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# Morphological Characterization of Mungbean [*Vigna radiata* (L.) Wilczek] Genotypes using DUS Descriptors

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**ABSTRACT: Mungbean [*Vigna radiata* (L.) Wilczek] is one of the major pulses of India, diversely grown in different agro-climatic zones during summer and *kharif* seasons. Distinctness, Uniformity and Stability (DUS) characterization is a significant approach in identifying and evaluating diverse genotypes for quality seed production. Therefore, the present experiment was conducted to characterize and evaluate variation present in mungbean genotypes through DUS descriptors. One hundred forty-two mungbean genotypes were analysed using 29 agro-morphological (21 qualitative and 8 quantitative) DUS descriptors in randomized block design with two replications during *kharif* 2021. Among twenty-nine DUS characters studied, nine characters showed trimorphic variation, *viz.*, plant growth habit, leaf shape, leaf size, seed size, plant height, number of branches per plant, number of pods per plant, number of seeds per pod and seed yield per plant. Seventeen characters had dimorphic variation and three characters (plant habit, stem pubescence and pod pubescence) were found similar in all the genotypes. A remarkable amount of variation was found in all the mungbean genotypes for these DUS descriptors.**

**Keywords:** Distinctness, Uniformity, Stability, *Vigna radiata* (L.) Wilczek, quality seed production.

## INTRODUCTION

In India, pulses have always been an integral part of the subsistence agriculture since ancient times. Pulses share a crucial role in the Indian economy. They have the innate ability to flourish well under unfavourable climate conditions and they can fix atmospheric nitrogen through their root nodules. They are among the healthy foods opted for providing millions of people a source of nutritional security and helps to cope protein malnutrition.

Among pulses, Mungbean [*Vigna radiata* (L.) Wilczek], also known as greengram, is a major pulse grown in Indian sub-continent. It is a self-pollinated crop having short duration crop cycle which is favourable for growing mungbean in diverse environmental conditions. Mungbean is considered as a good source of easily digesting protein (240g/kg), carbohydrates and many micronutrients for vegetarian Indian population (Sheena *et al.*, 2021 and Sunayana *et al*., 2017). However, the key constraints in production of mungbean are indeterminate type of plant growth which requires multiple harvesting, shattering of pods at maturity and susceptibility to diseases and insect pests. The environment plays a vital role in crop production by interacting with genetic architecture (Sharma *et al*., 2023). Lack of broad genetic base and non-availability of suitable genotypes for diverse cropping situations are the major concern in mungbean breeding programmes. Characterization and evaluation of available germplasm is a crucial step for its efficient utilization and conservation. Characterization also eases the improvement process of both quantitative and qualitative attributes (Gupta *et al.*, 2022).

Study of general agro-morphological attributes of genotypes is not efficient in characterizing them into diverse clusters. As per the standard measures stated under Protection of Plant Varieties and Farmers' Rights Act (PPV & FRA, 2001), Distinctness, Uniformity and Stability (DUS) characterization is crucial for identification and prevention of duplication as well as for proper varietal registration. DUS characterization has a considerable significance in the quality seed production and certification (Janghel *et al.*, 2020). The study of DUS descriptors is easy, cost effective and do not involve any sophisticated laboratory methodologies. Hence, proper characterization and evaluation of variation present in genotypes of mungbean is required to identify suitable genotypes that can be released commercially as a variety suitable for a specific agro-climatic zone (Dhaliwal *et al*., 2020 and Rohilla *et al*., 2022). In order to justify these points, the present work was planned to study the DUS characteristics of the elite genotypes of mungbean.

## MATERIALS AND METHOD

**Experimental location and material used.** The present experiment was conducted at Pulses Research Area of the Department of Genetics and Plant Breeding, CCS HAU, Hisar during *kharif* 2021, with one hundred

and forty-two genotypes of mungbean. The experiment location falls under the semi tropical region of the North West Plain Zone of India having semi-arid climate with hot and dry winds during *kharif* season.

**Experimental details and layout**. One hundred and forty-two mungbean genotypes were grown in Randomized Block Design (RBD) with two replications. Each genotype is grown in two rows with 45 cm row to row spacing and 10 cm plant to plant spacing.

**Plant Morphological Traits.** The study of each DUS descriptor is done according to the guidelines of PPV and FRA (Anonymous, 2007). Total twenty-one qualitative and eight quantitative agro-morphological descriptors were studied in mungbean genotypes at various life stages of plant growth. To record the distinctiveness and uniformity of descriptors, four types of assessment methods were used. At seedling stage, the data was recorded for the presence or absence of hypocotyl anthocyanin colouration. During flowering stage, various characters, namely, plant growth habit, plant habit, days to 50% flowering, stem colour, stem pubescence, leaflet lobes, leaf shape, leaf colour, leaf vein colour, petiole colour, leaf size and flower colour (standard petal) were recorded. Other traits *viz*., premature pod colour, pod pubescence, pod position and plant height were recorded when pods were fully developed and are green. At harvest maturity, characters like days to maturity, pod length, number of pods per plant, number of branches per plant, number of seeds per pod, mature pod colour and mature pod curvature were studied. Seed characters namely, seed colour, seed lusture, seed shape, seed size and seed yield per plant were evaluated after the crop harvest when seeds are fully matured.

## RESULTS AND DISCUSSION

During different growth stages of mungbean, total twenty-nine DUS descriptors were used to characterize one hundred forty-two elite genotypes of mungbean. Among the twenty-one diverse qualitative and eight quantitative characters analysed, eighteen qualitative and eight quantitative characters showed significant difference, respectively, which indicated the presence of a large and exploitable amount of genetic variability and usefulness of these descriptors in differentiating the genotypes (Table 1). Sheena *et al*. (2021); Rahangdale *et al*. (2022) and Joshi *et al*. (2022) also exploited DUS characterization in mungbean for the identification and protection.

**Seedling characters.** During cotyledonary stage of crop plants, hypocotyl colour is observed for the presence or absence of anthocyanin pigment. Hypocotyl colour is often considered as an important morphological marker in mungbean for identification and protection under intellectual property rights. In this study, out of total one hundred forty-two genotypes studied, eighteen genotypes were observed without anthocyanin pigmentation in hypocotyl region and were found green in colour. Rest of one hundred twenty-four genotypes showed presence of anthocyanin colour and were found purple in colour which indicated the significant presence of variation among these genotypes for this character. Moreover, this character can also be used as selection criteria for identification of the genotypes.

**Plant characters.** Plant growth habit, plant habit, petiole colour, plant height and number of branches per plant were characterized under plant characters. At 50 per cent flowering, plant growth habit showed significant variation with fourteen genotypes classified as erect, one hundred twenty-six as semi-erect and two as spreading type. Such trimorphic variation makes plant growth habit a suitable criterion to be used in varietal purity maintenance and identification. Generally, erect type of plants is preferred because of the better availability of sunshine to the plant and efficient synthesis of food by leaves for better growth and development. Therefore, the results suggests the need of incorporating more erect type of germplasm in future mungbean breeding programmes at Pulses Research Area, CCS HAU, Hisar. Plant habit was found monomorphic as all one hundred forty-two genotypes showed indeterminate type of growth. In case of petiole colour, totally green petiole was found in seventeen genotypes and rest of the one hundred twenty-five genotypes showed green petiole colour with purple splashes. The plant height was recorded when pods were fully developed. All the genotypes were classified into three different classes based on plant height, *viz*., short (less than 50cm), medium (50 cm to 70 cm) and long (more than 70cm). Eighty genotypes were found short in height, fifty-eight were of medium height and four genotypes were reported with tall height. Pusa BM 9 was the tallest genotype with 77 cm height and Sona Mung-1 was the shortest genotype with 26 cm height.

Yadav *et al*. (2020) and Sheena *et al*. (2021) also studied the presence of variability for plant height in their studies in lentil and mungbean, respectively. Number of branches per plant was observed at harvest maturity and this trait also showed trimorphic variation same as plant height with three different classes of genotypes, namely, low (less than 2), medium (2-3) and high (more than 3). The number of branches per plant was observed low in eight genotypes, medium in one hundred three genotypes and high in thirty-one genotypes.

**Stem characters.** All the characters related to stem were observed at 50 per cent flowering stage of Mungbam. Stem characters involve stem colour and stem pubescence. Among all the genotypes studied for stem colour, only twenty genotypes showed green stem colour and rest one hundred twenty-two genotypes were having green colour with purple splashes. Therefore, a significant amount of variation was observed in all the genotypes for stem colour.

