CHARACTERIZATION OF MUNGBEAN (*Vigna radiata* L. WILCZEK) GENOTYPES USING SEED AND SEEDLING DESCRIPTORS, AND CHEMICAL TESTS

***PATEL, J. D.; PATEL, J. B. AND CHETARIYA, C. P.**

DEPARTMENT OF SEED SCIENCE AND TECHNOLOGY
JUNAGADH AGRICULTURAL UNIVERSITY
JUNAGADH, GUJARAT-362 001, INDIA

****EMAIL: jaimindpatel1995@gmail.com***

ABSTRACT

The characterization and grouping of the forty four mung bean genotypes based on three seed morphological characters, four seedling characters and four chemical tests was carried out at Junagadh Agricultural University, Junagadh during kharif 2018. All the 44 mung bean genotypes evaluated were of green colour seeds. Based on seed shape, genotypes were grouped into drum (42 genotypes) and oval shape (two genotypes GJM 1011 and IC 24789). Seed size was medium in 32 genotypes and large in 12 genotypes. Coleoptiles anthocyanin colouration was absent in all 44 genotypes. Among 44 genotypes, significantly the highest seed germination percentage was observed in GAM 5 (96.67 %) followed by genotypes GM 4 (96.00 %), GJM 1027 (95.67 %), GJM 1004 (95.00 %) and GJM 1022 (95.00 %) and the lowest were observed in OUM 11-5 (91.00 %). Significantly the longest seedling length was recorded in the GAM 5 (31.66 cm) and the shortest seedling length in RMG 268 (23.93 cm). Significantly the highest seedling vigour index (length) was noticed in GAM 5 (3060.79) and the lowest seedling vigour index (length) was noticed in RMG 268 (2209.84). Based on seedling vigour index (length), the genotypes were grouped as high seedling vigour with one genotype (GAM 5), low seedling vigour with 24 genotypes and medium seedling vigour with 19 genotypes. All 44 genotypes expressed orange colour in potassium hydroxide test. Among 44 genotypes, phenol test exhibited brown colour response in eight genotypes and dark brown colour in remaining 36 genotypes. Peroxidase test showed light brown colour (13 genotypes) and dark brown colour (31 genotypes) response. Sodium hydroxide test recorded orange colour in 18 genotypes and straw color in 26 genotypes.

KEY WORDS: Characterization, Chemical tests, Mung bean, Seed characters, Seedling characters

INTRODUCTION

Mungbean (*Vigna radiata* L. Wilczek) or green gram is an important legume crop. It is a great source of proteins, vitamins, and minerals, particularly in South Asia. It is a self-pollinated crop having 2n = 2x = 22 chromosomes with a genome size of 579 Mb/1C. Its capacity to restore soil fertility through nitrogen fixation makes it a valuable crop in various cropping systems, particularly wheat-rice.

Genotype characterization using morphological characters possess several undesirable features like seasonal dependence, large space requirement, time consuming, tedious and environmental influence. To overcome these limitations, there is a need for rapid and reliable method

of varietal identification and genetic purity testing. The alternative way to speed up the testing procedures is to use chemical tests in place of morphological markers.

Laboratory procedures furnish several additional characteristics useful for genotype identification. These chemical tests are very quick, easy to do, reproducible and can be undertaken throughout the year under controlled conditions. In chemical tests, the chemical agents react with the seed and help in genotype identification. Some of the sensitive analytical techniques employed in the laboratory are phenol test, potassium hydroxide (KOH) test, sodium hydroxide (NaOH) test and peroxidise enzyme activity test.

Keeping this in view, the present study entitled "Characterization of mung bean [*Vigna radiata* (L.) Wilczek] varieties through seed and seedling characters and chemical tests" was carried out.

MATERIALS AND METHODS

The study on characterization of 44 mung bean genotypes based on seed characters, seedling characters and chemical tests was taken up at the Department of Seed Science and Technology, College of Agriculture, Junagadh Agricultural University, Junagadh during *Kharif*-2018. These forty four accessions were evaluated in the laboratory using C.R.D. with three replications. Data were recorded for three seed morphological characters (seed colour, shape and size (cm)), four seedling characters (germination (%), coleoptiles anthocyanin colouration, seedling length (cm), nad seedling cvigour index (length), and four chemical tests phenol test, peroxidase test, potassium hydroxide (KOH) test and sodium hydroxide (NaOH) test) following standard procedures and the genotypes were grouped.

RESULTS AND DISCUSSION

Seed characters

Seed morphological characteristics are useful in development of varietal identification keys and also in genetic purity testing. The seed characteristics such as seed colour, shape and size has been recorded and based on the variations in these seed characteristics, the genotypes were grouped into different categories (Table 1 and 2). All the 44 mung bean genotypes evaluated were of green colour and therefore, did not show any variation for seed colour. The seed shape and size varied among the mung bean genotypes. Based on seed shape, genotypes were grouped into drum (42 genotypes) and oval (two genotypes GJM 1011 and IC 24789) shape. The mean seed size of the genotypes was 4.69 g. Significantly the highest seed size was recorded in GM 02-13 (5.83 g) followed by GJM 1022 (5.80 g), OUM 11-5 (5.66 g), GJM 1026 (5.62 g) and J 781 (5.59 g) and the lowest was noted in GJM 1113 (3.64 g). Among 44 genotypes, the seed size was medium in thirty two genotypes and large in twelve genotypes (EC 251810, GJM 1022, GJM 1026, GJM 1112, GJM 1117, GM 04-02, GM 06-08, GM 02-13, GM 02-16, GM 4, J 781 and OUM-11-5). On the basis of seed morphological characteristics, genotype identification keys were prepared (Figure 1). The genotypes GJM 1011 and IC 24789 were distinct genotypes with oval seed shape and medium seed size. Genotypes *viz.*, EC 251810, GJM 1022, GJM 1026, GJM 1112, GJM 1117, GM 04-02, GM 06-08, GM 02-13, GM 02-16, GM 4, J 781 and OUM-11-5 were having similar seed morphology *viz*., green seed colour, drum seed shape and large seed size, while the remaining genotypes were having green seed colour, drum seed shape and small seed size.

