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PLANT PATHOLOGY

Characterization of mungbean genotypes against mungbean yellow mosaic virus and cercospora leaf spot diseases under north east plain zone

Chandra Mohan Singh*[1,2], Rahul Kumar[3], S. B. Mishra[4], Anil Pandey[4] and Madhuri Arya[4]

[1]Agro-meteorology Division, Faculty of Basic Science and Humanities, Rajendra Agricultural University, Pusa (Samastipur)- 848 125, Bihar, India.
[2]Department of Plant Breeding and Genetics, Rajendra Agricultural University, Pusa (Samastipur)- 848 125, Bihar, India.
[3]Department of Plant Pathology, Rajendra Agricultural University, Pusa (Samastipur)- 848 125, Bihar, India.
[4]Department of Plant Breeding and Genetics, Tirhut College of Agriculture, Dholi – 843 121, Muzaffarpur, Bihar, India.

*Corresponding author: cmsingh.gpb@gmail.com

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ABSTRACT

Mungbean is an important legume crop due to its short behavior, nutritious and green mannuring nature. But it is highly affected by several diseases and other factors, which reduces the yield and seed quality. Mungbean yellow mosaic virus (MYMV) and Cercospora leaf spot (CLS) are the major disease of mungbean. Therefore, the present study was conducted to characterize the 34 genotypes of mungbean against MYMV and CLS disease during Kharif 2012 under two different date of sowing. The present study indicated that the none of the genotype was found immune, resistant to MYMV and CLS, whereas five genotypes namely DMS 03-17-2, IPM 2K-14-9, P 1131, DMS 02-11-4 and IPM 99-1-6 were found with moderately resistant reaction. These genotypes may be added in breeding program for improvement of mungbean.

Highlights

- Thirty-four genotypes of mungbean were included in present study to characterize against MYMV and CLS. To get the authentic result, genotypes were sown in two different dates.
- None of genotype showed immune/ resistant reaction for MYMV and CLS.
- Genotypes *namely* DMS 03-17-2, IPM 2K-14-9, P 1131, DMS 02-11-4 and IPM 99-1-6 were isolated as moderately resistant for MYMV and may be included in breeding program.

Keywords: Mungbean, Characterization, MYMV and CLS.

Mungbean [Vigna radiata (L.) Wilczek] is an important short duration, self pollinated, annual grain legume of Asia. It is a good substitute for meat in most Asian diet and a significant component of various cropping system (Srinives *et al*., 2000; Rudy *et al*., 2006). It is an excellent source of proteins and minerals, has been considered as a "poor men's protein" (Mian 1976). The grains of mungbean are also used as animal feed. It also improves the soil health. But, there are various factors, which are responsible for poor yield of mungbean, among which disease infestation is one of the most important

factor (Bakr and Rahman 1998). Many diseases affect the mungbean crop, in which Mungbean yellow mosaic virus (MYMV) transmitted by white fly [Bashir *et al.*, 1988] and Cercospora leaf spot (CLS) disease caused by Cercospora cruenta, C. canescens are the most important and damaging diseases of mungbean (Ali *et al.*, 2010) and cause economic losses to mungbean. MYMV disease incidence as high as 100% in farmers' fields is common in the Indian subcontinent, often resulting in considerable losses (Jalaluddin and Shaikh, 1981; Varma *et al.*, 1992). CLS is also an important damaging diseases of mungbean and cause yield loss up to 58% (Lal *et al.*, 2001). Diseased plants produce lower number of pods with small and immature seeds (Poehlaman, 1991). Different approaches were adopted to manage the MYMV and CLS disease such as spray of insecticides, fungicides, different plant extracts and use of resistant variety. However, the efficacy of these approaches may vary due to method and time of application; and the geographical location of the country (Ali *et al.*, 2010. Thus, need to identify the elite lines of mungbean over diverse environments with outstanding performance to develop the MYMV and CLS resistant/ tolerant varieties. Therefore, the present investigation was undertaken to evaluate the 34 mungbean genotypes against MYMV and CLS under three environments by adjusting the sowing dates.

