INNSPUB

International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print), 2222-5234 (Online)
http://www.innspub.net
Vol. 16, No. 4, p. 448-454 2020

RESEARCH PAPER OPEN ACCESS

Analysis of mungbean germplasm against mungbean yellow mosaic virus disease and its management

Sadia Saeed[1], Safdar Ali[2], Amer Habib[2], Muhammad Ahmad Zeshan[3*], Rana Binyamin[4], Awais Ahmed Khan[3], Muhammad Usman Ghani[5], Suleman Saleem[3]

[1]*Department of Botany, University of Agriculture, Faisalabad. Pakistan. 38000*

[2]*Department of Plant Pathology, University of Agriculture, Faisalabad. Pakistan. 38000*

[3]*Department of Plant Pathology, College of Agriculture, University of Sargodha, Sargodha. Pakistan. 40100*

[4]*Department of Plant Pathology, University of Agriculture Faisalabad. Sub-Campus Burewala. Pakistan. 61010*

[5]*Institute of Soil and Environmental Sciences, University of Agriculture Faisalabad. Pakistan. 38000*

Key words: Mungbean; Stress; Whitefly; Insecticide, Nutrient.

http://dx.doi.org/10.12692/ijb/16.4.448-454 Article published on April 30, 2020

Abstract

The present experiment was planned to manage yellow mosaic disease through resistant source, application of nutrients and indirectly by insecticides against whitefly. Ten genotypes (MPP 16082, MPP 16001, MPP 16024, MPP 16016, MPP 16075, MPP 16074, MPP 16005, MPP 16055, MPP 16015 and MPP 16073) were sown in augmented design to find out resistant source. The management trial was conducted in randomized complete block design (RCBD) and five entries (MPP 16074, MPP 16005, MPP 16055, MPP 16015 and MPP 16073) were sown in three replications. Each variety contains the five rows from which four rows were treated with Zinc sulphate, Pyriproxyfen, Boric acid, Flonicamid and fifth row was kept as control. The data of growth and yield parameters (plant height, pod length, root length, no. of seeds/pod and seed weight) were recorded from treated and untreated plants of all entries. None of the screened genotypes showed highly resistant response against MYMV, only a single entry MPP 16082 was found resistant, two cultivars MPP 16001, MPP 16024 moderately resistant while MPP 16016 and MPP 16075 found moderately susceptible. Among the remaining genotypes MPP 16055 and 16074 were found to be susceptible while other three varieties MPP 16055, MPP 16015 and MPP 16073 were highly susceptible. All the treatments showed significant reduction in MYMV disease, whitefly population and enhanced the growth and yield parameters of the treated plants. Pyriproxyfen showed minimum disease incidence, disease severity and whitefly population while zinc sulphate was least effective against yellow mosaic virus disease and its vector.

* **Corresponding Author:** Muhammad Ahmad Zeshan ✉ ahmd_1566@yahoo.com

Introduction

Mungbean (*Vigna radiata* L.) is a famous crop with high nutritious value. It is abundant in proteins, minerals, amino acids, vitamin B and starch. Its grain consist of considerably large quantity of carbohydrates 52%, protein 28%, moisture 11% and vita A, B and C 3% (Asaduzzaman *et al.*, 2008). In Pakistan it has been grown on an area of 13.8 thousand hectors and annual yield of 89.5 thousand tones (GoP, 2018). Mungbean yellow mosaic virus (MYMV) is responsible for the severe damage of crop. MYMV is transmitted with the help of whitefly (*Bemisi tabaci*) (Biswas *et al.*, 2008; John *et al.*, 2008). Infected plants show chlorosis and necrosis of leaves with short internodes, few number of flowers, distorted pods, undeveloped and shrunken seeds (Akhtar *et al.*, 2009). Infected plants result in reduced grain yield up to 80% (Khattak *et al.*, 2000). MYMV infection at younger stages of the plant may cause complete crop failure with 100% yield loss (MYMV are comprised of single stranded DNA and have geminate imperfect icosahedral units. These are exclusive as monopartite which has single stranded DNA. Some are bipartite which consist of two DNA components. It all depends on their genomic make up (Mansoor *et al.*, 2003; Jeske, 2009). This virus mostly pay harm to plants which are dicotyledonous like urdbean, soybean and mungbean. The both components of DNA known as DNA-A and DNA B are approximately 2-6 kb in size (Borah and Dasgupta 2012).

The prevalence of yellow mosaic disease has close relationship with whitefly (Dhingra and Ghosh, 1993). However, yield loss is more severe when the disease appears at early growth stages and may even lead up to 100% yield loss (Kitsanachandee *et al.*, 2013).

