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REACTION OF MUNGBEAN (*VIGNARADIATA* L.) GENOTYPES TO SUCKING PEST COMPLEX AND YELLOW MOSAIC DISEASE UNDER DIFFERENT AGRO ECOLOGICAL CONDITIONS

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ABSTRACT

Developing host plant resistance is a cornerstone of sustainable pest management in mungbean (*Vigna radiata* L.). This study was conducted to evaluate the reaction of thirty-five mungbean genotypes, including one susceptible (DGGV-2) and one resistant (IPM-2-14) check, against the naturally occurring populations of major sucking pests (leaf hoppers, whiteflies, thrips) and the incidence of Mungbean Yellow Mosaic Disease (YMD). The screening was performed under three distinct environmental conditions: Dharwad during *Kharif* and *Rabi* seasons of 2024, and Gadagduring *Kharif* 2024. Significant variations in pest populations and disease incidence were observed among the genotypes across all locations. Genotypes IPM-2-14 (resistant check) and DGG-96 consistently exhibited low populations of leaf hoppers and whiteflies and demonstrated a resistant reaction (1.00-3.21 PDI) to YMD across all three environments. Conversely, genotypes 5 BRD-1, TRCRM-147, and DGGV-2 (susceptible check) were consistently found to be highly susceptible, harboring high pest populations and exhibiting severe YMD incidence (up to 64.66 per cent). The findings highlight the stability of resistance in genotypes IPM-2-14 and DGG-96, marking them as valuable genetic resources for breeding programs aimed at developing mungbean varieties with durable resistance to the sucking pest complex and YMD. The differential reactions of genotypes across seasons and locations underscore the influence of environmental factors on host-pest interactions.

Key words: Mungbean, *Vignaradiata*, Genotype screening, Host plant resistance, Sucking pests, *Bemisiatabaci, Empoascakerri*, Yellow Mosaic Disease (YMD).

Introduction

Mungbean, or green gram (*Vigna radiata* L. Wilczek), is the third most significant pulse crop in India, cultivated for its protein-rich, highly digestible grains. It plays a crucial role in the nation's food security and agricultural economy, contributing approximately 12 per cent to the total pulse output (3rd AE, DA&FW). Despite its importance, the national average productivity of mungbean remains low, largely due to a combination of abiotic and biotic constraints (Chauhan *et al.*, 2010). Among the biotic factors, insect pests are a primary cause of economic damage, with over 60 species recorded on the crop in India (Ooi, 1973).

The sucking pest complex, which includes whiteflies (*Bemisiatabaci* Gennadius), leaf hoppers (*Empoasca kerri* Pruthi), thrips (*Caliothrips indicus* Bagnall), and aphids (*Aphis craccivora* Koch), poses a significant threat to mungbean production. These pests cause damage both directly, by sucking plant sap, which leads to reduced vigor and photosynthetic activity, and indirectly, by acting as vectors for debilitating viral diseases (Lal, 1987; War *et al.*, 2017). The whitefly, *B. tabaci*, is particularly notorious as the vector of Mungbean Yellow Mosaic Virus (MYMV), a Begomovirus that can cause yield losses ranging from 30 per cent to 70 per cent (Swaminathan *et al*., 2012). The disease manifests as yellow mottling on leaves, which can spread to the entire foliage under severe infestation, leading to major photosynthetic losses and stunted plant growth (Ramarao *et al*., 2023).

While chemical control is a common management practice, the indiscriminate use of insecticides has led to resistance, pest resurgence, and harm to beneficial insects (Yadav and Singh, 2014). Therefore, developing resistant varieties is considered the most economical, effective, and environmentally sound strategy for managing these pests and diseases. Previous screening efforts have identified genotypes with varying levels of resistance to sucking pests and YMD (Yadav and Dahiya, 2000; Khattak *et al*., 2004; Panduranga *et al*., 2011). However, the stability of this resistance across different agro-ecological zones and seasons is crucial for its successful deployment in breeding programs. The identification of stable and diverse sources of resistance is essential for developing high-yielding varieties that can withstand pest and disease pressure under varying field conditions.

In view of these considerations, the present study was undertaken with the objective to screen a diverse set of mungbean genotypes to identify sources of resistance against the sucking pest complex and Yellow Mosaic Disease under the natural field conditions of major mungbean growing regions of Karnataka, India.

Materials and Methods

Experimental Locations and Design

The study was conducted across three distinct environments to evaluate the stability of genotypic reactions. The screening trials were laid out at the Main Agricultural Research Station (MARS), University of Agricultural Sciences, Dharwad, during the *Kharif* and *Rabi* seasons of 2024, and at a farmer's field near the Agricultural Research Station (ARS), Gadag, during *Kharif* 2024. Dharwad is situated in the transitional tract of Karnataka (Zone-8), while Gadag falls under the Northern dry zone (Zone-3), representing different agro-climatic conditions.