Table 1: Scale for scoring of mungbean yellow mosaic virus (MYMV) disease of mungbean

Score	Percentage of foliage affected
0	No visible symptom
1	<5.00% Leaf area covered
3	5.10-10.00% Leaf area covered
5	10.10-50.00% Leaf area covered
7	50.1-75.00% Leaf area covered
9	>75.10% Leaf area covered

Table 2. Scale for scoring of Cercospora leaf spot (CLS) disease of mungbean

Score	Percentage of foliage affected
0	No visible symptom
1	<5.00% Leaf area covered
3	5.10-10.00% Leaf area covered
5	10.10-25.00% Leaf area covered
7	25.10-50.00% Leaf area covered
9	>50.10% Leaf area covered

Table 3: Scale for disease reaction of mungbean yellow mosaic virus (MYMV) and Cercospora leaf spot (CLS) disease of mungbean

SN	Percent infection	Disease reaction
1	<5.00%	Immune
2	5.10-10.00%	Resistant
3	10.10-20.00%	Moderately resistant
4	20.10-30.00%	Tolerant
5	30.10-40.00%	Moderately tolerant
6	40.10-50.00%	Susceptible
7	50.10-80.00%	Moderately susceptible
8	>80.10%	Highly susceptible

Materials and Methods

The present investigation comprised 34 genotypes of mungbean and genotypes were received from Pulse Breeding Section, Department of Plant Breeding and Genetics, Tirhut College of Agriculture, Dholi, Munzaffarpur, Bihar, India. The experiment was conducted at Crop Research Farm of TCA, Dholi, which is situated (25.50N, 35.40E, 52.12 m MSL) in district Muzaffarpur of North Bihar, India. Field experiment was performed in Randomized Complete Block Design (RCBD) with 3 replications in two sowing dates at 15 days interval viz., 10 July 2012 (early sown) and 25 July 2012 (timely sown). Each genotype was sown in six rows in plot of 4 m length with 10 cm seed to seed and 30 cm row to row spacing. Weeding was

Table 4. Disease characteristics of mungbean genotypes against mungbean yellow mosaic virus (MYMV) disease

