ISSN NO. 2320-5407

Journal homepage: http://www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH

RESEARCH ARTICLE

Effect of Gamma rays on Quantitative Traits of Sesame (Sesamum indicum (L.) in M_1 generation

V. Ravichandran[1] and S. Jayakumar[2]

1.Department of Botany, Bharathidasan University, Tiruchirappalli, Tamilnadu, India.
2.Department of Botany, Government Arts College, Ariyalur-601713, Tamil Nadu, India.

Manuscript Info

Manuscript History:

Received: 10 June 2014
Final Accepted: 19 July 2014
Published Online: August 2014

Key words:
Gamma rays, Sesame, M_1 generation, quantitative traits and Mutation

***Corresponding Author**

V. Ravichandran

Abstract

Mutation breeding is relatively a quicker method for improvement of crop plants. It has been observed that induced mutations can increase yield as well as other quantitative traits in plants. The dormant seeds of sesame (Sesamum indicum (L.), genotype VRI-1 (Virudhachalam-1) were treated with various doses of gamma rays like 10, 20, 30, 40, 50, 60, 70, 80, 90 and 100KR and the LD_{50} values observed at 40KR of Gamma rays. Based on their LD_{50} values appreciable concentrations only selected for further study and their effects on various morphological characters such as plant height, number of branches per plant, number of leaves per plant, days to first flowering, number of capsules per plant, number of seeds per capsule and seed yield per plant (g) were measured quantitatively and the results showed that all the characters were consequently or significantly reduced when compared to control. The results were obtained in the present study clearly indicate that different doses of gamma rays can be effectively utilized to create variability for various quantitative traits of the crop.

Introduction

Sesame (Sesamum indicum (L.), otherwise known as Sesamum or benniseed, member of the family Pedaliaceae, is one of the most ancient oilseeds crop known to mankind. Sesame plays an important role in human nutrition. Most of the sesame seeds are used for oil extraction and the rest are used for edible purposes (El Khier et al., 2008). Sesame is grown primarily for its oil-rich seeds. Before seeds were appreciated for their ability to add nutty flavour or garnish foods, they were primarily used for oil and wine (Gandhii, 2009). The seed is rich in protein and the protein has disable amino acid profile with good nutritional value similar to soybean (Naerls, 2010). The chemical composition of sesame shows that the seed is an important source of oil (44-58%), protein (18-25%), carbohydrate (~13.5%) and ash (~5%) (Borchani et al., 2010). Sesame seeds are not only used for culinary purposes but also in traditional medicines for their nutritive, preventive and curative properties. Its oil seeds are sources for some phyto-nutrients such as omega-6 fatty acids, flavonoid phenolic anti-oxidants, vitamins and dietary fiber with potent anti-cancer as well as health promoting propertiesn. Sesame oil is an edible vegetable oil derived from sesame seeds used in various countries. It is used as cooking oil in South India and Asia and often as a flavor enhancer in Chinese, Japanese, Korean, and to a lesser extent Southern Asia cuisine

Mutation means a sudden heritable change in the genetic material at the gene or chromosome level (Chahal and Gosal, 2002). They may be caused by error during cell division or by exposure to the DNA-damaging agents or mutagens in the environment. A wide range of characters which have been improved through induced mutation breeding include plant architecture, yield, flowering and maturity duration, quality and tolerance to biotic and abiotic stresses. About 89 % of mutant varieties have been developed using physical mutagens such as X-rays, gamma rays, thermal and fast neutrons where as with gamma rays alone accounting for the development of 60 % of the mutant varieties (Kharkwal, 2000). Gamma irradiation has been widely applied in medicine and biology in terms of biological effects induced by a counter intuitive switch-over from low doses stimulation to high-doses inhibition (Charbaji and Nabulsi, 1999). Gamma irradiation has provided number of useful mutants and still shows an elevated potential for improving vegetative plants (Predieri, 2001). The present investigation was undertaken study the effect of gamma rays on quantitative characters of sesame in M_1 generation and results are discussed.

