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Identification of resistant source against yellow mosaic disease in mungbean through field screening

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Abstract
Yellow mosaic disease, a begomovirus, poses a significant obstacle to the successful and profitable growth of mungbeans, resulting in substantial losses in production and productivity in India. Host plant resistance is the most effective alternative for managing YMV in mungbean, offering an economical and eco-friendly methodof disease management. To identify sources of genetic resistance to YMV disease, 34 mungbean genotypes were tested through field screening at the Regional Agricultural Research Station, Warangal, Telangana, during 2023. Among 34mungbean genotypes, four genotypes, LGG610, LGG628, IPM2-14, and MGG 573 showed disease-free status, six genotypes showed a resistant reaction to YMV, namely 'PUSA23-111, PUSA 9072, MGG-385, MGG-576, and WGG-42 with low disease score. Eight genotypes were moderately resistant, whereasten genotypes were recorded as moderately susceptible. Seven genotypes, i.e., OBGG103, PUSA23-112, RM03-79, VGG 20-234, MGG-562, MGG-563, MGG-666, were Susceptible, and the WGG-2 is highly susceptible under field conditions. These lines can also be further exploited as a source of resistance in the breeding program to develop varieties resistant to the Yellow Mosaic disease.

Keywords: Mungbean, yellow mosaic virus, resistant, genotypes, susceptible

1. Introduction
Mungbean *Vigna radiata* (L.) R. Wilczek var. radiate is an economically important, short-duration grain legume crop that can be grown as a sole or intercrop for grain and green manure in different environments across three crop seasons, namely Kharif, Rabi, and Summer, in various parts of the country. India is one of the world's top producers of Mungbean, and it is grown in the states of Rajasthan, Maharashtra, Madhya Pradesh, Odisha, Andhra Pradesh, Tamil Nadu, Telangana, and Uttar Pradesh (Mallaiah and Krishna Rao, 2018, Avanija *et al*., 2023) [7, 4]. Despite these factors, several biotic and abiotic stresses are primarily responsible for the low productivity of this crop. Among all the constraints, the mung bean yellow mosaic virus (MYMV) caused by the Mung bean Yellow Mosaic Virus (MYMV) belonging to the Begomovirus species in the family, Geminiviridae, is the most destructive and causes significant yield losses by up to 100% or even kills a plant infected at an early vegetative stage (Naimuddin *et al*., 2011) [9]. The viruses are transmitted by the vector, whitefly (*Bemisiatabaci*), in a persistent calculative manner. In India, Mung bean yellow mosaic virus is the most virulently destructive disease of legumes, commonly known as the "yellow plague" of Kharif pulses. Mung bean yellow mosaic virus disease on mung bean was first reported from fields of IARI, New Delhi, in 1960 and is transmitted principally by whitefly, *Bemisia tabaci* (Genn.) and grafting, but not by sap, seed, or soil (Shad *et al*., 2005) [11]. Plants infected with MYMV generally exhibit yellowing or chlorosis of leaves, followed by necrosis, shortening of internodes, and severe stunting, resulting in no yield or few flowers, and deformed pods with small, immature, and shrivelled seeds (Akhtar *et al*., 2009) [1]. To overcome this vector-borne viral disease, various strategies have been developed; however, no breakthrough has been found for a cost-effective management solution. Although chemical management of the vector is seen as a simple measure, it is not cost-effective, as numerous insecticide sprays are required to control whiteflies. Recurrent sprayings also lead to health hazards and ecological imbalance of living

organisms. On the contrary, the use of virus-resistant varieties is the most effective approach to mitigate the occurrence of MYMV in areas where the infection is a recurring constraint (Meti *et al*., 2017) [8]. The use of resistant crop varieties is considered a reasonable, robust, and effective method of controlling viral diseases. High-quality research aimed at screening mungbean cultivars against MYMV for the identification of resistant sources is the way forward. Therefore, the present study was conducted to identify the resistant mungbean genotypes against MYMV under natural field conditions.

