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Genotypes against Major Diseases in Green Gram and Black Gram under Natural Field Conditions

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A B S T R A C T

Green gram and Black gram genotypes/germplasms were evaluated to identify the sources of resistance to leaf spot, powdery Mildew and mung bean yellow mosaic virus (mymv) diseases. Screening was done under natural field conditions at Regional Agricultural Research Station (RARS), Warangal, Telangana State, India. The experimental material consisted fifty two AICRP + nine advanced Warangal Green gram entries with two checks and 10 state Warangal Black gram entries with a check, which were screened against the major diseases during Kharif-2015 at RARS, Warangal. Out of sixty three Green gram entries, only one KMP-13 was moderately resistant to Cercospora leaf spot disease, three entries viz., KMP-36, KMP-39 and KMP-41 were found highly resistant to powdery mildew, ten entries viz., KMP-13,19,20,22,23,24,40,45,MLGG-8 and WGG-42 were found immune to mung bean yellow mosaic virus disease. Out of eleven Black gram entries, only one MASH-338 was moderately resistant to Corynespora leaf spot disease, four entries viz., PU-31, MASH-338, LBG-752 and MBG-1050 were found moderately resistant to powdery mildew and two entries viz., PU-31 and MASH-338 were found immune to mung bean yellow mosaic virus disease. Resistants' can be exploited to develop high yielding varieties of Green gram and Black gram by breeding.

Introduction

Green gram and Black gram crops are major pulse crops of Telangana State. The less production of Green gram and Black 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, leaf spot, powdery mildew and mungbean yellow mosaic virus (mymv) are major diseases and have been found to appear in the epiphytotic form thereby causing immense loss in farmers' field of Telangana State. Cercospora leaf spot was first known to be occurred in Delhi, India (Munjal *et al.,* 1960) and is prevalent in all parts of the humid tropical areas of India, Bangladesh, Indonesia, Malaysia, Philippines, Taiwan as well as Thailand (Pandey *et al.,* 2009). It becomes severe in the wet season causing 0.0 % to 100.0 per cent yield loss (Quebral and Cagampang, 1970; Amin and Singh, 1987; Grewal, 1988; Iqbal *et al.,* 1995; Pandey *et al.,* 2009). Powdery mildew occurs across India and Southeast Asian countries and becomes severe in dry season causing 9.0 %

to 50.0 per cent yield loss (Reddy *et al.*, 2008; Pandey *et al.*, 2009). The powdery mildew occurs throughout the year under favorable conditions and it is more severe in late sown kharif crop.

A factor limiting breeding progress is that selection for powdery mildew resistance is confined to the cool-dry season on mungbean (Chankaew *et al.*, 2013). Depending upon crop variety and location, disease incidence of MYMV was from 4% to 40% in Pakistan (Bashir *et al.*, 2006). 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). Singh *et al.*, (2000) 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 and Biswas *et al.*, 2012) in Black gram.

Numerous attempts have been made for the identification of resistant sources against these diseases (Basandrai *et al.*, 1999, 2003, 2011a; Iqbal *et al.*, 2004; Raje and Rao, 2002; Reddy *et al.*, 1994a, 2001 and 2008) of Green gram and Black gram.

Depending upon the temperature and humidity, these diseases spread rapidly in susceptible varieties. In Telangana state, it is cultivated in all most districts but prominently grown in Warangal, Khammam, Medak, Mahaboobunagar, 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 diseases in Green gram and Black gram.

Materials and Methods

Trial was conducted in a Randomized Block Design (RBD) with two replications during Kharif-2015 at RARS, Warangal, Telangana state. Recommended agronomic practices were followed.

Evaluation for leaf spot disease incidence on Green gram and Black gram

Sixty three Green gram and eleven Black gram germplasms were evaluated under natural environmental field conditions at RARS, Warangal during Kharif-2015. Germplasms were planted in two rows of 4 meter length with row spacing of 40 cm and 10 cm between plants. The trial was laid out in RBD with two replications.

