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INFLUENCE OF GAMMA-IRRADIATION ON FABA BEAN PLANTS GROWN UNDER *Orobanche*-FREE AND INFESTED CONDITIONS

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ABSTRACT

Two field experiments were carried out at the Experiments & Research Station, Faculty of Agriculture, Cairo University, Giza during 2000/2001 season. The objectives were to elucidate the effects of 3 and 6 Krd gamma ray irradiation compared to untreated check on anatomical, morphological and yield characteristics of M_1 plants of three faba bean genotypes under Orobanche-free and infested conditions.

All host morphological characters detected in samples taken after 90 days from sowing were reduced significantly under infestation as affected by gamma ray doses compared to non-irradiated check. Both gamma ray doses significantly increased the level of Orobanche-parasitism, particularly on susceptible genotypes. On the other hand, under Orobanche-free field such irradiation treatments positively significantly affected only the number of leaves/plant compared to control check. The genotypes x treatments interaction were significant for all detected growth traits except plant height under both studied conditions and shoot dry weight under free-infestation.

The irradiation treatments decrease significantly, comparing to control check, the percentages of emerged seedlings, counted at the age of 15 days as well as all yield characters under Orobanche-free field. The extent of reduction in all seed yield attributes especially percentage of plants bearing pods was parallel to increasing the applied dose. The reduction caused by the two-irradiation treatments on most seed yield attributes varied between the studied genotypes, which indicate different genotypic responses.

Under Orobanche infestations, the percentages of emerged and survived seedlings and all yield parameters were reduced as the irradiation dose increased and vice versa for number of Orobanche per host. The interaction between treatments and genotypes for yield components were significant except for pod-bearing plants percentages and seed yield per plant.

Transverse sections made in the main stem exhibited diminution in most of the studied characters as a result of irradiation treatments. Averages diameter of cross section, width of both major and minor bundles and thickness of cortex are reduced by 3 Krd dose. However, raising the irradiation dose up to 6 Krd increased these anatomical characters comparing with 3 Krd, but the values of these traits were still lower than those recorded for control plants. The total number of vascular bundles i.e. major and minor ones varied according to genotype and treatment.

Key words: *Faba bean, Gamma-ray, M_1 generation, Orobanche tolerance, Anatomical characters.*

INTRODUCTION

Faba bean (*Vicia faba* L.) is an important popular legume crop grown in Egypt. This crop suffers from various handicaps such as the parasitic weed *Orobanche crenata.* Several investigators found that applying low doses of gamma rays to faba bean may have beneficial effects. Hassanien (1973) reported an increment in germination percentages by applying 0.5 and 2 Krd, whereas 4 up to 18 Krd resulted in marked decreases. He reported also that low doses favoured mature plant surviving. Hussein and Abdalla (1974) found an increment in fertility by low gamma ray doses compared with the control. El-Kady (1978) observed also that relatively low doses of this mutagent increased the number of tillers, pods, seeds, seed yield and 100-seed weight, whereas the higher doses reduced these attributes. However, Filippetti and De Pace (1986) reported that M_1 and M_2 faba bean plants exhibited reduction in emergence, survival and fertility of surviving plants as seeds irradiated by gamma ray. Seeds treated with 8000 r showed lower survival than those received 5000 r. Abada (1995) reported significant decrease in M_1 seed germination percentages as a result of seed exposure to gamma ray irradiation at 10 and 15 Krd compared with untreated seeds. Seed germination, emergence and plant survivals of other legume crops seemed to be affected by gamma ray irradiation. Harb (1981) in his study on soybean and El-Sgai (1986) on lupin, found drastic decrease in seed germination up to complete lethal by high doses. Irradiation doses 6-9 Krd were reported to give survival rates below 40 % while those above 10 up to 15 severely inhibited faba bean seed germination (Kara *et al.* 1988). Several authors estimated different varietal response of faba bean plants to the same gamma ray dose(s) (Hussien and Abdalla 1974. El-Hosary 1977 and El-Kady 1978). Filippetti and De Pace (1986) recorded also faba bean varietal differences in sensitivity to gamma irradiation.

The present investigation aimed to elucidate the effects of gamma ray irradiation on anatomical, morphological and yield characteristics of M_1 plants of three faba bean genotypes, with various reactions to broomrape infestation, under *Orobanche*-free as well as infested conditions. The possibility of improving faba bean resistance/tolerance to *Orobanche* by gamma ray irradiation was also considered.

MATERIALS AND METHODS

Three faba bean genotypes having various reactions to *Orobanche*-parasitism were used in this study. The origin, sources and some features of these genotypes are as follows.

Code	Origin	Source	Some features
Line-X	Egyptian local selection.	Agron. Dept., Fac. Agric., Cairo Univ.	Medium *Orobanche*-tolerant.
24 Hyto	Egyptian local selection.	Agron. Dept., Fac. Agric., Cairo Univ.	*Orobanche*- tolerant.
Cairo 375	Egyptian local selection.	Agron. Dept., Fac. Agric., Cairo Univ.	High yielding ability, *Orobanche*-susceptible.

