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Field screening of greengram (*Vigna radiata* L.) genotypes for resistance against major viral diseases

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Abstract

Green gram genotypes were evaluated to identify the sources of resistance to Mung bean Yellow Mosaic Virus and Urdbean Leaf curl Crinckle Virus diseases. Screening was done under natural field conditions at Regional Agricultural Research Station, Warangal, Telangana State, India. The experimental material consisted fifty seven All India Coordinated Research Project and state nineteen Green gram entries with one check during *Kharif*-2017 and nineteen AICRP and twelve state green gram entries with a check during *Rabi*-2017, which were screened against the major viral diseases at RARS, Warangal. Out of one hundred eleven Green gram entries, one entry *viz.*, WGG-42 was found immune to mung bean yellow mosaic virus disease. Out of seventy eight green gram entries were screened against urdbean leaf crinckle virus disease during *Kharif* 2017, the disease severity index in seventy eight AICRP green gram germplasm lines range was from 1% to 5%. Based on the disease reaction of both replications during *Kharif*-2017, thirty entries *viz.*, BM 4, AKM 8802, AKM 12-28, ML- 2479, ML-818, SKNM 1504, SKNM 1502, VGG 16-036, LGG 607, LGG 460, LBG 450, Pant M4, PM 14-11, COGG 13-39, KM 2355, KM 2241, K 851, Pusa 0672, NDMK 16-324, JLM-30246, JAUM0936, MH1142, IPM 02-3, IPM 312-19, Kopergoan, MGG-387, MGG-295, MGG-359, MGG-360 and MGG-434 were found resistant to urdbean leaf curl virus disease.

Keywords: Genotypes, screening, resistance, mung bean yellow mosaic virus (MYMV) and urdbean leaf curl crinckle virus diseases, greengram

Introduction

Greengram crop is a major pulse crop of Telangana State. The less production of Green gram is mainly attributed to low genetic yield potentiality, indeterminate growth habit, canopy architecture, low partitioning efficiency, cultivation in marginal land, biotic and abiotic stresses. Among biotic stresses, mungbean yellow mosaic virus and urdbean leaf curl virus are major diseases and have been found to appear in the epiphytotic form thereby causing immense loss in farmers' field of Telangana State.

Depending upon crop variety and location, disease incidence of MYMV was from 4% to 40% in Pakistan (Bashir *et al.*, 2006) [4]. In several cases, leaves and other plant parts become completely yellow and the losses may be as high as 100% (Malik, 1991; Bashir *et al.*, 2006) [15, 4]. Singh *et al.*, (2000) [22] reported an incidence ranging from 0% to 58.5% among various varieties during their evaluation program for resistance against MYMV from Uttar Pradesh. MYMV disease leads to severe yield reduction not only in India, but also in Pakistan, Bangladesh and areas of South East Asia (Malathi *et al.*, 2008) [14] in Green gram.

Numerous attempts have been made for the identification of resistant sources against these diseases (Singh *et al.*, 2004; Raje and Rao, 2002, Ganapathi *et al.* 2003, Biswas *et al.* 2012 and Jameel Akhtar *et al.*, 2016) [23, 21, 7, 5, 10] of Green gram.

Urdbean leaf crinckle virus has been reported to decrease grain yield from 35% to 81% depending upon genotype and time of infection (Bashir *et al.*, 2005) [3]. Out of one hundred seven genotypes, five entries *viz.*, RME-16-3, RME-16-12, MLT-GG R-16-007, MLT-GG R-16-009 and COGG 1319 were highly resistant (HR) to Urdbean Leaf Crinckle Virus disease in greengram (Srivika *et al.*, 2019) [24].

Depending upon the temperature and humidity, these diseases spread rapidly in susceptible varieties.

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In Telangana state, it is cultivated in all most districts but prominently grown in Warangal, Khammam, Medak, Mahaboobnagar, Karimnagar, Nalgonda, Nizamabad and Rangareddy districts. Cultivation of resistant genotypes is an effective and cheaper method to combat the disease. Hence, several genotypes need to be screened to identify the source of resistance. Hence, an attempt was made to identify resistant genotypes against major viral diseases in Green gram.

Materials and Methods

Trial was conducted in a Randomized Block Design (RBD) with two replications during *Kharif-2017* and *Rabi 2017* at

RARS, Warangal, Telangana State. Germplasms were planted in two rows of 4 meter length with row spacing of 40 cm and 10 cm between plants. Recommended agronomic practices were followed.