| Table 1: Details of genotypes characterized using 29 DUS descriptors | | | |
|---|---|---|---|
| **CHARACTER** | **STATE (NOTE)** | **FREQ.** | **GENOTYPES** |
| **Hypocotyl colour** | Present (9) | 124 | PM 1801, JLPM 707-27, ML 818, RMG-1148, IPM 02-3, IPM 1604-1, MH 1468, Pusa M 22-32, KM 2419, BCM 20-6, MML 2577, SVM 55, PMD-14, IPM 1704-14, PMS-12, TMB 230, IPM 604-16, Virat (IPM 205-7), Pusa BM 9, VGG 18-002, IPMD 604-1-7, MML 2575 , SML 832, DGGV 91, MH 1762, SML 1932, OBGG 108, VGG 17-043, PM 1602, Pant M 5, SML 1933, Pusa M 19111, MH 1703, MML 2560, Pusa M 1971, PM 1601, PM 1520, TCADM 20-5, IPMD 1604, IPM 1603-1, TBMB 117-5, Pusa M 2131, IPM 1103-1, TBMB 17-2, Pusa BM 16, PM 1605, IPMD 101-2, MML 2568, Pusa M 2132, MHBC 20-7, PM 504-20-27, PM 1624, MH 1830, IPM 1610-1, RMG 1132, RMG 1166, OBGG 105, MH 1890, ANDGG 1301, MML 2576, PMD-8, Pusa M 2141, OBGG 106, PMD-7, MH 1801, PMD-9, SKNM 1911, VGG 17-036, BDYR-1, Pusa 1072, COGG 11-02, EC 30400, EC 399223, EC 393410, EC 470090, EC 581523, Ganga-8, HUM 16, IC 15276, IC 1031096, IPM 99-3, IPM 9901-8, Pusa 1701, IPM 2k 14-9, IPM 3072, 2KM 111, KM 2328, LGG 460, M 395, COGG 13-19, ML 778, COGG 13-14, NYL 638, NDMZ-13-11, NDMZ-15-2, NDMZ 215-1, NBPGR 150, OUM 11-5, PBM-14, PDM 96-262, PLM 24, Pusa 105, Pusa 0871, T-44, RMG 991, SML 1455, SMH 95-1, SMH 99-1, TRCM 2014-2, VGG ru-2, TBM 37, VGG 18-021, IPM 1205-2, VMK 18-02, MHBC 20-14, RMG 1169, MH 18-181, Pusa M 41, MHBC 20-8, MML 2579, IPMD 1202-1, Pusa M 42, MH 18-189, VGG 17-106 |
| | Absent (1) | 18 | IPM 410-3, SVM 98, MH1871, MH 421, SKNM 1801, VGG 16-047, COGG-8, EC 251552, IPM 512-1, 2KM 101, ML 194, Sona Mung-1, SVM 6111, WBM-031, VGG 16-036, KM 2421, SKNM 2006, MGG 499 |
| **Plant growth habit** | Erect (3) | 14 | JLPM 707-27, Pusa BM 9, VGG 16-047, SML 1932, Pant M 5, SML 1933, Pusa M 1971, PM 1520, IPMD 101-2, MML 2568, PM 1624, ANDGG 1301, VGG 18-021, MH 18-181 |
| | Semi-erect (5) | 126 | PM 1801, ML 818, RMG-1148, IPM 02-3, IPM 1604-1, MH 1468, Pusa M 22-32, KM 2419, BCM 20-6, MML 2577, SVM 55, IPM 410-3, PMD-14, SVM 98, IPM 1704-14, PMS-12, TMB 230, IPM 604-16, MH1871, Virat (IPM 205-7), VGG 18-002, MH 421, IPMD 604-1-7, MML 2575, SKNM 1801, SML 832, DGGV 91, MH 1762, OBGG 108, VGG 17-043, PM 1602, Pusa M 19111, MH 1703, MML 2560, PM 1601, TCADM 20-5, IPMD 1604, IPM 1603-1, TBMB 117-5, Pusa M 2131, IPM 1103-1, TBMB 17-2, Pusa BM 16, PM 1605, Pusa M 2132, MHBC 20-7, MH 1830, RMG 1132, RMG 1166, OBGG 105, MH 1890, MML 2576, PMD-8, Pusa M 2141, OBGG 106, PMD-7, MH 1801, PMD-9, SKNM 1911, VGG 17-036, BDYR-1, COGG-8, Pusa 1072, COGG 1102, EC 30400, EC 251552, EC 399223, EC 393410, EC 470090, EC 581523, IPM 512-1, Ganga-8, HUM 16, IC 15276, IC 1031096, IPM 99-3, IPM 9901-8, Pusa 1701, IPM 2k 14-9, IPM 3072, 2KM 101, 2KM 111, KM 2328, LGG 460, M 395, COGG 13-19, ML 194, ML 778, COGG 13-14, NYL 638, NDMZ-13-11, NDMZ-15-2, NDMZ 215-1, NBPGR 150, OUM 11-5, PBM-14, PDM 96-262, PLM 24, Pusa 105, Pusa 0871, T-44, RMG 991, SML 1455, SMH 95-1, SMH 99-1, Sona Mung-1, SVM 6111, TRCM 2014-2, VGG ru-2, WBM-031, VGG 16-036, TBM 37, IPM 1205-2, VMK 18-02, KM 2421, MHBC 20-14, RMG 1169, Pusa M 41, MHBC 20-8, MML 2579, SKNM 2006, IPMD 1202-1, Pusa M 42,MGG 499, MH 18-189, VGG 17-106 |
| | Spreading (7) | 2 | PM 504-20-27, IPM 1610-1 |
| **Plant habit** | Determinate (1) | 0 | - |
| | Indeterminate (3) | 142 | PM 1801, JLPM 707-27, ML 818, RMG-1148, IPM 02-3, IPM 1604-1, MH 1468, Pusa M 22-32, KM 2419, BCM 20-6, MML 2577, SVM 55, IPM 410-3, PMD-14, SVM 98, IPM 1704-14, PMS-12, TMB 230, IPM 604-16, MH1871, Virat (IPM 205-7), Pusa BM 9, VGG 18-002, MH 421, IPMD 604-1-7, MML 2575, SKNM 1801, SML 832, DGGV 91, VGG 16-047, MH 1762, SML 1932, OBGG 108, VGG 17-043, PM 1602, Pant M 5, SML 1933, Pusa M 19111, MH 1703, MML 2560, Pusa M 1971, PM 1601, PM 1520, TCADM 20-5, IPMD 1604, IPM 1603-1, TBMB 117-5, Pusa M 2131, IPM 1103-1, TBMB 17-2, Pusa BM 16, PM 1605, IPMD 101-2, MML 2568, Pusa M 2132, MHBC 20-7, PM 504-20-27, PM 1624, MH 1830, IPM 1610-1, RMG 1132, RMG 1166, OBGG 105, MH 1890, ANDGG 1301, MML 2576, PMD-8, Pusa M 2141, OBGG 106, PMD-7, MH 1801, PMD-9, SKNM 1911, VGG 17-036, BDYR-1, COGG-8, Pusa 1072, COGG 1102, EC 30400, EC 251552, EC 399223, EC 393410, EC 470090, EC 581523, IPM 512-1, Ganga-8, HUM 16, IC 15276, IC 1031096, IPM 99-3, IPM 9901-8, Pusa 1701, IPM 2k 14-9, IPM 3072, 2KM 101, 2KM 111, KM 2328, LGG 460, M 395, COGG 13-19, ML 194, ML 778, COGG 13-14, NYL 638, NDMZ-13-11, NDMZ-15-2, NDMZ 215-1, NBPGR 150, OUM 11-5, PBM-14, PDM 96-262, PLM 24, Pusa 105, Pusa 0871, T-44, RMG 991, SML 1455, SMH 95-1, SMH 99-1, Sona Mung-1, SVM 6111, TRCM 2014-2, VGG ru-2, WBM-031, VGG 16-036, TBM 37, VGG 18-021, IPM 1205-2, VMK 18-02, KM 2421, MHBC 20-14, RMG 1169, MH 18-181, Pusa M 41, MHBC 20-8, MML 2579, SKNM 2006, IPMD 1202-1, Pusa M 42,MGG 499, MH 18-189, VGG 17-106 |
| **Stem colour** | Green (1) | 20 | RMG-1148, IPM 02-3, IPM 1604-1, SVM 98, MH 421, SKNM 1801, VGG 16-047, IPM 410-3, COGG-8, EC 251552, IPM 512-1, 2KM 101, ML 194, Sona Mung-1, SVM 6111, WBM-031, VGG 16-036, KM 2421, SKNM 2006, MGG 499 |
| | Green with purple splashes (2) | 122 | PM 1801, JLPM 707-27, ML 818, MH 1468, Pusa M 22-32, KM 2419, BCM 20-6, MML 2577, SVM 55, IPM 410-3, PMD-14, IPM 1704-14, PMS-12, TMB 230, IPM 604-16, MH1871, Virat (IPM 205-7), Pusa BM 9, VGG 18-002, IPMD 604-1-7, MML 2575, SML 832, DGGV 91, MH 1762, SML 1932, OBGG 108, VGG 17-043, PM |

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|---|---|---|---|
| | | | 1602, Pant M 5, SML 1933, Pusa M 19111, MH 1703, MML 2560, Pusa M 1971, PM 1601, PM 1520, TCADM 20-5, IPMD 1604, IPM 1603-1, TBMB 117-5, Pusa M 2131, IPM 1103-1, TBMB 17-2, Pusa BM 16, PM 1605, IPMD 101-2, MML 2568, Pusa M 2132, MHBC 20-7, PM 504-20-27, PM 1624, MH 1830, IPM 1610-1, RMG 1132, RMG 1166, OBGG 105, MH 1890, ANDGG 1301, MML 2576, PMD-8, Pusa M 2141, OBGG 106, PMD-7, MH 1801, PMD-9, SKNM 1911, VGG 17-036, BDYR-1, Pusa 1072, COGG 1102, EC 30400, EC 399223, EC 393410, EC 470090, EC 581523, Ganga-8, HUM 16, IC 15276, IC 1031096, IPM 99-3, IPM 9901-8, Pusa 1701, IPM 2k 14-9, IPM 3072, 2KM 111, KM 2328, LGG 460, M 395, COGG 13-19, ML 778, COGG 13-14, NYL 638, NDMZ-13-11, NDMZ-15-2, NDMZ 215-1, NBPGR 150, OUM 11-5, PBM-14, PDM 96-262, PLM 24, Pusa 105, Pusa 0871, T-44, RMG 991, SML 1455, SMH 95-1, SMH 99-1, TRCM 2014-2, VGG ru-2, TBM 37, VGG 18-021, IPM 1205-2, VMK 18-02, MHBC 20-14, RMG 1169, MH 18-181, Pusa M 41, MHBC 20-8, MML 2579, IPMD 1202-1, Pusa M 42, MH 18-189, VGG 17-106 |
| **Stem pubescence** | Absent (1) | 0 | - |
| | Present (9) | 142 | PM 1801, JLPM 707-27, ML 818, RMG-1148, IPM 02-3, IPM 1604-1, MH 1468, Pusa M 22-32, KM 2419, BCM 20-6, MML 2577, SVM 55, IPM 410-3, PMD-14, SVM 98, IPM 1704-14, PMS-12, TMB 230, IPM 604-16, MH1871, Virat (IPM 205-7), Pusa BM 9, VGG 18-002, MH 421, IPMD 604-1-7, MML 2575, SKNM 1801, SML 832, DGGV 91, VGG 16-047, MH 1762, SML 1932, OBGG 108, VGG 17-043, PM 1602, Pant M 5, SML 1933, Pusa M 19111, MH 1703, MML 2560, Pusa M 1971, PM 1601, PM 1520, TCADM 20-5, IPMD 1604, IPM 1603-1, TBMB 117-5, Pusa M 2131, IPM 1103-1, TBMB 17-2, Pusa BM 16, PM 1605, IPMD 101-2, MML 2568, Pusa M 2132, MHBC 20-7, PM 504-20-27, PM 1624, MH 1830, IPM 1610-1, RMG 1132, RMG 1166, OBGG 105, MH 1890, ANDGG 1301, MML 2576, PMD-8, Pusa M 2141, OBGG 106, PMD-7, MH 1801, PMD-9, SKNM 1911, VGG 17-036, BDYR-1, COGG-8, Pusa 1072, COGG 1102, EC 30400, EC 251552, EC 399223, EC 393410, EC 470090, EC 581523, IPM 512-1, Ganga-8, HUM 16, IC 15276, IC 1031096, IPM 99-3, IPM 9901-8, Pusa 1701, IPM 2k 14-9, IPM 3072, 2KM 101, 2KM 111, KM 2328, LGG 460, M 395, COGG 13-19, ML 194, ML 778, COGG 13-14, NYL 638, NDMZ-13-11, NDMZ-15-2, NDMZ 215-1, NBPGR 150, OUM 11-5, PBM-14, PDM 96-262, PLM 24, Pusa 105, Pusa 0871, T-44, RMG 991, SML 1455, SMH 95-1, SMH 99-1, Sona Mung-1, SVM 6111, TRCM 2014-2, VGG ru-2, WBM-031, VGG 16-036, TBM 37, VGG 18-021, IPM 1205-2, VMK 18-02, KM 2421, MHBC 20-14, RMG 1169, MH 18-181, Pusa M 41, MHBC 20-8, MML 2579, SKNM 2006, IPMD 1202-1, Pusa M 42, MGG 499, MH 18-189, VGG 17-106 |
| **Leaflet lobes** | Absent (1) | 139 | PM 1801, JLPM 707-27, ML 818, RMG-1148, IPM 02-3, IPM 1604-1, MH 1468, Pusa M 22-32, KM 2419, BCM 20-6, MML 2577, SVM 55, IPM 410-3, PMD-14, SVM 98, IPM 1704-14, PMS-12, TMB 230, IPM 604-16, MH1871, Virat (IPM 205-7), Pusa BM 9, VGG 18-002, MH 421, IPMD 604-1-7, MML 2575, SKNM 1801, SML 832, DGGV 91, VGG 16-047, MH 1762, SML 1932, OBGG 108, VGG 17-043, PM 1602, Pant M 5, SML 1933, Pusa M 19111, MH 1703, MML 2560, Pusa M 1971, PM 1601, PM 1520, TCADM 20-5, IPMD 1604, IPM 1603-1, TBMB 117-5, Pusa M 2131, IPM 1103-1, TBMB 17-2, Pusa BM 16, PM 1605, IPMD 101-2, MML 2568, Pusa M 2132, MHBC 20-7, PM 504-20-27, PM 1624, MH 1830, IPM 1610-1, RMG 1132, RMG 1166, OBGG 105, MH 1890, ANDGG 1301, MML 2576, PMD-8, Pusa M 2141, OBGG 106, PMD-7, MH 1801, PMD-9, SKNM 1911, VGG 17-036, BDYR-1, COGG-8, Pusa 1072, COGG 1102, EC 30400, EC 251552, EC 399223, EC 393410, EC 470090, EC 581523, IPM 512-1, Ganga-8, HUM 16, IC 1031096, IPM 99-3, IPM 9901-8, Pusa 1701, IPM 2k 14-9, IPM 3072, 2KM 101, 2KM 111, KM 2328, LGG 460, M 395, COGG 13-19, ML 194, ML 778, COGG 13-14, NYL 638, NDMZ-13-11, NDMZ-15-2, NDMZ 215-1, NBPGR 150, OUM 11-5, PBM-14, PDM 96-262, PLM 24, Pusa 105, Pusa 0871, T-44, RMG 991, SML 1455, SMH 95-1, SMH 99-1, Sona Mung-1, SVM 6111, TRCM 2014-2, WBM-031, VGG 16-036, TBM 37, IPM 1205-2, VMK 18-02, KM 2421, MHBC 20-14, RMG 1169, MH 18-181, Pusa M 41, MHBC 20-8, MML 2579, SKNM 2006, IPMD 1202-1, Pusa M 42,MGG 499, MH 18-189, VGG 17-106 |
| | Present (9) | 3 | IC 15276, VGG ru-2, VGG 18-021 |
| **Leaf shape** | Deltoid (1) | 0 | - |
| | Ovate (2) | 138 | PM 1801, JLPM 707-27, ML 818, RMG-1148, IPM 02-3, IPM 1604-1, MH 1468, Pusa M 22-32, KM 2419, BCM 20-6, MML 2577, SVM 55, IPM 410-3, PMD-14, SVM 98, IPM 1704-14, PMS-12, TMB 230, IPM 604-16, MH1871, Virat (IPM 205-7), Pusa BM 9, VGG 18-002, MH 421, IPMD 604-1-7, MML 2575, SKNM 1801, SML 832, DGGV 91, VGG 16-047, MH 1762, SML 1932, OBGG 108, VGG 17-043, PM 1602, Pant M 5, SML 1933, Pusa M 19111, MH 1703, MML 2560, Pusa M 1971, PM 1601, PM 1520, TCADM 20-5, IPMD 1604, IPM 1603-1, TBMB 117-5, Pusa M 2131, IPM 1103-1, TBMB 17-2, Pusa BM 16, PM 1605, IPMD 101-2, MML 2568, Pusa M 2132, MHBC 20-7, PM 504-20-27, PM 1624, MH 1830, IPM 1610-1, RMG 1132, RMG 1166, OBGG 105, MH 1890, ANDGG 1301, MML 2576, PMD-8, Pusa M 2141, OBGG 106, PMD-7, MH 1801, PMD-9, SKNM 1911, VGG 17-036, BDYR-1, COGG-8, Pusa 1072, COGG 1102, EC 30400, EC 251552, EC 399223, EC 393410, EC 470090, EC 581523, IPM 512-1, Ganga-8, HUM 16, IC 1031096, IPM 99-3, IPM 9901-8, Pusa 1701, IPM 2k 14-9, IPM 3072, 2KM 101, 2KM 111, KM 2328, LGG 460, M 395, COGG 13-19, ML 194, ML 778, COGG 13-14, NYL 638, NDMZ-13-11, NDMZ-15-2, NDMZ 215-1, NBPGR 150, OUM 11-5, PBM-14, PDM 96-262, PLM 24, Pusa 105, Pusa 0871, T-44, RMG 991, SML 1455, SMH 95-1, SMH 99-1, SVM 6111, TRCM 2014-2, WBM-031, VGG 16-036, TBM 37, IPM 1205-2, VMK 18-02, KM 2421, MHBC 20-14, RMG 1169, MH 18-181, Pusa M 41, MHBC 20-8, MML 2579, SKNM 2006, IPMD 1202-1, Pusa M 42,MGG 499, MH 18-189, VGG 17-106 |
| | Lanceolate (3) | 1 | Sona Mung-1 |
| | Cuneate (4) | 3 | IC 15276, VGG ru-2, VGG 18-021 |
| **Leaf colour** | Green (1) | 112 | PM 1801, JLPM 707-27, ML 818, RMG-1148, IPM 02-3, IPM 1604-1, MH 1468, Pusa M 22-32, KM 2419, BCM 20-6, MML 2577, SVM 55, IPM 410-3, SVM 98, IPM |