Results and Discussion

Greengram

Leaf spot disease incidence

Leaf spot disease incidence in sixty three Green gram germplasms lines was from 0% to 96%. Based on the mean disease incidence of both replications during Kharif-2015, KMP-13 was found moderately resistant, eight entries viz., KMP -19, 22, 30, 34,39,40,41 and MLGG-8 were moderately susceptible and remaining entries were susceptible to leaf spot disease (Table 1).

Out of 696 germplasms screened against leaf spot disease, 15 lines viz., (ML5, 443, 453, 515, 610, 611, 613, 682, 688, 713, 728, 735,746,759 and 769) were found resistant to leaf spot disease (Singh *et al.*, 2004). Jameel Akhtar *et al.*, (2014) reported four genotypes viz., AKM 9910, IPM 02-5, ML 1299 and SML 668 were resistant to Cercospora leaf spot disease in Green gram.

Powdery mildew disease incidence

Powdery mildew disease incidence in sixty three Greengram germplasms lines was from 0% to 90%. Based on the mean disease incidence of both replications during Kharif-2015, three entries viz., KMP-36,39 and 41 were found highly resistant, fourteen entries viz., KMP -2,3,5,19,20,24,30,34,38,42,47,52 and MLGG-8 were found resistant and remaining entries were susceptible to powdery mildew disease (Table 1). Out of 374 accessions, six entries of Green gram were found to be highly resistant viz., BL 849, BL 865, LM1668, PBM, PMB 63 and AKM 8803 (Divya Ramakrishnan *et al.*, 2014). Similarly Jameel Akhtar *et al.*, (2014) found 13 genotypes viz., KGS 83, MH 96-1, Pusa 572, GS 33-5, AKM 99-4, GS 21-5, COGG 936, ML 1299, TMB 47, HUM 1, MH 429, MH 429 and MH 530 were highly resistant reaction to powdery mildew disease in Green gram.

Several sources of resistance to Powdery mildew disease in mungbean have been reported (Hartman *et al.*, 1993 and Reddy *et al.*, 1994b). Genetic studies using different resistance sources revealed different modes of inheritance (Reddy *et al.*, 1994a; Reddy, 2009; Sorajjapinun *et al.*, 2005 and Kasettranan *et al.*, 2009), suggesting that there are different mechanisms or genes conferring resistance to powdery mildew disease.

Mung bean yellow mosaic virus disease incidence

Yellow mosaic virus disease incidence in sixty three Green gram germplasms lines was from 0% to 100%. Based on the mean disease incidence of both replications during Kharif-2015, eleven entries viz., KMP-13,19,20,22,23,24,26,34,52,MLGG-8 and WGG-42 were found immune, five entries viz., KMP-35, MGG-360, 373, 385 and MGG 395 were resistant and remaining entries were susceptible to mung bean yellow mosaic virus disease, out of sixty three entries (Table 2).

Out of 64 Mung bean lines, only six entries viz., AZRI-1, NCM-15-11, NCM-21, NCM-11-8, 14063, AZRI-06 were found resistant to yellow mosaic virus disease in Green gram (Muhammad Hanif Munawar *et al.*, 2014). Pathak and Jhamaria (2004) 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-851a 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).

Black gram

Leaf spot disease incidence

Leaf spot disease incidence in eleven Black gram germplasms lines was from 6% to 50%. Based on the mean disease incidence of both replications during Kharif-2015, Only one entry MASH -338 was moderately resistant to leaf spot, six entries viz., PU-31, LBG-752, MBG-1042, MBG-1050, MBG-207 and WBG-26 were moderately susceptible and remaining entries were susceptible to leaf spot disease (Table 3).

Based on the disease incidence, genotypes are categorized for their reaction to leaf spot disease as detailed, according to Mayee and Datar (1986) on Greengram and Blackgram

Disease Scale	**Per cent Leaf area coverage**	**Description**	**Reaction**
0	0	No Symptom on the leaf	Immune (I)
1	<1	Lesions small, pin head sized, covering less than 1% leaf area	Resistant (R)
3	1-10	Lesions 1-2 mm in diameter, covering 1-10% of the leaf area	Moderately Resistant(MR)
5	11-25	Lesions enlarged but not coalescing covering 11-25% of the leaf area	Moderately Susceptible (MS)
7	26-50	Lesions coalescing covering 26-50% of leaf area.	Susceptible (S)
9	>50	Above 50% leaf area covered by large coalescing lesions defoliation of leaves.	Highly Susceptible (HS)

