



## Identification of Indian mustard (*Brassica juncea* L.) varieties by DUS testing using morphological characters

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### Abstract

Indian mustard [*Brassica juncea* (L.) Czern & Coss.] varieties were identified through distinctiveness, uniformity and stability (DUS) testing protocol on the basis of experiment conducted during 2013-14 and 2014-15 consecutive years. The experimental procedure was carried as per official guideline of Indian mustard (PPV & FRA, 2009). The selected mustard varieties were identified based on six morphological characters that had capability to separate varieties into groups. Further they were classified based on three qualitative characters viz., leaf hairiness, time of 50% flowering and maturity period, three quantitative characters viz., number of siliqua on main shoot, seeds per siliqua, and weight of 1000 seeds. The varieties PCR-7, Pusa Jaikisan, RH-781 and CS-52 were identified separately on the basis of hairiness, number of siliqua on main shoot and number of seeds per siliqua respectively. All the remaining varieties were classified into groups based on time of 50% flowering, maturity period and weight of 1000 seeds. Thus the present study concludes that morphological characters of DUS protocol prove to be very useful and convenient for varietal identification which in turn helps in maintenance of genetic purity of varieties.

**Key words:** Indian mustard, DUS test, morphological characters, classification and identification

### Introduction

Indian mustard (*Brassica juncea* L.) is an important oilseed crop grown across the world for its rich source of oil and protein meal. In India, it is cultivated in the states of Assam, Bihar, Gujarat, Haryana, Himachal Pradesh, Jammu & Kashmir, Madhya Pradesh, Odisha, Punjab, Rajasthan, Uttar Pradesh and West Bengal as a Rabi crop. At present large number of mustard cultivars are available for commercial cultivation. A set of descriptors/characters are generally being used for characterization, differentiation and protection of plant varieties. Begum and Kumar (2011) described descriptor as a characteristic that refers to the form, structure or behavior of an accession in a germplasm collection. Descriptors should be based on the relative characteristics of the plant (e.g. plant height, leaf shape, time of flowering), by which it can be defined as a variety in terms of Article 1(vi) of the 1991 act of the convention (UPOV 1991).

These descriptors should satisfy three technical requisites of Distinctness, Uniformity and Stability (DUS). Distinctness means the variety should be clearly distinct from existing varieties. Uniformity indicates the similarity of characteristics features among the plants of selected variety. Stability means that the variety should produce stable results year after year. Yadav *et al.* (2013) grouped 78 genotypes of mustard using DUS test traits. DUS testing of cultivars is required for granting Plant Breeders' Rights (PBR) and it is conducted according to the DUS guidelines. In DUS testing protocol morphological features of plant plays greater role as these are recognized as one of the most promising features which can differentiate the plant varieties. The promising way of determining whether descriptors could differentiate varieties or not can be best observed by studying the characteristics on field layouts at least for two years by keeping all the agronomical practices identical. Keeping in view of the above, the present study was attempted to

identify and classify 18 varieties of mustard in field by observing six morphological characteristics of DUS protocol.

### Materials and Methods

A total of 18 varieties viz. Pusa bold, Rohini, Pusabahar, Pusa Mahak, Pusa Agrani, Bio-YSR, RH-8113, CS-52, RH-781, RL-1359, PCR-7, RH-30, RH-819, Varuna, Kranti, GM-1, Pusa Jaikisan, PBR-97 of Indian mustard (*B. juncea*) were grown in RBD layout with three replication, each replication consisted of four rows of 4 meter length with 50 cm row to row and 15 cm plant to plant spacing at Central Institute of Agricultural Engineering, Bhopal, India to ensure authenticity of the varieties during rabi season of 2013-2014 to 2014-2015.

Six morphological characteristics (leaf hairiness, time of flowering, number of siliqua on main shoot, number

of seeds per siliqua, maturity period and weight of 1000 seeds) were studied in field plots as per DUS test Guidelines of Mustard (PPV & FRA, 2009). The observations were recorded on 10 randomly selected plants at each specified stage of crop growth. Leaf hairiness was observed at fully foliage stage after 60 days of sowing. This character was observed on lower side of the leaf. Time of flowering was recorded when 50 % of the plants had at least one open flower. Two characters (number of silique on main shoot and number of seed per silique) were observed at maturation stage after 85 days of sowing. Maturity period was noted as days from date of sowing to when 75% of silique turn yellowish. Lastly, seed characters like weight of 1000 seeds were observed after harvesting of crop. Based on these characters a dendrogram was developed by classifying the varieties under test based on characterization of morphological characters (Table 1).

