RESEARCH ARTICLE

Resistance in urdbean against yellow mosaic, leaf crinkle and Cercospora leaf spot diseases under natural epiphytotic condition in Keonjhar district of Odisha

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ABSTRACT: The present investigation aimed to identify resistance in urdbean (*Vigna mungo*) against yellow mosaic disease (YMD), urdbean leaf crinkle disease complex (ULCD) and Cercospora leaf spot (CLS) in a field trial conducted at Regional Research and Technology Transfer Station, Keonjhar (AICRP on MULLaRP sub-centre), OUAT, Odisha. Twenty four urdbean genotypes were screened in the summer season of the year of 2012- 2013 and 2013-2014. The severity of YMD and CLS was recorded following 0-9 scale and disease incidence was accounted for ULCD. The urdbean genotypes evaluated were grouped into different categories based on disease reaction. The present results indicated that genotype P-104 was immune to YMD, CLS and ULCD, two genotypes, P-102 and P-103 exhibited resistance to YMD and CLS and P-101 showed susceptibility to YMD but immune to CLS. Two genotypes PU 14-11 and P-107 showed high resistance to both YMD and CLS but were susceptible to ULCD. The genotype PU 14-7 was moderately susceptible to YMD and CLS but immune to ULCD. Rest of the genotypes were moderately to highly susceptible. It is concluded that 3 genotypes (P-104, P-102 and P-108) could be exploited for resistance breeding of urdbean against YMD, CLS and ULCD and P-104, PU 14-7 and PU 14-1 for ULCD. The urdbean genotypes P-105, P-108, P-109 and PU 14-1 could be the choice for resistance against ULCD.

Keywords: Cercospora leaf spot, disease reaction, genotype, resistance, ULCD, urdbean, YMD

Urdbean or black gram (*Vigna mungo*), the important pulse crop, is native of India from where it has spread to many African, European and American countries. Urdbean represents a cheap source of carbohydrates and high quality protein, folate and iron. Pulses having valuable nutritional and health benefits, compliment the daily diet of Indians along with cereals. Urdbean occupying an area about 3.25 million hectares with an average annual production of 1.5 million tones (http://www.aicrpmullarp.res.in/crop_profile.html) holds an important position after chickpea in India. It is a short duration legume and can be cultivated in three different season viz., Kharif, Rabi and Summer. However, the average yield of urdbean is low in the country due to several biotic and abiotic factors and among the biotic factors diseases play major role.

Urdbean is vulnerable to the attack of a number of diseases like yellow mosaic disease (YMD), Cercospora leaf spot (CLS) and urdbean leaf crinkle disease complex (ULCD) at the Keonjhar district in the Northeastern plateau zone of Odisha. The yield loss due to YMD on urdbean varies from 10-100% depending upon the time

of infection, susceptibility of the cultivar, season of cultivation and vector population during the growing season (Nene, 1972; Ghafoor *et al.*, 2000). The disease has been reported to cause upto 83.9% loss in yield in Bihar (Quaiser and Ahmed, 1991). Cercospora leaf spot is reported from all the urdbean growing areas in our country (Pandher and Singh, 1981) and yield loss was recorded upto 50% (Singh *et al.*, 1987; Prajapati *et al.*, 2007). Comparatively urdbean is more susceptible to leaf crinkle disease complex than mungbean and other pulses (Kadian, 1980; Rishi, 1990; Biswas *et al.*, 2009); in the epidemic years it cause almost 100% yield loss (Makkouk *et al.*, 2003; Kanimozhi *et al.*, 2009). As no specific control measures are available, and host resistance happens to be the prime weapon for managing the virus-like diseases; therefore use of resistant cultivars are essential for management of these diseases.

In the recent times, little work has been done for identification of resistant sources against the diseases occurring in the urdbean field. Therefore, an effort has been made in the present study to identify resistant sources of urdbean against the abovementioned diseases by screening of germplasms in the natural field condition.