Powdery mildew on Green gram and Black gram (0-5 Scale -Gawande and Patil, 2003)

Disease Scale	**Per cent Leaf area coverage**	**Description**	**Reaction**
0	0	Plants free from infection	Highly Resistant (HR)
1	1-10	Plant showing traces up to 10 % infection on leaves, stem free from infection	Resistant (R)
2	10.1- 25	Slight infection with thin coating of powdery growth on leaves covering 10.1-25 per cent leaf area, slight infection on stem,pods usually free	Moderately Resistant (MR)
3	25.1-50	Dense powdery coating covering covering 25.1 to 50% leaf area,moderate infection on stems,slight infection on pods	Moderately Susceptible (MS)
4	50.1-75	Dense powdery coating covering 50.1 to 75% leaf area, stem heavily and pods moderately infected.Infected portion turns greyish	Susceptible (S)
5	>75	Severe infection with dense powdery growth, covering more than 75 % area of the whole plant including pods, plants resulting in premature defoliation and drying	Highly Susceptible (HS)

MungbeanYellow MosaicVirus on Green gram and Black gram
(0-9 scale-Mayee and Datar, 1986)

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)

Table.1 Screening of Green gram genotypes against Leaf spot and Powdery Mildew Diseases

S.No.	Genotypes	Per cent Leaf area infection	Leaf spot (0-9 scale)	Reaction	Per cent Leaf area infection	Powdery Mildew (0-5 scale)	Reaction
1	KMP-1	30	7	S	12	2	MR
2	KMP-2	36	7	S	6	1	R
3	KMP-3	80	9	HS	8	1	R
4	KMP-4	42	7	S	60	4	S
5	KMP-5	40	7	S	4	1	R
6	KMP-6	38	7	S	56	4	S
7	KMP-7	35	7	S	20	2	MR
8	KMP-9	75	9	HS	60	4	S
9	KMP-11	82	9	HS	16	2	MR
10	KMP-12	86	9	HS	14	2	MR
11	KMP-13	5	3	MR	19	2	MR
12	KMP-14	70	9	HS	23	2	MR
13	KMP-17	78	9	HS	90	5	HS
14	KMP-18	84	9	HS	20	2	MR
15	KMP-19	22	5	MS	12	1	R
16	KMP-20	56	9	HS	14	1	R
17	KMP-22	20	5	MS	22	2	MR
18	KMP-23	90	9	HS	70	4	S
19	KMP-24	41	7	S	8	1	R
20	KMP-25	82	9	HS	68	4	S

21	KMP-26	80	9	HS	46	3	MS
22	KMP-28	41	7	S	62	4	S
23	KMP-30	23	5	MS	8	1	R
24	KMP-32	40	7	S	65	4	S
25	KMP-33	62	9	HS	70	4	S
26	KMP-34	21	5	MS	4	1	R
27	KMP-35	92	9	HS	70	4	S
28	KMP-36	100	9	HS	0	0	HR
29	KMP-38	86	9	HS	5	1	R
30	KMP-39	22	5	MS	0	0	HR
31	KMP-40	19	5	MS	32	3	MS
32	KMP-41	16	5	MS	0	0	HR
33	KMP-42	96	9	HS	8	1	R
34	KMP-44	42	7	S	44	3	MS
35	KMP-45	60	9	HS	7	1	R
36	KMP-46	32	7	S	68	4	S
37	KMP-47	83	9	HS	6	1	R
38	KMP-48	46	7	S	70	4	S
39	KMP-52	40	7	S	3	1	R
40	MGG-313	81	9	HS	32	3	MS
41	MGG-339	76	9	HS	40	3	MS
42	MGG-359	70	9	HS	82	5	HS
43	MGG-360	62	9	HS	14	2	MR
44	MGG-370	58	9	HS	16	2	MR
45	MGG-373	82	9	HS	60	4	S
46	MGG-385	74	9	HS	18	2	MR
47	MGG-386	86	9	HS	41	3	MS
48	MGG-387	90	9	HS	80	5	HS
49	MGG-395	92	9	HS	15	2	MR
50	MLGG-1	66	9	HS	40	3	MS
51	MLGG-2	72	9	HS	66	4	S
52	MLGG-3	54	9	HS	42	3	MS
53	MLGG-4	76	9	HS	20	2	MR
54	MLGG-5	80	9	HS	18	2	MR
55	MLGG-6	70	9	HS	70	4	S
56	MLGG-7	42	7	S	44	3	MS
57	MLGG-8	21	5	MS	8	1	R
58	MLGG-9	84	9	HS	70	4	S
59	PANT-M2	68	9	HS	42	3	MS
60	PANT-M3	75	9	HS	36	3	MS
61	PBM-1	88	9	HS	20	2	MR
62	WGG-37 S.check	38	7	S	80	5	HS
63	WGG-42 S.check	40	7	S	20	2	MR