SN	Genotypes	Disease Incidence (%)		Disease Severity (%)	
		Mean ± S.E.		Mean ± S.E.	
		DS1	DS2	DS1	DS2
1	HUM 12	38.93 ± 0.33	47.03 ± 0.70	11.79 ± 0.32	24.08 ± 0.50
2	IPM 02-4	55.66 ± 0.86	64.09 ± 2.03	29.27 ± 2.05	34.42 ± 0.62
3	NDM 09-18	51.46 ±0.36	59.10 ± 1.22	21.45 ± 1.31	24.83 ± 0.48
4	ML 1666	54.01 ± 0.40	60.91 ± 0.49	28.72 ± 2.29	30.24 ± 0.42
5	PM 08-02	29.94 ± 0.27	37.12 ± 2.13	12.81 ± 2.36	28.56 ± 0.87
6	SML 668	60.36 ± 0.63	70.43 ± 0.78	31.17 ± 1.44	48.22 ± 0.71
7	DM 99-11-5	52.47 ± 0.92	58.75 ± 1.10	22.95 ± 0.78	36.35 ± 0.90
8	DMS 03-17-2	44.55 ± 1.14	53.52 ± 1.46	16.40 ± 1.01	19.72 ± 1.82
9	DMS 01-34-2	51.99 ± 0.78	58.35 ± 1.23	20.66 ± 0.74	28.04 ± 0.58
10	DM 05-12-1-42-3	55.54 ± 0.81	63.46 ± 0.50	33.80 ± 0.79	36.20 ± 0.46
11	MEHA	60.35 ± 1.95	66.46 ± 1.53	37.63 ± 0.80	43.81 ± 0.87
12	DMC 17	54.18 ± 1.56	58.37 ± 0.82	21.50 ± 0.75	26.77 ± 1.86
13	TMB 37	58.63 ± 1.03	66.14 ± 1.43	32.15 ± 1.01	36.81± 1.29
14	SAMRAT	54.30 ± 0.62	59.44 ± 1.49	17.73 ± 0.50	23.87 ± 1.40
15	HUM 16	43.00 ± 1.00	51.58 ± 0.83	15.11 ± 0.40	20.12 ± 1.53
16	P 1232	52.19 ± 0.77	58.32 ± 0.81	19.35 ± 0.89	26.34 ± 0.25
17	P. Vishal	54.30 ± 0.38	59.33 ± 0.98	27.65 ± 0.68	32.31 ± 0.45
18	P 1131	52.98 ± 0.74	62.20 ± 0.97	20.67 ± 0.97	28.92 ± 0.39
19	IPM 2K-15-4	50.50 ± 1.18	58.56 ± 1.79	20.39 ± 0.74	22.39 ± 0.54
20	P 9531	46.74 ± 6.31	59.57 ± 0.37	21.35 ± 0.79	26.14 ± 0.24
21	PM 08-2	53.41 ± 1.31	60.85 ± 0.69	28.70 ± 0.87	32.88 ± 0.21
22	NDM 12-308	49.63 ± 0.77	52.69 ± 0.98	20.11 ± 0.75	22.81 ± 0.12
23	DMS 02-11-13	45.66 ± 1.20	51.45 ± 0.38	15.04 ± 1.15	20.27 ± 1.08
24	IPM 99-394	52.08 ± 0.90	58.59 ± 1.48	20.39 ± 0.58	22.86 ± 0.96
25	SML 1186	54.49 ± 0.29	58.85 ± 2.03	23.09 ± 0.93	26.51 ± 0.13
26	PM 5	51.47 ± 0.35	63.74 ± 0.26	25.03 ± 0.84	29.26 ± 0.24
27	SML 1151	48.47 ± 1.00	56.77 ± 1.57	18.37 ± 0.77	23.19 ± 0.98
28	IPM 2K-14-9	29.04 ± 1.14	35.88 ± 1.56	11.82 ± 1.14	17.49 ± 1.00
29	DM 05-74-11	52.77 ± 0.53	59.38 ± 0.56	22.32 ± 0.52	30.15 ± 0.58
30	IPM 99-01-10	51.06 ± 0.59	61.11 ± 2.08	20.40 ± 1.15	23.20 ± 1.30
31	PM 2	53.59 ± 0.22	61.97 ± 0.89	23.64 ± 0.88	36.57 ± 0.53
32	P 1131	44.36 ± 0.66	50.61 ± 0.14	15.47 ± 0.94	19.06 ± 1.74
33	DMS 02-11-4	38.32 ± 0.87	47.66 ± 0.22	15.18 ± 1.68	18.61 ± 2.34
34	IPM 99-1-6	39.32 ± 1.72	46.70 ± 0.93	17.03 ± 0.79	17.56 ± 1.49
	C.D.	4.03	3.13	3.02	2.49
	SE(m)	1.42	1.11	1.07	0.88
	SE(d)	2.01	1.56	1.51	1.24
	C.V.	4.97	3.36	8.49	5.52

SN= Serial number, SE= Standard error, DS1= first sowing date, DS2= Second sowing date, CD= Critical difference, SE(m)= Standard error of mean, SE(d)= Standard deviation, CV= coefficient of variation.

