



Research Paper

Induced mutagenesis for resistance to mungbean yellow mosaic virus and yield traits in mungbean

Deepthi ST^{1*}, Sumangala Bhat¹, Suma C Mogali¹, PR Saabale² and Kiranakumar DM¹

¹Department of Genetics and Plant Breeding, College of Agriculture, UAS, Dharwad – 580 005, Karnataka, India.

²ICAR-Indian Institute of Pulses Research, Regional Research Station, UAS, Dharwad-580 005, Karnataka, India.

*Corresponding author e-mail: deepthist72@gmail.com

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ABSTRACT

The M₀ seeds of mungbean variety DGGV 2 treated with different doses of ethyl methane sulphonate (EMS) at 0.1%, 0.2% and 0.3% concentrations were assessed for Mungbean Yellow Mosaic Virus (MYMV) in M₂ generation during summer 2023 at University of Agricultural Sciences, Dharwad. Considering the yield superiority over check (Mean + 2 Standard Deviation) and highly resistant response to MYMV disease, out of 962 M₂ plants 17 superior M₂ plants were identified. The seed yield plant⁻¹ in these identified mutants ranged from 21.9 to 32.0 g which is higher compared to the average yield of check DGGV 2 (11.7 g) during that season. Also, the other yield contributing traits such as number of productive branches, number of cluster plant⁻¹, number of pods cluster⁻¹, and number of pods plant⁻¹ were observed to be higher in these mutants in comparison to check variety.

Key words: Mungbean, EMS, MYMV, Mutants

INTRODUCTION

Mungbean [*Vigna radiata* (L.) Wilczek] (2n=2x=22) is one of the most important pulse crops of South and Southeast Asia which belongs to the family Fabaceae and sub family Papilionaceae. It is an important pulse crop in India due to its richness with vegetarian protein (24%). Each 100 grams of dry seeds provides 94 mg of vitamin A, 7.3 mg of iron, 124 mg of calcium, 3 mg of zinc, and 549 mg of folate (Kumar *et al.* 2023). It holds great significance due to its year-round cultivation feasibility, short duration and adaptability to diverse environments. It is particularly beneficial for resource-poor farmers as it requires low inputs and can restore soil fertility through symbiotic nitrogen fixation (Ali *et al.* 2012).

The average productivity of mungbean remains is quite low and has shown little improvement over the year. This is mainly attributed to the limited genetic variability and its susceptibility to various foliar diseases such as cercospora leaf spot, powdery mildew, anthracnose and mungbean yellow mosaic, asynchronous habit of pod maturity, shedding of flowers/newly formed pods and indeterminate and long duration of growth resulting in low seed yield per plant in some of the presently cultivated genotypes. To address this bottleneck of narrow genetic variability, induced mutation, using physical and chemical mutagen, is a way to generate genetic variation, resulting in the creation of new

varieties with better characteristics (Wongpiyasatid *et al.* 2000). Induced mutation and its breeding strategies are potential tools for improving both quantitative and qualitative traits in crops within a much shorter period of time (6 to 7 years) than conventional breeding (8 to 10 years) (Oladosu *et al.* 2016). In mungbean, mutation breeding resulted in development of sixteen high-yielding and disease resistant varieties during 1979-2010 (Kumar *et al.* 2021). Therefore, in this study, an effort was made to induce mutations in a popular variety of mungbean DGGV 2 which became highly vulnerable to foliar diseases in recent years, and to identify mutants with high yield and resistant reaction to MYMV disease.

MATERIALS AND METHODS

The M₂ generation of DGGV 2 was obtained by treating seeds with ethyl methane sulphonate (EMS) at 0.1%, 0.2%, and 0.3% concentrations and raised during summer 2023 at the University of Agricultural Sciences, Dharwad. The M₂ seeds harvested from individual M₁ plants were sown in an unreplicated design along with resistant check (IPM 2-14) and susceptible check (DGGV 2) after every ten rows to raise M₂ generation. Observations were recorded on each plant separately on various quantitative traits such as the number of productive branches, number of clusters plant⁻¹, number of pods

cluster⁻¹, number of pods plant⁻¹, pod length, seed yield plant⁻¹ and their response to MYMV disease. The field was regularly examined to observe the symptoms of MYMV under natural field conditions. Each M₂ plant was monitored separately for the occurrence of MYMV disease at 30, 45, and 60 days after sowing (DAS). The mutants exhibiting higher yield and other yield-related traits in comparison to the check variety were identified through statistical analysis (Mean + Standard Deviation) using Excel software. The M₂ plants were classified into different groups based on the severity of MYMV disease symptoms on leaves and other plant parts using 0-5 scale (Bashir *et al.* 2005; Table 1 & Plate 1).

