Environment and Ecology 42 (4) : 1491—1494, October—December 2024
Article DOI: https://doi.org/10.60151/envec/LZZB9580
ISSN 0970-0420

Effect of Gamma Irradiation and Ems on Germination and Survival of Okra (*Abelmoschus esculentus* L.) cv Arka Nikita

Sourab Kalyane, P. Umamaheswarappa, Ramesh A. N., V. Srinivasa, Kumar Naik A. N.

Received 14 May 2024, Accepted 19 August 2024, Published on 18 October 2024

ABSTRACT

The present investigation was devised to observe different doses of chemical and physical mutagen on the germination and survival percentage of okra variety Arka Nikita. Seeds of okra variety Arka Nikita were treated with different doses of gamma rays and EMS. The experiment was laid out in Randomized Complete Block Design (RCBD) with thirteen treatments and three replications. It was clearly observed that germination and survival percentage decreased with increase in doses of gamma rays and EMS. Results revealed that among different treatments, treatment T_1 (Control) recorded maximum germination (85) and survival per cent (98.82) and observed dose-dependent reduction in biological factors such as germination and survival, the LD_{50} values for gamma rays and EMS were 0.4% and 60 kR, respectively.

Keywords Gamma rays, EMS, Germination, Survival, LD_{50}.

INTRODUCTION

Okra (*Abelmoschus esculentus* (L.) Moench), familiar as bhendi or Lady's finger is the sixth important annual vegetable crop belongs to the family Malvaceae. It is widely grown all over the world 's warmer regions throughout the year. The immature edible green fruits of okra are rich in iodine and other unsaturated fatty acids such as oleic and linoleic acids. The total production and average productivity of okra has been declining over the years due to lack of genetic variability available for further selection. The low production potential of the commercial varieties and the incidences of novel and devastating viral diseases such as yellow vein mosaic had limited the yield of okra. To touch the emerging demand of the okra production, alternative and sustainable means of breeding strategies should be employed so as to increase the genetic potential of the crop.

Sourab Kalyane[1], Dr P. Umamaheswarappa[2]*, Dr Ramesh A. N.[3], Dr V. Srinivasa[4], Dr Kumar Naik A. N.[5]

[2]Professor, [3]Assistant Professor,
[4]Professor and Head, [5]Associate Professor
[1,2,4]Department of Vegetable Science, College of Horticulture, Mudigere, Keladi Shivappa Nayaka University of Agricultural and Horticultural Sciences, Iruvakki, Shivamogga 577432, Karnataka, India

[3]Department of Crop Improvement and Biotechnology, College of Horticulture, Hiriyur, Keladi Shivappa Nayaka University of Agricultural and Horticultural Sciences, Iruvakki, Shivamogga 577132, Karnataka, India

[5]Department of Agronomy, ZAHRS, Hiriyur, Iruvakki, Keladi Shivappa Nayaka University of Agricultural and Horticultural Sciences, Iruvakki, Shivamogga 577204, Karnataka, India

Email: pumamaheswarappa@uahs.edu.in
*Corresponding author

Induced mutagenesis is used in many crops for the improvement of economically valuable traits. A random change in the nucleotide sequence in the DNA can induce macro as well as micro mutations in the organisms. Various physical and chemical mutagens are popular for inducing such mutations in plant species. Among which the gamma radiations are known to induce large genetic variations in the crop plants (Chandrashekar *et al.* 2013). In okra, mutation breeding using gamma rays and EMS has been done by Baghery *et al.* (2016), Sood *et al.* (2016), Asare *et al.* (2017), Hazra *et al.* (2021) and Sasipriya and Gangaprasad (2021).

MATERIALS AND METHODS

The present investigation was carried out at College of Horticulture, Hiriyur using okra variety Arka Nikita. The seeds were treated with different doses of gamma rays (10 kR, 20 kR, 30 kR, 40 kR, 50 kR and 60 kR) from IIHR, Bangalore and EMS (0.1%, 0.2%, 0.3%, 0.4%, 0.5% and 0.6%). About 100 seeds for each treatment and a set of control of Arka Nikita were utilized for giving each treatment. The experiment was laid out in Randomized Complete Block Design, with thirteen treatments and three replications. The seeds were sown with a spacing of 45 cm × 60 cm. Observation on germination and survival percentage were recorded. LD_{50} was estimated using Probit curve analysis.

RESULTS AND DISCUSSION

The data regarding germination percent and survival percent is recorded and presented in Table 1. Significant differences were recorded for both germination per cent and survival per cent among various treatments.

Germination percent

The maximum germination per cent (85) was recorded in T_1 (Control) whereas, the minimum germination per cent (60) was recorded in T_{13} – 0.6% EMS (Table 1).