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

Table.2 Screening of Green gram genotypes against Mung bean Yellow Mosaic Virus (MYMV) disease

S.No.	Genotypes	Per cent Leaf area infection	MYMV (0-9 scale)	Reaction
1	KMP-1	40	7	S
2	KMP-2	22	5	MS
3	KMP-3	24	5	MS
4	KMP-4	75	9	HS
5	KMP-5	88	9	HS
6	KMP-6	20	5	MS
7	KMP-7	46	7	S
8	KMP-9	92	9	HS
9	KMP-11	19	5	MS
10	KMP-12	96	9	HS
11	KMP-13	0	0	I
12	KMP-14	20	5	MS
13	KMP-17	18	5	MS
14	KMP-18	46	7	S
15	KMP-19	0	0	I
16	KMP-20		0	I
17	KMP-22	0	0	I
18	KMP-23	0	0	I
19	KMP-24	0	0	I
20	KMP-25	100	9	HS
21	KMP-26	0	0	I
22	KMP-28	90	9	HS
23	KMP-30	46	7	S
24	KMP-32	23	5	MS
25	KMP-33	19	5	MS
26	KMP-34	0	0	I
27	KMP-35	0.6	1	R
28	KMP-36	46	7	S
29	KMP-38	98	9	HS
30	KMP-39	86	9	HS
31	KMP-40	7	3	MR
32	KMP-41	76	9	HS
33	KMP-42	40	7	S
34	KMP-44	92	9	HS
35	KMP-45	8	3	MR
36	KMP-46	96	9	HS
37	KMP-47	46	7	S
38	KMP-48	80	9	HS
39	KMP-52	0	0	I
40	MGG-313	75	9	HS

41	MGG-339	8	3	MR
42	MGG-359	4	3	MR
43	MGG-360	0.5	1	R
44	MGG-370	22	5	MS
45	MGG-373	6	3	R
46	MGG-385	4	3	R
47	MGG-386	20	5	MS
48	MGG-387	23	5	MS
49	MGG-395	6	3	R
50	MLGG-1	28	7	S
51	MLGG-2	13	5	MS
52	MLGG-3	15	5	MS
53	MLGG-4	17	5	MS
54	MLGG-5	78	9	HS
55	MLGG-6	44	7	S
56	MLGG-7	82	9	HS
57	MLGG-8	0	0	I
58	MLGG-9	18	5	MS
59	PANT-M2	72	9	HS
60	PANT-M3	79	9	HS
61	PBM-1	88	9	HS
62	WGG-37 S.check	82	9	HS
63	WGG-42 R.check	0	0	I

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

Table.3 Screening of Black gram genotypes against Leaf spot and Powdery Mildew diseases

S. No.	Genotypes	Per cent Leaf area infection	Leaf Spot Scale (0-9)	Reaction	Per cent Leaf area infection	Powdery Mildew scale (0-5 scale)	Reaction
1	PU-31	18	5	MS	23	2	MR
2	MASH-338	6	3	MR	15	2	MR
3	LBG-752	22	5	MS	21	2	MR
4	MBG-1044	44	7	S	40	3	MS
5	MBG-1045	35	7	S	32	3	MS
6	MBG-1050	20	5	MS	11	2	MR
7	MBG-1051	50	7	S	60	4	S
8	WBG-26	23	5	MS	38	3	MS
9	MBG-207	20	5	MS	30	3	MS
10	MBG-1047	46	7	S	28	3	MS
11	MBG-1042	25	5	MS	50	3	MS

