The Pharma Innovation Journal 2022; 11(7): 3666-3668

www.ThePharmaJournal.com

The Pharma Innovation

Effect of gamma irradiation on quantitative traits of two genotypes of sesame crop in M_1 generation

Pallavi R Sasane, Dr. ER Vaidya, Dr. DT Deshmukh, Dr. SS Gomashe, Dr. SK Burghate, RD Walke and YC Raut

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(7): 3666-3668

www.thepharmajournal.com
Received: 02-04-2022
Accepted: 06-06-2022

Pallavi R Sasane
Ph.D., Student, Department of Genetics and Plant Breeding, Dr. Panjabrao Deshmukh Krishi Vidyapeeth Akola, Maharashtra, India

Dr. ER Vaidya
Senior Research Scientist, Pulses Research Unit, Dr. Panjabrao Deshmukh Krishi Vidyapeeth Akola, Maharashtra, India

Dr. DT Deshmukh
Associate Professor, Department of Agricultural Botany, Panjabrao Deshmukh Krishi Vidyapeeth Akola, Maharashtra, India

Dr. SS Gomashe
Principal Scientist, NBPGR, Akola, Maharashtra, India

Dr. SK Burghate
Assistant Professor, Department of Agricultural Botany, Panjabrao Deshmukh Krishi Vidyapeeth Akola, Maharashtra, India

RD Walke
Associate Professor, Department of Economics and Statistics, Dr. Panjabrao Deshmukh Krishi Vidyapeeth Akola, Maharashtra, India

YC Raut
M.Sc., Department of Agriculture Genetics and Plant Breeding, Dr. Panjabrao Deshmukh Krishi Vidyapeeth Akola, Maharashtra, India

Corresponding Author:
Pallavi R Sasane
Ph.D., Student, Department of Genetics and Plant Breeding, Dr. Panjabrao Deshmukh Krishi Vidyapeeth Akola, Maharashtra, India

Abstract
The mutagenic effects of different doses of gamma rays (400, 500, 600 and 700 Gy) on sesame (*Sesamum indicum* L.) genotypes i.e. AKT-64 and N-8 in M_1 generation with aims to evaluate the effects of gamma rays on days to 50% flowering, days to maturity, plant height, number of branches per plant, number of capsules per plant, 1000 seed weight and seed yield per plant. In M_1 generation the results revealed that there was more reduction at higher doses compared to lower doses for all the characters. Mutation breeding offers the possibility of recovering some of the lost but useful variability in sesame, especially improved yield.

Keywords: Sesame, Gamma rays, quantitative characters, M_1 generation

Introduction
Sesame (*Sesamum indicum* L.) which is commonly known as gingelly is a diploid (2n=26) dicotyledonous and one of the ancient oilseed crops used by human beings. It belongs to the family Pedaliaceae, which comes under the order Tubiflorae. Out of the 37 species known, *Sesamum indicum* L. is the dominant cultivated species. Besides *S. indicum,* some wild species such as *S. angustiflolium* and *S. radiatum*are also cultivated in some African countries as leafy vegetables (Ashri,1998) [1].
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%) (Elleuch *et al*. 2007). 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 of some phytonutrients such as omega-6 fatty acids, flavonoids, phenolics, antioxidants, vitamins and dietary fiber with potent anti-cancer as well as health promoting properties.
Mutation breeding has long been known as a potential technique to unlock additional genetic variability for supplementing conventional crop breeding methodology. Mutagenesis offers a unique scope for creating variation, as it may alter even those genes that are common to all the varieties of a species. Gustafsson (1947) [6] advocated that the mutation approach was superior to other methods of crop improvement to create genetic variability. Induced mutation has been extensively and successfully used for the improvement of many crops including oilseed crops like sesame. Gamma rays are ionizing physical mutagens capable of inducing mutations in plants and animals. They have a shorter wavelength and therefore possess more energy per photon than X-rays. These rays penetrate up to many cm which is generally produced in a wide range of energies like X-rays.
The number of workers attracted towards induced mutation study in different crops. The variation of induced mutation is not merely due to the recombination as in hybridization but they are original and newly created, induced mutation is used in different ways in plant breeding (Gual 1964). The present investigation was undertaken to study the effect of gamma rays on quantitative sesame characters in M_1 generation and the results are discussed.