Similar observations and grouping of genotypes based on seed morphological characters were made by Katiyar *et al*. (2008), Singh *et al*. (2014) and Kaur *et al*. (2017) in mung bean.; Chakrabarty and

Agarwal (1989a) in black gram; Basavaraj *et al*. (2012) and Kumar and Shrikant (2016) in cowpea, Gnyandev (2009), Sarao *et al.* (2009), Joshi and Yasin (2014) and Sastry *et al.* (2014) in chickpea, Das *et al.* (2014) in french bean; Khare *et al.* (2006) in lentil; and Kanaka Durga *et al.* (2015) in horse gram.

Seed germination and seedling characters

Based on seed germination and seedling characters, mung bean genotypes were categorized into different groups (Table 3, 4 and 5). The coleoptiles anthocyanin colouration didn't show any variation in mung bean genotypes evaluated. Coleoptiles anthocyanin colouration was absent in all 44 genotypes. The germination percentage, seedling length and seedling vigour index were varied among different mung bean genotypes. The mean seed germination percentage of the genotypes was 93.71 per cent. Among 44 genotypes, significantly the highest seed germination percentage was observed in GAM 5 (96.67 %) followed by genotypes GM 4 (96.00 %), GJM 1027 (95.67 %), GJM 1004 (95.00 %) and GJM 1022 (95.00 %) and the lowest were observed in OUM 11-5 (91.00 %). The mean seedling length of the genotypes was 26.57 cm. Significantly the longest seedling length was recorded in the GAM 5 (31.66 cm) and the shortest seedling length was recorded in the RMG 268 (23.93 cm). The mean seedling vigour index (length) of the genotypes was 2491.26. Significantly the highest seedling vigour index (length) was noticed in GAM 5 (3060.79) followed by GM 4 (2902.72), GJM 1012 (2607.06) and GJM 1007 (2603.31) and the lowest seedling vigour index (length) was noticed in RMG 268 (2209.84). Based on seedling vigour index (length), the genotypes were grouped as high seedling vigour with one genotype (GAM 5), low seedling vigour with 24 genotypes and medium seedling vigour with 19 genotypes.

Similar observations and grouping was made based on the seed germination and seedling characters by Katiyar *et al*. (2008), Singh *et al*. (2014) and Kaur *et al*. (2017) in mung bean; Chakrabarthy and Agarwal (1989b) in black gram; Gnyandev (2009) in chickpea; Basavaraj *et al*. (2012) in cowpea; Kumar *et al*. (2013) in guar; and Das *et al*. (2014) in french bean.

Chemical tests

Chemical tests are useful in development of varietal identification keys and also in genetic purity testing. The chemical tests such as phenol test, peroxidase enzyme activity test, potassium hydroxide test, sodium hydroxide test, etc., which helps in classifying the genotypes into different groups (Table 6 and 7). The potassium hydroxide test didn't show any variation in mung bean genotypes. All 44 genotypes expressed orange colour in potassium hydroxide test. The phenol test, peroxidase enzyme activity test and sodium hydroxide test varied among different mung bean genotypes. Among 44 genotypes, phenol test exhibited brown colour in eight genotypes (GAM 5, GJM 1007, GJM 1016, GJM 1025, GM 02-15, GM 4, K 851 and Kopergaon), while it recorded dark brown colour in remaining thirty six genotypes. Peroxidase test showed light brown colour in thirteen genotypes and dark brown colour in thirty one genotypes. Sodium hydroxide test recorded orange colour in eighteen genotypes and straw colour in twenty six genotypes. On the basis of chemical tests, genotype identification keys were prepared (Figure 2). All the chemical tests except KOH test, individually grouped the genotypes into different category based on the colour reaction. Amongst 44 genotypes, genotype GAM 5 was distinct with respect to chemical test, as it showed light brown colour reaction in peroxidase test, brown colour in phenol test and straw colour in NaOH test. Similarly, K 851 and Kopergaon

showed same response as light brown colour reaction in peroxidase test, brown colour in phenol test and orange colour in NaOH test. The other genotypes did not show clear cut reaction. Genotypes EC 482907, EC 496841, GJM 1011, GJM 1012, GJM 1026, GJM 1113, GM 05-05, GM 1924, IC 24789 and RMG 268 expressed light brown colour response in peroxidase test and dark brown colour response in phenol test, but of these genotypes EC 482907, EC 496841, GM 1924 and RMG 268 showed orange colour in NaOH test, while remaining showed straw colour response in NaOH test. Genotypes GJM 1007, GJM 1016, GJM 1025, GM 02-15 and GM 4 showed brown colour reaction in phenol test, dark brown colour response in peroxidase test, but of these genotypes GJM 1007 and GJM 1016 showed straw colour response in NaOH test and GJM 1025, GM 02-15 and GM 4 showed orange colour response in NaOH test. The remaining genotypes showed similar dark brown colour reaction in phenol and peroxidase test, but expressed different reaction in NaOH test, means they can be grouped on the basis of NaOH test only.

