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# Gamma radiation induced changes in morphological characters in *Lathyrus sativus* cv. NLK-73

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**Abstract**
Seeds of *L. sativus* cv. NLK-73 were exposed at three different doses of gamma radiation (250Gy, 300Gy, and 350 Gy) to study effect of gamma radiation on germination. 100 seed weight and grain yield per plant in $M_2$ generation. The experiment was conducted at Research Farm, Shankar Nagar, Botany section, College of Agriculture, Nagpur during *rabi* 2020-2021. Gamma rays reduced germination in $M_1$ and increased in $M_2$ generation. 100 seed weight decreased in all treatments highest mean value was in 350Gy (6.91g) and lowest in 250Gy (6.30g) as compared to control (4.26g). Plant produced the highest grain yield at 350 GY (24.56g) and the lowest at 300 GY (20.20g). The variability showed the coefficient of variation (increased or decreased?) in all treatments. In $M_2$ generation germination and yield per plant increased significantly in all treatments and 100 seed weight significantly decreased in all treatments as compared to control.

**Keywords:** Lathyrus NLK-73, gamma rays, germination, 100 seed weight, grain yield

## Introduction
Lathyrus (*Lathyrus sativus* L.) (2n = 14) (Leguminaceae) is an annual herb and an important pulse crop rich in protein contain (28%) next to soybean locally called as grass pea, khesari dal, peavine or chanamatra. This pulse is consumed in various form like chapaties, wadas and curries and feeds to cattle as green fodder and stover since ancient times (Smartt 1984) [10]. It is one of the important pulse crop in India and other countries like Bangaladesh, Australia, South America and North Africa. It fulfils major pulses need in our country.
The area, Production and Productivity of Lathyrus crop given below:

| Region | Area | Production | Productivity |
|---|---|---|---|
| (a) World | 1.50 mha | 1.20 mt | 5.33 $qha^{-1}$ |
| (b) India | 0.58 mha | 0.15 mt | 742 kg $ha^{-1}$ |
| (c) Maharashtra (EVZ) | 37948 ha | | 300 kg $ha^{-1}$ |

(***Source***: Anonymous, 2023)

Although important in dietary purpose, ban was imposed on cultivation of this crop, due to presence of neurotoxin, (β-N- oxalyl-L- α, β-diaminopropionic acid) β-ODAP in its seedlings and seeds which causes neurolathyrism a non-reversible neurological disorder in human and animals (Dwivedi and Prasad, 1964) [4].
The mutation breeding has been used worldwide for improvement of grain legumes through increased genetic variation and of novel alleles. Therefore, mutation breeding is more desirable to create variability in grasspea. Physical and chemical mutagens provide handy tools to enhance natural mutation rate, thereby enlarging the genetic variability and increasing the scope of obtaining desired mutant. In order to induce variability and utilize useful mutation for efficient plant breeding, the systematic and comparative study of induce mutagenic effectiveness and mutagenic efficiency in a variety of crop plant is essential.
The traditional varieties of grass pea contain 0.5 –2.5% β-ODAP (Kumar *et al.* 2011) [6]. Hence development of high yielding varieties with low β-ODAP content has been remained prime objective in Lathyrus breeding. Present study aims to study effect of gamma radiation on yield and morphological characters in *L. sativus*.

## Material and Methods

Genetically pure seeds of Lathyrus cv. NLK-73 were irradiated with three doses of gamma rays i. e. 250, 300, and 350 Gy. The treated seeds along with control were sown immediately after treatment to raise the $M_1$ generation at research farm, Agril. Botany section, College of Agriculture, Nagpur. All the recommended cultural practices and management were given to raise a healthy crop. Seeds from each plant of $M_1$ generation we harvested separately and labelled with plant number along with doses and stored to raise $M_2$ generation. $M_2$ generation was raised in rabi 2021. on the fertile and well levelled piece of land in the research farm of Agril. Botany section, College of Agriculture, Nagpur. Observation were recorded at different growth stages in $M_1$ and $M_2$. In $M_2$ generations, Plant height (cm), number of branches plant$^{-1}$, number of pods plant$^{-1}$, 100 seed weight (g) and seed yield plant$^{-1}$ data recorded.

