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Response of Host Resistance in Mungbean Cultivars against Yellow Mosaic Disease Caused by Mungbean Yellow Mosaic Virus (MYMV)

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A B S T R A C T

Absence of host resistance in mungbean against diseases and insect pests (*Vigna radiata* L. Wilczek) is one of the main reasons for its low yield in India. Mungbean Yellow Mosaic Virus (MYMV) causing yellow mosaic disease is one of the most threatening diseases of mungbean. It causes 100 per cent yield losses and has become a challenge to scientists and growers both. Transmission by whitefly is forcing chemical management but is not economically viable. Hence, host resistance is the only alternative under this circumstance. The present investigation aimed to identify MYMV resistant cultivars suitable for cultivation in North Eastern Karnataka (NEK) region. The study was conducted during *kharif*, 2016 consisting of nine mungbean cultivars of which four were from IIPR, Kanpur, two recently released and remaining locally cultivated. Results revealed that, IPM-2-3 cultivar released from IIPR, Kanpur showed lowest disease incidence of 6.13 per cent with highest yield of 701 kg ha^{-1} followed by PDM-139 which recorded 6.41 per cent disease and 676.66 kg ha^{-1} seed yield. The highest disease of 12.52 per cent was recorded in BGS-9 with seed yield of 464 kg ha^{-1} followed by in Pusa baisaki with disease incidence of 10 per cent and seed yield of 143 kg ha^{-1}. This experiment concludes that IPM-2-3 is most suitable MYMV resistant cultivar with good yield potential followed by PDM-139. Results conclude adoption of resistant cultivar as well as use of resistant source for improving the local cultivars which enhances production and productivity of mungbean.

Introduction

India is a major pulses contributor in global pulses economy. In spite of highest area and production, still domestic demand relies on imports from other Asiaa and African countries. In pulses, mungbean (*Vigna radiata* L. Wilczek) is very important *kharif* crop of the country grown under rainfed situations. The short duration crop which grows well under minimum moisture with low inputs makes it more attractive among poor and marginal farmers. Its wide demand is driven by its wider acceptability and adoptability by different ethnic groups used for different purpose *viz*., dal, curries and snacks *etc*. Mungbean is also cultivated in spring season in northern India and winter cultivation is done in rice fallow in southern and coastal areas. The food value of mungbean lies in its high and easily digestible protein which is approximately 25-28 per cent. However, its cultivation is hindered by many biotic and abiotic stresses. The viral disease caused by

Mungbean Yellow Mosaic Virus (MYMV) has been a major hurdle in its cultivation (Kang *et al.,* 2005). The MYMV, a member of the family Geminiviridae (William *et al.,* 1968), genus begomovirus (Bos, 1999) has long been a great threat to legume crops. These are plant infecting single stranded DNA viruses composed of either monopartite (a single DNA) or bipartite (with two DNA components: DNA-A and DNA-B) based on their genome organization (Mansoor *et al.,* 2003; Jeske 2009). The virus is known to be transmitted by whitefly (*Bemisia tabaci* Genn.) in a persistent, circulative manner (Rosen *et al.,* 2015). It's a ubiquitous pest of many field and horticultural crops. The yellow mosaic disease is wide spread in most of the South East Asian countries. In addition, majority of the cultivars in the field are susceptible to MYMV which is mainly responsible for reduced production and productivity in mungbean growing countries. Singh (1980) and Marimuthu *et al.,* (1981) reported that yield loss due to MYMV disease in mungbean was about 76 to 100 per cent. Often the outbreak of the disease has caused complete loss of the crop across the districts and region. In Karnataka during 2014 and 2015 government farmers insured their crop to overcome the losses due to yellow mosaic disease. To overcome this vector borne viral disease different strategies are formed but no breakthrough is found for cost effective management.

Though chemical management of vector is seen as simple answer but is not cost-effective. Since, numerous sprays of insecticides are required to control whitefly. Recurrent sprayings also lead to health hazard and ecological imbalance of living organisms. On the contrary, use of virus resistant varieties, if available, is the best approach to alleviate occurrence of YMD in areas where the infection is recurring constraint. Use of resistant crop varieties is considered as the reasonable, robust and perfect method of controlling viral diseases. A good quality research directed towards screening mungbean cultivars against MYMV for the identification of resistant sources under diverse environmental conditions is way forward. Hence, the present experiment was conducted to assess the genetic behavior of mungbean cultivars against YMD under natural environmental conditions of MYMV recurring place in North Eastern Karnataka (NEK), where high population of viruliferous white fly are always present.