Similar findings and grouping of genotypes based on phenol test were made by Gupta *et al.* (2007), Mansing (2010), El-Kalla *et al.* (2010) and Ukani *et al.* (2016) in wheat; Anitalakshmi *et al.* (2014), Sripunitha and Sivasubramaniam (2014) and Debbarma *et al.* (2018) in rice; and Karivaratharaju (2005) in cotton. Grouping of genotypes based on peroxidise test were made by Mckee (1973) in barley; Chakrabarthy and Agarwal (1990) in urd bean; Reddy *et al.* (2008) in cotton; Ukani *et al.* (2016) in wheat; and Thawari *et al.* (2014) in sunflower. Grouping of genotypes based on NaOH test were made by Chakrabarthy and Agarwal (1990) in urd bean; Rao *et al*. (2013) in groundnut; Reddy *et al.* (2008) in cotton; Ukani *et al.* (2016) in wheat; and Sripunitha and Sivasubramaniam (2014), Chandusingh *et al.* (2017) and Debbarma *et al.* (2018) in rice. Similar to KOH results obtained in the present study, Ukani *et al.* (2016) did not differentiated any of the wheat varieties studied and observed negative (no colour to the solution) response.

CONCLUSION

In the present study, based on chemical tests, genotype GAM 5 was distinct, as it showed light brown colour reaction in peroxidase test, brown colour in phenol test and straw colour in NaOH test. Similarly, K 851 and Kopergaon showed same response as light brown colour reaction in peroxidase test, brown colour in phenol test and orange colour in NaOH test. The study suggested that seed and seedling morphological characteristics were found to be useful in classification of mung bean genotypes. The study suggested that the cultivar reaction to different chemicals like potassium hydroxide, sodium hydroxide, peroxidase test and phenol test were also found useful in grouping of mungbean genotypes.

REFERENCES

Anitalakshmi, V.; Gowda, R.; Sathisha, C. S. and Prasad, R. (2014). Varietal response to various chemical tests for their characterization in rice (*Oryza sativa* L.). *Indian J. Plant Sci*., **3(2)**: 177-179.

Basavaraj, M.; Deshpande, V. K.; Deshpande, S. K. and Jaba, J. (2012). Characterization of cowpea genotypes based on the morphological characters of seed and seedling. *Bioinfolet*, **9**(4B): 656-660.

Chakrabarthy, S. K. and Agarwal, R. L. (1989a). Identification of black gram varieties I: Utilization of seed characteristics. *Seed Res*., **17(1)**: 23-28.

Chakrabarthy, S. K. and Agrawal, R. L. (1989b0. Identification of black gram varieties II: Utilization of morphological characteristics of seedling. *Seed Res*., **17**(1) 139-142.

Chakrabarthy, S. K. and Agrawal, R. L. (1990). Identification of black gram varieties III: Utilization of seedling growth response to added chemicals. *Seed Res.,* **18**(1): 34-39.

Chandusingh, S.; Jeevankumar, S. P.; Sripathy, K. V.; Somasundaram, G.; Udaya, K.; Ramesh, K. V. and Prasad, R. (2017). Characterization and identification of rice germplasm accessions using chemical tests. *Seed Res.,* **45**(1): 75-83.

Das, R.; Thapa, U.; Debnath, S.; Lyngdoh, Y. A. and Mallick, D. (2014). Evaluation of french bean (*Phaseolus vulgaris* L.) genotypes for seed production. *J. Appl. Nat. Sci.,* **6**(2): 594-598.

Debbarma, M.; Deka, S. D. and Sarma, D. (2018). Genetic purity test of hybrid rice (*Oryza sativa* L.) based on chemical test. *Int. J. Chemical Studies*, **6**(1): 110-112.

El-Kalla, S. E.; Lillah, A. A.; El-Emery, M. I. and Kishk, A. M. S. (2010). Determination of genetic purity in three common wheat (*Triticum aestivum* L.) varieties. *Res. J. Seed Sci.,* **3**: 227-233.

Gnyandev, B. (2009). Seed technological studies in chickpea varieties (*Cicer arietinum* L.). Ph. D. Thesis (Unpublished) Submitted to University of Agricultural Sciences, Dharwad, Karnataka (India).

Gupta, N.; Joshi, M. A.; Sarao, N. K. and Sharma, R. C. (2007). Utility of phenol test in varietal characterization. *Crop Improve.*, **34(1)**: 77-81.

Joshi. P. and Yasin, M. (2014). Characterization of diverse angular, owl's head and pea seed shapes germplasm of chickpea (*Cicer arietinum* L.). *J. Medi. Pharma. Allied Sci.,* **3**(6): 1-9.

Kanaka Durga, K.; Ankaiah, R. and Ganesh, M. (2015). Characterization of horse gram cultivars using plant morphological characters. *Indian J. Agril. Res.,* **49**(2): 215-221.

Karivaratharaju, T. V. (2005). Physical and biochemical techniques for crop variety identification. *Training Manual on DUS Test in cotton with reference to PPV and FR legislation, 2001, All India Coordinated Cotton Improvement Project, CICR, Coimbatore, Tamil Nadu,* p.101-115.