A total of thirty-five mungbean genotypes were evaluated, including a susceptible check (DGGV-2) and a resistant check (IPM-2-14) (Table 1). The experiment was conducted in an Augmented Block Design with two replications. Each genotype was sown in paired rows of three-meter length, with a spacing of 30 cm between rows and 10 cm between plants. The crop was raised following all recommended packages of practices for the region, with the exception of any plant protection measures against insect pests, to allow for natural pest and disease infestation.

Table 1: Details of mungbean genotypes screened for resistance.

Sl. No.	Genotypes
1	SM 24-104
2	SM 24-106
3	DGWG-11
4	DGG-100
5	DGG-96
6	DGG-21
7	BWMCD-31
8	DGGV 2 X IPM409-4
9	DGGV 2 X SONAMUNG 8-1
10	DGG 10
11	DGGV 2 X RMG1028
12	DGGV 2 X V-02-802
13	DGG1 X TM 96-2
14	DGG-218
15	DGG-201
16	DGG-211
17	DGG-7
18	DGG-266
19	4 MBRD-76
20	5 BRD-1
21	8 BRD-20
22	DGG-269
23	DGG-195 X VGG rul 4-2
24	SM 24-214
25	SM 24-216
26	SM 24-222
27	SM 24-221
28	SM 24-198
29	SM 24-202
30	DGG-87
31	TRCRM-147
32	DGWG-57
33	DGG-1
34	DGGV-2 (S. Check)
35	IPM-2-14 (R. Check)

Observation of Pest and Disease Incidence

Observations on the sucking pest complex and YMD were recorded under natural infestation conditions. Five plants were randomly selected and tagged in each plot for recording data.

Sucking Pest Population

The populations of whiteflies (nymphs and adults), aphids (nymphs and adults), and leaf hoppers (nymphs and adults) were recorded from three leaves (one each

Table 2: Disease rating scale for Mungbean Yellow Mosaic Disease.

Rating	Per cent Disease Index (PDI)	Reaction
0	No symptoms on the plant	Immune (I)
1	1 per cent or less	Resistant (R)
3	1-10 per cent	Moderately Resistant (MR)
5	11-25 per cent	Moderately Susceptible (MS)
7	26-50 per cent	Susceptible (S)
9	51 per cent or more	Highly Susceptible (HS)

from the top, middle, and bottom canopy) of each tagged plant. Observations were made during the early morning hours. The mean population was calculated and expressed as the number of insects per trifoliate leaf. For thrips, the population was estimated by tapping the leaves five times over a white cardboard sheet and counting the dislodged insects using a hand lens. The mean was expressed as the number of thrips per trifoliate leaf.

Mungbean Yellow Mosaic Disease (YMD) Incidence

The incidence of YMD was recorded by counting the total number of plants and the number of infected plants in each plot. The Percent Disease Index (PDI) was calculated using the formula proposed by Wheeler (1969):

$$\text{PDI (\%)} = \frac{\text{Number of infected plants in a plot}}{\text{Total number of plants in a plot}} \times 100$$

Based on the PDI, genotypes were categorized for their reaction to YMD using the 0-9 rating scale suggested by Mayee and Datar (1986), as detailed in Table 2.

Statistical Analysis

The data collected on pest populations were transformed using the square root transformation ($\sqrt{(x+0.5)}$), while the disease incidence percentage data were subjected to Arcsin transformation to normalize the variance. The transformed data were then analyzed using Analysis of Variance (ANOVA) for the Augmented Block Design. The treatment means were compared for significance using the Tukey test at a 5 per cent level of probability.

Results

The 35 mungbean genotypes exhibited a wide spectrum of reactions to the sucking pest complex and YMD across the three screening environments. The pest and disease pressure varied with season and location, allowing for a robust evaluation of genotypic stability. The detailed results for each location are presented below.

Screening of Genotypes at Dharwad (*Kharif* 2024)

During the *Kharif* 2024 season at Dharwad, significant differences were observed among the genotypes for their reaction to all recorded pests and YMD (Table 3). The leaf hopper population ranged from 0.19 (DGG-96) to 8.20 (TRCRM-147) per trifoliate leaf. Genotype DGG-96 was the most resistant, while TRCRM-147, 5 BRD-1 (6.83), and SM 24-216 (6.93) were highly susceptible. For whiteflies, the population varied from 1.25 (IPM-2-14) to 8.64 (TRCRM-147) per trifoliate leaf. The resistant check IPM-2-14, along with DGG-96 (1.35) and SM 24-106 (1.45), showed the lowest infestation. In contrast, TRCRM-147, the susceptible check DGGV-2 (8.30), and 5 BRD-1 (8.24) harbored the highest whitefly populations. Thrips incidence ranged from 2.54 (4 MBRD-76) to 10.89 (IPM-2-14) per trifoliate leaf. Interestingly, the resistant check IPM-2-14 recorded a high thrips population, similar to the susceptible check DGGV-2 (10.35).

