Symptom Based Screening of Urdbean Accessions against Leaf Crinkle, Bud Deformation and Yellow Mosaic under Natural Conditions

Abhishek K. Dubey¹, N. K. Gautam², Sajad Un Nabi³, Saurabh K. Dubey³, Pankhuri Singhal³, Manoj K. Yadav³, Saritha R. K.³ and V. K. Baranwal³*

¹Division of Crop Research, ICAR-Research Complex for Eastern Region, Patna, Bihar-14, India
²ICAR-National Bureau of Plant Genetic Resource, New Delhi-12, India
³Division of Plant Pathology, ICAR- Indian Agricultural Research Institute, New Delhi-12, India

*Corresponding author

A B S T R A C T

Among several factors responsible for low production and productivity, Urdbean leaf crinkle disease (ULCD) and yellow mosaic are considered to be the major threat for urdbean cultivation. The lack of resistance in urdbean against mixed infection of symptoms like crinkling, mosaic and bud deformation is major concern in urdbean productivity. In present study, the symptom based screening in urdbean accessions against leaf crinkle; bud deformation and yellow mosaic under natural conditions were done. The results revealed that all the three symptoms viz., crinkling, mosaic and bud deformation were observed from various accessions. The nature of the symptoms observed varied from severe to mild. All the accessions showed severe (50-100 % leaf area) or moderate (20-50 % leaf area) crinkling except KU-321, KU-1408, KU-1375 and KU-1373 which showed mild type of crinkling. The accessions KU-321, KU-1408 and KU-1375 showed only mild symptoms of crinkling, but no mosaic or bud deformation was observed, hence these can be used for cultivation after proper evaluation for yield parameters.

Keywords
Screening, Symptoms, Urdbean, Accessions, Natural

Article Info
Accepted: 08 January 2020
Available Online: 10 February 2020

Introduction

Vigna mungo (L.) Hepper, (chromosome no 2n=24) commonly known as urdbean orurad or blackgram or mash, is a leguminous crop and belongs to family Fabaceae. It’s progenitor is V. mungo var. silvestris which is native to India, where it has been in cultivation from ancient times (Lukoki et al., 1980). Plants are annual herbaceous, semi-erect, erect to spreading or trailing types in habit with 30-100 cm in height. Leave are trifoliate, alternate and sparsely hairy on both the surfaces.

Urdbean is mainly cultivated as kharif crop almost in all states in India. In northern plains, it is cultivated during spring as a catch crop and in southern and south-eastern states. It needs relatively heavier, well drained,
moisture retentive, deep loam soils free from excessive soluble salts and sodicity. It is grown as a rainfed crop in the warm plains as well as in the foot-hills and up to an altitude of 2,000m. The 100 grams of urdbean contain water -10.80 g, energy- 341 kcal, protein- 25.21 g, total lipid (fat)- 1.64 g carbohydrate- 58.99 g, minerals; Calcium (Ca)-138 mg, Iron(Fe)-7.57 mg, Magnesium (Mg)-267 mg, Phosphorus (P)-379 mg, Potassium (K)-983 mg, Sodium (Na)-38 mg, Zinc (Zn)-3.35 mg, Vitamins; Thiamin-0.273 mg, Riboflavin-0.254 mg, Niacin -1.447 mg, Vitamin B6-0.281 mg, Vitamin B12 -0.00 µg, Vitamin A, (RAE)-1 µg and Vitamin A, -23 IU (USDA National Nutrient Database for Standard Reference Report, 2016).

High values of lysine make urdbean an excellent complement to rice in terms of balanced human nutrition. It is good source of phosphorus and known to be having significant hypolipidemic, anticancer and hypoglycemic action (Indira and Kurup, 2003). Urdbean contribute about 11% of total pulse production in India.

Despite of advancement in agricultural production technology, due to various factors there is stagnation in urdbean production in country. Crop losses due to emerging plant diseases particularly those of viral origin are of great concern(Anderson et al., 2004). Among the diseases, urdbean leaf crinkle disease (ULCD) and mosaic are most important depending on variety cultivated and season (Reddy et al., 2005, Sharma et al., 2015).

Multiple viral symptoms with mixed infection of different viruses in open field conditions cause severe yield losses in pulses in India (Biswa set al., 2015). The mixed infection in urdbean shows various symptoms like bud deformation, yellow mosaic and leaf crinkle (Biswas et al., 2009).

