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Effect of gamma irradiation on OKRA (*Abelmoschus esculentus* L.)

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ABSTRACT

The investigation was carried out to evaluate the effect of different doses of gamma rays (100, 200, 300, 400, 500 Gy and zero doses as control) on various morphological aspects of *Abelmoschus esculentus*. A comparison of the results of different doses with control showed that gamma irradiation significantly affected various parameters. Days to germination were almost the same as compared to control, but 400 Gy took minimum days to germination. Germination % was 100% both in control and the irradiated plants. 100 Gy took minimum days for flower initiation as compared to control and other doses. Fruit initiation early occurred in 100Gy as compared to other doses, and fruit maturation occurred early in 300 Gy as compared to control. Plant height was significantly increased at 500 Gy as compared to control. Number of fruits per plant was significantly decreased at 200 Gy as compared to control. Fruit length decreased in all doses but in control fruit length was maximum. Number of seeds per fruit was maximum at control, fresh and dry weights of seeds were increased in control as compared to other doses. The number of nodes decreased in all doses but in the control the numbers of nodes were maximum. Branches were increased in100Gy as compare to 200, 300,400,500 Gy as well in control. Numbers of leaves were increased in 300 Gy as compared to other doses.

1. Introduction

Okra or Okro (*Abelmoschus esculentus* Moench) is, known in many countries as "Ladies finger, Bhindi, Bamia, Ochro or Gumbo, is a flowering plant in Malvaceae family. Malvaceae contains 243 genera and 4225 species. Okra family contains well-known members which are cotton and cacao. The largest genera in terms of a number of species include *Hibiscus* (300 species), *Sterculi*a (250 species), *Dombeya* (250 species), *Pavonia* (200 species) and *Sida* (200 species). Okra is a vegetable crop with multi purpose, having low calories and consists of many nutrients involving vitamins B and C, fiber, calcium, and folic acid. Okra pods are variable in colors (white, red, green and purple). It is widely grown. The immature fruit of okra is eaten green either fresh or prepared by boiling, frying and also used in making soups and stews (Bleasdale, 1984). The genus *Abelmoschus* belongs to family Malvaceae and is represented by 12 species [1], in which the most important vegetable crop is okra. Okra is the sixth important popular vegetable crop that is widely grown under varying climatic condition in almost all part of Pakistan throughout the year except in the mountainous region. Its nutritional value lies in its high amount of calcium and phosphorus. It also contains carbohydrate, protein and fats and some amount of vitamins [2].

Okra is the sixth important vegetable that is widely grown under various climatic conditions throughout the year in almost all parts of Pakistan except in the mountainous regions. It is estimated that about 5 to 6 billion tons okra is producing in the world. The largest producer of okra is India that is covering an area of 3.8 lakh hectares with an annual production of 36.84 lakh tons [3].

Okra seed is highly suitable for fats. It contains highly unsaturated fatty acids, linoleic and oleic acid of about 70% is present. The oil is highly hydrogenated for use as solid shortening and it is used in place of margarine. Because of the many uses, the production of okra at present cannot cope up with the demand considering the increase in population. Martin [4] stated that okra seed as a source of oil and proteins, the seed oil content is about 20% to 40% after the removal of the hull, and the

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Table 1
Effect of gamma radiation on some temporal parameters.

Parameter							
Radiation doses	Days to germination	Germination percentage	Flower initiation	Fruit initiation	Fruit maturation	No of fruits per plant	Plant height (cm)
Control	9.6 a	24 a	84.4a	102a	95.6a	2.8a	16.4 a
100 Gy	10.6 a	24 a	77a	77.2a	51.2abc	2.6 a	13.234 a
200 Gy	9 a	24a	60.8a	75a	69.6ab	1.6ab	10.6 a
300 Gy	10.4 a	12 a	81.2a	60.2a	14.4	0 b	15.6 a
400 Gy	6.4 a	12 a	26a	26.2a	0c	0b	5.8 a
500 Gy	12.8 a	8 a	54.6a	56a	0c	0 b	18.2 a
LSD value at $\alpha = 0.05$	6.8742	26.106	30.879	35.827	21.363	2.459	17.968

Data are represented as Mean ($n = 05$). Means followed by different letter within the column are significantly different ($P < 0.05$). (ANOVA followed by Tukey LSD test).