Two field experiments were carried out at the Experiments & Research Station, Faculty of Agriculture, Cairo University, Giza during 2000/2001 season to evaluate the M_1 generation. The first trial was conducted in an *Orobanche*-infested field but the second was sown in *Orobanche*-free one. A random sample of air dried seeds represented each of the three genotypes were exposed to two gamma ray irradiation doses, 3 and 6 Krd, generated from Cobalt-60 at the National Center for Research and Radiation Technology, Nasr-City, Cairo, Egypt. Each trial included three treatments (two-irradiation doses and control check) in combination with the three-faba bean genotypes in a split-plot design with three replications. The genotypes were distributed in the main plots and the treatments were assigned to the sub-plots. Each sub-plot consisted of 4 ridges 3 m long and 60 cm apart. Seeds were hand planted in one side of the ridge in single-seed hills distanced 20 cm after 48 hr of the exposure to irradiation. Recommended cultural practices were adopted.

After 2 weeks from sowing the emerged seedlings were counted and the percentages to the planted seeds were estimated/plot. At day 30 a sample comprised 2 plants per plot were taken from the *Orobanche*-free field for studying the internal structure of the main stem as affected by applied doses of gamma rays. Cross sections were made in the fifth internode of the main stem. Specimens were killed and fixed in F.A.A. (10-ml formalin, 5-ml glacial acetic acid and 85 ml ethyl alcohol 70 %). Fixed materials were washed in 50 % ethyl alcohol, dehydrated in a normal butyl alcohol series and embedded in paraffin wax of melting point 52-54 °C. Sections of 15-20 μ thick were cut. Crystal violet-erythrosin combination method (Jackson 1926) was used for staining. Stained sections were cleared in xylene and mounted in Canada balsam (Willey 1971). Sections were read to detect histological manifestation of noticeable response resulted from gamma ray irradiation.

Five plants from successive guarded hills of the first bordered ridge per each sub-plot were carefully uprooted at day 90 to study the influence of treatments on the growth of studied genotypes under both conditions. Plant height, number of basal branches and leaves per plant were recorded. The dry weight of roots and shoots per faba bean plant and of *Orobanche*/host plant (in infested trial) were recorded after oven-drying to a constant weight at 70 °C for about 72 h.. At harvest, the pod-bearing plants were determined and their percentages to emerged seedlings were calculated. Under *Orobanche*-free field, the individual plant characters were studied using random sample comprised 15-guarded plants taken from bordered ridge. The seeds of rest plants of that ridge in addition to those of individual plant samples were considered as seed yield per ridge. Under *Orobanche* infested field, the numbers of surviving hosts (podded or podless) were recorded before maturity and the percentages to emerged seedlings were estimated. However, the pod-bearing percentages were determined of podded hosts to all harvested ones either under free or infested experiments.

RESULTS AND DISCUSSION

Morphology of growth samples

Tables (1& 2) show the mean performance of some morphological characters detected in samples taken after 90 days from sowing under *Orobanche*-free and infested fields.

Irrespective of irradiation effect, genotypes varied significantly under both investigated conditions for all traits except for plant height and basal branches under *Orobanche*-infested nursery. In comparison with the other two genotypes, Line-X recorded the maximum shoot dry weight per plant under free infestation, though it developed the shortest plants under the same condition (Table 1). Data of Table (2) clearly showed that the tolerant genotype 24 Hyto performed better under infested condition for most of the studied characters comparing with the other two genotypes. It recorded significantly the highest shoot and root dry weights/plant with lowest *Orobanche* dry weight.

Generally, all studied characters were reduced significantly under infestation as affected by gamma ray doses compared to the control check. Moreover, such treatments significantly increased the parasite dry weight/plant by about 200 and 400 % for the two irradiation doses 3 and 6 Krd, respectively (Table 2). Shoots dry weight of the host plant was the most affected character by irradiation. This trait underwent drastic decrease (50 %) by applying 3 Krd and reached about 20 % by 6 Krd. No parallel

Table 1. Means of M_1 plant characters recorded 90 day-old of genotypes affected by irradiation doses in 2000/2001 season under *Orobanche*-free field.

Dose / Genotype	Plant height, cm				No. basal branches/plant				No. leaves/plant				Shoot dry weight/plant, g				Root dry weight/plant, g			
	0.0	3 Krd	6 Krd	Mean	0.0	3 Krd	6 Krd	Mean	0.0	3 Krd	6 Krd	Mean	0.0	3 Krd	6 Krd	Mean	0.0	3 Krd	6 Krd	Mean
Line-X	96.0	99.0	100.5	98.5	2.0	1.5	2.0	1.8	43.5	42.0	41.5	42.3	24.4	24.2	24.0	24.2	5.3	5.8	2.1	4.4
24 Hyto	104.5	101.5	110.5	105.5	2.0	1.0	2.0	1.7	34.0	24.5	44.0	34.2	23.1	20.9	26.6	23.5	4.1	4.3	6.6	5.0
Cairo 375	108.5	117.0	106.5	110.7	2.0	2.5	2.0	2.2	39.0	51.5	41.5	44.0	16.6	22.6	18.7	19.3	6.7	5.3	5.6	5.8
Mean	103.0	105.8	105.8		2.0	1.7	2.0		38.8	39.3	42.3		21.4	22.6	23.1		5.3	5.1	4.7	
$LSD_{0.05}$ for																				
Genotypes:	4.1				0.4				3.3				4.0				1.0			
Doses:	ns				ns				2.0				ns				ns			
Doses x genotypes:	ns				0.7				5.8				ns				1.67			

Table 2. Means of M_1 plant characters recorded 90 day-old of genotypes affected by irradiation doses in 2000/2001 season under *Orobanche*-infested field.

