Int.J.Curr.Microbiol.App.Sci (2017) *6*(4): 88-98

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 6 Number 4 (2017) pp. 88-98**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2017.604.011

Evaluation of Mungbean (*Vigna radiata* L.) Cultivars for Resistance to Yellow Mosaic Virus

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Keywords

Mungbean, YMV, Incidence, Severity.

Article Info

Accepted:
02 March 2017
Available Online:
10 April 2017

A B S T R A C T

Two year field screening was undertaken during Kharif season of 2011 and 2012 with eight varieties of Mungbean to ascertain its resistance against Yellow mosaic virus disease. It is evident from the pooled data that no varieties/ lines showed complete resistance to YMV disease during both the consecutive years 2011 and 2012 but it was found that the incidence of the disease varied from 36.70% to 9.12%. The significant lowest incidence was recorded in Sukumar (9.12%), followed by Meha (9.39%). Highest yield was recorded in Sukumar (1.80 kg/plot) and it was at par with Meha (1.71 kg/plot). Significant lowest disease severity was also recorded in Sukumar (3.60 %) and it was statistically at par with Meha (3.91 %). Although PM 05 gave significant higher yield but disease severity and incidence were not statistically at par. Results indicate that both Sukumar and Meha could be cultivated in the plains of West Bengal as a tolerant variety and can also be used as parental lines. The other variety PM 05 may also be used as parental line from the genetic point of view.

Introduction

Pulses are one of the important segments of Indian Agriculture after cereals and oilseeds. Owing to their fairly large seeds, good storability, and high nutritional value and also due to its usefulness in improving the soil health by enriching nitrogen status and providing long-term fertility and sustainability to the cropping systems it is grown throughout the world. India is the largest producer and consumer of pulses in the world contributing around 25-28 per cent of the total global production. The estimates for 2010-11 indicate that the total pulse production is 17.29 mt from 25.51 mha area which is all times high and is the only exception year (IIPR, 2011 on Vision 2030).

Mungbean or green gram, scientifically known as *Vigna radiata* L. Wilczek, is one of the important short duration pulse crops of Indian origin. Mungbean is cultivated across the country throughout the year with an area and production of 3.77 mha and 1.52 mt, respectively (AICRP on Mullarp, 2009). The major biotic constraints diseases that delimit the productivity of Mungbean consist of viruses, fungi, bacteria and nematodes. Of which whitefly (*Bemisia tabaci*) transmitted

Mungbean yellow mosaic virus (MYMV) is widely distributed and most destructive. In India, Nariani (1960) reported first the yellow mosaic virus (YMV) diseases of mungbean (*Vigna radiata*), considering the importance and wide distribution of YMV, in India Nene (1972) made a comprehensive study of this disease in Uttar Pradesh and reported that YMV is present where ever the crops are grown. Mungbean plants infected with YMD generally show yellowing or chlorosis of leaves followed by necrosis, shortening of internodes, and severe stunting of plants with no yield or few flowers and deformed pods produced with small, immature and shrivelled seeds (Akhtar *et al*., 2009).

Considering the immense economic significance of 'Mungbean Yellow Virus disease' investigations are being carried out both at the national and international levels on different aspects of this disease particularly on the management by means of, suitable tolerant varieties, control of its insect vector (*Bemisia tabaci* Genn.) and by using chemical insecticides. But spraying of chemical insecticides possesses a threat to environment and health hazard. So, taking into account this fact, experiment was conducted to seek out tolerant varieties.

A field experiment was conducted at the Instructional Farm, BCKV, Jaguli, for consecutive two years 2011 and 2012 with eight different varieties of Mungbean which was collected from the Department of Agronomy, BCKV to study the effect of relative susceptibility to Mungbean Yellow Mosaic Virus. The site of the experiment located at south of tropic of cancer with 22^0 93´ N latitude, 88^0 53´ E longitude with an elevation of 9.75 m from mean sea level. Soil is of sandy loam type and having good irrigation facility.

The experimental design used was R.B.D (Randomized Block Design) with three replications. The date of sowing was 7. 3. 2011 and 7. 3. 2012, spacing used was 30cm x 15cm and plot size 5m x 4m. Fertilized were applied @ 15:45:20 kg/ha of N.P.K. The nitrogen was applied in two split doses, half at the time of sowing and rest half at 21 DAS, whereas total phosphorus and potash were applied at the time of sowing.

