SHORT COMMUNICATION

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Effect of gamma irradiation on seed germination and survival of seedlings of pomegranate (*Punica granatum* L.)

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Pomegranate (*Punica granatum* L.) is the important crop of arid and semi-arid regions of India. Maharashtra is the leading state for area and production of pomegranate followed by Karnataka and Andhra Pradesh. At present, Maharashtra occupies about 92,000 ha area out of 1.3 lakh ha area available under pomegranate in India. In pomegranate, genetic base is very narrow. Therefore, creation of variability is utmost important need for crop improvement programme. Attempts have been made earlier to induce mutation in pomegranate by treating seeds with gamma rays (5-20 kR) and various forms were obtained with desirable traits. However, the dwarf mutation forms were most commonly observed in pomegranate (Akhund- zade-IM, 1979 and Levin, 1990). Gamma irradiation as a breeding tool to create variability in both horticulture and field crops was reported by several workers (Haskins and Chapman, 1956; Mikaelsen, 1968 and Pathak, 2003). Several released varieties of field and fruit crops have been enlisted which were developed through gamma irradiation (Anon., 1981). Considering the significance of gamma irradiation in crop improvement, the present study was under taken and response of gamma irradiation on seed germination and subsequent survival of seedlings of pomegranate was studied.

The present investigation was carried out at the National Research Centre on Pomegranate, Solapur, Maharashtra during 2006-07. The seeds of pomegranate cv. Ganesh was extracted and dried in shade during January 2007. The dried seeds were treated with gamma radiation at Bhabha Atomic Research Centre, Trombay, Mumbai. In all, 11 gamma radiation treatments viz., 0, 3, 6, 9, 12, 15, 18, 21, 24, 27, 30 kR with four replications were taken for the present study. In each replication, 50 seeds were sown in polythene bags containing sand, soil and FYM in 1:1:1 ratio during first week of May 2007. The experiment was laid out in randomized block design. Standard nursery practices were followed during the experimentation. The seed germination was recorded on 10, 14, 18, 22 and 26 days after sowing (DAS) and expressed in terms of per cent germination. Survival of germinated seedlings was counted on 70 DAS and expressed as per cent survival. The data were analyzed statistically and used for interpretation of the results.

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Seed germination

The seed germination was significantly influenced by gamma irradiation treatments at different germination stages (Table 1). In general, the germination started from 8 days after sowing (DAS) and continued till 26 DAS in different treatments. On 10 DAS, seed germination ranged from 4.0 to 29.5 per cent. The seed germination was higher at control, 3 kR and 6 kR and their values were at par to each other. Beyond 6 kR treatments, the seed germination was decreased and it was noted minimum (4.0 %) at 30 kR indicating that higher doses (> 6 kR) of gamma rays had negative effect on germination.

On 14 DAS, the germination ranged from 11.5 to 55.0 per cent. Control, 3kR and 6kR showed higher germination which ranged from 51.5 to 55.0 per cent, but these treatments were at par to each other. Beyond 6 kR, the germination per cent gone below 50.0 per cent and in general, the germination decreased gradually with increasing doses of gamma irradiation and thus, the minimum germination was recorded at 30 kR (11.5%). The same trend was noted at 18 DAS and 22 DAS also and their germination per cent ranged from 19.5 - 60.5 and 23.0 - 63.5, respectively.

On 26 DAS, almost all the germinable seeds have germinated and after that, no further germination was noted. The germination per cent ranged from 23.0 and 67.5 in different treatments. Although, the maximum seed germination (67.5 %) was recorded with 6kR but control, 3 kR and 6 kR treatments were at par. Beyond 6 kR treatments, the seed germination, in general, was in decreasing trend and recorded minimum (23.0 %) at 27 kR which was at par with 24 kR and 30 kR. Interestingly, 9 kR and 12 kR treatments were at par to each other and their values ranged from 41.5 and 47.0 per cent showing below 50.0 % seed germination. Now, it is clear from the data that LD 50 for cv. Ganesh would be 9 kR or 12 kR. However, irradiation treatment beyond 6 kR was found to be lethal as they showed inhibitory effect on seed germination. The decrease in germination percentage of seeds might be attributed to the possible chromosomal aberrations caused by the mutagens (Gordon and Weber, 1955). According to Evans (1965), the reduction in germination of irradiated seeds is a cumulative expression of at least three different types of effects occurring in the meristematic cells that is cytologically identifiable. Earlier reports indicate that seed treatments with 5-20 kR gamma rays in pomegranate induced mutation and produced different desirable forms including dwarf types (Akhund- zade-IM, 1979; Levin, 1990). Our study (not included) also indicated that in irradiated seedling population some dwarf forms are there and they will be reported separately.

Survival of seedlings

Regarding the survival of seedlings on 70 DAS, the survival ranged from 8.9 to 95.4 per cent and the treatments differed significantly (Table 1). The survival of seedlings did not differ significantly among control to 15 kR treatments and their values ranged from 92.1 - 95.4 per cent. Subsequently the survival percentage decreased after 15kR with increasing doses of gamma radiation and least values recorded at 27 kR and 30 kR (8.9 to 10.4 %). The lethal dose for survival of 50 per cent seedlings was found to be close to 24 kR. Beyond 24 kR, the gamma irradiation was found to have deleterious effect on the survival of seedlings. The reduction in survival per cent at higher doses of gamma radiation may be attributed to cell death and higher rate of ionization in the nuclei. The drastic decrease in survival percentage beyond 18 kR may be due to physiological imbalance and damages caused at the molecular level, which results in chromosomal aberrations causing considerable cytological changes. This is in line with the findings of Vishwanathan *et al.*, (1992) in their observation on the effect of gamma irradiation in *Kaempferia*. The reduction in survival of irradiated seedlings might be attributed to auxin destruction in the juvenile seedlings (Skoog, 1935) and failure of the assimilatory mechanisms in the later stage (Quastler and Baer, 1950).

From the study, it is concluded that LD 50 for cv. Ganesh found to be 9 kR or 12 kR. However, up to15 kR doses, there was no deleterious effect on survival of pomegranate seedlings. Among different irradiation doses tested, 27 kR and 30 kR were most deleterious and caused very poor survival of seedlings.

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Table 1. Effect of gamma irradiation on seed germination and seedling survival of pomegranate cv. Ganesh

Treatment	Germination (%)					Survival (%) at 70 DAS
	10 DAS	14 DAS	18 DAS	22 DAS	26 DAS	
Control	29.5	51.5	55.0	58.5	61.5	95.4
3 kR	29.5	55.0	60.0	63.5	64.5	93.3
6 kR	24.0	53.5	60.5	62.5	67.5	95.1
9 kR	16.0	31.0	41.5	46.0	47.0	92.1
12 kR	18.0	32.0	38.5	40.0	41.5	92.4
15 kR	12.0	21.3	26.0	29.0	33.0	93.5
18 kR	7.50	15.5	19.0	21.5	22.5	85.1
21 kR	8.0	19.5	29.5	33.5	35.0	70.3
24 kR	9.0	18.0	24.0	26.5	28.0	54.2
27 kR	6.0	16.0	19.5	25.0	23.0	8.9
30 kR	4.0	11.5	19.0	23.0	23.5	10.4
CD (0.05)	9.06	6.46	7.45	8.67	9.06	8.72