Katiyar, P. K.; Dixit G. P. and Singh B. B. (2008). Morphological characterization of green gram (*Vigna radiata*) varieties and their application for distinctness, uniformity and stability testing. *Indian J. Agri. Sci.,* **78**(5): 439-444.

Kaur, R.; Toor, A. K.; Geeta, B. and Bains, T. S. (2017). Characterization of mung bean (*Vigna radiata* L. Wilczek) varieties using morphological and molecular descriptors. *Int. J. Curr. Microbiol. App. Sci*., **6**(6): 1609-1618.

Khare, D.; Gosavi, S.; Tomar, R. and Singh, K. (2006). Characterization of lentil varieties based on morphological and biochemical tests at seed and seedling stages. *Seed Res.,* **34**(2): 134-139.

Kumar, S. and Shrikant. (2016). Evaluation of cowpea (*Vigna unguiculata* (L.) Walp.) cultivars using morphological indices. *Asian J. Multidisciplinary Studies*, **4**(6): 158-164.

Kumar, S.; Joshi, U. N.; Singh, V.; Singh, J. V. and Saini, M. L. (2013).

Characterization of released and elite genotypes of guar (*Cyamopsis tetragonoloba* (L.) Taub.) from India proves unrelated to geographical origin. *Genet. Resour. Crop Evol*., **60**(7): 2017-2032.

Mansing, J. S. (2010). Characterization of wheat (*Triticum* spp.) genotypes trough morphological, chemical and molecular markers. M.Sc. (Agri.) Thesis (Unpublished) Submitted to University of Agricultural Sciences, Dharwad.

Mckee, G. W. (1973). Chemicals and biochemical techniques for varietal identification. *Seed Sci. Technol.*, **1**: 181-199.

Rao, P. S.; Bharathi, M. and Bayyapu Reddy, K. (2013). Identification of peanut (*Arachis hypogea* L.) varieties through chemical test and electrophoresis of soluble seed proteins. *Legume Res*., **36**(6): 475-483.

Reddy, M.; Hunje, R.; Nadaf, H. L.; Biradar, D. P. and Vyakarnahal, B. S. (2008). Identification of cotton hybrids and parents through chemical tests. *Agril. Sci. Digest*, **28**(1): 51-53.

Sarao, N. K.; Joshi, M. A.; Sharma, R. C.; Sandhu, J. S. and Kumar, J. (2009). Characterization of chickpea based on morphological markers. *J. Food Legumes*, **22**(4): 251-253.

Sastry, D. V. S. S. R.; Upadhyaya, H. D. and Gowda, C. L. L. (2014). Determination of physical properties of chickpea seeds and their relevance in germplasm collections. *Indian J. Plant Genet. Resources*, **27**(1): 1-9.

Singh, C. M.; Mishra, S. B.; Pandey, A. and Arya, M. (2014). Morphological characterization and discriminant functions analysis in mung bean (*Vigna radiata* L. Wilczek) germplasm. *Elect. J. Plant Breed*., **5**(1): 87-96.

Sripunitha A. and Sivasubramaniam, K. (2014). Varietal characterization of rice varieties based on chemical methods. *Trends in Biosci*., **7(20)**: 3139-3146.

Thawari, S. B.; Patil, H. E.; Bhakre, R. L. and Mali, R. S. (2014). Characterization of sunflower hybrids and parental lines by seed peroxidase isozymes. *Trends in Biosci*., **7(9)**: 803-805.

Ukani, J. D.; Patel, J. B.; Babariya, C. A. and Ramani, P. S. (2016). Characterization of wheat varieties (*Triticum Spp*.) through chemical tests. *The Bioscan*, **11**(1): 315-319.

Table 1: Identification and grouping of mung bean genotypes based on seed colour and seed shape

Sr. No.	Genotypes	Seed colour	Seed shape	Sr. No.	Genotypes	Seed colour	Seed shape
1	EC 251810	Green	Drum	23	GJM 1113	Green	Drum
2	EC 450450	Green	Drum	24	GJM 1116	Green	Drum
3	EC 482907	Green	Drum	25	GJM 1117	Green	Drum
4	EC 501569	Green	Drum	26	GM 04-02	Green	Drum
5	EC 496841	Green	Drum	27	GM 05-05	Green	Drum
6	GAM 5	Green	Drum	28	GM 06-08	Green	Drum
7	GJM 1004	Green	Drum	29	GM 02-13	Green	Drum
8	GJM 1007	Green	Drum	30	GM 02-15	Green	Drum
9	GJM 1008	Green	Drum	31	GM 02-16	Green	Drum
10	GJM 1011	Green	Oval	32	GM 1924	Green	Drum
11	GJM 1012	Green	Drum	33	GM 1925	Green	Drum
12	GJM 1016	Green	Drum	34	GM 4	Green	Drum
13	GJM 1020	Green	Drum	35	IC 12434	Green	Drum
14	GJM 1022	Green	Drum	36	IC 24789	Green	Oval
15	GJM 1025	Green	Drum	37	IC 8917	Green	Drum
16	GJM 1026	Green	Drum	38	J 781	Green	Drum
17	GJM 1027	Green	Drum	39	K 851	Green	Drum
18	GJM 1028	Green	Drum	40	Kopergaon	Green	Drum
19	GJM 1103	Green	Drum	41	OUM 11-5	Green	Drum
20	GJM 1104	Green	Drum	42	Pant M-3	Green	Drum
21	GJM 1110	Green	Drum	43	RMG 268	Green	Drum
22	GJM 1112	Green	Drum	44	TARM 18	Green	Drum