Genotype resistance is the most durable option to get rid of MYMV but due to increasing rate of mutation in virus, resistance is easily compromised (Karthikeyan *et al.*, 2011). To control mungbean yellow mosaic virus disease, there must be reduction in the number of whitefly population. Among the several methods of management of whitefly, control with the help of chemicals is the major method used widely (Kulkarni and Raja, 2019). The triazophos, ethion, imidachlorpid and acetamiprid are general chemical insecticides. These insecticides provide improved control of whiteflies. These kill population of whitefly even when come into contact but these chemicals penetrate into the plant cells and protect from attacks in future (Wang *et al.*, 2009). Plant nutrition enhance the plant defense mechanism and minimizes the damages caused by yellow mosaic disease (Islam *et al.*, 2002). The experiment was conducted on mungbean in the field to evaluate insecticides and plant defense activators against MYMV disease and whitefly.

Materials and methods

Collection of germplasm

Ten varieties/lines of mungbean (MPP 16082, MPP 16001, MPP 16024, MPP 16016, MPP 16075, MPP 16074, MPP 16005, MPP 16055, MPP 16015, and MPP 16073) were obtained from Pluses Research Institute of Ayub Agricultural Research Institute (AARI), Faisalabad.

Establishment of mungbean screening plot under field conditions

The land was properly prepared by ploughing in the field for trial in the research area of Department of Plant Pathology, University of Agriculture Faisalabad.

Ten mungbean varieties was sown and screened out against the mungbean yellow mosaic disease. The data of disease incidence, disease severity, whitefly population, plant length, pods length, number of pods per plant, number of seeds per pod, root length and yield was estimated in diseased and healthy mungbean cultivars.

Management trial

In management trial, five moderately resistant to moderately susceptible varieties/lines (MPP 16082, MPP 16001, MPP 16024, MPP 16075 and 16085) were used. Each variety was consisted of five rows with ten plants each by maintaining 30 cm plant to plant and 60 cm row to row distance.

The experiment was conducted in randomized complete block design (RCBD) three replications. The crop was sprayed with following four treatments to manage MYMVD and whitefly population.

Serial No.	Treatments	Dose
T1	Pyriproxyfen	5ml/L
T2	Boric acid	5gm/L
T3	Flonicamid	5gm/L
T4	Zinc sulphate	5ml/L

Data recording

The data of disease incidence and disease severity were recorded by using the formulas given below:

$$\text{Disease incidence} = \frac{\text{Number of infected plants}}{\text{Total number of plants}} \times 100$$

$$\text{Disease severity} = \frac{\text{Number of infected leaf}}{\text{Total number of leaf}} \times 100$$

Whitefly population was recorded in the upper, middle and lower part of the leaves. The percentage disease decrease over control was find out by the formula which is given below:

$$\text{Disease decrease over control (\%)} = \frac{\text{Disease incidence in control} - \text{Disease incidence in Treatment}}{\text{Disease Incidence in Control}} \times 100$$

The mungbean germplasm was categorised with the help of following standard disease rating scale (Bashir *et al.*, 2005).

Disease rating scale

Scale	Infection Percentage	Reaction
0	0%	Highly Resistant
1	1-10%	Resistant
2	11-20%	Moderately Resistant
3	21-30%	Moderately Susceptible
4	31-40%	Susceptible
5	More than 40%	Highly Susceptible

Data recording of whitefly population

The data on the population of whitefly was note down early in the morning. Ten plants were chosen from each replication in a random manner and whitefly population was taken from upper, middle and lower of the mungbean plant.

Data of growth and yield parameters

Plant length, root length and pod length were measured in five randomly selected plants with meter scale in centimeters. Number of pods per plant and number of seeds in each pod were counted.

The seed weight was taken when the crop was fully mature at the end. The seed pod are separated from the plants in treatment wise in each replication and weight was taken in grams.

Statistical analysis

The calculated data was statistically analyzed by ANOVA. Means were compared through least significant difference test at 0.05 probability level (Steel *et al.*, 1997).

Results

Germplasm response against mungbean yellow mosaic virus disease (MYMVD)

In screening experiment, ten genotypes (MPP 16082, MPP 16001, MPP 16024, MPP 16016, MPP 16075, MPP 16074, MPP 16005, MPP 16055, MPP 16015 and MPP 16073) were screened against MYMVD.

