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Characterization of urdbean (*Vigna mungo* L. Hepper) genotypes through quality parameters and chemical tests

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Abstract
An experiment was carried out at the Seed Testing Laboratory, Department of Seed Science and Technology, Junagadh Agricultural University, Junagadh, to characterize thirty urdbean genotypes based on quality parameters and chemical tests. Among 30 genotypes, seedling vigour index I was high in all thirty genotypes. The seeds were subjected to NaOH bleach test, KOH test and growth response test for differentiating the genotypes. The genotypes were grouped based on Potassium Hydroxide bleach test into orange color (26 genotypes) and dark orange red color (4 genotypes) types. Based on Sodium Hydroxide test, the genotypes were grouped into orange color (19 genotypes) and dark orange red color (11 genotypes) types. Based on growth response test, the genotypes were grouped into very low (4 genotypes), low (5 genotypes), medium (3 genotypes) and high (18 genotypes) types.

Keywords: Urdbean, characterization, quality parameters, chemical tests

Introduction

Vigna mungo (L.) Hepper (2n=22) also referred to as the urad, blackgram, urdbean, mash, black lentil or white lentil. It belongs to the family Fabaceae and sub family Papilionoideae and has a haploid chromosome number of 11. It is considered to have been domesticated in India from its wild ancestral form (*Vigna mungo var. silvestris*) (Lukoki *et al.*, 1980) [14]. The seeds of blackgram contain a moderately high amount of calories (calorific value of 350 cal/100g), carbohydrates (56.6%), proteins (26.2%) and fat (1.2%), it is also rich in essential mineral and vitamins for human body (Shafique *et al.*, 2011) [26]. Being a short duration crop, it is grown primarily as intercrop with jowar, bajra, pigeonpea, etc. during *kharif* and as a sole crop during *rabi* and *zaid*. It can be used as green manure crop with residues incorporated into soil after pods have been harvested. It helps to enrich the soil by symbiotic relationship with specific soil rhizobia of the genus *Brady rhizobium*. It also helps in soil conservation through thick canopy.

As a pulse crop in India, blackgram stands third in terms of production after chickpea and pigeonpea. Because of the high protein content pulses are a food of choice among the vegetarian population. They are comparatively a cheaper source of proteins to overcome protein malnutrition in human beings. Blackgram occupies about 12% of the total pulse area, contributing to about 8% of the total pulse production. It is mostly cultivated in Madhya Pradesh, Uttar Pradesh, Andhra Pradesh, Rajasthan, Tamil Nadu, Maharashtra, Jharkhand and Gujarat. In India, pulses are grown in nearly 293.6 lakh hectare area with production status of nearly 245.1 lakh tons at an average productivity level of 835 kg/ha (Anon., 2018) [3]. As of the 2017-18 cultivation statistics in India, blackgram was grown on 50.31 lakh hectares with a production status of 32.84 lakh tones and productivity of 652 kg/ha. In Gujarat, blackgram was grown on 1.33 lakh hectares with a production status of 0.96 lakh tons and productivity of 721 kg/ha (Anon., 2018) [3].

Maintenance of genetic purity of varieties is of primary importance for preventing varietal deterioration during successive regeneration cycles and for ensuring varietal performance at an expected level. The aspects of Distinctness, Uniformity and Stability (DUS) are fundamental for characterization of varieties. In countries having Plant Breeder's Right (PBR) in operation, a new variety is registered only, if it is distinct from other varieties, uniform in its characteristics and genetically stable. In the light of the above facts, the present study on the documentation of characters for urdbean genotypes was planned with the objective to identify stable diagnostic characteristics of plant morphology of urdbean genotypes.

