Screening for identification of resistance source in Mung bean against Yellow Mosaic Virus (YMV)

Abstract

Mung bean [*Vigna radiata* (L.)] is an important pulse crop in South East Asia but also grown in some part of America and Africa and native to India-Burma region of South-East Asia belonging Leguminaceae family. It is being affected by a number of insect pests from seedling stage to maturity. Among them whitefly is an important pest that transmit the yellow mosaic virus (YMV), which is a major disease resultant in severe yield losses accounting 70% or more, at early stages may result in complete failure of the crop economically. Experiment was conducted to identify the source of resistance against MYMV during *Kharif*, 2017. Ten Indian mung bean varieties/ genotypes obtained from AICRP on Arid legumes, RARI, Durgapura, Jaipur and the obtained results revealed that there was significant variation among the genotypes for resistance against MYMV. Based on the average MYMV score, only two entries (IPM 02-3 and IPM 0205-7) were found completely free from the disease and plant had maximum chlorophyll content whereas IPM-409-4 and RMG 991 were found resistant and chlorophyll content was low as compared to highly resistance varieties. Rest of six varieties observed moderately resistance, moderately susceptible, susceptible and highly susceptible to the disease.

Key words: Mung bean, Vector, *Bemisia tabaci*, Yellow Mosaic Virus and Resistance Source

Introduction:

The mungbean [*Vigna radiata* (L.)] is native to India-Burma region of South-East Asia. Mungbean belongs to the leguminaceae family and sub family Papilinoaceae. It is very primeval annual crop in Indian farming cultivation. A numerous varieties of this crop are cultivated in various parts of country. The crop is being sown usually as dry land crop in almost all the states of India. It is also known as greengram, greenbean, mashbean, goldengram, chickasawpe and greensoy (Markam *et al*., 2018). Being a short duration pulse crop, it fits well in mixtures and crop rotation and it can be used as green manure crop or as a combined cash and soil improvement crop with residues incorporated into soil after pods have been harvested and it helps to enrich the soil by symbiotic relationship with specific soil rhizobia of the genus Bradyrhizobium. It is an excellent source of high quality protein with easy digestibility hence referred to patient too. It fixes biological nitrogen ranging 30-74 kg/ha in the soil and also

provides plant residues 15-20 q/ha. The mung bean rank third to Bengalgram and Redgram. It contains protein 24 per cent, Fat 1.3 per cent, Carbohydrates 56 per cent, Fibre 4.1 per cent, Moisture 10 per cent, Minerals 4 per cent, Iron 7.3 mg per 100 g, Calcium 124 mg per 100 gm, Phosphorus 326 mg per 100 g. As vegetable protein, it is rich in vitamin B which is protective against the beriberi disease.

Mung bean being an extremely drought resistant crop is extensively cultivated in arid and semi-arid areas of Rajasthan, Gujarat, Maharashtra, Haryana, U.P., Andhra Pradesh and Orissa. In Rajasthan Mung bean mostly grown under rain fed condition Jaipur, Ajmer, Nagour, Sikar and Tonk. This crop is sown in *kharif* season during July-August and harvested from October to November. The reasons for low productivity may be traditional methods off cultivation practiced by the farmer with the development of high yielding varieties and better management practices; there is a much scope for further increase in yield. In the arid areas of Rajasthan, this is the only crop taken during *Kharif* and cannot be replaced by other legumes like moth bean, cowpea, guar etc. because of its drought resistance.

There are various factors which limit the production of the crop including several diseases viz, cercospora leaf spot (*C. canescens*,), powdery mildew (*Erysiphe polygoni*), root disease complex (*Pythium spp.* or *Fusarium spp.*) and the reniform (*Rotylenchulus reniformis*) and root knot (*Meloidogyne spp.*) nematodes, viruses namely, bean common mosaic virus, cucumber mosaic virus, leaf crinkle virus, leaf curl virus, mosaic mottle virus and mung bean yellow mosaic virus. Among all the constraints, mung bean yellow mosaic virus (MYMV) caused by the Mung bean Yellow Mosaic Virus (MYMV) belonging to Begomovirus species in the family, Geminiviridae is the most destructive and cause significant yield losses by up to 100% or even kill a plant infected at an early vegetative stage (Kitsanachandee *et al.*, 2013). The viruses are transmitted by the vector, whitefly (*Bemisia tabaci*) in a persistent circulative manner. In India, Mung bean yellow mosaic is the most viral destructive disease of legumes popularly known as yellow plague of *Kharif* pulses. Mung bean yellow mosaic virus disease on mung bean was first ever reported from fields of IARI, New Delhi in 1960 and is transmitted principally by whitefly, *Bemisia tabaci* (Genn.) and grafting but not by sap, seed or soil (Nariani, 1960). Whitefly is the only vector reported by several scientists for the natural transmission of virus in different plants. The virus has geminate particle morphology (20 x 30 nm) and the coat protein encapsulates spherical, single stranded DNA genome of approximately 2.8 Kb.