Observations on the incidence and severity of the disease were recorded starting from 20 DAS at an interval of 10 days up to 50 DAS.

The population of whitefly was also determined by counting on the mungbean plant and the mean of 3 replications was taken for population study of whitefly incidence and yield of the crop recorded at harvest and the data were statistically analyzed.

Disease incidence and severity were calculated by the following formulas

$$\text{Disease Incidence} = \frac{\text{No. of plants infected in a plot}}{\text{Total no. of plants in that plot}} \times 100$$

$$\text{Disease severity} = \frac{\sum \text{Numerical Ratings}}{\text{No. of leaves observed x Highest rating scale}} \times 100$$

Scale

0:- No. of plants not showing any symptom.
1:- Less than 1 per cent plants showing symptoms.
3:- 1-10 per cent plants showing mottling of leaves.
5:- 11-20 per cent plants showing mottling and yellow discolouration of leaves.
7:- 21-50 per cent plants showing mottling and yellow discoloration of leaves and stunting of plants.
9:- 51 per cent or more plants affected, stunting of plants pronounced, flowers and fruits reduced and appearance of severe yellow mottling on the leaves.

The scoring system was based on 1 to 9 rating scale as suggested by (Mayee and Datar, 1986).

Results and Discussions

Effect of varietal screening on the incidence, severity and yield of Mungbean Yellow Mosaic Virus

An experiment was conducted under field condition to determine the disease incidence and severity percentage of mungbean yellow mosaic virus among different varieties of mungbean in different days starting from 20 Days after Sowing (DAS). The data on field screening of mungbean yellow mosaic virus has been presented in tables: 1–3 and figures: 1–3.

In the first season (2011), it was found that none of the varieties/lines were free from the disease, but the percentage of incidence and severity varies among the eight varieties/lines. Out of these eight varieties/lines, Samrat was taken as check. Significant lowest incidence and highest disease control was recorded in T_8 (Sukumar) and the disease incidence was 9.09 % and disease control over check was 75.60 %. This was followed by, T_5 (Meha), T_3 (Sonali) and T_6 (PM 05), and the percentage of disease incidence of these varieties/lines were 9.40, 11.30 and 13.73 respectively and the percentage disease control were 74.77, 69.66 and 63.14 respectively.

The percentage of the incidence of disease was statistically at par in T_8 and T_5. Highest incidence of the disease was found in T_4 (Samrat) and the percentage of incidence was 37.25 followed by, T_7 (RMG 62), T_1 (Bireshwar) of 22.65 and 21.60 respectively. The percentage control of the disease over check variety were 39.19, 42.01 respectively. It was further noted that, first symptom appeared 20 days after sowing. The percentage of incidence was increased with the increase of the age of the plant, but the most susceptible period for infection was in between 30 and 40 DAS.

Significant lowest severity was found in the variety Sukumar followed by Meha and PM 05 and the severity of disease was 3.72%, 3.90% and 5.31% respectively. Disease severity of Meha and Sukumar were statistically at par. The percentage of disease severity was highest in the variety Samrat and it was 86.94, followed by RMG-62, Bireshwar, IPM 02/03, Sonali, and the disease severity was 76.51%, 66.67%, 53.33% and 12.12% respectively. The percentages of control of the disease over check variety were 12.00, 23.31, 38.66, and 86.06 respectively (Table 1).

In the second season (2012), it was also found that none of the varieties/lines were free from the disease, but the percentage of incidence and severity varies among the eight varieties/lines. Significant lowest incidence and highest disease control was recorded in T_8 (Sukumar) and the disease incidence was 9.14 % and disease control over check was 74.72 %. This was followed by, T_5 (Meha), T_3 (Sonali) and T_6 (PM 05), and the percentage of disease incidence of these varieties/lines were 9.39, 11.80 and 12.68 respectively and disease control over the check were 74.02, 67.36 and 64.43 respectively. The percentage of the incidence of disease was statistically at par in T_8 and T_5. Highest incidence of the disease was found in T_4 (Samrat) and the percentage of incidence was 36.15 followed by, T_7 (RMG 62), T_1 (Bireshwar) of 22.30 and 21.38 respectively. The percentage control of the disease over check variety were 38.31, 40.86 respectively. The percentage of incidence was increased with the increase of the age of the plant, but the most susceptible period for infection was in between 30 and 40 DAS (Table 2). Significant lowest severity was found in the variety Sukumar followed by