Materials and Methods

An experiment was conducted at the Seed Testing Laboratory, Department of Seed Science and Technology, Junagadh Agricultural University, Junagadh, during 2018-19 to characterize the 30 genotypes of urdbean (*Vigna mungo* L. Hepper) *viz*., GJU 1506, GJU 1509, GJU 1601, GJU 1603, GJU 1607, GJU 1608, GU 1, T 9, Pant U 31, Pant U 35, Pant U 40, TU 94-2, TU 67, Jawahar urd 2, Jawahar urd 3, TPU 4, LBG 752, COBG 593, Vamban 8, IC 1575, IC 3928 A, IC 14691, IC 24811, IC 45208, IC 56051, IC 59718, IC 61097, IC 73291, IC 214845 and IC 336975 based on quality parameters and chemical tests. The experiment was conducted as per Completely Block Design with four repetitions. The observations *viz*., seed germination, shoot length, root length, seedling fresh weight, seedling dry weight, seedling vigour index I, seedling vigour index II, Potassium hydroxide bleach test, Sodium hydroxide test and growth response test. The data obtained from laboratory experiment conducted in CRD were analyzed as per standard method suggested by Panse and Sukhatme (1985) [16].

Results and Discussion

Based on seed germination and seedling characters, urdbean genotypes were, categorized into different groups (Table 1 and 2). The seed germination percentage varied among the genotypes due to the quality parameters and could be attributed to better development of seeds. The seed germination percentage ranged from IC 59718 (83.67 per cent) to GJU 1601, TU 67 and IC 73291 (97.33 per cent) with a mean seed germination percentage of 94.36 per cent.

The shoot length ranged from Vamban 8 (6.43 cm) to GJU 1509 (16.60 cm) with a mean shoot length of 10.29 cm. The root length ranged from TPU 4 (2.97 cm) to COBG 593 (9.40 cm) with a mean root length of 6.83 cm. The seedling fresh weight ranged from 1.43 g (IC 3928 A) to 2.05 g (Pant U 35) with a mean seedling fresh weight of 1.70 g. The seedling dry weight ranged from 0.09 g (COBG 593) to 0.22 g (Pant U 40) with a mean seedling dry weight of 0.153 g. The seedling vigour index I ranged from 861.76 (TPU 4) to 2433.10 (GJU 1509) with a mean seedling vigor index I of 1609.50. Among 30 genotypes, seedling vigour index I was high vigorous in all thirty genotypes (GJU 1506, GJU 1509, GJU 1601, GJU 1603, GJU 1607, GJU 1608, GU 1, T 9, Pant U 31, Pant U 35, Pant U 40, TU 94-2, TU 67, Jawahar urd 2, Jawahar urd 3, TPU 4, LBG 752, COBG 593, Vamban 8, IC 1575, IC 3928 A, IC 14691, IC 24811, IC 45208, IC 56051, IC 59718, IC 61097, IC 73291, IC 214845 and IC 336975).The seedling vigour index II ranged from 8.58 (COBG 593) to 20.89 (Pant U 40) with a mean seedling vigor index II of 14.53.

Table 1: Identification and grouping of urdbean genotypes based on germination percentage, shoot length (cm), root length (cm) and seedling fresh weight (g)

Genotypes	Germination percentage	Shoot length (cm)	Root length (cm)	Seedling fresh weight (g)
GJU 1506	96.67	10.27	5.27	1.63
GJU 1509	96.33	16.60	9.20	2.03
GJU 1601	97.33	9.77	8.63	1.76
GJU 1603	95.67	13.57	6.33	1.90
GJU 1607	91.33	10.27	8.10	1.72
GJU 1608	96.67	14.27	7.13	1.71
GU 1	95.00	9.77	8.13	1.54
T 9	95.67	7.50	5.03	1.58
Pant U 31	87.67	8.20	5.50	1.58
Pant U 35	90.67	10.57	6.97	2.05
Pant U 40	94.67	12.33	5.00	1.53
TU 94-2	96.33	8.30	5.07	1.48
TU 67	97.33	9.63	7.30	1.83
Jawahar urd 2	96.67	9.37	8.83	1.82
Jawahar urd 3	96.00	14.50	8.60	2.01
TPU 4	91.67	6.80	2.97	1.79
LBG 752	95.33	9.83	5.13	1.63
COBG 593	95.67	13.70	9.40	1.69
Vamban 8	96.00	6.43	6.97	1.56
IC 1575	95.00	12.17	9.20	1.75
IC 3928 A	94.67	6.50	7.47	1.43
IC 14691	95.67	7.27	5.97	1.51
IC 24811	96.67	8.57	4.10	1.56
IC 45208	84.00	11.83	7.10	2.00
IC 56051	94.67	14.20	6.20	1.79
IC 59718	83.67	9.60	6.40	1.44
IC 61097	96.33	7.50	7.07	1.61
IC 73291	97.33	9.10	5.97	1.54
IC 214845	96.67	8.90	8.93	1.80
IC 336975	93.67	11.67	7.07	1.72
Mean	94.36	10.29	6.83	1.70
S.Em ±	1.71	0.19	0.13	0.027
C.D. at 5%	4.85	0.56	0.36	0.078
CV %	3.15	3.33	1.41	2.84