Materials and Methods

Host resistance is considered as novel and cheapest way of mitigating pest and diseases. However, in case of MYMV, no resistant cultivars are available for cultivation in NEK region. In order to find out a suitable resistant cultivar, the present experiment was implemented to evaluate mungbean cultivars against MYMV. The experiment was carried out during *kharif* at Main Agriculture Research Station, Raichur. Total nine cultivars were subjected to evaluation. Four cultivars *viz*., IPM-2-14, IPM-2-3, PDM-139 and IPM-99-125 released by Indian Institute of Pulse Research, Kanpur, other cultivars like BGS-9 and DGGV-2 released in last three years by UAS, Raichur and UAS, Dharwad respectively were included in the study. Shining moong (SM), selection-4 and Pusa Baisaki already released for cultivation in the region and popular among the farmers were also part of nine cultivars subjected for study. Each cultivar was sown in three replications of 5 x 3 m plot size at 30 x 10 cm spacing in RCBD (Randomized Complete Block Design) design. All recommended agronomic and cultural practices of mungbean were followed. The observations on disease incidence at weekly interval were recorded. Yield parameters such as pods /plant and seed yield were recorded and subjected to statistical analysis. The per cent disease incidence was calculated based on the following formula.

$$\text{Per cent Disease Incidence (PDI)} = \frac{\text{Number of plants infected}}{\text{Total number of plants observed}} \times 100$$

Results and Discussion

In the present experiment, mungbean cultivars were evaluated for their response against the yellow mosaic in comparison with popular cultivars released in NEK region. The results revealed that, response of cultivars from IIPR, Kanpur was found significantly superior compared to the already cultivated cultivars with respect to expression of resistance against MYMV and yield parameters recorded. These were superior in terms of expression of disease resistance in comparison with recently released cultivars viz., BGS-9 and DGGV-2.

The observations on disease incidence showed lowest MYMV incidence ranging from 6.13 to 6.81 per cent with higher seed yield ranging from 495 to 701 kg^{-h} among the cultivars from IIPR, Kanpur, whereas cultivars already released showed higher disease incidence in the range of 8.12 to 12.52 per cent with lower seed yield of 143 to 445 kg/ha.

The incidence of MYMV increased at weekly observations with similar trend in all the cultivars tested. In the experiment, lowest disease incidence of 6.13 per cent was noticed in IPM-2-3 with highest seed yield of 701 kg^{-h} followed by PDM-139 which had 6.41 per cent of disease incidence and 676.66 kg^{-h} seed yield (Table 1). The highest disease of 12.52 per cent was recorded in BGS-9 with seed yield of 464 kg/ha followed by in Pusa Baisaki with disease incidence of 10 per cent and seed yield of 143 kg/ha. Though there was no statistical significance difference observed between the cultivars from IIPR with respect to disease incidence and seed yield but found superior in comparison with already released cultivars. IPM 2-14 was claimed as most resistant, but the expression of resistance depends on strain of local MYMV and weather conditions which favor spread of virus and was well proved by Sing *et al.,* (2010).

The yield parameter of number of pods/plant was higher in IPM-99-125 (13.80) followed by PDM-139 (12.36) and DGGV-2 (11.16) which contradict with yield obtained was mainly due to shriveled, small and chaffy pods in severely affected susceptible plants. BGS-9 released by UAS, Raichur had given a good yield of 464 kg ha^{-1} in spite of highest incidence (12.52%) of MYMV.

These findings indicate that there is a scope for adoption of cultivars such as IPM-2-3 or PDM-139 or IPM 2-14 from IIPR, Kanpur (Fig. 1).

In addition, integration of resistance in to BGS may give still higher yield when resistance against MYMV will be incorporated in to the cultivar. The other cultivar DGGV released by UAS, Dharwad may also be considered for desirable gene transfer.