Regarding YMD, genotype 5 BRD-1 was rated highly susceptible (HS) with 55.62 per cent incidence, along with the susceptible check DGGV-2 (37.48 per cent, rated HS). The resistant check IPM-2-14 (2.42 per cent) and DGG-96 (3.21 per cent) were rated as resistant (R). Several genotypes, including DGG 10 (2.69 per cent) and DGGV 2 × RMG1028 (3.51 per cent), were found to be moderately resistant (MR).

Screening of Genotypes at Dharwad (*Rabi* 2024)

The screening during the *Rabi* 2024 season at Dharwad revealed similar trends but with generally higher pest pressure (Table 3). The leaf hopper population ranged from 3.02 (IPM-2-14) to 11.12 (TRCRM-147) per trifoliate leaf. The resistant check IPM-2-14 and DGG-96 (3.11) were the most resistant. Whitefly incidence varied from 1.95 (DGG-96) to 11.06 (5 BRD-1) per trifoliate leaf. DGG-96 and IPM-2-14 (3.07) again showed strong resistance. The thrips population ranged from 4.04 (DGG-96) to 12.86 (DGGV-2) per trifoliate leaf with DGG-96 showing the lowest incidence.

For YMD, the disease pressure was higher in the *Rabi* season. Genotypes 5 BRD-1 (64.66 per cent) and DGGV-2 (54.39 per cent) were confirmed as highly susceptible (HS). Both IPM-2-14 and DGG-96 maintained their resistant (R) status with a very low incidence of 1.00 per cent. Genotypes such as DGG 10 (9.01 per cent) and SM 24-106 (9.64 per cent) were rated as moderately resistant (MR).

Screening of Genotypes at Gadag (*Kharif* 2024)

The trial at Gadagduring *Kharif* 2024 was conducted

Table 3: Screening of genotypes against mungbean pests at Dharwad during *Kharif*-2024.

