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Screening of Mungbean Genotype/varieties for Resistance to *Macrophomina phaseolina* Infection using Seed and Soil Inoculation Method

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ABSTRACT: Mungbean (*vigna radiata* (L.) Wilczek), commonly recognized as green gram is the most significant and often advanced pulse crop. Pulses are an important component of the cropping system because they have wide flexibility to fit with the *Leguminosae* family. The pathogen also caused 17 to 90 per cent incidence in India and 30 to 40 per cent in Rajasthan, the dry root rot disease caused 25 to 48 per cent yield loss from seedling to the mature stage. The aim of this study is to draw a systematic and comprehensive picture of resistant reaction of many genotypes/varieties of mungbean against *Macrophomina phaseolina,* which can be used by farmers for more production. In the present study, fifty-two different mungbean genotype/varieties lines were screened against *Macrophomina phaseolina* at Rajasthan Agricultural Research Institute, Durgapura under artificially seed and soil inoculated conditions in the field. Present data revealed that out of fifty-two genotypes/varieties, only 2 genotypes/varieties were found completely resistant, 1 moderately resistant, 14 moderately susceptible, 29 susceptible and highly susceptible 6 against dry root rot disease caused by *Macrophomina phaseolina.* Two method of seed and soil inoculated conditions in the field.

Keywords: *Macrophomina phaseolina*, disease incidence, inoculation.

INTRODUCTION

Mungbean or green gram [*vigna rediata* (L.) wilczek] is the most important economically and widely cultivated pulse crop. Pulses are essential component to sustain the agriculture manufacture as the pulse crops possess wide adaptability to fit into various cropping systems, belongs to family *Leguminosae* (Wilczek, 1954), it improve the soil fertility and physical health of soil while making soil more porus due to tap root system. Mungbean was originated either from India (De Candolle, 1886) or the Indo-Burmese region (Vivalov, 1951).

Mungbean is an excellent source of high quality protein. It is consumed in different ways such as *dal*, *halwa*, *snacks* and so many others preparations. Ascorbic acid (vitamin-C) is synthesized in sprouted seeds of mungbean. It has the capacity to fix atmospheric nitrogen through symbiotic nitrogen fixation. It is also used as green manure crop. The seed are highly nutritious as it contains about 23.86% protein, 62.6% carbohydrates, 1.15% fat, 5.27% crude fibre, 3.32% ash besides rich in lysine (436 mg/g), Ca, Fe and K. It is also a good source of vitamins mainly thiamine and niacin. Pulses are the main source of protein particularly for vegetarians and contribute about 14 percent of the total protein of an Indian average diet. Production of pulses in the country is far below the requirement to meet even the minimum level of per capita consumption. The per capita availability of pulses is dwindling fast from 74.9 gms in 1959 to 33 gms in 1998 as against the minimum requirement of 70 gms per day/capita prescribed by ICMR, which is causing malnutrition among the growing people.

The Mungbean is short duration, fast-growing, warm-season legume crop and erect, sub erect and deep rooted crop. It quickly reached at maturity under tropical and subtropical conditions with optimum temperatures about 28°-30°C and which always remain above 15°C. It does not require large amounts of water (600-1000 mm rainfall/year), tolerant to drought and sensitive to water logging. High moisture at maturity tends to spoil the seeds that may be sprouted before harvested. Mungbean grows wide range of soils but prefers well-drained loam or sandy loams, with a pH ranging from 5 to 8. It is somewhat tolerant to saline soils.

India is the largest producer with more than 50% of world production with a production of 2.34 Mt (Anonymous, 2019-20). Major mungbean growing states in India are Rajasthan, Maharashtra, Madhya Pradesh, Orissa, Andhra Pradesh, Tamilnadu, and Uttar Pradesh. This crop is grown mainly as rainfed but sometimes cultivated under irrigated conditions especially in Sriganganagar district and to some extent in other districts also. Main limiting factor in profitable cultivation of this crop in Rajasthan is the attack of several diseases caused by fungi, bacteria and viruses

which take heavy toll of the crop at all the stages of growth right from sowing to harvest and also during storage. The incidence of disease varied from 17-90 per cent in India and 30-40 per cent in Rajasthan, Jhamaria and Sharma (2002).