According to disease rating scale, none of the cultivars gave highly resistant response, MPP 16082 were resistant, MPP 16001 and MPP 16024 gave moderately resistant response while MPP 16016 and MPP 16075 were moderately susceptible. Among remaining entries, MPP 16074, MPP 16005 were ranked as susceptible while MPP 16055, MPP 16015 and MPP 16073 as highly susceptible (Table. 1).

The data shows that the low disease incidence (38.29), disease severity (07.64) and whitefly population (04.61) were observed in the variety MPP 16082. The highest disease incidence (75.14), disease severity (47.53) and whitefly population (34.67) were recorded in the variety MPP 16074.

Effect of treatments on MYMV disease severity and whitefly infestation

The Pyriproxyfen showed the most effective to control the disease severity and whitefly population (Table 2).

It gave maximum disease reduction (70.49%) with minimum disease severity (16.35%) and maximum control of whitefly (74.96%) with minimum whitefly infestation (09.73). Zinc sulphate showed the least effective result while depicting 55.08% decrease in yellow mosaic disease severity and 58.13% decrease in whitefly population as compared with untreated control.

Table 1. Comparison of mungbean genotypes for disease incidence, disease severity and whitefly infestation.

Genotypes	Disease incidence	Disease severity	Reaction	Mean whitefly infestation
MPP 16082	38.29j	07.64j	R	04.61j
MPP 16001	44.02i	13.24i	MR	11.96i
MPP 16024	49.48h	17.81h	MR	12.83h
MPP 16075	51.84g	24.92g	MS	15.58g
MPP 16016,	53.42f	29.05f	MS	17.51f
MPP 16005	58.17d	36.77d	S	22.07e
MPP 16015	55.23e	32.38e	S	24.25d
MPP 16055	74.19b	45.23b	HS	28.19c
MPP 16073	68.15c	42.19c	HS	33.33b
MPP 16074	75.14a	47.53a	HS	34.67a

LSD= 1.2 Similar letters in a column indicate significantly different means at p = 0.05.

Effect of growth and yield parameters in screening trial

The impact of insecticides and defense activators were studied on growth and yield parameters (Table 3). In case of MYMV disease, Pyriproxyfen was showed the maximum (68.01 cm) plant length and Zinc sulphate showed the minimum plant length (60.83 cm). The remaining treatments such as Boric acid and Flonicamid showed the 63.37 cm and 64.51 plant length, respectively. Pyriproxyfen was showed the maximum (58.33) number of pod per plant and Zinc sulphate showed the minimum number of pod per plant (41.03). Boric acid and Flonicamid showed 46.04 and 51.11 number of pods per plant respectively. The highest number of seeds per pod (13.33) was recorded from plants treated with pyriproxyfen while minimum (1167) in zinc sulphate treated plants. Pod with maximum length (09.33 cm) was found in pyriproxyfen sprayed mungbean plants while rest of the treatments were less effective. Similarly, pyriproxyfen gave increased root length and seed weight as compared to untreated control.

Table 2. Effect of insecticides, boric acid and zinc sulphate on MYMV disease severity and whitefly infestation**.**

Treatments	Disease severity	Decrease over control (%)	Whitefly population	Decrease over control (%)
Pyriproxyfen	16.35	70.49a	09.73	74.96a
Boric acid	21.48	61.24c	13.88	64.28c
Flonicamid	18.95	65.81b	11.94	69.27b
Zinc sulphate	24.89	55.08d	16.27	58.13d
Control	55.42		38.86	

LSD= 1.4 Similar letters in a column indicate significantly different means at p = 0.05.

Discussion

Mungbean is severely infected by mungbean yellow mosaic virus disease (Kang *et al.*, 2005). The economic damages because of YMVD holds up to 82% in case of green gram which is scattering rapidly in different new areas (Haq *et al.*, 2011). The recent experiment has based on the management of mungbean yellow mosaic virus disease and number of

whitefly population by the application of insecticides and nutrients but screening trial is without the involvement of any chemical spray.

Under field conditions none of the varieties was found to be highly resistant while only one variety was resistant. Among the tested genotypes, moderately resistant, moderately susceptible and susceptible groups received two entries each whereas rest were regarded as highly susceptible according to disease rating scale. The lack of resistance was also noted by Akhtar *et al.*, (2011) who screened one hundred fifty five genotypes of mungbean against mungbean yellow mosaic virus disease from different regions of world and its vector whitefly. The level of resistance was evaluated by examining the symptoms in the field, no genotype was found resistant against disease. It was also thoroughly linked to the experimentation of Habib *et al.*, (2007) who screened 107 lines of mungbean under usual environmental circumstances in randomized completed block design. There was no test entry that seemed to be moderately resistant, highly resistant and resistant, all of 107 test records were graded as highly susceptible. Bashir (2003) analyzed 278 lines and only 12 were regarded as resistant. Some of the stated resistant lines found to be extremely susceptible when there was low rainfall and favorable temperature for whitefly infestation.