Similar observations and grouping was made based on the seed germination and seedling characters by Ravikumar (1999) [22] and Chavan (2010) [7] in soybean; Basavaraj *et al.* (2012) [4] in cowpea; Ankaiah *et al.* (2013) in groundnut; Kumar *et al.* (2013) [13] in guar; Das *et al.* (2014) in french bean and Hemender *et al.* (2017) [9] in pearl millet.

Table 2: Identification and grouping of urdbean genotypes based on seedling dry weight (g), seedling vigour index I and seedling vigour index II

Genotypes	Seedling dry weight (g)	Seedling vigour index I	Groups	Seedling vigour index II
GJU 1506	0.16	1504.75	High vigorous	15.47
GJU 1509	0.17	2433.10	High vigorous	16.45
GJU 1601	0.14	1752.62	High vigorous	14.49
GJU 1603	0.14	1905.17	High vigorous	13.36
GJU 1607	0.16	1670.12	High vigorous	14.49
GJU 1608	0.16	2059.94	High vigorous	15.57
GU 1	0.15	1692.46	High vigorous	14.26
T 9	0.15	1184.78	High vigorous	14.37
Pant U 31	0.13	1203.20	High vigorous	11.55
Pant U 35	0.17	1540.41	High vigorous	15.50
Pant U 40	0.22	1627.54	High vigorous	20.89
TU 94-2	0.15	1244.41	High vigorous	14.63
TU 67	0.15	1636.51	High vigorous	14.70
Jawahar urd 2	0.16	1745.66	High vigorous	15.46
Jawahar urd 3	0.16	2216.96	High vigorous	15.13
TPU 4	0.15	861.76	High vigorous	13.80
LBG 752	0.14	1416.10	High vigorous	13.36
COBG 593	0.09	2214.88	High vigorous	8.58
Vamban 8	0.17	1271.77	High vigorous	16.52
IC 1575	0.14	2036.16	High vigorous	13.32
IC 3928 A	0.15	1336.56	High vigorous	14.32
IC 14691	0.14	1250.85	High vigorous	13.45
IC 24811	0.17	1251.82	High vigorous	16.60
IC 45208	0.20	1592.32	High vigorous	16.92
IC 56051	0.12	1914.82	High vigorous	11.49
IC 59718	0.20	1328.39	High vigorous	16.72
IC 61097	0.13	1405.24	High vigorous	12.39
IC 73291	0.14	1470.06	High vigorous	13.64
IC 214845	0.17	1740.39	High vigorous	16.55
IC 336975	0.13	1776.27	High vigorous	12.12
Mean	0.153	1609.50		14.53
S.Em ±	0.002	18.74		0.207
C.D. at 5%	0.005	53.02		0.586
CV %	2.33	2.01		2.46

Note: Seedling vigour index 1
Less vigorous : < 500
High vigorous : > 500

The chemical tests such as potassium hydroxide bleach test, sodium hydroxide test and growth response test, which help for classifying the genotypes into different groups (Table 3).