2. Materials and Methods

The present experiment was conducted during the *Rabi* season, 2023-24. Field studies were conducted at the Regional Agricultural Research Station, SiddapurFarm, Warangal District.A total of 34 genotypes were collected from IIPR, Kanpur, and ARS, Madira. This experiment was laid out in a Randomised Block Design (RBD) with two replications, alternated by a susceptible check, WGG-2, after two test entries.Each plot consisted of a single row, 4 meters in length, with row-to-row and plant-to-plant distances of 30 cm and 10 cm, respectively.The infector row method was adopted, in which one row of the infector line of WGG-2 was raised after two test entries to evaluate YMV infection. The disease scoring was based on the visual symptoms of the disease observed on the plants. All the recommended cultural practices were followed to express the full genetic potential of the genotypes without insecticide sprays, so as to maintain optimum whitefly (vector) population for high inoculum pressure of MYMV pathogen. The crop was regularly monitored for the development of disease symptoms, and observations were recorded on 10 randomly selected plants from each genotype in each replication. The reaction of the entries to YMV was recorded at 30 and 50 DAS by using a disease rating scale developed by AICRP, MULLaRP (2023) [3] (Table1), and further statistical analysis by GRAPES 1.0.0 (Gopinath *et al*., 2020) [5].

The per cent disease index (PDI) was computed from the above scale by using the following formula (Wheeler, 1969) [12]

$$\text{Percent Disease Index} = \frac{\text{Sum of individual disease ratings}}{\text{No. of observations} \times \text{max. disease grade}} \times 100$$

3. Results and Discussion

Screening of Mung bean genotypes against Yellow mosaic virus

Among various strategies to manage the diseases, cultivating resistant varieties is an eco-friendly, practically feasible, and economically viable method. Therefore, the most effective way to control yellow mosaic disease is by using resistant varieties.

The data from Table 2 shows screening of mung bean genotypes against MYMV under field conditions. The data is collected at 30DAS and 50DAS by using a rating scale.

At 30days after sowing, the disease reaction was recorded as follows. Out of the 36 entries screened, LGG 610, LGG 628, Pusa 23-111, MGG573, WGG42, MGG576, MGG 385, and IPM2-14 were shown to have YMV disease-free reaction with no symptoms of the disease, whereas fourentries, namely LGG607, Pusa 9072, VBN(Gg)2, and MGG571, were recorded with score 1 and characterised as resistant against YMV disease. Most of the entries were characterised as moderately resistant to YMV disease at 30 days after sowing, with a disease score of 3, and 9 entries, *viz*., LGG657, RM03-79, VGG20-157, VGG20-234, MGG563, MGG553, MGL-562, MGG-570, and MGG-666, showed a moderately susceptible reaction to the disease with a disease score of 5 (Table 2). Only the MGG 295 entry showed a susceptible response with a score of 6, along with the susceptible check WGG-2.

DGG218, IGKM2021-1, LGG685, MGG514, MGG519, OBG 105, OBGG103, Pusa23-112, VBN4, MGG-565, MGG-564 At 50 days after sowing, the disease reaction of the test entries revealed that, out of 36 entries screened against yellow mosaic virus of Mungbean, four entries (LGG-610, LGG-628, IPM2-14, and MGG573) were disease-free (Immune) to Yellow Mosaic Virus. Pusa 23-111, Pusa 9072, MGG-385, MGG576 and WGG-42 were recorded as resistant to YMV and seven entries (IGKM2021-1, LGG607, LGG685, VBN GG-2, MGG565, MGG 556 and MGG571) were recorded as Moderately resistant with 10 to 20 per cent of leaf area covered with YMV disease (Table 3), whereas Moderately susceptible reaction was observed with the entries of DGG218, LGG657, MGG514, MGG519, OBG105, VBN-4, VGG20-157, MGG553, MGG570 and MGG564 and seven entries i.e., OBGG 103, Pusa 23-112, RM 03-79, VGG 20-234, MGG562, MGG563, MGG666 showed susceptible reaction to YMV with 30 to 50 per cent pf leaf area covered with YMV disease and MGG295 and WGG-2 were highly susceptible to YMV with disease scale 9 (Table2 & 3).

When, the overall reaction of the genotypes against yellow mosaic disease observed, it was found that the genotypes Pusa23-111, WGG 42, MGG 576, and MGG 386 initially showed a resistant response at 30 DAS. However, they were recorded as moderately resistant, similar to LGG 607, VBNGg-2, and MGG 571 entries, which have undergone significant changes from resistant to moderately resistant against YMV disease. However, LGG610, LGG628, IPM2-14, and MGG 573 exhibited a stable reaction to yellow mosaic disease at 30 DAS and 50 DAS (Fig. 1 & 2), indicating disease-free status to YMV. Hence, they may be chosen as donors for the development of a resistant variety against YMV in the further breeding programme.

