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Screening of mungbean germplasm for powdery mildew disease resistance

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Abstract

Absence of resistance against diseases and insect pests in mungbean [*Vigna radiata* (L.) Wilczek] varieties, is one of the main reasons for their low yield. During the Kharif season, powdery mildew epidemic damages the crop in most of the mungbean growing areas. For the purpose of identifying resistance/tolerance in mungbean germplasm, a disease screening nursery, comprising of 374 test entries, was developed. Screening was done under natural environmental conditions in 2010 at University of Agricultural Sciences, GKVK, Bangalore, India against powdery mildew disease. Out of 374 test entries 6 were highly resistant, 68 showed resistance, 47 moderately resistant, 50 moderately susceptible, 99 susceptible and 104 were highly susceptible. The resistant ones can be exploited in breeding programme to develop high yielding varieties of mungbean.

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Introduction

Mungbean (*Vigna radiata* (L).Wilczek) also called green gram. It is an ancient and well known *kharif* pulse crop of India. India is the largest producer of mungbean, where it is the third most important pulse crop with an area of approximately 3.5 million hectares (about 15% of the national pulse crop area) producing 1.2 million tonnes of grain (8.5% of the pulse production in the country) (Gupta, 2011). The annual world production area of mungbean is about 5.5 million ha^{-1} and India contributes about 75% of the world production of mungbean (Taunk *et al.*, 2012). To meet global mungbean demand, it is imperative to improve the current average global productivity (~400 kg ha^{-1}) as well as to expand the crop into new regions (Nair *et al.*, 2012).

Green gram has substantial amounts of low flatulence proteins, which makes the crop indispensable in Indian vegetarian diet. The yield of mungbean is affected by several biotic and abiotic factors (Anonymous, 2001). Among the biotic factors, Powdery mildew, MYMV and *Cercospora* leaf spot *etc.*, are of prime importance in reducing crop yield. Among these, powdery mildew is one of the most important diseases of mungbean, which is caused by the fungal pathogen *Erysiphe polygoni* DC. Powdery mildew disease will occur during cool-dry months and the disease epidemic form covers the upper surface of the leaf forming white hyphae which gives a white floury patches appearance. Parts of the leaves later changes in to brown colour. Yield losses due to the disease were reported to be 20-40% at the reproductive stages (Fernandez and Shanmugasundaram, 1988), but the damage can be more serious when the epidemic starts at the reproductive stages (Poehlman, 1991).

During the winter/spring season it is a severe constraint in the production of bean crops. It is common foliar disease of mung bean particularly in the cool dry season. Major powdery mildew control strategies include usage of chemicals. But due to the cost of chemicals famers rarely practice such control measures and the usage of such fungicides will negatively affect environment and especially human health. Therefore the most effective way to control powdery mildew is the use of resistant varieties. Keeping this in view, disease screening studies were made to understand the development of powdery mildew disease. Since powdery mildew may inflict heavy losses to the crop in the country and the present cultivars are susceptible to this disease, therefore, this study was initiated to evaluate available mungbean germplasm for identification of resistance sources to breed disease resistance cultivars.

Material and methods

Disease Screening

Three hundred and seventy four mungbean genotypes were screened for identification of resistance sources against natural infection by powdery mildew disease under field conditions at University of Agricultural Sciences, Bangalore during the late *kharif* seasons of 2010. All the genotypes in the germplasm collection are from India. The experimental material obtained from AICRP, UAS, GKVK, Bangalore, Tamil Nadu Agricultural University, Coimbatore and National Bureau of Plant Genetic Resoures, New Delhi. The test entries were planted during mid august and harvested during the last week of October. Each test entry was planted in a single row subplot of 1 m length in an augmented design with row to row and plant to plant spacing of 45 cm and 10 cm, respectively. Susceptible check (Chinamung) was also planted in each plot along with test entries. All the recommended package of practices was followed except spraying of plant protection chemicals to allow maximum inoculam of powdery mildew. The natural disease incidence was quite severe during the season due to conditions favourable for the development of the disease. Disease intensity on each accession was recorded on 40 days after sowing (DAS), 50 DAS and at the time of harvesting. Powdery mildew was scored on 0-5 scale as recommended by Reddy *et al.* (1994b) where as the susceptible check rows exhibited hundred percent infections.