S. no.	Genotypes	Leaf hoppers/ trifoliate	White fly population	No. of thrips	*YMD per cent	Disease Score	Rating
1	SM 24-104	2.09(1.61)^{efghijk}	5.68(2.49)^{abcd}	6.07(2.56)^{abcde}	36.81(37.35)^{abc}	5	MS
2	SM 24-106	1.23(1.32)^{hijk}	1.45(1.4)^{ef}	2.91(1.85)^{cde}	9.18(17.64)^{ghij}	3	MR
3	DGWG-11	1.09(1.26)^{ijk}	3.13(1.91)^{cdef}	3.95(2.11)^{bcde}	13.65(21.68)^{fghi}	5	MS
4	DGG-100	4.13(2.15)^{abcdefghi}	5.83(2.52)^{abcd}	6.23(2.59)^{abcde}	20.24(26.74)^{bcdefg}	5	S
5	DGG-96	0.19(0.83)^{k}	1.35(1.36)^{ef}	2.88(1.84)^{de}	3.21(10.32)^{ij}	1	R
6	DGG-21	3.03(1.88)^{bcdefghij}	6.09(2.57)^{abcd}	4.74(2.29)^{bcde}	10.46(18.87)^{ghij}	9	HS
7	BWMCD-31	2.47(1.72)^{cdefghijk}	6.37(2.62)^{abcd}	5.3(2.41)^{abcde}	15.72(23.36)^{efgh}	5	MS
8	DGGV 2 X IPM409-4	2.15(1.63)^{defghijk}	5.62(2.47)^{abcd}	4.1(2.14)^{bcde}	7.87(16.29)^{ghij}	3	MR
9	DGGV 2 X SONAMUNG 8-1	2.32(1.68)^{cdefghijk}	5.99(2.55)^{abcd}	5.65(2.48)^{abcde}	10.35(18.77)^{ghij}	5	MS
10	DGG 10	1.45(1.4)^{ghijk}	3.18(1.92)^{bcdef}	2.58(1.75)^{e}	2.69(9.44)^{ij}	3	MR
11	DGGV 2 X RMG1028	1.1(1.26)^{ijk}	3.73(2.06)^{abcdef}	3.77(2.07)^{bcde}	3.51(10.8)^{hij}	3	MR
12	DGGV 2 X V-02-802	3.32(1.95)^{bcdefghij}	2.41(1.71)^{def}	2.18(1.64)^{e}	8.43(16.88)^{ghij}	5	MS
13	DGG1 X TM 96-2	3.43(1.98)^{bcdefghi}	3.51(2)^{abcdef}	3.43(1.98)^{bcde}	17.22(24.52)^{defg}	5	MS
14	DGG-218	2.27(1.66)^{cdefghijk}	6.66(2.68)^{abcd}	6.59(2.66)^{abcde}	31.87(34.37)^{bcde}	7	S
15	DGG-201	5.56(2.46)^{abcde}	7.24(2.78)^{abc}	8.43(2.99)^{abcd}	36.62(37.24)^{abc}	7	S
16	DGG-211	6.45(2.64)^{ab}	6.81(2.7)^{abcd}	6.58(2.66)^{abcde}	39.04(38.67)^{abc}	7	S
17	DGG-7	5.04(2.35)^{abcdef}	7.83(2.89)^{abc}	8.17(2.94)^{abcd}	35.34(36.48)^{abcd}	7	S
18	DGG-266	3.91(2.1)^{abcdefghi}	2.97(1.86)^{cdef}	4.59(2.26)^{bcde}	19.5(26.21)^{cdefg}	5	MS
19	4 MBRD-76	2.21(1.65)^{defghijk}	4.15(2.16)^{abcdef}	2.54(1.74)^{e}	11.64(19.95)^{ghij}	5	MS
20	5 BRD-1	6.83(2.71)^{ab}	8.24(2.96)^{ab}	7.05(2.75)^{abcde}	55.62(48.23)^{a}	9	HS
21	8 BRD-20	5.54(2.46)^{abcde}	5.18(2.38)^{abcde}	5.19(2.39)^{abcde}	8.93(17.39)^{ghij}	5	MS
22	DGG-269	1.38(1.37)^{ghijk}	3.06(1.89)^{cdef}	3.56(2.01)^{bcde}	17.15(24.46)^{defg}	5	MS