## Results and Discussion

### Germination and Mortality percent

Seeds exposed at three different doses of gamma radiation (250, 300 and 350Gy) showed, reduction in germination percent in comparison with control (Table1). Seeds exposed at 350Gy showed highest reduction in germination percent (41.12%) followed by seeds exposed at 300Gy (51.30%) and 250 Gy (47.26%). Thus, in $M_1$ generation germination percent reduced with the increased dose of gamma rays. In case of mortality, highest mortality was recorded at 350 Gy treatment (77.96%) while the lowest was observed at 250 Gy treatment (58.28%). Control showed 25.37% of mortality Thus, in $M_1$ generation mortality percent increased with increased dose of gamma rays (Table 1) $M_2$ generation (*rabi* 2021) germination percent were found to be reduced with increase of doses of gamma rays. (Table 2). Similarly, the highest mortality was found at 350 Gy treatment while the lowest was observed in (Table 2) 300 Gy treatment.

The germination percentage increased in $M_2$ as compared to $M_1$. The reduction in germination may be either due to genetic cause or inhibition of physiological process in cell by mutagen. In accordance to this result Aditya *et al*. (2017) [1] reported reduction in seed germination percent with an increasing dose of gamma rays in BSS-2 and RKS-18 varieties of soybean. Kusmiyati *et al*. (2018) [7] also observed that higher doses of gamma rays significantly reduced germination percentage of the first and final count in soybean. Chavan *et al*. (2019) [3] also reported decrease in germination percentage compared to control in both $M_1$ and $M_2$ generation in Lathyrus.

The results on mortality percent revealed that mortality percent was increased with increase in gamma rays dose as compared to control. Similar results are also reported in soybean by Aditya *et al*. (2017) [1]. The prime cause of mortality could be physiological imbalance or different types of chromosomal aberrations Aditya *et al*. (2017) [1]. Chavan *et al*. (2019) [3] reported that mortality percentage increased as compared to control in both $M_1$ and $M_2$ generation in lathyrus (after exposure to gamma rays). Vijaykumar *et al*. (2021) [13] also observed that rate of reduction in biological damage on quantitative characters was directly proportional to the dose of Physical mutagen (gamma rays) irrespective of the varieties and mutagens used in Lathyrus

**100 seed weight:** Effect of different doses of gamma rays on 100 seed weight in $M_2$ generation are presented in table 3. The mean value for 100 seed weight showed significant difference. The maximum mean value for the character was observed in 350 Gy treatment (6.91 g) and minimum in 250 Gy treatment (6.30 g) and control showed a mean value of 4.26 g. Highest range for this trait was recorded in 300 Gy treatment - (9.29 g) followed by 250 Gy treatment - (8.96 g) and lowest range in 350 Gy treatment (5.66 g) as compared to control (2.20 g).

The coefficient of variation increased in 250 Gy treatment for 100 seed weight and reduced in 300 Gy and 350 Gy treatment as compared to control. The maximum coefficient of variation was observed in 250 Gy treatment (17.14%) while the minimum in 350 Gy treatment (11.40%) while control showed 14.67% of coefficient of variation.

The results on 100 seed weight revealed that gamma rays treatment resulted in increase in mean 100 seed weight in 300Gy treatments followed by 250 Gy and decreased in 350 Gy treatment as compared to control. Our results are In accordance with Waghmare and Mehara (2000), who reported significant reduction in 100 grain weight in grasspea irradiated with gamma rays. Similar results are reported by Usharani and Kumar (2015) [12] in blackgram. In contrast to our results, Chavan *et al*. (2019) [3] reported that 100 seed weight increased in 250 Gy, 300 Gy and 350 Gy while decreased in 150 Gy and 200 Gy over control in lathyrus.

### Grain yield per plant

Effect of different gamma rays doses on seed yield plant$^{-1}$ in $M_2$ generation are presented in table 4. The mean value for seed yield plant$^{-1}$ showed significant differences among the treatment. The maximum mean value for this characters was observed in 350 Gy treatment (24.56 g) and minimum in 300 Gy treatment - (20.20 g) and control showed a mean value of 20.25 g. Highest range for this trait was recorded in 300 Gy Treatment - (79.31 g) and lowest range in 350 Gy treatment (63.6 g) as compared to control (26.92 g).