Results and discussion

The success of breeding programs is principally dependent on genetic variation availability in the breeding materials. Evaluating and understanding the extent of genetic variability existing in the germplasm is important and leads to effective utilization of the germplasm. Thus only a small portion of genetic variability has been exploited in genetic improvement of this crop. In spite of several thousands of diverse mungbean accessions having been collected, only a few have been chosen and repeatedly employed in cultivar development programmes. AVRDC used to carry one of the most effective mungbean breeding programs in the world. The germplasm from India was a prime source for resistance to diseases and insect pests, while that from the Philippines was utilized for improvement of yield potential (Tays, 1993; Srinives, 1998).

Disease Incidence/ Severiety

A total of 374 accessions were screened for their reaction against powdery mildew disease and depending upon their genetic makeup of each accession responded differently to powdery mildew disease. The list of genotypes and disease reaction are presented in table 2. Out of 374 accessions, six were found to be highly resistant *viz*., BL 849, BL 865, LM1668, PBM, PMB 63 and AKM 8803 and it could be utilized as donor parents for powdery mildew resistance breeding programme. Another 68 genotypes were found to be resistant (R1) and it showed 1– 5% disease infection. Fourty seven genotypes were moderately resistant (R2) showed 5.1 – 30% infection. Fifty genotypes expressed 30.1 – 65% infection with which confers reaction type 3 were moderately susceptible (MS). Ninety nine responded susceptible (S) reaction with 65.1 – 90% infection and with score of 4. While 104 genotypes showed highly susceptible (HS) reaction with score 5 and the *per cent* of infection was 90.1 - 100. Environmental factors such as humidity, temperature or light can influence development of the disease, possibly explaining these differences in scores. Expression of resistance to powdery mildew associated with high temperatures (25°C) was described in pea (Fondevilla *et al*., 2006). Despite being highly susceptible, some test entries produced good yield and showed tolerance to powdery mildew disease. Genotype PBM is highly resistant not only for powdery mildew but also for *Cercospora* leaf spot and MYMV. But the yield related character like number of pods per plant is very less; and this genotype shows very late flowering. Compared to other entries, PBM shows higher pod length and seed size also relatively high. These characters can be exploited in future breeding programmes.

Although mungbean has short growth duration and three or four generations can be produced per year, progress in breeding cultivars with powdery mildew disease resistance has been slow. A factor limiting breeding progress is that selection for powdery mildew resistance is confined to the cool-dry season (Chankaew *et al*., 2013). Several sources of resistance to powdery mildew disease in mungbean have been reported (Yohe and Poehlman, 1975; Fernandez and Shanmugasundaram, 1988; Hartman *et al*., 1993; Reddy *et al*., 1994b). Genetic studies using different resistance sources revealed different modes of inheritance (Yohe and Poehlman, 1975; Reddy *et al*., 1994a; Reddy, 2009; Sorajjapinun *et al*., 2005; Kasettranan *et al*., 2009), suggesting that there are different mechanisms or genes conferring resistance to powdery mildew disease. Plant breeders need to explore the nature of disease resistance and identify additional resistance genes from new sources.

According to the gene-for-gene concept, resistance genes in plants may be successively overcome by new pathotypes with matching virulence factors (Flor, 1955). As a race-specific resistance breaks down, some cultivars may become susceptible to the disease and must be replaced. Different strategies have been proposed to prolong durability and broaden the spectrum of resistance genes. These strategies include the use of multiline cultivars, use of partial resistance in combination with race-specific resistance, and deployment of cultivars with different resistance genes (Kelly *et al*., 1995; Jiang *et al*., 2004; Shi *et al*., 2009). However, if the resistance genes used by plant

breeders are closely linked or allelic, the number of gene combinations that can be used in developing new cultivars will be limited. There are resistance genes that have not been exploited, and new sources of resistance need to be identified in landraces and wild relatives. Recently Reddy (2009) identified a new resistance gene, Pm3, for powdery mildew resistance in the Indian mungbean landrace Mulmarada. Mulmarada showed complete resistance to powdery mildew isolate *avr1avr1Avr2Avr2*.