Table 5: Disease characteristics of mungbean genotypes against Cercospora leaf spot (CLS) disease

SN	Genotypes	Disease Incidence (%)		PDI (%)	
		Mean ± S.E.		Mean ± S.E.	
		DS1	DS2	DS1	DS2
1	HUM 12	26.34 ± 0.81	27.36 ± 0.63	32.95 ± 0.32	39.09 ± 0.16
2	IPM 02-4	34.32 ± 0.60	39.83 ± 0.48	35.85 ± 0.27	45.84 ± 0.57
3	NDM 09-18	34.31 ± 0.75	38.75 ± 0.29	39.71 ± 0.25	50.91 ± 0.30
4	ML 1666	20.58 ± 1.23	27.70 ± 0.58	45.95 ± 0.56	52.43 ± 0.88
5	PM 08-02	24.26 ± 1.23	34.60 ± 0.59	39.41 ± 0.23	47.97 ± 1.67
6	SML 668	19.52 ± 0.58	35.8± 0.293	45.17 ± 0.54	54.02 ± 0.37
7	DM 99-11-5	17.91 ± 1.11	22.50 ± 0.40	49.36 ± 0.79	55.79 ± 0.92
8	DMS 03-17-2	21.77 ± 0.68	31.55 ± 0.92	40.14 ± 0.57	47.81 ± 0.08
9	DMS 01-34-2	21.05 ± 1.28	26.76 ± 0.73	39.67 ± 0.44	50.84 ± 0.35
10	DM 05-12-1-42-3	18.02 ± 0.38	23.72 ± 0.61	42.70 ± 0.44	49.20 ± 0.84
11	MEHA	34.13 ± 0.48	45.31 ± 0.33	50.67 ± 0.17	57.30 ± 0.27
12	DMC 17	42.11 ± 1.75	51.03 ± 1.84	47.58 ± 0.38	53.50 ± 0.42
13	TMB 37	26.63 ± 0.83	35.98 ± 0.32	37.80 ± 0.80	44.96 ± 0.06
14	SAMRAT	17.94 ± 0.55	24.13 ± 0.42	47.67 ± 0.29	56.57 ± 0.25
15	HUM 16	24.97 ± 0.85	34.82 ± 0.84	47.13 ± 0.37	55.66 ± 0.76
16	P 1232	20.24 ± 0.74	26.83 ± 0.63	49.28 ± 0.84	54.65 ± 0.27
17	P. Vishal	32.60 ± 1.37	46.25 ± 0.64	50.75 ± 0.04	56.31 ± 1.31
18	P 1131	30.86 ± 0.46	43.89 ± 0.69	41.92 ± 0.36	50.43 ± 0.36
19	IPM 2K-15-4	21.66 ± 0.88	28.01 ± 0.79	45.76 ± 1.06	49.07 ± 1.11
20	P 9531	32.70± 0.48	46.25 ± 1.56	39.16 ± 0.06	47.87 ± 0.13
21	PM 08-2	18.68 ± 0.46	24.76 ± 1.14	40.40 ± 0.38	51.04 ± 0.57
22	NDM 12-308	25.06 ± 1.06	33.08 ± 0.20	40.21 ± 0.95	44.98 ± 0.07
23	DMS 02-11-13	19.70 ± 1.60	27.85 ± 0.19	47.53 ± 0.33	53.94 ± 0.29
24	IPM 99-394	34.16 ± 0.38	47.37 ± 0.27	50.98 ± 0.22	57.31 ± 0.50
25	SML 1186	25.09 ± 1.06	37.01 ± 1.14	41.86 ± 0.25	50.23 ± 0.52
26	PM 5	21.80 ± 0.60	32.44 ± 0.84	38.75 ± 0.50	44.71 ± 0.31
27	SML 1151	18.18 ± 0.83	24.64 ± 0.86	36.94 ± 0.46	42.45 ± 0.23
28	IPM 2K-14-9	36.84 ± 1.33	50.34 ± 0.59	47.95 ± 0.58	56.52 ± 0.28
29	DM 05-74-11	34.41 ± 0.53	46.41 ± 0.88	47.37 ± 0.48	56.25 ± 0.52
30	IPM 99-01-10	37.94 ± 0.88	50.64 ± 0.27	46.38 ± 0.94	53.56 ± 0.64
31	PM 2	27.39 ± 0.76	39.08 ± 0.14	49.86 ± 1.01	55.99 ± 2.35
32	P 1131	27.17 ± 0.48	40.72 ± 0.50	35.83 ± 0.28	44.64 ± 0.34
33	DMS 02-11-4	17.89 ± 1.67	27.54 ± 0.59	34.36 ± 0.62	43.31 ± 0.54
34	IPM 99-1-6	22.21 ± 0.80	28.55 ± 0.96	34.28 ± 0.60	38.95 ± 0.31
	C.D.	2.46	1.95	1.54	2.06
	SE(m)	0.87	0.69	0.54	0.73
	SE(d)	1.23	0.98	0.77	1.03
	C.V.	5.76	3.38	2.19	2.51