Table 2: Identification and grouping of mung bean genotypes based on seed size

Sr. No.	Genotypes	Seed size (g)	Group	Sr. No.	Genotypes	Seed size (g)	Group
1	EC 251810	5.21	Large	**23**	GJM 1113	3.64	Medium
2	EC 450450	4.47	Medium	**24**	GJM 1116	4.84	Medium
3	EC 482907	4.46	Medium	**25**	GJM 1117	5.38	Large
4	EC 501569	4.23	Medium	**26**	GM 04-02	5.16	Large
5	EC 496841	4.56	Medium	**27**	GM 05-05	3.84	Medium
6	GAM 5	4.80	Medium	**28**	GM 06-08	5.37	Large
7	GJM 1004	4.70	Medium	**29**	GM 02-13	5.83	Large
8	GJM 1007	4.03	Medium	**30**	GM 02-15	4.83	Medium
9	GJM 1008	4.70	Medium	**31**	GM 02-16	5.43	Large
10	GJM 1011	4.55	Medium	**32**	GM 1924	4.29	Medium
11	GJM 1012	3.71	Medium	**33**	GM 1925	4.86	Medium
12	GJM 1016	4.58	Medium	**34**	GM 4	5.18	Large
13	GJM 1020	4.82	Medium	**35**	IC 12434	4.05	Medium
14	GJM 1022	5.80	Large	**36**	IC 24789	4.96	Medium
15	GJM 1025	4.45	Medium	**37**	IC 8917	4.62	Medium
16	GJM 1026	5.62	Large	**38**	J 781	5.59	Large
17	GJM 1027	4.17	Medium	**39**	K 851	4.85	Medium
18	GJM 1028	4.05	Medium	**40**	Kopergaon	3.82	Medium
19	GJM 1103	4.34	Medium	**41**	OUM 11-5	5.66	Large
20	GJM 1104	4.40	Medium	**42**	Pant M-3	4.41	Medium
21	GJM 1110	4.68	Medium	**43**	RMG 268	4.39	Medium
22	GJM 1112	5.15	Large	**44**	TARM 18	4.27	Medium
	Mean	4.69					
	S.Em ±	0.07					
	C.D. at 5 %	0.21					
	CV %	2.69					

Note: ***Seed size (based on 100 seed weight (g))***

Small : < 3 g
Medium : 3-5 g
Large : > 5 g

Table 3: Identification and grouping of mung bean genotypes based on seed germination (%) and coleoptiles anthocyanin colouration

Sr. No.	Genotypes	Seed germination (%)	Coleoptiles anthocyanin colouration	Sr. No.	Genotypes	Seed germination (%)	Coleoptiles anthocyanin colouration
1	EC 251810	94.00	Absent	**23**	GJM 1113	94.00	Absent
2	EC 450450	93.33	Absent	**24**	GJM 1116	94.00	Absent
3	EC 482907	93.67	Absent	**25**	GJM 1117	94.00	Absent
4	EC 501569	92.33	Absent	**26**	GM 04-02	93.00	Absent
5	EC 496841	93.67	Absent	**27**	GM 05-05	92.00	Absent
6	GAM 5	96.67	Absent	**28**	GM 06-08	94.00	Absent
7	GJM 1004	95.00	Absent	**29**	GM 02-13	92.00	Absent
8	GJM 1007	93.67	Absent	**30**	GM 02-15	94.00	Absent
9	GJM 1008	94.33	Absent	**31**	GM 02-16	93.33	Absent
10	GJM 1011	93.67	Absent	**32**	GM 1924	93.33	Absent
11	GJM 1012	94.33	Absent	**33**	GM 1925	92.33	Absent
12	GJM 1016	94.00	Absent	**34**	GM 4	96.00	Absent
13	GJM 1020	94.33	Absent	**35**	IC 12434	94.00	Absent
14	GJM 1022	95.00	Absent	**36**	IC 24789	93.00	Absent
15	GJM 1025	94.33	Absent	**37**	IC 8917	92.33	Absent
16	GJM 1026	94.00	Absent	**38**	J 781	92.67	Absent
17	GJM 1027	95.67	Absent	**39**	K 851	93.00	Absent
18	GJM 1028	94.67	Absent	**40**	Kopergaon	94.00	Absent
19	GJM 1103	94.33	Absent	**41**	OUM 11-5	91.00	Absent
20	GJM 1104	94.67	Absent	**42**	Pant M-3	92.33	Absent
21	GJM 1110	94.67	Absent	**43**	RMG 268	92.33	Absent
22	GJM 1112	94.33	Absent	**44**	TARM 18	92.00	Absent
	Mean	93.71					
	S.Em ±	0.98					
	C.D. at 5 %	NS					
	CV %	1.82					