protein content is 18-27% and is rich in tryptophan. Mutation is a sudden heritable change in an organism. It may be structural or functional, but generally, structure changes occur. It can be spontaneously or artificially made in seeds and vegetatively propagated crops. Seed is commonly used in mutational studies because it can tolerate the physical condition. In the improvement of crops, an induced mutation in the plant is an effective tool. Radiations are the best tools to induce genetic variability within a very short span of time. Induced mutation highly effects in enhancing and it has been used in the developing of improved cultivars of cereals, fruit, and crops [5]. Barley root meristems cultured on X-ray or gamma irradiated potato mash or fruit juices showed chromosome aberrations. Also, [6] working on the effect of irradiation of cultured media, on germination and growth of pollen grains of *Tropeolum majus*, showed that as the dose was increased the deleterious effect on pollen germination was increased. The following mutagens are the most prominent and of applied value as reported by Upadhyaya and Chopra [7] these include seven mutagens with their main attribute i.e., Gamma rays (Gy) give high yield, X-rays give early maturity, Neutron give resistance toward diseases, Ethyl methane sulphonate (EMS) gives quality character, Dimethyl sulphate (DMS) increase grain quality, Ethylene imine (EI) gives A biotic stress resistance, and Sodium azide (NaN3) improved plant types. The plant productivity is found to be increased by gamma irradiation. Singh, and Datta [9] stated that one of the important physical agents is the gamma radiation which is used to improve the characters and productivity of many plants (e.g. rice, maize, cowpea, potato, and bean). Gamma arrays and X-rays are non-particulate electromagnetic radiations with a wave length of 10 cm. These are high-energy radiations and consist of photons, i.e., small pockets of energy. The physical properties and biological effects of X-rays and gamma rays are similar but they differ in the source of their origin, X-rays are produced by x-rays tubes, while gamma rays are produced by radioactive decay of certain element, e.g. radium, Co etc. [9]. Gamma rays found also to cause a modulation in protein patterns by inducing appearance and/or disappearance of some protein bands. This conclusion was attained by Rasheed et al. [10]. Yoko et al. [11] studied the effect of gamma irradiation on the genomic DNA of corn, soybeans, and wheat. They concluded that large DNA strands were broken into small strands at low irradiation dose but small and large DNA strands were broken at higher irradiation doses. The RAPD method was also used [10] to detect the genetic variation induced by gamma rays. Radiation by gamma rays leads to increasing the level of DNA break formation. These different types of DNA damages could be detected by changes in RAPD profiles [12]. The present study is also carried out to study the effect of gamma rays on morphological and biochemical parameters of okra.

2. Material and methods

2.1. Gamma irradiation

Gamma ray was conducted using gamma Cobalt-60 source in Nuclear Institute for Food and Agriculture (NIFA) Peshawar, Pakistan. The total doses for the treated seeds were 100, 200, 300, 400, and 500 Gy.

2.2. Field experiment

A field experiment was carried out in a botanical garden, Department of Botany, Islamia College Peshawar, during 2014–2015. Seeds were sown in pots, all pots were equally spaced with equal soil contents in each pot. The experimental design was completely random with each dose having 5 replicates. An equal number of seeds was sown in all pots. The pots were checked regularly for water requirements. The seeds of each dose along with a control for both varieties were sown on 7 May 2015.

2.3. Parameters

The following parameters were studied during this experiment.

Days to germination, Germination percentage, Initiation of flower, Initiation of fruit, Number of fruits per plant, Fruit maturation, Fruit length, Number of seeds per plant, Fresh weight of seeds,

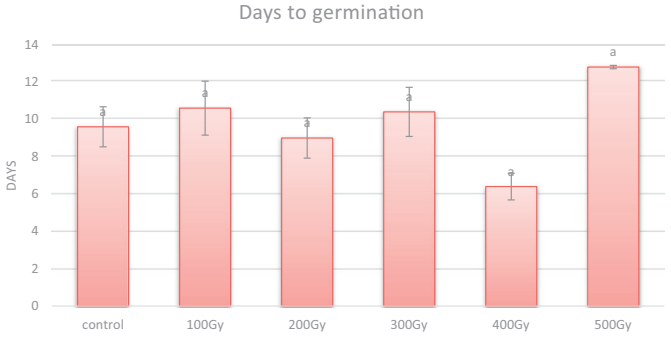

Fig. 1. Effect of gamma irradiation on days to germination. Each bar represent the values as Mean ± SD, ($n = 05$). Means followed by different letter are significantly different ($P < 0.05$). (ANOVA followed by Tukey LSD test).

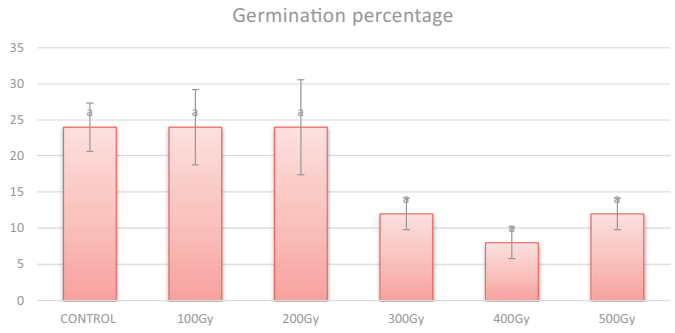

Fig. 2. Effect of gamma irradiation on germination percentage. Each bar represent the values as Mean ± SD, ($n = 05$). Means followed by different letter are significantly different ($P < 0.05$). (ANOVA followed by Tukey LSD test).

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