

## Example varieties for DUS testing in muskmelon (*Cucumis melo* L.)

B.R. Choudhary\*, S. Pandey<sup>1</sup>, E.S. Rao<sup>2</sup>, S. Kumar and S.K. Sharma  
ICAR-Central Institute for Arid Horticulture, Bikaner (Rajasthan)-334 006

<sup>1</sup>ICAR-Indian Institute of Vegetable Research, Varanasi

<sup>2</sup>ICAR-Indian Institute of Horticultural Research, Bengaluru

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### Abstract

The present study was carried out for morphological characterization of thirteen reference varieties of muskmelon (*Cucumis melo* L.) to validate DUS testing guidelines using plant descriptors adopted from the DUS guidelines of PPV&FRA. Among 34 morphological characteristics studied, 19 were visually assessed and 15 were measured. Under results, no intra-varietal variation was observed for any of the visual characteristics examined. Further, the expression of characters in different varieties remained same for the three consecutive years confirming the uniformity and stability of the variety for visual characteristics. The varieties were grouped into different categories for each character based on 34 descriptors which may be used as reference varieties. The morphological characterization of extant varieties was completed to establish distinctness of the candidate variety from all other varieties to utilize these varieties as reference material for protection of other varieties under PPV&FR Act. A strict maintenance breeding of the reference varieties, including the example varieties, and use of alternate example varieties for conduct of DUS testing in muskmelon, if needed, are also suggested.

**Key words:** DUS test, Example variety, PPV&FR Act, Muskmelon.

### Introduction

The “Protection of Plant Varieties and Farmers' Rights Act” (PPV&FR Act, 2001) was passed by the Government of India in 2001 with the objective of providing an effective system of protection against unlawful commercial exploitation of new plant varieties, the rights of farmers and plant breeders and to encourage the development of new varieties of plants. The Protection of Plant Varieties and Farmers' Rights Authority, New Delhi established by the Government has the responsibility of implementing the provisions of this Act. The examination of a new plant variety for establishment of distinctiveness, uniformity and stability is known as “Distinctiveness, Uniformity and Stability (DUS) test”. The success of DUS test trials rest on a set of general principles and specific guidelines. The evaluation of a variety for DUS generates a description of the variety using its relevant morpho-physiological characteristics which have been recognized universally as undisputed descriptors for characterization and DUS testing of plant varieties. The use of morphological descriptors in sequential order is

useful and convenient to differentiate the varieties from each other. A variety is identified on the basis of a set of characteristics differing from other known varieties of that species. A guideline to conduct DUS test is required for describing a variety, assessing the level of uniformity of characteristics and the stability of expression of those in different growing locations over the years. For the purpose of an objective comparison and uniform evaluation by the DUS testing personnel, example varieties are identified and included in the Table of Characteristics to exemplify the characteristic state of expression. These example varieties must exhibit the specific state of a characteristic without any ambiguity. A strict maintenance breeding for genetic purity of all the example varieties is warranted for a valid DUS testing for proper implementation of PPV&FR Act (Chakrabarty *et al.*, 2012). In India, the great variability exists in muskmelon genotypes and the true character expression in the example varieties assume a greater significance under PPV&FR Act, 2001 for their protection on a set of relevant characteristics prescribed in the 'Minimal Descriptors of Vegetable crops' for muskmelon (Srivastava *et al.*, 2001). Therefore, the present study carried out with the objective to 'validate DUS testing guidelines of the

\*Corresponding authors email:  
choudharybr71@gmail.com

example varieties of muskmelon for the states of expression of various characteristics'.

### Material and Methods

The study material comprised genetically pure seed of 13 extant varieties of muskmelon (*Cucumis melo* L.) viz., Arka Jeet, Arka Rajhans, MHY-3, MHY-5, RM-43, RM-50, Durgapura Madhu, Kashi Madhu, Pusa Madhuras, Pusa Sharbati, GMM-3, Punjab Sunehri and Hara Madhu. The seeds of all extant varieties were sown with five rows of 5.6m length keeping a row to row and plant to plant spacing of 2.5m and 0.8m respectively in Randomized Block Design replicated thrice. The experiments were carried out at three locations namely Central Institute for Arid Horticulture (CIAH), Bikaner (Rajasthan), Indian Institute of Vegetable Research (IIVR), Varanasi (UP) and Indian Institute of Horticultural Research (IIHR), Bengaluru (Karnataka) for three consecutive years from 2011 to 2013 during summer season. All recommended package of practices were followed during three consecutive years.