Meha and PM 05 and the percentage of disease severity was, 3.47, 3.92 and 5.05 respectively. Variety Sukumar and Meha were statistically at par. The percentages of control of the disease over check variety were 95.89, 95.36, 94.03 respectively. The percentage of severity of disease was highest in the variety Samrat and it was 84.52, followed by RMG-62, Bireshwar, IPM 02/03, Sonali, and the percentage of disease severity was 75.96, 66.67, 53.33 and 13.26 respectively. The percentages of control of the disease over check variety were 10.13, 21.12, 36.90, and 84.31 respectively.

From pooled data, it was also found that none of the varieties/lines were free from the disease, but the percentage of incidence and severity varies among the eight varieties/lines. Significant lowest incidence and highest disease control was recorded in T_8 (Sukumar) and the disease incidence was 9.12 % and disease control over check was 75.15 %. This was followed by, T_5 (Meha), T_3 (Sonali) and T_6 (PM 05), and the percentage of disease incidence of these varieties/ lines were 9.39, 11.55 and 13.30 respectively and disease control over the check i.e. Samrat were analysed and those were 74.41, 68.53 and 63.76 respectively (Table 3 and Figure 1). The percentage of the incidence of disease was statistically at par in T_8 and T_5. Highest incidence of the disease was found 36.70 % in T_4 (Samrat) and followed by, T_7 (RMG 62), T_1 (Bireshwar) of 22.48% and 21.49% respectively. The percentage control of the disease over check variety were 38.75, 44.14 respectively. The percentage of incidence was increased with the increase of the age of the plant, but the most susceptible period for infection was in between 30 and 40 DAS.

Significant lowest disease severity was found in the variety Sukumar followed by Meha and PM 05 and the percentage of disease severity was, 3.60, 3.91 and 5.18 respectively. The percentages of control of the disease were 95.80, 95.44, 93.96 respectively. Variety Sukumar and Meha were statistically at par. The percentage of severity of disease was highest in the variety Samrat and it was 85.73, followed by RMG-62, Bireshwar, IPM 02/03, Sonali, and the percentage of disease severity was 76.24, 66.67, 53.33 and 12.69 respectively. The percentage of control of the disease over check variety was 11.07, 22.23, 37.79, and 85.20 respectively.

Population of whitefly and yield on different varieties/lines in mungbean crop

During the first season 2011, the average number of Whitefly (*Bemisia tabaci*) (Table 1) was found highest in variety IPM02/03 (9.34 per plant), followed by RMG 62, Samrat, Bireshwar, the average number of whitefly population were, 8.58, 8.50 and 7.42 per plant respectively. The average number of Whitefly population was lowest in Sukumar (1.83), followed by Meha, PM 05 and the number of whitefly was 2.09, 3.00 respectively. There was a positive correlation between average number of whitefly per plant and incidence of the disease.

Significant highest yield was obtained from Sukumar variety and it was 1.79 kg/plot followed by Meha and PM 05 variety and the yield of Mungbean plant recorded (Table 1) were 1.72 and 1.63 kg/plot respectively. Yield of T_5 and T_8 were statistically at par. Lowest yield was found in RMG 62 (0.60 kg/plot), Samrat (0.60 kg/plots) and Bireshwar (1.07 kg/plot).

The average number of Whitefly population (*Bemisia tabaci*) in the second season (2012), (Table 2) was found highest in variety IPM 02/03 (9.17 per plant), followed by RMG 62, Samrat, Bireshwar, the average number of whitefly population were 8.34, 8.00 and 6.58 per plant respectively.