23	DGG-195 X VGG rul 4-2	0.66(1.08)^{jk}	2.95(1.86)^{cdef}	2.58(1.75)^{e}	8.29(16.73)^{ghij}	7	S
24	SM 24-214	4.33(2.2)^{abcdefgh}	4.93(2.33)^{abcdef}	2.49(1.73)^{e}	31.17(33.94)^{bcdef}	7	S
25	SM 24-216	6.93(2.73)^{ab}	5.06(2.36)^{abcdef}	7.05(2.75)^{abcde}	32.68(34.87)^{bcde}	7	S
26	SM 24-222	6.65(2.67)^{ab}	6.85(2.71)^{abcd}	9.49(3.16)^{abc}	37.38(37.69)^{abc}	7	S
27	SM 24-221	4.23(2.17)^{abcdefgh}	4.2(2.17)^{abcdef}	4.34(2.2)^{abcde}	16.03(23.6)^{efg}	5	MS
28	SM 24-198	5.9(2.53)^{abcd}	4.84(2.31)^{abcdef}	5.02(2.35)^{abcde}	31.72(34.28)^{bcde}	7	S
29	SM 24-202	3.98(2.12)^{abcdefghi}	4.99(2.34)^{abcdef}	5.96(2.54)^{bcde}	29.77(33.07)^{bcdef}	7	S
30	DGG-87	6.02(2.55)^{abc}	7.11(2.76)^{abc}	9.26(3.12)^{ab}	34.96(36.25)^{abcd}	7	S
31	TRCRM-147	8.2(2.95)^{a}	8.64(3.02)^{a}	7.5(2.83)^{abcde}	40.13(39.31)^{ab}	7	S
32	DGWG-57	4.45(2.22)^{abcdefg}	4.47(2.23)^{abcdef}	4.54(2.24)^{abcde}	19.55(26.24)^{cdefg}	5	MS
33	DGG-1	3.08(1.89)^{bcdefghij}	4.12(2.15)^{abcdef}	5.57(2.46)^{bcde}	15.6(23.26)^{efgh}	5	MS
34	DGGV-2 (S. Check)	3.05(1.88)^{bcdefghij}	8.3(2.97)^{a}	10.35(3.29)^{ab}	37.48(37.75)^{abc}	9	HS
35	IPM-2-14 (R Check)	1.79(1.51)^{fghijk}	1.25(1.32)^{f}	10.89(3.37)^{a}	2.42(8.95)^{j}	1	R
	SEm	0.16	0.18	0.19	2.23	-	-
	CD 5 per cent	0.45	0.52	0.54	6.28	-	-
	CV	14.15	13.89	13.92	14.64	-	-

Figures in parenthesis are ARCSIN transformed (*) and square root ($\sqrt{x+0.5}$) transformed values,
Means showing similar alphabets do not differ significantly by Tukey test, R- Resistant,
MR-Moderately resistant, HS-Highly susceptible, S-Susceptible, MS- Moderately susceptible

to assess the stability of resistance in a different agro-ecological zone (Table 3). The results largely corroborated the findings from Dharwad. The leaf hopper population ranged from 2.19 (IPM-2-14) to 10.29 (TRCRM-147) per trifoliate leaf. Whitefly incidence varied from 1.12 (DGG-96) to 10.23 (5 BRD-1) per trifoliate leaf. In both cases, IPM-2-14 and DGG-96 demonstrated superior resistance. The thrips population ranged from 1.93 to 12.57 per trifoliate leaf with IPM-2-14 again showing a paradoxically high population (12.57), similar to the susceptible check DGGV-2 (12.03).