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| | | | 1704-14, PMS-12, TMB 230, IPM 604-16, MH1871, Virat (IPM 205-7), Pusa BM 9, IPMD 604-1-7, MML 2575, SML 832, DGGV 91, MH 1762, SML 1932, OBGG 108, VGG 17-043, PM 1602, SML 1933, Pusa M 19111, MH 1703, MML 2560, Pusa M 1971, PM 1601, PM 1520, TCADM 20-5, IPMD 1604, TBMB 117-5, IPM 1103-1, Pusa BM 16, PM 1605, MML 2568, MHBC 20-7, PM 504-20-27, MH 1830, IPM 1610-1, RMG 1132, RMG 1166, OBGG 105, MH 1890, ANDGG 1301, MML 2576, PMD-8, Pusa M 2141, MH 1801, BDYR-1, COGG-8, Pusa 1072, COGG 1102, EC 30400, EC 251552, EC 399223, EC 393410, EC 470090, IPM 512-1, IC 15276, IC 1031096, IPM 99-3, IPM 9901-8, Pusa 1701, IPM 2k 14-9, IPM 3072, 2KM 101, 2KM 111, KM 2328, COGG 13-19, ML 194, ML 778, NYL 638, NDMZ-13-11, NDMZ-15-2, NDMZ 215-1, NBPGR 150, OUM 11-5, PBM-14, PDM 96-262, PLM 24, Pusa 105, Pusa 0871, T-44, RMG 991, SML 1455, SMH 95-1, SMH 99-1, Sona Mung-1, SVM 6111, TRCM 2014-2, WBM-031, VGG 16-036, TBM 37, IPM 1205-2, KM 2421, MHBC 20-14, RMG 1169, Pusa M 41, MHBC 20-8, SKNM 2006, IPMD 1202-1, MGG 499, MH 18-189 |
| | Dark green (2) | 30 | PMD-14, VGG 18-002, MH 421, SKNM 1801, VGG 16-047, Pant M 5, IPM 1603-1, Pusa M 2131, TBMB 17-2, IPMD 101-2, Pusa M 2132, PM 1624, OBGG 106, PMD-7, PMD-9, SKNM 1911, VGG 17-036, EC 581523, Ganga-8, HUM 16, LGG 460, M 395, COGG 13-14, VGG ru-2, VGG 18-021, VMK 18-02, MH 18-181, MML 2579, Pusa M 42, VGG 17-106 |
| **Leaf vein colour** | Green (1) | 18 | RMG-1148, IPM 410-3, SVM 98, MH 421, SKNM 1801, VGG 16-047, COGG-8, EC 251552, IPM 512-1, 2KM 101, ML 194, Sona Mung-1, SVM 6111, WBM-031, VGG 16-036, KM 2421, SKNM 2006, MGG 499 |
| | Purple (3) | 124 | PM 1801, JLPM 707-27, ML 818, IPM 02-3, IPM 1604-1, MH 1468, Pusa M 22-32, KM 2419, BCM 20-6, MML 2577, SVM 55, PMD-14, IPM 1704-14, PMS-12, TMB 230, IPM 604-16, MH1871, Virat (IPM 205-7), Pusa BM 9, VGG 18-002, IPMD 604-1-7, MML 2575 , SML 832, DGGV 91, MH 1762, SML 1932, OBGG 108, VGG 17-043, PM 1602, Pant M 5, SML 1933, Pusa M 19111, MH 1703, MML 2560, Pusa M 1971, PM 1601, PM 1520, TCADM 20-5, IPMD 1604, IPM 1603-1, TBMB 117-5, Pusa M 2131, IPM 1103-1, TBMB 17-2, Pusa BM 16, PM 1605, IPMD 101-2, MML 2568, Pusa M 2132, MHBC 20-7, PM 504-20-27, PM 1624, MH 1830, IPM 1610-1, RMG 1132, RMG 1166, OBGG 105, MH 1890, ANDGG 1301, MML 2576, PMD-8, Pusa M 2141, OBGG 106, PMD-7, MH 1801, PMD-9, SKNM 1911, VGG 17-036, BDYR-1, Pusa 1072, COGG 11-02, EC 30400, EC 399223, EC 393410, EC 470090, EC 581523, Ganga-8, HUM 16, IC 15276, IC 1031096, IPM 99-3, IPM 9901-8, Pusa 1701, IPM 2k 14-9, IPM 3072, 2KM 111, KM 2328, LGG 460, M 395, COGG 13-19, ML 778, COGG 13-14, NYL 638, NDMZ-13-11, NDMZ-15-2, NDMZ 215-1, NBPGR 150, OUM 11-5, PBM-14, PDM 96-262, PLM 24, Pusa 105, Pusa 0871, T-44, RMG 991, SML 1455, SMH 95-1, SMH 99-1, TRCM 2014-2, VGG ru-2, TBM 37, VGG 18-021, IPM 1205-2, VMK 18-02, MHBC 20-14, RMG 1169, MH 18-181, Pusa M 41, MHBC 20-8, MML 2579, IPMD 1202-1, Pusa M 42, MH 18-189, VGG 17-106 |
| **Leaf size** | Small (3) | 12 | IPM 1604-1, Virat (IPM 205-7), DGGV 91, MH 1762, IPM 1603-1, TBMB 117-5, Pusa M 2131, TBMB 17-2, EC 30400, IC 1031096,IPM 99-3, Sona Mung-1 |
| | Medium (5) | 117 | ML 818, RMG-1148, IPM 02-3, MH 1468, KM 2419, BCM 20-6, MML 2577, SVM 55, IPM 410-3, SVM 98, IPM 1704-14, TMB 230, IPM 604-16, MH1871, Pusa BM 9, VGG 18-002, MH 421, IPMD 604-1-7, MML 2575, SKNM 1801, SML 832, VGG 16-047, SML 1932, OBGG 108, VGG 17-043, PM 1602, Pant M 5, SML 1933, Pusa M 19111, MH 1703, MML 2560, Pusa M 1971, PM 1601, PM 1520, TCADM 20-5, IPMD 1604, IPM 1103-1, Pusa BM 16, PM 1605, IPMD 101-2, MML 2568, Pusa M 2132, MHBC 20-7, PM 504-20-27, MH 1830, IPM 1610-1, RMG 1132, RMG 1166, OBGG 105, MH 1890, ANDGG 1301, MML 2576, PMD-8, Pusa M 2141, OBGG 106, PMD-7, MH 1801, PMD-9, SKNM 1911, VGG 17-036, BDYR-1, COGG-8, Pusa 1072, COGG 1102, EC 251552, EC 399223, EC 393410, EC 470090, EC 581523, IPM 512-1, Ganga-8, IC 15276, IPM 9901-8, Pusa 1701, IPM 2k 14-9, IPM 3072, 2KM 101, 2KM 111, KM 2328, LGG 460, COGG 13-19, ML 194, ML 778, NYL 638, NDMZ-13-11, NDMZ-15-2, NDMZ 215-1, NBPGR 150, OUM 11-5, PBM-14, PDM 96-262, Pusa 105, Pusa 0871, T-44, RMG 991, SML 1455, SMH 95-1, SMH 99-1, SVM 6111, TRCM 2014-2, VGG ru-2, WBM-031, VGG 16-036, TBM 37, VGG 18-021, IPM 1205-2, VMK 18-02, KM 2421, MHBC 20-14, RMG 1169, MH 18-181, Pusa M 41, MHBC 20-8, MML 2579, SKNM 2006, IPMD 1202-1, MH 18-189 |
| | Large (7) | 13 | PM 1801, JLPM 707-27, Pusa M 22-32, PMD-14, PMS-12, PM 1624, HUM 16, M 395, COGG 13-14, PLM 24, Pusa M 42, MGG 499, VGG 17-106 |
| **Petiole colour** | Green (1) | 17 | IPM 410-3, SVM 98, MH 421, SKNM 1801, VGG 16-047, COGG-8, EC 251552, IPM 512-1, 2KM 101, ML 194, Sona Mung-1, SVM 6111, WBM-031, VGG 16-036, KM 2421, SKNM 2006, MGG 499 |
| | Green with purple splashes(2) | 125 | PM 1801, JLPM 707-27, ML 818, RMG-1148, IPM 02-3, IPM 1604-1, MH 1468, Pusa M 22-32, KM 2419, BCM 20-6, MML 2577, SVM 55, PMD-14, IPM 1704-14, PMS-12, TMB 230, IPM 604-16, MH1871, Virat (IPM 205-7), Pusa BM 9, VGG 18-002, IPMD 604-1-7, MML 2575 , SML 832, DGGV 91, MH 1762, SML 1932, OBGG 108, VGG 17-043, PM 1602, Pant M 5, SML 1933, Pusa M 19111, MH 1703, MML 2560, Pusa M 1971, PM 1601, PM 1520, TCADM 20-5, IPMD 1604, IPM 1603-1, TBMB 117-5, Pusa M 2131, IPM 1103-1, TBMB 17-2, Pusa BM 16, PM 1605, IPMD 101-2, MML 2568, Pusa M 2132, MHBC 20-7, PM 504-20-27, PM 1624, MH 1830, IPM 1610-1, RMG 1132, RMG 1166, OBGG 105, MH 1890, ANDGG 1301, MML 2576, PMD-8, Pusa M 2141, OBGG 106, PMD-7, MH 1801, PMD-9, SKNM 1911, VGG 17-036, BDYR-1, Pusa 1072, COGG 11-02, EC 30400, EC 399223, EC 393410, EC 470090, EC 581523, Ganga-8, HUM 16, IC 15276, IC 1031096, IPM 99-3, IPM 9901-8, Pusa 1701, IPM 2k 14-9, IPM 3072, 2KM 111, KM 2328, LGG 460, M 395, COGG 13-19, ML 778, COGG 13-14, NYL 638, NDMZ-13-11, NDMZ-15-2, NDMZ 215-1, NBPGR 150, OUM 11-5, PBM-14, PDM 96-262, PLM 24, Pusa 105, Pusa 0871, T-44, RMG 991, SML 1455, SMH 95-1, SMH 99-1, TRCM 2014-2, VGG ru-2, TBM 37, VGG 18-021, IPM 1205-2, VMK 18-02, MHBC 20-14, RMG 1169, MH 18-181, Pusa M 41, MHBC 20-8, MML 2579, IPMD 1202-1, Pusa M 42, MH 18-189, VGG 17-106 |
| **Flower colour** | Yellow (3) | 21 | JLPM 707-27, MH1871, MH 421, SML 832, VGG 16-047, Pant M 5, SML 1933, Pusa M 19111, MML 2560, MML 2568, PM 504-20-27, ANDGG 1301, Ganga-8, LGG |

