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**M Vamsi**  
M. Sc (Hort.), Department of  
Vegetable Science, Dr. YSR  
Horticultural University, College of  
Horticulture, Anantharajupeta,  
Andhra Pradesh, India

**Syed Sadarunnisa**  
Professor & Head, Department of  
Vegetable Science, Dr. YSR  
Horticultural University, College of  
Horticulture, Anantharajupeta,  
Andhra Pradesh, India

**P. Syam Sundar Reddy**  
Principal Scientist and Head,  
Horticulture, Dr. YSR  
Horticultural University, Citrus  
Research Station, Petlur, Andhra  
Pradesh, India

**G Lakshmidivi**  
Assistant Professor, Department of  
Biotechnology, Dr. YSR  
Horticultural University, College of  
Horticulture, Anantharajupeta,  
Andhra Pradesh, India

## Corresponding Author:

**M Vamsi**  
M. Sc (Hort.), Department of  
Vegetable Science, Dr. YSR  
Horticultural University, College of  
Horticulture, Anantharajupeta,  
Andhra Pradesh, India

## Evaluation of growth and yield traits in gamma-induced m<sub>7</sub> generation mutants of field bean [*Lablab purpureus* var. *lignosus* (L.) prain]

**M Vamsi, Syed Sadarunnisa, P Syam Sundar Reddy and G Lakshmidivi**

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### Abstract

An experiment was conducted at the vegetable block, College of Horticulture, Anantharajupeta, Andhra Pradesh, during 2024-25 to evaluate the elite mutant lines of the gamma-irradiated population of the field bean variety TFB-2 in the M<sub>7</sub> generation. Among all the mutant lines of M<sub>7</sub> generation, significant variability was observed among 15 mutant lines of field bean across key agronomic traits. Plant height ranged from 179.38 cm to 280.62 cm, with M<sub>7.16</sub> being the tallest. M<sub>6.4</sub> had the highest number of primary branches (3.60), while M<sub>7.17</sub> flowered earliest (51.67 days). M<sub>7.19</sub> excelled in inflorescence count (59.20), and M<sub>7.28</sub> had the longest inflorescence (45.56 cm). Pod traits peaked in M<sub>7.18</sub>, which showed the highest pod count per inflorescence (9.07), the longest pod (58.90 mm), and the highest fresh seed yield (1005.72 g) and dry seed yield (310.38 g) per plant. These findings highlight M<sub>7.18</sub>, M<sub>7.3</sub>, and M<sub>7.4</sub> as promising lines for yield improvement.

**Keywords:** Dolichos bean, gamma irradiation, M<sub>7</sub> generation, mutants

### Introduction

The dolichos bean (*Lablab purpureus* L.), also known as the field bean, Indian bean, hyacinth bean, or Egyptian kidney bean, is a traditional legume cultivated in tropical regions across Africa, Asia, and Australia. The term "Lablab" comes from Arabic and Egyptian, referring to the soft rattling sound made by seeds inside dry pods (Sonali, Manju, and Ashwin, 2015). This plant is self-pollinating, grows in a semi-upright bushy form, and has 22 chromosomes (2n = 22). It belongs to the Fabaceae family and is thought to have originated in India (Ramesh and Byregowda, 2016) [18]. Studies have shown that legumes may help prevent and manage health issues such as diabetes, heart disease, colon cancer, and other metabolic disorders. More recent research highlights that dolichos bean extracts can block viral infections, including influenza and SARS-CoV-2, both of which have been declared global pandemics by the World Health Organization (Liu *et al.*, 2020) [11]. In recent years, mutation breeding has become a reliable method for enhancing crop yields (Acharya *et al.*, 2006) [1]. Over the past 70 years, more than 2,600 mutant crop varieties have been officially released, showing a wide range of improved traits. These varieties were developed using different types of mutagens, including X-rays, gamma rays, and neutrons, with gamma rays alone accounting for nearly 60% of the progress. Most of the improved grain legume varieties include crops such as soybeans (*Glycine max*), groundnuts (*Arachis hypogaea*), common beans (*Phaseolus vulgaris*), peas (*Pisum sativum*), and mung beans (*Vigna radiata*) (Bhatia *et al.*, 2001) [28]. The experiment aimed to examine the performance of characters in the M<sub>7</sub> generation of dolichos bean mutants treated with 30 kR gamma irradiation.