Table 4: Seedling length (cm) variation in mung bean genotypes

Sr. No.	Genotypes	Seedling length (cm)	Sr. No.	Genotypes	Seedling length (cm)
1	EC 251810	25.55	23	GJM 1113	26.81
2	EC 450450	24.87	24	GJM 1116	26.67
3	EC 482907	25.94	25	GJM 1117	27.50
4	EC 501569	25.84	26	GM 04-02	26.68
5	EC 496841	26.78	27	GM 05-05	25.83
6	GAM 5	31.66	28	GM 06-08	25.37
7	GJM 1004	26.68	29	GM 02-13	25.20
8	GJM 1007	27.79	30	GM 02-15	25.62
9	GJM 1008	26.47	31	GM 02-16	25.63
10	GJM 1011	26.57	32	GM 1924	26.75
11	GJM 1012	27.64	33	GM 1925	26.46
12	GJM 1016	27.49	34	GM 4	30.24
13	GJM 1020	26.82	35	IC 12434	26.62
14	GJM 1022	26.87	36	IC 24789	26.55
15	GJM 1025	26.89	37	IC 8917	26.94
16	GJM 1026	26.48	38	J 781	26.77
17	GJM 1027	26.54	39	K 851	25.91
18	GJM 1028	26.79	40	Kopergaon	25.70
19	GJM 1103	26.76	41	OUM 11-5	25.78
20	GJM 1104	26.78	42	Pant M-3	25.69
21	GJM 1110	26.76	43	RMG 268	23.93
22	GJM 1112	26.67	44	TARM 18	25.97
	Mean	26.57			
	S.Em ±	0.16			
	C.D. at 5 %	0.46			
	CV %	1.07			

Table 5: Identification and grouping of mung bean genotypes based on seedling vigour index (length)

Sr. No.	Genotypes	Seed vigour index (length)	Group	Sr. No.	Genotypes	Seed vigour index (length)	Group
1	EC 251810	2401.70	Low	**23**	GJM 1113	2519.83	Medium
2	EC 450450	2321.20	Low	**24**	GJM 1116	2506.98	Medium
3	EC 482907	2429.40	Low	**25**	GJM 1117	2585.31	Medium
4	EC 501569	2386.20	Low	**26**	GM 04-02	2481.24	Low
5	EC 496841	2508.08	Medium	**27**	GM 05-05	2376.67	Low
6	GAM 5	3060.79	High	**28**	GM 06-08	2384.78	Low
7	GJM 1004	2534.92	Medium	**29**	GM 02-13	2318.09	Low
8	GJM 1007	2603.31	Medium	**30**	GM 02-15	2408.59	Low
9	GJM 1008	2497.00	Low	**31**	GM 02-16	2391.82	Low
10	GJM 1011	2489.04	Low	**32**	GM 1924	2496.67	Low
11	GJM 1012	2607.06	Medium	**33**	GM 1925	2443.45	Low
12	GJM 1016	2584.37	Medium	**34**	GM 4	2902.72	Medium
13	GJM 1020	2530.33	Medium	**35**	IC 12434	2502.59	Medium
14	GJM 1022	2552.97	Medium	**36**	IC 24789	2468.84	Low
15	GJM 1025	2536.31	Medium	**37**	IC 8917	2487.15	Low
16	GJM 1026	2489.12	Low	**38**	J 781	2480.69	Low
17	GJM 1027	2538.67	Medium	**39**	K 851	2409.32	Low
18	GJM 1028	2536.12	Medium	**40**	Kopergaon	2415.80	Low
19	GJM 1103	2524.36	Medium	**41**	OUM 11-5	2345.98	Low
20	GJM 1104	2535.49	Medium	**42**	Pant M-3	2372.35	Low
21	GJM 1110	2533.60	Medium	**43**	RMG 268	2209.84	Low
22	GJM 1112	2515.87	Medium	**44**	TARM 18	2389.24	Low
	Mean	2491.26					
	S.Em ±	31.89					
	C.D. at 5 %	89.63					
	CV %	2.21					

Note: ***Seedling vigour index (Length)***
Low : < 2500
Medium : 2500-3000
High : > 3000

Table 6: Identification and grouping of mung bean genotypes based on phenol test and peroxidase test

Sr. No.	Genotypes	Phenol test	Peroxidase test	Sr. No.	Genotypes	Phenol test	Peroxidase test
1	EC 251810	Dark brown	Dark brown	**23**	GJM 1113	Dark brown	Light brown
2	EC 450450	Dark brown	Dark brown	**24**	GJM 1116	Dark brown	Dark brown
3	EC 482907	Dark brown	Light brown	**25**	GJM 1117	Dark brown	Dark brown
4	EC 501569	Dark brown	Dark brown	**26**	GM 04-02	Dark brown	Dark brown
5	EC 496841	Dark brown	Light brown	**27**	GM 05-05	Dark brown	Light brown
6	GAM 5	Brown	Light brown	**28**	GM 06-08	Dark brown	Dark brown
7	GJM 1004	Dark brown	Dark brown	**29**	GM 02-13	Dark brown	Dark brown
8	GJM 1007	Brown	Dark brown	**30**	GM 02-15	Brown	Dark brown
9	GJM 1008	Dark brown	Dark brown	**31**	GM 02-16	Dark brown	Dark brown
10	GJM 1011	Dark brown	Light brown	**32**	GM 1924	Dark brown	Light brown
11	GJM 1012	Dark brown	Light brown	**33**	GM 1925	Dark brown	Dark brown
12	GJM 1016	Brown	Dark brown	**34**	GM 4	Brown	Dark brown
13	GJM 1020	Dark brown	Dark brown	**35**	IC 12434	Dark brown	Dark brown
14	GJM 1022	Dark brown	Dark brown	**36**	IC 24789	Dark brown	Light brown
15	GJM 1025	Brown	Dark brown	**37**	IC 8917	Dark brown	Dark brown
16	GJM 1026	Dark brown	Light brown	**38**	J 781	Dark brown	Dark brown
17	GJM 1027	Dark brown	Dark brown	**39**	K 851	Brown	Light brown
18	GJM 1028	Dark brown	Dark brown	**40**	Kopergaon	Brown	Light brown
19	GJM 1103	Dark brown	Dark brown	**41**	OUM 11-5	Dark brown	Dark brown
20	GJM 1104	Dark brown	Dark brown	**42**	Pant M-3	Dark brown	Dark brown
21	GJM 1110	Dark brown	Dark brown	**43**	RMG 268	Dark brown	Light brown
22	GJM 1112	Dark brown	Dark brown	**44**	TARM 18	Dark brown	Dark brown