SN= Serial number, SE= Standard error, DS1= first sowing date, DS2= Second sowing date, CD= Critical difference, SE(m)= Standard error of mean, SE(d)= Standard deviation, CV= coefficient of variation.

performed when required during the growth period of the crop. No any irrigation was provided due to rainy season. No plant protection measure such as insecticidal or fungicidal spray was adopted for controlling the pest and diseases of the crop i.e. the crop was allowed to grow in natural condition. The visible symptoms of the CLS disease were critically observed and infected plants were identified in the field on the basis of symptom according to Bakr (1991). The number of plants showing MYMV symptoms was recorded by Visual Diagnosis Method (VDM) according to Ahmed (1985). The disease incidence of MYMV and CLS were recorded at 60 day after sowing (DAS). The incidence of CLS or MYMV was calculated as follows:

$$\text{Disease incidence of MYMV and CLS (\%)} = \frac{\text{Number of infected plants in each plot}}{\text{Total number of plants in each plot}} X$$

The disease severity was recorded at 60 DAS. The severity of MYMV and CLS disease was recorded on 1-9 scale according to Singh *et al.*, (1982) and Singh *et al.*, (1995), respectively. Five infected plants were selected randomly in each plot and 5 leaves from each plant were selected for scoring the disease severity data. The percent disease incidence (PDI) of MYMV and CLS were calculated as per methodology of Mian (1995).

$$\text{PDI (\%)} = \frac{\text{Sum of all disease rating}}{\text{Total number of leaves X Maximum grade}} X\,100$$

At random, five plants were selected in each plot to record the data on biological yield and Seed yield per plant. The data were subjected to statistical analysis by using online computer programme OPSTAT for proper interpretation.

Results and Discussion

Critical differences (CD) of genotypes showed significant differences for disease incidence and disease severity for MYMV; and disease incidence and PDI for CLS under both sowing dates indicated the presence of sufficient variability (Table 4 and 5).

The disease characteristics (incidence and severity) and disease reaction of MYMV has been presented in Table 4 and 6, respectively. The disease incidence for MYMV was ranged from 29.04 - 60.36% and 35.88 - 70.43%; whereas disease severity was ranged from 11.79 – 33.80% and 17.49 – 48.22% for both sowing dates (SD), respectively. For MYMV, the minimum disease severity was recorded for HUM 12 followed by IPM 2K-14-9, PM 08-02, Samrat, DMS 03-17-2, DMS 02-11-13, HUM 16, P 1131, DMS 02-11-4, IPM 99-1-6, P 1232 under DS1, whereas DMS 03-17-2, IPM 2K-14-9, P 1131, DMS 02-11-4, IPM 99-1-6 were recorded with low disease severity under DS2. This finding indicated that the five genotypes DMS 03-17-2, IPM 2K-14-9, P 1131, DMS 02-11-4, IPM 99-1-6 showed low severity for MYMV under both sowing dates and identified as moderately resistant genotypes may be used as donor parents for mungbean improvement.

Similarly for CLS, the disease characteristics (incidence and PDI) and disease reaction of MYMV has been presented in Table 5 and 7 respectively. The disease incidence for CLS was ranged from 17.89 – 42.11% and 22.50 – 51.03%; whereas PDI was ranged from 32.95 – 50.98% and 38.95 – 57.31% for both sowing dates (SD), respectively. For CLS, the disease incidence in DS2 was found higher than the corresponding DS1, indicating the proportion of infected plants was high in DS2 population. Out of 34 genotypes, 12 and 2 genotypes were found moderately tolerant under DS1 and DS2, respectively. Rest of the genotypes were grouped in moderately susceptible and susceptible group. Thus, these two genotypes viz., HUM 12 and IPM 99-1-6 may be added in mungbean breeding programme. None of genotypes showed resistant and tolerant disease reaction.

