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RESEARCH ARTICLE

EFFECT OF GAMMA RAYS ON SEED GERMINATION IN BHINDI [*ABELMOSCHUS ESCULENTUS* (L.) MOENCH]

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ABSTRACT

Bhindi [*Abelmoschus esculentus* (L.) Moench], is the most important vegetable crop grown in tropical conditions. It is used to cure goiter, leucorrhoea, diabetes, constipation, catarrhal jaundice etc. With the objective of producing disease resistant variety gamma irradiation was done in bhindi. The effect of gamma radiation on seed germination, survival of seedlings and root growth were recorded in the present study.

INTRODUCTION

Bhindi [*Abelmoschus esculentus* (L.) Moench], belongs to Malvaceae is one of the most important vegetable crops grown in tropical conditions. It is a crop valued for its tender green fruits. It is extensively grown all over India due to its wide range of adaptability and ease of cultivation. India is the largest producer of bhindi and it is used to cure goiter, leucorrhoea, functional impotency, diabetes, constipation, catarrhal jaundice and burning in the eyes and all over the body. However, the widespread incidence of yellow vein mosaic disease in this crop has affected its successful cultivation. It is a virus disease transmitted by the white fly (*Bemisia tabaci*). In bhindi, previous authors (Norfadzrin *et al*., 2007; Manju and Gopimony, 2009; Phadvibulya *et al*., 2009; Hegazi and Hamideldin, 2010; Muralidharan and Rajendran, 2013) have also attempted mutation breeding by using various doses of gamma irradiations. With the objective of producing disease resistant variety gamma irradiation was done in *A. esculentus*. With the objective of producing disease resistant variety gamma irradiation was done in bhindi. The effect of gamma radiation on seed germination, root growth and survival of seedlings were studied.

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MATERIALS AND METHODS

In the previous study, out of the 25 accessions collected from different localities of Kerala a superior variety namely Anakomban was selected based on the comparative studies on yield attributing characters. This variety was used for irradiation for further improvement of characters in the present study. The seeds were irradiated at five different dose levels such as 100Gy, 200Gy, 300Gy, 400Gy and 500Gy. These doses were delivered from a 3500 curie CO^{60} gamma cell installed at Kerala Agriculture University, Vellanikkara. The gamma source was stationery and its irradiations were done at a dose rate of 3200 Rads/min by moving down a cylindrical gasket carrying the seeds. Twenty seeds were used for each treatment. Control with 20 seeds were also kept. After the treatment seeds were put in water overnight. In the next day these seeds were placed on blotting paper kept inside the petriplate. Seeds were then watered regularly. Data on germination, percentage of survival of seedlings and length of roots at regular intervals were taken. The data were recorded for germination and survival two days after sowing and 15 days after germination respectively.

RESULTS AND DISCUSSION

Seed germination

The data on germination of seeds sown after gamma irradiation are presented in Table 1. It is seen that percentage of germination varied from 45 per cent in 500Gy to 95 per cent in 400Gy exposure and the 400Gy exceeded to that of control

Table 1. Percentage of germination of seeds and survival of seedlings in *A.esculentus* after gamma irradiation

Dose of gamma irradiation	Control	100Gy	200Gy	300Gy	400Gy	500Gy
Percentage of germination	90.0	85.0	75.0	70.0	95.0	45.0
Percentage of survival of seedlings	94.7	82.3	60.0	56.2	89.4	33.3

Table 2. Length of roots developed from seeds in *A.esculentus* after gamma irradiation