### 2. Materials and methods

A widely cultivated local variety of dolichos bean, TFB-2, was treated with 30 kR gamma irradiation to initiate the development of the M<sub>1</sub> generation, with untreated TFB-2 seeds included as a control. In the subsequent M<sub>2</sub>, M<sub>3</sub>, M<sub>4</sub> and M<sub>5</sub> generations, mutants exhibiting morphological abnormalities or suboptimal performance compared to the parental

traits were eliminated. In the M<sub>6</sub> generation, stability analysis was conducted to examine stability across various locations. Subsequently, in the M<sub>7</sub> generation, fourteen dolichos bean mutants, along with the parent variety, were evaluated using a randomized block design with three replications at the experimental field of the Department of Vegetable Science, Dr. YSRHU- College of Horticulture, Anantharajupeta, during the 2024-25 growing season. The mutants were planted with a spacing of 1 m between rows and 1 m between plants. Optimal crop growth was ensured by applying the recommended dose of fertilizers and implementing appropriate cultural practices. Observations on various traits were recorded from five randomly selected and tagged competitive plants from each replication.

### 3. Results and Discussion

The results obtained during the investigation with respect to morphological parameters namely., plant height at harvest, number of primary branches per plant, days to 50% flowering, number of inflorescences per plant, length of inflorescence, number of pods per inflorescence, length of the pod, width of the pod, weight of 10 green pods, number of pods per plant, number of seeds per pod, fresh pod yield per plant and dry seed yield per plant are presented in table 1. A wide range of variation in the mean performance of genotypes was observed for the characters under study.

#### 3.1 Plant height at harvest (cm)

Plant height at harvest among the mutant lines showed noticeable variation, ranging from 179.38 cm to 280.62 cm, with an overall average of 223.41 cm. Five mutant lines grew taller than this average. The tallest plant was recorded in mutant line M<sub>7.16</sub> at 280.62 cm, followed by M<sub>7.19</sub> and M<sub>7.18</sub>, which reached heights of 252.89 cm and 252.76 cm, respectively. On the other hand, mutant line M<sub>7.30</sub> had the shortest height at 179.38 cm. This could be because radiation led to the formation of harmful free radicals or caused significant changes in chromosome structure, both of which may have resulted in lethal effects (Selim *et al.*, 1974) <sup>[22]</sup>. These results corresponded with the findings of Manasa *et al.* (2022) <sup>[14]</sup>, Mahla *et al.* (2010) <sup>[13]</sup>, and Masry *et al.* (2019) <sup>[15]</sup> in cluster bean.

#### 3.2 Number of primary branches per plant

The number of primary branches per plant varied noticeably among the mutant lines, ranging from 2.40 to 3.60, with an average of 2.94. Out of the 15 mutants studied, five showed branch counts above the overall mean. Mutant line M<sub>6.4</sub> recorded the highest number of branches (3.60), closely followed by M<sub>7.3</sub> and M<sub>7.19</sub>, both with 3.40 branches. In contrast, M<sub>7.14</sub> had the fewest branches, with just 2.40. These results align with the findings of Girija and Dhanavel (2013), Devi, A.S., and Mullainathan (2012) <sup>[6, 4]</sup>.

#### 3.3 Days to 50% flowering

The time taken for 50% flowering among the mutant lines ranged from 51.67 to 59.00 days, with an average of 55.58 days. Mutant line M<sub>7.17</sub> showed the earliest flowering at 51.67 days, closely followed by M<sub>7.18</sub> (53.00 days) and M<sub>7.4</sub> (53.33 days). In contrast, M<sub>7.15</sub> had the longest flowering duration at 59.00 days. Overall, seven mutant lines flowered earlier than the average. Similar observations were reported by Aruna *et al.* (2013), Manasa *et al.* (2022) <sup>[2, 14]</sup>.

