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EXPLOITATION OF URDBEAN GERMPLASMS FOR MUNGBEAN YELLOW MOSAIC VIRUS (MYMV) MANAGEMENT AND IMPROVED SEED YIELD

EQUBAL M.J., SAHNI S.*, SINGH D. AND KUMAR B.

Tirhut College of Agriculture, Dholi, Muzaffarpur - 843 121, RAU, Pusa, Bihar, India.
*Corresponding Author: Email- sangitampp@gmail.com

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Abstract- Absence of resistant/tolerant genotypes against diseases and insect pests in urdbean (*Vigna mungo* (L.) Hepper) are one of the main reasons for their low yield in India. During the summer and *Kharif* season, yellow mosaic disease epidemically damages the crop in most of the urdbean growing areas of India. Identification of resistant genotypes is one of the most important aspects in the management of viral diseases, which might be the best possible solution to the viral disease problems. For the purpose of identifying resistance/tolerance in urdbean germplasm, field screenings were conducted for four consecutive seasons during summer and *Kharif*, 2013 & 2014, comprising of 100 test entries. Screening was done under natural environmental field conditions against yellow mosaic disease (YMD). Out of 100 entries tested, only one entry, NDU 12-1 was found to be disease free, nine genotypes (IPU 10-23, KUG 586, Mash-338, NDU 12-300, PU 09-35, UH 07-06, Uttara, VBG 10-008, and VBN 6) found to be highly resistance and four genotypes (Kopergaon, RUG-44, VBG 09-005, and NDU 11-201) showed resistance consistently in both the seasons over two year. However, out of 100 genotypes, only four genotypes i.e. VBN (BG) 7, IPU 2 -43, KUG 586 and KUG 503 were found to be superior for seed yield as well as resistant to MYMV.

Keywords- Mungbean yellow mosaic virus (MYMV), Resistance, Seed yield, and Urdbean

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Introduction

Urdbean (*Vigna mungo* L. Heper), known as urd dal/black gram, is an important pulse crop in India as well as in South East Asia. It is cultivated in three different season, *viz*., *kharif*, *Rabi* and summer. In India, it is cultivated on 3.30 million hectares and the production is 1.83 million tons. The average yield of urdbean fluctuates between 300 to 500 kg/ha for a decade in India. The yield losses (5-100%) reported due to various biotic stresses which is responsible for the fluctuation in the average yield. The biotic stresses like yellow mosaic, powdery mildew, cercospora leaf spot and web blight are major limiting factors for high yield. Among these, Yellow mosaic disease (YMD) is caused by Mungbean yellow mosaic virus (MYMV), is a most destructive disease of urdbean not only in India, but also in Pakistan, Bangladesh, Srilanka and contiguous areas of South East Asia [1-4]. This disease is vital, serious, critical, open spread and inflicts heavy yield losses annually. This disease is transmitted by white fly (*Bemisia tabaci* Gennadius) and not by mechanical inoculation or by seed [5], but MYMV strains found in Thailand are reported to be mechanically transmitted [6]. MYMV infects mungbean, soybean, mothbean, cowpea and urdbean (Mash) and some other leguminous hosts [7,8]. MYMV belongs to genus *Begomovirus* of the family Geminiviridae [9]. 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 [10]. In India, this virus cause more severe yellow mosaic disease in urdbean than mungbean [11]. Yield losses due to this disease vary from 5 to 100 per cent depending upon disease severity, susceptibility of cultivars and population of whitefly [12-14]. The infection of the viruses reduces not only yield but also severely impairs the grain size and quality [15]. Reduction in number of pods/plant seeds/pod and seed weight are the main contributing factors for yield reduction [7,16]. Though there is large area under urdbean cultivation in India, the productivity levels are low because of MYMV infections. The chemical management of the vector is not cost-effective since numerous sprays of insecticides are required to control whitefly. Recurrent sprayings also lead to health danger and ecological effluence. 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 a major constraint to production. The reasonable, robust and perfect method of controlling viral diseases is regarded as the use of resistant crop varieties. A good quality of research efforts have been directed towards screening urdbean germplasm against MYMV for the identification of resistant sources under diverse environmental conditions and a number of resistant lines have been reported [17]. Therefore, in present investigation an attempt was made to screen urdbean germplasm against YMD under natural environmental conditions, where high population of viruliferous white fly is always present.