Disease symptoms and vector population is significantly influenced by weather factors like temperature and humidity. Temperature range of 30-35°C is reported to be most conducive for disease development of ULCD (Dubey et al., 2019).

There are several reports on screening for ULCD and mosaic resistance in Vigna species (Binyamin et al., 2011 and Biswas et al., 2017). We also devised a study to screen the various accessions of urdbean against urdbean leaf crinkle, bud deformation and mosaic under field conditions.

Materials and Methods

Seed collection and raising of plants

During the year2013-14 and 2014-15 (Kharif), 53 urdbean accessions (Table 1) were collected from ICAR-NBPGR, New Delhi. The seeds were sown in experimental field of ICAR-NBPGR, (28.6377° N and 77.1571° E) in 20×25 m² area in three replications. Timely watering and fertilizer application as per standard agronomic package were done for proper growth of plants.

Disease Incidence and severity

The disease intensity was calculated after 40 and 60 days after sowing. The severity was calculated based on symptoms present on each accession. For ULCD, 50 -100 % crinkled leaves were considered severe,20-50% leaf area moderate and 1-20% as mild.

For bud deformation, 50- 100% deformed floral buds were considered severe, 20-50% as moderate and 1-20% as mild. Observations on mosaic were recorded by using a 1 to 9 point rating scale with slight modification as shown below (Singh et al., 1992).
Results and Discussion

The 53 accessions from ICAR-NBPGR grown at experimental field of ICAR-NBPGR were constantly observed for various symptoms at 40 and 60 DAS. The symptoms observed were of different types and nature. Three types of symptoms were observed; leaf crinkling, yellow mosaic and bud deformation (Fig 1a and Fig 1b). The nature of the symptoms observed varied from severe to mild in all three types of symptoms.

Most of the urdbean accessions showed severe crinkling (50-100%), the accessions KU-820, KU-1401, KU-1412, KU-1400, KU-3727, KU-1424, IC-251387, IC-1572, SU-12-116, SU-12-123 and SU-12-99 showed moderate crinkling (20-50%) however KU-321, KU-1408, KU-1375, and KU-1373 showed mild (1 to 20 %) type of crinkling. Yellow mosaic varied from mild to severe in urdbean accessions however various accessions KU-1164, KU-1355, KU-321, KU-820, KU-1386, KU-1367, KU-1408, KU-1375, KU-1396, KU-1411, KU-1393, KU1388, KU-1412, KU-1421,KU-1400,KU-3727,KU-1424,KU-1390,KU-1423, IC-251387, IC-539797, IC-1572, IC-485638, SU-12-116, SU-12-123, SU-12-99, TU-77-44, WBU-108 and Azad 2 did not show any yellow mosaic symptom. Bud deformation again varied from mild to severe however three accessions viz., KU-321, KU-1408 and KU-1375 did not exhibit any bud deformation. The result revealed that KU-321, KU-1408 and KU-1375 also did not show either mosaic and bud deformation however, mild crinkling was observed. The overall symptom based screening observed on all accessions and varieties are shown in table 1.

Urdbean (V. mungo L. Hepper), an Asiatic species of genus Vigna is an important pulse crop of South-East Asia which is widely adapted to both subtropical and semi-arid areas (Ganguly and Bhat, 2012). Among several factors responsible for low production and productivity, Urdbean leaf crinkle disease (ULCD) and mosaic are considered to be the major threat for urdbean cultivation (Reddy et al., 2005). There are several reports on screening for ULCD and mosaic resistance in Vigna species (Binyamin et al., 2011 and Biswas, 2017). Kadian (1980) screened 528 germplasm lines of vigna species by sap inoculation in net house and found only two urd bean and two mungbean varieties resistant/tolerant. Rishi (1990) screened many urdbean germplasm and found PLU-158, PLU-213, 83183-43, UH81-7, UH-82-11, UH82-45, UH83-13, Berisal and Saradomash were resistant to ULCD in a 2-year field experiment under heavy inoculum pressure.
Table 1: Observation of symptoms on different urdbean accessions collected from ICAR-NBPGR, New Delhi