Table 1. Powdery mildew was scored on 0 -5 scale (Reddy *et al.,* 1994b).

Score	*Per cent of leaf area infested*	*Disease reaction*	*Genotypes*
0	0	Highly resistant (R0)	BL 849, BL 865, LM1668, PBM, PMB 63, AKM 8803
1	1 – 5	Resistant (R1)	MAVT801, MDU2010, ML1670, PUSA271, LM182, LM192, LM568, ML1380, SOABOURCATE, AGASTYALINGAPURAM, AKM9911, BL842, BL856, BL 862, GA 8810, IC 39526 ,LM 172, LM1081, LM 1900,LM 567, MAVT 807, MDU 3379, MGG 341, MH 96-1,WGG 37, SALEM, TM 9947, PUSA 9471, PUSA 271, PLM 66, PLM 30-1, PLM 275, PLM 246, PLM 233, PLM 162, PLM 87, PANT M 4, MRG 335, ML 1670, ML 1380, MH 96-1, MGG 341, MDU 3397, MAVT 807, LM 2029, IC 39565, IC 39564, IC 39543, IC 39541, IC 39527, IC 39526, IC 39493, IC 39491, IC 39295, BPM 145, GANGA 5, GM 84-26, IC 39507, IC 39506, IC 39510, IC 39520, IC 39521, IC 39522, MAVT 832, MAVT 836, MAVT 855, MGG 335, MIVT 866
2	5.1 – 30	Resistant (R2)	BL 847, EC 259559, EC 501569, Hg 19A, MDU1948, MDU2268, VBNGG 2, K.PUDUR 2, MGG 221, EC314286, EC 501566, Hum1, KAHIKOLA, LGG 460, MDU 3405, MDU 3486, TM 94-12,V 1972, LM 13, KG 52, AC 5, BL843, BAPATLA, , DM 2, CO 4, EC 251810, HYB-12, IPM 99-125, KM 2194, MDU 3487, ML 347, TENKASI 2, TM 99-47,WBM, 4-31-1-1, B1, BL 860, BODI 1, AVT 336, BL 845, BL 867, CO 6, KAVILPATTI, LGG 461, M 108, MDU 1942, MGG 221, K 851
3	30.1 - 65	Moderately susceptible (MS)	OBGG 11,PS 16, TV.MALAI (D),VELLURIOR, SKU-06, BPMR145, ILONGAI1, KM1/1, LM159, NEELAMBUR, PDM154, PUSABAISAKI, RAJENDRAN, SONAMUNG, EC396523, MDU3387, MDU 3404/1, EC 450450, EC 496841, K.PUDUR1, KKM4, MDU3372, TENKASI1, MDU3476, BL854, KKM3, ADT1, MDU3404, MDU3484, NIGERIAN VARIETY, PANT.M103, VELLATTIKULAM, BBS-1-1, EC 482907, H 70/16, MDU 3156, T44, EC 450446, EC 482908, EC 496839, M 1319B, MDU 3385, NP 36, T 3485, T .V.MALAI(S), T 2272, PLM 333, IC 39496, IC 39499, IC 39558
4	65.1 - 90	Susceptible (S)	CHINAMUNG, TAP7, EC482909, VGG4, KPUDUR3, KANGYAN, M986, VELAMPATTI, THOKKAVADI, PUSA RIAGLE, ATTIYAMPALAYA, BA8D74,IC11660, IC11668, IC118559, IC12434, IC14520, IC14695, IC1575, IC204869, IC 20811, IC 20811, IC 212655, IC 214811, IC 214844, IC 214845, IC 24811, IC 29789, IC 311395, IC 311409, IC 311410, IC 311419, IC 311420, IC 311425, IC 311446, IC 323498, IC 324005, IC 324012, IC 324021, IC 324025, IC 324036, IC 325738, IC 325752, IC 325756, IC 325770, IC 325782, IC 325788, IC 325791, IC 325799, IC 325810, IC 325817,IC 325823,IC 325833, IC 325853, IC 325987, IC 329057, IC 329067, IC 329078, IC 336975, IC 343547, IC 362819, IC 367823, IC 369790, IC 370467, IC 370489, IC 370497, IC 370498, IC 370532, IC 370575, IC 37067, IC 370714, IC 370723, IC 373426, IC 373547, IC 415105, IC 415117, IC 45208, IC 49203, IC 56048, IC 56057, IC 59718, IC 61097, IC61100, IC73291, IC 862819, IC 873536, IC 8917, SML348, VPB-99-3
5	90.1 - 100	Highly susceptible (HS)	IC103213, M980, MAVT805, MAVT817, MAVT 832, MAVT 836, MAVT 847, MAVT849, MAVT855, MAVT865, MDU1380, MDU1404, MDU196, MDU2196, MDU348, MDU3812, MDU4387, MGG335,MH1, MH91/2,ML481, ML5,ML520, ML567, ML611, ML613, ML62, ML627, MS9192, MS9348, MS9712, MS9720/2, MS9721, MS 9722, MS 9727, MS 9927, MUM 1, MUM 2, MUM 5, MUM 6, PLM 343A, PARJALA, PMD 63, IC 103316, RMG 62, SM 29, SML 134, SML 151, SML 331, TB 7, TB 7/3, TM 159, TM 97-55, TRAM 2, V2964, VBNGG 1, WB 3141, IC 103213, LGG 122, MDU 2106, PLM 202, PLM 89, PLM 214,11889, MH.1 (B), IC 39487, TT.9E, MS 9722, PLM 149, IC 103300, IC 39569, IC 39497, IC 39488, IC 103986, IC 103975, UPM 79-3-4, PLM 149, PLM 29, PLM 311, PLM 216, THOPPAKUNDA, PLM 350, IC 39487, IC 52078, M 980, IC 39589, IC 39498, IC 39574, IC 103993, IC 103196, MS 9384, MS 9722, 24/2, PLM 393, IC 39559, IC 103179, PLM 101, IC 39568, MDU 3156, IC 39547, IC 103224, IC 103179, IC 39455, IC 39559