Materials and Methods

Studies were undertaken to identify the resistance of urdbean germplasms against mungbean yellow mosaic virus disease. Field experiments were conducted for four consecutive seasons during summer and *Kharif,* 2013 & 2014, in the experimental Farm of Tirhut college of Agriculture, Dholi, Muzaffarpur (Rajendra Agricultural University, Bihar, Pusa, Samastipur). Well levelled plot with satisfactory drainage system was selected for the experiment.

A total of 100 urdbean genotypes, collected from All India Coordinated Research Project (AICRP) on MULLaRP, T.C.A., Dholi were assessed for their reaction against MYMV under natural field conditions in the augmented design by planting 2 rows of two test entries each alternated with one row of LBG 623 as susceptible check. Each test entry was planted in a row of 4 meter in length with row to row distance 30 cm and within plant distance 10 cm. Two rows of spreader were planted all around the experiment in order to attract white fly and enhance infection of MYMV. General cultural practices were adopted to maintain the experiment except that insecticide sprays were not applied in order to encourage the population of whitefly for natural disease spreading. Percent disease incidence were calculated and the genotypes were later grouped into different categories based on 1 to 9 scales used in All India Coordinated Research Project on MULLaRP [18] at pod formation stage from highly susceptible to disease free which is described in [Table-1]. Ripened pods in the individual row were gradually picked at appropriate times, sun dried for 10 days, and grains were separated and weighed to record the yield.

Table 1- Disease rating scale (1-9) for MYMV

Disease Score	Description	Disease Reaction
1	No visible symptoms on leaves or very minute yellow specks on leaves	Free
2	Small yellow specks with restricted spread covering 0.1-5% leaf area	HR
3	Mottling of leaves covering 6-10% leaf area	R
4	Yellow mottling covering 11-15% leaf area	MR
5	Yellow mottling and discolouration of 15-20% leaf area	MS
6	Yellow coloration of 21-30% leaves and yellow pods	S
7	Pronounced yellow mottling and discoloration of leaves and pods, reduction in leaf size and stunting of plants covering 30-50% 0f foliage	S
8	Severe yellow discoloration of leaves covering 50-75% of foliage, stunting of plants and reduction in pod size	HS
9	Severe yellowing of leaves covering above of foliage, stunting of plants and no pod formation	HS

Results and Discussion

In the present investigation, a total of 100 urdbean genotypes were assessed to identify the resistant genotypes against MYMV under natural field conditions during four consecutive season summer and *Kharif,* 2013&2014. Germination was completed within a week and the first appearance of yellow mosaic was recorded in several genotypes two weeks after planting. Mild to severe yellow specks were first observed on young leaves. Within next 2 weeks, these specks increased, coalesced and turned into yellow and green patches. The severity of disease increased with the passage of time.