| S. No. | Germplasm   | Crinkling | Yellow mosaic | Bud deformation |
|--------|-------------|-----------|---------------|-----------------|
| 1      | Barabanki Local | severe    | Mild          | severe          |
| 2      | KU-1164     | severe    | -             | mild            |
| 3      | KU-1355     | severe    | -             | severe          |
| 4      | KU-1382     | severe    | moderate      | severe          |
| 5      | KU-321      | mild      | -             | -               |
| 6      | KU-820      | moderate  | -             | mild            |
| 7      | KU-1401     | moderate  | mild          | mild            |
| 8      | KU-1386     | severe    | -             | severe          |
| 9      | KU-1364     | severe    | moderate      | severe          |
| 10     | KU-1426     | severe    | moderate      | severe          |
| 11     | KU-1367     | severe    | -             | severe          |
| 12     | KU-1374     | severe    | moderate      | severe          |
| 13     | KU-1391     | severe    | severe        | severe          |
| 14     | KU-1363     | severe    | severe        | severe          |
| 15     | KU-1368     | severe    | moderate      | severe          |
| 16     | KU-1408     | mild      | -             | -               |
| 17     | KU-1375     | mild      | -             | -               |
| 18     | KU-1373     | mild      | moderate      | mild            |
| 19     | KU-1396     | severe    | -             | severe          |
| 20     | KU-1411     | severe    | -             | severe          |
| 21     | KU-1407     | severe    | severe        | severe          |
| 22     | KU-1393     | severe    | -             | severe          |
| 23     | KU-1388     | severe    | -             | severe          |
| 24     | KU-1412     | moderate  | -             | mild            |
| 25     | KU-1421     | severe    | -             | severe          |
| 26     | KU-1400     | moderate  | -             | severe          |
| 27     | KU-1376     | severe    | mild          | severe          |
| 28     | KU-1427     | severe    | severe        | severe          |
| 29     | KU-1409     | severe    | severe        | severe          |
| 30     | KU-3727     | moderate  | -             | mild            |
| 31     | KU-1424     | moderate  | -             | mild            |
| 32     | KU-1390     | severe    | -             | severe          |
| 33     | KU-1423     | severe    | -             | severe          |
| 34     | KU-1404     | severe    | moderate      | severe          |
| 35     | IC-485636   | severe    | severe        | severe          |
| 36     | IC-485638   | severe    | severe        | severe          |
| 37     | IC-251387   | moderate  | -             | moderate        |
| 38     | IC-1572     | moderate  | severe        | mild            |
| 39     | IC-539797   | severe    | -             | severe          |
| 40     | IC-11613    | severe    | severe        | severe          |
| 41     | IC-144901   | severe    | severe        | severe          |
| 42     | IC-1572     | severe    | -             | moderate        |
| 43     | IC-485638   | severe    | -             | severe          |
Some of urdbean cultivars viz., HpU 27, 102, 164, and 315 have been reported to be resistant to ULCD (Sharma and Dubey, 1984). However 67 black gram germplasm of Indian origin were screened under field conditions by Chaudhry et al., (2007) and none of them were found to be resistant against ULCD. Ashfaq et al., (2007) evaluated 87 urdbean cultivars from Pakistan and found nine genotypes free from disease and categorized as ‘highly resistant. The lack of resistance in urdbean against mixed infection of all three symptoms is the major concern to build up adequate viral inoculum pressure (Biswa et al., 2015). Therefore, greater attention is needed in searching pathogen derived resistance in exploiting genetic engineering approach, an alternate path for development of resistant cultivars.

Some of urdbean cultivars viz., HpU 27, 102, 164, and 315 have been reported to be resistant to ULCD (Sharma and Dubey, 1984). However 67 black gram germplasm of Indian origin were screened under field conditions by Chaudhry et al., (2007) and none of them were found to be resistant against ULCD. Ashfaq et al., (2007) evaluated 87 urdbean cultivars from Pakistan and found nine genotypes free from disease and categorized as ‘highly resistant. The lack of resistance in urdbean against mixed infection of all three symptoms is the major concern to build up adequate viral inoculum pressure (Biswa et al., 2015). Therefore, greater attention is needed in searching pathogen derived resistance in exploiting genetic engineering approach, an alternate path for development of resistant cultivars.