RESULTS AND DISCUSSION

Identification of superior mutants based on yield and response to MYMV disease

Several attempts have been made to boost up yield of mungbean during the past two decades through mutation breeding. Previous studies by Auti *et al.* (2012) and Wani *et al.* (2017) have successfully achieved the aim of improving yield but there are only a few reports on MYMV resistance in mungbean through mutation breeding.

Since yield plant per plant is the most desirable character, several mutants that were distinctly superior to the others about seed yield plant⁻¹ were selected in the M₂ generation. Generally, superior segregants compared to the check variety are identified in early segregating generations based on mean plus one/ two standard deviations (Kencharaddi *et al.* 2013). In the present study, efforts were made to identify mutants with improved yield (Mean + 2 SD) over DGGV 2 and highly resistant response to MYMV disease in M₂ population. The average yield of DGGV 2 was 11.7 g whereas the average yield of the identified superior mutants ranged from 21.9 to 32.0 g. A total of 12, 3, and 2 superior mutants were identified in M₂ population

derived from the use of 0.1, 0.2 and 0.3% EMS, respectively (Table 2, 3 and 4). The highest yield of 32.0 g was produced by the mutant 2-9-10. This considerable increase in yield is owing to an increase in the number of clusters plant⁻¹ (16), the number of pods cluster⁻¹ (5), and the number of pods plant⁻¹ (80) while check DGGV 2 had an average of 4.6 productive branches, 5.0 clusters plant⁻¹, 3.6 pods cluster⁻¹, 18.5 pods plant⁻¹ and mean seed yield of 11.7 g per plant. The poor performance of the control plants was due to susceptibility to MYMV disease. Likewise, mutants 2-5-9 and 3-6-10 recorded seed



Highly susceptible check (DGGV 2)

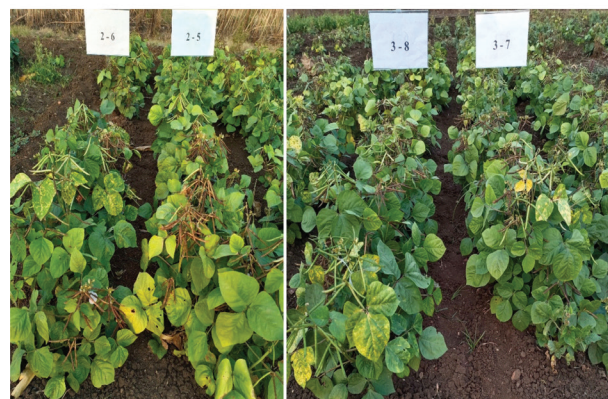


Plate 1. M₂ plants showing susceptible and resistant response to MYMV

Table 1. Disease rating scale for Mungbean Yellow Mosaic Virus (MYMV)

Symptoms	Disease scale	Disease Reaction
Complete absence of symptoms	0	Highly resistant
Few small yellow specks or spots on a few leaves were seen after careful observation	1	Resistant
Bright yellow specks or spots common on leaves are easily observed and some coalesce	2	Moderately resistant
Mostly coalesced bright yellow specks or spots common on leaves, but no or minor reduction in yield.	3	Moderately susceptible
Plants showing coalesced bright yellow specks or spots on all leaves, with no or minor stunting, and set fewer normal pods	4	Susceptible
Yellowing or chlorosis of all leaves on the whole plant followed by necrosis, shortening of internode, severe stunting of plants with no yield or few flowers & deformed pods produced with small, immature, and shriveled seeds.	5	Highly susceptible

Table 2. Performance of superior mutants in the M₂ population derived from 0.1% EMS for yield (Mean + 2 SD) and reaction to MYMV disease