Table 3: Identification and grouping of urdbean genotypes based on potassium hydroxide (KOH) bleach test, sodium hydroxide (NaOH) test and growth response test

Genotypes	Potassium hydroxide (KOH) bleach test	Sodium hydroxide (NaOH) test	Growth response test (hypocotyl length (cm))	Group
GJU 1506	Orange	Orange	16.43	High
GJU 1509	Orange	Orange	18.10	Very low
GJU 1601	Orange	Dark orange red	16.43	High
GJU 1603	Orange	Orange	15.00	Low
GJU 1607	Orange	Orange	18.00	High
GJU 1608	Orange	Dark orange red	30.47	High
GU 1	Orange	Orange	22.97	High
T 9	Orange	Orange	19.40	High
Pant U 31	Dark orange red	Orange	17.17	High
Pant U 35	Orange	Orange	16.07	High
Pant U 40	Orange	Orange	14.67	Low
TU 94-2	Orange	Orange	23.07	High
TU 67	Dark orange red	Dark orange red	12.50	Low
Jawahar urd 2	Orange	Orange	20.83	High

Jawahar urd 3	Orange	Orange	15.37	Very low
TPU 4	Orange	Dark orange red	12.90	High
LBG 752	Orange	Dark orange red	27.83	High
COBG 593	Dark orange red	Dark orange red	14.67	Very low
Vamban 8	Dark orange red	Dark orange red	20.43	High
IC 1575	Orange	Orange	14.10	Low
IC 3928 A	Orange	Orange	13.20	High
IC 14691	Orange	Orange	10.93	High
IC 24811	Orange	Dark orange red	18.07	High
IC 45208	Orange	Orange	15.87	Medium
IC 56051	Orange	Orange	18.80	Medium
IC 59718	Orange	Dark orange red	17.93	High
IC 61097	Orange	Dark orange red	10.10	Medium
IC 73291	Orange	Orange	10.33	Low
IC 214845	Orange	Dark orange red	18.87	High
IC 336975	Orange	Orange	11.87	Very low
Mean			17.07	
S.Em ±			0.43	
C.D. at 5%			1.23	
CV %			4.42	

Note: Growth response test (percent increase in hypocotyl length over control)

Very low : < 10%
Low : 10-30%
Medium : 30-50%
High : > 50%

On the basis of chemical tests, genotype identification keys were prepared (Figure 1). Genotypes *viz.*, GJU 1506, GJU 1607, GU 1, T 9, Pant U 35, TU 94-2, Jawaharurd 2, IC 3928 A and IC 14691 were having similar orange color potassium hydroxide bleach test, orange color sodium hydroxide test and high growth response test.