However, several reports on disease resistant of MYMV are available and clearly indicated the involvement of single recessive gene in governing the MYMV resistance (Khattak *et al.*, 2000; Khan *et al.*, 2007) and CLS resistance (Mishra *et al.*, 1988) of mungbean. Reddy, 2009 reported the single recessive gene controlling the partial resistance and assumed that two recessive genes may govern the complete resistance in mungbean. Shukla and pandya (1985) reported the two recessive complementary genes for

Table 6: Grouping of genotypes based on disease reaction for MYMV disease

SN	Disease reaction	Number of genotypes	≠Genotypes (DS1)	Number of genotypes	≠Genotypes (DS2)
1	Immune	-	-	-	-
2	Resistant	-	-	-	-
3	Moderately resistant	11	1, 5, 8, 14, 15, 16, 23, 28, 32, 33, 34	05	8, 28, 32, 33, 34
4	Tolerant	19	2, 3, 4, 7, 9, 12, 17, 18, 19, 20, 21, 22, 24, 25, 26, 27, 29, 30, 31	18	1, 3, 5, 9, 12, 14, 15, 16, 18, 19, 20, 22, 23, 24, 25, 26, 27, 30
5	Moderately tolerant	04	6, 10, 11, 13	09	2, 4, 7, 10, 13, 17, 21, 29, 31
6	Susceptible	-	-	-	-
7	Moderately susceptible	-	-	02	6, 11
8	Highly susceptible	-	-	-	-

SN= Serial number, ≠Serial number of genotypes are same as Table 4, DS1= First sowing date, DS2 = Second sowing date, -Nil.

Table 7: Grouping of genotypes based on disease reaction for CLS disease

SN	Disease reaction	Number of genotypes	≠Genotypes (DS1)	Number of genotypes	≠Genotypes (DS2)
1	Immune	-	-	-	-
2	Resistant	-	-	-	-
3	Moderately resistant	-	-	-	-
4	Tolerant	-	-	-	-
5	Moderately tolerant	12	1, 2, 3, 5, 9, 13, 20, 26, 27, 32, 33, 34	02	1, 34
6	Susceptible	03	11, 17, 24,	20	3, 4, 6, 7, 9, 11, 12, 14, 15, 16, 17, 18, 21, 23, 24, 25, 28, 29, 30, 31
7	Moderately susceptible	19	4, 6, 7, 8, 10, 12, 14, 15, 16, 18, 19, 21, 22, 23, 25, 28, 29, 30, 31	12	2, 5, 8, 10, 12, 19, 20, 22, 26, 27, 32, 33
8	Highly susceptible	-	-	-	-

SN= Serial number, ≠Serial number of genotypes are same as Table 4, DS1= First sowing date, DS2 = Second sowing date, -Nil.

complete resistance in mungbean. Thus, it cannot be transferred easily from donor to recipient. But crossing between extreme parents may give some proportion of resistant plants in early segregating generations. Reddy (2009) tried to improve the YMV resistance in mungbean through mutation breeding and found partial resistant mutant. Thus, elite lines isolated from this study may be added in crossing program for MYMV and CLS resistance in early segregating generations. The crosses (F1) of resistance/ tolerant and susceptible may also be used in mutation breeding program to get new combinations.

Conclusion

The present study indicated that the genotypes DMS 03-17-2, IPM 2K-14-9, P 1131, DMS 02-11-4 and IPM 99-1-6 showed MR reaction for MYMV and none of the genotypes showed with outstanding performance for CLS. Thus, these five genotypes may be added in breeding program as donor for MYMV resistance after molecular characterization.

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