Table.1 Field screening of mungbean varieties/lines against yellow mosaic virus disease of mungbean (2011)

SL. No.	Treatment	Incidence of Disease (per cent)				Severity (per cent) (50 DAS)	Per cent of Disease control over check		Yield (kg/plot)
		Days after sowing							
		20	30	40	50		Incidence	Severity	
1	T_1	1.38 (6.75)	15.97(23.55)	16.16(23.70)	21.60(27.69)	66.67(54.74)	42.01	23.31	1.07
2	T_2	1.45 (6.92)	9.63(18.08)	15.62(23.28)	15.95(23.54)	53.33(46.91)	57.18	38.66	1.10
3	T_3	1.18 (6.24)	7.28(15.65)	9.29(17.75)	11.30(19.64)	12.12(20.37)	69.66	86.06	1.43
4	$T_{4\ (Check)}$	1.47 (6.96)	12.90(21.05)	30.97(33.81)	37.25(37.61)	86.94(68.81)	-	-	0.60
5	T_5	1.19 (6.26)	6.32(14.56)	7.78(16.20)	9.40(17.85)	3.90(11.39)	74.77	95.51	1.72
6	T_6	1.25 (6.42)	12.90(21.05)	13.37(21.45)	13.73(21.75)	5.31(13.32)	63.14	93.89	1.63
7	T_7	4.00 (11.54)	11.90(20.18)	20.47(26.90)	22.65(28.42)	76.51(61.01)	39.19	12.00	0.60
8	T_8	0.50 (4.05)	2.30(8.72)	5.62(13.71)	9.09(17.55)	3.72(11.12)	75.60	95.72	1.79
	S.Em±	0.20	1.30	0.29	0.31	0.54	-	-	0.06
	CD at 0.05	0.61	3.95	0.89	0.95	1.63	-	-	0.18

Figures in parenthesis indicate angular transformed value, DAS=Days after Sowing.

T_1=Bireshwar, T_2=IPM 02/03, T_3=Sonali, T_4=Samrat, T_5=Meha, T_6=PM 05, T_7=RMG 62, T_8=Sukumar.

Table.2 Field screening of mungbean varieties/lines against yellow mosaic virus disease of mungbean (2012)

SL. No.	Treatment	Incidence of Disease (per cent)				Severity (per cent) (50 DAS)	Per cent of Disease control over check		Yield (kg/plot)
		Days after sowing							
		20	30	40	50		Incidence	Severity	
1	T_1	1.26(6.45)	15.52(23.20)	16.77(24.17)	21.38(27.54)	66.67(54.74)	40.86	21.12	1.17
2	T_2	1.37(6.72)	9.83(18.27)	14.33(22.24)	15.94(23.53)	53.33(46.91)	55.91	36.90	1.17
3	T_3	1.65(7.38)	7.35(15.73)	9.24(17.70)	11.80(20.09)	13.26(21.35)	67.36	84.31	1.41
4	T_4 (Check)	2.61(9.30)	12.87(21.02)	31.46(34.12)	36.15(36.96)	84.52(66.83)	-	-	0.50
5	T_5	1.34(6.65)	6.67(14.97)	7.71(16.12)	9.39(17.84)	3.92(11.42)	74.02	95.36	1.69
6	T_6	1.31(6.57)	12.07(20.33)	13.13(21.24)	12.86(21.01)	5.05(12.99)	64.43	94.03	1.67
7	T_7	4.00(11.54)	12.66(20.84)	20.29(26.77)	22.30(28.18)	75.96(60.64)	38.31	10.13	0.57
8	T_8	1.16(6.18)	2.35(8.82)	5.52(13.59)	9.14(17.60)	3.47(10.74)	74.72	95.89	1.82
	S.Em±	0.57	1.02	0.25	0.22	0.92	-	-	0.08
	CD at 0.05	1.74	3.11	0.75	0.66	2.78	-	-	0.25

Figures in parenthesis indicate angular transformed value, DAS=Days after Sowing.
T_1=Bireshwar, T_2=IPM 02/03, T_3=Sonali, T_4=Samrat, T_5=Meha, T_6=PM 05, T_7=RMG 62, T_8=Sukumar

Table.3 Field screening of mungbean varieties/lines against yellow mosaic virus disease of mungbean (Pooled)