YMD incidence at Gadag was severe. Genotypes 5 BRD-1 (58.25 per cent), DGG-21 (53.00 per cent), and DGGV-2 (52.11 per cent) were rated as highly susceptible (HS). Once again, IPM-2-14 and DGG-96 proved to be

Table 4: Screening of genotypes against mungbean pests at Dharwad during *Rabi* -2024.

S. no.	Genotypes	Leaf hoppers/ trifoliate	White fly population	No. of thrips	*YMD per cent	Disease Score	Rating
1	SM 24-104	5.01(2.35)^{abcde}	7.5(2.83)^{abcd}	8.58(3.01)^{abc}	21.6(27.69)^{efghij}	5	MS
2	SM 24-106	4.15(2.16)^{bcde}	3.27(1.94)^{cde}	5.42(2.43)^{abc}	9.64(18.09)^{jk}	3	MR
3	DGWG-11	4.01(2.12)^{bcde}	4.95(2.33)^{abcde}	6.46(2.64)^{abc}	18.59(25.54)^{hij}	5	MS
4	DGG-100	7.05(2.75)^{abcde}	7.65(2.85)^{abcd}	8.74(3.04)^{abc}	28.65(32.36)^{cdefghij}	5	S
5	**DGG-96**	3.11(1.9)^{de}	1.95(1.57)^{e}	4.04(2.13)^{c}	1(5.74)^{k}	**1**	**R**
6	DGG-21	5.95(2.54)^{abcde}	7.91(2.9)^{abcd}	7.25(2.78)^{abc}	58(49.6)^{ab}	9	HS
7	BMCD-31	5.39(2.43)^{abcde}	8.19(2.95)^{abcd}	7.81(2.88)^{abc}	20.66(27.03)^{fghij}	5	MS
8	DGGV 2 X IPM409-4	5.07(2.36)^{abcde}	7.44(2.82)^{abcd}	6.61(2.67)^{abc}	15.03(22.81)^{j}	3	MR
9	DGGV 2 X SONAMUNG 8-1	5.24(2.4)^{abcde}	7.81(2.88)^{abcd}	8.16(2.94)^{abc}	16.99(24.34)^{ij}	5	MS
10	DGG 10	4.37(2.21)^{bcde}	5(2.35)^{abcde}	5.09(2.36)^{abc}	9.01(17.47)^{jk}	3	MR
11	DGGV 2 X RMG1028	4.02(2.13)^{bcde}	5.55(2.46)^{abcde}	6.28(2.6)^{abc}	9.56(18.01)^{jk}	3	MR
12	DGGV 2 X V-02-802	6.24(2.6)^{abcde}	4.23(2.17)^{bcde}	4.69(2.28)^{bc}	14.94(22.74)^{j}	5	MS
13	DGG1 X TM 96-2	6.35(2.62)^{abcde}	5.33(2.41)^{abcde}	5.94(2.54)^{abc}	24.49(29.66)^{cdefghij}	5	MS
14	DGG-218	5.19(2.39)^{abcde}	8.48(3)^{abcd}	9.1(3.1)^{abc}	40.86(39.73)^{abcdefgh}	7	S
15	DGG-201	8.48(3)^{abcde}	9.06(3.09)^{abc}	10.94(3.38)^{abc}	44.49(41.84)^{abcdef}	7	S
16	DGG-211	9.37(3.14)^{abc}	8.63(3.02)^{abcd}	9.09(3.1)^{abc}	47.53(43.58)^{abcd}	7	S
17	**DGG-7**	7.96(2.91)^{abcde}	9.65(3.19)^{ab}	10.68(3.34)^{abc}	45.43(42.38)^{abcde}	7	S
18	DGG-266	6.83(2.71)^{abcde}	4.79(2.3)^{abcde}	7.1(2.76)^{abc}	24.44(29.63)^{cdefghij}	5	MS
19	4 MBRD-76	5.13(2.37)^{abcde}	5.97(2.54)^{abcde}	5.05(2.36)^{bc}	19.19(25.98)^{ghij}	5	MS
20	5 BRD-1	9.75(3.2)^{ab}	11.06(3.4)^{a}	12.24(3.57)^{ab}	64.66(53.52)^{a}	9	HS
21	8 BRD-20	8.46(2.99)^{abcde}	7(2.74)^{abcde}	7.7(2.86)^{abc}	16.87(24.25)^{ij}	5	MS
22	DGG-269	4.3(2.19)^{bcde}	4.88(2.32)^{abcde}	6.07(2.56)^{abc}	22.09(28.03)^{efghij}	5	MS
23	DGG-195 X VGG rul 4-2	3.58(2.02)^{cde}	4.77(2.3)^{abcde}	5.09(2.36)^{abc}	45.28(42.29)^{abcde}	7	S
24	SM 24-214	7.25(2.78)^{abcde}	6.75(2.69)^{abcde}	5(2.35)^{bc}	38.42(38.3)^{bcdefghi}	7	S
25	SM 24-216	9.85(3.22)^{ab}	6.88(2.72)^{abcde}	9.56(3.17)^{abc}	41.49(40.1)^{abcdefgh}	7	S
26	SM 24-222	9.57(3.17)^{abc}	8.67(3.03)^{abcd}	12(3.54)^{ab}	44.5(41.84)^{abcdef}	7	S
27	SM 24-221	7.15(2.77)^{abcde}	6.02(2.55)^{abcde}	6.85(2.71)^{abc}	22.72(28.47)^{efghij}	5	MS
28	SM 24-198	8.82(3.05)^{abcde}	6.66(2.68)^{abcde}	7.53(2.83)^{abc}	39.1(38.7)^{abcdefghi}	7	S
29	SM 24-202	6.9(2.72)^{abcde}	6.81(2.7)^{abcde}	8.47(2.99)^{abc}	40.57(39.56)^{abcdefgh}	7	S
30	DGG-87	8.94(3.07)^{abcd}	8.93(3.07)^{abcd}	11.77(3.5)^{ab}	42.99(40.97)^{abcdefg}	7	S
31	TRCRM-147	11.12(3.41)^{a}	10.46(3.31)^{ab}	10.01(3.24)^{abc}	48.64(44.22)^{abc}	7	S
32	DGWG-57	7.37(2.81)^{abcde}	6.29(2.61)^{abcde}	7.05(2.75)^{abc}	23.41(28.94)^{defghij}	5	MS
33	DGG-1	6(2.55)^{abcde}	5.94(2.54)^{abcde}	8.08(2.93)^{abc}	19.78(26.41)^{ghij}	5	MS
34	DGGV-2 (S. Check)	5.97(2.54)^{abcde}	10.12(3.26)^{ab}	12.86(3.66)^{a}	54.39(47.52)^{ab}	9	HS
35	IPM-2-14 (R Check)	3.02(1.88)^{e}	3.07(1.89)^{de}	9.55(3.17)^{abc}	1(5.74)^{k}	1	R
	SEm	0.21	0.21	0.23	2.66	-	-
	CD 5 per cent	0.59	0.6	0.64	7.51	-	-
	CV	13.8	13.8	13.78	14.5	-	-

