Effect of Gamma radiation on growth of *Vigna radiata* (L.) Wilezek cv. Local and Indian

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Abstract

Seeds of Mungbean *Vigna radiata* (L.) Wilezek cv. Local and Indian were treated with different doses of gamma rays viz.;5.5R, 11.1R,16.6R, 22.2R, 27.7R & 33.2R. Observations were recorded on the effect of gamma rays on an important characters viz.; seedling length, root length, number of secondary branches, length of main branches, length of secondary branches, number of pods, length of pods and weight of dry 100 seeds. The significant effect on the growth of two cultivars, with best dosages of (33.2, 27.7 and 22.2 k/rad) respectively.

Key words: Gamma rays, Mungbean, *Vigna* radiata, cultivar.

Introduction:

Mungbean *Vigna radiata* (L.) Wilezek is a widely-grown, short-duration grain legume crop grown in South and Southeast Asia. It is an important source of inexpensive protein in most Asian diets and is a significant component of various cropping systems. However, the average yields in the farmers' fields are still low, ranging from 500 to 600kg/ha. One reason is due to the use of traditional cultivars and low management inputs used by most farmers (12**).**The induced mutations have been used to improve agronomic traits of many crops. The use of ionizing radiations, such as X-rays ,gamma rays, neutrons and chemical mutagens for inducing genetic variation is well established **(**11**).** Mutation induction with radiation is most frequently used method to develop direct mutant varieties, as improvement by acclimatization, selection and hybridization have proven to be time consuming, and laborious with limited genetic variation **(**6 & 17**).** The study of the effects of Gamma Radiation (GR) on plants is a broad and complex field. Work is being done in many areas on a large number of plant species.**(9).**Several workers have studied the effect of gamma rays as well as chemical mutagen on various biological parameters**(**2, 7 , 10, 15, 16**).** These workers have observed dose dependent reduction of the above mentioned biological parameters.

Mutation breeding has become increasingly popular in recent times as an effective tool for crop improvement and an efficient means supplementing existing germplasm for cultivar improvement in breeding program's **(**1 & 5**).**

Materials and methods:

The laboratory experiment was conducted in the Laboratory of Biology, Department, Faculty of Education - Aden , as well as a field experiment conducted during the academic year 2011 in the study area (Bait Eiadh) Lahj Governorate. The seeds of two varieties local and Indian presoaked with distilled water for 4 hours and were used as experimental material . Then, seeds were exposed to γ-radiation with 5.5R, 11.1R,16.6R, 22.2R, 27.7R &33.2R. After that, seeds were, washed through a sifter with distilled water to remove of residues of radiation. Control seeds, only treated with distilled water without exposure to γ-radiation, then they were prepared for germination. About 100 seeds for each variety (Yemeni and Indian) then seeds were put on a plastic dishes which were prepared in advance on a rows , light drops of sterilized water were splashed on the Kleenex papers before and after the process , the plastic dishes then were left on the lab. benches to complete the germination for a period of 12 days . Readings were taken daily, for 10 plants for both cultivars of each dish. After 12 days of germination, the germination rate, length of radical, and length of seedling were recorded.

The percentage of germination was calculated according to Bamoamen 1995(4), as the following function:

$$\text{Germination (\%)} = \frac{\text{Germinated Seeds Number}}{\text{Total Seeds Number}}$$

As well as for a field experiment three replication of 100 seeds each were sown for every treatment in each variety in the field. The distance between seeds in a row and between the rows was kept 30 x 60 cms. respectively.

The results of the present investigation obtained from the statistical analysis were analyzed by the (Randomized Complete Block Design (RCBD), and data were analyzed statistically then compared by using the Low Significant Difference (LSD) test at 0.05,by using the statistical analysis software (GENSTAT 5 Release 3.2) according to the recommendations of **(3 & 4).**

Results and discussion:

1. Germination of seeds:

The seeds which were presoaked in distilled water for 4 hrs and exposed to gamma radiation (γ-Rays) 5.5R, 11.1R,16.6R, 22.2R, 27.7R, 33.2R, has a significant effects too, with a best radiation dosages of 33.3 and 22.2 and 27.7, k/rad respectively the germination percentage for reached to 100% .92% and 92%, respectively of the Yemeni var. and 100%, 100% and 96%, respectively for the Indian var. with comparison to the control, which gave a germination percentage reaching to 65 % of the Yemeni var. and 94 % for the Indian var. accordingly, we were noted clearly, the superiority of the Indian var. during the presoaking periods (3 - 4 hrs) on the Yemeni var. under the same radiation dosage, in comparison with seeds undergo a less presoaking periods (1– 2 hrs), before exposed to the radiation. No significant differences between seeds presoaked in distilled water for different periods of time was observed, when exposed to gamma radiation (γ-Rays), because of the highly germination percentage that the results showed which were between (22 - 25) seed, as compared by (25) seeds, which was in the germinated dish . This indicates no effects of gamma radiation (γ-Rays) on the germination in both cultivars (Yemeni and Indian). Our results differs from the results of each of Kumar and Mishra (10) who reported that the germination percentage decreased in okra (*Abelmoschus esculentus*) with increasing doses of gamma rays. Reduced germination percentage with increasing doses of gamma radiation has also been reported in *Pinus* Thapa, (15), Rye Akgun and Tosum(2) Chickpea Khan et al. (8) and Toker *et al*., (16). In the present study, seeds of *Vigna radiate* were treated with gamma rays of 33.3, 27.7 and 22.2 k/rad In the laboratory , germination test reveals that increase in concentration of gamma rays had an adverse effect (table 1).