SL. No.	Treatment	Incidence of Disease (per cent)				Severity (per cent) (50 DAS)	Per cent of Disease control over check		Yield (kg/plot)
		Days after sowing							
		20	30	40	50		Incidence	Severity	
1	T_1	1.32(6.60)	15.74(23.37)	16.47(23.94)	21.49(27.62)	66.67(54.74)	41.44	22.23	1.12
2	T_2	1.41(6.82)	9.73(18.18)	14.98(22.77)	15.95(23.54)	53.33(46.91)	56.54	37.79	1.13
3	T_3	1.42(6.84)	7.32(15.70)	9.26(17.72)	11.55(19.87)	12.69(20.87)	68.53	85.20	1.42
4	$T_{4\ (Check)}$	2.04(8.21)	12.89(21.04)	31.21(33.96)	36.70(37.29)	85.73(67.81)	-	-	0.55
5	T_5	1.27(6.47)	6.50(14.77)	7.75(16.16)	9.39(17.84)	3.91(11.40)	74.41	95.44	1.71
6	T_6	1.28(6.50)	12.49(20.70)	13.25(21.35)	13.30(21.39)	5.18(13.16)	63.76	93.96	1.64
7	T_7	4.00(11.54)	12.28(20.51)	20.38(26.84)	22.48(28.30)	76.24(60.83)	38.75	11.07	0.58
8	T_8	0.83(5.23)	2.33(8.78)	5.57(13.65)	9.12(17.58)	3.60(10.94)	75.15	95.80	1.80
	S.Em±	0.43	1.17	0.28	0.27	0.75	-	-	0.07
	CD at 0.05	0.88	2.39	0.56	0.55	1.53	-	-	0.16

Figures in parenthesis indicate angular transformed value, DAS=Days after Sowing.
T_1=Bireshwar, T_2=IPM 02/03, T_3=Sonali, T_4=Samrat, T_5=Meha, T_6=PM 05, T_7=RMG 62, T_8=Sukumar

Table.3 Population of whitefly on mungbean plants at different days after sowing on different varieties (2011)

SL. No.	Treatment	Population of white fly/plant (DAS)				Average
		20	30	40	50	
1	T_1	5.00	7.33	8.33	9.00	7.42
2	T_2	9.00	8.00	9.67	10.67	9.34
3	T_3	2.33	4.67	8.33	3.00	4.58
4	T_4	8.33	7.00	10.33	8.33	8.50
5	T_5	1.33	2.67	1.67	2.67	2.09
6	T_6	1.67	4.00	3.00	3.33	3.00
7	T_7	10.67	8.00	10.33	5.33	8.58
8	T_8	1.00	2.00	3.00	1.33	1.83

DAS = Days after sowing**.** T_1=Bireshwar, T_2=IPM 02/03, T_3=Sonali, T_4=Samrat, T_5=Meha, T_6=PM 05, T_7=RMG 62, T_8=Sukumar

Table.4 Population of whitefly on mungbean plants at different days after sowing on different varieties (2012)

SL. No.	Treatment	Population of white fly/plant (DAS)				Average
		20	30	40	50	
1	T_1	4.00	6.00	8.00	8.33	6.58
2	T_2	8.33	8.33	9.33	10.67	9.17
3	T_3	2.00	4.33	8.33	4.00	4.67
4	T_4	6.33	9.00	9.67	7.00	8.00
5	T_5	1.67	2.67	2.33	2.67	2.34
6	T_6	2.00	4.33	2.33	3.00	2.92
7	T_7	9.67	7.67	9.00	7.00	8.34
8	T_8	1.33	1.67	2.33	2.33	1.92

DAS = Days after sowing**.** T_1=Bireshwar, T_2=IPM 02/03, T_3=Sonali, T_4=Samrat, T_5=Meha, T_6=PM 05,T_7=RMG 62, T_8=Sukumar.

Table.5 Population of whitefly on mungbean plant at different days after sowing on different varieties (pooled)

SL. No.	Treatment	Population of white fly/plant (DAS)				Average
		20	30	40	50	
1	T_1	4.50	6.67	8.17	8.67	7.00
2	T_2	8.67	8.17	9.50	10.67	9.25
3	T_3	2.17	4.50	8.33	3.50	4.63
4	T_4	7.33	8.00	10.00	7.67	8.25
5	T_5	1.50	2.67	2.00	2.67	2.21
6	T_6	1.83	4.17	2.67	3.17	2.96
7	T_7	10.17	7.83	9.67	6.17	8.46
8	T_8	1.17	1.83	2.67	1.83	1.88

DAS = Days after sowing**.**

T_1=Bireshwar, T_2=IPM 02/03, T_3=Sonali, T_4=Samrat, T_5=Meha, T_6=PM 05, T_7=RMG 62, T_8=Sukumar

Figure.1 Effect of disease incidence and severity on different varieties of mungbean against mosaic yellow virus disease of pooled

