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Varietal Screening of Mungbean Genotypes against Whitefly (*Bemisia tabaci* Genn.), Mungbean Yellow Mosaic Virus (MYMV) and *Cercospora* Leaf Spot

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A B S T R A C T

Field screening of 52 mungbean genotypes for resistance against whitefly, Mungbean Yellow Mosaic Virus (MYMV) and *Cercospora* leaf spot was carried out during *Rabi* and *Kharif* on 2015-2016. Population of whitefly ranged from 2.5 to 7.7 no./3 leaves while MYMV incidence ranged from 13.7 to 66.2 per cent. Two cultures *viz*., VBN 2 and CO 8 recorded low mean population of whitefly 2.5 and 2.7 no/3 leaves, respectively followed by VBN-3 (2.9 no. /3 leaves), PDM-54 (3.1 no. /3 leaves) and GM 4 (3.5 no. /3 leaves) whereas RM 612 recorded high mean population of whitefly (7.7 no. /3 leaves) followed by VGG-07-007 (7.1 no. /3 leaves) and VGG-007-002 (7.6 no. /3 leaves). MYMV incidence was low in VBN 2(13.7%) followed by Co 8 (20.0%) and VGG-10-002 (17.5%) while high in RM 612 (66.2%) followed by VGG-007-002 (60.0%) andVGG-07-007 (58.7%). Based on 0-5 scale, none of the entries were found to be highly resistant/ resistant to MYMV. However, nine genotypes were found to be moderately resistant. With regard to *Cercospora* leaf spot screening based on Rating Scale and Per cent Disease Intensity (PDI), minimum PDI was recorded in Co4 (6.6) followed by VGG-099-021 (9.4) and hence regarded as resistant while SLM-130(16.6) showed moderately resistant reaction followed by GM4 (18.6).

Introduction

Mungbean, [*Vignaradiata* (L.) Wilczek)] is considered as one of the most economically important food legume crops of India. In India, it is the third most popular pulse crop after chickpea and pigeonpea. Despite its short duration, nearly 85 insect pests attack mungbean from field to storage. Aphids, whitefly, leafhopper, thrips, stem fly, pod bug and pod borer complex are more significant on mungbean throughout the country. Among these, whiteflies acts as vector of mungbean yellow mosaic virus (MYMV). The mosaic incidence is as high as cent per cent in farmer's field in the Indian subcontinent, often resulting in considerable yield losses. Important diseases of greengram are root rot, wilt, leaf spot, powdery mildew, leaf curl and leaf crinkle disease. *Cercospora* leaf spot is one of the important diseases that cause serious losses to mungbean crop and 23 per cent losses in yield have been reported (Quebral and Cagampang, 1970). The disease starts appearing about 30 to 40 days after planting. Depending upon the temperature and humidity, it spreads rapidly in susceptible varieties causing premature defoliation and

reduction in size of pods and grains (Grewal *et al.,* 1980). The cheapest, practical and economical control of the pest and disease can be achieved by the resistant source of insect and disease. Therefore, it is necessary to identify resistant /moderately resistant genotype to reduce the insect and disease population as well as the production cost to protect the environment. The present investigation on the identification of the sources of resistance is present-day requisite.

Materials and Methods

Field screening was carried out in farmer's holding at Thuyyaneri, Madurai East Block during *Rabi* and *kharif* on 2015- 2016 with 52 mungbean genotypes obtained from TNAU, Coimbatore and NPRC, Pudukottai. Each genotype was sown in two rows of one metre length with row to row spacing and plant to plant spacing of 30x10 cm. Each treatment was replicated two times in a Randomized Block Design (RBD). The crop was grown by following recommended agronomic practices (Crop Production Guide, 2014) without spraying any insecticide.

Whitefly and Mungbean Yellow Mosaic Virus (MYMV)

The whitefly count was taken at 35 and 45days after sowing (DAS) when its population was high selecting five plants from each genotype and from each plant three leaves representing top, middle and bottom part and over all mean was computed. For recording MYMV incidence, observations were recorded on total plant stand of each genotype and those attacked by MYMV at 45 and 55 days after sowing (DAS). Based on the severity of the MYMV incidence, the genotypes were grouped into different categories based on 0 - 5 scale, as shown below (Bashir, 2005).