[Resistant(R), Moderately Resistant (MR), Susceptible(S), Moderately Susceptible (MS)]

Table.4 Screening of Black gram genotypes against Yellow Mosaic Virus disease

S. No.	Genotypes	Per cent Leaf area infection	YMV scale (0-9)	Reaction
1	PU-31	0	0	I
2	MASH-338	0	0	I
3	LBG-752	0.8	1	R
4	MBG-1044	9	3	MR
5	MBG-1045	6	3	MR
6	MBG-1050	15	5	MS
7	MBG-1051	0.6	1	R
8	WBG-26	30	7	S
9	MBG-207	42	7	S
10	MBG-1047	7	3	MR
11	MBG-1042	50	7	S

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

Out of 14 genotypes of screened Black gram, one entry KUG 216 was found as highly resistant whereas three genotypes viz., BS 2-3, IPU 02-43 and B 3-8-8 were recorded as resistant to leaf spot disease (Jameel Akhtar *et al.*, 2014).

Powdery mildew disease incidence

Powdery mildew disease incidence in eleven Black gram germplasms lines was from 11% to 60%. Based on the mean disease incidence of both replications during Kharif-2015, only four entries i.e.PU-31, MASH -338, LBG-752 and MBG-1050 were found moderately resistant and remaining entries susceptible to powdery mildew disease (Table 3).

Out of 126 genotypes screened, none of them were found to be immune, however, three genotypes viz., LBG-17, LBG-685 and LBG-685×VT (F2-F3) were found to be resistant to powdery mildew disease in Black gram (Channaveeresh *et al.,* 2014). Jameel Akhtar *et al.,* (2014) noticed five genotypes viz., Pant U 31, BS 2-3, IPU 02-43, KU 323 and KU 99-21 were highly resistant to powdery mildew disease.

Yellow Mosaic Virus disease incidence

Yellow mosaic virus disease incidence in eleven Black gram germplasms lines was from 0% to 50%. Based on the mean disease incidence of both replications during Kharif-2015, two entries viz.,PU-31 and MASH-338 were found immune, one entry LBG-752 was resistant and remaining entries were susceptible to yellow mosaic virus disease, out of 11 entries(Table 4).

Ganapathy *et al.,* (2003) evaluated 71 urdbean genotypes to identify resistance against mungbean yellow mosaic virus, urdbean leaf crinkle virus and leaf curl virus and found five genotypes namely RU 2229,VBG 86,2KU 54,VBG 89 and SU16 were highly resistant to MYMV. Out of 45 genotypes screened, 19 lines (viz., PU-31, PU-205,PU 1075,IC-1704,IC-11668,IC-37978, IC-49203, MASH-1-1,IC -6110, PDBG-10, PU-30, MASH-114, PU-35,IC-59702,TBG-104,PU-19,TU94-2,MASH338 and IC-14691) were free from disease with one score/resistant (Prasanthi *et al.,* 2013). Out of 56 screened genotypes against YMV, 22 entries (viz., PU-202,205,206,207,208,209,210,P-1051,P-1051, P-1052,P-1053,P-1058,P-1059,P-1060,P-

1061,P-1062,P-1064, P-1065, P-1070, P-1075,P-715 and PU-31) showed resistance to YMV (Obaiah *et al.,* 2013).

Multiple resistances

Only one entry KMP-13 was found resistant to leaf spot and mung bean yellow mosaic virus diseases. Two entries (viz., KMP-52 and MLGG-8) were found resistant to powdery mildew and yellow mosaic virus diseases and remaining entries were susceptible to the above three diseases in Green gram.

Only one entry Mash-338 was found moderately resistant to leaf spot and powdery mildew diseases and LBG-752 entry was found resistant to powdery mildew and yellow mosaic virus diseases in Black gram.

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