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| | | | 460, OUM 11-5, Pusa 105, RMG 991, SML 1455, SVM 6111, MHBC 20-14, IPMD 1202-1 |
| | Light yellow (5) | 121 | PM 1801, ML 818, RMG-1148, IPM 02-3, IPM 1604-1, MH 1468, Pusa M 22-32, KM 2419, BCM 20-6, MML 2577, SVM 55, IPM 410-3, PMD-14, SVM 98, IPM 1704-14, PMS-12, TMB 230, IPM 604-16, Virat (IPM 205-7), Pusa BM 9, VGG 18-002, IPMD 604-1-7, MML 2575, SKNM 1801, DGGV 91, MH 1762, SML 1932, OBGG 108, VGG 17-043, PM 1602, MH 1703, Pusa M 1971, PM 1601, PM 1520, TCADM 20-5, IPMD 1604, IPM 1603-1, TBMB 117-5, Pusa M 2131, IPM 1103-1, TBMB 17-2, Pusa BM 16, PM 1605, IPMD 101-2, Pusa M 2132, MHBC 20-7, PM 1624, MH 1830, IPM 1610-1, RMG 1132, RMG 1166, OBGG 105, MH 1890, MML 2576, PMD-8, Pusa M 2141, OBGG 106, PMD-7, MH 1801, PMD-9, SKNM 1911, VGG 17-036, BDYR-1, COGG-8, Pusa 1072, COGG 1102, EC 30400, EC 251552, EC 399223, EC 393410, EC 470090, EC 581523, IPM 512-1, HUM 16, IC 15276, IC 1031096, IPM 99-3, IPM 9901-8, Pusa 1701, IPM 2k 14-9, IPM 3072, 2KM 101, 2KM 111, KM 2328, M 395, COGG 13-19, ML 194, ML 778, COGG 13-14, NYL 638, NDMZ-13-11, NDMZ-15-2, NDMZ 215-1, NBPGR 150, PBM-14, PDM 96-262, PLM 24, Pusa 0871, T-44, SMH 95-1, SMH 99-1, Sona Mung-1, TRCM 2014-2, VGG ru-2, WBM-031, VGG 16-036, TBM 37, VGG 18-021, IPM 1205-2, VMK 18-02, KM 2421, RMG 1169, MH 18-181, Pusa M 41, MHBC 20-8, MML 2579, SKNM 2006, Pusa M 42, MGG 499, MH 18-189, VGG 17-106 |
| **Pod pud.** | Absent (1) | 0 | - |
| | Present (9) | 142 | PM 1801, JLPM 707-27, ML 818, RMG-1148, IPM 02-3, IPM 1604-1, MH 1468, Pusa M 22-32, KM 2419, BCM 20-6, MML 2577, SVM 55, IPM 410-3, PMD-14, SVM 98, IPM 1704-14, PMS-12, TMB 230, IPM 604-16, MH1871, Virat (IPM 205-7), Pusa BM 9, VGG 18-002, MH 421, IPMD 604-1-7, MML 2575, SKNM 1801, SML 832, DGGV 91, VGG 16-047, MH 1762, SML 1932, OBGG 108, VGG 17-043, PM 1602, Pant M 5, SML 1933, Pusa M 19111, MH 1703, MML 2560, Pusa M 1971, PM 1601, PM 1520, TCADM 20-5, IPMD 1604, IPM 1603-1, TBMB 117-5, Pusa M 2131, IPM 1103-1, TBMB 17-2, Pusa BM 16, PM 1605, IPMD 101-2, MML 2568, Pusa M 2132, MHBC 20-7, PM 504-20-27, PM 1624, MH 1830, IPM 1610-1, RMG 1132, RMG 1166, OBGG 105, MH 1890, ANDGG 1301, MML 2576, PMD-8, Pusa M 2141, OBGG 106, PMD-7, MH 1801, PMD-9, SKNM 1911, VGG 17-036, BDYR-1, COGG-8, Pusa 1072, COGG 1102, EC 30400, EC 251552, EC 399223, EC 393410, EC 470090, EC 581523, IPM 512-1, Ganga-8, HUM 16, IC 15276, IC 1031096, IPM 99-3, IPM 9901-8, Pusa 1701, IPM 2k 14-9, IPM 3072, 2KM 101, 2KM 111, KM 2328, LGG 460, M 395, COGG 13-19, ML 194, ML 778, COGG 13-14, NYL 638, NDMZ-13-11, NDMZ-15-2, NDMZ 215-1, NBPGR 150, OUM 11-5, PBM-14, PDM 96-262, PLM 24, Pusa 105, Pusa 0871, T-44, RMG 991, SML 1455, SMH 95-1, SMH 99-1, Sona Mung-1, SVM 6111, TRCM 2014-2, VGG ru-2, WBM-031, VGG 16-036, TBM 37, VGG 18-021, IPM 1205-2, VMK 18-02, KM 2421, MHBC 20-14, RMG 1169, MH 18-181, Pusa M 41, MHBC 20-8, MML 2579, SKNM 2006, IPMD 1202-1, Pusa M 42, MGG 499, MH 18-189, VGG 17-106 |
| **Premature pod colour** | Green (1) | 87 | PM 1801, RMG-1148, IPM 1604-1, MH 1468, KM 2419, SVM 55, IPM 410-3, PMD-14, SVM 98, IPM 1704-14, PMS-12, TMB 230, IPM 604-16, MH1871, Pusa BM 9, VGG 18-002, MH 421, IPMD 604-1-7, SKNM 1801, SML 832, VGG 16-047, MH 1762, SML 1932, OBGG 108, VGG 17-043, PM 1602, Pant M 5, SML 1933, Pusa M 19111, MH 1703, Pusa M 1971, PM 1520, TCADM 20-5, IPMD 1604, IPM 1603-1, TBMB 117-5, Pusa BM 16, PM 1605, MHBC 20-7, IPM 1610-1, RMG 1132, OBGG 105, MH 1890, ANDGG 1301, Pusa M 2141, OBGG 106, SKNM 1911, VGG 17-036, BDYR-1, COGG-8, Pusa 1072, EC 30400, EC 251552, EC 581523, IPM 512-1, Ganga-8, HUM 16, IPM 99-3, IPM 9901-8, IPM 2k 14-9, 2KM 111, KM 2328, ML 194, ML 778, COGG 13-14, NDMZ 215-1, PLM 24, Pusa 105, RMG 991, SML 1455, SMH 95-1, SMH 99-1, Sona Mung-1, SVM 6111, TRCM 2014-2, VGG ru-2, WBM-031, VGG 16-036, VGG 18-021, KM 2421, MHBC 20-14, MH 18-181, SKNM 2006, IPMD 1202-1, Pusa M 42, MGG 499, MH 18-189, VGG 17-106 |
| | Green with pigmented suture (2) | 55 | JLPM 707-27, ML 818, IPM 02-3, Pusa M 22-32, BCM 20-6, MML 2577, Virat (IPM 205-7), MML 2575, DGGV 91, MML 2560, PM 1601, Pusa M 2131, IPM 1103-1, TBMB 17-2, IPMD 101-2, MML 2568, Pusa M 2132, PM 504-20-27, PM 1624, MH 1830, RMG 1166, MML 2576, PMD-8, PMD-7, MH 1801, PMD-9, COGG 1102, EC 399223, EC 393410, EC 470090, IC 15276, IC 1031096, Pusa 1701, IPM 3072, 2KM 101, LGG 460, M 395, COGG 13-19, NYL 638, NDMZ-13-11, NDMZ-15-2, NBPGR 150, OUM 11-5, PBM-14, PDM 96-262, Pusa 0871, T-44, SMH 95-1, TBM 37, IPM 1205-2, VMK 18-02, RMG 1169, Pusa M 41, MHBC 20-8, MML 2579 |
| **Pod position** | Above (1) | 141 | PM 1801, JLPM 707-27, ML 818, RMG-1148, IPM 02-3, IPM 1604-1, MH 1468, Pusa M 22-32, KM 2419, BCM 20-6, MML 2577, SVM 55, IPM 410-3, PMD-14, SVM 98, IPM 1704-14, PMS-12, TMB 230, IPM 604-16, MH1871, Virat (IPM 205-7), Pusa BM 9, VGG 18-002, MH 421, IPMD 604-1-7, MML 2575, SKNM 1801, SML 832, DGGV 91, VGG 16-047, MH 1762, SML 1932, OBGG 108, VGG 17-043, PM 1602, Pant M 5, SML 1933, Pusa M 19111, MH 1703, MML 2560, Pusa M 1971, PM 1601, PM 1520, TCADM 20-5, IPMD 1604, IPM 1603-1, TBMB 117-5, Pusa M 2131, IPM 1103-1, TBMB 17-2, Pusa BM 16, PM 1605, IPMD 101-2, MML 2568, Pusa M 2132, MHBC 20-7, PM 504-20-27, PM 1624, MH 1830, IPM 1610-1, RMG 1132, RMG 1166, OBGG 105, MH 1890, ANDGG 1301, MML 2576, PMD-8, Pusa M 2141, OBGG 106, PMD-7, MH 1801, PMD-9, SKNM 1911, VGG 17-036, BDYR-1, COGG-8, Pusa 1072, COGG 1102, EC 30400, EC 251552, EC 399223, EC 393410, EC 470090, EC 581523, IPM 512-1, HUM 16, IC 15276, IC 1031096, IPM 99-3, IPM 9901-8, Pusa 1701, IPM 2k 14-9, IPM 3072, 2KM 101, 2KM 111, KM 2328, LGG 460, M 395, COGG 13-19, ML 194, ML 778, COGG 13-14, NYL 638, NDMZ-13-11, NDMZ-15-2, NDMZ 215-1, NBPGR 150, OUM 11-5, PBM-14, PDM 96-262, PLM 24, Pusa 105, Pusa 0871, T-44, RMG 991, SML 1455, SMH 95-1, SMH 99-1, Sona Mung-1, SVM 6111, TRCM 2014-2, VGG ru-2, WBM-031, VGG 16-036, TBM 37, VGG 18-021, IPM 1205-2, VMK 18-02, KM 2421, MHBC 20-14, RMG 1169, MH 18-181, Pusa M 41, MHBC 20-8, MML 2579, SKNM 2006, IPMD 1202-1, Pusa M 42,MGG 499, MH 18-189, VGG 17-106 |
| | Intermediate (2) | 1 | Ganga-8 |
| | Not seen (3) | 0 | - |
| **Pod colour** | Brown (1) | 118 | PM 1801, JLPM 707-27, RMG-1148, IPM 02-3, IPM 1604-1, Pusa M 22-32, KM 2419, BCM 20-6, MML 2577, SVM 55, IPM 410-3, PMD-14, SVM 98, IPM 1704-14, PMS-12, TMB 230, IPM 604-16, MH1871, Pusa BM 9, VGG 18-002, IPMD 604-1-7, MML 2575, SKNM 1801, DGGV 91, VGG 16-047, MH 1762, SML 1932, OBGG |