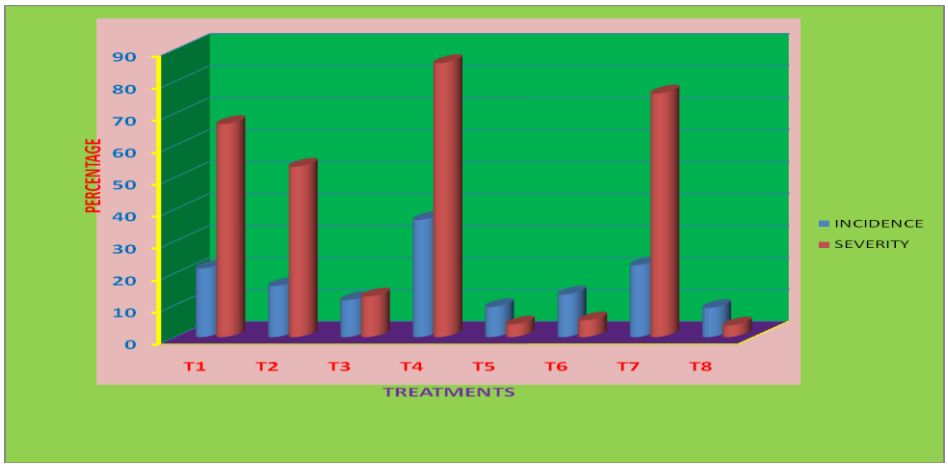


Figure.2 Effect of yield on different varieties of mungbean against mungbean yellow mosaic virus (Pooled)

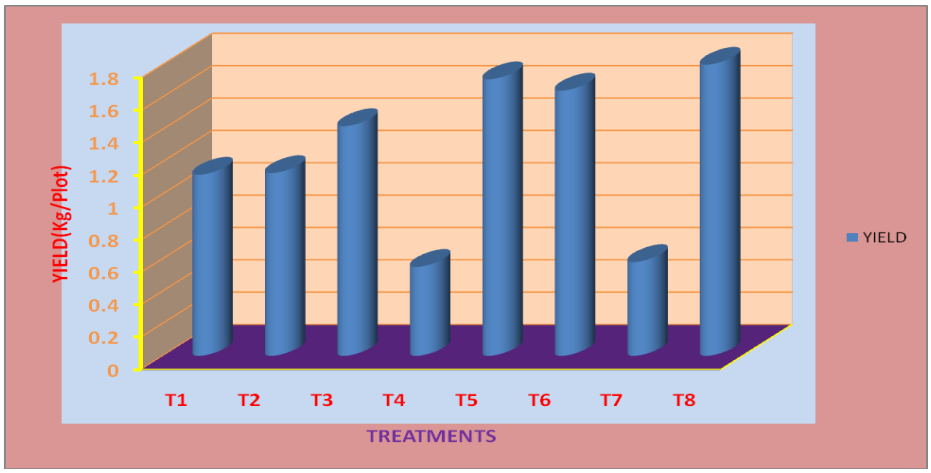
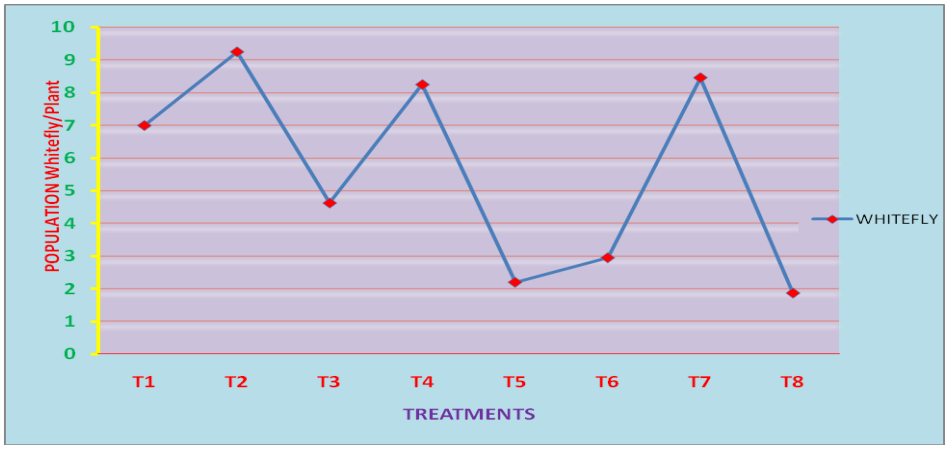


Figure.3 Population of whitefly on different varieties of mungbean plant (Pooled)



The average number of Whitefly was lowest in Sukumar followed by Meha, PM 05 and the number of whitefly was 1.92, 2.34 and 2.92 respectively. There was a positive correlation between average number of whitefly per plant and incidence of the disease.