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MATERIALS AND METHODS

Field experiments were conducted at the Regional Research and Technology Transfer Station, Keonjhar (OUAT), Odisha during the *summer* seasons for the two consecutive years of 2012-13 and 2013-14 using 24 urdbean genotypes obtained from All India Coordinated Research Project on MULLaRP. The planting was done on 150 cm long rows, with row to row and plant to plant distance of 30 and 10 cm, respectively. Each entry was replicated twice. One row of highly susceptible check (var. Sekhar-1) was planted after every two test entries (following infector row technique) to spread the disease on the entries. Seed rate, fertilizers and manures were applied as per recommendation. The genotypes were allowed to be exposed to natural occurrence of YMD, ULCD and CLS. All the entries were categorized into six groups according to 0-9 scale for YMD and CLS. 0= No visible symptoms (Immune), 1= less than 1% leaf area infected (Highly resistant; HR), 3= 1-10% leaf area infected (Resistant; R), 5= 11-20% leaf area infected (Moderately susceptible; MS), 7= 21-50% leaf area infected (Susceptible; S) and 9= 51% or more leaf area infected (Highly Susceptible; HS) proposed by Iqbal *et al.* (2005). For YMD first disease scoring was done at 30 DAS and second before maturity.

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 YMD symptoms was recorded by Visual Diagnosis Method (VDM) according to Ahmed (1985).

Percent disease index (PDI) for the diseases was computed following as per the methodology given by Mian (1995):

$$\text{PDI} = \frac{\text{Sum of all numerical ratings}}{\text{Total number of leaf observed} \times \text{maximum rating}} \times 100$$

For Percent disease incidence for ULCD, the standard formula used was disease incidence (DI) % = No. of plant infected in a plot/ total no. of plants in that plot $\times 100$

The onset time was monitored for the appearance of first symptom and the disease severity was recorded every 10 days subsequently and averaged over the last observation. Ten plants per plot were selected for recording the disease severity under natural epiphytotic condition at random and whole plants were assessed up to 15 days before the harvest. Border rows were discarded for the assessment.

RESULTS AND DISCUSSION

The most feasible and durable solution of management of virus and virus-like diseases like YMD and ULCD can be obtained using resistant cultivars. Screening of urdbean genotypes against diseases under natural condition is the first step to identify the resistance in plants. In the present study, twenty-four urdbean

germplasms were screened during the *summer* under field condition by raising infector rows between two test entries for the years of 2012-13 and 2013-14 at the RRTTS, Keonjhar. Percent disease index (PDI) was estimated for YMD and CLS, and disease incidence was estimated for ULCD (Table 1). PDI of YMD varied from 0.34 to 45.47 in the year 2012-13 and 0.37 to 48.57 during 2013-14.

While screening, the pooled data (Table 1.) revealed that out of 24 urdbean genotypes screened against YMD, four genotypes, P-102, P-103, P-104 and P-112 were found to be immune. Eight genotypes, PU 14-6, PU 14-8, PU 14-3, PU 14-5, PU 14-11, P-107, P-108 and P-113 showed average disease score '1' indicating highly resistant. Seven genotypes, PU 14-9, PU 14-4, PU 14-2, PU 14-1, PU 14-10, PU 14-12 and P-105 showed disease score '3' indicating resistant reaction against the disease while four genotypes, PU 14-7, P-106, P-109 and P-110 showed disease score '5' indicating moderately susceptible. One genotype P-101 appeared to be susceptible with disease score '7' (Table 2.) with PDI of 47.02 (Table 1). Earlier, Obaiah *et al.* (2013) reported that 22 urdbean entries out of 56 genotypes were promising resistant genotypes against YMD under natural field conditions. Of 132 urdbean genotypes screened against YMD and ULCD, 53 genotypes were highly resistant to YMD and 26 genotypes to ULCD (Basir and Zubair, 2002). Ilyas *et al.* (1992) reported that none of the urdbean genotypes was found resistant when they tested 49 entries, however, 5 genotypes showed moderate disease reaction. The variations in disease reaction may be attributed to the inherent genetic nature of the genotypes influenced by the environmental factors.

The results (Table 1) showed that there were considerable differences among the genotypes for the level of resistance against CLS of urdbean. The PDI of CLS ranged from 0.46 to 18.77 and 0.37 to 20.47 for the two experimental years of 2012-13 and 2013-14 respectively. For both the YMD (PDI: 62.93) and CLS (PDI: 47.40), the susceptible check showed maximum disease aggravation under natural epidemic condition which helped the spread of the diseases over the test entries when planted alternately with every two rows. The genotypes screened were grouped into different categories based on their disease reaction and are presented in the table (Table 2, 3 and 4). The data indicated that out of 24 genotypes tested 17 showed immune response to CLS during *summer* in both the seasons. Four genotypes (PU14-2, PU14-10, PU14-11 and P-107) fell under highly resistant category. Two genotypes (PU14-8 and PU14-5) were under resistant and one (PU 14-7) was under moderately susceptible category (Table 3). There are several reports on screening of mungbean genotypes to *Cercospora* leaf spot. Earlier, Iqbal *et al.* (2004) reported 12 resistant mungbean genotypes after testing of 58 genotypes. Raju and Rao (2002) screened 200 genotypes of mungbean against *Cercospora* leaf spot and reported 174 genotypes as resistant. However, of 100 diverse stock of mungbean tested, only 18 genotypes were identified