Dose of gamma irradiation	Mean length of roots at various periods after sowing				
	2 days	4 days	6 days	8 days	10 days
Control	1.93 ± 0.08	3.31 ± 0.20	4.45 ± 0.32	5.32 ± 0.31	5.44 ± 0.41
100Gy	1.90 ± 0.10	3.24 ± 0.35	3.98 ± 0.64	4.68 ± 0.31	5.29 ± 0.32
200Gy	1.56 ± 0.09	3.08 ± 0.63	3.38 ± 0.42	3.65 ± 0.43	3.83 ± 0.44
300Gy	1.48 ± 0.02	2.90 ± 0.17	3.32 ± 0.44	3.39 ± 0.54	3.72 ± 0.23
400Gy	1.82 ± 0.09	3.78 ± 0.23	6.68 ± 0.23	7.32 ± 0.24	7.77 ± 0.26
500Gy	0.73 ± 0.28	1.56 ± 0.61	2.28 ± 1.00	3.22 ± 0.69	3.48 ± 0.81

FIG.1. EFFECT OF GAMMA IRRADIATION ON GERMINATION & SURVIVAL

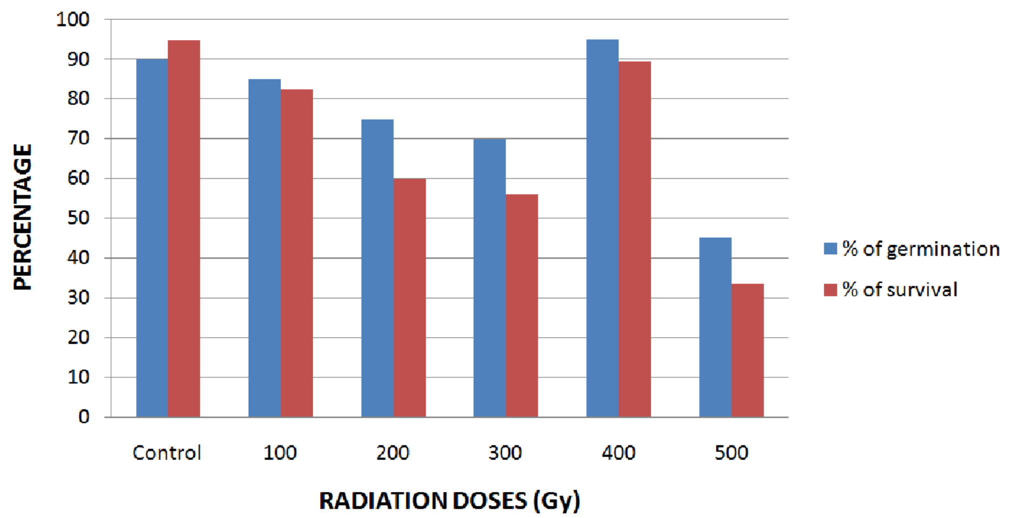
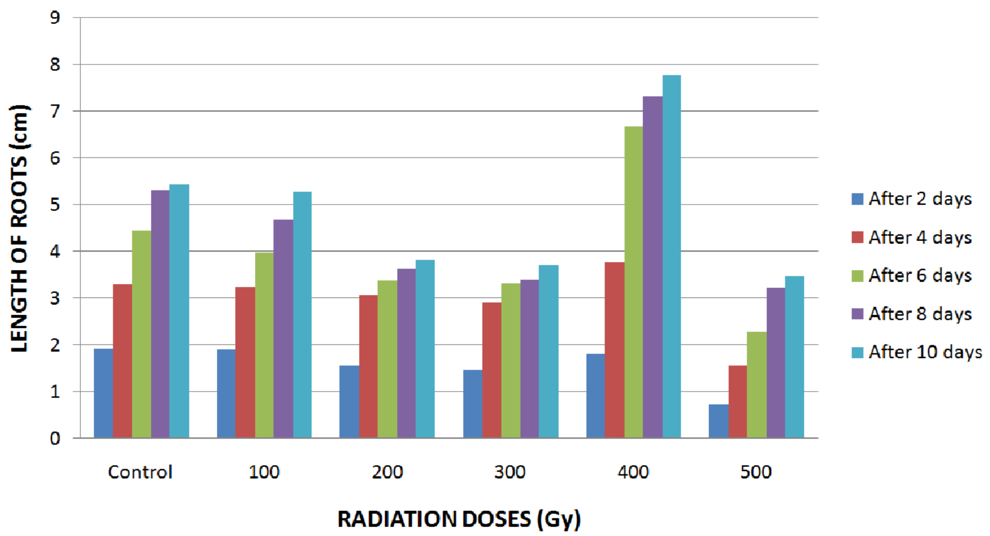