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| | | | 108, VGG 17-043, PM 1602, SML 1933, Pusa M 19111, MML 2560, Pusa M 1971, PM 1601, PM 1520, TCADM 20-5, IPMD 1604, IPM 1603-1, TBMB 117-5, Pusa M 2131, IPM 1103-1, TBMB 17-2, Pusa BM 16, PM 1605, IPMD 101-2, MML 2568, Pusa M 2132, PM 1624, MH 1830, IPM 1610-1, RMG 1166, MH 1890, ANDGG 1301, MML 2576, PMD-8, Pusa M 2141, PMD-7, PMD-9, SKNM 1911, VGG 17-036, BDYR-1, COGG-8, Pusa 1072, EC 30400, EC 251552, EC 399223, EC 393410, EC 581523, IPM 512-1, Ganga-8, HUM 16, IC 15276, IC 1031096, IPM 99-3, IPM 9901-8, Pusa 1701, IPM 2k 14-9, IPM 3072, 2KM 101, 2KM 111, KM 2328, LGG 460, M 395, COGG 13-19, ML 194, ML 778, COGG 13-14, NYL 638, NDMZ-15-2, OUM 11-5, PBM-14, PDM 96-262, PLM 24, Pusa 105, Pusa 0871, T-44, RMG 991, SML 1455, SMH 99-1, Sona Mung-1, SVM 6111, TRCM 2014-2, VGG ru-2, WBM-031, VGG 16-036, IPM 1205-2, VMK 18-02, KM 2421, MHBC 20-14, RMG 1169, Pusa M 41, MHBC 20-8, SKNM 2006, IPMD 1202-1, MGG 499, MH 18-189, VGG 17-106 |
| | Black (2) | 24 | ML 818, MH 1468, Virat (IPM 205-7), MH 421, SML 832, Pant M 5, MH 1703, MHBC 20-7, PM 504-20-27, RMG 1132, OBGG 105, OBGG 106, MH 1801, COGG 1102, EC 470090, NDMZ-13-11, NDMZ 215-1, NBPGR 150, SMH 95-1, TBM 37, VGG 18-021, MH 18-181, MML 2579, Pusa M 42 |
| **Mature pod curvature** | Straight (1) | 42 | PM 1801, JLPM 707-27, MH 1468, KM 2419, BCM 20-6, MML 2577, PMD-14, SVM 98, IPM 1704-14, PMS-12, IPM 604-16, MH1871, Virat (IPM 205-7), MH 421, Pant M 5, Pusa M 19111, MH 1703, PM 1601, PM 1520, TBMB 17-2, MML 2568, OBGG 105, OBGG 106, MH 1801, SKNM 1911, COGG-8, HUM 16, KM 2328, M 395, COGG 13-14, OUM 11-5, SML 1455, SVM 6111, TBM 37, VGG 18-021, VMK 18-02, MHBC 20-14, MHBC 20-8, IPMD 1202-1, Pusa M 42, MGG 499, MH 18-189 |
| | Curved (3) | 100 | ML 818, RMG-1148, IPM 02-3, IPM 1604-1, Pusa M 22-32, SVM 55, IPM 410-3, TMB 230, Pusa BM 9, VGG 18-002, IPMD 604-1-7, MML 2575, SKNM 1801, SML 832, DGGV 91, VGG 16-047, MH 1762, SML 1932, OBGG 108, VGG 17-043, PM 1602, SML 1933, MML 2560, Pusa M 1971, TCADM 20-5, IPMD 1604, IPM 1603-1, TBMB 117-5, Pusa M 2131, IPM 1103-1, Pusa BM 16, PM 1605, IPMD 101-2, Pusa M 2132, MHBC 20-7, PM 504-20-27, PM 1624, MH 1830, IPM 1610-1, RMG 1132, RMG 1166, MH 1890, ANDGG 1301, MML 2576, PMD-8, Pusa M 2141, PMD-7, PMD-9, VGG 17-036, BDYR-1, Pusa 1072, COGG 1102, EC 30400, EC 251552, EC 399223, EC 393410, EC 470090, EC 581523, IPM 512-1, Ganga-8, IC 15276, IC 1031096, IPM 99-3, IPM 9901-8, Pusa 1701, IPM 2k 14-9, IPM 3072, 2KM 101, 2KM 111, LGG 460, COGG 13-19, ML 194, ML 778, NYL 638, NDMZ-13-11, NDMZ-15-2, NDMZ 215-1, NBPGR 150, PBM-14, PDM 96-262, PLM 24, Pusa 105, Pusa 0871, T-44, RMG 991, SMH 95-1, SMH 99-1, Sona Mung-1, TRCM 2014-2, VGG ru-2, WBM-031, VGG 16-036, IPM 1205-2, KM 2421, RMG 1169, MH 18-181, Pusa M 41, MML 2579, SKNM 2006, VGG 17-106 |
| **Seed colour** | Yellow (1) | 3 | IPMD 604-1-7, EC 251552, Sona Mung-1 |
| | Green (2) | 139 | PM 1801, JLPM 707-27, ML 818, RMG-1148, IPM 02-3, IPM 1604-1, MH 1468, Pusa M 22-32, KM 2419, BCM 20-6, MML 2577, SVM 55, IPM 410-3, PMD-14, SVM 98, IPM 1704-14, PMS-12, TMB 230, IPM 604-16, MH1871, Virat (IPM 205-7), Pusa BM 9, VGG 18-002, MH 421, MML 2575, SKNM 1801, SML 832, DGGV 91, VGG 16-047, MH 1762, SML 1932, OBGG 108, VGG 17-043, PM 1602, Pant M 5, SML 1933, Pusa M 19111, MH 1703, MML 2560, Pusa M 1971, PM 1601, PM 1520, TCADM 20-5, IPMD 1604, IPM 1603-1, TBMB 117-5, Pusa M 2131, IPM 1103-1, TBMB 17-2, Pusa BM 16, PM 1605, IPMD 101-2, MML 2568, Pusa M 2132, MHBC 20-7, PM 504-20-27, PM 1624, MH 1830, IPM 1610-1, RMG 1132, RMG 1166, OBGG 105, MH 1890, ANDGG 1301, MML 2576, PMD-8, Pusa M 2141, OBGG 106, PMD-7, MH 1801, PMD-9, SKNM 1911, VGG 17-036, BDYR-1, COGG-8, Pusa 1072, COGG 1102, EC 30400, EC 399223, EC 393410, EC 470090, EC 581523, IPM 512-1, Ganga-8, HUM 16, IC 15276, IC 1031096, IPM 99-3, IPM 9901-8, Pusa 1701, IPM 2k 14-9, IPM 3072, 2KM 101, 2KM 111, KM 2328, LGG 460, M 395, COGG 13-19, ML 194, ML 778, COGG 13-14, NYL 638, NDMZ-13-11, NDMZ-15-2, NDMZ 215-1, NBPGR 150, OUM 11-5, PBM-14, PDM 96-262, PLM 24, Pusa 105, Pusa 0871, T-44, RMG 991, SML 1455, SMH 95-1, SMH 99-1, SVM 6111, TRCM 2014-2, VGG ru-2, WBM-031, VGG 16-036, TBM 37, VGG 18-021, IPM 1205-2, VMK 18-02, KM 2421, MHBC 20-14, RMG 1169, MH 18-181, Pusa M 41, MHBC 20-8, MML 2579, SKNM 2006, IPMD 1202-1, Pusa M 42,MGG 499, MH 18-189, VGG 17-106 |
| | Mottled (3) | 0 | - |
| | Black (4) | 0 | - |
| **Seed lusture** | Shine (1) | 130 | PM 1801, ML 818, RMG-1148, IPM 02-3, IPM 1604-1, MH 1468, Pusa M 22-32, KM 2419, BCM 20-6, MML 2577, IPM 410-3, PMD-14, SVM 98, IPM 1704-14, PMS-12, IPM 604-16, MH1871, Virat (IPM 205-7), Pusa BM 9, VGG 18-002, MH 421, IPMD 604-1-7, MML 2575, SKNM 1801, SML 832, DGGV 91, VGG 16-047, MH 1762, SML 1932, OBGG 108, VGG 17-043, PM 1602, Pant M 5, SML 1933, Pusa M 19111, MH 1703, MML 2560, Pusa M 1971, PM 1601, IPMD 1604, IPM 1603-1, TBMB 117-5, Pusa M 2131, IPM 1103-1, TBMB 17-2, Pusa BM 16, PM 1605, IPMD 101-2, MML 2568, Pusa M 2132, MHBC 20-7, PM 504-20-27, PM 1624, MH 1830, IPM 1610-1, RMG 1132, RMG 1166, OBGG 105, MH 1890, ANDGG 1301, MML 2576, PMD-8, Pusa M 2141, OBGG 106, PMD-7, MH 1801, PMD-9, SKNM 1911, VGG 17-036, BDYR-1, Pusa 1072, COGG 1102, EC 30400, EC 251552, EC 399223, EC 393410, EC 470090, EC 581523, IPM 512-1, Ganga-8, HUM 16, IC 15276, IC 1031096, IPM 99-3, IPM 9901-8, Pusa 1701, IPM 2k 14-9, IPM 3072, 2KM 111, KM 2328, LGG 460, M 395, COGG 13-19, ML 194, ML 778, COGG 13-14, NYL 638, NDMZ-13-11, NDMZ-15-2, NDMZ 215-1, NBPGR 150, OUM 11-5, PBM-14, PDM 96-262, PLM 24, Pusa 105, Pusa 0871, T-44, RMG 991, SML 1455, SVM 6111, TRCM 2014-2, VGG ru-2, VGG 16-036, TBM 37, VGG 18-021, IPM 1205-2, VMK 18-02, KM 2421, MHBC 20-14, RMG 1169, MH 18-181, Pusa M 41, MHBC 20-8, MML 2579, SKNM 2006, IPMD 1202-1, Pusa M 42, MH 18-189, VGG 17-106 |
| | Dull (2) | 12 | JLPM 707-27, SVM 55, TMB 230, PM 1520, TCADM 20-5, COGG-8, 2KM 101, SMH 95-1, SMH 99-1, Sona Mung-1, WBM-031, MGG 499 |
| **Seed shape** | Oval (1) | 1 | TBM 37 |
| | Drum (3) | 141 | PM 1801, JLPM 707-27, ML 818, RMG-1148, IPM 02-3, IPM 1604-1, MH 1468, Pusa M 22-32, KM 2419, BCM 20-6, MML 2577, SVM 55, IPM 410-3, PMD-14, |