Figures in parenthesis are ARCSIN transformed (*) and square root ($\sqrt{x+0.5}$) transformed values, Means showing similar alphabets do not differ significantly by Tukey test, R- Resistant, MR-Moderately resistant, HS-Highly susceptible, S-Susceptible, MS- Moderately susceptible

highly resistant (R), each with only 1.00 per cent disease index. Several genotypes, including DGG 10 (5.32 per cent) and DGGV 2 × RMG1028 (6.14 per cent), were identified as moderately resistant (MR).

Discussion

The screening of thirty-five mungbean genotypes across three different environments provided a robust assessment of their genetic potential for resistance to the sucking pest complex and YMD. The significant variation observed among genotypes confirms the presence of genetic diversity for these traits within the tested germplasm, which is a prerequisite for any successful resistance breeding program. The findings are in agreement with previous studies that have reported differential responses of mungbean and urdbean

Table 5: Screening of genotypes against mungbean pests at Gadagduring *Kharif* -2024.

S. no.	Genotypes	Leaf hoppers/ trifoliate	White fly population	No. of thrips	*YMD per cent	Disease Score	Rating
1	SM 24-104	4.18(2.16)^{abcd}	6.67(2.68)^{abcde}	7.75(2.87)^{ab}	24.17(29.45)^{cdefghij}	5	MS
2	SM 24-106	3.32(1.95)^{abcd}	2.44(1.71)^{def}	4.59(2.26)^{b}	8.52(16.97)^{jklm}	3	MR
3	DGWG-11	3.18(1.92)^{abcd}	4.12(2.15)^{abcdef}	5.63(2.48)^{ab}	16.28(23.8)^{ghijkl}	5	MS
4	DGG-100	6.22(2.59)^{abcd}	6.82(2.71)^{abcde}	7.91(2.9)^{ab}	32.34(34.66)^{bcdefghi}	5	S
5	DGG-96	2.28(1.67)^{d}	1.12(1.27)^{f}	3.21(1.93)^{b}	1(5.74)^{m}	1	R
6	DGG-21	5.12(2.37)^{abcd}	7.08(2.75)^{abcde}	6.42(2.63)^{ab}	53(46.72)^{ab}	9	HS
7	BWMCD-31	4.56(2.25)^{abcd}	7.36(2.8)^{abcd}	6.98(2.73)^{ab}	18.35(25.36)^{fghijkl}	5	MS
8	DGGV 2 X IPM409-4	4.24(2.18)^{abcd}	6.61(2.67)^{abcde}	5.78(2.51)^{ab}	9.52(17.97)^{jklm}	3	MR
9	DGGV 2 X SONAMUNG 8-1	4.41(2.22)^{abcd}	6.98(2.73)^{abcde}	7.33(2.8)^{ab}	12.98(21.12)^{ijkl}	5	MS
10	DGG 10	3.54(2.01)^{abcd}	4.17(2.16)^{abcdef}	4.26(2.18)^{b}	5.32(13.34)^{lm}	3	MR
11	DGGV 2 X RMG1028	3.19(1.92)^{abcd}	4.72(2.28)^{abcdef}	5.45(2.44)^{ab}	6.14(14.35)^{klm}	3	MR
12	DGGV 2 X V-02-802	5.41(2.43)^{abcd}	3.4(1.97)^{cdef}	3.86(2.09)^{b}	11.06(19.42)^{jklm}	5	MS
13	DGG1 X TM 96-2	5.52(2.45)^{abcd}	4.5(2.24)^{abcdef}	5.11(2.37)^{ab}	19.85(26.46)^{efghijkl}	5	MS
14	DGG-218	4.36(2.2)^{abcd}	7.65(2.85)^{abc}	8.27(2.96)^{ab}	34.5(35.97)^{abcdefgh}	7	S
15	DGG-201	7.65(2.85)^{abc}	8.23(2.95)^{abc}	10.11(3.26)^{ab}	39.25(38.79)^{abcdef}	7	S
16	DGG-211	8.54(3.01)^{ab}	7.8(2.88)^{abc}	8.26(2.96)^{ab}	41.67(40.2)^{abcde}	7	S
17	DGG-7	7.13(2.76)^{abcd}	8.82(3.05)^{abc}	9.85(3.22)^{ab}	37.97(38.04)^{abcdef}	7	S
18	DGG-266	6(2.55)^{abcd}	3.96(2.11)^{bcdef}	6.27(2.6)^{ab}	22.13(28.06)^{defghijk}	5	MS
19	4 MBRD-76	4.3(2.19)^{abcd}	5.14(2.37)^{abcdef}	4.22(2.17)^{b}	14.27(22.19)^{hijkl}	5	MS
20	5 BRD-1	8.92(3.07)^{a}	10.23(3.28)^{a}	8.73(3.04)^{ab}	58.25(49.75)^{a}	9	HS
21	8 BRD-20	7.63(2.85)^{abc}	6.17(2.58)^{abcde}	6.87(2.71)^{ab}	11.56(19.88)^{ijkl}	5	MS
22	DGG-269	3.47(1.99)^{abcd}	4.05(2.13)^{bcdef}	5.24(2.4)^{ab}	19.78(26.41)^{efghijkl}	5	MS
23	DGG-195 X VGG rul 4-2	2.75(1.8)^{cd}	3.94(2.11)^{bcdef}	4.26(2.18)^{b}	46.28(42.87)^{abc}	7	S
24	SM 24-214	6.42(2.63)^{abcd}	5.92(2.53)^{abcde}	4.17(2.16)^{ab}	33.8(35.55)^{bcdefgh}	7	S
25	SM 24-216	9.02(3.09)^{a}	6.05(2.56)^{abcde}	8.73(3.04)^{ab}	35.31(36.46)^{abcdefg}	7	S
26	SM 24-222	8.74(3.04)^{a}	7.84(2.89)^{abc}	11.17(3.42)^{ab}	40.01(39.24)^{abcdef}	7	S
27	SM 24-221	6.32(2.61)^{abcd}	5.19(2.39)^{abcdef}	6.02(2.55)^{ab}	18.66(25.59)^{fghijkl}	5	MS
28	SM 24-198	7.99(2.91)^{abc}	5.83(2.52)^{abcde}	6.7(2.68)^{ab}	34.35(35.88)^{abcdefgh}	7	S
29	SM 24-202	6.07(2.56)^{abcd}	5.98(2.55)^{abcde}	7.64(2.85)^{ab}	32.4(34.7)^{bcdefghi}	7	S
30	DGG-87	8.11(2.93)^{abc}	8.1(2.93)^{abc}	10.94(3.38)^{ab}	37.59(37.81)^{abcdef}	7	S
31	TRCRM-147	10.29(3.28)^{abc}	9.63(3.18)^{ab}	9.18(3.11)^{ab}	42.76(40.84)^{abcd}	7	S
32	DGWG-57	6.54(2.65)^{abc}	5.46(2.44)^{abcde}	6.22(2.59)^{ab}	22.18(28.1)^{defghijk}	5	MS
33	DGG-1	5.17(2.38)^{abcd}	5.11(2.37)^{abcdef}	7.25(2.78)^{ab}	18.23(25.28)^{fghijkl}	5	MS
34	DGGV-2 (S. Check)	5.14(2.37)^{bcd}	9.29(3.13)^{ab}	12.03(3.54)^{ab}	52.11(46.21)^{ab}	9	HS
35	IPM-2-14 (R Check)	2.19(1.64)^{abcd}	2.24(1.66)^{ef}	12.57(3.62)^{a}	1(5.74)^{m}	1	R
	SEm	0.20	0.20	0.22	2.48	-	-
	CD 5 per cent	0.55	0.56	0.61	7.00	-	-
	CV	13.86	13.85	13.82	14.61	-	-