Dry root rot also called as charcoal rot is caused by *Macrophomina phaseolina* (Tassi.) Goild reported as an emerging disease of mungbean and yield losses ranged from 25 to 48% Bashir and malik, (1988); Iqbal and Mukhtar, (2014) by reducing plant population in the field both at seedling as well as reproductive mature stage (Khan *et al*., 2016). It produces symptoms like seeding rot, collar rot, leaf blight and pod rot in mungbean. The pathogen attacks on all parts of plant i.e. root, stem, branches, petiols, leaves, pods and seeds. Infection of *M. phaseolina* on seeds with only 2.2 to 15.7% causes 10.8% losses in grain yield and 12.3% in protein content of seed in mungbean (Kaushik *et al.*, 1987).

MATERIALS AND METHOD

Now a days the entire community of agriculture is focusing on the use of high-yielding resistant cultivars is the most viable, environmentally safe, economical sound and less expensive technique for the management of the disease and most remunerative to farmers. Therefore, the identification of the resistance source is a basic need in breeding for disease resistance. Hence, the present investigation is therefore proposed to find out the resistant sources against dry root rot of mungbean. The fifty-two different mungbean genotype/varieties lines were screened against *Macrophomina phaseolina* at Rajasthan Agricultural Research Institute, Durgapura under artificially seed and soil inoculated conditions in the field. The infestation of soil was done by adding *M. phaseolina* multiplied on sand sorghum medium as described under the pathogenicity test. The seeds of each genotype/variety line received from Indian Institute Pulse Research, Kanpur were surface sterilized and sown in two rows during *Kharif* 2020-21 and 2021-2022. The plants of each germplasm/variety affected from root rot were counted and the per cent disease incidence was calculated by the following formula (Horsfall and Cowling, 1978) and the incidence was scored on a 1-9 rating scale (Nene *et al.*, 1981).

These surface sterilized pieces were transferred on potato dextrose agar (PDA) medium in Petri dishes and kept in BOD incubator for 7 days at 28±2°C for growth of the pathogen. The growth of the fungus was conspicuous after 24 hr of incubation. The pure colonies which developed from the bits were transferred to poured plates and incubated in biological oxygen demand (BOD) incubator for ten days. The obtained culture was maintained on PDA slants for Department of Plant Pathology, Durgapura. Fungus-infected sand sorghum seed was mixed in the soil of each plots. Thus, the pathogenicity of this isolate was confirmed by soil inoculation and seed inoculation method.

A. Seed inoculation

Fifty apparently healthy surface sterilize seeds (variety: RMG-62) were rolled on 7 days old culture of *M. phaseolina* thriving on PDA in Petri plates. Inoculated seeds were sown in field containing sterilized soil. The uninoculated surface sterilized and apparently healthy seeds were served as a check. Observation on seed germination was recorded after one week of sowing and seedling mortality was recorded after 15 days of germination.

B. Soil inoculation

Inoculated with pathogen *M. phaseolina* multiplied on sorghum grains as described earlier, using modified method of Kataria and Grover (1976) in a proportion of 1:10 by thoroughly mixing it in the upper 4-5 cm layer of soil and allowed to stabilized for one week. A check was also maintained without inoculum. After a week of colonization of soil seeds (variety: RMG-62) were sown in these field. Initial seedling emergence was recorded. Seedling infection was recorded after 15 days of germination.

Observations were recorded at the initiation of the disease and at weekly intervals starting from germination to harvesting. The final observations on disease incidence were considered to categorize (Table 1) the varieties/ genotypes into different reactions.

