد طول النبات باستخدام الجرعات المنخفضة ٣ ، ٦ ك. ر لكلا الصنفين بينما تأثر طول النبات بالانخفاض بزيادة جرعات الإشعاع. وأدى استخدام الجرعة ١٥ ك. ر إلى التبيكير فسي التزهير بحوالي ٣ - ٧ يوم والتبيكير في النضج بحوالي ٤ - ٧ يوم عن الكنترول.
- ٤- أعطت الجرعات المنخفضة أعلى عدد فروع على النبات لكلا الصنفين. وأدى استخدام الجرعات المنخفضة ٣ ، ٦ ك. ر إلى زيادة عدد القرون والبذور ومحصول النبات بالجرام. وكان أعلى محصول هو ٥٦.٣٠ جرام مقارنة مع ١٤.٩٧ جرام للصنف مصر ١ بينما كان ٥٥.٦٤ جرام مقارنة مع ٣٨.٣٨ جرام للصنف جيزة ٤٦١ .
- ٥- أدى استخدام المعاملة المرتفعة ١٥ ك. ر إلى زيادة وزن ال ١٠٠ بذرة في الصنف جيزة ٤٦١ (٩٤.٦٣ جرام مقارنة مع ٧٥.٧٣ جرام) بينما كان التأثير غير واضح في الصنف مصر ١ .
- ٦- تأثر طول القرن باستخدام الجرعات العالية في الصنف مصر ١ حيث أعطت الجرعة ١٢ ك. ر طول قرن ٩ - ٩.١ سم وعلى العكس أعطت الجرعة المنخفضة في الصنف جيزة ٤٦١ أعلى طول قرن ٩.٨ - ١٢.٣ سم مقارنة مع ٧.٠ سم للكنترول.