Disease rating scale used for categorization of mungbean genotypes against MYMV

Scale	Percent infection	Infection category	Reaction group
0	All plant free of disease symptoms	Highly resistant	HR
1	1-10	Resistant	R
2	11-20	Moderately resistant	MR
3	21-30	Moderately susceptible	MS
4	31-50	Susceptible	S
5	More than 50	Highly susceptible	HS

Cercospora leaf spot

Ten plants per plot were selected and tagged for observations. The observation on leaf spot infection was recorded at 30 and 40 days after sowing by selecting three leaves each from top, middle and lower portion of the plant. The genotypes were grouped in 0-5 scale based on the area affected, as shown below (Sabalpara *et al.,* 2008) (Fig. 1).

Rating Scale	Per cent area infection
0	No infection
1	1 to 20 per cent necrotic leaf area
2	21 to 40 per cent necrotic leaf area
3	41 to 60 per cent necrotic leaf area
4	61 to 80 per cent necrotic leaf area
5	Above 80 per cent necrotic leaf area

The per cent disease intensity was calculated by using the formula used by Sabalpara *et al.*, (2008)

$$PDI = \frac{\text{Sum of ratings of infected leaves observed}}{\text{No. of leaves observed x Maximum disease score}} \times 100$$

Per Cent Disease Intensity used for categorization of mungbean genotypes against leaf spot

PDI	Reaction
0.0 to 10.0	Resistant (R)
10.1 to20.0	Moderately Resistant (MR)
20.1 to40.0	Moderately Susceptible (MS)
40.1 to 60.0	Susceptible(S)
Above 60.0	Highly Susceptible (HS)

Yield

The grain yield was recorded from each plot (20 plants) and converted into kg/ha.

Statistical procedures

The data were analyzed as per standard statistical procedures in AGRES software. Whitefly population data were subjected to square root transformation and for disease incidence data were subjected to angular transformation and analysis of variance P=0.05.

Results and Discussion

Whitefly

In the field screening of 52 genotypes, the whitefly population ranged from 2.5 to 7.7 no. / 3 leaves. As observed, VBN - 2(2.5no. / 3 leaves) was found to be the least preferred genotype on par with CO 8 (2.7no./ 3 leaves) and VGG-10-002 (2.7 no./ 3 leaves). While RM 612 (7.7 no. / 3 leaves) was the most preferred genotype followed by VGG-007-002 (7.6 no. /3 leaves) and VGG-07-007 (7.1 no. /3 leaves) (Table 1)**.** Panduranga *et al.*, (2011) reported KM 200 recorded low whitefly population (1.55 no. /plant) while high in MGG (7.66/plant).

Mungbean yellow mosaic virus

The MYMV incidence ranged from 13.7 to 66.2 per cent. None of the entries were found to be highly resistant/ resistant to MYMV (Scale 0 and 1). However, nine genotypes were found to be moderately resistant (Table 2)**.** Significantly low incidence of MYMV was recorded in VBN 2 (13.7%) followed by CO 8 (20.0%) and VGG-10-002 (20.5%) and highest in RM 612 (66.2%) followed by VGG-007-002 (60.0%) and VGG-07-007 (58.7%).These results gain support from Panduranga *et al.*, (2011) and Aswathi *et al.*, (2008).

Sana Habib *et al.*, (2007) reported out of 108 test lines, the two test lines NM-38-203-34 and NCM-257-10-36 showed the minimum incidence of 8 per cent, and eight test lines exhibited 17 per cent incidence. The remaining test lines showed the disease incidence ranging from 33-67 per cent.