Table 1. Scoring of different diseases on urdbean germplasms at RRTTS, Keonjhar during summer of 2012-13, 2013-14

Genotypes	YMD (PDI)			CLS (PDI)			ULCD (DI)		
	2012-13	2013-14	Pooled	2012-13	2013-14	Pooled	2012-13	2013-14	Pooled
P-101	45.47	48.57	47.02	-	-	-	34	25	29.5
P-102	-	-	-	-	-	-	37	28	32.5
P-103	-	-	-	-	-	-	50	55	52.5
P-104	-	-	-	-	-	-	-	-	-
P-105	6.73	7.35	7.04	-	-	-	-	-	-
P-106	17.33	19.57	18.45	0.49	0.39	0.44	38	35	36.5
P-107	0.56	0.67	0.62	0.57	0.60	0.59	29	25	27.0
P-108	0.36	0.47	0.42	-	-	-	-	-	-
P-109	12.46	14.44	13.45	-	-	-	-	-	-
P-110	13.33	16.46	14.90	-	-	-	27	33	30.0
P-112	-	-	-	-	-	-	42	47	44.5
P-113	0.79	0.56	0.68	-	-	-	31	35	33.0
PU14-9	7.95	9.95	8.95	-	-	-	48	46	47.0
PU 14-6	0.56	0.37	0.47	-	-	-	29	28	28.5
PU 14-4	6.48	7.79	7.14	-	-	-	10	19	14.5
PU 14-2	5.59	8.49	7.04	0.46	0.37	0.42	35	25	30.0
PU 14-8	0.86	0.48	0.67	7.49	8.94	8.22	-	-	-
PU 14-3	0.95	0.86	0.91	-	-	-	60	64	62.0
PU 14-5	0.34	0.45	0.40	5.94	7.78	6.86	28	24	26.0
PU 14-7	13.37	15.57	14.47	18.77	20.47	19.62	-	-	-
PU 14-1	2.48	3.49	7.97	-	-	-	-	-	-
PU 14-10	4.57	5.67	5.12	0.56	0.48	0.52	42	39	40.5
PU 14-11	0.78	0.89	0.84	0.67	0.59	0.63	33	29	31.0
PU 14-12	7.77	8.94	8.36	-	-	-	36	40	38.0
Sekhar 1 (Check)	60.48	65.38	62.93	45.85	48.94	47.40	20	15	17.5

PDI= Percent disease index, DI= Disease incidence; YMD= Yellow mosaic disease, CLS= Cercospora leaf spot, ULCD: Urdbean leaf crinkle disease complex

Table 2. Grouping of urdbean germplasms based on yellow mosaic disease reaction under natural field condition

Disease grade	Disease reaction	No. of genotype	Genotype
0	Immune	4	P-102, P-103, P-104, P-112
1	Highly resistant	8	PU 14-6, PU 14-8, PU 14-3, PU 14-5, PU 14-11, P-107, P-108, P-113
3	Resistant	7	PU 14-9, PU 14-4, PU 14-2, PU 14-1, PU 14-10, PU 14-12, P-105
5	Moderately susceptible	4	PU 14-7, P-106, P-109, P-110
7	Susceptible	1	P-101
9	Highly susceptible		

Table 3. Grouping of urdbean germplasms based on Cercospora leaf spot disease reaction under natural field condition

Disease grade	Disease reaction	No. of genotype (s)	Genotype (s)
0	Immune	17	PU14-9, PU14-6, PU14-4, PU14-3, PU14-1, PU14-12, P-101, P-102, P-103, P-104, P-105, P-106, P-108, P-109, P-110, P-112, P-113
1	Highly resistant	4	PU14-2, PU14-10, PU14-11, P-107
3	Resistant	2	PU14-8, PU14-5
5	Moderately susceptible	1	PU14-7
7	Susceptible		
9	Highly susceptible		

as resistant to YMD (Basandra *et al.*, 1999). In the present study, the result is in contradiction from the report of Haque *et al.* (1997) where none of the mungbean cultivars was resistant. The present study reported maximum number of genotypes to be resistant, indicating urdbean is more resistant than mungbean. It needs to be investigated if YMD causing virus strain in Keonjhar area of Odisha.