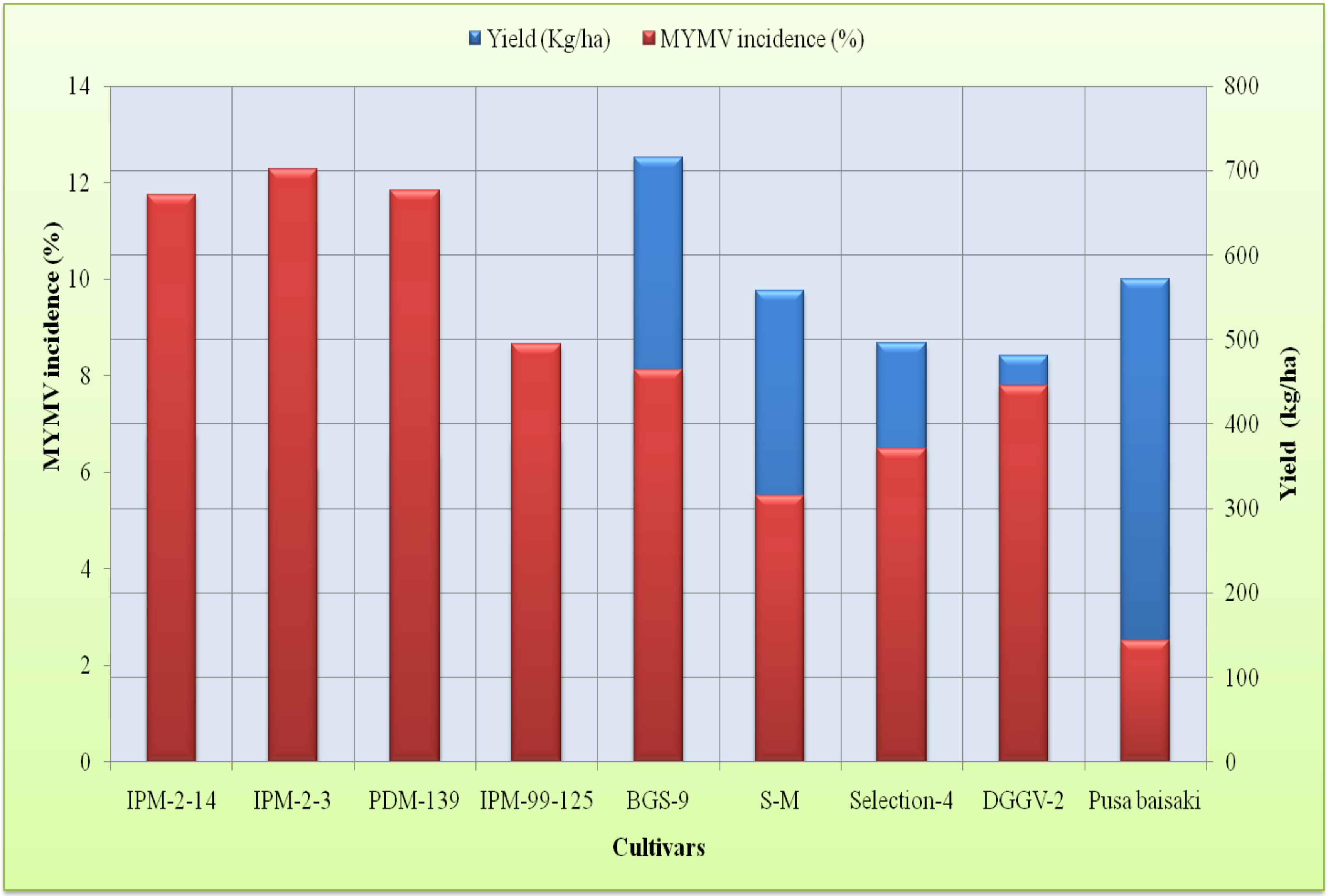
Such an effort by Durgaprasad *et al.,* (2015) had helped in developing a highly resistant mungbean cultivar PU31, VBN Bg (4) and VBN Bg (6) by recombination breeding with two or three cycles of recurrent selection using resistance donor from different places and locally grown high yielding susceptible recipient. Ahmed (1990) reported maximum incidence of 62.94 per cent due to mungbean yellow mosaic infection in *Vigna radiata* cv. Pusa baisakhi.

Table.1 Performance of different mungbean cultivars against MYMV incidence during *kharif* 2016