Mung bean yellow mosaic virus causes irregular green and yellow patches in older leaves and yellowing of younger leaves. Affected plants produce fewer flowers and pods, pods often develop mottling, remain small and contain fewer and smaller seeds thus affecting yields qualitatively and quantitatively. Yellow mosaic virus infection bring about drastic change in the biochemical components such as chlorophyll “a”, “b” and total chlorophyll, nitrogen, protein etc. There deviation from normal development and functioning of plant due to virus infection the extent of metabolize disturbance brought by viral infection with in the host plant. In order to gain an insight in the deranged physiology of yellow mosaic effect on mung bean comparative studies is healthy and diseased tissue of some of the biochemical resistance were carried out

The most economic, operative and ecological method to minimize the losses due to MYMV is the utilization of natural genetic resource and resistant cultivars against MYMV. Thus the present experiment objects to identification of MYMV resistant genotypes among the popular released varieties and local green gram varieties of Rajasthan arid zone. This will help in the identification of green gram genotypes which can be recommended for cultivation in mungbean growing areas.

Material and Methods:

The present study was carried out at Agronomy Research Farm, SKN College of Agriculture, Jobner during *Kharif*, 2017. The field experiment was conducted in randomized block design in 3 m × 2 m plot at a spacing of 40 cm × 15 cm with four replications. Mung bean varieties/germplasm entries were obtained from AICRP on Arid legumes, the Department of Plant Breeding and Genetics, RARI, Durgapura, Jaipur. Ten germplasm entries and varieties were screened out against Mung bean yellow mosaic disease under field conditions and total chlorophyll content (mg/g f. wt) were also observed of the all ten screened varieties.

Estimation of chlorophyll (Chlorophyll a, b and total Chlorophyll)

Chlorophyll was estimated in healthy and diseased leaves showing four categories of disease severity (25%, 50%, 75% and 100%). One gram fresh plant material of each of healthy and diseased leaves was rapidly used and homogenized with 25 ml of 80 per cent acetone in Mortar with Pestle. The homogenate was centrifuged at 2000 rpm for 20 minutes and the volume made to 100 ml. The optical density was read at 645 nm, 652nm & 663 nm using 80 per cent acetone as blank. Three replicates of each sample were prepared and mean value of optical density was recorded.

For calculation of total chlorophyll, chlorophyll a and b following equation were used:

$$\text{Total chlorophyll} = \frac{20.2A_{645} + 8.02A_{663}}{a \times 1000 \times W} \times V \quad (\text{mg/g f. wt.})$$

$$\text{Chlorophyll a} = \frac{12.7A_{663} - 2.69A_{645}}{a \times 1000 \times W} \times V \quad (\text{mg/g f. wt.})$$

$$\text{Chlorophyll b (mg/gm)} = \frac{22.9A_{645} - 4.68A_{663}}{a \times 1000 \times W} \times V \quad (\text{mg/g f. wt.})$$

Where,

a = Length of light path in the cell (usually 1 cm)

V = Volume of the extract in ml.

W = Fresh weight of the sample in gram

*A_{645} and A_{663} are the optical densities of the sample at 645 nm and 663 nm, respectively.

The seeds of each variety was sown in two rows and flanked with one line of local susceptible variety to Mung bean yellow mosaic disease on both sides. Observations for disease intensity were being recorded near to crop maturity. Total chlorophyll content of all the varieties were also recorded with above procedure. Per cent disease index were be calculated by scoring disease as per disease rating scale of 0 – 5 and using following formula suggested by Mc Kinney (1923).

$$\text{PDI} = \frac{\text{Sum of all numerical ratings} \times 100}{\text{Number of plants assessed} \times \text{Maximum disease rating}}$$

Mung bean yellow vein mosaic virus disease was scored on 0-5 arbitrary scale as suggested by Bashir (2006) and the genotypes were scored as Highly Resistant (HR), Resistant (R), Moderately Resistant (MR), Susceptible (S) and Highly Susceptible (HS) based on disease severity.