Cercospora leaf spot

Out of fifty two genotypes screened under natural condition, minimum per cent disease index was recorded in CO4 (6.6%) followed by VGG-099-021 (9.4%) and hence regarded as resistant while SLM-130(16.6%) showed moderately resistant reaction followed by GM 4,VGG-10-008, VGG-10-005, VGG-04-008, VGG-10-004 and VGG-05-006, The other genotypes *viz*. KM-2, VGG-10-002, KM-14-53, VGG-05-010, VGG-08-003, VBN-1, RM-604, VGG-04-013, VGG-05-009, MG-161, JALAGAM, VGG-05-001, VGG-10-023, PDM-54, AC-154, CO-5 and VGG-05-006 were moderately susceptible (Table 3).

Table.1 Screening of green gram genotypes for resistance to whitefly *Bemisia tabaci* against mungbean yellow mosaic virus and leaf spot disease

S. No	Genotypes	Mean number of whitefly / 3 leaves[#]	MYMV incidence (%)[#]	Leaf spot PDI (%)[#]	Yield (kg/ ha)
1.	KM-2	4.9 (2.2)$^{e-l}$	28.7 (32.3)$^{b-h}$	36.1 (36.7)$^{h-o}$	610
2.	CO-7	3.9 (1.9)$^{b-f}$	27.5 (31.5)$^{b-g}$	70.8 (57.4)$^{u-x}$	862
3.	VGG-10-008	5.0 (2.2)$^{e-l}$	25.0 (29.9)$^{b-f}$	18.6 (25.2)$^{b-e}$	633
4.	VGG-10-005	5.6 (2.3)$^{l-r}$	25.0 (29.7)$^{b-e}$	19.1 (25.7)$^{b-e}$	668
5.	KM-14-54	6.8 (2.6)$^{h-n}$	56.2 (48.6)^{kl}	84.1 (68.6)^{x}	466
6.	VGG-10-002	2.7 (1.6)^{a}	17.5 (24.4)^{ab}	33.7 (35.4)$^{h-n}$	881
7.	GM 4	3.5 (1.8)$^{b-f}$	20.0 (26.3)$^{a-c}$	18.6 (25.2)$^{b-e}$	762
8.	VGG-099-021	5.8 (2.4)$^{h-o}$	41.2 (39.9)$^{h-j}$	9.4 (17.8)^{ab}	586
9.	KM-14-53	4.4 (2.1)$^{c-h}$	26.2 (30.5)$^{b-g}$	25.5 (30.3)$^{c-h}$	807
10.	VGG-10-001	3.20 (1.7)$^{a-d}$	18.7 (25.6)$^{a-c}$	46.8 (43.1)$^{n-r}$	626
11.	VGG-05-010	4.6 (2.1)$^{e-k}$	27.5 (31.5)$^{b-g}$	27.6 (31.5)$^{c-i}$	720
12.	VGG-08-003	4.6 (2.1)$^{b-e}$	27.5 (31.5)$^{b-g}$	22.6 (28.3)$^{c-g}$	541
13.	PUSA-103	3.5 (1.8)$^{b-f}$	17.5 (24.4)^{ab}	51.9 (46.1)$^{p-r}$	736
14.	KM-14-55	4.9 (2.2)$^{e-k}$	27.5 (31.5)$^{b-g}$	56.1 (48.5)$^{q-t}$	800
15.	VBN-1	5.7 (2.3)$^{h-o}$	36.2 (36.9)$^{d-g}$	28.6 (32.2)$^{d-k}$	678
16.	RM-604	5.3 (2.3)$^{h-n}$	27.5 (31.5)$^{b-g}$	21.1 (27.2)$^{c-f}$	557
17.	VGG-04-008	5.3 (2.3)$^{i-n}$	30.0 (32.9)$^{c-h}$	16.2 (23.7)^{bc}	599
18.	VGG-04-013	6.0 (2.4)$^{i-q}$	48.7 (44.2)$^{i-k}$	28.3 (31.9)$^{d-j}$	591
19.	VGG-05-009	4.8 (2.2)$^{e-l}$	28.7 (32.2)$^{b-h}$	25.6 (30.4)$^{c-h}$	701
20.	SLM-130	5.4 (2.3)$^{e-l}$	26.2 (30.7)$^{b-g}$	16.6 (23.6)^{bc}	645
21.	V 1388	5.0 (2.2)$^{g-n}$	32.5 (34.6)$^{d-h}$	49.1 (44.4)$^{o-r}$	679
22.	EC-396114	4.6 (2.1)$^{e-j}$	27.5 (31.5)$^{b-g}$	44.4 (41.7)$^{m-q}$	641