The per cent disease incidence was calculated by using the following formula:

$$\text{Disease incidence (\%)} = \frac{\text{Number of diseased plants}}{\text{Total No. of plants}} \times 100$$

Table 1: Categories of resistance against dry root rot disease

Sr. No.	Per cent root rot (mortality)	Reaction
1.	0-10%	Resistant (R)
2.	10.1-20%	Moderately Resistant (MR)
3.	20.1-30%	Moderately Susceptible (MS)
4.	30.1-50%	Susceptible (S)
5.	>50%	Highly Susceptible (HS)

RESULT AND DISCUSSION

Total fifty-two genotypes of mungbean were screened under artificial inoculation field conditions at Rajasthan Agricultural Research Institute, Durgapura, Jaipur against dry root rot disease during the *Kharif* seasons of 2020 and 2021. The observations on disease incidence on various genotypes/ varieties were recorded and were categorized as per their reaction (Table 2). The rating scale 1-9 was used for recording the observation on root.

Table 2: Reaction of mungbean genotypes/varieties to *M. phaseolina* under artificial inoculation conditions.

Sr. No.	Genotypes/ varieties	Per cent disease incidence			Disease reaction
		Kharif 2020	*Kharif* 2021	Pooled	
1.	BCM 18-1	32.70 (34.85)	40.45 (39.46)	36.58 (37.17)	S
2.	BCM 18-2	21.75 (27.75)	23.50 (28.96)	22.63 (28.39)	MS
3.	COGG 16-10	43.17 (41.05)	36.56 (37.16)	39.87 (39.12)	S
4.	DGGV 91	55.10 (47.91)	56.30 (48.60)	55.70 (48.25)	HS
5.	IGM 06-18-3	43.17 (41.05)	35.33 (36.44)	39.25 (38.76)	S
6.	IPM 1604-1	56.20 (48.55)	54.65 (47.65)	55.43 (48.09)	HS
7.	IIPM 20-1	28.45 (32.21)	36.15 (36.92)	32.30 (34.58)	S
8.	IIPM 20-2	43.70 (41.36)	39.47 (38.90)	41.59 (40.14)	S
9.	IPM 2-14	54.40 (47.51)	55.42 (48.10)	54.91 (47.80)	HS
10.	IPM 2-14-9 (Varsha)	39.56 (38.95)	46.54 (43.00)	43.06 (40.98)	S
11.	IPM 2-3	30.20 (33.31)	36.60 (37.20)	33.40 (35.26)	S
12.	IPM 312-394-1	39.50 (38.92)	45.15 (42.20)	42.33 (40.56)	S
13.	IPM 604-1-2	54.05 (47.31)	50.14 (45.06)	52.10 (46.18)	HS
14.	KM 2419	51.56 (45.87)	47.56 (43.58)	49.56 (44.73)	HS
15.	Kopergaon	37.33 (37.63)	43.12 (41.00)	40.23 (39.34)	S
16.	LGG 450	40.50 (39.50)	45.44 (42.36)	42.97 (40.94)	S
17.	LGG 460	34.31 (35.82)	39.40 (38.85)	36.86 (37.35)	S
18.	LGG 600	38.59 (38.38)	42.67 (40.76)	40.63 (39.58)	S
19.	MH 1468	29.20 (31.43)	34.40 (35.89)	30.83 (33.67)	S
20.	MH 1703	29.21 (32.68)	25.25 (30.14)	27.23 (31.42)	MS
21.	MH 1772	32.66 (34.82)	27.29 (31.45)	29.98 (33.16)	MS
22.	MH 2-15	25.70 (30.42)	33.78 (35.47)	29.74 (32.99)	MS
23.	ML 2459	40.43 (39.46)	34.97 (36.19)	37.70 (37.85)	S
24.	ML 2482	23.20 (28.74)	26.83 (31.17)	25.02 (29.98)	MS
25.	ML 818	41.11 (39.85)	46.67 (43.07)	43.89 (41.47)	S
26.	MLS	39.45 (38.88)	44.04 (41.56)	41.75 (40.23)	S
27.	OBGG 104	44.45 (41.79)	48.56 (44.16)	46.51 (42.98)	S
28.	OBGG 109	27.45 (31.58)	23.16 (28.75)	25.31 (30.17)	MS
29.	PM 1603	24.85 (29.86)	29.70 (32.99)	27.28 (31.45)	MS
30.	PM 1609	36.25 (37.00)	41.10 (39.85)	38.68 (38.43)	S
31.	PM 4	19.67 (26.27)	23.79 (29.12)	21.73 (27.75)	MS
32.	PM 6	20.90 (27.13)	25.40 (30.25)	23.15 (28.72)	MS
33.	Pusa 0672	32.25 (34.57)	37.73 (37.87)	34.99 (36.23)	S
34.	Pusa 0871	8.67 (17.10)	9.50 (17.83)	9.09 (17.53)	R
35.	Pusa 1371	20.90 (27.15)	25.50 (30.31)	23.20 (28.75)	MS
36.	Pusa 2071	24.90 (29.92)	28.40 (32.17)	26.65 (31.05)	MS
37.	Pusa 2072	42.50 (40.67)	36.15 (36.92)	39.33 (38.80)	S
38.	Pusa BM -5	28.70 (32.37)	32.25 (34.58)	30.48 (33.49)	S
39.	Pusa BM-6	41.35 (40.00)	38.80 (38.51)	40.08 (39.26)	S
40.	RMG 1139	15.40 (23.03)	13.17 (21.16)	14.29 (22.18)	MR
41.	RVSM 18-1	20.50 (26.89	23.80 (29.16)	22.15 (28.05)	MS
42.	SKNM 1705	18.70(25.58)	21.70 (27.73)	20.20 (26.68)	MS
43.	SML 1839	5. 50 (13.37)	6.85 (15.09)	6.18 (14.36)	R
44.	SML 2015	31.42 (34.07)	34.10 (35.70)	32.76 (34.90)	S
45.	VBN-4	25.72 (30.41)	19.50 (26.17)	22.61 (28.33)	MS
46.	VGG 15-013	45.25 (42.25)	41.78 (40.25)	43.52 (41.26)	S
47.	VGG 17-049	40.30 (39.39)	44.27 (41.68)	42.29 (40.54)	S
48.	MGG 453	31.45 (34.08)	34.99 (36.25)	33.22 (35.17)	S
49.	MI 181-1	41.26 (39.95)	37.29 (37.62)	39.28 (38.79)	S
50.	MI 750-1	28.20 (32.03)	32.33 (34.63)	30.27 (33.35)	S
51.	PKV AKM 4	34.74 (36.09)	38.30 (38.21)	36.52 (37.16)	S
52.	RMG-62	50.50 (45.27)	56.82 (48.90)	53.66 (47.08)	HS
C.D at 5%		**6.71**	**7.22**	**6.47**	
S.Em.(±)		**2.36**	**2.53**	**2.27**	
C.V.		**9.81**	**10.06**	**9.24**	