The results revealed that there was a great variation among genotypes. All the genotypes were grouped into different categories based on 1 to 9 scales used in All India Coordinated Research Project on MULLaRP [18] at pod formation stage from highly susceptible to disease free [Table-1]. Results of disease reaction of genotypes during summer and *kharif*, 2013 & 2014 have been presented in [Table-2]. Out of 100 genotypes evaluated, only nine genotypes (IPU 10-23, KUG 586, Mash-338, NDU 12-300, PU 09-35, UH 07-06, Uttara, VBG 10-008 and VBN 6) found to be highly resistance and four genotypes (Kopergaon, RUG-44, VBG 09-005, and NDU 11-201) showed resistance consistently in both the season over two year. Although, eighteen genotypes i.e. IPU 2-43, KPU 1-10, KU 363, KUG 503, KUG 540, LRB 332, Mash 1-1, Mash-114, NDU 11-202, P 719, PU 08-5, PU 31, UH 08-05, VBG 10-0024, VBN (BG) 7, ACM 05-007, Naveen, and Pant U 30 exhibited disease free reaction in one season and highly resistance reaction in another season or highly resistance in one of season and resistance in another season. Five genotypes (IGKU 02-1, KU 1106, KUG 391, KUG 662 and UG- 218) showed moderately resistance reaction in one of the season and highly resistance or resistance in another season. Forty seven genotypes, i.e. AKU 10-1, AKU 9804, AKU 9904, B-3-8-8, Barabanki, BDU-1, Birsa Urd-1, CBG 703, CBG-757, CO 6, COBG 10-5, COBG 653, COBG 761, DBG 1, K 851, KKB 05-011, KPU 26-10, KPU 405, KPU 406, KPU-07-06, KPU-07-08, KUG 752, Kullu 4, KKB 20055, LBG 752, LBG 792, LBG 17, LBG-20, LBG-685, Mash 391, NUL 7, OBG 35, P 726, Palampur 93, Pragya, Phule U-0014, RBU-38, RUG-10, RVSU 11-8, RVSU 60, T9, TAU-9, TPU-4, TU 631, TU-94-2, VBN (BG) 3, VBN (BG) 5 were found to be moderately susceptible, susceptible and highly susceptible in one of the season, Whereas, sixteen genotypes, i.e. AAU 34, AKU-7-1, AKU 7 -4, AKU 10-4, AKU 15, CO 5, LBG 623, LBG-645, NUL 2-5, NUL-138, PDU 1, TAU-1, TAU-4, TU 17-4, TU-26,VBN (BG) 4 were found to be highly susceptible against MYMV in both the season over two year, showing severe yellow discoloration of leaves covering 50-75 % of foliage, stunting of plants and reduction in pod size. The present study showed that some genotypes showed different reaction against MYMV during summer and *Kharif* season. The variation in disease reaction might be because of variation in temperature and relative humidity that may have direct influence on vector population and its migration. Similar effect of climate on vector population was earlier reported [19,20]. In general, overall disease incidence was more and the majority of genotypes tested, have recorded susceptible and highly susceptible reaction against MYMV. Similar type of varietal evaluations were previously documented by several workers [13, 18, 21-28].

Table 2- Reaction of urdbean genotypes against MYMV during summer and Kharif, 2013 & 2014

Genotypes	Total no. of entries	Reaction group
NDU 12-1	1	Free-Free
IPU 10-23, KUG 586, Mash-338, NDU 12-300,PU 09-35, UH 07-06, Uttara, VBG 10-008, VBN 6	9	HR-HR
IPU 2-43, KPU 1-10, KU 363, KUG 503, KUG 540, LRB 332, Mash 1-1, Mash-114, NDU 11-202, P 719, PU 08-5, PU 31, UH 08-05, VBG 10-0024, VBN (BG) 7	15	Free-HR, HR-Free
ACM 05-007, Naveen, Pant U 30	3	HR-R, R-HR
Kopergaon, RUG-44, VBG 09-005, NDU 11-201	4	R-R
IGKU 02-1, KU 1106, KUG 391, KUG 662, UG-218	5	HR/R-MR, MR-HR/R
AKU 10-1, AKU 9804, AKU 9904, B-3-8-8, Barabanki, BDU-1, Birsa Urd-1, CBG 703, CBG-757, CO 6, COBG 10-5, COBG 653, COBG 761, DBG 1, K 851, KKB 05-011, KPU 26-10, KPU 405, KPU 406, KPU-07-06, KPU-07-08, KUG 752, Kullu 4, KKB 20055, LBG 752, LBG 792, LBG 17, LBG-20, LBG-685, Mash 391, NUL 7, OBG 35, P 726, Palampur 93, Pragya, Phule U-0014, RBU-38, RUG-10, RVSU 11-8, RVSU 60, T9, TAU-9, TPU-4, TU 631, TU-94-2, VBN (BG) 3, VBN (BG) 5	47	HS/ MS/S in one of season
AAU 34, AKU-7-1, AKU 7-4, AKU 10-4, AKU 15, CO 5, LBG 623, LBG-645, NUL 2-5, NUL-138, PDU 1, TAU-1, TAU-4, TU 17-4, TU-26,VBN (BG) 4	16	HS-HS

Seed Yield and Disease Incidence of Urdbean Genotypes showing Disease Free, HR, R, MR Reaction against MYMV during Summer and *Kharif*, 2013 & 2014