Materials and Methods
The study was carried out at the Instructional Farm of Department of Agricultural Botany, Dr. PDKV, Akola Maharashtra. Two genotypes of sesame *viz.*, AKT-64 and N-8 were treated with gamma rays treatments used in the present study. Dry, uniform, seeds of AKT-64 and N-8, were irradiated with 400Gy, 500Gy, 600Gy and 700Gy gamma rays using Cobalt-60 (^{60}Co) as gamma source at BARC (Bhabha Atomic Research Center) Trombay, Mumbai.

The irradiated seeds were sown in the field along with control (non-treated) seeds in a Randomized Block Design with five replications by adopting a spacing of 30 cm between rows and 10 cm between plants. All the recommended cultural practices and plant protection measures were followed uniformly for all the treatments. This study aims to evaluate the effects of gamma rays on days to 50% flowering, days to maturity, plant height, number of branches per plant, number of capsules per plant, 1000 seed weight and seed yield per plant based on mean performance.

Result and Discussion

The effects of gamma rays on quantitative characters were studied in all the doses (400, 500, 600, and 700 Gy) like days to 50% flowering, days to maturity, plant height, number of branches per plant, number of capsules per plant, capsule length, seeds per capsule, 1000 seed weight, seed yield per plant. All the mutagenic doses showed a gradual reduction of mean performance than the control with increasing doses (Tables - 1 and 2).

In M_1 generation quantitative characters were decreased but the flowering date was increased in treated plants when compared to both controls. But 500Gy dose (46.80days) showed earlier flowering than control (47.60days) in AKT-64 and 400Gy (58.40days) dose in N-8 (59.00days). For days to maturity, genotype AKT-64 showed a delay in maturity days was recorded in all doses of gamma rays except 500Gy dose. Similar to N-8 all doses showed a delayed maturity as compared to control. Similar result was reported by Saha and Paul (2017) [14], the gamma rays delayed the days to 50% flowering irrespective of treatment level reported in cowpea by Grija *et al*., (2013) and in black gram by Yasmin *et al*., (2016) [15].

In both the genotypes, all the doses caused a reduction in the plant height compared with both the controls. The minimum reduction in plant height was observed at 400Gy dose (114.57cm and 106.41cm in AKT-64 and N-8 respectively) of gamma rays. The maximum reduction in plant height was recorded at 700Gy dose of gamma rays (90.46cm and 91.20cm in AKT-64 and N-8 respectively). Similar results were observed by Rajaramadoss *et al.* (2014) [11] and Ravichandra and Jayakumar (2018) [13] in sesame. The inhibition of growth was also reported due to the slow rate of cell division, decreased amylase activity and increased peroxidase activity (Rao, 1988) [12].

The minimum reduction in number of branches per plant in both the genotypes was recorded in lower doses i.e. 400Gy dose (3.48 and 3.16 in AKT-64 and N-8 respectively) and the highest reduction was found in 700Gy dose (2.64 and 2.28 AKT-64 and N-8 respectively) of gamma rays and found to be most effective in reducing the number of branches in both the genotypes of sesame.

Yield and yield component characters were decreased with increased doses in mutagenic treatments of gamma rays in sesame. A general reduction in number of capsules per plant, capsule length and seeds per capsule, 1000 seed weight and seed yield per plant was affected in both genotypes. A dose dependent reduction in all the characters was noticed the lowest dose 400Gy showed a low effect comparable to that of the control. Many workers found a similar effect of mutagens on sesame (Rajaramadoss *et al*., 2014) [11].