Materials and methods

The dry and dormant seeds of the sesame (Sesamum indicum L.) variety VRI-1 were treated with gamma rays treatments were used in the present study. 1000 well filled healthy seeds were packed in moist germination paper and selected for each treatment in the gamma chamber at 10, 20, 30, 40, 50, 60, 70, 80, 90 and 100KR doses of gamma rays in ^{60}CO gamma source. The gamma irradiation was carried out at sugarcane breeding institute (ICAR), Coimbatore, India. The untreated seeds were presoaked in distilled water for six hours and used as control. The treated and untreated seeds were spread over moist germinating paper in petri plates with three replications for each treatment and observed the germination capacity of treated seeds under laboratory conditions. Based on the germination percentage, the LD_{50} value (50 % reduction of germination and seedling size) was observed in 40KR of gamma rays. Based on the LD_{50} value of mutagens, only appreciable doses (Gamma rays 20, 30, 40, 50 and 60KR) were selected for field studies and they were sown in separate rows with three replications in a randomized block design to raise the M_1 generation. All the necessary plant production methods like irrigation and weeding were carried out during the period of crop growth and also measured the morphological and yield parameters viz., plant height per plant, number of branches per plant, number of leaves per plant, days to first flowering, number of capsules per plant, number of seeds per capsule and seed yield per plant were also studied.

Results and Discussion

The germination percentage recorded on 7th DAS. In the present investigation, the germination percentages were gradually decreased with increasing dose or concentrations of gamma rays when compared to control (Table -1). The maximum reduction was observed at higher concentrations of the mutagens (100KR) and the LD_{50} value (50 % reduction of seed germination and seedling size) was observed in 40KR gamma rays and the same results were also been reported in sesame by (Rangaswamy, 1973);(Ganesan, 1995); (Anitha vasline and Saravanan, 2011); (Prabhakaran, 1992); (Radhakrishnan et al., 2001); (Shivaji gohini et al., 2001); (Sheebha et al., 2004) and (Mensah et al., 2007) were also calculated.

Table 1. Determination of LD_{50} Value for gamma rays in Sesame (*Sesamum indicum* L.). Variety Virudhachalam-1.

S. No	Treatment (KR)	Germination (%)	Percent of decrease / Increase over control
1	Control (0)	97.81 2.93	00.00
2	10	88.162.64	-9.86
3	20	72.252.16	-26.13
4	30	68.482.05	-29.98
5	**40**	**52.161.56**	**-46.67**
6	50	41.861.25	-57.20
7	60	38.231.14	-60.91
8	70	26.520.79	-72.88
9	80	14.260.42	-85.42
10	90	8.930.26	-90.87
11	100	2.160.06	-97.79

In the present investigation, at higher dosage of mutagens, the seed germination got delayed and the seedlings were shorter which subsequently died in a short period. This might be due to the effect of mutagens by which, affected seedlings after the cotyledonary emergence remained alive only for a particular period of time. The mutagenic sensitivity of a biological material can be attributed to the level of differentiation and development of embryo at the time of treatment and also to the extent of damage to the growth processes like rate of cell division, cell elongation, various stages of hormone and biosynthetic pathways observed by Scholz and Lehman (1962).

In M_1 generation, all the quantitative characters showed the decreasing trend with increasing concentrations of mutagens, but in case of flowering date was increased (Delayed flowering) in all the treated progenies when compared to control (Table- 2). The gamma rays delayed the days to first flower irrespective of treatment level. The days to first flowering was delayed by gamma rays at higher dose of 60KR. The minimum day's take-in first flowering was observed in control (39.00 days) and maximum day's take-in first flowering observed in 60KR of gamma rays (47.00 days). Similar results were also reported in sesame by Ganesan (1998); Rahman and Das (1998).

In the present study, all the morphological parameters like plant height per plant, number of branches per plant, number of leaves per plant was showed decreasing trend at higher concentrations level when compared to control. The maximum plant height was observed at 20KR of gamma rays (67.18). The minimum plant height was recorded at 60 KR of gamma rays (45.39). The maximum number of branches was observed at 20KR of gamma rays (7.92) while minimum number of branches was observed at 60KR of gamma rays (4.78) and compared with control. Prabhakar (1985) observed that the reduction in number of branches per plant in sesame for M_1 generation. The number of branches per plant showed a negative shift in mean value of mutagenic treatments. Similar results were recorded in black gram (Deepalakshmi and Anandakumar, 2004) and in cowpea (Rizwana Banu et al., 2005; Girija and Dhanavel, 2013). A broad-spectrum reduction in number of leaves per plant was observed in all the mutagenic treatments than in the control. The maximum number of leaves was observed at 20KR of gamma rays (92.54) while minimum number of leaves was observed at 60KR of gamma rays (54.76) in gamma rays treatments.