Table 1: Characterization of Indian mustard varieties based on morphological characters

| Leaf hairiness | Time of flowering (DAS)   | No. of siliqua on main shoot | Maturity period (DAS)       | No. of seeds per siliqua  | Seeds size            |
|----------------|---------------------------|------------------------------|-----------------------------|---------------------------|-----------------------|
| 1-Absent       | 1-Early ( $\leq 40$ days) | 1-Very few ( $\leq 40$ )     | 1-Early ( $\leq 110$ days)  | 1- Very few ( $\leq 12$ ) | 1-Small ( $< 5.0$ gm) |
| 2-Sparse       | 2-Medium (41–50 days)     | 2-Few (41-50)                | 2-Medium (111-130 days)     | 2- Few (13-16)            | 2-Medium (5.0-6.0 gm) |
| 3-Dense        | 3-Late ( $> 50$ days)     | 3-Medium (51-60)             | 3-Late (131-150 days)       | 3- Medium (17-20)         | 3-Bold ( $> 6.0$ gm)  |
|                |                           | 4-Many ( $> 60$ )            | 4-Vary late ( $> 150$ days) | 4- Many ( $> 20$ )        |                       |

The leaf hairiness was categorized into three classes viz. sparse, absent and dense. Likewise, time of flowering was categorized into three classes i.e. early ( $< 40$  days), medium (41-50 days) and late ( $> 50$  days). Similarly, number of silique on main shoot was grouped in to four categories i. e. very few ( $< 40$ ), few (41-50), medium (51-60) and many ( $> 60$ ). In case of maturity period, varieties have been grouped into four categories, viz. early ( $< 110$  days), medium (111-130 days), late (131-150 days) and very late ( $> 150$  days). Number of seeds per silique was grouped into four categories i. e. very few ( $< 12$ ), few (13-16), medium (17-20) and many ( $> 20$ ). Three types of seed size (small  $< 5.0$  gm, medium 5.0-6.0

gm, bold  $> 6.0$ ) were identified in the present study.

### Results and Discussion

The classification on Indian mustard varieties under this study were presented in figure 1. The dendrogram indicated that seven varieties viz., RH-30, RH-819, Varuna, Kranti, GM-1, Pusa jaikisan, PBR-97 were having dense hairs and rest of the 10 varieties viz., Pusa bold, Pusabahar, Pusa mahak, Pusa agrani, Rohini, RH-8113, CS-52, RL-1359, RH-781, Bio YSR were found to be having sparse hairs. The leaf hairs were absent in only one variety (PCR 7). Based on flowering time 3 varieties (Pusa bold, Pusa mahak and Pusa agrani), 8 varieties (Pusa

bahar, RH-781, CS-52, RH-30, RH-819, PBR-97, Kranti and GM-1) and 6 varieties (RH-8119, Rohini, RL-1359, Bio YSR, Varuna and Pusa jaikisan) were grouped in early, medium and late categories respectively. Based on the number of siliqua on main shoot, one variety (Pusa jaikisan) was classified

as medium type, while remaining four varieties viz., Pusa bahar, Rohini, RH 30, GM 1 were found to behaving very few number of siliqua on main shoot and rest of 9 varieties CS 52, RH 781, RH 8113, RL 1359, RH 819, PBR 97, Kranti and Varuna were having few siliqua on main shoot.

Table 2: Effect of Qualitative Morphological characters on classification of varieties