Treatment	Cultivars	Per cent Disease Incidence (%)							Pods per plant	Yield (kg ha^{-1})
		36 DAS	43 DAS	50 DAS	57 DAS	64 DAS	71 DAS	78 DAS		
T1	IPM-2-14	0.13 (2.09)	0.52 (4.15)	0.78 (5.09)	1.31 (6.59)	2.87 (9.76)	6.29 (14.53)	6.81 (15.12)	10.53 (18.93)	671.33
T2	IPM-2-3	0.27 (3.02)	0.48 (3.99)	0.83 (5.23)	3.28 (10.44)	3.62 (10.97)	6.13 (14.34)	6.13 (14.34)	10.30 (18.71)	701.33
T3	PDM-139	0.28 (3.07)	0.40 (3.65)	0.69 (4.77)	0.75 (4.99)	4.16 (11.78)	6.33 (14.57)	6.41 (14.67)	12.36 (20.58)	676.66
T4	IPM-99-125	0.22 (2.73)	0.78 (5.07)	0.76 (5.03)	2.15 (8.43)	5.32 (13.33)	6.69 (14.99)	6.69 (14.99)	13.80 (21.80)	495.33
T5	BGS-9	0.40 (3.66)	0.95 (5.59)	3.10 (10.15)	3.89 (11.38)	8.21 (16.65)	11.05 (19.41)	12.52 (20.72)	10.26 (18.68)	464.00
T6	S-M	0.38 (3.55)	3.15 (10.22)	4.68 (12.49)	6.67 (14.97)	8.89 (17.35)	9.32 (17.77)	9.76 (18.20)	10.40 (18.81)	315.33
T7	Selection-4	0.38 (3.54)	2.22 (8.58)	3.67 (11.05)	4.12 (11.71)	5.52 (13.59)	7.98 (16.41)	8.67 (17.12)	10.80 (19.18)	371.33
T8	DGGV-2	0.32 (3.24)	1.14 (6.13)	2.40 (8.92)	2.77 (9.58)	5.75 (13.88)	7.74 (16.16)	8.41 (16.86)	11.16 (19.51)	445.33
T9	Pusa baisaki	0.67 (4.71)	2.47 (9.04)	3.81 (11.26)	5.10 (13.05)	6.96 (15.30)	9.16 (17.61)	10.00 (18.43)	9.40 (17.85)	143.33
S.Em ±		0.02	0.10	0.18	0.27	0.46	0.51	0.62	0.64	
CD at 5 %		0.07	0.31	0.56	0.83	1.43	1.58	1.91	1.97	
CV		11.36	13.05	13.68	13.94	14.05	11.29	12.80	10.09	

* Figures in parenthesis are arcsine transformed values

Fig.1 Response of different mungbean cultivars against MYMV incidence and their yields during *kharif* 2016



The results of present screening were in accordance with several other findings. Asthana (1998) from Indian Institute of Pulses Research, Khanpur reported PDM-11, PDM-84, PDM-84-139 and PDM-84-143 as resistance against yellow mosaic disease. Paul *et al.,* (2013) screened 18 germplasm lines against MYMV, one was found resistant (ML-818) and one was susceptible (Pusa baisaki). Remaining nine was moderately resistant and seven were moderately susceptible. ML-818, IPM-99-125, PANT-M-4, PDM-139, UPM-9903, Pusa-2072, SML-668, Asha, PS-16 and MH-96-1 were found prominent lines against mosaic infection. In the present study also all the cultivars from IIPR, Kanpur were found resistant with less than 10 per cent disease incidence. In another screening experiment by Mohan *et al.*, (2014), they reported that none of the test entries were immune. Genotypes EC-398897, TM-11-07, TM-11-34, PDM-139, IPM-2-3, IPM-2-14, Pusa-0672, Pusa-0871 and MH-521 exhibited resistance. This indicates that there is scope for exploiting the resistance source used in developing IPM and PDM series cultivars for introgression in to the locally released cultivars which may perform well than their current response. Similarly, 12 mungbean genotypes were screened by Jameel *et al.*, (2016) and only two Meha and ML-1477 were found resistant at Jharkhand region. Another report studied in North Eastern Karnataka by Deepa *et al.,* (2017) revealed none of genotypes as highly resistant or resistant. But, 19 genotypes were found moderately resistant, 22 genotypes were moderately susceptible, 50 were susceptible and 15 highly susceptible. Screening of mungbean entries against MYMV was also carried by Ahmad *et al.,* (2017), they failed to find any entry under the category of highly resistant, however there were six entries (BRM-325, BRM-345, BRM-363, BRM-364, BRM-366 and NM-2011) found resistant, 10 (BRM-311, BRM-312, BRM-321, BRM-331, BRM-335, BRM-365, BRM-378, BRM-382, BRM-343 and BRM-353) moderately resistant, five entries (Chakwal-06, BRM-334, BRM-348, BRM-354 and BRM-356) moderately susceptible and 2 entries BRM-349 and BRM350 showed susceptible and highly susceptible response respectively. Since viruses such as the single-stranded (ss) DNA begomoviruses, are emergent problems worldwide (Rojas and Gilbertson, 2008 and Seal *et al.*, 2006). They have higher mutation rates than other pathogens, and distinct evolutionary dynamics compared to bacterial and fungal phytopathogens. Therefore breeding and screening of mungbean for resistance against MYMV should be carried out regularly and regionally for identification of suitable cultivars. The outcome of the current experiment gives way for adoption of resistant cultivars for cultivation and also use of resistance sources in improving the released cultivars for disease resistance and yield potential, this will certainly booster mungbean production and productivity in the NEK region.

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