#### 3.4 Number of inflorescences per plant

The number of inflorescences per plant among the mutant lines

ranged from 43.00 to 59.20, with an average of 50.86. Seven mutants produced more inflorescences than this overall mean. Mutant line M<sub>7.19</sub> recorded the highest count at 59.20, closely followed by M<sub>7.4</sub> (58.27) and M<sub>7.17</sub> (58.13). In contrast, M<sub>7.30</sub> had the lowest number of inflorescences, with just 43.00. These findings align with the research outcomes of Vanmathi *et al.* (2021) <sup>[26]</sup> and Moushree and Kundagrami (2018) <sup>[16]</sup>.

#### 3.5 Length of inflorescence (cm)

Inflorescence length among the mutant lines varied from 38.88 cm to 45.56 cm, with an average of 42.94 cm. Mutant line M<sub>7.28</sub> recorded the longest inflorescence at 45.56 cm, followed by M<sub>7.16</sub> (44.67 cm) and M<sub>7.4</sub> (44.57 cm). In contrast, M<sub>7.20</sub> had the shortest length, measuring 38.88 cm. Among the 15 mutants evaluated, nine lines had inflorescence lengths that exceeded the average. These results align with studies conducted by Kimno *et al.* (2021) <sup>[9]</sup> on the dolichos bean.

#### 3.6 Number of pods per inflorescence

The number of pods per inflorescence varied among the mutant lines, ranging from 6.53 to 9.07, with an average of 8.01. Mutant line M<sub>7.18</sub> recorded the highest pod count at 9.07, followed closely by M<sub>7.3</sub> (8.87), M<sub>7.19</sub> (8.80), M<sub>7.15</sub> (8.73), M<sub>7.16</sub> (8.60), and M<sub>7.23</sub> (8.53). In total, nine mutants produced more pods per inflorescence than the overall mean. The lowest count was observed in M<sub>7.1</sub>, with just 6.53 pods per inflorescence. Similar results were reported by Vanmathi *et al.* (2021) and Jatav (2010) <sup>[26, 8]</sup>.

#### 3.7 Length of the pod (mm)

Pod length in the M<sub>7</sub> generation showed considerable variation, ranging from 50.86 mm to 58.90 mm. The average pod length across the 15 mutant lines was 54.98 mm, with ten lines exceeding this mean. Mutant line M<sub>7.18</sub> recorded the longest pod at 58.90 mm, closely followed by M<sub>7.19</sub> (57.20 mm) and M<sub>6.28</sub> (56.41 mm). In contrast, M<sub>7.32</sub> had the shortest pod length at 50.86 mm. Similar findings were observed by Patel *et al.* (2010) <sup>[17]</sup>, Sadashiv *et al.* (2012) <sup>[20]</sup>, and Manasa *et al.* (2022) <sup>[14]</sup>.

#### 3.8 Width of the pod (mm)

Pod width among the mutant lines ranged from 19.34 mm to 23.17 mm, with an average of 21.31 mm. Out of the 15 mutants evaluated, seven showed pod widths greater than the mean. The widest pod was recorded in M<sub>7.19</sub> (23.17 mm), followed by M<sub>7.18</sub> (21.99 mm) and M<sub>7.1</sub> (21.94 mm). In contrast, M<sub>7.15</sub> had the narrowest pod width at 19.34 mm. These results aligned with Galal, R.M., and Mohamed, A.G. (2019), and Mahesha *et al.* (2024) <sup>[5, 12]</sup>.

#### 3.9 Weight of 10 green pods (g)

The weight of 10 green pods among the mutant lines varied from 26.67 g to 33.40 g, with an average of 29.07 g. Eight mutants recorded pod weights above this mean. The highest 10 pod weight was observed in mutant line M<sub>7.14</sub> (33.40 g), followed by M<sub>7.4</sub> (31.07 g) and M<sub>7.15</sub> (30.00 g). In contrast, M<sub>7.1</sub> had the lowest 10 pod weight at 26.67 g. The results are consistent with the observations of Harishkumar *et al.* (2017) <sup>[27]</sup>.