*Figures given in parentheses are angular transformed.

Table 3: Reaction of mungbean genotypes/varieties against *M. phseolina* under artificial inoculation conditions (Pooled).

Disease reaction	Disease (%)	Entries	Total
Resistant	0-10	Pusa 0871, SML 1839	2
Moderately resistance	10.1-20	RMG 1139	1
Moderately susceptible	20.1-30	BCM 18-2, MH 1703, MH 1772, MH 2-15, ML 2482, OBGG 109, PM 1603, PM 4, PM 6,Pusa 1371, Pusa 2071, RVSM 18-1, SKNM 1705, VBN-4	14
Susceptible	30.1-50	BCM 18-1, COGG 16-10, IGM 06-18-3, IIPM 20-1, IIPM 20-2, IPM 2-14-9 (Varsha), IPM 2-3, IPM 312-394-1, Kopergaon, LGG 450, LGG 460, LGG 600, MH 1468, ML 2459, ML 818, MLS, OBGG 104, PM 1609, Pusa 0672, Pusa2072, Pusa BM -5, Pusa BM-6, SML 2015, VGG 15-013, VGG 17-049, MGG 453, MI 181-1, PKV AKM4, MI 750-1	29
Highly susceptible	Above 50	DGGV 91, IPM 1604-1, IPM 2-14, IPM 604-1-2, KM 2419, RMG-62	6