FIG.2. EFFECT OF GAMMA IRRADIATION ON ROOT LENGTH



with 90 per cent. The irradiated seeds showed a tendency to decrease in percentage of germination with increase in dose with the exception of the treatment with 400Gy (Fig.1). Effect of gamma radiation at the lower exposure of gamma ray (100 Gy) germination was almost similar to control but when higher doses (200, 300, 400 and 500Gy) were given, germination was delayed and the percentage of germination was reduced except in 400Gy. Lowest percentage of germination was found after 500Gy exposure and LD_{50} was set at 500Gy exposure. Hegazi and Hamideldin (2010) reported that among the three doses of gamma rays such as 300, 400 and 500Gy exposures, maximum percentage of seeds germinated in 400Gy exposure compared to the control. Gnanamurthy *et al.* (2013) have also observed higher percentage of germination at lower doses of gamma rays and lower percentage at higher doses in cow pea. The progressive decrease in percentage of germination with increase in gamma ray doses was also reported by Boranayaka *et al.* (2010) and Anbarasan *et al.* (2013) in Sesame.

Survival of seedlings

The data regarding survival of seedlings are presented in the Table 1. It is clear from the table that the percentage of survival of seedlings ranged from 33.3 per cent in 500Gy exposure to 94.7 per cent in control. The irradiated seedlings showed a tendency for decrease in percentage of survival with increase in dose with the exception of treatment with 400Gy exposure. The percentage of survival of 400Gy was maximum compared to other doses such as 100Gy (82.3%), 200Gy (60.0%), 300Gy (56.2%) and 500Gy (33.3%). (Fig.1). Norfadzrin *et al.* (2007) and Muralidharan and Rajendran (2013) have also reported that increase in dose of gamma rays decreased the percentage of germination and survival of seedlings in okra. It was reported that the percentage of survival was higher at lower doses and lower at higher doses in Sesame (Boranayaka *et al.*, 2010) and in Cow pea (Gnanamurthy *et al.*, 2013). According to Manju and Gopimony (2009) the influence of mutagen on plant growth regulators caused a delay in the initiation of germination. The reduction in the survival of plants is an index of post-germination mortality as a result of cytological and physiological disturbances due to the radiation effect.

Root length

The rate of growth of roots in the irradiated seeds is presented in Table 2. Length of root ranged from 7.77±0.26 cm in 400Gy to 3.48±0.81 cm in 500Gy. It is seen that the rate of root growth was delayed in all the treated seeds compared to that of control two days after sowing. But after fourth day onwards 400Gy exposures showed high rate of growth and exceeded to that of control. However, in other exposures such as 100, 200, 300 and 500Gy, there is a progressive reduction in the root length with increased dose of gamma ray irradiation (Fig.2). The seedlings of 400Gy exposure showed maximum root length with higher number of lateral branches/primary root and vigour. Cotyledonary leaves are also more in the seedlings of 400Gy exposure. Boranayaka *et al.* (2010) and Anbarasan *et al.* (2013) reported that root length, number of lateral branches/primary root and seedling vigour were decreased progressively by increasing doses of gamma radiations in Sesame. It is thus clear that among the various treatments seeds irradiated with 400Gy gamma irradiation is found to increase the percentage of seed germination, survival of seedlings and rate of root growth and roots with highest number of lateral roots.

Conclusion

Among the various doses of gamma radiations, 400Gy exposure is reported to increase percentage of seed germination, survival of seedlings and root growth and root with maximum number of lateral roots. LD_{50} was set at 500Gy exposure.

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