Mungbean Yellow Mosaic Virus disease incidence

Seventy eight Green gram and thirty three green gram germplasms were evaluated under natural environmental field conditions at RARS, Warangal during *Kharif-2017* and *Rabi-2017*. The trial was laid out in RBD with two replications.

Mung bean Yellow Mosaic Virus on Green gram (0-9 scale-Mayee and Datar, 1986)^[16].

Table 1: Show the per cent leaf area coverage and description

Disease Scale	Per cent leaf area coverage	Description	Reaction
0	0	No visible Symptoms on leaves	Immune (I)
1	<1	Small yellow specks covering 0.1 to 1%	Resistant (R)
3	1-10	Yellow mottling of leaves covering 1.1 to 10% leaf area	Moderately Resistant (MR)
5	11-25	Yellow mottling of leaves covering leaf area 11 to 25%	Moderately Susceptible (MS)
7	26-50	Yellow mottling and discoloration of 26 -50% leaf area	Susceptible (S)
9	>50	Pronounced yellow mottling, discoloration of leaves and pods, reduction in leaf size and pod size, stunting of plants and no pod formation (Above 50% leaf area and pod)	Highly Susceptible (HS)

Urdbean leaf crinkle virus disease incidence

Fifty eight entries of AICRP Green gram and twenty entries of state green gram germplasms were evaluated under natural

environmental field conditions at RARS, Warangal during *Kharif-2017*. The trial was laid out in RBD with two replications.

Table 2: Disease rating scale (0-5) for ULCV (Bashir *et al.*, 2004)^[2].

Disease reaction	Disease Severity Index (DSI)	Reaction
All plants free of symptoms	0	HR
1-10% plants infected showing mild crinkling at the top, pods normal	1	R
11- 20% plants infected showing crinkling and curling of top leaves, pods normal	2	MR
21-30% plants infected with crinkling, puckering, malformation, shortening of pods	3	MS
31-40% plants infected showing all the typical disease Symptoms	4	S
More than 40% plants infected showing all the plants with severe symptoms, few pods containing few seeds	5	HS

Results and Discussion

Evaluation of Mung bean yellow mosaic virus disease incidence-Kharif-2017: Seventy eight Green gram germplasms were evaluated under natural environmental field conditions at RARS, Warangal during *Kharif-2017*. Yellow mosaic virus disease incidence in seventy eight Green gram

germplasms lines was from 0% to 90%. Based on the mean disease incidence of both replications during *Kharif-2017*, one entry WGG-42 was found immune; sixty eight entries were resistant; six entries were moderately resistant and remaining entries were susceptible to mung bean yellow mosaic virus disease (Table 3 and 4).

Table 3: Screening of Green gram entries against Yellow Mosaic Virus and Urdbean Leaf Crinkle Virus diseases – *Kharif-2017* (AICRP entries)

S.NO.	Entries	Yellow Mosaic Virus disease			Urdbean Leaf Crinkle Virus disease	
		% Leaf area coverage	0-9 scale	Reaction	Disease Severity Index	Reaction
1	BM 4	0.6	1	R	1.0	R
2	NVL 855	0.5	1	R	2.0	MR
3	AKM 8802	0.4	1	R	1.0	R
4	AKM 12-28	0.6	1	R	1.0	R
5	AKM 12-24	0.7	1	R	5.0	HS
6	ML 2479	0.4	1	R	1.0	R
7	ML 818	8.5	3	MR	1.0	R
8	SML 1808	0.6	1	R	2.0	MR
9	SKNM 1504	0.4	1	R	1.0	R
10	SKNM 1502	0.3	1	R	1.0	R
11	VGG 16-055	0.5	1	R	2.0	MR
12	VGG 16-036	0.6	1	R	1.0	R
13	LGG 607	0.2	1	R	1.0	R
14	LGG 460	0.3	1	R	1.0	R
15	LBG 450	1.0	1	R	1.0	R
16	Pant M 4	0.8	1	R	1.0	R
17	Pant M 6	1	1	R	2.0	MR
18	PM 14-3	1	1	R	2.0	MR