Observations revealed *Kharif*-pooled presented in (Table 3) that the among fifty two genotypes/varieties, only two varieties *i.e.* Pusa 0871 and SML 1839 found completely resistant against dry root rot disease. Among different genotypes/svarieties, 1 were found moderately resistant RMG 1139 whereas 14 were moderately susceptible BCM 18-2, MH 1703, MH 1772, MH 2-15, ML 2482, OBGG 109, PM 1603, PM 4, PM 6, Pusa 1371, Pusa 2071, RVSM 18-1, SKNM 1705 and VBN-4. Twenty nine genotypes/ BCM 18-1, COGG 16-10, IGM 06-18-3, IIPM 20-1, IIPM 20-2, IPM 2-14-9 (Varsha), IPM 2-3, IPM 312-394-1, Kopergaon, LGG 450, LGG 460, LGG 600, MH 1468, ML 2459, ML 818, MLS, OBGG 104, PM 1609, Pusa 0672, Pusa 2072, Pusa BM -5, Pusa BM-6, SML 2015, VGG 15-013, VGG 17-049, MGG 453, MI 181-1, PKV AKM4 and MI 750-1 were found susceptible whereas, highly DGGV 91, IPM 1604-1, IPM 2-14, IPM 604-1-2, KM 2419 and RMG-62.

However, genotypes BCM 18-2, MH 1703, MH 1772, MH 2-15, ML 2482, OBGG 109, PM 1603, PM 4, PM 6, Pusa 1371, Pusa 2071, RVSM 18-1, SKNM 1705 and VBN-4 were moderately susceptible (MS) in the *kharif* seasons of 2020 and 2021, but were considered under susceptible (S) on the basis of the average of both *kharif* seasons. Under artificial inoculation condition, the same classified pattern was applied in mungbean genotypes. Mehta, (2004); Khan and Shuaib (2007) found similar results when they evaluated various mungbean varieties/genotypes against *M. phaseolina* using artificial inoculations.

Similarly finding also reported by Choudhary *et al.* (2011); Iqbal *et al*. (2003) they screened twenty five mungbean genotypes to identify source of resistant to dry root rot caused by *M. phaseolina*. Three genotypes namely MSJ-118, KM- 4-44 and KM-4-59 were found to be resistant. These resistant genotypes had significantly greater root and shoot length, root and shoot weight than those of the susceptible check RMG-62.

Similar results also found by Haseeb *et al.* (2013); Iqbal *et al*. (2010) they screened 27 different mungbean varieties/line against *M. phaseolina* and reported that no varieties/ line was found immune to charcoal rot disease. Azri 2006, NM 2006 and AUM were found resistant in first disease screening nursery and second disease 2006 screening nursery. The varieties/lines 8010, AUM 38 and 7009 were moderately susceptible to susceptible and susceptible in all the disease screening nurseries. The rest of the varieties showed varied results in all the nurseries.

SUMMARY AND CONCLUSION

During the *Kharif* seasons of 2020 and 2021, 52 genotypes of mungbean were screened for dry root rot disease under artificial inoculation field settings at Rajasthan Agricultural Research Institute, Durgapura, Jaipur. The signs of *M. phaseolina* caused dry root rot were first seen in the field at the seedling stage, after 20 days of planting on particularly susceptible variety, and then spread to all other mungbean genotypes at the blooming and podding stages. During the *kharif* seasons of 2020 and 2021, none of the 52 genotypes evaluated were found to be fully free of *M. phaseolina* infection. Only two genotypes of Pusa 0871, SML 1839 are resistant and two variants RMG 1139 are moderatery resistant (MR). The 14 mungbean genotypes classified as moderately susceptible (MS) and the 29 genotypes classified as susceptible (S). During both *kharif* seasons, six individuals were identified as highly sensitive (HS) to *M. phaseolina* infection in mungbean.

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Conflict of Interest. None.

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