Dose / Genotypes	Plant height, cm				No. basal branches/plant				No. leaves/plant			
	0.0	3 Krd	6 Krd	Mean	0.0	3 Krd	6 Krd	Mean	0.0	3 Krd	6 Krd	Mean
Line-X	99.0	91.5	88.0	92.8	1.5	2.0	3.0	2.2	35.0	38.0	41.5	38.2
24 Hyto	102.5	104.5	97.5	101.5	3.0	0.5	2.5	2.0	49.0	24.0	39.0	37.3
Cairo 375	115.0	86.0	93.0	98.0	2.5	2.5	1.5	2.2	46.5	45.0	41.5	44.3
Mean	105.5	94.0	92.8		2.3	1.7	2.3		43.5	35.7	40.7	
$LSD_{0.05}$ for												
Genotypes:	ns				ns				4.0			
Doses:	9.5				0.6				4.3			
Doses x genotypes:	ns				1.0				7.0			
	Shoot dry weight/plant, g				Root dry weight/plant, g				Orobanche-dry weight, g			
	0.0	3 Krd	6 Krd	Mean	0.0	3 Krd	6 Krd	Mean	0.0	3 Krd	6 Krd	Mean
Line-X	11.9	6.8	13.3	10.7	2.95	2.85	4.05	3.28	2.80	9.20	14.65	8.89
24 Hyto	24.2	9.4	12.4	15.3	8.25	4.30	3.60	5.38	1.96	0.00	0.45	0.80
Cairo 375	10.0	7.1	11.8	9.6	2.80	3.20	4.15	3.38	3.35	12.75	17.40	11.17
Mean	15.4	7.8	12.5		4.67	3.45	3.93		2.70	7.32	10.83	
$LSD_{0.05}$ for												
Genotypes:	1.0				0.59				1.64			
Doses:	1.0				0.70				1.64			
Doses x genotypes:	1.7				1.02				2.83			

reduction was recorded for most traits i.e. plant height, number of leaves and number of branches. Therefore, the effects of irradiation treatments on host-shoot dry weight under infestation may be mainly due to the depression in specific dry weight of leaves. On the other hand, under *Orobanche*-free field such irradiation treatments positively significantly affected the number of leaves/plant and showed no significant effect on the other studied traits compared to control check (Table 1). It could be concluded that both gamma ray doses significantly increased the level of *Orobanche*-parasitism, particularly on susceptible genotypes, which affected indirectly their host attributes or may be had synergistic effects on susceptible plants. M_1 plants received 6 Krd recorded the maximum *Orobanche* dry weight/plant with significant difference with untreated control or with those received 3 Krd i.e. sensitivity to *Orobanche* increased as the irradiation dose increased.

Regarding the interaction between irradiation treatments and genotypes, no significant differences were detected with respect to each of plant height under both studied conditions and shoot dry weight under free-infestation. Under free infestation the number of basal branches, which of great importance in carrying the reproductive organs consequently expected yield, exhibited no significant differences for all studied genotypes received the applied doses (except plants of 24 Hyto treated by 3 Krd) (Table 1). The later genotype recorded non-significant increase in shoots dry weight per plant over untreated control as radiated by 6 Krd. This increment due to increasing each of plant height and number of leaves per plant. Variable responses were detected by the other two genotypes with respect to all studied traits as increasing the irradiation dose. In their studies on faba bean plant, Hassanien (1973) reported a constant increase in plant height as well as favouring branching by applying low doses of gamma-ray, i.e 0.5 and 2.0 Krd, whereas the highest doses 10-18 showed consistent and significant stunting effect. El-Hosary (1977) reported an increase in the same traits by increasing gamma-ray irradiation dose only at early stages of growth. Number of branches tended to be increased by applying gamma ray 5 and 10 Krd then reduced by 15 and 20 ones (El-Kady, 1978). Tolba (1980) recorded greater plant height and number of branches in M_1 generation received 1 and 4 Krd of gamma ray radiation. In agreement with variable genotypic responses detected in the present study, Hussein and Abdalla (1974), El-Hosary (1977) and El-Kady (1978) and others reported varietal differences between faba bean cvs. in many M_1 characters as affected by different mutagenic treatments.