23.	MG-161	5.7 (2.4)$^{l-r}$	38.7 (37.9)$^{f-i}$	29.7 (32.8)$^{e-l}$	465
24.	JALAGAM	7.1 (2.6)^{prs}	58.7 (50.0)^{kl}	25.5 (30.1)$^{c-h}$	834
25.	SALEM LOCAL	7.1 (2.6)^{rs}	55.0 (47.9)$^{j-l}$	69.3 (57.0)$^{u-w}$	762
26.	RM 612	7.7 (2.7)$^{k-r}$	66.2 (54..5)$^{j-l}$	80.2 (60.6)$^{v-x}$	609
27.	VBN-3	2.9 (1.7)$^{a-c}$	18.7 (25.6)$^{a-c}$	40.2 (39.3)$^{i-p}$	940
28.	VGG-06-03	4.9 (2.2)$^{f-m}$	30.0 (32.3)$^{b-h}$	46.5 (42.9)$^{n-r}$	756
29.	MEGA	5.6 (2.3)$^{h-n}$	37.5 (37.7)$^{e-i}$	54.0 (47.3)$^{p-s}$	632
30.	VGG-10-004	5.8 (2.4)$^{i-q}$	35.0 (36.2)$^{d-i}$	17.3 (24.4)$^{b-d}$	686
31.	RM 605	5.6 (2.3)$^{h-o}$	38.7 (38.3)$^{g-i}$	70.0 (57.9)$^{u-w}$	660
32.	CO 6	4.0 (2.0)$^{b-f}$	27.5 (31.5)$^{b-g}$	41.5 (40.1)$^{k-p}$	689
33.	VGG-05-001	4.5 (2.13)$^{e-l}$	27.5 (31.5)$^{b-g}$	32.0 (34.3)$^{f-m}$	664
34.	MGG-351	7.0 (2.6)^{qrs}	56.2 (48.6)^{kl}	68.3 (56.4)$^{t-w}$	763
35.	KM-14-57	7.0 (2.6)$^{m-s}$	53.7 (47.1)$^{j-l}$	78.7 (62.9)$^{v-x}$	803
36.	VGG-07-007	7.1 (2.67)$^{n-s}$	60.0 (50.8)^{kl}	73.5 (44.0)$^{v-x}$	816
37.	VGG-10-012	4.8 (2.1)$^{e-i}$	28.7 (31.7)$^{b-g}$	54.1 (47.4)$^{p-s}$	648
38.	VGG-10-023	4.8 (2.1)$^{e-j}$	28.7 (32.2)$^{b-h}$	36.7 (37.2)$^{h-o}$	618
39.	PLS-313	3.2 (1.7)$^{a-c}$	20.0 (26.4)$^{a-c}$	40.9 (39.7)$^{j-p}$	704
40.	PUSA-121	4.1 (2.0)$^{b-e}$	26.2 (30.5)$^{b-g}$	42.5 (40.6)$^{l-q}$	726
41.	PDM-54	3.1 (1.7)$^{a-c}$	18.7 (25.5)$^{a-c}$	21.3 (27.4)$^{c-g}$	900
42.	VGG-04-019	5.7 (2.3)$^{k-r}$	35.0 (36.2)$^{d-i}$	17.0 (25.1)$^{b-d}$	590
43.	AC-154	5.8 (2.4)$^{j-p}$	37.5 (37.4)$^{e-i}$	30.1 (33.1)$^{e-l}$	710
44.	CO-5	5.6 (2.3)$^{l-r}$	62.5 (52.2)^{kl}	27.7 (31.5)$^{c-i}$	600
45.	VGG-007-002	7.6 (2.7)^{s}	58.7 (50.0)^{kl}	79.1 (64.3)^{wx}	642
46.	LM 222	7.0 (2.6)$^{o-s}$	56.2 (48.6)^{kl}	70.4 (57.3)$^{u-w}$	719
47.	ML-1012	7.0 (2.6)$^{j-r}$	58.7 (50.0)^{kl}	67.0 (55.3)$^{s-v}$	838