In a similar study, Kasniya *et al*. (2025) [6] reported that MH 1142, MH 1908, MI 2023-01, ML 2748, and OBGG 107 consistently exhibited resistance across multiple locations, making them potential candidates for breeding YMD-resistant genotypes. In the present study, similarly, we identified fourstable resistant genotypes that showed the lowest percent disease index against YMV disease. Shreelaxmi *et al*. (2021) evaluated and reported that the lines DGGV-200, DGGV-218, DGGV-281 andDGGV-284 were observed to be resistant and DGGV-198, DGGV-206, DGGV-212, DGGV-215, DGGV-226, DGGV-268and DGGV-282 were moderately resistant to YMV. Anitha *et al*. (2023) conducted a study to identify the resistant Mung bean varieties against MYMV in *Kharif* during 2017 and revealed that there was significant variation among the genotypes for resistance against MYMV. Based on the average MYMV score, only two genotypes (IPM 02-3 and IPM 0205-7) were found completely free from the disease and the plants had maximum chlorophyll content whereas IPM-409-4 and RMG 991 were found resistant and chlorophyll content was low as compared to the highly resistant genotypes. Saable *et al*. (2024) [10] evaluated 104 genotypes against yellow mosaic virus, and indicated that six genotypes namely, IPM-1205-2, IPM-2-14, IPM-410-3, IPM14-10, IPM-205-7 and IPM-1604-1 were showed stability for MYMV resistance. Similarly, in this study, we also reported five genotypes Pusa 23-111, Pusa 9072, MGG-385, MGG576 and WGG-42 showing stable resistance against yellow mosaic disease during *Rabi* 2023-24.

Table 1: Disease scoring for YMV disease - AICRP on MULLaRP scale, 2023

Grade	Description	Reaction	Designation
0	No visible symptoms	Free	F
1	0.1-10.0% leaf area covered with symptoms	Resistant	R
3	10.1-20.0% leaf area covered with symptoms	Moderately Resistant	MR
5	20.1-30.0% leaf area covered with symptoms	Moderately Susceptible	MS
7	30.1-50.0% leaf area covered with symptoms	Susceptible	S
9	>50.1% leaf area covered with symptoms	Highly Susceptible	HS

Table 2: Phenotypic reaction of the mungbean entries against MYMV under field conditions

S. No.	Name of the entry	Disease scale 30 DAS	Host reaction 30 DAS	Disease scale 50 DAS	Host reaction 50 DAS
1	DGG 218	2	MR	5	MS
2	IGKM 2021-1	2	MR	3	MR
3	LGG 607	1	R	3	MR
4	LGG 610	0	F	0	F
5	LGG 628	0	F	0	F
6	LGG 657	4	MS	4	MS
7	LGG 685	2	MR	3	MR
8	MGG 514	3	MR	5	MS
9	MGG 519	2	MR	4	MS
10	OBG 105	2	MR	5	MS
11	OBGG 103	2	MR	6	S
12	Pusa 23-111	0	F	1	R
13	Pusa 23-112	3	MR	7	S
14	Pusa 9072	1	R	1	R
15	RM 03-79	4	MS	6	S
16	VBN (Gg) 2	1	R	3	MR
17	VBN-4	3	MR	4	MS
18	VGG 20-157	4	MS	5	MS
19	VGG 20-234	4	MS	6	S
20	MGG-563	5	MS	7	S
21	MGG-553	4	MS	5	MS
22	MGG-565	2	MR	3	MR
23	MGG-573	0	F	0	F
24	WGG-42	0	F	1	R
25	MGG-576	0	F	1	R
26	MGG-556	2	MR	3	MR
27	MGG-571	1	R	2	MR
28	MGG-385	0	F	1	R
29	MGL-562	4	MS	6	S
30	IPM2-14	0	F	0	F
31	MGG-570	4	MS	5	MS
32	MGG-295	6	S	8	HS
33	MGG-564	3	MR	4	MS
34	MGG-666	5	MS	7	S
35	WGG-2	7	S	9	HS
36	WGG-42	0	F	0	F