2. Seedling length:

It's clearly shown from the Tables 2&3 that the length of the seedling for seeds exposed to radiation of gamma (γ-Rays) 5.5R, 11.1R,16.6R, 22.2R, 27.7R &33.2R, were not of a significant effects on this trait, and all dosages gave a comparable lengths, between 13.45 – 18.55 cm for the cv. Local, while it was between 12.94 – 18.90 cm for the cv. Indian as compared to the control, which gives a total length of the seedling that reached 12.09 cm for the Local cv. and 11.59 cm for the Indian cultivar.

The seeds which exposed to gamma radiation (33.2R) was the highest of seedling length for the two cultivars (Local and Indian), 18.55 cm and 18.90 cm respectively.

3. Root length:

It is clearly shown from the Tables (2 & 3) that the length of the root for the seeds exposed to gamma radiation (γ-Rays) 5.5R, 11.1R,16.6R, 22.2R, 27.7R& 33.2R was of a significant effect and gave the best lengths of root at dosages of (27.7 & 33.2 k/rad), reaching the lengths of 11.20 and 15.01 cm respectively, for the Local cultivar, and10.75 and 13.41 cm respectively for the Indian cultivar, as compared to the control which gave the length of the root about 6.09 and 7.07 cm for the Local and Indian cultivars respectively.

4. Length of main branches:

The length of the main branches varied from cultivar to cultivar (Tables 2 & 3)**.**The dosages were of a significant effects on the length of the main branches, with the best dosage of (33.2R),

which gave a lengths of the main branches reaching 146.33 cm for the Local cultivar, while the same dosage gave a lengths of main branches reached (179.00 cm), of the Indian cultivar, compared to the control that gave a total length of the main branches reach (120.33 and 130.70 cm) for the Local and Indian cultivars respectively. Our results correspond to Khan et.al. **(8)** who mentioned that the data recorded for plant height (cm) showed that gamma rays used were capable of inducing much variation for this character. The range was much wider as compared to the control. It shifted only in positive direction. The mean plant height varied in the individual treatments of gamma rays**.**

5. Number of secondary branches:

The number of branches ranged from 1.67 to 7.33 in the Local cultivar, while it ranged from 2.00 to 8.00 in the Indian cultivar. The highest number of secondary branches was produced by cultivars show in Tables (2 & 3).

The number of secondary branches or (sub-branch), with the dosages were of a significant effects on the number of secondary branches, with a best dosages were (33.2, 27.7 and 22.2), k/rad respectively, where the number of secondary branches were 7.33, 5.33 and 4.67 branches respectively, of the Local cultivar, while the same dosages gave number of secondary branches reaching 8.00, 7.33 and 6.33 branches respectively, of the Indian cultivar, compared to the control, which gave a number of secondary branches reaching 1.67 branches for the cv. Local and 2.00 branches of the Indian cultivar.

6. Length of secondary branches:

The length of secondary branches for the radiation dosages were of significant effects (Tables 2 & 3). The best radiation dosages were 33.2, 27.7 and 22.2 k/rad respectively, which gave a length of secondary branches reaching 136.67, 134.00 and 128.33 cm respectively, for the Local cv., while the same dosages gave a length of secondary branches reaching 154.30, 145.70 and 134.70 cm respectively, for the Indian cultivar, compared to the control that gave a total length of the secondary branches 99.00 cm for the cv. Local and 130.70 cm of the Indian cultivar.

7. Number of pods:

The mean concerning the main genotypic effect revealed that the number of pods ranged from 16 to 30.00per plant in cv. Local and 22.33 to 38.67 per plant in India cultivar. The interaction effect revealed that in all the cultivars of pods the number increased with all the dose of gamma radiation. However, the differences were statically significant. The best radiation dosages were 33.2, 27.7 and 22.2 k/rad respectively, which given a number of pods reaching 30.00, 27.67 and 24.00 pods respectively, for the cv. Local, while given with the same dosages a number of pods reached 38.67, 36.67 and 33.00 pods respectively, for the of Indian cultivar, as compared to the control, which gave a number of pods reaching 16.00 pods for the cv. Local and 22.33 pods for the Indian cultivar. Our results are correspond to **Yaqoob and Rashid (17) and Singh and Malhotra (13),**who showed that the pod / plant is one of the most important components of yield in green gram. **Swaminathan (14)** has suggested that an increase in the yield of pluses could be achieved by enhancing pod number. The present investigation indicates that such an enhancement in pod number and also concomitant changes in the morphological framework of the mungbean plant could be achieved through induces mutation.