Under infestation, irradiation gradually reduced plant height except slight increase shown by genotype 24 Hyto at 3 Krd (Table 2). Plants of less *Orobanche*- tolerant genotypes, i.e. Line X and Cairo 375 showed an increment in both shoot and root dry weights as received 6 Krd over control. On the other hand, dry weight of *Orobanche* shoot attached to their roots exhibited gradual increase as increasing irradiation dose. Hence, the treated plants showed the higher *Orobanche* attached comparing with untreated infested control plants. Most of studied traits of genotype 24 Hyto exhibited notable reduction by irradiation especially shoot and root dry weights (by 3 Krd). Considerable reduction was recorded for *Orobanche* dry weight when 24 Hyto plants received gamma ray doses. It could be concluded that under infestation also, the studied genotypes behaved differently as affected by gamma ray doses. Hussein *et al* (1988) reported substantial degree of *Orobanche* tolerance or resistance in two faba bean cvs. by applying gamma rays. Abada (1995) reported that gamma-ray irradiation (10 and 15 Krd) induced variable levels of rust disease resistance for three commercial faba bean cvs.

Emergence, yield and yield components under *Orobanche*-free infestation

Data in Table (3) summarizes means of genotypes; treatments and their interaction for M_1 studied characters of plants grown under *Orobanche*-free conditions. Regardless the influence of irradiation treatments, no significant differences were detected between genotypes in all studied traits. The applied doses significantly affected all of these traits comparing to control check regardless the effect of genotype. Irradiation treatments seemed to decrease the percentages of emerged seedlings, counted at the age of 15 days as well as all yield characters under study. The extent of reduction was parallel to increasing the applied dose. A noticeable reduction was observed in the weight of seed yield per ridge as M_1 plants treated by 6 Krd. This reduction could be attributed to the decrease in all seed yield attributes especially percentage of plants bearing pods. The interaction between irradiation treatments and the studied genotypes revealed that the two applied doses negatively affected all yield characters besides reduction caused by irradiation on the percentages of emerged seedlings. Seedlings of both Line-X and Cairo 375 received 6 Krd were the most affected by irradiation treatment with significant differences comparing to those received 3 Krd and control ones. A significant notable reduction in the percentages of plants bearing pods was observed as all genotypes treated by 6 Krd significantly differed with both received 3 Krd and untreated control.

Table 3. Emergence, pod-bearing percentages and seed yield attributes of three genotypes treated with gamma ray under *Orobanche*-free field during 2000/2001.

Genotypes \ Dose	Emergence %				No. pods/plant				No. seeds/plant			
	0.0	3 Krd	6 Krd	Mean	0.0	3 Krd	6 Krd	Mean	0.0	3 Krd	6 Krd	Mean
Line-X	93.8	82.3	75.0	83.7	18.1	16.5	12.9	15.8	49.4	41.0	30.2	40.2
24 Hyto	94.0	85.5	82.3	87.2	20.0	16.9	15.5	17.5	52.3	46.9	41.3	46.8
Cairo 375	93.8	80.2	72.9	82.3	19.3	13.1	13.6	15.3	54.4	34.4	34.2	41.0
Mean	93.8	82.7	76.7		19.1	15.5	14.0		52.1	40.8	35.2	
$LSD_{0.05}$ for Genotypes:	ns				ns				ns			
Doses:	3.4				1.7				6.3			
Doses x genotypes:	5.9				3.0				10.9			
	Pod-bearing %				Seed yield/plant, g				Seed yield/ridge, g			
	0.0	3 Krd	6 Krd	Mean	0.0	3 Krd	6 Krd	Mean	0.0	3 Krd	6 Krd	Mean
Line-X	91.3	72.9	64.6	76.3	33.9	28.0	20.6	27.5	534.7	470.3	372.3	459.1
24 Hyto	90.4	75.0	65.6	77.0	36.5	33.2	29.2	32.9	627.7	497.7	479.3	534.9
Cairo 375	89.8	69.8	61.5	73.7	35.8	23.6	22.6	27.3	556.0	353.7	327.0	412.2
Mean	90.5	72.6	63.9		35.4	28.3	24.1		572.8	440.6	392.9	
$LSD_{0.05}$ for Genotypes:	ns				ns				ns			
Doses:	3.7				4.5				53.6			
Doses x genotypes:	6.5				7.7				92.8			

The extent of reduction caused by the two-irradiation treatments on the recorded weight of seed yield/plant varied between the studied genotypes. This might be attributed to different genotypic responses appeared also in many studied traits. Seed yield per ridge seemed also to decrease as the irradiation dose increased with different genotypic responses.

In disagreement with the previous results low dose of gamma ray tended to increase faba bean seed germination as reported by Hassanien (1973) and Hassan (1977). Gamma ray has an adverse effect on emergence, germination and survival as reported by many investigators (El-Hosary 1977, Hussein 1982, Filippetti and De Pace 1986 and Abada 1995). Drastic but sometimes-lethal effects on M_1 generation were reported also by applying high radiation doses(Hassanien 1973, Hassan 1977 and Abada 1995).