All cultivars under study were evaluated for 34 DUS characters at specified stage of crop growth period when characters under study had full expression following the guidelines of IPGRI, 1988, Srivastava *et al.*, 2001 and UPOV, 2006. The observations for the assessment of distinctiveness and stability were made on 10 plants or parts of plants from each replication selected randomly. The assessment of uniformity of characteristics in the plot as a whole was done visually by a single observation of a group of plants or parts of plants. The stages of observations were as follows.

I. Observations on the cotyledon were made just

- before the development of the first true leaf.
- ii. All observations on the leaf were recorded on fully developed but not old leaves, preferably between the 5<sup>th</sup> and 8<sup>th</sup> node when the plant had at least one fruit set.
- iii. All observations on the fruit traits were made on 1<sup>st</sup> or 2<sup>nd</sup> well developed mature fruit.
- iv. All observations on the ovary were recorded on the day of anthesis.
- v. All observations on width were recorded at the maximum point of width of the part concerned.
- vi. All observations on the seeds were made on fully developed, matured and dry seeds, after washing and drying.

The type of assessment of characteristics indicated in Table 1 is as follows:

MG: Measurement by a single observation of a group of plants or parts of plants

MS: Measurement of a number of individual plants or parts of plants.

VG: Visual assessment by a single observation of a group of plants or parts of plants.

VS: Visual assessment by observations of individual plants or parts of plants.

### Results and Discussion

Among the 13 muskmelon varieties, considerable variation was observed for all the important characters under study. The states of expression of a particular trait along with example varieties of muskmelon are depicted in Table 1.

Table 1. Example varieties validated for the state of the characteristics

S. No.	Characteristics	State of expression	Example varieties	Type of assessment
1.	Cotyledon: length (cm)	Short (<2.75)	Punjab Sunehri	MS
		Medium (2.75-3.25)	Arka Jeet	
		Long (>3.25)	RM-50, Pusa Madhuras	
2.	Cotyledon: width (cm)	Narrow (<1.5)	Kashi Madhu, Durgapura Madhu	MS
		Medium (1.5-1.75)	GMM-3, RM-43	
		Broad (>1.75)	Pusa Madhuras	
3.	Leaf blade: length (cm)	Short (<8)	RM-43	MS
		Medium (8-10)	Kashi Madhu	
		Long (>10)	MHY-3, Durgapura Madhu	
4.	Leaf blade: width (cm)	Narrow (<11)	GMM-3, RM-43	MS
		Medium (11-13)	Kashi Madhu	
		Broad (>13)	Pusa Madhuras	

5.	Leaf blade: depth of lobes (depth of terminal lobe)	Weak	MHY-3	VG
		Medium	GMM-3	
		Strong	RM-50	
6.	Leaf blade: length of terminal lobe (cm)	Short (<2.5)	-	MS
		Medium (2.5-4.5)	Kashi Madhu	
		Long (>4.5)	RM-50	
7.	Leaf blade: dentation of margin	Weak	RM- 43	VG
		Strong	Kashi Madhu, RM-50	
8.	Leaf blade: petiole length (cm)	Short (<7)	RM-43, Durgapura Madhu	MS
		Medium (7-9)	Pusa Madhuras, MHY - 5	
		Long (>9)	RM-50, Hara Madhu	
9.	Appearance of first perfect/ pistillate flower in 50% plants from date of sowing (days)	Early (<45)	Durgapura Madhu	MG
		Medium (45-50)	MHY-3, RM -43, Kashi Madhu	
		Late (>50)	-	
10. (*)	Sex expression (at full flowering)	Monoecious	-	VG
		Andromonoecious	Kashi Madhu, Pusa Madhuras, Hara Madhu, Durgapura Madhu	
		Others	-	
11.	Male sterility	Absent	Kashi Madhu, Pusa Madhuras, Hara Madhu, Durgapura Madhu	VG
		Present	-	
12.	Ovary: length (cm)	Short (<1)	Punjab Sunehari	MS
		Medium (1-1.5)	MHY-5	
		Long (>1.5)	Durgapura Madhu, RM 50	
13.	Ovary: width (cm)	Narrow (<0.6)	Kashi Madhu	MS
		Medium (0.6-0.8)	Hara Madhu	
		Broad (>0.8)	MHY-5	
14.	Ovary: pubescence	Sparse	Arka Jeet	VG
		Dense	Kashi Madhu	
15.	Fruit: length (cm)	Short (<10)	Arka Jeet	MG
		Medium (10-15)	Pusa Madhuras	
		Long (>15)	Durgapura Madhu	
16.	Fruit: diameter (cm)	Narrow (<9)	RM-43, Arka Jeet	MG
		Medium (9-12)	RM-50	
		Broad (>12)	GMM-3, Kashi Madhu	
17. (*)	Fruit: shape in longitudinal section	Ovate	MHY-5	VG
		Oval	-	
		Elongated globe	Arka Rajhans	
		Round	-	
		Oblate (Flat globe)	GMM-3, Kashi Madhu	
		Obovate	Durgapura Madhu	
		Cylindrical	-	