8. Pods length:

Dosages of radiation were of a significant effects on the length of pods, and the best dosages were (33.2, 27.7 and 22.2) k/rad respectively, which gave a length of pods reaching 12.00, 11.00 and 10.67 cm respectively, for the cv. Local, while the same dosages gave length of pods reaching 14.00, 13.00 and 12.00 cm respectively, for the Indian cultivar, as compared to the control that gave a total length of pods reached 6.00 cm for the cv. Local and 7.00 cm for the Indian cultivar (Tables 2 &3).

9. One-hundred seeds weight :

The radiation dosage were of a significant effects on the weight of one hundred seeds, with a best radiation dosages of (33.2, 27.7 and 22.2) k/rad respectively, which gave a one hundred seeds weight reaching 148.33, 142.0 and 136.00 g respectively, for the cv. Local, while the same radiation dosages gave a one hundred seeds weights of reaching 170.00, 146.70 and 143.30 g

respectively, of the Indian cultivar, as compared to the control, which gave a one hundred seeds weights reached 115.00 g for the cv. Local, and 116.70 g for the Indian cultivar. The means for plant height, pods /cluster and 100 seed weight, increased in all doses (Tables 2 & 3).

Table(1) effect of gamma rays on seeds germination of Mungbean (Ymeni & Indian verieties)

Treatments doses	hour		2 hours		3 hours		4 hours	
	Varieties (Yemeni & Indian)							
	Y	I	Y	I	Y	I	Y	I
Control	23.71	23.0	23.0	22.57	22.56	24.00	16.14	23.57
5.5R	23.43	24.0	22.71	22.71	20.71	24.00	20.71	23.00
11.1R	23.43	22.29	22.71	23.00	20.71	25.00	22.00	25.00
16.6R	24.71	23.00	25.00	24.86	19.29	23.00	22.71	25.00
22.2R	24.71	24.00	25.00	24.86	20.57	23.00	24.00	23.00
27.7R	24.43	24.00	24.00	24.57	21.57	24.00	23.00	24.00
33.2R	24.71	24.00	23.00	23.71	21.14	25.00	25.00	24.00
Mean	24.16	23.47	23.63	23.76	20.98	24.00	21.94	23.94
LSD 5%	0.86	0.87	0.44	0.82	NS	NS	1.54	0.22

Table 2 :Effect of gamma radiation on growth of *Vigna radiata* (L.)Wilezek cv. Local.

Gamma doses	Seedling length (cm)	Root length (cm)	No. of secondary branches	Length of main branches (cm)	Length of second branches (cm)	No. of pods	Pod length (cm)	100 seeds weight (g)
Control	12.09	6.09	1.67	120.33	99.00	16.00	6.00	115.00
5.5R	13.45	7.84	2.67	123.67	109.67	17.67	7.33	118.33
11.1R	14.22	8.44	3.67	126.00	117.67	18.00	8.67	122.67
16.6R	16.37	8.48	4.00	130.00	120.67	20.00	9.33	130.33
22.2R	17.45	9.90	4.67	139.00	128.33	24.00	10.67	136.00
27.7R	17.45	11.20	5.33	141.33	134.00	27.67	11.00	142.00
33.2R	18.55	10.01	7.33	146.33	136.67	30.00	12.00	148.33
LSD5%	NS	3.09	1.75	4.31	7.46	3.48	3.66	4.41

Table 3: Effect of gamma radiation on growth of *Vigna radiata* (L.) Wilezek cv. Indian.

Gamma doses	Seedling length (cm)	Root length (cm)	No. of secondary branches	Length of main branches (cm)	Length of second branches (cm)	No. of pods	Pod length (cm)	100 seeds weight (g)
Control	11.59	7.07	2.00	130.70	103.70	22.33	7.00	116.70
5.5R	12.94	7.90	3.67	132.00	110.00	28.00	8.67	130.00
11.1R	14.36	9.4	4.33	133.30	117.30	30.00	9.33	136.70
16.6R	15.60	9.27	6.00	136.00	127.00	31.33	10.00	138.00
22.2R	15.93	10.18	6.33	142.70	134.70	33.00	12.00	143.30
27.7R	17.24	10.75	7.33	156.30	145.70	36.67	13.00	146.70
33.2R	18.90	13.41	8.00	179.00	154.30	38.67	14.00	170.00
LSD5%	NS	4.21	3.33	11.20	16.99	5.27	2.06	11.68

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تأثير أشعة جاما على نمو صنفين من نبات الكشري *Vigna radiata* (L.) Wilezek (محلي وهندي)

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الملخص

عوملت بذور الكشري *Vigna radiata* (L.) Wilezek mungbean صنف محلي وآخر هندي بجرعات مختلفة من أشعة جاما 5.5R, 11.1R, 16.6R, 22.2R, 27.7R, 33.2R رصدت نتائج تأثير أشعة جاما على أهم الصفات مثل: طول البادرات، طول الساق الأساسي ، طول الفروع الرئيسية والثانوية وعددها، عدد القرون وطولها ووزن 100 بذرة. كان التأثير المعنوي على نمو نوعي النبات ، وكانت أفضل الجرعات (33.2, 27.7 and 22.2) k/rad بالترتيب.

الكلمات المفتاحية : أشعة جاما، كشري، صنف.