**Fig.1** Plants with leaf crinkle and bud deformation symptom (a) and plants with leaf crinkle, yellow mosaic and bud deformation symptom (b)

|   |   |   |   |
|---|---|---|---|
| 44 | SU-12-116 | moderate | - | mild |
| 45 | SU-12-123 | moderate | - | mild |
| 46 | SU-12-99  | moderate | - | mild |
| 47 | TU-77-44  | severe | - | moderate |
| 48 | IB-233-1  | severe | severe | severe |
| 49 | IPU-2-43  | severe | severe | severe |
| 50 | WBU-108   | severe | - | moderate |
| 51 | Uttara     | severe | moderate | severe |
| 52 | Azad-2     | severe | - | moderate |
| 53 | Pant U-40  | severe | severe | severe |

**References**

Anderson PK, Cunningham AA, Patel NG, Morales FJ, Epstein PR and Daszak P (2004). Emerging infectious diseases of plants: pathogen pollution, climate change and agrotechnological drivers. *Trends Ecol. Evol.*, 19:535–544.

Ashfaq M, Khan A, Mughal M, Javed N, Tariq and Bashir M (2007). Evaluation of urdbean germplasm for resistance against urdbean leaf crinkle virus. *Pak. J. Bot.*, 39(6): 2103-2111.

Binyamin R, Khan MA, Ahmad N and Ali S (2011). Relationship of epidemiological factors with urdbean leaf crinkle virus disease and its management using plant extracts. *Int. J. Agric. Biol.*, 13, 411–414.

Biswa K K., Biswas K and Tarafdar A. (2015). Multiple and mixed infections with yellow
mosaic, leaf crinkle and bud necrosis disease complex in mungbean: A threat to cultivation of mungbean in India. *Legume Research.* 38(3):2015: 382-388.

Biswas, K. K., Tarafdar, A., Kumar, A., Dikshit, H. K. and Malathi, V. G. (2009) Multiple infection in urdbean (*Vigna mungo*) in natural condition by begomovirus, tospovirus and urdbean leaf crinkle virus complex *Indian Phytopath.* 62 (1): 75-82.

Biswas, K.K., 2017. *Plant viruses, diseases and their management.* IK International Pvt. Limited.

Chaudhry MA, Ilyas MB and Ghazanfar MU (2007). Screening of urdbean germplasm for the sources of resistance against urdbean leaf crinkle virus. *Mycopathology* 5:1–4.

Dubey, A.K., Sinha, P., Baranwal, V.K., Mishra, S. and Saritha, R.K. (2019). Temperature influence on leaf crinkle disease expression in urdbean (*Vigna mungo* (L.) Hepper) and potential distribution of the disease in India. *Crop Protection* 120: 84–90.

Ganguly PR, Bhat KV (2012). Study of the pattern of variation for microsatellite markers in Black gram (*Vigna mungo* (L.) Hepper) germplasm. *Inter J Biomedical Life Sci* 3(1):1–6.

Indira M and Kurup PK (2003). Blackgram (*vignamungo*): A hypolipidemic pulse. *Natural product radiance,* 2 (5): 240-242.

Kadian OP (1980). Studies on leaf crinkle disease of urdbean (*Vignamungo*(L.) Hepper) mungbean (*V. radiata*(L.) Wilczek) and its control, *Ph.D. Thesis,* p: 177. Department of Plant Pathology Haryana Agricultural University, Hisar, India.

Lukoki L, Marechal R and Otoul E (1980). The wild ancestors of the cultivated beans *Vigna radiata* and *Vigna mungo.* *Bull. Jard. Bot. Nat. Belg.* 28:23–30.

Reddy, TonapiCh VA, Varanasiappan S, Navi SS and Jayarajan R (2005). Influence of plant age on infection and symptomatological studies on urdbean leaf crinkle virus in urdbean (*Vigna mungo*). *Int. J. Agri. Sci.* 1:1-6.

Rishi N (1990). Seed and crop improvement of northern Indian pulses (*Pisum* and *Vigna*) through control of seed-borne mosaic viruses. inal Technical Report (US-India Fund) Dept. Plant Pathology, CCS Haryana Agric. Univ, Hisar, p 122.

Sharma I, Dubey GS (1984) Control of urdbean leaf crinkle virus through heat treatment, chemotherapy and resistance. *Indian Phytopathol* 37:26–30

Sharma P N, Sharma A and Singh M. (2015). Effect of leaf crinkle disease on yield and quality of urdbean (*Vigna mungo* L. Hepper) in Himachal Pradesh. *Himachal Journal of Agricultural Research* 41(1): 80-82.

Singh, G., Sharma, Y.R. and Kaur, L. 1992. Method of rating mungbean yellow mosaic virus in mungbean and urdbean. *Plant Disease Research.* 7: 1-6.

USDA national nutrient database for standard reference report 2016 (https://www.nutrition-and-you.com/black-gram.html)