#### 3.10 Number of pods per plant

The number of pods per plant among the mutant lines ranged from 182.40 to 373.67, with an overall mean of 284.69. Mutant line M<sub>7.18</sub> recorded the highest pod count at 373.67, followed by M<sub>7.3</sub> (339.73) and M<sub>7.4</sub> (315.53). In contrast, M<sub>7.16</sub> had the lowest number of pods per plant at 182.40. Out of the 15 mutants

evaluated, ten lines produced more pods than the average. These findings aligned with the results reported by Harishkumar *et al.* (2017) [27], Masry *et al.* (2021) [29], Syaiful *et al.* (2024) [24], and Barela *et al.* (2022) [3].

### 3.11 Number of seeds per pod

The number of seeds per pod among the mutant lines showed noticeable variation, ranging from 3.20 to 4.33, with an average of 3.63. Mutant line M<sub>7.14</sub> recorded the highest seed count per pod (4.33), followed by M<sub>7.15</sub> and M<sub>7.1</sub> (both with 3.87), and M<sub>7.16</sub> and M<sub>7.17</sub> (each with 3.73). In contrast, M<sub>7.30</sub> had the lowest seed count at 3.20. Out of the 15 mutants studied, eight produced more seeds per pod than the overall mean. The findings are consistent with the observations of Harishkumar *et al.* (2017) [27], Patel *et al.* (2010) [17], Sadashiv *et al.* (2012) [20], and Vanmathi *et al.* (2021) [26].

### 3.12 Fresh pod yield per plant (g)

Fresh pod yield per plant showed considerable variation, ranging from 400.51 g to 1005.72 g, with an average of 709.52 g. Seven mutant lines produced yields above the mean. The highest yield

was recorded in M<sub>7.18</sub> (1005.72 g), followed by M<sub>7.3</sub> (971.40 g) and M<sub>7.4</sub> (860.72 g). In contrast, M<sub>7.32</sub> had the lowest yield at 400.51 g. The rise in average plant yield may be attributed to a greater number of flowers, productive branches, and pods in black gram, as noted by Goyal *et al.* (2020). These findings are consistent with earlier reports by Manasa *et al.* (2022) [14], and Thilagavathi & Mullainathan (2011) [25].

### 3.13 Dry seed yield per plant (g)

Dry seed yield per plant among the mutant lines showed a wide range, from 81.31 g to 310.38 g, with an average of 182.24 g. Out of the 15 mutants evaluated, seven produced yields above the overall mean. The highest seed yield was recorded in M<sub>7.18</sub> (310.38 g), followed by M<sub>7.4</sub> (260.31 g) and M<sub>7.17</sub> (224.36 g). In contrast, M<sub>7.16</sub> had the lowest yield at 81.31 g. Khan *et al.* (2014) [30] reported that mutagens can enhance the activity of enzymes and growth hormones associated with seed yield. These findings are in agreement with those of Ramya *et al.* (2014) [19], Mahesha *et al.* (2024) [12], Lande *et al.* (2018) [10], and Sarker *et al.* (2014) [21].