It was clearly observed that germination percentage decreased with increase in doses of gamma rays and EMS. The reduction in germination percentage at higher doses might have an impact on the ability of seeds to germinate due to injury to seed embryos, disturbances caused at the physico-chemical level of cells, chromosomal damage or their combined effect (Bashir *et al.* 2013). This finding was in close conformity with the earlier findings of Elangovan and Pavadai (2015), Baghery *et al.* (2016), Laskar *et*

Table 1. Effect of gamma rays and EMS on germination, survival and mortality per cent in M_1 generation.

Treatment	Germination (%)	Survival (%)
T_1 - Untreated (control)	85.00	98.82
T_2 - 10 kR	83.30	89.16
T_3 - 20 kR	81.80	84.15
T_4 - 30 kR	78.20	78.20
T_5 - 40 kR	75.00	68.00
T_6 - 50 kR	72.70	60.27
T_7 - 60 kR	68.75	50.72
T_8 - 0.1% EMS	83.89	88.09
T_9 - 0.2% EMS	81.73	85.36
T_{10} - 0.3% EMS	80.40	71.25
T_{11} - 0.4% EMS	75.89	50.00
T_{12} -0.5% EMS	68.75	27.54
T_{13} - 0.6% EMS	60.00	6.67
SEm±	3.30	2.99
CD @ 5 %	9.64	8.73

Table 2. Calculating LD_{50}/LC_{50} using probit analysis for gamma treatment.

Dose/Conc	Total	Dead	Log_{10} dose	Empirical probits
0.00	100	0		
10.00	100	16.7	1.00	4.03
20.00	100	18.2	1.30	4.09
30.00	100	21.8	1.48	4.22
40.00	100	25	1.60	4.33
50.00	100	27.3	1.70	4.40
60.00	100	31.25	1.78	4.51

Table 3. Calculating LD_{50}/LC_{50} using probit analysis for EMS treatment.

Dose/Conc	Total	Dead	Log_{10} dose	Empirical probits
0.00	100	0		
0.1 %	100	18.27	1.00	4.09
0.2 %	100	19.6	1.30	4.14
0.3 %	100	24.11	1.48	4.30
0.4 %	100	31.25	1.60	4.51
0.5 %	100	40	1.70	4.75
0.6 %	100	10	1.78	3.72

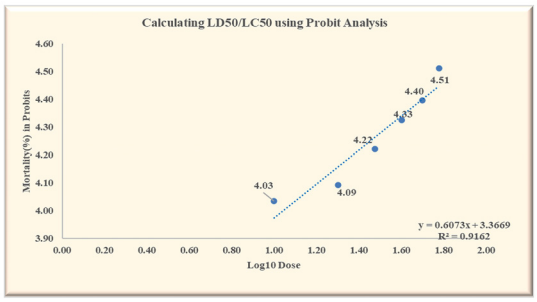

Fig. 1. Calculating LD_{50}/LC_{50} using probit analysis for gamma treatment.

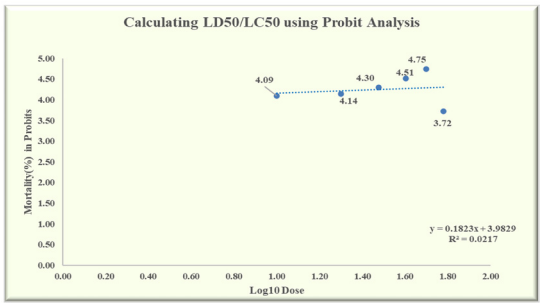

Fig 2. Calculating LD_{50}/LC_{50} using probit analysis for EMS treatment.

al. (2018) in tomato, Hasan *et al.* (2020) in chilli and Sasipriya and Gangaprasad (2021) in okra,.

Survival percent

The maximum survival per cent (98.82) were recorded in T_1 (Control). Whereas, the minimum survival per cent (6.67) were recorded in T_{13} - 0.6% EMS (Table 1).

It was clearly observed that survival percentage decreased with increase in doses of gamma rays and EMS. The decrease in survival after mutagen exposure could be due to inactivation or a decrease in auxin content, which might affect cell division and resulted in poor establishment. This finding was in close conformity with the earlier findings of Elangovan and Pavadai (2015), Baghery *et al.* (2016), Laskar *et al.* (2018) in tomato, Hasan *et al.* (2020) in chilli and Sasipriya and Gangaprasad (2021) in okra.