Seed exposure to low doses of gamma irradiation was reported to increase faba bean yield characters (Hassanien 1973, El-Kady 1978, Shamsi and Sofajy 1980 and Tolba 1980). Moreover, Hassan (1977) and Filippetti and De Pace (1986) reported reduction in yield parameters as the irradiation dose increased. Hanna (1969) and El-Hosary (1977) recorded no detectable effect on seed weight as M_1 plants affected by gamma irradiation.

Emergence, yield and yield components under *Orobanche*-infestation

Table (4) presents the effect of gamma irradiation on M_1 plants under *Orobanche* infestation. Regardless the influence of irradiation, studied genotypes exhibited no significant differences with respect to percentages of emerged plants whereas survived plants of both Line-X and 24 Hyto exhibited significant differences compared with the most susceptible genotype Cairo 375. Susceptibility and tolerance to *Orobanche* parasitism apparently reflected on yield parameters. The maximum seed yield per ridge recorded by tolerant genotype 24 Hyto corresponded to recording the maximum percentage of pod-bearing plants; this reflected also fertility of formed pods. Data revealed that the recorded numbers of *Orobanche* shoots attached to their hosts are parallel with genotypic susceptibility to *Orobanche* parasitism.

Regardless of genotypic effect, emergence and surviving percentages reduced as the irradiation dose increased. The same trend exhibited by all yield parameters under study and vice versa by number of *Orobanche* per host. No significant differences were detected by pod-bearing plant % and seed yield per plant. At harvest irradiation seemed to

Table 4. Emergence, surviving, pod-bearing percentages and seed yield attributes as well as the number of *Orobanche*/host of three genotypes treated with gamma ray under *Orobanche*-infsted field during 2000/2001.

Dose / Genotypes	Emergence %				Surviving %				Pod-bearing %			
	0.0	3 Krd	6 Krd	Mean	0.0	3 Krd	6 Krd	Mean	0.0	3 Krd	6 Krd	Mean
Line-X	93.8	82.3	75.0	83.7	89.0	82.5	83.3	84.9	60.0	64.7	61.9	62.2
24 Hyto	90.6	85.4	82.3	86.1	87.2	84.2	79.9	83.8	90.8	86.9	82.4	86.7
Cairo 375	93.8	80.2	72.9	82.3	77.7	77.8	73.0	76.2	55.8	56.5	58.7	57.0
Mean	92.7	82.6	76.7		84.6	81.5	78.7		68.9	69.4	67.7	
$LSD_{0.05}$ for Genotypes:	ns				6.2				7.1			
Doses:	3.2				4.1				ns			
Doses x genotypes:	5.5				6.4				ns			
	Seed yield/plant, g				Seed yield/ridge, g				No. *Orobanche*/host			
	0.0	3 Krd	6 Krd	Mean	0.0	3 Krd	6 Krd	Mean	0.0	3 Krd	6 Krd	Mean
Line-X	7.2	7.1	5.4	6.6	191.4	153.9	108.2	151.2	6.3	15.2	17.5	13.0
24 Hyto	14.8	13.1	14.7	14.2	375.4	298.2	307.2	326.9	5.3	6.4	7.5	6.4
Cairo 375	4.2	4.6	4.6	4.5	98.4	92.2	77.4	89.3	13.5	17.4	19.7	16.9
Mean	8.7	8.3	8.2		221.7	181.4	164.3		8.4	13.0	14.9	
$LSD_{0.05}$ for Genotypes:	1.8				26.7				3.1			
Doses:	ns				32.6				1.9			
Doses x genotypes:	ns				56.5				4.5			

have increased susceptibility to *Orobanche* parasitism, 6 Krd recorded the maximum number of *Orobanche* with significant difference comparing with control or 3 Krd treatment. The interaction between treatments and studied genotypes exhibited that irradiation decreased the percentages of emerged and survived plants of all genotypes under study. The interaction behaved insignificantly in both of pod-bearing plants percentages and seed yield per plant.

Different genotypic responses were observed as the individual genotype irradiated by 3 and 6 Krd comparing with control check. Irradiation has an adverse effect on seed yield per ridge, which considered as an important eventual yield parameter. This observation may be due to a synergistic effect of both irradiation and *Orobanche* parasitism i.e. irradiation do not enhance *Orobanche* resistance and/or do not enable infested plants to overcome the adverse effect of parasitism on both survival and seed yield. Worthily to notice that the adverse effect of irradiation on seed yield per ridge in all studied genotypes is a direct effect of reducing the emergence and surviving percentages.

The effects of irradiation on *Orobanche* dry weight obtained at 90 days corresponded to those at harvest especially in susceptible genotypes, i.e. number of *Orobanche* shoots attached to host plant increased by increasing dose. In other words, sensitivity to *Orobanche* parasitism increased as the irradiation dose increased.

Hussein *et al.* (1988) reported substantial degree of *Orobanche* tolerance or resistance as plants of faba bean were treated by gamma rays (10, 15 and 20 Krd).

Under infestation yield parameters underwent drastic decrease comparing untreated control plants with those under free-infested conditions. This is due to the harmful effect of *Orobanche* parasitism, which reported also by many investigators (Abdalla 1982, Mesa-Garcia and Garcia Torres 1985, Abdalla and Darwish 2002 and Abou Taleb and Darwish 2003). Reduction in yield components recorded by irradiated plants may be attributed to synergistic effect of both parasitism and irradiation.