48.	PBM-84-143	4.9 (2.2)$^{d-i}$	27.5 (31.5)$^{b-g}$	51.9 (46.1)$^{p-r}$	670
49.	CO-8	2.7 (1.6)^{a}	20.0 (26.3)$^{a-c}$	60.2 (50.9)$^{r-t}$	970
50.	VBN-2	2.5 (1.5)^{ab}	13.7 (21.5)^{a}	56.2 (48.6)$^{q-t}$	932
51.	CO-4	5.8 (2.4)$^{i-r}$	38.7 (38.0)$^{g-i}$	6.6 (14.9)^{a}	743
52.	VGG-05-006	5.9 (2.4)$^{i-q}$	48.7 (44.2)$^{i-k}$	20.5 (26.9)$^{c-f}$	743
	SED	0.21	5.7	5.8	0.57
	CD(0.05)	0.416	11.3	11.4	1.14
	CV %	9.03	5.78	8.28	2.16

[#] Mean of two seasons.
Values in parentheses are transformed value**.**

Table.2 Categorization of mungbean genotypes based on the incidence of whitefly and resistance reaction to MYMV (0 -5 scale)

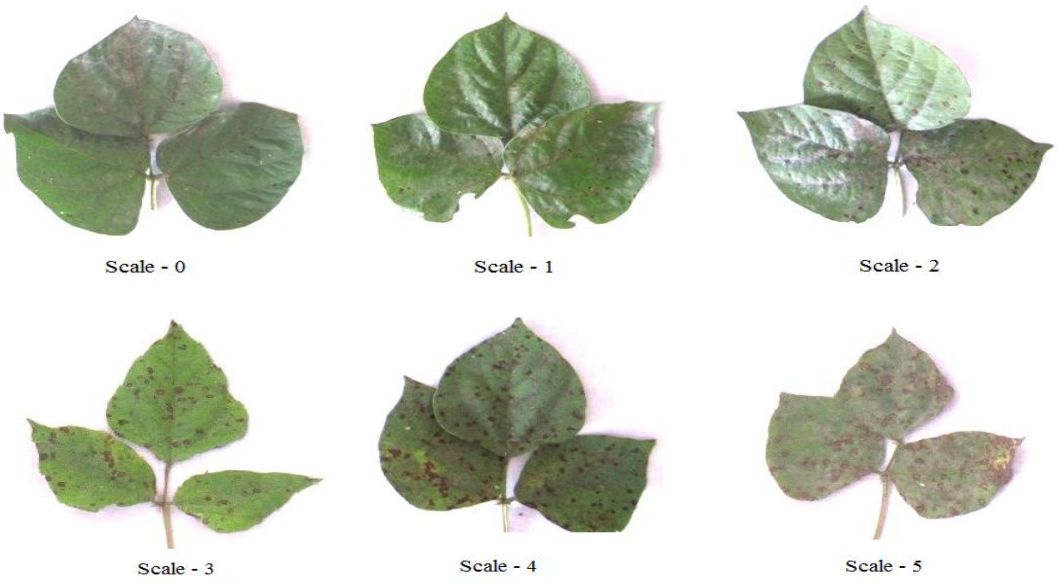
S. No	Genotypes	Mean number of Whitefly/ 3 leaves[#]	MYMV incidence (%)	Disease scale	Reaction group
1	-----	----		0	HR
2	-----	----		1	R
3	VBN-2, CO-8, PDM-54,VGG-10-002, GM-4, VGG-10-001, PUSA 103,VBN-3 and PLS-313.	2.50 - 3.55	13.75-20.00	2	MR
4	KM-2, CO-7, KM-14-53,VGG-05-010, VGG-10-008,VGG-10-005, VGG-08-003, KM-14-55, RM-604, VGG-04-008, VGG-05-009, SLM-130, V-1388,EC-396114, VGG-06-03, VGG-05-001, VGG-10-012, VGG-10-023, PBM-84-143 and Co - 6.	3.90-5.65	25.00 - 30.00	3	MS
5	VGG-099-021, VBN-1, VGG-04-013, MG-161, VGG-10-004, RM 605, VGG-04-019, AC-154,CO-4,VGG-05-006, MEGA and CO-5.	5.60 - 6.00	35.00 - 48.75	4	S
6	KM-14-54, JALAGAM, SALEM LOCAL, RM 612, MGG-351, KM-14-57,VGG-07-007,VGG-007-002, ML-1012 and LM 222.	6.90 - 7.70	53.75-66.25	5	HS