Figures in parenthesis are ARCSIN transformed (*) and square root ($\sqrt{x+0.5}$) transformed values,
Means showing similar alphabets do not differ significantly by Tukey test, R- Resistant,
MR-Moderately resistant, HS-Highly susceptible, S-Susceptible, MS- Moderately susceptible

genotypes to sucking pests and YMD (Yadav and Dahiya, 2000; Kumar *et al*., 2006; Panduranga *et al*., 2011).

The most significant outcome of this study is the consistent and stable performance of genotypes IPM-2-14 (the resistant check) and DGG-96. Across all three trials (Dharwad *Kharif*, Dharwad *Rabi*, and Gadag *Kharif*), these two genotypes consistently recorded the lowest populations of leaf hoppers and whiteflies, and exhibited a strong resistant reaction to YMD. This stability across different seasons and agro-ecological zones is highly desirable, as it suggests that the resistance mechanism is robust and less influenced by environmental fluctuations. The low whitefly population on these genotypes is particularly important, as it directly correlates with the low incidence of YMD, confirming the role of antixenosis or antibiosis against the vector as a key resistance mechanism. This aligns with the findings of Kooner and Cheema (2007), who identified resistant donors against *B. tabaci* and the associated virus.

Conversely, the consistent high susceptibility of genotypes 5 BRD-1, TRCRM-147, and the susceptible check DGGV-2 to both the sucking pests (especially whiteflies and leaf hoppers) and YMD across all environments validates their use as reliable susceptible checks in future screening programs. The high pest load and disease incidence on these genotypes confirm that the environmental conditions were conducive for pest multiplication and disease development, thereby ensuring adequate screening pressure.

An interesting and somewhat paradoxical observation was the high population of thrips on the YMD-resistant check, IPM-2-14, in two of the three trials. This suggests that the genetic mechanisms conferring resistance to whiteflies and YMD may not be effective against thrips. It highlights the complexity of breeding for multiple pest resistance and indicates that resistance to different pests can be governed by independent genetic factors. This finding is crucial for breeding programs, emphasizing the need to pyramid different resistance genes to develop varieties with a broader resistance spectrum.

The identification of moderately resistant (MR) genotypes like DGG 10 and SM 24-106 is also valuable. While not as effective as the resistant genotypes, they still represent a significant improvement over the susceptible ones and can be used as parents in breeding programs to introgress moderate levels of resistance into high-yielding backgrounds. The performance of genotypes varied between the *Kharif* and *Rabi* seasons at Dharwad, with generally higher pest and disease pressure observed during *Rabi*. This seasonal variation underscores the importance of multi-season and multi-location testing to identify genotypes with stable and durable resistance.

Conclusion

The study successfully identified stable sources of resistance to the sucking pest complex and Mungbean Yellow Mosaic Disease. Genotypes IPM-2-14 and DGG-96 consistently demonstrated high levels of resistance to leaf hoppers, whiteflies, and YMD across different seasons and locations, making them excellent donor parents for resistance breeding programs. Their stable performance suggests the presence of durable resistance mechanisms. Genotypes 5 BRD-1 and DGGV-2 were confirmed as reliable susceptible checks. The study also revealed that resistance to different sucking pests may be independently controlled, highlighting the need for targeted breeding strategies to pyramid multiple resistance genes. The identified resistant and moderately resistant genotypes are valuable genetic resources that can be exploited to develop high-yielding mungbean varieties with enhanced protection against the major biotic stresses in the region.

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