The coefficient of variation increased in all the treatments for seed yield plant$^{-1}$ as compared to control. The maximum coefficient of variation was observed in 300 Gy treatment (53.31%) followed by 250 Gy treatment (45.66%) while the mini350 Gy treatment (40.51%). The range of coefficient of variation in treated population was 40.51% to 53.31% as compared to control (34.17%).

The result on seed yield plant$^{-1}$ revealed that the mean seed yield plant$^{-1}$ increased in most of treatments *viz*., 350 Gy and 250 Gy treatment and decreased in i300 Gy treatment as compared to control. But the wide range of variation observed in all the treatments as compared to control indicated the presence of high variation in between and within treatment. In accordance to this result, Aney (2013) [2] reported significant variability in yield in gamma irradiated population of pea. In contrary to this Usharani and Kumar (2015) [12] observed decrease in mean values for single plant yield below control in most of the treatments and more than control in some treatment. Aditya *et al*. (2017) [1] also reported that seed yield plant$^{-1}$ in variety BSS-2 of soybean showed maximum mean in control closely followed by 50 Gy, 100 Gy and 150 Gy, while it decreased in higher doses. Chavan *et al.* (2019) [3] also reported that grain yield plant$^{-1}$ was found to increase in 150 Gy, 250 Gy and 300 Gy and decreased in 200 Gy and 350 Gy treatments as compared to control.

**Table 1:** Germination and Mortality percent in $M_1$ generation (*Rabi* 2020)

| S.N. | Treatment | Germination (%) | Mortality (%) |
|---|---|---|---|
| 1. | $T_1$ (250 Gy) | 51.30 | 58.28 |
| 2. | $T_2$ (300 Gy) | 47.26 | 58.69 |
| 3. | $T_3$ (350 Gy) | 41.12 | 77.96 |
| 4. | $T_4$ (Control) | 71.50 | 25.37 |

**Table 2:** Germination and Mortality percent in $M_2$ generation (*rabi* 2021)

| S.N. | Treatment | Germination (%) | Mortality (%) |
|---|---|---|---|
| 1. | $T_1$ (250 Gy) | 68.34 | 49.31 |
| 2. | $T_2$ (300 Gy) | 67.81 | 50.01 |
| 3. | $T_3$ (350 Gy) | 56.96 | 54.38 |
| 4. | $T_4$ (Control) | 84.84 | 21.42 |

**Table 3:** Effect of gamma rays treatments on 100 seed weight (g) in $M_2$ generation

| Sr. No | Treatments | Range | Mean | Variance | S.D | CV |
|---|---|---|---|---|---|---|
| 1 | $T_1$ (250 Gy) | 8.96 | 6.30 | 1.16 | 1.08 | 17.14 |
| 2 | $T_2$ (300 Gy) | 9.29 | 6.84 | 0.71 | 0.84 | 12.32 |
| 3 | $T_3$ (350 Gy) | 5.66 | 6.91 | 0.62 | 0.78 | 11.40 |
| 4 | (Control) | 2.20 | 4.26 | 0.39 | 0.62 | 14.67 |

**Table 4:** Effect of gamma rays treatments on seed yield plant$^{-1}$ in $M_2$ generation

| Sr. No | Treatments | Range | Mean | Variance | S.D | CV |
|---|---|---|---|---|---|---|
| 1 | $T_1$ (250 Gy) | 76.54 | 23.77 | 117.92 | 10.85 | 45.66 |
| 2 | $T_2$ (300 Gy) | 79.31 | 20.20 | 124.92 | 11.17 | 53.31 |
| 3 | $T_3$ (350 Gy) | 63.66 | 24.56 | 99.04 | 9.95 | 40.51 |
| 4 | Control | 26.92 | 20.25 | 47.89 | 6.92 | 34.17 |