It was seen that in AKT-64 and N-8, there was a maximum decrease in number of capsules per plant in 700Gy dose (32.32 and 26.28 in AKT-64 and N-8 respectively) over control (50.12 and 45.24 in AKT-64 and N-8 respectively). The reduction in number of capsules per plant may be due to a probable inhibiting action of enzymes, changes in the enzymes activity and the toxicity of the mutagen. These attributes of physiological and biochemical disturbances in the development of plants as already been reported by Larik (1975) [8]. The highest dose of gamma rays was found to be very effective in significantly reducing the sesame characters *viz*. length of capsule and number of seeds per capsule in both the genotypes.

The effect of the highest dose of gamma rays was pronounced in reducing 1000 seed weight and seed yield per plant than in lower doses, which were observed to be comparable. The reduction in 1000 seed weight and seed yield per plant with an increase in doses of gamma rays was also reported by Rajaramadoss *et al.* (2014) [11] in sesame.

In both the genotypes, the minimum reduction in seed yield per plant was observed at 400Gy dose (6.38g and 4.94g in AKT-64 and N-8 respectively) of gamma rays, while the maximum reduction of seed yield per plant was observed at 700Gy (3.09g and 2.33g in AKT-64 and N-8 respectively) of gamma rays. Genotypes, AKT-64 and N-8 showed a decrease in seed yield per plant with increasing doses of gamma rays. This was in conformity with the observation of Rajaramadoss *et al*., (2014) [11] and Ravichandra and Jayakumar (2018) [13] in sesame. Similar result was recorded in different crops like soybean (Kalpande *et al*., 2020) [7] and Peanut (Gunasekaran and Padavai 2015) [5].

All the morphological characters of M_1 generation were decreased with an increase in the doses of gamma rays compared to controls. The maximum reduction of quantitative characters was noted at 700Gy dose of gamma rays compared to other doses and control. The reduced morphological variations may be due to physiological and some other disturbances at the genetic level like chromosomal damage, disturbed chromosomal coiling, failure or restricted pairing, etc. Similar results were reported in linseed (Rai and Das, 1978) [10], and Niger (Naik and Murthy, 2009) [9].

Table 1: Mean performance of the sesame genotype along with gamma rays doses for yield and its contributing characters in M_1 generation (AKT-64)

Genotype	Doses	Days to 50% flowering	Days to maturity	Plant height (cm)	No. branches / plant	No. of capsules / plant	Capsule length (cm)	No. of seeds/ capsule	1000 seed weight (g)	Seed yield /plant (g)
AKT-64	400Gy	47.80	94.40	114.57	3.48	45.68	2.58	55	2.73	6.38
	500Gy	46.80	93.40	113.64	3.44	40.68	2.50	51	2.66	5.45
	600Gy	48.80	95.80	107.29	2.88	35.88	2.28	45	2.42	3.44
	700Gy	51.40	96.20	90.46	2.64	32.32	2.26	42	2.20	3.09
	Control	47.60	93.60	116.55	4.04	50.12	2.72	60	2.92	7.23
	SE (m)	0.81	1.80	4.86	0.22	2.79	0.09	2.01	0.08	0.36
	CD @ 5%	2.42	5.38	14.47	0.65	8.38	0.27	6.02	0.24	1.07
	C.V. %	3.72	4.20	10.02	14.07	15.26	8.12	8.92	6.93	15.60

Table 2: Mean performance of the sesame genotype along with gamma rays doses for yield and its contributing characters in M_1 generation (N-8)