Table 3: Grouping of Mung bean genotypes against YMV disease during Rabi, 2023

Scale & grade	Description	Category of the genotypes
0- F	No visible symptoms	LGG610, LGG628, IPM2-14 and MGG 573 (4)
1- R	0.1-10.0% leaf area covered with symptoms	PUSA23-111, PUSA 9072, MGG-385, MGG-576 and WGG-42 (5)
3- MR	10.1-20.0% leaf area covered with symptoms	IGKM2021-1,LGG607, LGG685, VBN GG -2, MGG-565, MGG-556 and MGG-571 (8)
5- MS	20.1-30.0% leaf area covered with symptoms	DGG 218, LGG 657, MGG514, MGG519, OBG105, VBN-4, VGG 20-157, MGG-553, MGG-570, MGG564 (10)
7- S	30.1-50.0% leaf area covered with symptoms	OBGG103, PUSA23-112, RM03-79, VGG 20-234, MGG-562, MGG-563, MGG-666 (7)
9- HS	>50.1% leaf area covered with symptoms	MGG-295 and WGG-2 (2)

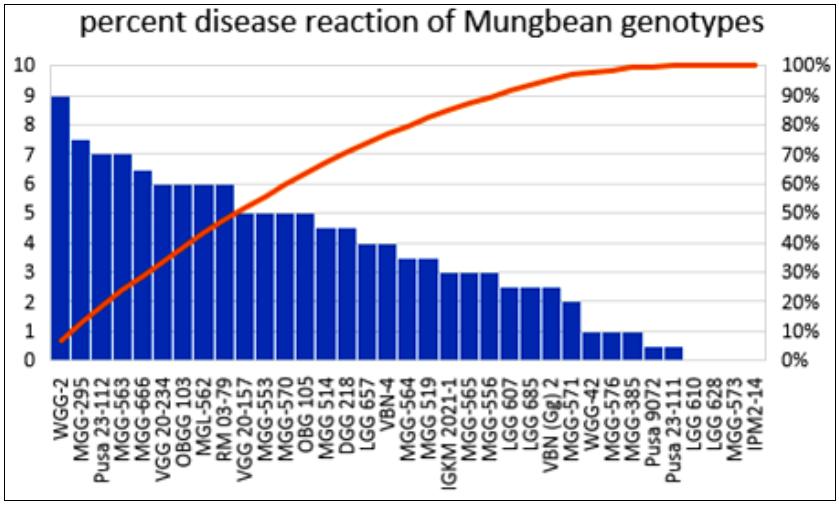

Fig 1: Graphical representation of Percent Disease reaction of Mungbean genotypes

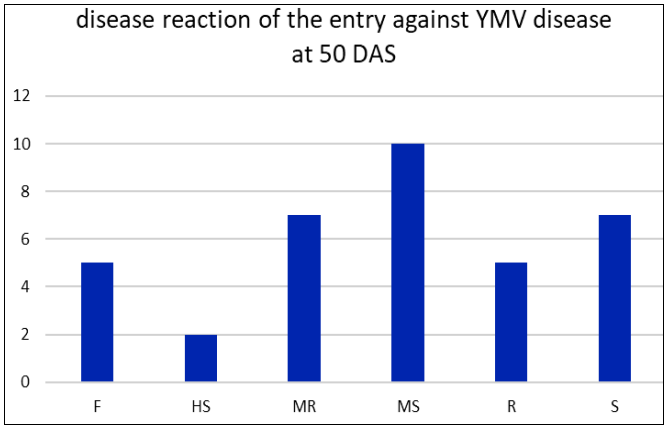

Fig 2: Graphical representation of the reaction of Mungbean genotypes against YMV disease

4. Conclusion

In the present study, 34 genotypes were screened against yellow mosaic disease in field conditions during Rabi 2023.The results concluded that among 34 genotypes, MBG LGG610, LGG628, IPM2-14, and MGG 573 exhibited stable resistance to yellow mosaic disease at 30 DAS and 50 DAS. Hence, these identified genotypes can be used as potential donors for a resistance breeding programme against yellow mosaic disease in Mungbean. These resistant cultivars need further biochemical mechanism studies to depict variable disease reactions.

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Conflict of Interest

The authors declare that there is no conflict of interest.

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