In the M_1 generation, all the treated progenies revealed that yield and yield component characters were progressively decreased with different increasing concentrations of gamma rays when compared to control plants and their similar results also been proposed earlier by Rangaswamy, (1973) in sesame; soybean in Pavadai and Dhanavel, (2004); Cowpea in Girija and Dhanavel, (2013). Maximum yield was obtained from control plants, minimum number of capsules (55.67), number of seed per capsules (22.69) and seeds yield per plants (3.45) were observed at 60KR gamma rays (Table -2).

Table 2. Effect of gamma rays on quantitative characters in M_1 generation of sesame (*Sesamum indicum* L.). Variety Virudhachalam-1.

S. No	**Treatment (KR)**	**Plant height / plant (cm) (Mean ± SE)**	**No. of branches / plant (Mean ± SE)**	**No. of leaves / plant (Mean ± SE)**	**Days to first flowering (Mean ± SE)**	**No. of capsules / plant (Mean ± SE)**	**No. of seeds / capsule (Mean ± SE)**	**Seed yield / plant (g) (Mean ± SE)**
1	Control	74.232.22	7.920.23	104.363.13	39.001.17	75.232.25	38.061.14	6.280.18
2	20KR	67.182.01	6.820.20	92.542.77	41.001.23	71.422.14	34.261.02	5.260.15
3	30KR	62.351.87	6.160.18	81.252.43	42.001.26	69.882.09	31.820.95	4.840.14
4	**40KR**	**58.761.76**	**5.880.17**	**76.512.29**	**44.001.32**	**62.181.86**	**29.260.87**	**4.220.12**
5	50KR	52.181.56	5.250.15	68.212.04	45.001.35	59.351.78	24.550.73	3.960.11
6	60KR	45.391.36	4.780.14	54.761.64	47.001.41	55.671.67	22.690.68	3.450.10

The marked reduction caused by mutagens in seed yield per plant can be attributed to high seed sterility as caused by physiological and biochemical disturbances in the development of seeds (Rangaswamy, 1973 and Prabakaran, 1992). The reduced morphological variations may be due to physiological and some other disturbances at genetic level like chromosomal damage disturbed chromosomal coiling, failure or restricted pairing etc. Similar results were reported in linseed (Rai and Das, 1978), green gram (Koteswara Rao et al., 1983), cowpea (Odeigah et al., 1998) and Niger (Naik and Murthy, 2009).

Conclusion

The present investigation revealed that the all quantitative traits were proportionately decreased with increased in dose of gamma rays in sesame. This is due to physiological disturbance or chromosomal damage caused to the cells of plants.