| Varieties     | Hairiness     |               |        | Time of 50% flowering (DAS) |               |        | Maturity Period |               |        |
|---------------|---------------|---------------|--------|-----------------------------|---------------|--------|-----------------|---------------|--------|
|               | 2013<br>-2014 | 2014<br>-2015 | Pooled | 2013<br>-2014               | 2014<br>-2015 | Pooled | 2013<br>-2014   | 2014<br>-2015 | Pooled |
| Pusa Bold     | 2             | 2             | 2      | 39                          | 40            | 39.42  | 117             | 119           | 118    |
| Varuna        | 3             | 3             | 3      | 43                          | 52            | 47.33  | 123             | 122           | 122    |
| Pusa Bahar    | 2             | 2             | 2      | 41                          | 47            | 44.00  | 121             | 124           | 123    |
| Pusa Mahak    | 2             | 2             | 2      | 26                          | 40            | 33.17  | 92              | 95            | 93     |
| Pusa Agrani   | 2             | 2             | 2      | 31                          | 36            | 33.33  | 108             | 101           | 105    |
| Pusa Jaikisan | 2             | 3             | 2      | 55                          | 55            | 54.75  | 113             | 115           | 114    |
| Rohini        | 3             | 2             | 3      | 47                          | 52            | 49.50  | 122             | 125           | 124    |
| Kranti        | 3             | 3             | 3      | 44                          | 47            | 45.67  | 122             | 124           | 123    |
| RH-30         | 3             | 3             | 3      | 48                          | 49            | 48.67  | 120             | 122           | 121    |
| PBR-97        | 2             | 3             | 2      | 46                          | 47            | 46.67  | 122             | 126           | 124    |
| GM-1          | 3             | 3             | 3      | 42                          | 47            | 44.67  | 113             | 117           | 115    |
| RH-8113       | 2             | 2             | 2      | 52                          | 52            | 51.83  | 121             | 126           | 123    |
| CS-52         | 2             | 2             | 2      | 44                          | 48            | 46.00  | 123             | 125           | 124    |
| RH-819        | 3             | 3             | 3      | 46                          | 47            | 46.42  | 116             | 115           | 115    |
| RL-1359       | 2             | 2             | 2      | 54                          | 52            | 52.92  | 120             | 122           | 121    |
| PCR-7         | 1             | 1             | 1      | 53                          | 47            | 50.17  | 124             | 123           | 124    |
| RH-781        | 2             | 2             | 2      | 55                          | 48            | 51.42  | 120             | 120           | 120    |
| Bio YSR       | 3             | 2             | 3      | 55                          | 58            | 56.50  | 121             | 123           | 122    |
| SEm±          | 0.14          | 0.11          | 0.11   | 1.92                        | 1.27          | 1.51   | 1.82            | 1.99          | 1.88   |

Out of 3 varieties with early flowering, only one variety (Pusa agrani) was found to have early maturity and remaining two varieties (Pusa bold and Pusa mahak) having medium maturity. Out of 2 varieties (CS-52 and RH-781) having few number of siliqua on main shoot, RH-781 had very few and CS-52 had few number of seeds per siliqua. According to weight of 1000 seeds (seed size) 4 varieties (Pusa mahak, GM-1, RH-819 and Kranti) had small size seeds, 2 varieties (RH-30 and PBR-97) had medium size seed and Pusa bold had bold seed size. Similar results were also reported by Katiyar *et al.*, (2008). Therefore, out of 18 varieties, 4 varieties (PCR-7, Pusa jaikisan, RH-781 and CS-52) were identified and classified

separately while remaining 14 varieties were classified into different groups.

The data presented in table-2 revealed that out of 18 varieties 5 percent varieties was found to be non-hairy, 56 % of the total varieties were found to be with sparse hairs while 39 percent varieties were found to be having dense hairs with SEM of 0.11. It was also found that 50 percent flowering is achieved during 31 to 58 DAS. About 17 percent of the varieties achieved 50 percent flowering during 31-40 DAS and 50 percent achieved during 40-50 DAS while 33 percent of varieties achieved 50 percent flowering between 50-58 DAS with SEM of 1.51.



Fig. 1- Dendrogram to establish distinctness of the 18 varieties

The study also revealed that the crop comes to maturity during 90-140 DAS. Most of the varieties (89%) comes to maturity between 114- 126 DAS and about 11 percent of the varieties comes to maturity between 92-105 DAS with an SEM of 1.88.

Pooled data of quantitative characters showed that (table 3) the number of siliqua on main shoot was found to be range of between 33 to 70. It was found

that 6 varieties were found to be between 33-40 number of siliqua on main shoot which is about 33 percent and about 8 varieties were found to be in the range of 40 -50 which is about 45 percent and 22 percent varieties were found to be in the range 50-60 with an SEM of 1.79. The number of seeds per siliqua range between 12-20 seeds. About 22 percent of the varieties had seeds up to 12 per siliqua and 67 percent of varieties had 13 to 17 seeds per siliqua, while 11percent varieties had 18-20 seeds per siliqua with an SEM of 0.14. The weight of 1000 seeds ranged between 3.30 g to 6.90 g. about 50 percent of the varieties had 1000 seeds weight between 4-5g and 39 percent of the varieties were between 5-7 g while 11 percent of the varieties were found to be having 1000 seeds weight between 3-4 g. it was found that kranti variety having(3.45) least 1000 seeds weight while Pusa bahar is having (6.82) highest 1000 seeds weight.

