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Genetic resistance in mungbean and mashbean germplasm against mungbean yellow mosiac begomovirus

* **Muhammad Bashir, Ali Raza Jamali and Zahoor Ahmad**

National Agricultural Research Centre, Park Road, Islamabad, Pakistan.
*E-mail: *fodder47@hotmail.com"*

Abstract

In order to identify sources of resistance against mungbean yellow mosaic (begomo) virus (MYMV), 110 lines of mungbean and 134 of mashbean were evaluated under field conditions. Out of 110 mungbean lines, 85 were found as highly resistant (HR), 14 resistant (R) and 5 moderately resistant (MR). Only six accessions were graded as susceptible (S) to highly susceptible (HS). In case of mashbean, 43 accessions were found as highly resistant (HR), 28 resistant (R) and 18 moderately resistant (MR), whereas, the others 45 were susceptible to highly susceptible. Although resistance against MYMV in mungbean and mashbean has been previously reported, but this study reports some additional new sources of resistance to be included in breeding programme to develop MYMV-resistant varieties in the country.

Key words: Accessions, begomovirus, mosaic, mashbean, mungbean, resistance.

Introduction

Mungbean (*Vigna radiata* (L.) Wilczek.) and mashbean (*Vigna mungo* L.) are two short duration pulse crops grown in summer season (July to October) in Pakistan. Mungbean yellow mosaic disease caused by mungbean yellow mosaic begomovirus (MYMV) is the most destructive viral disease of mungbean and mashbean not only in Pakistan but also in India, Bangladesh, Srilanka and adjacent area of Southeast Asia (Bakar, 1981; Jayasekera and Ariyarantne, 1988; Malik, 1991). Mungbean yellow mosaic is widely distributed throughout the country and attacks not only mungbean and mashbean but also other pulse crops such as cowpea, moth and common beans. Due to introduction of MYMV-resistant cultivars of mungbean in the country, the disease is now more serious on mashbean than mungbean. Due to importance of MYMV, it has been studied by many investigators (Ahmad and Harwood, 1973; Bashir and Malik, 1988; Malik, 1991; Bashir and Zubair, 2002). This virus has a wide host range and is transmitted by whitefly (*Bemisia tabac*i Genn.) and not through seed, sap and soil (Nene, 1972). In severe cases, the leaves and other plant parts become completely yellow (Malik, 1991). The losses may be as high as 100 percent (Malik, 1991). The exotic large seeded varieties from Asian Vegetable Research and Development Centre (AVRDC), Taiwan when tested in Pakistan are highly susceptible to this disease and fail to survive during summer months (Ahmad, 1975; Malik *et. al*., 1988).

Resistant cultivars offer the best means for the control of MYMV. Of 157 local and exotic mungbean varieties screened in 1975 against MYMV, no resistant variety was found. Only six out of 34 local collections showed some tolerance to the disease (Ahmad, 1975). Later on some mungbean cultivars (e.g. NM-28, NM 121-25, NM. 19-19, NM 20-21, NM-13) resistant to MYMV were developed and released through mutation breeding by Nuclear Institute for Agriculture and Biology (NIAB), Faisalabad for commercial cultivation during 1983 to 1986 (Malik, 1991; Sarwar and Rajput, 1999). Out of 132 breeding lines of mashbean when evaluated against MYMV, 53 showed resistance under field conditions (Bashir and Zubair, 2002). In order to identify some more sources of resistance from local breeding material to develop resistant cultivars, this study was conducted at National Agricultural Research Centre (NARC), Islamabad, Pakistan during summer season of 2003.

Materials and Method

During summer season of 2003, 110 mungbean and 134 of mashbean germplasm accessions were evaluated against MYMV under natural field conditions. The source of these accessions has been shown in Table-1. Each test entry was planted in a row of 4 meter in length with 40 cm row to row distance during mid of July, 2003. One row of a susceptible check (Burma mash) was planted after every two test entries in addition to two rows of susceptible check all around the experiment. General cultural practices were

followed to maintain the experiment except that insecticide sprays were not given to encourage the whitefly population for spread of the disease. Disease infection was scored on 1-6 arbitrary scale at 10 days interval. The identity of MYMV was confirmed by Polymerase Chain Reaction (PCR) with the cooperation of Dr. S.K. Green (Virologist), AVRDC, Taiwan. The following scoring scale (1-6) was followed to determine the response of mungbean and mashbean lines to MYMV infection.

Disease Scoring Scale (1-6) for MYMV

Points	Reaction Grade	Reaction Group
1	Highly Resistant (HR) (0% infection, all plants free of symptoms)	1
2	Resistant (R) (1-5% plants infected with MYMV)	11
3	Moderately Resistant (MR) (5-10% plants infected with MYMV)	111
4	Moderately Susceptible (MS) (10-20% plants infected with MYMV)	1V
5	Susceptible (S) (20-40% plant infected with MYMV)	V
6	Highly Susceptible (More than 40% plants infected with MYMV)	V1

Results and Discussion

The first symptoms of yellow mosaic started to appear on the susceptible check lines about 25 days after planting. Scattered yellow specks of mild intensity were first observed on young leaves in susceptible lines. After one week, alternate yellow and green patches with irregular margins developed in the first fully-formed trifoliate leaf next to the apex. The intensity of disease increased with passage of time. In case of severe infection at the end of August, all the check lines turned completely yellow with 6-10 whiteflies per plant. Similar spread of yellow mosaic pattern was reported by Jalaluddin and Sheikh (1981). The infected pods were also turned yellow and a few shriveled seeds were observed. The most susceptible plants bore a few pods (1-3 pods/plant) with few seeds (2-3 seed/pod).