19	PM 14-11	1	1	R	1.0	R
20	COGG 13-39	0.6	1	R	1.0	R
21	COGG 13-19	1	1	R	2.0	MR
22	COGG 912	0.7	1	R	2.0	MR
23	KM 2355	1	1	R	1.0	R
24	KM 2241	0.8	1	R	1.0	R
25	Type 44	0.9	1	R	2.0	MR
26	K 851	0.6	1	R	1.0	R
27	Pusa 1772	0.5	1	R	2.0	MR
28	Pusa 1771	1	1	R	2.0	MR
29	Pusa 0672	1	1	R	1.0	R
30	RMG 1087	0.9	1	R	5.0	HS
31	RMG 1092	1	1	R	2.0	MR
32	RMG 1097	0.8	1	R	2.0	MR
33	NDMK16-324	0.9	1	R	1.0	R
34	SVM 6133	1	1	R	2.0	MR
35	NMK 15-08	0.6	1	R	2.0	MR
36	MDGGV 18	1.0	1	R	2.0	MR
37	JLM302-46	10	3	MR	1.0	R
38	JAUM 0936	0.8	1	R	1.0	R
39	MH 2-15	1	1	R	2.0	MR
40	MH 1142	0.6	1	R	1.0	R
41	MH 1323	1	1	R	3.0	MS
42	IPM 02-14	0.9	1	R	2.0	MR
43	IPM 02-3	1	1	R	1.0	R
44	IPM 512-1	0.9	1	R	2.0	MR
45	IPM 14-7	0.8	1	R	2.0	MR
46	IPM 312-19	1	1	R	1.0	R
47	IPM 312-20	1	1	R	2.0	MR
48	OBBG 56	0.7	1	R	2.0	MR
49	OBBG 58	1	1	R	3.0	MS
50	IGKM 2016-1	1.0	1	R	2.0	MR
51	Kopergoan	9.0	3	MR	1.0	R
52	TMB 126	0.8	1	R	2.0	MR
53	DGG 7	0.6	1	R	2.0	MR
54	MGG 387	0.4	1	R	1.0	R
55	IPM 410-9	0.5	1	R	2.0	MR
56	RMB 12-07	0.6	1	R	2.0	MR
57	Barabanki Local	0.8	1	R	3.0	MS
58	WGG-42(Check)	0	0	I	2.0	MR

[Immune (I), Highly Resistant (HR), Resistant(R), Moderately Resistant (MR), Moderately Susceptible (MS), Susceptible(S), Highly Susceptible (HS)]

Table 4: Screening of Green gram entries against Yellow Mosaic Virus and Urdbean Leaf Crinkle diseases -*Kharif-2017* (Station entries)

S. No.	Entries	Yellow Mosaic Virus disease			Urdbean Leaf Crinkle Virus disease	
		% Leaf area coverage	0-9 Scale	Reaction	Disease Severity Index	Reaction
1	MGG-295	0.8	1	R	1.0	R
2	MGG-388	0.9	9	R	3.0	MS
3	MGG-429	1.0	1	R	2.0	MR
4	MGG-434	0.9	1	R	1.0	R
5	MGG-389	10	3	MR	2.0	MR
6	MGG-444	1	1	R	2.0	MR
7	MGG-399	85	9	R	3.0	MS
8	MGG-351	1	1	R	2.0	MR
9	MGG-359	0.9	1	R	1.0	R
10	MGG-360	1	1	R	1.0	R
11	MGG-385	0.8	1	R	2.0	MR
12	MGG-395	75	9	HS	3.0	MS
13	MGG-402	90	9	HS	4.0	S
14	TM-96-2	10	3	MR	2.0	MR
15	MGG-387	0.9	1	R	2.0	MR
16	MGG-417	1	1	R	2.0	MR
17	LGG-460	0.7	1	R	2.0	MR
18	LGG-450	1.0	1	R	2.0	MS
19	WGG-37	1.0	3	R	2.0	MR
20	WGG-42 (Check)	0	0	I	2.0	MR

[Immune (I), Highly Resistant (HR), Resistant (R), Moderately Resistant (MR), Moderately Susceptible (MS) Susceptible (S), Highly Susceptible (HS)]

Rabi-2017

Thirty three green gram germplasms were evaluated under natural environmental field conditions at RARS, Warangal during *Rabi-2017*.

Yellow mosaic virus disease incidence in thirty three Green gram germplasms lines was from 0% to 25%. Based on the mean disease incidence of both replications during *Rabi-2017*, three entries *viz.*, WGG-42, MUM-2 and SML-32 were found immune, eight seven entries *viz.*, MGG-385, Kopergoan, ML 818, MGG-388, LGG 607, MLGG-17-6, MLGG-17-5 and WGG-37 were resistant; nineteen entries were moderately resistant and remaining entries were susceptible to mung bean yellow mosaic virus disease (Table 3 and 4).