SI No	Mutant number	Number of productive branches	Number of clusters plant ⁻¹	Number of pods cluster ⁻¹	Number of pods plant ⁻¹	Pod length (cm)	Seed yield plant ⁻¹ (g)	Disease reaction to MYMV
1.	1-4-5	10	12	5	60	8.5	22.8	HR
2.	1-25-13	10	12	5	58	5.0	22.0	HR
3.	1-53-3	10	15	5	70	7.0	26.6	HR
4.	1-57-6	9	15	4	58	7.5	22.2	HR
5.	1-58-1	10	15	4	60	7.5	22.9	HR
6.	1-59-10	10	14	5	70	7.0	26.6	HR
7.	1-76-4	10	16	5	80	6.5	30.4	HR
8.	1-76-5	8	12	5	60	5.0	22.8	HR
9.	1-78-5	8	12	5	58	8.0	22.8	HR
10.	1-85-5	9	15	4	60	6.5	22.8	HR
11.	1-91-5	9	15	4	60	7.0	22.8	HR
12.	1-38-A-6	10	12	5	60	6.0	21.9	HR
	DGGV 2	4.6	5	3.6	18.5	8.75	11.7	S - HS
	Mean	7.61	8.78	3.18	28.02	6.81	10.65	
	Standard deviation (SD)	2.18	3.25	0.81	13.98	0.97	5.31	
	Mean + 2 SD	11.97	15.28	4.80	55.98	8.75	21.27	

HR- Highly resistant, S- Susceptible, HS- Highly susceptible

Table 3. Performance of superior mutants in the M₂ population derived from 0.2% EMS for yield (Mean + 2 SD) and reaction to MYMV disease

SI No	Mutant number	Number of productive branches	Number of clusters plant ⁻¹	Number of pods cluster ⁻¹	Number of pods plant ⁻¹	Pod length (cm)	Seed yield plant ⁻¹ (g)	Disease reaction to MYMV
1.	2-5-9	10	16	5	80	5.0	31.8	HR
2.	2-9-9	10	15	5	75	8.0	30.0	HR
3.	2-9-10	9	16	5	80	7.0	32.0	HR
	DGGV 2	4.6	5	3.6	18.5	8.75	11.7	S - HS
	Mean	7.64	9.61	3.44	33.21	7.04	13.28	
	Standard deviation (SD)	1.92	3.40	0.80	14.49	0.71	57.99	
	Mean + 2 SD	11.48	16.42	5.05	62.20	8.47	24.88	

HR- Highly resistant, S- Susceptible, HS- Highly susceptible

Table 4. Performance of superior mutants in the M₂ population derived from 0.3% EMS for yield (Mean + 2 SD) and reaction to MYMV disease

SI No	Mutant number	Number of productive branches	Number of clusters plant ⁻¹	Number of pods cluster ⁻¹	Number of pods plant ⁻¹	Pod length (cm)	Seed yield plant ⁻¹ (g)	Disease reaction to MYMV
1.	3-6-10	10	16	5	80	7	30.4	HR
2.	3-7-4	10	15	5	70	7	26.6	HR
	DGGV 2	4.6	5	3.6	18.5	8.75	11.7	S - HS
	Mean	7.35	9.44	3.38	32.12	6.54	12.21	
	Standard deviation (SD)	1.85	3.02	0.85	14.69	0.80	5.58	
	Mean + 2 SD	11.04	15.48	5.07	61.50	8.14	23.37	

HR- Highly resistant, S- Susceptible, HS- Highly susceptible

yields of 31.8 g and 30.4 g, respectively. This increase in the yield of these mutants can be attributed to the number of productive branches (10), number of clusters plant⁻¹ (16), number of pods cluster⁻¹ (5), and

number of pods plant⁻¹ (80). Similarly, other high-yielding mutants could be due to improvement in yield attributing traits like number of productive branches, number of clusters plant⁻¹, number of pods

cluster⁻¹ and number of pods plant⁻¹ and their highly resistant response to MYMV disease. In comparison to check DGGV 2, all these identified superior M₂ plants showed considerable improvement for the majority of the characters studied except for pod length. Several high yielding mutants were also identified in different crops by many researchers such as Tickoo and Chandra (1999), Senapati *et al.* (2008), Ramya *et al.* (2014), Das and Baisakh (2018) and Wani (2021) in mungbean, Amin *et al.* (2015) and Laskar *et al.* (2018) in lentil and Raina *et al.* (2019) in chickpea. The superior mutants identified in the present study can be tested for their stable response in subsequent generations.

The present study helped to identify several mutants having high yield and MYMV disease resistance in the M₂ generation, offering valuable insights for improving the productivity and disease resistance of the popular variety DGGV 2. This widely accepted variety, known for its desirable pod and seed features, is susceptible to foliar diseases, including MYMV. Therefore, induced mutagenesis presents a promising approach to enhancing desirable traits in existing varieties. These findings contribute to the development of stable mutant lines with high yield and enhanced MYMV resistance in mungbean, thereby boosting the productivity and resilience of this essential pulse crop.

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