Table 2. Percent of leaf area and disease reaction.

Score	*Per cent of leaf area infested*	*Disease reaction*
0	0	Highly resistant (R0)
1	1 – 5	Resistant (R1)
2	5.1 – 30	Moderately Resistant (R2)
3	30.1 - 65	Moderately susceptible (MS)
4	65.1 - 90	Susceptible (S)
5	90.1 - 100	Highly susceptible (HS)

Table 3. Weekly mean of weather parameters and weekly total rainfall for the experimental period (July – October, 2010).

Standard week Number	*Standard week*	*Mean temp. (°C)*		*Mean Relative Humidity %*		*Rainfall (mm)*	*Scoring time*
		Min.	Max.	I hr (0720 hrs IST)	II hr (1420 hrs IST)		
31	Jul 30 - Aug 5	19.0	26.3	94	57	13.2	
32	Aug 6 - Aug 12	19.2	28.2	94	54	26.4	
33	Aug 13 - Aug 19	19.9	27.4	94	58	35.8	Sowing was done
34	Aug 20 - Aug 26	19.0	26.4	94	63	51.0	
35	Aug 27 - Sep 2	18.6	26.3	95	61	45.6	
36	Sep 3 - Sep 9	18.9	26.1	93	63	0.40	
37	Sep 10 - Sep 16	19.2	26.7	94	59	11.8	1st scoring was done
38	Sep 17 - Sep 23	19.4	27.3	89	60	13.4	
39	Sep 24 - Sep 30	19.3	28.9	90	53	63.2	
40	Oct 1 - Oct 7	19.4	28.9	93	51	83.6	2nd scoring was done
41	Oct 8- Oct 14	18.9	27.8	92	56	27.6	
42	Oct 15 - Oct 21	18.4	27.5	94	55	8.0	
43	Oct 22 - Oct 28	19.1	27.8	93	53	0.0	3rd scoring was done(at the time of harvesting)
44	Oct 29 - Nov 4	19.0	26.9	96	57	12.4	

References

Chankaew S, Somta P, Isemura T, Tomooka N, Kaga A, Vaughan DA and Srinives P. 2013. Quantitative trait locus mapping reveals conservation of major and minor loci for powdery mildew resistance in four sources of resistance in mungbean [*Vigna radiata* (L.) Wilczek]. Molecular Breeding **32,** 121–130.