For evaluation of urdbean genotypes to ULCD, it was found that 17 genotypes were susceptible but the disease incidence varied from genotypes to genotypes and it ranged from 10 to 50% in the year 2012-13 and 19-55% in the year 2013-14. Among the genotypes tested, P-103 exhibited highest disease incidence (Table 1). Ashfaq *et al.* (2007) evaluated 87 urdbean cultivars against ULCD under field condition during spring and summer and they found more than 50% of the genotypes were infected. Binyamin *et al.* (2011) testified 40 urdbean varieties/lines against ULCD under field conditions and they reported none of the lines appeared to be highly resistant or resistant.

Urdbean genotype P-104 was found to have multiple resistances to YMD, ULCD and LCV. However, P-102 and P-103 exhibited immune reaction against YMD and CLS. On the contrary, genotype P-101 showed susceptible reaction to YMD but was immune to CLS. The genotypes PU 14-11 and P-107 exhibited highly resistance to both YMD and CLS but susceptible to ULCD on urdbean. The genotype PU 14-7 showed moderately susceptible to YMD and CLS but immune to ULCD. Rest of the urdbean genotypes came under either moderately susceptible or susceptible category.

As resistance against the virus is non-durable, battle between disease and search for resistance source is a never ending process. The resistance in cultivated species of urdbean not only to YMD and ULCD but also to the fungal disease is not stable and resistance breakdown frequently is common in resistant cultivars. Therefore, regular screening of resistant source and replacement of susceptible cultivars are obviously required for further development of resistant cultivars for successful management of the diseases. In the present study, it is concluded that three urdbean genotypes, P-104, P-102 and P-108 are suitable and could be exploited in urdbean resistant breeding programme against YMD and CLS. The urdbean genotypes, P-104, PU 14-7 and PU 14-1 could also be exploited exclusively for the development of ULCD resistant urdbean cultivar. However, care should be taken for that some genotypes are resistant at one location but become susceptible at another place as reported earlier by Iqbal *et al.* (1991) and Bashir *et al.* (2005), and therefore, genetic diversity of the crop genotypes and also pathogens coupled with environmental conditions should be taken into consideration for identification of durable resistant crop cultivars.