**Table 1:** Mean performances of dolichos bean yield attributes

Mutants	PHH	NPBPP	DFF	NIPP	LI	NPPI	LP	WP	WTGP	NPPP	NSPP	FPYPP	DSYPP
M <sub>7.1</sub>	221.72	2.87	57.33	47.00	40.98	6.53	55.56	21.94	26.67	286.13	3.87	795.48	164.71
M <sub>7.3</sub>	248.76	3.40	54.00	50.87	44.10	8.87	55.18	21.20	29.87	339.73	3.33	971.40	222.73
M <sub>7.4</sub>	215.41	3.60	53.33	58.27	44.57	8.07	55.83	21.19	31.07	315.53	3.53	860.72	260.31
M <sub>7.10</sub>	206.25	2.80	56.33	43.40	41.75	7.13	55.80	21.53	27.47	294.33	3.60	726.48	182.42
M <sub>7.14</sub>	204.72	2.40	56.67	54.87	42.72	8.07	55.62	21.89	33.40	287.67	4.33	669.56	163.53
M <sub>7.15</sub>	235.27	3.13	59.00	52.47	43.28	8.73	51.11	19.34	30.00	239.07	3.87	631.06	163.17
M <sub>7.16</sub>	280.62	2.67	54.33	50.47	44.67	8.60	54.47	20.95	27.00	182.40	3.73	426.70	81.31
M <sub>7.17</sub>	232.17	2.80	51.67	58.13	43.58	8.47	55.34	21.43	29.87	311.57	3.73	628.02	224.36
M <sub>7.18</sub>	252.76	3.00	53.00	51.67	44.13	9.07	58.90	21.99	27.67	373.67	3.67	1005.72	310.38
M <sub>7.19</sub>	252.89	3.40	54.00	59.20	43.59	8.80	57.20	23.17	29.93	309.87	3.47	827.90	195.17
M <sub>7.20</sub>	187.42	2.87	57.33	47.27	38.88	6.93	56.18	21.58	29.67	275.13	3.67	717.64	107.94
M <sub>7.23</sub>	210.45	2.80	56.67	50.07	43.09	8.53	53.23	21.90	27.93	321.07	3.67	702.46	217.42
M <sub>7.28</sub>	218.96	2.87	58.67	48.47	45.56	7.80	56.41	20.67	28.13	294.80	3.47	669.76	173.75
M <sub>7.30</sub>	179.38	2.93	56.33	47.80	40.60	7.07	53.04	21.28	28.20	238.13	3.20	609.42	107.90
M <sub>7.32</sub>	204.34	2.53	55.00	43.00	42.59	7.53	50.86	19.62	29.13	201.20	3.27	400.51	158.57
Mean	223.41	2.94	55.58	50.86	42.94	8.01	54.98	21.31	29.07	284.69	3.63	709.52	182.24
S.Em±	3.279	0.143	0.733	1.168	0.263	0.203	0.861	0.382	0.515	4.878	0.124	10.028	7.087
CD 5%	9.475	0.414	2.119	3.374	0.760	0.586	2.489	1.104	1.487	14.096	0.358	28.978	20.478

PH (cm) - Plant height (cm), NPBPP- No. of primary branches per plant, DFF - Days to 50% flowering, NIPP - No. inflorescence per plant, LI (cm) - Inflorescence length (cm), NPPI- No. of pods per Inflorescence, LP (cm) - Pod length (cm), WP (cm) - Pod width (cm), WTGP (g)- 10 green pod weight per plant, NPPP - No. pods per plant, NSPP - No. of seeds per pod, FPYPP (g) - Fresh pod yield per plant (g), DSYPP (g) – Dry seed yield per plant (g)

### Conclusion

The results on the mean performance of mutant lines in the M<sub>7</sub> generation revealed significant variability for all the observations. The tallest plant was recorded in mutant line M<sub>7.16</sub>. Mutant line M<sub>6.4</sub> recorded the highest number of branches (3.60), mutant line M<sub>7.17</sub> showed the earliest flowering at 51.67 days, mutant line M<sub>7.19</sub> recorded the highest count of inflorescences per plant, M<sub>7.28</sub> recorded the longest inflorescence, mutant line M<sub>7.18</sub> recorded the highest pod count, M<sub>7.18</sub> recorded the longest pod, the widest pod was recorded in M<sub>7.19</sub>, the highest 10 pod weight was observed in mutant line M<sub>7.14</sub>, mutant line M<sub>7.18</sub> recorded the highest pod, M<sub>7.14</sub> recorded the highest seed count

per pod, the highest yield was recorded in M<sub>7.18</sub>, the highest seed yield was recorded in M<sub>7.18</sub>.

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