Out of sixty four Mung bean lines, only six entries *viz.*, AZRI-1, NCM-15-11, NCM-21, NCM-11-8, 14063 and AZRI-06 were found resistant to yellow mosaic virus disease in Green gram (Muhammad Hanif Munawar *et al.*, 2014) [17]. Pathak and Jhamaria (2004) [19] evaluated fourteen Mung bean varieties for resistance against YMV and found ML-5 and MUM-2 with resistance of 2.22% and 3.12% infection as against 100% infection in K-851 a Check cultivar. Two entries *viz.*, GG41 and GG42 were found resistant and GG52 showed moderate resistance to MYMV in Green gram (Peerajade *et al.*, 2004) [20].

Out of twelve genotypes of green gram, only two genotypes, Meha and ML 1477 were recorded as resistant to YMV (Jameel Akhtar *et al.*, 2016) [10].

Sixty three greengram accessions evaluated, eleven entries

viz., KMP-13, 19, 20, 22, 23, 24, 26, 34, 52, MLGG-8 and WGG-42 were found immune to mung bean yellow mosaic virus disease (Vijaya Bhaskar, 2017).

Total twenty five genotypes of mungbean, seven entries *viz.*, IPM 02-03, KM 2241, PDM 139, Pusa 0672, HUM 16, ML 1464 and TARM-1 of the genotypes exhibited resistance to Yellow mosaic virus disease (Nishant Bhanu *et al.*, 2017) [12].

Among thirty five mungbean genotypes, five genotypes namely, Meha, Bada Mung 7, KM 2245, IPM 0205-7 and IPM 02-3 found highly resistant to yellow mosaic virus (Darshan *et al.*, 2018) [6].

According to Mahalingam *et al.*, 2018 [13], Out of ten greengram germplasms, only two SML 1815 and MH 421 showed resistant reaction to Yellow mosaic virus.

Twenty genotypes of mungbean germplasm were evaluated. ten lines were found resistant namely, IPM-99-125, IPM-02-14, IPM-02-03, Sweta, SML-832, PUSA-5931, MH-125, Pant Mung 4, Pant Mung5 and MH 421 to YMV (Kirti Pawar *et al.*, 2019) [11].

Out of fifty two mungbean genotypes, five genotypes namely, PM 10-18, PUSA 1371, BM 2012-09, DGGV-2 and MH 810 were found resistant to YMV (Subhash Chandra *et al.*, 2019) [25]. Among the forty eight individuals, ten progenies namely, Resplant5, Resplant22, Resplant28, Resplant35, Resplant88, Resplant92, Resplant123, Resplant156, Resplant157 and Resplant5168 are confirmed for resistance to YMV in greengram (Pandiyan *et al.*, 2020) [18].

Table 5: Screening of Green gram entries against Yellow Mosaic Virus Diseases *Rabi-2017* (AICRP entries)

S.NO.	Entries	Yellow Mosaic Virus disease		
		% Leaf area coverage	0-9 scale	Reaction
1	Pusa-9072	10	3	MR
2	TARM 1	9	3	MR
3	CO 6	10	3	MR
4	VBN (Gg)2	25	5	MS
5	MGG -385	24	5	MS
6	VGG- 15-030	9	3	MR
7	COGG -13-39	8	3	MR
8	VGG- 16-027	10	3	MR
9	VGG- 16-036	10	3	MR
10	VGG -16-055	9	3	MR
11	AGG- 35	8	3	MR
12	MGG-387	10	3	MR
13	NVL-722	10	3	MR
14	OBGG-56	9	3	MR
15	OBGG-57	8	3	MR
16	OBGG-58	10	3	MR
17	LGG- 450	10	3	MR
18	LGG- 460	9	3	MR
19	Kopergaon	8	3	MR
20	WGG-42 (Check)	0	0	I

[Immune (I), Resistant(R), Moderately Resistant (MR), Moderately Susceptible (MS), Susceptible(S), Highly Susceptible (HS)]

Table 6: Screening of Green gram entries against Yellow Mosaic Virus Diseases *Rabi-2017* (Station entries)