Fernandez GCJ and Shanmugasundaram S. 1988. The AVRDC mungbeans improvement programme: The past, present and future. In: McLean BT (ed.) Mungbean: Proceeding of the second international symposium. Asian Vegetable Research and Development Center, Taiwan. 58–70.

Flor HH. 1955. Host-parasite interactions in flax rust its genetics and other implications. Phytopathalogy **45**, 680–685.

Fondevilla S, Carver TLW, Moreno MT and Rubiales D. 2006 Macroscopic and histological characterization of genes *er1* and *er2* for powdery mildew resistance in pea. European Journal of Plant Pathology **115**, 309–321.

Gupta S. 2011. Indian Institute of Pulses Research (IIPR) Vision 2030. In: Indian Institute of Pulses Research (ICAR) (ed.). Kanpur, India. 42.

Hartman GL, Wang TC and Kim D. 1993. Field evaluation of mungbeans for resistance to *Cercospora* leaf spot and powdery mildew. International Journal of Pest Management **39**, 418–421.

Jiang GH, Xu CG, Tu JM, Li XH, He YQ and Zhang QF. 2004. Pyramiding of insect and disease resistance genes into an elite *indica*, cytoplasm male sterile restorer line of rice, Minghui 63. Plant Breeding **123**, 112–116.

Kasettranan W, Somta P and Srinives P. 2009. Genetics of the resistance to powdery mildew disease in mungbean (*Vigna radiata* (L.) Wilczek). Journal of Crop Science and Biotechnology **12(1)**, 37–42.

Kelly JD, Afanador L and Haley SD. 1995. Pyramiding genes for resistance to bean common mosaic virus. Euphytica **82**, 207–212.

Nair RM, Schafleitner R, Kenyon L, Srinivasan R, Easdown W, Ebert A and Hanson P. 2012. Genetic improvement of mungbean productivity. In: Proc. of the 12th SABRAO Congress on Plant Breeding towards 2025: Challenges in a Rapidly Changing World, 13-18 January 2012, Chiang Mai, Thailand. p. 27-28.

Poehlman JM.1991. The Mungbean. Boulder, Co, U.S.A. Westview Press. 262-229.

Reddy KS, Pawar SE, Wanjari KB and Bhatia CR. 1994b. Development of powdery mildews resistant and high yielding varieties of mungbean. In: International Symposium on Pulses Research, New Delhi. 146-147.

Reddy KS. 2009. Identification and inheritance of a new gene for powdery mildew resistance in mungbean (*Vigna radiata* L. Wilczek). Plant Breeding **128**, 521–523.

Reddy KS, Pawar SE, and Bhatia CR. 1994a. Inheritance of powdery mildew (*Erysiphe polygoni* D.C.) resistance in mungbean (*Vigna radiata* L. Wilczek). Theoretical and Applied Genetics **88**, 945–948.

Shi A, Chen P, Li D, Zheng C, Zhang B and Hou A. 2009. Pyramiding multiple genes for resistance to soybean mosaic virus in soybean using molecular markers. Molecular Breeding **23**, 113–124.

Sorajjapinun W, Rewthongchum S, Koizumi M and Srinives P. 2005. Quantitative inheritance of resistance to powdery mildew disease in mungbean (*Vigna radiata* (L.) Wilczek). SABRAO Journal of Breeding and Genetics **37**, 91–96.

Taunk J, Bharti Aneja B, Yadav NR, Yadav RC and Yadav RK. 2012, Genetic diversity among greengram [*Vigna radiata* (L.) Wilczek] genotypes varying in micronutrient (Fe and Zn) content using RAPD markers. Indian Journal of Biotechnology **11**, 48-53

Tays DCS. 1993. Genepool of improved mungbean from AVRDC. ACIAR Grain Legumes Newsletter **18**, 5–7.

Yohe JM, Poehlman JM. 1975. Regression, correlations and combining ability in mungbeans (*Vigna radiata* (L.) Wilczek). Tropical Agriculture **52**, 343–352.