Significant highest yield was obtained from Sukumar variety and it was 1.82 kg/plot followed by Meha and PM 05 variety and the yield of Mungbean plant recorded (Table 2) were 1.69 and 1.67 kg/plot respectively. Yield of T_5 and T_8 were statistically at par. Lowest yield was found in Samrat (0.50 kg/plot), RMG 62 (0.57 kg/plot), Bireshwar (1.17 kg/plot) and IPM 02/03 (1.17 kg/plot).

From two years pooled mean it was found that, the average number of Whitefly population (*Bemisia tabaci*) (Table 3 and Figure 3) was found highest in variety IPM 02/03 (9.25 per plant), followed by RMG 62, Samrat, Bireshwar, the average number of whitefly population was 8.46, 8.25 and 7.00 per plant respectively. The average number of Whitefly was found lowest in Sukumar followed by Meha, PM 05 and the number of whitefly was 1.88, 2.21 and 2.96 respectively. There was a positive correlation between average number of whitefly per plant and incidence of the disease.

Significant highest yield was obtained from Sukumar variety and it was 1.80 kg/plot followed by Meha and PM 05 varieties and the yields of Mungbean plant, recorded (Table 3 and Figure 2) were 1.71 and 1.64 kg/plot respectively. Yield of Meha and Sukumar were statistically at par. Lowest yield was found in Samrat (0.55 kg/plot), RMG 62 (0.58 kg/plots) and Bireshwar (1.12 kg/plots).

Pathak *et al.,* (2004) taken a total of 14 cultivars *of* mungbean and evaluated against MYMV in Alwar, Rajasthan, India during 2000-01. The percent disease incidence for yellow mosaic symptom was 4.44 and 6.25 in ML-5 and MUM-2, respectively. The average MYMV infection percentage was 2.22, 3.12 in ML-5 and MUM-2 respectively, compared to 100.0 in 'K-851' (control cultivar). Most of the cultivars were highly susceptible (72.22%) to the pathogen.

Hamid *et al.,* (2004) reported, BUmug-1, released in Bangladesh in the year 2000, is a new mungbean cultivar released for stable and high yield with combined resistance to mungbean yellow mosaic virus. It is an early maturing bold seeded material with synchronous pod maturity.

In conclusion screening of eight Mungbean varieties/lines under field condition was studied to ascertain its resistance against yellow mosaic virus disease. It was found that none of the varieties/ lines showed complete resistance but the incidence of the disease varied from 36.70% to 9.12%. The significant lowest incidence was recorded in Sukumar (9.12%), followed by Meha (9.39%). Moderate incidence was found in Sonali (11.55%), PM 05(13.30%) and IPM 02/03(15.95%). Highest yield was recorded in Sukumar (1.80 kg/plot) and it was at par with Meha (1.71 kg/plot). Significant lowest disease severity was also recorded in Sukumar (3.60 %) and it was statistically at par with Meha (3.91 %), while the first symptom appeared 20 days after sowing. The percentage of incidence was increased with the increase of the age of the plant, but the most susceptible period for infection was in between 30 and 40 DAS.

Although PM 05 gave significant higher yield but disease severity and incidence were not statistically at par. So from the above discussion it may be concluded that Sukumar and Meha could be cultivated in the plains of West Bengal as a tolerant variety and also used as parental lines. The other variety PM

05 may also be used as parental line from the genetic point of view.

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How to cite this article:

Dharnendra Reang, Prasad Singha, Abishak Thapa, Barun Rai, Nirmal Sarkar and Nath, P.S. 2017. Evaluation of Mungbean (*Vigna radiata* L.) Cultivars for Resistance to Yellow Mosaic Virus. *Int.J.Curr.Microbiol.App.Sci.* 6(4): 88-98.
doi: https://doi.org/10.20546/ijcmas.2017.604.011