Seed yield and disease incidence of urdbean genotypes showing disease free, HR, R, MR reaction against MYMV in both the season over two year are shown in [Table-3]. Seed yield of urdbean genotypes showing disease free, HR, R, MR reaction against MYMV ranged from 8.43 g to 0.07 g per plant. VBN (BG) 7 produced the highest seed yield of 8.43g per plant, with 3.17% disease incidence followed by IPU 2-43 (6.40 g per plant), KUG 586 (5.24 g per plant) and KUG 503 (5.04g per plant) and exhibited highly resistance reaction with rating scale "2" showing yellow specks with restricted spread covering 0.1-5 % leaf area. Four genotypes yielded more than 5.04 grams per plant in spite of variable incidence of MYMV; seven genotypes produced between 4.10-4.89 g per plant, eleven genotypes produced between 3.06-3.84 g per plant, ten genotypes between 2.06-2.94 g per plant and 5 genotypes less than 2.06 g per plant. As regards grains yield; some tests lines were good yielder in spite of high disease incidence. Kopergaon produced only 0.07 g seed yield per plant, although found to be resistant with rating scale "3" and disease incidence 96.16 %. Similarly, ACM 05-007 produced only 1.16 g seed yield per plant showing highly resistance with rating scale "2" and disease incidence 10.05 %. Whereas, UG-218 produced 4.36 g seed yield per plant designated as moderately resistance and showing 98.00 % disease incidence. Stable genotypes for seed yield per plant in blackgram were reported earlier [17]. Earlier reports revealed that only a limited number of cultivars expressed high or good resistance and partial resistance [18]. However, resistance against YMD was rare and scarce [29]. They found a good quality of resistance in urdbean and soybean which led them to successful hybridization and interspecific transfer of resistance. On the basis of these findings it could be concluded that out of 100 genotypes, only four genotypes i.e. VBN (BG) 7, IPU 2-43, KUG 586, and KUG 503 were found to be superior for seed yield as well as showing stable and durable resistance to MYMV during both the seasons for two year. However, there is need to test these four genotypes i.e. VBN (BG) 7, IPU 2-43, KUG 586, and KUG 503, showing high seed yield with disease resistance in large scale yield trials across the environments for further confirmation of their stable performance. Location specific evaluation of germplasms to test and screen out their yield and disease resistance potential has some practical utilities. The resistant germplasm could be used as a source of resistance for the development of resistant cultivars and also the resistant germplasm i.e. VBN (BG) 7, IPU 2-43, KUG 586, and KUG 503, showing high seed yield and stable and durable disease resistance may be used for large scale cultivation at the tested location.

Table 3- Seed yield and disease incidence of urdbean genotypes showing disease free, HR, R, MR reaction against MYMV during summer and Kharif, 2013& 2014

S. No.	Entries	Percent disease incidence *	Yield/Plant* (g)
1	NDU 12-1	1.41	3.68
2	IPU 10-23	2.6	3.31
3	KUG 586	8.55	5.24
4	Mash-338	9.64	3.06
5	NDU 12-300	6.43	2.18
6	PU 09-35	4.85	2.94
7	UH 07-06	4.08	4.13
8	Uttara	4.53	4.18
9	VBG 10-008	2.13	3.26
10	VBN 6	3.95	1.83
11	IPU 2-43	1.92	6.4
12	KPU 1-10	1.98	3.4
13	KU 363	5.34	3.77
14	KUG 503	1.88	5.04
15	KUG 540	5.5	3.84
16	LRB 332	1.45	2.38
17	Mash 1-1	7.96	2.62
18	Mash-114	3.81	4.1
19	NDU 11-202	1.34	3.48
20	P 719	3.23	2.79
21	PU 08-5	2	3.6
22	PU 31	2.67	1.89
23	UH 08-05	0.63	4.57
24	VBG 10-0024	2.88	4.26
25	VBN (BG) 7	3.17	8.43
26	Kopergaon	96.16	0.07
27	RUG-44	88.23	3.3
28	VBG 09-005	84.66	2.1
29	NDU 11-201	91.6	2.06
30	ACM 05-007	10.05	1.16
31	Naveen	8.99	2.76
32	Pant U 30	83.6	3.53
33	IGKU 02-1	95.35	2.44
34	KU 1106	4.26	4.89
35	KUG 391	41.53	2.34
36	KUG 662	63.74	1.93
37	UG-218	98	4.36

*Data are mean value of 4 seasons

Abbreviations

HR: Highly resistance

R: Resistance

MR: Moderately resistance

MS: Moderately susceptible

S: Susceptible

HS: Highly susceptible

Conflicts of Interest: None declared.

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