REFERENCES

1. Anitha Vasline, Y., Saravanan, 2011. Studies on induced mutagenesis in (Sesamum indicum L.) Ph.D. (Ag.), Thesis, Annamalai University, Annamalainagar.
2. Borchani C, Bebess S, Blecker Ch, Attia H. 2010. Chemical Characteristics and Oxidative Stability of Sesame Seed, Sesame Paste, and Olive Oils. Journal of Agriculture Sciences and Technology, 12: 585-596.
3. Chahal, G.S. and S.S. Gosal, 2002. Principles and Procedures of Plant Breeding. pp. 399-412. Oxford: Alpha Science International Ltd.
4. Charbaji, T. and I. Nabulsi, 1999. Effect of low doses of gamma irradiation on in vitro growth of grapevine. Plant Cell Tissue Organ Culture, 57(2): 129-132.
5. Deepalakshmi, A.J. and C.R. Anandakumar, 2004. Creation of genetic variability for different polygenic traits in black gram (Vigna mungo (L.) Hepper) through induced mutagenesis. Legume Res, 27(8): 188-192.
6. El Khier, M. K. S., Ishag K.E.A., & Yagoub A. E.A. 2008. Chemical Composition and Oil Characteristics of Sesame Seed Cultivars Grown in Sudan. Research Journal of Agriculture and Biological Sciences, 4(6): 761-766.
7. Gandhi A.P. 2009. Simplified process for the production of sesame seed (Sesamum indicum L.) butter and its nutritional profile. Asian J. Food & Agro-Industry. 2(1), 24-27
8. Ganesan J. 1995. Induction mutations for sesame improvement. IAEA Res. Rept. 1. pp. 38.
9. Ganesan J. 1998. Induced mutations for sesame improvement. Proc. Third FAO/IAEA Res. Co-ord. Meet. On induced mutations for sesame improvement. 6-10 April, Bangkok, Thailand.
10. Girija M, Dhanavel D. 2013. Effect of Gamma rays on quantitative traits of Cowpea in M_1generation. Inter. J. Res. Biol. Sci, 3(2): 84-87.
11. Kharkwal, M.C., 2000. Induced mutations in chickpea (Cicer arietinum L.) IV. Types of macromutations induced. Indian J. Genet., 60: 305- 320.
12. Koteswara Rao, Y., N. Seetharama Reddi and D. Subramanyyam, 1983. Effect of induced mutagenesis on polygenic variability in green gram. The Andhra Agric. J., 30(3): 200-202.
13. Mensah, J.K, B.O., Obadoni, P.A., Akomeah, B. Ikhajiagbe and Ajibolu, Janet, 2007. The effects of sodium azide and colchicine treatments on morphological and yield traits of sesame seed (Sesamum indicum L.). African J. of Biotech. 6(5): 534 -538.
14. Naerls, 2010. Beniseed production and utilisation in Nigeria. Extension Bulletin No 154, Horticulture Series No 5. Available at www.naerls.gov.ng /extmat/ bulletins/ Beniseed.pdf.
15. Naik, P. M. and H. N. Murthy, 2009. The effects of gamma and ethyl methane sulphonate treatments on agronomical traits of niger (Guizotia abyssinica Cass.). African J. of Biotech., 8(18): 4459 – 4464.
16. Odeigah, P.G.C., A.O. Osanyinpeju and G.O. Myers, 1998. Induced mutations in cowpea (Vigna unguiculata (L.) Walp.). Rev. Biol. Trop., 46(3): 579-586.
17. Pavadai, P. and D. Dhanavel, 2004. Effect of EMS, DES and colchicine treatment in soybean. Crop Research, 28 (1-3): 118-120.
18. Prabakaran, A. J. 1992. Identification of male sterile sources through wide hybridization and induced mutagenesis in sesame (Sesamum indicum L.). Ph. D. Thesis, TNAU, Coimbatore.
19. Prabhakar, L.V. 1985. Studies on induced mutagenesis in (Sesamum indicum L.) M.Sc. (Ag.) Thesis, Tamil Nadu Agricultural University, Coimbatore, India.
20. Predieri, S. 2001. Mutation induction and tissue culture in improving fruits. J. of Plant cell Tiss. Org.Cult, 64:185-219.
21. Radhakrishnan, V., S. Prabhu, Sivaji, Gogineni, R. Suresh, Y. Anbuselvam and J. Ganesan. 2001. Effect of DES as mutagen on germination and seedling behaviour in sesame (Sesamum indicum L.). National seminar on sesame crop improvement and future prospects, 28th February and 1st March, Dept. Agrl. Botany, Annamalai University: pp. 19.
22. Rahman A., M. L. Das, 1998. Evolution of improved varieties of sesame through induced mutations. Proc. Third FAO/IAEA Res, Co-ord. Meet. On induced mutations for sesame improvement. 6-10 April, Bangkok, Thailand.
23. Rai, M. and K. Das, 1978. Sterility and yield reduction after gamma irradiation in linseed. Indian J.Genet. 38: 289-292.

24. Rangaswmay, M. 1973. Induced mutagenesis in gingelly (Sesamum indicum L.) with gamma rays and ethyl methane sulphonate. M.Sc. (Ag.) Thesis, TNAU, Coimbatore.
25. Rizwana Banu, M., A. Kalamani, S. Ashok and N. Makesh, 2005. Effect of mutagenic treatments on quantitative characters in M1 generation of cowpea (Vigna unguiculata (L.) Walp). Ad. Plant Sci., 18(11): 505-510.
26. Scholz, F. and C.O. Lehman 1962. Die Gatensle bener Mutantender saat gerstle in Bezihnug Zur Formrumarnning feltigkeit der Art. Hordeum vulgare. L.S. IV. Kulturpf lanse, 10:312-314.
27. Sesame oil.
28. Sesame seeds nutrition facts. Sheeba, A., S. M. Ibrahim., P. Yogameenakshi and S. Babu. 2004. Mutagen induced polygenic variability in sesame (Sesamum indicum L.). Madras Agric. J., 91(4-6): 195-197.
29. Shivaji Gohini, S. Prabu, V. Radhakrishnan, R. Suresh, Y. Anbuselvam and J. Ganesan. 2001. Effect of mutagen on germination and seedling behaviour in sesame (Sesamum indicum L.), National seminar on sesame crop improvement and future prospects, 28th February and 1st March, Dept. of Agrl. Botany, Annamalai University, pp. 19.