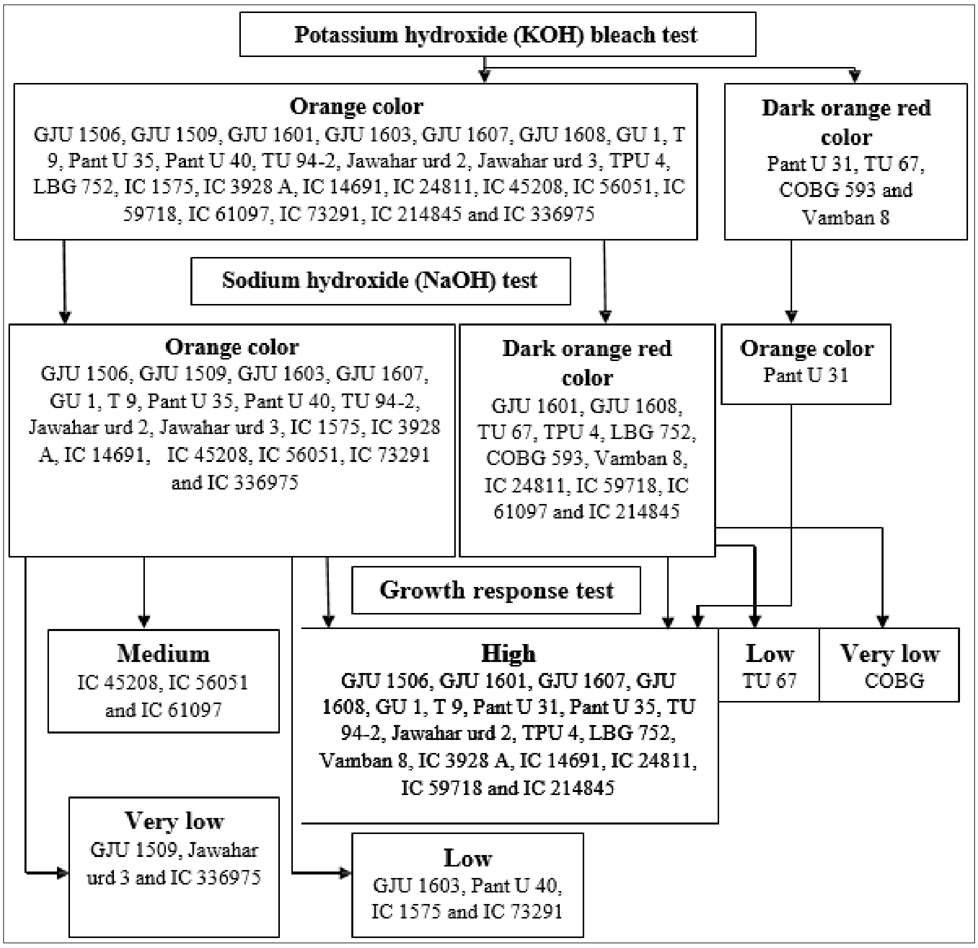

Fig 1: Urdbean genotypes identification keys on the basis of chemical tests

Genotypes *viz.*, GJU 1509, Jawahar urd 3 and IC 336975 were having similar orange color potassium hydroxide bleach test, orange color sodium hydroxide test and very low growth response test while the genotype COBG 593 was differing from above genotypes with respect to dark orange red color potassium hydroxide bleach test and dark orange red color sodium hydroxide test.

Genotypes *viz.*, GJU 1603, Pant U 40, IC 1575 and IC 73291 were having similar orange color potassium hydroxide bleach test, orange color sodium hydroxide test and low growth response test while the genotype TU 67 was differing from above genotypes with respect to dark orange red color potassium hydroxide bleach test and dark orange red color sodium hydroxide test.

Genotypes *viz.*, IC 45208 and IC 56051 were having similar orange color potassium hydroxide bleach test, orange color sodium hydroxide test and medium growth response test while the genotype IC 61097 was differing from above genotypes with respect to dark orange red color sodium hydroxide test.

Genotypes *viz.*, GJU 1601, GJU 1608, TPU 4, LBG 752, IC 24811, IC 59718 and IC 214845 were having similar orange color potassium hydroxide bleach test, dark orange red color sodium hydroxide test and high growth response test.

Genotype Pant U 31 was having dark orange red color potassium hydroxide bleach test, orange color sodium hydroxide test and high growth response test. Genotype Vamban 8 was having dark orange red color potassium hydroxide bleach test, dark orange red color sodium hydroxide test and high growth response test.

Assessment of genetic purity is an important criterion in seed production programme. Therefore, simple and reliable techniques need to be developed for genetic purity assessment and genotype characterization. The study suggested that plant morphological characteristics were found to be useful in broad classification of urdbean genotypes.

Similar findings and grouping of genotypes based on potassium hydroxide bleach test, sodium hydroxide test and growth response test were made by Agrawal and Sharma (1989) [2], Chakrabarthy and Agrawal (1990) [5] in blackgram; Rao *et al.* (2002) [21], Keshavulu *et al.* (2003) [11] and Rao *et al*. (2013) [20] in groundnut; Suhasini (2006) [27] and Mesfin *et al*. (2013) [15] in sesame; Agrawal and Pawar (1990) [1], Richard *et al.* (1998) [24], Chavan (2010) [7] in soybean; Sathisha *et al.* (2012) [25], Kallihal *et al*. (2013) [10] and Prasad *et al.* (2013) [19] in sunflower; Patil *et al.* (2006) [17] in safflower; Ponnuswamy *et al.* (2003) [18], Kirankumar (2004) [12] and Reddy (2005) [23] in cotton; Thangavel *et al.* (2005) [28] in sorghum and Chandusingh *et al.* (2017) [6] in rice.

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