Anatomical study

Table (5) presents the anatomical measurements of cross sections made in the fifth internode of the main stem of M_1 plants irradiated by 3 and 6 Krd and non-irradiated control of the three genotypes, Line-X, 24 Hyto and Cairo 375 at the age of 30 days. All studied genotypes exhibited diminution in most of the studied characters as a result of irradiation

Table 5. Average of different anatomical parameters of the fifth internode of the main stem (μ) for M1 plants grown in *Orobanche* –free field during 2000/2001 season of studied genotypes at day 30 as affected by various irradiation treatments.

Dose / Genotypes		Line-X			24 Hyto			Cairo 375		
		Control	3 Krd	6 Krd	Control	3 Krd	6 Krd	Control	3 Krd	6 Krd
Diameter of cross section μ		4282.4	2628.8	2756.0	2734.8	2257.8	2618.2	2999.8	2364.0	2438.0
Diameter of cavity μ		1531.3	1128.8	1023.8	743.8	813.8	1531.3	1268.8	612.5	743.8
		36 %	43 %	37 %	27 %	36 %	58 %	42 %	26 %	30 %
Stem wall thickness		1365	756.9	861.9	1023.8	730.6	761.3	962.5	945	901.3
Major bundles μ	Length	490	332.5	354.4	309.4	301.9	293	315	367.5	310.6
	width	441.9	323.8	402.5	280	196.5	336.9	249.4	240.6	284.4
Minor bundles μ	Length	389.4	161.9	196.9	201.3	157.5	227.5	249.4	214.4	227.5
	width	376.3	135.6	170.7	179.4	131.3	210.0	227.5	210	223
Thickness of xylem μ		231.9	109.4	126.9	126.9	91.9	157.5	175	118.1	118.1
Thickness of cortex μ		494.4	467.9	472.5	380.6	271.3	424.4	485.6	323.8	345.6
Total number of vascular bundles		23	19	23	26	24	24	19	19	24

treatments (Figs.1,2 and 3). Averages diameter of cross section, width of both major and minor bundles and thickness of cortex are reduced by 3 Krd dose. However, raising the irradiation dose up to 6 Krd increased these anatomical characters comparing with the lower rate, 3 Krd, but the values of these traits were still lower than those recorded for control plants. However, the averages length of minor bundles, width of major and minor bundles as well as thickness of cortex of 24 Hyto stems received 6 Krd surpassed their control counterparts (Figs.2a & c). Increment in these tissues might contribute to some extent in the insignificant increase in shoot dry weight/plant recorded at the age of 90 days due to treatment with irradiation at 6 Krd (Table 1). Stem wall thickness decreased gradually by increasing gamma ray dose in genotype Cairo 375 (Figs. 3a-c), while this trait exhibited a considerable reduction due to 3 Krd treatment in both other genotypes Line-X and 24 Hyto (Figs.1 and 2). The total number of vascular bundles i.e. major and minor ones varied according to genotype and treatment. Plants of genotype Line-X received 3 Krd exhibited reduction in the total number of vascular bundles while 6 Krd had no effect comparing with untreated control. Slight decrease was detected as M_1 plants of genotype 24 Hyto received 3 or 6 Krd. A notable increment in the total number of vascular bundles showed by genotype Cairo 375 when treated by 6 Krd, whereas 3 Krd did not affect this trait. An increase caused by 6 Krd might be due to initiation of new-developed vascular bundles (Fig. 3c).

Regardless the effect of irradiation, the non-irradiated plants of Line-X recorded the maximum averages cross-section diameter and stem wall thickness comparing with those of the other two genotypes (Figs. 1a, 2a and 3a). Superiority in these characters might be contribute in the heaviest shoot dry weight recorded before for this genotype.

Reduction in leaf thickness as affected by gamma rays irradiation was reported in eggplant (0-80 Krd) by Dhopte and More (1975) and in banana (10-40 Gy) by Bayerly (2003). This reduction was attributed to decreasing midrib and leaf blade thickness as well as size of vascular bundles. Hammad (1980) attributed reduction to the decrease in the amount of phloem and xylem vessels as well as shrinkage and collapse of the cells.