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| | | | SVM 98, IPM 1704-14, PMS-12, TMB 230, IPM 604-16, MH1871, Virat (IPM 205-7), Pusa BM 9, VGG 18-002, MH 421, IPMD 604-1-7, MML 2575, SKNM 1801, SML 832, DGGV 91, VGG 16-047, MH 1762, SML 1932, OBGG 108, VGG 17-043, PM 1602, Pant M 5, SML 1933, Pusa M 19111, MH 1703, MML 2560, Pusa M 1971, PM 1601, PM 1520, TCADM 20-5, IPMD 1604, IPM 1603-1, TBMB 117-5, Pusa M 2131, IPM 1103-1, TBMB 17-2, Pusa BM 16, PM 1605, IPMD 101-2, MML 2568, Pusa M 2132, MHBC 20-7, PM 504-20-27, PM 1624, MH 1830, IPM 1610-1, RMG 1132, RMG 1166, OBGG 105, MH 1890, ANDGG 1301, MML 2576, PMD-8, Pusa M 2141, OBGG 106, PMD-7, MH 1801, PMD-9, SKNM 1911, VGG 17-036, BDYR-1, COGG-8, Pusa 1072, COGG 1102, EC 30400, EC 251552, EC 399223, EC 393410, EC 470090, EC 581523, IPM 512-1, Ganga-8, HUM 16, IC 15276, IC 1031096, IPM 99-3, IPM 9901-8, Pusa 1701, IPM 2k 14-9, IPM 3072, 2KM 101, 2KM 111, KM 2328, LGG 460, M 395, COGG 13-19, ML 194, ML 778, COGG 13-14, NYL 638, NDMZ-13-11, NDMZ-15-2, NDMZ 215-1, NBPGR 150, OUM 11-5, PBM-14, PDM 96-262, PLM 24, Pusa 105, Pusa 0871, T-44, RMG 991, SML 1455, SMH 95-1, SMH 99-1, Sona Mung-1, SVM 6111, TRCM 2014-2, VGG ru-2, WBM-031, VGG 16-036, VGG 18-021, IPM 1205-2, VMK 18-02, KM 2421, MHBC 20-14, RMG 1169, MH 18-181, Pusa M 41, MHBC 20-8, MML 2579, SKNM 2006, IPMD 1202-1, Pusa M 42,MGG 499, MH 18-189, VGG 17-106 |
| **Seed size** | Small (3) | 9 | RMG-1148, IPM 02-3, IPM 410-3, EC 399223, Sona Mung-1, WBM-031, IPM 1205-2, MHBC 20-14, MH 18-181 |
| | Medium (5) | 107 | PM 1801, JLPM 707-27, ML 818, IPM 1604-1, MH 1468, Pusa M 22-32, KM 2419, BCM 20-6, MML 2577, SVM 55, PMD-14, SVM 98, IPM 1704-14, PMS-12, TMB 230, IPM 604-16, MH1871, Virat (IPM 205-7), Pusa BM 9, MH 421, IPMD 604-1-7, SML 832, DGGV 91, VGG 16-047, MH 1762, SML 1932, OBGG 108, VGG 17-043, PM 1602, MH 1703, Pusa M 1971, PM 1601, PM 1520, TCADM 20-5, IPMD 1604, IPM 1603-1, IPM 1103-1, TBMB 17-2, Pusa BM 16, PM 1605, IPMD 101-2, MHBC 20-7, PM 504-20-27, PM 1624, MH 1830, IPM 1610-1, RMG 1132, RMG 1166, MH 1890, ANDGG 1301, PMD-8, OBGG 106, PMD-7, MH 1801, VGG 17-036, BDYR-1, COGG-8, Pusa 1072, COGG 1102, EC 30400, EC 393410, EC 470090, IPM 512-1, HUM 16, IC 1031096, IPM 99-3, IPM 9901-8, Pusa 1701, IPM 2k 14-9, IPM 3072, 2KM 101, 2KM 111, LGG 460, COGG 13-19, ML 194, ML 778, COGG 13-14, NYL 638, NDMZ-13-11, NDMZ-15-2, NDMZ 215-1, NBPGR 150, OUM 11-5, PBM-14, PLM 24, Pusa 0871, T-44, RMG 991, SMH 95-1, SMH 99-1, SVM 6111, TRCM 2014-2, VGG ru-2, TBM 37, VGG 18-021, VMK 18-02, KM 2421, RMG 1169, Pusa M 41, MHBC 20-8, MML 2579, SKNM 2006, IPMD 1202-1, Pusa M 42, MGG 499, MH 18-189, VGG 17-106 |
| | Large (7) | 26 | VGG 18-002, MML 2575, SKNM 1801, Pant M 5, SML 1933, Pusa M 19111, MML 2560, TBMB 117-5, Pusa M 2131, MML 2568, Pusa M 2132, OBGG 105, MML 2576, Pusa M 2141, PMD-9, SKNM 1911, EC 251552, EC 581523, Ganga-8, IC 15276, KM 2328, M 395, PDM 96-262, Pusa 105, SML 1455, VGG 16-036 |
| **Days to 50% flowering** | Early | 61 | IPM 02-3, IPM 1604-1, MH 1468, KM 2419, SVM 55, SVM 98, IPM 604-16, MH1871, Virat (IPM 205-7), Pusa BM 9, VGG 18-002, MH 421, IPMD 604-1-7, MML 2575, SKNM 1801, SML 832, DGGV 91, VGG 16-047, MH 1762, SML 1932, OBGG 108, Pant M 5, SML 1933, Pusa M 19111, MH 1703, TCADM 20-5, IPM 1603-1, IPM 1103-1, MHBC 20-7, MH 1830, RMG 1166, OBGG 105, MML 2576, PMD-8, OBGG 106, MH 1801, PMD-9, COGG-8, COGG 1102, IPM 512-1, HUM 16, IPM 9901-8, LGG 460, COGG 13-19, COGG 13-14, NDMZ-15-2, NBPGR 150, OUM 11-5, RMG 991, SML 1455, SVM 6111, IPM 1205-2, VMK 18-02, MHBC 20-14, RMG 1169, MH 18-181, Pusa M 41, MHBC 20-8, SKNM 2006, Pusa M 42, MH 18-189 |
| | Medium | 81 | PM 1801, JLPM 707-27, ML 818, RMG-1148, Pusa M 22-32, BCM 20-6, MML 2577, IPM 410-3, PMD-14, IPM 1704-14, PMS-12, TMB 230, VGG 17-043, PM 1602, MML 2560, Pusa M 1971, PM 1601, PM 1520, IPMD 1604, TBMB 117-5, Pusa M 2131, TBMB 17-2, Pusa BM 16, PM 1605, IPMD 101-2, MML 2568, Pusa M 2132, PM 504-20-27, PM 1624, IPM 1610-1, RMG 1132, MH 1890, ANDGG 1301, Pusa M 2141, PMD-7, SKNM 1911, VGG 17-036, BDYR-1, Pusa 1072, EC 30400, EC 251552, EC 399223, EC 393410, EC 470090, EC 581523, Ganga-8, IC 15276, IC 1031096, IPM 99-3, Pusa 1701, IPM 2k 14-9, IPM 3072, 2KM 101, 2KM 111, KM 2328, M 395, ML 194, ML 778, NYL 638, NDMZ-13-11, NDMZ 215-1, PBM-14, PDM 96-262, PLM 24, Pusa 105, Pusa 0871, T-44, SMH 95-1, SMH 99-1, Sona Mung-1, TRCM 2014-2, VGG ru-2, WBM-031, VGG 16-036, TBM 37, VGG 18-021, KM 2421, MML 2579, IPMD 1202-1, MGG 499, VGG 17-106 |
| **Days to maturity** | Early | 26 | MH 1468, IPM 604-16, MH1871, Virat (IPM 205-7), VGG 18-002, MH 421, IPMD 604-1-7, DGGV 91, MH 1762, OBGG 108, IPM 1610-1, MML 2576, OBGG 106, MH 1801, IC 15276, Pusa 1701, OUM 11-5, SVM 6111, VMK 18-02, MHBC 20-14, RMG 1169, MH 18-181, MHBC 20-8, SKNM 2006, IPMD 1202-1, MH 18-189 |
| | Medium | 91 | ML 818, RMG-1148, IPM 02-3, IPM 1604-1, Pusa M 22-32, KM 2419, BCM 20-6, MML 2577, SVM 55, IPM 410-3, PMD-14, SVM 98, IPM 1704-14, PMS-12, TMB 230, Pusa BM 9, MML 2575, SKNM 1801, SML 832, VGG 16-047, SML 1932, VGG 17-043, Pant M 5, SML 1933, Pusa M 19111, TCADM 20-5, IPM 1603-1, TBMB 117-5, IPM 1103-1, MML 2568, MHBC 20-7, PM 504-20-27, MH 1830, RMG 1132, RMG 1166, OBGG 105, MH 1890, PMD-8, Pusa M 2141, PMD-7, PMD-9, SKNM 1911, VGG 17-036, BDYR-1, COGG 1102, EC 30400, EC 251552, EC 399223, EC 393410, EC 470090, EC 581523, IPM 512-1, Ganga-8, HUM 16, IC 1031096, IPM 99-3, IPM 9901-8, IPM 3072, 2KM 101, 2KM 111, KM 2328, LGG 460, M 395, COGG 13-19, COGG 13-14, NYL 638, NDMZ-13-11, NDMZ-15-2, NDMZ 215-1, NBPGR 150, PBM-14, PDM 96-262, PLM 24, Pusa 105, Pusa 0871, T-44, RMG 991, SML 1455, SMH 99-1, Sona Mung-1, TRCM 2014-2, WBM-031, TBM 37, VGG 18-021, IPM 1205-2, KM 2421, Pusa M 41, MML 2579, Pusa M 42, MGG 499, VGG 17-106 |
| | Late | 25 | PM 1801, JLPM 707-27, PM 1602, MH 1703, MML 2560, Pusa M 1971, PM 1601, PM 1520, IPMD 1604, Pusa M 2131, TBMB 17-2, Pusa BM 16, PM 1605, IPMD 101-2, Pusa M 2132, PM 1624, ANDGG 1301, COGG-8, Pusa 1072, IPM 2k 14-9, ML 194, ML 778, SMH 95-1, VGG ru-2, VGG 16-036 |
| **Plant height** | Short | 80 | RMG-1148, IPM 02-3, Pusa M 22-32, BCM 20-6, MML 2577, SVM 55, IPM 410-3, PMD-14, SVM 98, IPM 1704-14, PMS-12, MH 421, Pusa M 19111, TCADM 20-5, IPMD 1604, IPM 1603-1, TBMB 117-5, Pusa M 2131, IPM 1103-1, TBMB 17-2, MML 2568, Pusa M 2132, MHBC 20-7, PM 504-20-27, MH 1830, IPM 1610-1, RMG 1166, OBGG 105, MH 1890, ANDGG 1301, MML 2576, PMD-8, OBGG 106, PMD-7, PMD-9, SKNM 1911, BDYR-1, Pusa 1072, COGG 1102, EC 251552, EC 399223, EC 470090, IPM 512-1, IC 15276, IC 1031096, IPM 99-3, IPM 9901-8, Pusa 1701, IPM 2k 14-9, IPM 3072, 2KM 101, COGG 13-19, ML 194, COGG 13-14, NYL 638, NDMZ-13-11, NDMZ-15-2, NDMZ 215-1, NBPGR 150, OUM 11-5, PDM 96-262, PLM 24, Pusa 0871, T-44, RMG 991, SML 1455, SMH 95-1, SMH 99-1, |