The natural disease infection was quite severe. The disease reactions as recorded on 1-6 scale have been presented in Table-2. On the basis of disease severity recorded, the mungbean and mashbean genotypes were classified into six groups (Table-2). Out of 110 mungbean accessions, 85 were found highly resistant (HR), 14 resistant (R) and 5 were moderately resistant (MR). Only 6 accessions were found susceptible to highly susceptible. In case of mashbean, 43 accessions were highly resistant (HR), 28 were resistant (R) and 18 were moderately resistant (MR), whereas the other 45 lines were moderately to highly susceptible. The lines found highly resistant to yellow mosaic disease both in case of mungbean and mashbean are shown in Table-3. Due to planting of the most susceptible check after every two test entries, and due to good build-up of whitefly population (6-10 whiteflies/plant) there were good chances of spread of disease minimizing the chances of disease escape. At the end of the experiment, all the check lines were showing maximum disease severity ensuring good evaluation of mung and mash germplasm against yellow mosaic. In case of mungbean, majority of the lines (more than 80%) were found as highly resistant (HR) and resistant (R) to yellow mosaic whereas, in case of mashbean, 53% were highly resistant (HR) and resistant (R). The local land races of mashbean grown by small farmers in the country are highly susceptible to yellow mosaic, which depending on the severity of the disease may inflict to heavy losses (Bashir & Malik, 1988). The disease is caused by a virus transmitted by vector, whitefly (*Bemisia tabaci*) (Ahmad & Harwood, 1973). High temperature from June to August favours the spread of the vector, which find ample opportunity to multiply on the host. Due to inadequate plant protection measures, mash as well as mungbean is infested by whitefly and additional damage to this crop is caused by the MYMV transmitted by the whitefly vector (Shakoor *et. al.*, 1977). Complete genetic resistance to MYMV has not been reported from the local as well as exotic mungbean and mashbean germpalsm evaluated at national and international research institutes (Ahmad, 1975). However, during the last two decades, a number of mungbean and mashbean

genotypes have been identified as resistant and moderately resistant to MYMV (Ali and Akram, 1999; Ghafoor *et. al*., 1992; Iqbal *et. al.*, 1990). Due to introduction of high yielding and MYMV-resistant mashbean and mungbean cultuivars such as Mash-1, Mash-2, Mash-3, Mash-97, NM-92, NM-98 and Ckakwal, Mung-97 from provincial and federal research institutes in the country, the crop situation is being improved and the local land races of mashbean and mungbean which are susceptible to MYMV are being replaced by the newly developed disease resistant cultivars. The mung and mash genotypes found resistant to yellow mosaic in this study have been developed either through mutation breeding at Nuclear Institute for Agriculture and Biology (NIAB), Faisalabad or through conventional breeding at other stations such as National Agricultural Research Centre (NARC), Islamabad, Barani Agricultural Research Institute (BARI), Chakwal and Ayub Agricultural Research Institute (AARI), Faisalabad. The seed of resistance lines of mungbean and mashbean is available for use in breeding program.

Table 1: Source of mungbean and mashbean germplasm evaluated against MYMV during summer season of 2003 at NARC, Islamabad, Pakistan.

S. No	Source of Material	Number of Accessions Obtained	
		Mungbean	Mashbean
1	Nuclear Institute for Agriculture and Biology (NIAB), Faisalabad	34	-
2	Plant Genetic Resources Institute (PGRI), NARC, Islamabad.	4	110
3	Pulses Programme, NARC, Islamabad.	72	24
Total:		**110**	**134**

Table 2: Six disease reaction groups of mungbean and mash germplasm accessions to reaction grades as measured on 1-6 arbitrary scale.

Reaction Group On 1-6 Scale	Reaction Grade	Number of accessions falling under each group	
		Mungbean	Mashbean
I	Highly Resistant (HR)	85	43
II	Resistant (R)	14	28
III	MR (Moderately Resistant)	5	18
IV	MS (Moderately Susceptible)	2	7
V	S (Susceptible)	2	6
VI	HS (Highly Susceptible)	2	32
	Total:	**110**	**134**

Table 3: Mungbean and mashbean lines found Highly Resistant (HR) to yellow mosaic disease caused by MYMV under field conditions.

Name of Crop	Lines found highly resistant (HR)
Mungbean	NM-49-9, NM-92, NM-1, NM 20-24, NM 15-5, NM 22-5-1, NM-2, NM-98, NM 10-12-1, 3960A-88, NIAB-1, -2, -92, -4, -5, -6, -7, -10, -11, -12, -13, -14, -15, -16, -17, -18, -19, -20, -21, -22, VC3960 x A88, VC3960 x A88-1, C1/94-4-19, c2/94-4-42, 98CMG-003, M-6, NCM-209, NCM 257-2, NCM 257-10, NCM-257-8, NCM 251-12, NCM 258-1, NCM 255-3, NCM 252-10, NCM 257-5, NCM 258-6, NCM 252-1, NCM 255-2, NCM 251-4, NCM 257-6, NCM 254-7, NCM 251-16, Mung 97, ML-267, VC 6173-B, SML-134, IVM-98, 95B0X002, 95011, 95013, NCM-254-2, NCM 258-10.
Mashbean	45014, 45015, 45016, 45021, 45022, 45024, 45028, 45030, 45032, 45036, 45047, 45049, 45062, 45064, 45083, 45090, 45091, 45092, 45093, 45094, 45096, 45097, 45101, 45114, 45116, 45126, 45134, 45138, 45139, 45141, 45157, 45159, 45162, 45163, 45164, 45173, 45174, 45235, 45336, 45339, 45340, 45342, 45788

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