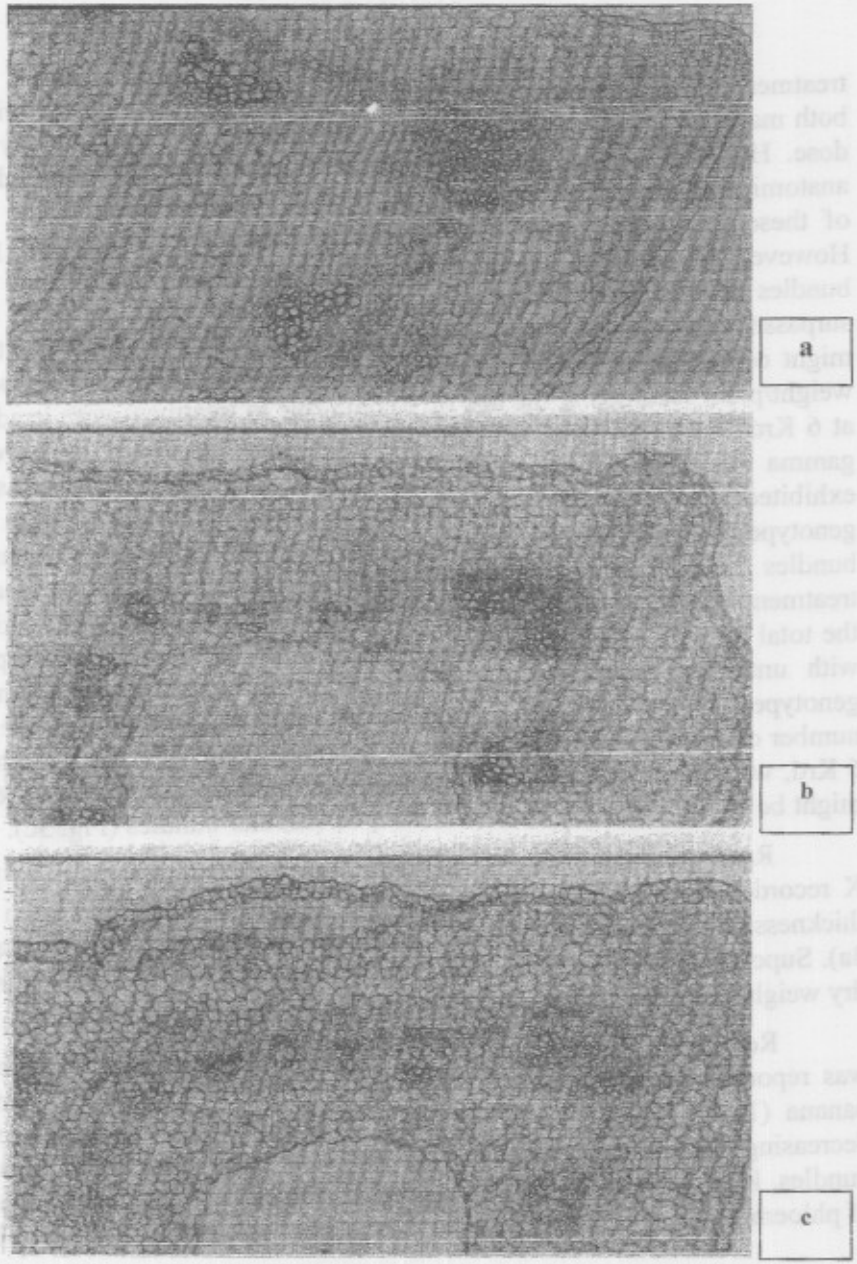

Fig. 1. Transverse section of faba bean main stem, at the age of 30 days (Line X)
a- Non-irradiated control b- irradiated by 3 Krd c- irradiated by 6 Krd