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| | | | Sona Mung-1, SVM 6111, TRCM 2014-2, VGG ru-2, WBM-031, KM 2421, MHBC 20-14, MH 18-181, MHBC 20-8, SKNM 2006, IPMD 1202-1, Pusa M 42 |
| | Medium | 58 | PM 1801, JLPM 707-27, ML 818, IPM 1604-1, MH 1468, KM 2419, TMB 230, IPM 604-16, MH1871, Virat (IPM 205-7), VGG 18-002, IPMD 604-1-7, MML 2575, SKNM 1801, SML 832, DGGV 91, VGG 16-047, MH 1762, SML 1932, OBGG 108, VGG 17-043, Pant M 5, SML 1933, MH 1703, MML 2560, Pusa M 1971, PM 1520, Pusa BM 16, IPMD 101-2, PM 1624, RMG 1132, Pusa M 2141, MH 1801, VGG 17-036, COGG-8, EC 30400, EC 393410, EC 581523, Ganga-8, HUM 16, 2KM 111, KM 2328, LGG 460, M 395, ML 778, PBM-14, Pusa 105, VGG 16-036, TBM 37, VGG 18-021, IPM 1205-2, VMK 18-02, RMG 1169, Pusa M 41, MML 2579, MGG 499, MH 18-189, VGG 17-106 |
| | Long | 4 | Pusa BM 9, PM 1602, PM 1601, PM 1605 |
| **Number of branches per plant** | Low | 8 | ANDGG 1301, OBGG 106, SKNM 1911, PLM 24, VGG 18-021, VMK 18-02, IPMD 1202-1, VGG 17-106 |
| | Medium | 103 | PM 1801, ML 818, RMG-1148, Pusa M 22-32, KM 2419, MML 2577, IPM 410-3, SVM 98, IPM 1704-14, PMS-12, TMB 230, IPM 604-16, MH1871, Virat (IPM 205-7), Pusa BM 9, VGG 18-002, MH 421, IPMD 604-1-7, MML 2575, SKNM 1801, DGGV 91, VGG 16-047, MH 1762, SML 1932, OBGG 108, VGG 17-043, Pant M 5, SML 1933, Pusa M 19111, MH 1703, MML 2560, PM 1601, TCADM 20-5, IPMD 1604, IPM 1603-1, TBMB 117-5, Pusa M 2131, IPM 1103-1, TBMB 17-2, Pusa BM 16, PM 1605, IPMD 101-2, MML 2568, Pusa M 2132, MHBC 20-7, PM 504-20-27, PM 1624, MH 1830, IPM 1610-1, RMG 1132, RMG 1166, OBGG 105, MH 1890, MML 2576, PMD-8, Pusa M 2141, PMD-7, MH 1801, PMD-9, VGG 17-036, Pusa 1072, COGG 1102, EC 399223, EC 470090, IPM 512-1, IC 1031096, IPM 9901-8, IPM 2k 14-9, IPM 3072, 2KM 101, 2KM 111, COGG 13-19, ML 194, COGG 13-14, NYL 638, NDMZ-15-2, NDMZ 215-1, NBPGR 150, OUM 11-5, PDM 96-262, Pusa 105, Pusa 0871, T-44, RMG 991, SML 1455, SMH 95-1, SMH 99-1, SVM 6111, TRCM 2014-2, WBM-031, TBM 37, IPM 1205-2, KM 2421, MHBC 20-14, RMG 1169, MH 18-181, Pusa M 41, MHBC 20-8, MML 2579, SKNM 2006, Pusa M 42, MGG 499, MH 18-189 |
| | High | 31 | JLPM 707-27, IPM 02-3, IPM 1604-1, MH 1468, BCM 20-6, SVM 55, PMD-14, SML 832, PM 1602, Pusa M 1971, PM 1520, BDYR-1, COGG-8, EC 30400, EC 251552, EC 393410, EC 581523, Ganga-8, HUM 16, IC 15276, IPM 99-3, Pusa 1701, KM 2328, LGG 460, M 395, ML 778, NDMZ-13-11, PBM-14, Sona Mung-1, VGG ru-2, VGG 16-036 |
| **Number of pods per plant** | Low | 6 | TBMB 17-2, PM 1624, ANDGG 1301, IC 1031096, M 395, MGG 499 |
| | Medium | 34 | PMS-12, TMB 230, PM 1602, Pant M 5, Pusa M 19111, IPM 1103-1, PM 1605, MHBC 20-7, PMD-8, PMD-7, COGG-8, EC 30400, EC 399223, Ganga-8, IC 15276, Pusa 1701, IPM 2k 14-9, 2KM 111, KM 2328, LGG 460, ML 194, NDMZ-15-2, NDMZ 215-1, NBPGR 150, PBM-14, PDM 96-262, T-44, RMG 991, SVM 6111, WBM-031, TBM 37, VGG 18-021, IPMD 1202-1, VGG 17-106 |
| | High | 102 | PM 1801, JLPM 707-27, ML 818, RMG-1148, IPM 02-3, IPM 1604-1, MH 1468, Pusa M 22-32, KM 2419, BCM 20-6, MML 2577, SVM 55, IPM 410-3, PMD-14, SVM 98, IPM 1704-14, IPM 604-16, MH1871, Virat (IPM 205-7), Pusa BM 9, VGG 18-002, MH 421, IPMD 604-1-7, MML 2575, SKNM 1801, SML 832, DGGV 91, VGG 16-047, MH 1762, SML 1932, OBGG 108, VGG 17-043, SML 1933, MH 1703, MML 2560, Pusa M 1971, PM 1601, PM 1520, TCADM 20-5, IPMD 1604, IPM 1603-1, TBMB 117-5, Pusa M 2131, Pusa BM 16, IPMD 101-2, MML 2568, Pusa M 2132, PM 504-20-27, MH 1830, IPM 1610-1, RMG 1132, RMG 1166, OBGG 105, MH 1890, MML 2576, Pusa M 2141, OBGG 106, MH 1801, PMD-9, SKNM 1911, VGG 17-036, BDYR-1, Pusa 1072, COGG 1102, EC 251552, EC 393410, EC 470090, EC 581523, IPM 512-1, HUM 16, IPM 99-3, IPM 9901-8, IPM 3072, 2KM 101, COGG 13-19, ML 778, COGG 13-14, NYL 638, NDMZ-13-11, OUM 11-5, PLM 24, Pusa 105, Pusa 0871, SML 1455, SMH 95-1, SMH 99-1, Sona Mung-1, TRCM 2014-2, VGG ru-2, VGG 16-036, IPM 1205-2, VMK 18-02, KM 2421, MHBC 20-14, RMG 1169, MH 18-181, Pusa M 41, MHBC 20-8, MML 2579, SKNM 2006, Pusa M 42, MH 18-189 |
| **Number of seeds per pod** | Low | 40 | PM 1801, JLPM 707-27, ML 818, RMG-1148, IPM 02-3, Pusa M 22-32, KM 2419, BCM 20-6, MML 2577, SVM 55, SVM 98, PMS-12, TMB 230, Virat (IPM 205-7), Pusa BM 9, OBGG 108, SML 1933, Pusa M 19111, MH 1703, PM 1601, PM 1520, IPM 1603-1, TBMB 117-5, PM 1605, IPMD 101-2, MHBC 20-7, RMG 1166, MML 2576, PMD-8, COGG 1102, IC 15276, Pusa 1701, IPM 2k 14-9, 2KM 111, COGG 13-19, Pusa 0871, Sona Mung-1, VMK 18-02, RMG 1169, IPMD 1202-1 |
| | Medium | 83 | IPM 1604-1, MH 1468, IPM 410-3, PMD-14, IPM 1704-14, IPM 604-16, MH1871, VGG 18-002, MH 421, IPMD 604-1-7, MML 2575, SKNM 1801, SML 832, DGGV 91, VGG 16-047, MH 1762, VGG 17-043, Pant M 5, Pusa M 1971, IPMD 1604, Pusa M 2131, IPM 1103-1, TBMB 17-2, Pusa BM 16, MML 2568, Pusa M 2132, PM 504-20-27, IPM 1610-1, RMG 1132, OBGG 105, MH 1890, ANDGG 1301, Pusa M 2141, OBGG 106, PMD-7, MH 1801, PMD-9, SKNM 1911, VGG 17-036, BDYR-1, COGG-8, Pusa 1072, EC 30400, EC 251552, EC 399223, EC 393410, EC 470090, EC 581523, IPM 512-1, HUM 16, IC 1031096, IPM 9901-8, IPM 3072, 2KM 101, KM 2328, ML 194, NYL 638, NDMZ-13-11, NDMZ-15-2, NDMZ 215-1, NBPGR 150, OUM 11-5, PDM 96-262, PLM 24, RMG 991, SMH 95-1, SMH 99-1, SVM 6111, TRCM 2014-2, VGG ru-2, WBM-031, VGG 16-036, TBM 37, IPM 1205-2, MHBC 20-14, Pusa M 41, MHBC 20-8, MML 2579, SKNM 2006, Pusa M 42, MGG 499, MH 18-189, VGG 17-106 |
| | High | 19 | SML 1932, PM 1602, MML 2560, TCADM 20-5, PM 1624, MH 1830, Ganga-8, IPM 99-3, LGG 460, M 395, ML 778, COGG 13-14, PBM-14, Pusa 105, T-44, SML 1455, VGG 18-021, KM 2421, MH 18-181 |
| **Pod length** | Short | 129 | PM 1801, JLPM 707-27, ML 818, RMG-1148, IPM 02-3, IPM 1604-1, MH 1468, Pusa M 22-32, KM 2419, BCM 20-6, MML 2577, SVM 55, IPM 410-3, PMD-14, SVM 98, IPM 1704-14, PMS-12, TMB 230, IPM 604-16, MH1871, Virat (IPM 205-7), Pusa BM 9, VGG 18-002, MH 421, IPMD 604-1-7, MML 2575, SKNM 1801, SML 832, DGGV 91, VGG 16-047, MH 1762, SML 1932, OBGG 108, VGG 17-043, PM 1602, Pant M 5, SML 1933, Pusa M 19111, MH 1703, Pusa M 1971, PM 1601, PM 1520, TCADM 20-5, IPMD 1604, IPM 1603-1, TBMB 117-5, Pusa M 2131, IPM 1103-1, TBMB 17-2, Pusa BM 16, PM 1605, IPMD 101-2, MML 2568, Pusa M 2132, MHBC 20-7, PM 504-20-27, MH 1830, RMG 1132, RMG 1166, OBGG 105, MH 1890, ANDGG 1301, MML 2576, PMD-8, OBGG 106, SKNM 1911, BDYR-1, |