0 = No virus symptoms seen (Highly Resistant)

1= Occasional mild symptoms (1-10% infection) (Resistant)

2= moderate infections (11-20% infection) (Moderately Resistant)

3= 21-30% infection (Moderately Susceptible)

4 = severe and wide spread symptoms (30-50% infection) (Susceptible)

5 = Severe with likely loss in yield (More than 50% infection) (Highly Susceptible)

Result and Discussion:

Resistant varieties are considered to be the most practical and economical means of controlling a plant-disease Ten varieties/Germplasms/entries of mung bean were screened under natural field conditions against yellow mosaic disease. The observations on disease intensity on various varieties were recorded total chlorophyll content (mg/g f. wt.). The results of pooled data presented in table-1, revealed that only two entries (IPM 02-3 and IPM 0205-7) were found completely free from the disease whereas IPM-409-4 and RMG 991 were found resistant. IPM 02-17 was found moderately resistant. Further, two varieties namely RMG 1145, RMG 1136 were found moderately susceptible whereas RMG 62 and RMG 1099 were found susceptible to the disease. Remaining entry, RMG 344 was found highly susceptible to the Mung bean yellow mosaic disease.

Table: 1 Screening of biochemical nature of resistance in different varieties against Mung bean yellow mosaic virus

S.No.	Variety/ Entries	Percent Disease Intensity (PDI)	Total chlorophyll content (mg/g f.wt.)*	Host Reaction
1	RMG-1099	34.45	0.70	S
2	RMG-62	45.32	0.65	S
3	RMG-1145	22.62	0.80	MS
4	RMG-1136	26.48	0.78	MS
5	RMG-344	16.41	0.46	HS
6	IPM-02-17	58.61	0.86	MR
7	IPM-409-4	6.62	0.91	R
8	RMG-991	7.52	0.94	R
9	IMP-0205-7	0.00	0.98	HR
10	IPM-02-3	0.00	1.07	HR

*Average of four Replications

Chlorophyll content of highly resistance varieties IPM 02-3 and IPM 0205-7 were recorded 1.07 and 0.98 (mg/g f. wt.), respectively. Whereas chlorophyll content 0.46 (mg/g f. wt.) was recorded in highly susceptible variety RMG 344. It was noted that total chlorophyll content recorded more in highly resistance varieties followed by resistance, moderately resistance, moderately susceptible, susceptible and highly susceptible.

Out of ten screened varieties of mung bean under natural field conditions against yellow mosaic disease, only two entries (IPM 02-3 and IPM 0205-7) were found completely free from the disease and plant had maximum chlorophyll content whereas, IPM-409-4 and RMG 991 were found resistant and chlorophyll content was low as compared to highly resistance varieties. Similar result was obtained by Darshan *et al.* (2018). They screened 35 mung bean genotypes against MYMV. Among these five were found highly resistant.

IPM 02-3 and IPM 0205-7 either be released as a variety or can be utilized as a source of resistance in future breeding programs for improvement of the crop. Earlier also, resistance to yellow mosaic in mung bean has been reported by Singh *et al*.(1988) and Singh *et al*. (1989). Present investigation was found that total chlorophyll content was also found lower in virus infected mung bean varieties supported with the study of Sinha and Shrivastava (2010) . They reported that the effect of mung bean yellow mosaic virus on the chlorophyll content in three varieties of mung bean plants – HUM-2, ML-192 and Pusa baishakhi had lowest total chlorophyll content. John *et al.* (2015) screened one hundred genotypes of mung bean (*Vigna radiata* L. Wilczek) against Mung bean yellow mosaic virus under natural field condition in Agricultural Research Station, TNAU, Virinjipuram, Tamil Nadu. They observed mung bean genotypes to yellow mosaic virus showed that 11 genotypes were found to be resistant, 23 genotypes were found to be moderately resistant reaction and 21 genotypes were moderately susceptible to mung bean yellow mosaic virus. Screening of genotypes for yellow mosaic resistance is the most important step in developing MYMV resistant genotypes. Screening of green gram for yellow mosaic disease resistance in natural field condition was earlier studied by many authors viz. Mohan *et al.,* (2014), Suman *et al.,* (2015), Bhanu *et al.,* (2017), Deepa *et al.,* (2017), Khaliq *et al.,* (2017), Awasthi *et al.,* (2007) *etc.*

Summary and Conclusion:

The present investigation concluded and reveals that two varieties/genotypes viz. IPM 02-3 and IPM 0205-7 were identified as Resistant against to the MYMV that can be used to further developing of resistant varieties against MYMV through different breeding techniques.

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