40 X

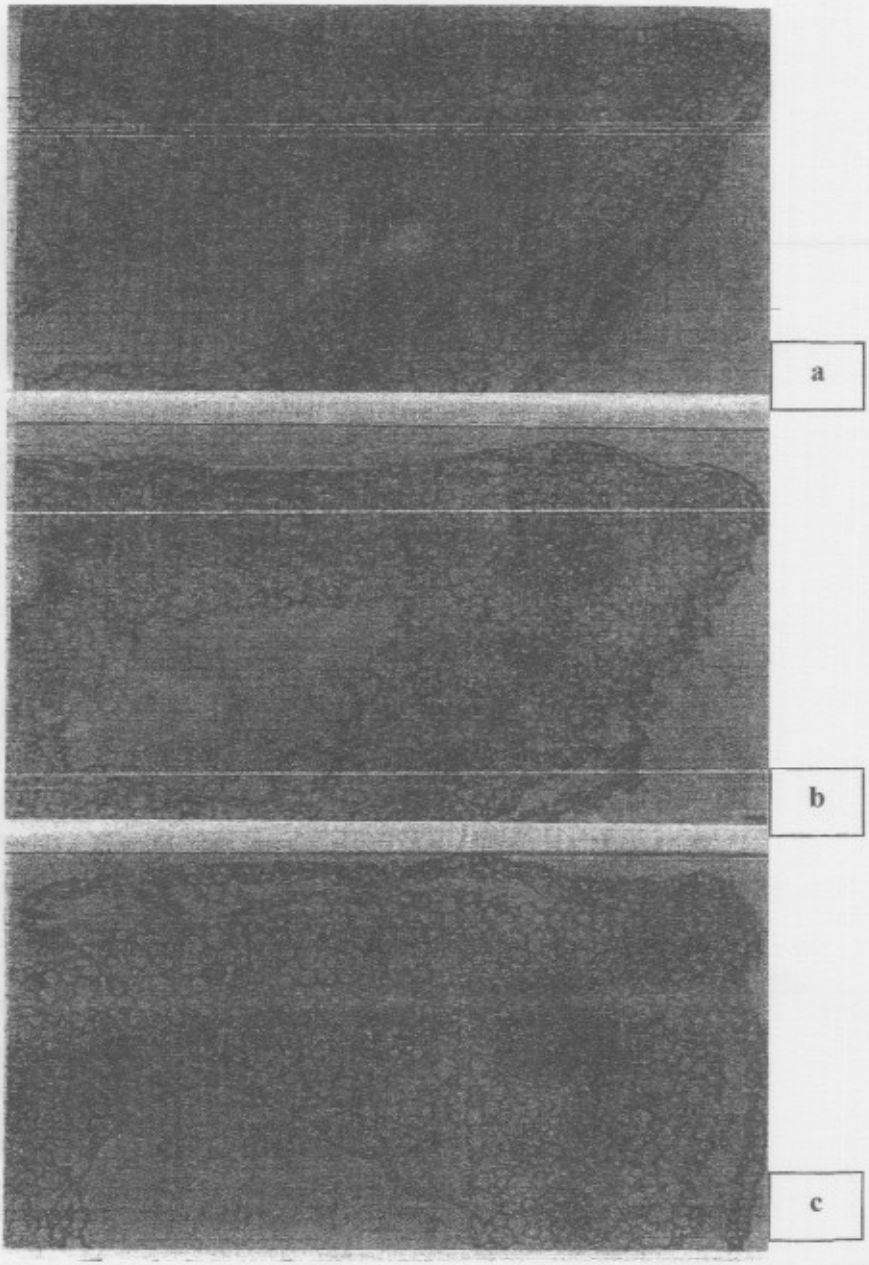

Fig. 2. Transverse section of faba bean main stem, at the age of 30 days (Line 24 Hyto)
a- Non-irradiated control b- irradiated by 3 Krd c- irradiated by 6 Kr

40 X

Fig. 3. Transverse section of faba bean main stem, at the age of 30 days (Cairo 375)
a- Non-irradiated control b- irradiated by 3 Krd c- irradiated by 6 Kr

40 X

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تأثير المعاملة بأشعة جاما على نباتات الفول البلدى المنزرعة فى الحقول الخالية من الهالوك والمصابة به

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أجريت تجربتان حقليتان فى محطة التجارب والبحوث الزراعية - كلية الزراعة - جامعة القاهرة بالجيزة، خلال الموسم الزراعي ٢٠٠٠/٢٠٠١ ، بهدف تقييم تأثيرات معاملة البذور بأ شعة جاما على الصفات التشريحية والمورفولوجية وكذلك صفات المحصول لنباتات الجيل الأول الطفرى لثلاثة من التراكيب الوراثية للفول البلدى ذات درجات مختلفة لتحمل الإصابة بالهالوك . ونفذت التجربة الأولى تحت ظروف عدم الإصابة أما الثانية فزرعت فى حقل معروف عنه الإصابة ببذور حشيشة الهالوك المتطفلة. ولقد استخدمت جرعتان من أشعة جاما هما ٣ و ٦ كيلو راد والمنبعثة من العنصر كوبالت -٦٠ إضافة إلى معاملة الكونترول غير المشععة. وكانت أهم النتائج المتحصل عليها هى:

١-أظهرت التراكيب الوراثية المستخدمة فى التجربة تباينا فى استجابتها لمعاملات أشعة جاما، وذلك فى معظم الصفات المورفولوجية والتشريحية وكذلك صفات المحصول . وأختلفت هذه الإستجابات ما بين ظروف الإصابة بالهالوك عن عدم الإصابة به .

٢-أثرت المعاملة بالإشعاع إيجابياً على مستوى الإصابة بالهالوك خاصة فى التراكيب الوراثية الحساسة للإصابة ، بينما حدث العكس فى التركيب الوراثى المتحمل للإصابة (خاصة عند عمر ٩٠يوم) . علاوة على ذلك فقد ازدادت الحساسية للهالوك بزيادة جرعة المعاملة . ولقد أثرت زيادة مستوى الإصابة على كل الصفات المورفولوجية و المحصولية للنباتات العائلة للهالوك، وبذلك يمكن القول بأنه تحت ظروف الإصابة بالهالوك فإن التأثير العكسى على العائل يمكن أن يكون مرجعة إلى تأثير متداخل متكامل لكل من المعاملة بالإشعاع والإصابة بالهالوك .

٣-أدت المعاملة بالإشعاع إلى نقص معنوى فى نسبة ظهور البادرات المسجلة تحت ظروف عدم الإصابة وكذلك ظروف الإصابة بالهالوك .

٤-كذلك أدت المعاملة بتلك الجرعات الصغيرة من أشعة جاما إلى نقص معنوى فى وزن البذور للخط تحت ظروف عدم الإصابة والإصابة بالهالوك.

٥-أظهرت الدراسة التشريحية تباينا فى استجابة التراكيب الوراثية لجرعتى الإشعاع المستخدمتين كالتباين الحادث فى صفتى سمك جدار الساق وكذلك العدد الكلى للحزم الوعائية .

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