| | | | |
|---|---|---|---|
| | | | COGG-8, Pusa 1072, COGG 1102, EC 30400, EC 251552, EC 399223, EC 393410, EC 470090, IPM 512-1, Ganga-8, IC 15276, IC 1031096, IPM 9901-8, Pusa 1701, IPM 2k 14-9, IPM 3072, 2KM 101, 2KM 111, KM 2328, LGG 460, M 395, COGG 13-19, ML 194, COGG 13-14, NYL 638, NDMZ-13-11, NDMZ-15-2, NDMZ 215-1, NBPGR 150, OUM 11-5, PBM-14, PDM 96-262, PLM 24, Pusa 105, Pusa 0871, T-44, RMG 991, SML 1455, SMH 95-1, SMH 99-1, Sona Mung-1, TRCM 2014-2, VGG ru-2, WBM-031, VGG 16-036, TBM 37, VGG 18-021, IPM 1205-2, VMK 18-02, KM 2421, MHBC 20-14, RMG 1169, MH 18-181, Pusa M 41, MHBC 20-8, MML 2579, SKNM 2006, IPMD 1202-1, Pusa M 42, MGG 499, MH 18-189, VGG 17-106 |
| | Medium | 13 | MML 2560, PM 1624, IPM 1610-1, Pusa M 2141, PMD-7, MH 1801, PMD-9, VGG 17-036, EC 581523, HUM 16, IPM 99-3, ML 778, SVM 6111 |
| **Seed yield per plant** | Low | 37 | VGG 16-047, TBMB 17-2, PM 1605, PM 1624, PMD-7, Pusa 1072, EC 399223, EC 470090, IPM 512-1, IC 1031096, IPM 99-3, Pusa 1701, IPM 2k 14-9, IPM 3072, 2KM 101, 2KM 111, LGG 460, COGG 13-19, ML 194, COGG 13-14, NYL 638, NDMZ-13-11, NDMZ 215-1, PBM-14, PLM 24, Pusa 0871, T-44, SMH 95-1, SMH 99-1, Sona Mung-1, TRCM 2014-2, VGG ru-2, WBM-031, VGG 16-036, TBM 37, MGG 499, VGG 17-106 |
| | Medium | 22 | PMS-12, TMB 230, VGG 17-043, PM 1602, TCADM 20-5, TBMB 117-5, PM 504-20-27, ANDGG 1301, PMD-8, BDYR-1, COGG-8, EC 251552, Ganga-8, HUM 16, IC 15276, KM 2328, M 395, ML 778, OUM 11-5, PDM 96-262, RMG 991, SML 1455 |
| | High | 83 | PM 1801, JLPM 707-27, ML 818, RMG-1148, IPM 02-3, IPM 1604-1, MH 1468, IPM 410-3, Pusa M 22-32, KM 2419, BCM 20-6, MML 2577, SVM 55, PMD-14, SVM 98, IPM 1704-14, IPM 604-16, MH1871, Virat (IPM 205-7), Pusa BM 9, VGG 18-002, MH 421, IPMD 604-1-7, MML 2575, SKNM 1801, SML 832, DGGV 91, MH 1762, SML 1932, OBGG 108, Pant M 5, SML 1933, Pusa M 19111, MH 1703, MML 2560, Pusa M 1971, PM 1601, PM 1520, IPMD 1604, IPM 1603-1, Pusa M 2131, IPM 1103-1, Pusa BM 16, IPMD 101-2, MML 2568, Pusa M 2132, MHBC 20-7, MH 1830, IPM 1610-1, RMG 1132, RMG 1166, OBGG 105, MH 1890, MML 2576, Pusa M 2141, OBGG 106, MH 1801, PMD-9, SKNM 1911, VGG 17-036, COGG 1102, EC 30400, EC 393410, EC 581523, IPM 9901-8, NDMZ-15-2, NBPGR 150, Pusa 105, SVM 6111, VGG 18-021, IPM 1205-2, VMK 18-02, KM 2421, MHBC 20-14, RMG 1169, MH 18-181, Pusa M 41, MHBC 20-8, MML 2579, SKNM 2006, IPMD 1202-1, Pusa M 42, MH 18-189 |

However, all the genotypes showed presence of stem pubescence indicating absence of variation which makes stem pubescence a less significant descriptor to use in identification and purity maintenance.

**Leaf characters.** All the leaf morphological characters, namely, leaf colour, shape, size, leaflet lobes and vein colour were analysed during 50 per cent flowering stage of mungbean. Leaf is the main site for photosynthesis and transpiration in plants; therefore, leaf characters are crucial for the analysis of the yielding ability of the crop plants. All the leaf characters studied showed presence of significant amount of variability among the genotypes. Based on leaf colour, all the genotypes were classified into two classes, *viz.*, green colour in one hundred twelve genotypes and dark green in remaining thirty genotypes. A significant trimorphic variation was recorded for leaf shape with one hundred thirty-eight genotypes having ovate shape of leaves, one genotype with lanceolate shape and three genotypes with cuneate leaf shape. In case of leaf size, twelve genotypes were found with small leaves, one hundred seventeen genotypes with medium sized leaves and thirteen genotypes with large leaves. The presence and absence of leaflet lobes was studied and only three genotypes were found with the presence of lobes in their leaves, whereas, it was absent in remaining one hundred thirty-nine genotypes. Another leaf character analysed under this study was leaf vein colour which showed dimorphic variation with presence of green colour veins in eighteen genotypes and purple colour veins in one hundred twenty-four genotypes. All the leaf characters (foliage colour, leaf shape, leaf size and leaflet lobes) showed great variation and are useful in the characterization but due to their polygenic control, the effect of environmental factors is very high on these characters.

**Flower characters.** Flower colour and days to 50 per cent flowering were analysed in flower characters. Flower colour is used as a reliable morphological marker for distinguishing the mungbean genotypes. In this study, one hundred and twenty-one genotypes were reported with light yellow flower colour and twenty-one with yellow flower colour. Based on days to 50 per cent flowering, all the genotypes were classified into two distinct classes, *i.e*., early (less than 40 days) with sixty-one genotypes and medium (40 to 50 days) with eighty-one genotypes. The range of days to 50 per cent flowering varied from 33.50 (MH 421) to 47.50 (VGG 16-036). No late maturing genotype was observed in all the genotypes studied, therefore, all these genotypes have great potential to be used as early maturing genotypes in mungbean breeding to overcome the adverse effects of terminal heat stress and untimely rains at the time of harvest.

**Pod characters.** In Mungbean, for identification of genotypes, pod characteristics are considered as important yield attributing characters. Premature pod colour, pod pubescence and pod position were studied when green pods were fully developed whereas days to maturity, pod colour, curvature of mature pod, pod length and number of pods per plant were observed during harvest maturity stage of mungbean. All pod characters had significant variation except pod pubescence. Premature pod colour was found green in eighty-seven genotypes and green with pigmented suture in fifty-five genotypes. Pod pubescence was present in all genotypes. Above canopy type pod position was observed in one hundred forty one genotypes and only one genotype had intermediate pod position. Similar findings were reported by Kaur *et al*. (2017) and Elahi *et al*. (2022) for pod position.

Based on days to maturity, three different groups of genotypes were observed, namely, early (less than 60 days), medium (61-69 days) and late (more than 69 days). Twenty-six genotypes were found early maturing, ninety-one genotypes were taking in between 61 to 69 days for maturing and twenty-five genotypes were late maturing. Another useful morphological marker in mungbean is pod colour of mature pods which can be used for monitoring mixture of other varieties at maturity stage during quality seed production. For pod colour, significant variation was found in present material constituting one hundred eighteen genotypes with brown mature pods and twenty-four genotypes with black mature pods. Curvature of mature pod was straight in forty-two genotypes and curved in one hundred genotypes. Pod length showed dimorphic variation and all the genotypes were classified into two groups, namely, short (less than 8cm) and medium (8 to 10cm). One hundred twenty-nine genotypes were observed to have short pod length and thirteen genotypes showed medium pod length. PMD-7 had the longest pod with 9.15 cm length and ML 818 had the shortest pod with 4.88 cm length. Number of pods per plant was reported with trimorphic variation with six genotypes having low (less than 16) number of pods per plant, thirty-four genotypes having medium (16-20) number of pods per plant and one hundred two genotypes with high (more than 20) number of pods per plant. Highest number of pods per plant was recorded in COGG 13-14 (29.50) whereas lowest number of pods per plant was found in ANDGG 1301 (13.10). Therefore, these pod characters can be exploited for identification and characterization of mungbean genotypes. However, due to the polygenic control and presence of environmental influence, their expression is variable. Chakraborty *et al*. (2022) had similar findings for pod characters.

**Seed characters.** Various seed characteristics of mungbean like, seed colour, seed size, seed lusture and seed shape, are the deciding factors for consumer acceptance and in negotiating price of premium genotypes (Pratap *et al*., 2018). Generally, medium sized oval seeds with shining green colour are preferred. In present study, all the seed related characters, namely, seed colour, seed shape, seed size, seed lusture, number of seeds per pod and seed yield per plant were recorded after harvest. Seed colour was classified into two classes, *viz.*, yellow and green with three and one hundred thirty-nine genotypes, respectively. Seed colour is a useful determinant for phytic acid levels in the seed and as per reports, yellow

seeds have low phytic acid content which is favourable for human consumption, therefore, genotypes with yellow colour can be used as a donor for quality improvement of mungbean seeds. In case of seed shape, most of the genotypes were having drum shaped seeds and only one genotype was found with oval seed shape. Nine genotypes had small seed size whereas one hundred seven genotypes were classified with medium sized seeds and twenty-six genotypes with large seeds. Seed lusture was absent in twelve genotypes having dull seeds and rest of the one hundred thirty genotypes had shiny seeds. Number of seeds per pod showed three different classes, *viz.*, low (less than 8), medium (8-10) and high (more than 10). Forty genotypes were reported with low number of seeds per pod, eighty-three genotypes had medium number of seeds per pod and nineteen genotypes had high number of seeds per pod. Seed yield per plant is the most important attribute of mungbean and genotypes with high seed yield are preferred for future breeding programmes. Trimorphic variation was seen in seed yield per plant with thirty-seven low yielding (less than 8g), twenty-two medium yielding (8-10g) genotypes and eighty-three high yielding (more than 10g) genotypes. Thus, all the seed characters showed presence of variation among all the genotypes studied and some of these genotypes can be further used in future breeding programmes of mungbean for producing more consumer-oriented genotypes with favourable seed traits at premium prices in the market. Yadav *et al*. (2020) and Chakraborty *et al*. (2022) also studied the importance of seed characters in the characterization of genotypes in mungbean.

## CONCLUSION

In present study, a significant amount of variation was reported in all the genotypes studied using diverse DUS descriptors. Trimorphic grouping was seen in nine characters and three characters showed lack of variation in them. Rest of seventeen characters had dimorphic grouping of all the genotypes. Overall, present DUS characterization of mungbean genotypes can be further used in future breeding programmes as reference to identify and classify various genotypes into different categories for specific trait. The present study also facilitates the easy registration of new genotypes with these distinct characters under PPVFRA and highlighted the importance of introduction of new germplasm for the broadening of genetic base at Research station.

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