Genotype	Doses	Days to 50% flowering	Days to maturity	Plant height (cm)	No. branches / plant	No. of capsules / plant	Capsule length (cm)	No. of seeds/ capsule	1000 seed weight (g)	Seed yield /plant (g)
N-8	400Gy	58.40	125.80	106.41	3.16	38.76	2.49	48	2.63	4.94
	500Gy	60.20	126.60	103.90	2.60	32.64	2.40	45	2.42	3.54
	600Gy	63.20	128.20	101.95	2.44	29.72	2.21	40	2.37	3.29
	700Gy	65.60	129.60	91.20	2.28	26.28	2.18	38	2.09	2.33
	Control	59.00	119.20	108.30	3.36	45.24	2.60	52	2.85	6.36
	SE (m)	1.13	2.27	3.83	0.20	2.35	0.10	2.51	0.07	0.29
	CD @ 5%	3.37	6.79	11.50	0.59	7.05	0.30	7.51	0.21	0.88
	C.V. %	4.11	4.02	9.38	15.70	15.20	9.39	12.60	6.22	16.09

Conclusion

All the quantitative traits were proportionately decreased with increased in dose of gamma rays in sesame. Decrease quantitative characters in M_1 generation due to gamma rays treatment in sesame seeds was mainly attributed to the physiological disturbance or chromosomal damage caused to the cells of the plants. Mutations in plants are powerful tools, not only for clarifying physiological mechanisms in plants but also for developing new plant genotypes in practical breeding programs. Mutation breeding offers the possibility of recovering some of the lost but useful variability in sesame, especially improved yield.

References

1. Ashri A. Sesame breeding. Plant Breeding Reviews. 1998;16:179-228.
2. Ellench M, Besbes S, Roiseux O, Blecker C, Attia H. Quality characteristics of sesame seeds and by products. Food Chem. 2007;103:641-650.
3. Gaul H. Mutations in plant breeding. Radiation Botany, 1964;4(3):155-232.
4. Girija M, Dhanavel D. Effect of gamma rays on quantitative traits of cowpea in M_1 generation, International Journal of Research in Biological Sciences. 2013;3(2):84-87.
5. Gunasekaran A, Pavadai P. Studies on induced physical and chemical mutagenesis in groundnut (*Arachis hypogia*). International Letters of Natural Sciences, 2015, 8.
6. Gustafsson A. A study on induced mutations in plants. In Induced mutations in plants, International Atomic Energy Agency, Vienna, 1947, 9-35.
7. Kalpande HV, Borgaonkar SB, Chavan SK. Mutagenic Induction of Yield Contributing Traits in of Soybean (*Glycine max* (L.) Merrill) with Gamma Irradiation and EMS, Int. J Curr. Microbiol. App. Sci. 2020;9(6):3057-3063.
8. Larik AS. Radiation induced chromosome breakage in bred wheat (*Triticum aestivum* L.). Genetica Polonica, 1975;16:295-300.
9. Naik PM, Murthy HN. The effects of gamma and ethyl methane sulphonate treatments on agronomical traits of niger (*Guizotia abyssinica* Cass.). African J of Biotech. 2009;8(18):4459-4464.
10. Rai M, Das K. Sterility and yield reduction after gamma irradiation in linseed. Indian J. Genet. 1978;38:289-292.
11. Rajaramadoss B, Ganesamurthy K, Angappan K, Gunasekaran M. Evaluation of the effect of gamma rays on sesame genotype TTVS 51 and TTVS 19 in M_1 generation, International Journal of Development Research. 2014;4(2):273-277.
12. Rao DM, Reddy TP, Kinoshita T. Characterization of induced polygenic variability in pigeonpea [*Cajanus cajan* (L.) Mill sp.] J Faculty of Agriculture. 1988;63(4):387-395.
13. Ravichandran V, Jayakumar S. Effect of gamma rays on quantitative traits of sesame (*Sesamum indicum* L.) in M_1 generation, The Pharma Innovation Journal. 2018;7(10):547-550.
14. Saha S, Paul A. Gamma irradiation effect on yield and yield attributing traits of sesame (*Sesamum indicum* L.) in M_1 generation. Journal of Pharmacognosy and Phytochemistry. 2017;6:1311-131.
15. Yasmin K, Arulbalachandran D. Effect of Gamma Rays on morphological and quantitative traits of Black gram (*Vigna mungo* (L.) Hepper) in M_1 Generation. International Journal Current Trend in Research. 2016;4(2):5-12.