The correlation analysis of 1000 seed weight with morphological characters indicated that there is a

Table 3 Effect of Quantitative Morphological characters on classification of varieties

| Varieties     | Siliqua : Number on main shoot |           |        | Number of seeds per siliqua |           |        | Weight of 1000 seeds (gm) |           |        |
|---------------|--------------------------------|-----------|--------|-----------------------------|-----------|--------|---------------------------|-----------|--------|
|               | 2013-2014                      | 2014-2015 | Pooled | 2013-2014                   | 2014-2015 | Pooled | 2013-2014                 | 2014-2015 | Pooled |
| Pusa Bold     | 39                             | 52        | 45.7   | 2                           | 2         | 2      | 6.2                       | 6.2       | 6.2    |
| Varuna        | 66                             | 51        | 58.7   | 2                           | 2         | 2      | 4.1                       | 4.4       | 4.3    |
| Pusa Bahar    | 33                             | 36        | 34.4   | 2                           | 2         | 2      | 6.7                       | 6.9       | 6.8    |
| Pusa Mahak    | 37                             | 44        | 40.4   | 2                           | 2         | 2      | 4.5                       | 4.4       | 4.4    |
| Pusa Agrani   | 44                             | 40        | 41.6   | 1                           | 1         | 1      | 5.5                       | 5.7       | 5.6    |
| Pusa Jaikisan | 58                             | 45        | 51.7   | 1                           | 1         | 1      | 3.6                       | 3.5       | 3.5    |
| Rohini        | 55                             | 44        | 49.5   | 1                           | 1         | 1      | 5.4                       | 5.2       | 5.3    |
| Kranti        | 62                             | 42        | 51.8   | 2                           | 2         | 2      | 3.6                       | 3.3       | 3.5    |
| RH-30         | 34                             | 36        | 34.8   | 2                           | 2         | 2      | 5.5                       | 5.7       | 5.6    |
| PBR-97        | 32                             | 40        | 36.2   | 2                           | 2         | 2      | 5.1                       | 5.2       | 5.1    |
| GM-1          | 37                             | 33        | 34.8   | 2                           | 2         | 2      | 4.3                       | 4.2       | 4.2    |
| RH-8113       | 44                             | 54        | 48.8   | 3                           | 3         | 3      | 4.5                       | 4.5       | 4.5    |
| CS-52         | 70                             | 42        | 55.8   | 2                           | 2         | 2      | 4.4                       | 4.2       | 4.3    |
| RH-819        | 30                             | 44        | 36.6   | 3                           | 3         | 3      | 4.4                       | 4.3       | 4.4    |
| RL-1359       | 56                             | 43        | 49.5   | 2                           | 2         | 2      | 4.6                       | 4.9       | 4.7    |
| PCR-7         | 41                             | 53        | 46.9   | 2                           | 2         | 2      | 4.7                       | 4.6       | 4.7    |
| RH-781        | 43                             | 37        | 39.6   | 1                           | 1         | 1      | 4.7                       | 4.7       | 4.7    |
| Bio YSR       | 46                             | 47        | 46.7   | 2                           | 2         | 2      | 5.4                       | 5.2       | 5.3    |
| SEm±          | 2.91                           | 1.47      | 1.8    | 0.14                        | 0.14      | 0.14   | 0.2                       | 0.2       | 0.2    |

Table 4: Correlation Coefficient (r) between 1000 seeds weight and morphological characters (pooled mean)

| Morphological character         | correlation | value |
|---------------------------------|-------------|-------|
| Hairiness                       | 0.188       | NS    |
| Time of 50% flowering           | 0.392       | NS    |
| Maturity period                 | 0.568       | **    |
| Number of silique on main shoot | 0.712       | **    |
| Number of seeds per siliqua     | 0.616       | **    |

strong correlation between number of siliqua on main shoot and number of seeds per siliqua while a weak correlation was observed between Hairiness and time of 50% flowering of Indian mustard which was found to be non-significant. The characters maturity of crop, number of siliqua on main shoot and number of seeds per siliqua were found to be significant at 1 % level of significance.

### Conclusion

From the present investigation it was found that morphological characteristics through DUS test protocol plays a vital role in identification/classification of Indian mustard (*Brassica juncea* L.) varieties. The characters maturity of crop, number of siliqua on main shoot and number of seeds per siliqua were found to be significant in classification of the varieties. The varieties PCR-7, Pusa Jaikisan, RH-781 and CS-52 were identified individually based on hairiness, number of siliqua on main shoot, number of seeds per siliqua respectively. These characters had higher potential to classify varieties. Thus this study helps in maintenance of genetic purity to the highest level in varieties. It is further suggested that this exercise may also be

undertaken on a regular basis for validating the varieties and revising the DUS guidelines, if needed. However a strict adherence to the maintenance reading procedures to maintain varietal purity would of utmost important. Thus, the present study concludes that morphological characters of DUS protocol prove to be very useful and convenient for varietal identification and to maintain the genetic purity of cultivars.

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