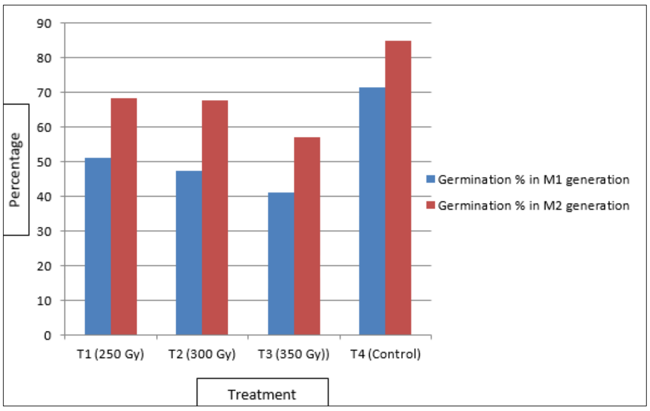


**Fig 1:** Impact of treatment with gamma rays on germination percentage in $M_1$ and $M_2$ generation

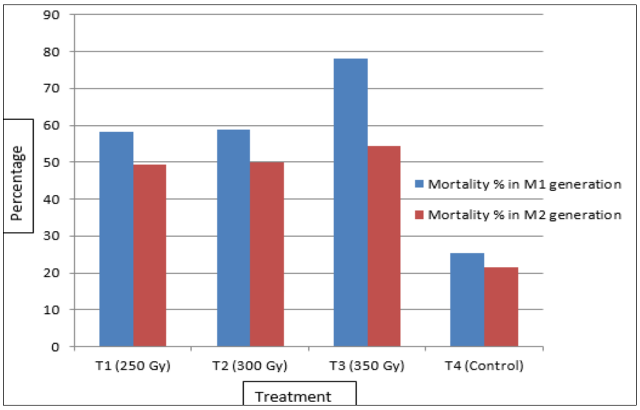


**Fig 2:** Impact of treatment with gamma rays on mortality percentage in $M_1$ and $M_2$ generation

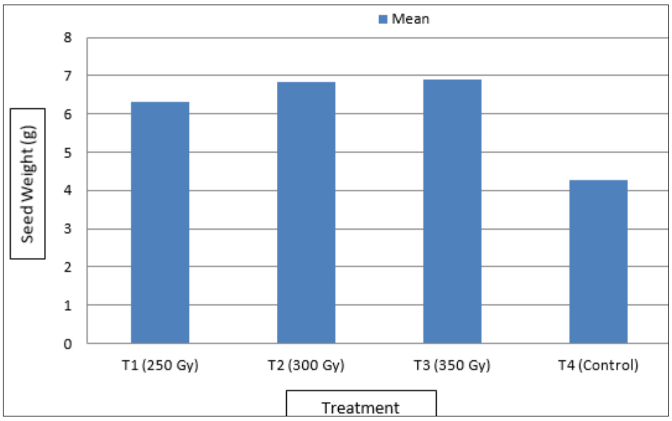


**Fig 3:** Impact of gamma rays treatment on 100 seed weight (g) in M2 generation

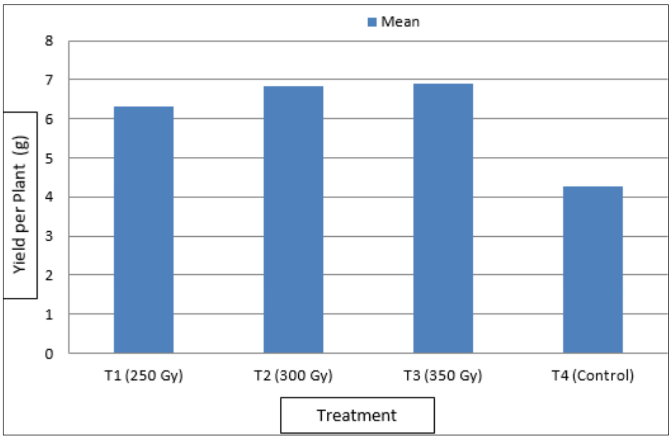


**Fig 4:** Gamma rays treatment effect on seed yield plant$^{-1}$ (g) in M2 generation.

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