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REFERENCES

- Ahmed Q (1985). Fungicidal control of *Cercospora* leaf spot of mungbean (*Vigna radiata* L. Wilczek). *Indian Phytopath.* 38: 418-422.
- Ashfaq M, Khan MA, Mughal SM, Javed N, Mukhtar T and Bashir M (2007). Evaluation of urdbean germplasm for resistance against urdbean leaf crinkle virus. *Pak. J. Bot.* 39: 2103-2111.
- Bakr MA (1991). Management of important disease of major pulses: Advances in pulse research in Bangladesh: Proceedings of the Second National Workshop on Pulse 6-8 June 1998. ICRIASAT, India. pp. 121-125.
- Basandrai AK, Gartan SL, Basandrai D and Kalia V (1999). Blackgram (*Phaseolus mungo*) germplasm evaluation against different diseases. *Indian J. Agric. Sci.* 7: 506-508.
- Bashir M, Ahmad Z and Ghafoor A (2005). Sources of genetic resistance in mungbean and blackgram against urdbean leaf crinkle virus (ULCV). *Pak. J. Bot.* 37: 47-51.
- Bashir M and Zubair M (2002). Identification of resistance in urd bean (*Vigna mungo*) against two different viral diseases. *Pak. J. Bot.* 34: 49-51.
- Binyamin R, Khan M, Khan A, Khan AI, Azam M, Awan FS and Khan NA (2011). Molecular characterization of urdbean (*Vigna mungo*) germplasm related to resistance against urdbean leaf crinkle virus. *Genet. Mol. Res.* 10: 1681-1688.
- Biswas KK, Tarafdar A, Kumar A, Dikshit HK and Malathi VG (2009). Multiple infection in urdbean (*Vigna mungo*) in natural condition by begomovirus, tospovirus and urdbean leaf crinkle virus complex. *Indian Phytopath.* 62: 75-82.
- Ghafoor A, Ahmed Z, Quresi AS and Iqbal SM (2000). Significance of mungbean yellow mosaic virus on yields and its component in *Vigna mungo* L. Hepper. *Pak. J. Phytopathol.* 12: 74-78.
- Haque MF, Mukherjee AK, Mahto RN, Jha DK, Chakraborty M, Srivastava GP and Prasad D (1997). Birsia Urid-1 - a new variety for Chotanagpur region of Bihar. *J. Res.* 9: 177-178.
- Iqbal SM, Zubair M and Haqqani AM (2004). Resistance in mungbean to *Cercospora* leaf spot disease. *Int. J. Agric. Biol.* 6: 792-793.
- Iqbal SM, Ghafoor A, Zubair M and Malik BA (1991). Reactions of urdbean cultivars against leaf crinkle virus disease. *J. Agric. Res.* 29: 415-418.
- Iqbal SM, Haq IK, Baksh A, Ghafoor A and Haqqani AM (2005). Screening of chickpea genotypes for resistance against *Fusarium* wilt. *Mycopathology* 3: 1-5.
- Kadian OP (1980). Studies on leaf crinkle disease of urd bean (*Vigna mungo* L. Hepper), mungbean (*Vigna radiata* L. Wilczek) and its control. Ph.D Thesis, Department of Plant Pathology, Haryana Agricultural University, Hisar. pp. 177.
- Kanimozhi S, Ganapathy T and Rajinimala N (2009). Seed transmission of ULCV in mung bean and urdbean plants infected with both MYMV and ULCV. *Arch. Phytopathol. Plant Prot.* 42: 401-408.
- Ilyas MB, Anwar-UI-Haq M and Iltikhar K (1992). Screening of urdbean germplasm for the source of resistance against yellow mosaic virus and leaf crinkle virus. *Pak. J. Agric. Sci.* 29: 144-147.

- Makkouk KM, Kumari SG, Huges JDA, Muniyappa V and Kulkarni NK (2003). Other legumes. In: Virus and virus like disease of major crops in developing countries. Leobenson G and Thollapilly G (Eds.). Kluwer Academic Publishers, Dordrecht, The Netherlands. pp. 447-476.
- Mian AL (1995). Grow more pulse to keep your pulse well. An essay of Bangladesh Pulse, Department of Agronomy, BAU, Mymensingh. pp. 11-15.
- Nene YL (1972). A survey of viral diseases of pulse crop in Uttar Pradesh. Research Bulletin No. 4, GB Pant University of Agriculture and Technology, Pantnagar, U.P., India. pp. 191.
- Obaiah S, Reddy BVB, Reddy NPE and Siva Prasad Y (2013). Screening of some black gram (*Vigna mungo* L. Hepper) genotypes for resistance to yellow mosaic virus. *Curr. Biot.* 7: 96-100.
- Pandher RS and Singh G (1981). Studies on physiological pathogenicity, symptomatology, morphology of *Cercospora cenescens* and *C. cruenta* on mung bean (*Vigna radiata* L. Wilczek, In: Third International Symposium, Plant Pathology, Dec 14-18, IARI, New Delhi.
- Prajapati RK, Choudhary RG and Viswadhar (2007). Integrated management strategies on pulse. In: Eco friendly management of plant disease. Ahmed S and Narain U (Eds.) Daya Publishers, New Delhi. pp. 277-287.
- Quaiser A and Ahmed Q (1991). Growth attributes and grain yield of mung bean plants affected by mung bean yellow mosaic virus in field. *Indian Phytopath.* 43: 559-560.
- Raje RS and Rao SK (2002). Screening of mungbean (*Vigna radiata* L. Wilczek) germplasm for yellow mosaic virus and *Cercospora* leaf spot. *Legume Res.* 25: 99-104
- Rishi N (1990). Seed and crop improvement of Northern Indian Pulses (*Pisum and Vigna*) through control of seed borne mosaic viruses. Final Technical Report, (US-India Fund), Department of Plant Pathology, CCS Haryana Agricultural University, Hisar, India. pp.122.
- Singh RA, Amin KS and Gurha SN (1987). Investigation on major diseases of mungbean and urdbean. Annual report, Directorate of Pulse Research, Kanpur. pp. 75-76.