Table 7: Identification and grouping of mung bean genotypes based on potassium hydroxide (KOH) test and sodium hydroxide (NaOH) test

Sr. No.	Genotypes	Potassium hydroxide (KOH) test	Sodium hydroxide (NaOH) test	Sr. No.	Genotypes	Potassium hydroxide (KOH) test	Sodium hydroxide (NaOH) test
1	EC 251810	Orange	Orange	**23**	GJM 1113	Orange	Straw
2	EC 450450	Orange	Orange	**24**	GJM 1116	Orange	Straw
3	EC 482907	Orange	Orange	**25**	GJM 1117	Orange	Straw
4	EC 501569	Orange	Orange	**26**	GM 04-02	Orange	Straw
5	EC 496841	Orange	Orange	**27**	GM 05-05	Orange	Straw
6	GAM 5	Orange	Straw	**28**	GM 06-08	Orange	Straw
7	GJM 1004	Orange	Orange	**29**	GM 02-13	Orange	Straw
8	GJM 1007	Orange	Straw	**30**	GM 02-15	Orange	Orange
9	GJM 1008	Orange	Orange	**31**	GM 02-16	Orange	Orange
10	GJM 1011	Orange	Straw	**32**	GM 1924	Orange	Orange
11	GJM 1012	Orange	Straw	**33**	GM 1925	Orange	Straw
12	GJM 1016	Orange	Straw	**34**	GM 4	Orange	Orange
13	GJM 1020	Orange	Straw	**35**	IC 12434	Orange	Straw
14	GJM 1022	Orange	Straw	**36**	IC 24789	Orange	Straw
15	GJM 1025	Orange	Orange	**37**	IC 8917	Orange	Orange
16	GJM 1026	Orange	Straw	**38**	J 781	Orange	Straw
17	GJM 1027	Orange	Straw	**39**	K 851	Orange	Orange
18	GJM 1028	Orange	Straw	**40**	Kopergaon	Orange	Straw
19	GJM 1103	Orange	Straw	**41**	OUM 11-5	Orange	Orange
20	GJM 1104	Orange	Straw	**42**	Pant M-3	Orange	Orange
21	GJM 1110	Orange	Straw	**43**	RMG 268	Orange	Orange
22	GJM 1112	Orange	Straw	**44**	TARM 18	Orange	Orange