Table 3. Comparison of growth and yield parameters in treated and untreated mungbean plants

Treatments		Plant length (cm)	Pod length (cm)	No. of pods/plant	Root length (cm)	No. of seeds/pod	Seed weight (g)
Pyriproxyfen	Treated	68.01a	09.33a	58.33a	07.83a	13.33a	171.33a
	Control	56.52	05.01	39.09	05.19	09.23	120.31
Boric acid	Treated	63.37c	07.41c	46.04c	07.45c	12.03c	161.00c
	Control	58.83	05.12	39.86	05.81	09.17	118.95
Flonicamid	Treated	64.51b	08.47b	51.11b	07.63b	12.42b	164.02b
	Control	54.22	05.93	39.27	05.44	09.62	121.73
Zinc sulphate	Treated	60.83d	06.53d	41.04d	07.16d	11.67d	147.67d
	Control	55.48	05.22	40.13	05.89	09.53	119.55

LSD= 0.85 Similar letters in a column indicate significantly different means at p = 0.05.

In trial of management the result of these chemical was visualized on whitefly, disease severity and rate of disease of mungbean yellow mosaic virus disease especially in mungbean. The pyriproxyfen showed the minimum disease incidence, disease severity and whitefly infestation followed by flonicamid while the zinc sulphate showed the maximum disease incidence, disease severity and whitefly infestation followed by boric acid. Due to reduced whitefly infestation and yellow mosaic disease; growth and yield parameters were significantly better in insecticide treated plants than zinc sulphate and boric acid. These results could be endorsed by the findings of Ghosh *et al.*, (2009) who sprayed chlorpyriphos, imidacloroprid, Monocrotophos, Thimethoxam, Dimethoate and Econeem in mungbean crop and recorded minimum whitefly population and YMVD as compared to control. Singh and Bhan (1998) and Debnath and Nath (2002) reported that there was reduction in yellow mosaic disease severity after the use of insecticides. Zeshan *et al.*, (2017) estimated that number of whitefly was lesser in plots treated with acetamiprid in comparison with control. Hossain *et al.*, (2010) conducted a trial to calculate the severity of few selected extracts of plant, cultural practices and insecticides for the decreasing disease incidence of mungbean yellow mosaic virus.

The minimum symptoms of disease showed in true leaves recorded from Admire treated plot as compare to the control at forty eight days after growing.

The insecticide Admire 200SL treated plot showed minimum severity of disease and maximum plant as compare to control. There was also calculated pods per plant and in control also. The pod length increased by plot treated by Admire while it was lesser treated with tape reflective.

Boric acid and zinc sulphate reduced the disease severity and whitefly population as compared to control. The active ingredients in both of these compounds, boron and zinc boost up the defense system of the plant and manages to repair the damages incited by viral attack (Pramanik and Ali, 2001). Nutrients helps in stimulation of plant defense mechanism and enhancement of growth and development (Sunil *et al.*, 2011).

MYMV disturbs the plant physiology by interfering with chloroplast cells and thus reducing the photosynthetic rate. Infected plants exhibit decreased production of photosynthats that leads to reduced metabolic activities and significant reductionin plant height, pod length, seed weight and seed yield (Salam *et al.*, 2011).

Conclusion

The results of the present study showed that treatment with pyriproxyfen followed by flonicamid, boric acid and zinc sulphate are effective against MYMV and whitefly.

Acknowledgement

The authors are thankful to Chairman Department of Plant Pathology, University of Agriculture Faisalabad for providing necessary facility for conducting research.

References

Akhtar KP, Kitsanachandee R, Srinives P, Abbas G, Asghar MJ, Shah TM, Atta BM, Chatchawankanphanich O, Sarwar G, Ahmad M, Sarwar N. 2009. Field evaluation of mungbean recombinant inbred lines against mungbean yellow mosaic disease using new disease scale in Thailand. Plant Pathology Journal **25,** 422-428.

Asaduzzaman M, Karim F, Ullah MJ, Hasanuzzaman M. 2008. Response of mungbean (*Vigna radiata* L.) to nitrogen and irrigation management. American Eurasian Journal of Scientific Research **3,** 40-43.

Bashir M. 2003. Studies on viral diseases of major pulse crops and identification of resistant sources. Tech. Annual Report Project. p 76.