HS - Highly Resistant, R - Resistant, MS - Moderately resistant, MS - Moderately susceptible, S - Susceptible, HS - Highly susceptible

Table.3 Categorization of mungbean genotypes based on the PDI and resistance reaction to leaf spot disease

S. No	Genotypes	PDI (%)	Reaction group
1.	CO-4 andVGG-099-021	6.67-9.44	Resistant (R)
2.	VGG-10-008, VGG-10-005, VGG-04-008, VGG-10-004, VGG-05-006 and GM 4	16.67-19.17	Moderately resistant (MR)
3.	KM-2, VGG-10-002, KM-14-53,VGG-05-010, VGG-08-003, VBN-1, RM-604, VGG-04-013, VGG-05-009, MG-161, JALAGAM, VGG-05-001, VGG-10-023, PDM-54, AC-154, CO-5 and VGG-05-006	21.11-36.11	Moderately susceptible (MS)
4.	VGG-10-001, PUSA-103, KM-14-55, V-1388, EC-396114, VBN-3, VGG-06-03, MEGA, CO 6, VGG-10-012, PLS-313, PUSA-121, PBM-84-143 and VBN-2	40.28-56.25	Susceptible(S)
5.	CO-7, KM-14-54, SALEM LOCAL, RM 612, RM 605, MGG-351, KM-14-57, VGG-07-007, VGG-007-002, LM 222,ML-1012 and CO-8,	60.28-84.17	Highly susceptible (HS)

Fig.1 Rating scale per cent area infection



Similar studies were carried out by Sabalpara *et al*., (2008) and reported minimum PDI in CO 4 (8.66%) and GM 4 (21.99%). Iqbal *et al*., (2004) evaluated fifty eight mungbean genotypes for resistance against *Cercospora* leaf spot disease under artificially inoculated disease condition in the field and 12 genotypes(NM-98, 98-cmg-003, C2/94-4-42, NM-1, NM-2, 98cmg-018, BRM-188, CO-3, Basanti, PDM-11, BARI Mung-2, VC3960-88) were identified as highly resistant.

Yield

Greengram variety Co 8 which showed

moderately resistant reaction to MYMV and recorded significantly highest yield (970kg/ ha.) followed by VBN 3 (940 kg/ha) and VBN 2 (932 kg /ha) (Table 1).*Cercospora* resistant genotypes are CO 4 and VGG-099-021 which recorded yield of 743 and 586 kg /ha., respectively. Panduranga *et al.,* (2011) reported that entry ML 267 which showed resistant reaction to MYMV recorded significantly higher yield of 1033 kg/ha as against lowest yield (291kg/ha) recorded in the susceptible check WGG 2. Mondol *et al.,* (2013) reported that among the less MYMV infected 18 mungbean lines, ACC12840014 gave highest yield (2888 kg/ha) followed by VC1007A (2844 kg/ha.) and VO-1319 (B-G) (2788 kg/ha).

To summarize, mungbean genotypes *viz*., VBN 2, CO 8 and VGG-10-002 were least preferred by the whitefly population and had significantly low incidence of MYMV. With regard to *Cercospora* leaf spot minimum per cent disease index was recorded in CO 4 (6.6%) followed by VGG-099-021 (9.4%). On the basis of these findings, it could be concluded that VBN 2, CO 8 and VGG-10-002 as moderately resistant to whitefly and MYMV, while CO 4 and VGG-099-021 as resistant to *Cercospora* leaf spot which may further be exploited in breeding programme.

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