Probit curve analysis

Gamma irradiation

The standardized dose for gamma rays in the current investigation was 60 kR with a log 10 dose value of 1.78 and Empirical probit value of 4.51 (Table 2). As increase in 1 unit of log 10 dose as a result 0.6073% increase in the Empirical probit value. Irrespective of the log 10 dosage the average numerical probit value is 3.3669 (Fig. 1) 91.62% of variation in numerical probit value is explained by log 10 dose and rest of the variation is due to other variable which are not involved in the studies.

EMS treatment

The standardized dose for EMS in the current investigation was 0.4% EMS with a log10 dose value of 1.60 and Empirical probit value of 4.51(Table 3). As increase in 1 unit of log 10 dose as a result 0.1823% increase in the Empirical probit value. Irrespective of the log 10 dosage the average numerical probit value is 3.9829, 2.17% (Fig. 2) of variation in numerical probit value is explained by log 10 dose and rest of the variation is due to other variable which are not involved in the studies.

Such reduction in seed germination and survival could be ascribed to gamma ray's doses and EMS concentrations, which disrupt genetic and cytological processes, leading to early seedling elimination. The results were supported by the works done by Gupta *et al.* (2016), Hazra *et al.* (2021), Sasipriya and Gangaprasad (2021).

CONCLUSION

The significant differences were recorded for the germination and survival per cent (Table 1) among various treatments. The maximum germination per cent (85) and survival per cent (98.82) was recorded in T_1 (Control) whereas, the minimum germination (60) and survival per cent (6.67) was recorded in T_{13} – 0.6 % EMS. The LD_{50} values for gamma rays and EMS were 0.4% and 60 kR, (Tables 2–3) respectively.

ACKNOWLEDGMENT

The author is highly thankful to the Guide, Depart-

ment of Vegetable Science, College of Horticulture, Mudigere and Head, Department of Vegetable Science, College of Horticulture, Mudigere, Members, College of Horticulture, Hiriyur and KSNUAHS, Shivamogga (Karnataka) for providing essential facilities and support during the research experiment.

REFERENCES

Asare AT, Mensah F, Acheampong S, Bediako E, Armah J (2017) Effects of gamma irradiation on agromorphological characteristics of okra (*Abelmoschus esculentus* L. Moench.). *Advances in Agriculture* 1: 2385106.

Baghery MA, Kazemitabar SK, Kenari RE (2016) Effect of EMS on germination and survival of okra (*Abelmoschus esculentus* L.). *Biharean Biologist* 10 (1) : 33—36.

Bashir S, Wani AA, Nawchoo IA (2013) Studies on mutagenic effectiveness and efficiency in Fenugreek (*Trigonella foenumgraecum* L.). *African Journal of Biotechnology* 12 (18) : 2437—2440.

Chandrashekar K, Somashekarappa H, Souframanien J (2013) Effect of gamma irradiation on germination, growth, and biochemical parameters of *Terminalia arjuna* Roxb. *Radiation Protection and Environment* 36 (1) : 38—44.

Elangovan R, Pavadai P (2015) Effect of gamma rays on germination, morphological and yield characters of bhendi (*Abelmoschus esculentus* (L.) Moench). *Horticultural Biotechnology Research* 1 : 35—38.

Gupta N, Sood S, Singh Y, Sood D (2016) Determination of lethal dose for gamma rays and ethyl methane sulphonate induced mutagenesis in okra (*Abelmoschus esculentus* (L.) Moench.). *SABRAO Journal of Breeding & Genetics* 48 (4) : 344—351.

Hasan N, Choudhary S, Laskar RA (2020) Studies on qualitative and quantitative characters of mutagenized chili populations induced through MMS and EMS. *Vegetos* 33 (4) : 793—799.

Hazra S, Gorai S, Umesh KV, Bhattacharya S, Maji A, Jambhulkar S, Ali N, Chattopadhyay A (2021) Optimization of gamma radiation dose for induction of mutations in okra. *International Journal of Vegetable Science* 27 (6) : 574—584.

Laskar RA, Chaudhary C, Khan S, Chandra A (2018) Induction of mutagenized tomato bibliography vii populations for investigation on agronomic traits and mutant phenotyping. *Journal of the Saudi Society of Agricultural Sciences* 17 (1) : 51—60.

Sasipriya S, Gangaprasad (2021) Gamma radiation induced effects for germination and seedling vigor parameters in two varieties of okra (*Abelmoschus esculentus* L. Moench.). *Research Gate* 11 : 2045—2050.

Sood S, Jambulkar SJ, Sood A, Gupta N, Kumar R, Singh Y (2016) Median lethal dose estimation of gamma rays and ethyl methane sulphonate in bell pepper (*Capsicum annuum* L.). *SABRAO Journal of Breeding & Genetics* 48 (4) : 528—535.