Biswas KK, Malath VG, Varma A. 2008. Diagnosis of symptomless Yellow mosaic *Begomovirus* infection in pigeonpea by using cloned Mungbean yellow mosaic India virus as probe. Journal of Plant Biochemistry and Biotechnology **17,** 9-14.

Borah BK, Dasgupta I. 2012. *Begomovirus* research in India a critical appraisal. Bioscience **37,** 791-806.

Debnath S, Nath PS. 2002. Management of yellow vein mosaic okra though insecticides, plant products and suitable varities. Annals of Protection Science **10,** 340-342.

Dhingra KL, Ghosh DK. 1993. Efficiency of whitefly vector (*Bemisia tabaci*) in transmission of mungbean yellow mosaic virus in different souece test plant combination. International Journal of Tropical Agriculture **11(2),** 149-152.

Ghosh D, Laha SK, Biswas NK. 2009. Effect of different pesticides on incidence of mungbean yellow mosaic virus incidence. International Journal of Plant Protection **2,** 67-70.

Go P. 2018. Economic Survey. Government of Pakistan. Finance Division, Economic Advisor's Wing, Islamabad.

Haq Q, Arif MIA, Malathi VG. 2011. Infectivity analysis of a black gram isolate of mungbean yellow mosaic virus and genetic assortment with MYMIV in selective hosts. Virus Research **42,** 429-439.

Hossain AS, Islam SMA, Akhtera K, Muqit A. 2010. Effect of plant extracts, insecticides and cultural practices on growth characters and disease severity of mungbean yellow mosaic virus. International Journal of Sustainable Crop Production

2, 16-20.

Khattak G, Haq MA, Ashraf M, Elahi T. 2000. Genetics of mungbean yellow mosaic virus (MYMV) in mungbean (*Vigna radiata* L.) Wilczek. Journal of Genetics and Breeding **54,** 237-243.

Islam MR, Ali MA, Islam MS, Golam AFM, Hossain F. 2002. Effect of nutrients and weeding on the incidence of mungbean mosaic. Plant Pathology Journal **1,** 48-50.

Jeske H. 2009. Geminiviruses. Current Top Microbiology Immunology **331,** 185-226.

John P, Sivalingam PN, Haq QMI, Kumar N, Mishra A, Briddon RW, Malathi VG. 2008. Cowpea golden mosaic disease in Gujarat is caused by a mungbean yellow mosaic india virus isolate with a DNA-B variant. Archives of Virology **151,** 1359-1365.

Karthikeyan A, Sudha M, Pandiyan M, Senthil N, Shobana VG, Nagarajan P. 2011. Screening of MYMV resistant mungbean (*Vigna radiata* L. Wilczek) progenies through agro-inoculation. International Journal of Plant Pathology **2,** 115-125.

Kitsanachandee R, Somta P, Chatchawankanphanich O, Akhtar KP, Shah TM, Nair RM, Bains TS, Sirari A, Kaur L. Srinives P. 2013. Detection of quantitative trait loci for mungbean yellow mosaic india virus (MYMIV) resistance in mungbean (*Vigna radiata* (L.) Wilczek) in India and Pakistan. Breeding Science **63,** 367-373.

Kulkarni S, Shobharani M, Raja. 2019. Integrated management of yellow mosaic disease (YMD) of mungbean. International Journal of Current Microbiology and Applied Sciences **8(8),** 859-864.

Pramanik BK, Ali MA. 2001. Cultural and nutritional management of yellow mosaic in winter mungbean. Pakistan Journal of Biological Sciences **4,** 59-62.

Salam SA. 2011. Studies on mungbean yellow mosaic virus disease on greengram. Karnataka Journal of Agricultural Sciences **24(2),** 247-248.

Singh G, Bhan LK. 1998. Diseases of mungbean and urdbean and their management. In IPM System in Agriculture **4,** 311-371.

Steel RGD, Torrie JH, Dickey TA. 1997. Principal and practices of statistics. A biomedical approach. New YorkMCcGraw Hill. 3rd Edition. p 297-9.

Sunil CD, Singh B. 2010. Seed treatment and foliar application of insecticides and fungicides for management of Cercospora leaf spots and yellow mosaic of mungbean (*Vigna radiata*). Intternational Journal of Pest Management **56,** 309-314.

Wang ZY, Yao MD, Wu YD. 2009. Cross-resistance, inheritance and biochemical mechanisms of imidacloprid resistance in biotype *Bemisia tabaci*. Pest Management Science **65,** 1189-1194.