S. No.	Entries	Yellow Mosaic Virus disease		
		% Leaf area coverage	0-9 scale	Reaction
1	LGG-460	10	3	MR
2	MGG-385	0.8	1	R
3	Kopergaon	0.6	1	R
4	ML- 818	0.9	1	R
5	MGG-388	1.0	1	R
6	LGG 607	0.8	1	R
7	MUM-2	0	0	I
8	SML-32	0	0	I

9	MLGG-17-6	0.9	1	R
10	MLGG-17-5	1.0	1	R
11	WGG-2	25	5	MS
12	WGG-37	10	3	MR
13	WGG-42 (Check)	0	0	I

[Immune (I), Resistant(R), Moderately Resistant (MR), Moderately Susceptible (MS), Susceptible (S), Highly Susceptible (HS)]

Evaluation for urdbean leaf crinckle virus incidence

Fifty eight entries of AICRP Green gram and twenty entries of state green gram germplasms were evaluated under natural environmental field conditions at RARS, Warangal during *Kharif-2017*. The trial was laid out in RBD with two replications.

Urdbean leaf crinckle virus disease severity index in fifty eight AICRP green gram germplasm lines was from 1% to 5%. Based on the disease reaction of both replications during *Kharif-2017*, twenty six entries *viz.*, BM 4, AKM 8802, AKM 12-28, ML- 2479, ML-818, SKNM 1504, SKNM 1502, VGG 16-036, LGG 607, LGG 460, LBG 450, Pant M 4, PM 14-11, COGG 13-39, KM 2355, KM 2241, K 851, Pusa 0672, NDMK 16-324, JLM-30246, JAUM0936, MH1142, IPM 02-3, IPM 312-19, Kopergoan and MGG 387 were found resistant, twenty seven entries were moderately resistant, three entries were moderately susceptible and remaining two entries were highly susceptible to urdbean leaf crinckle virus disease (Table 3).

Urdbean leaf crinckle virus disease severity index in twenty state green gram germplasm lines was from 1% to 4%. Based on the disease reaction of both replications during *Kharif-2017*, four entries *viz.*, MGG-295, MGG-359, MGG-360 and MGG-434 were found resistant; eleven entries *viz.*, MGG-351, MGG-385, MGG-387, MGG-389, MGG-429, MGG-444, LGG-417, LGG-460, WGG-37, WGG-42 and TM-96-2 were moderately resistant, four entries (MGG-388, MGG-395, MGG-399 and LGG-450) were moderately susceptible and one entry (MGG-402) was highly susceptible to urdbean leaf crinckle virus disease (Table 4). Iqbal *et al.*, (1991)^[8] reported that out of fifty five germplasms, two entries namely, S 332 and S 539 were found to be highly resistant to ULCV in greengram. Total sixteen genotypes mungbean, only five genotypes *viz.*, VC-3960 (A-88), VC-3960 (A- 89), 98-CMH-016, NM-2 and BRM-195 were found highly resistant to ULCV (Bashir *et al.*, 2005)^[3] Among eighty seven genotypes, only four *viz.*, IAM 382-1, IAM382-9, IAM382-15 and IAM133 entries were found highly resistant to Urdbean Leaf Crinckle Virus (Ashfaq *et al.*, 2007)^[1]. According to Sravika *et al.*, 2019^[24], Out of one hundred seven genotypes, five entries *viz.*, RME-16-3, RME-16-12, MLT-GG R-16-007, MLT-GG R-16-009 and COGG 1319 were highly resistant (HR) to Urdbean Leaf Crinckle Virus disease in *Rabi* greengram.

Conclusion

Out of one hundred eleven entries, only one entry WGG-42 was found immune to mung bean yellow mosaic virus disease in *Kharif* and *Rabi* seasons. Thirty entries *viz.*, BM 4, AKM 8802, AKM 12-28, ML- 2479, ML-818, SKNM 1504, SKNM 1502, VGG 16-036, LGG 607, LGG 460, LBG 450, Pant M 4, PM 14-11, COGG 13-39, KM 2355, KM 2241, K 851, Pusa 0672, NDMK 16-324, JLM-30246, JAUM0936, MH1142, IPM 02-3, IPM 312-19, Kopergoan, MGG 387, MGG-295, MGG-359, MGG-360 and MGG-434 were found resistant to urdbean leaf crinckle disease in Green gram. Two entries *viz.*, MGG-389 and TM-96-2 were found moderately resistant to Yellow

mosaic virus and Urdbean leaf crinckle virus diseases in Green gram.

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