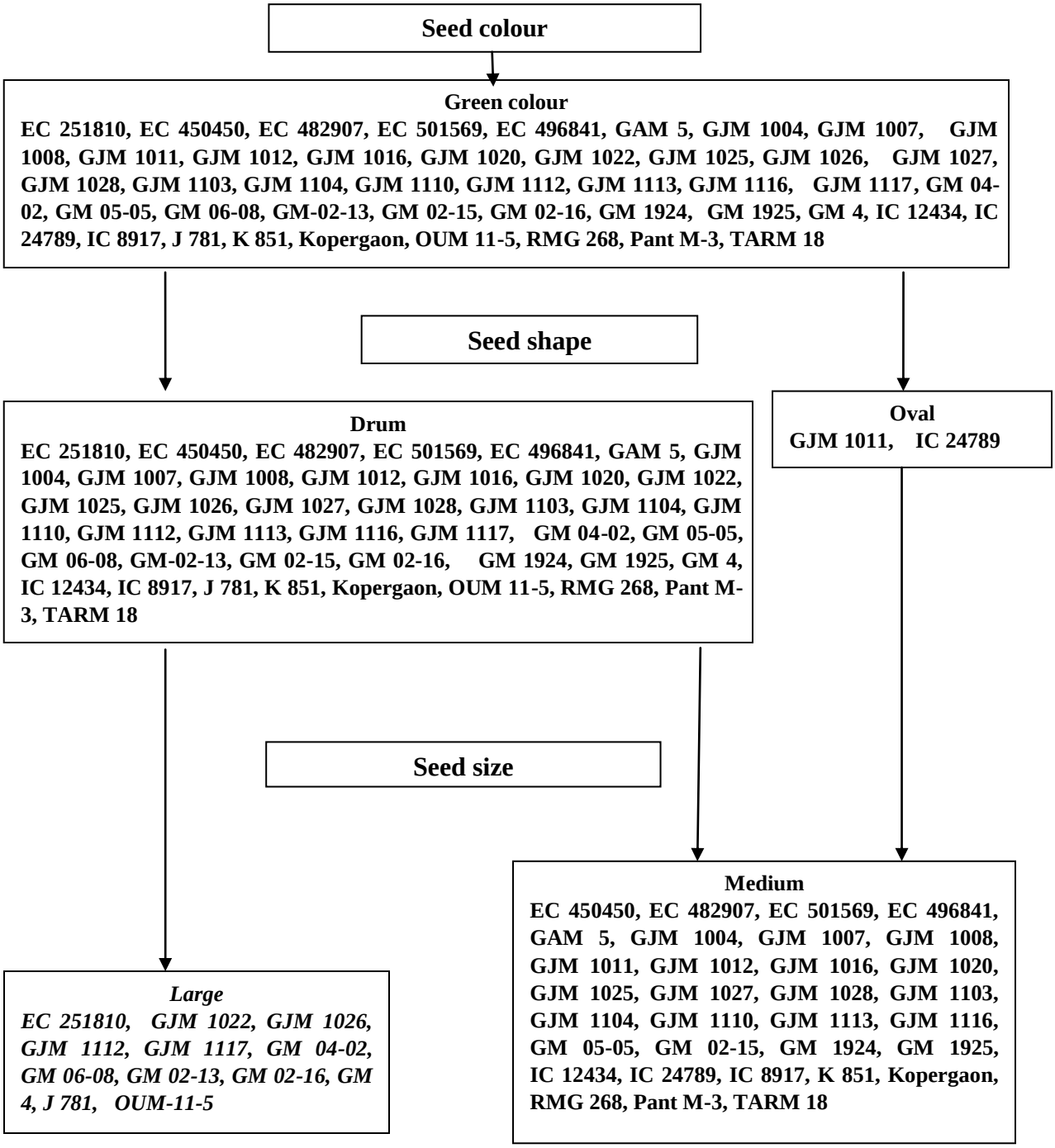

Fig. 1: Mung bean genotypes identification keys on the basis of seed characters

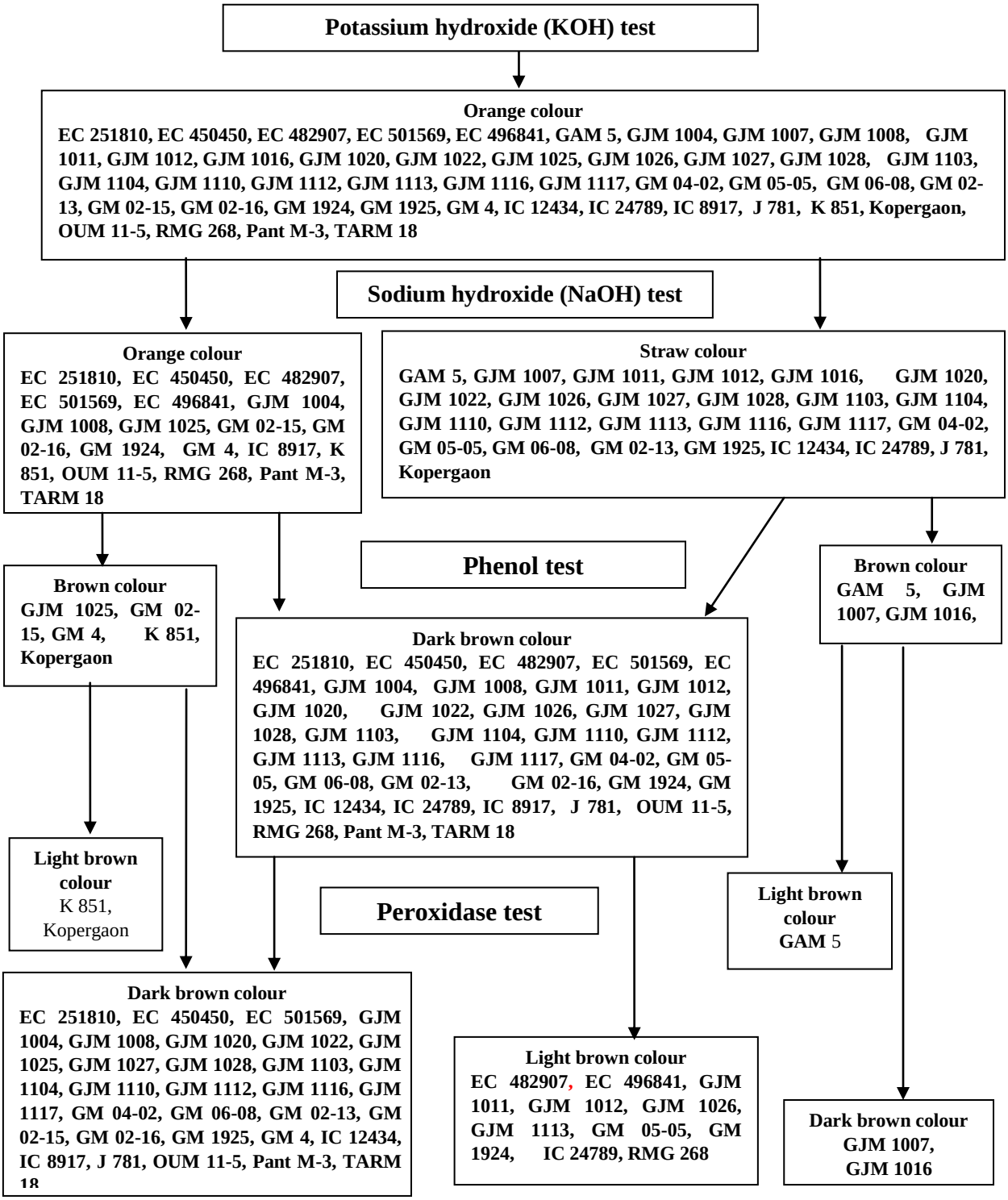

Fig. 2: Mung bean genotypes identification keys on the basis of chemical tests

[MS received : September 04 , 2019] *[MS accepted : September 19, 2019]*