18. (*)	Fruit: rind colour	Creamy white	-	VG
		Yellow	Kashi Madhu	
		Yellow Green	Durgapura Madhu	
		Orange	Arka Jeet	
		Others	-	
19.	Fruit: patches	Absent	Arka Jeet, MHY-3	VG
		Present	Kashi Madhu, GMM-3	
20.	Fruit: peduncle at maturity	Slipable	Kashi Madhu	VG
		Non-slipable	Hara Madhu	
21.	Fruit: shape at peduncle end	Pointed	Durgapura Madhu	VG
		Rounded	Hara Madhu, Pusa Madhuras	
		Truncate	Kashi Madhu	
22.	Fruit: shape at blossom end	Pointed	Durgapura Madhu	VG
		Intermediate	-	
		Truncate	Kashi Madhu	
23.	Fruit: diameter of blossom end scar (cm)	Small (<1)	Arka Jeet, Durgapura Madhu	MS
		Medium (1-2)	Pusa Madhuras	
		Large (>2)	Kashi Madhu	
24.	Fruit: surface	Smooth	Arka Jeet, MHY-3	VG
		Grooved	RM-43, Kashi Madhu	
25. (*)	Fruit: sutures	Absent	Arka Jeet, MHY-3	VG
		Present	Hara Madhu, Kashi Madhu	
26.	Fruit: suture colour	Creamy	Arka Rajhans	VG
		Green	Kashi Madhu, Hara Madhu	
		Others	-	
27. (*)	Fruit: surface netting	Absent	Arka Jeet, MHY-5	VG
		Moderate	RM-50, Punjab Sunehri	
		Dense	-	
28.	Fruit: flesh thickness at position of maximum fruit diameter (cm)	Thin (<2)	Arka Jeet	MS
		Medium (2-3)	MHY-5	
		Thick (>3)	GMM-3	
29. (*)	Fruit: flesh colour	Creamish white	Arka Jeet	VG
		Grey orange	GMM-3	
		Yellowish green	Durgapura Madhu	
		Green	Hara Madhu	
		Orange	Kashi Madhu	
30.	Fruit: flesh texture	Mealy	Hara Madhu	VS
		Intermediate	-	
		Crispy	Kashi Madhu	
31.	Fruit: flavour	Mild	Arka Rajhans	VG
		Medium	Kashi Madhu, Durgapura Madhu	
		Strong	-	

32.	Seed: length (cm)	Short (<1)	Kashi Madhu, Hara Madhu	MS
		Long (>1)	Pusa Madhuras	
33.	Seed: width (cm)	Narrow (<0.4)	Durgapura Madhu	MS
		Broad (>0.4)	Pusa Madhuras	
34.	Seed: colour	Creamy white	Kashi Madhu, Arka Jeet	VG
		Yellowish	Durgapura Madhu, Hara Madhu	

(\*) Grouping trait

The example varieties are expected to be highly uniform and stable in expression of the characteristics at a particular state. It is applicable for the qualitative characteristics which are least influenced by environmental conditions. The number of example varieties should be less in number to reduce cost of DUS testing and for easy maintenance of the set of example varieties which involve high cost due to cross pollination of muskmelon. More than one example variety for a state of expression of a characteristic is desirable in case the variety deteriorates for the given characteristic and/or it does not express in some growing condition and areas. The reference varieties are of utmost importance in DUS testing for comparing characteristic states of the candidate varieties. Any chance of impurity of seed in the set of reference varieties would lead to wrong or invalid DUS test result. Therefore, maintenance of genetic purity to the highest level in the reference varieties is a basic requirement for the successful conduct of DUS test. It is also suggested that a periodical review of all example varieties be undertaken at all the DUS test centres to validate the set of example varieties.

The varieties characterized for DUS were grouped into different categories for each character which could be used as reference varieties. These varieties can be used in the varietal improvement programme of muskmelon for desirable traits. Genetic improvement of desirable varieties can also be done through gene combinations from unadapted sources having resistance against biotic/ abiotic stresses. These test guidelines apply to all varieties, hybrids and parental lines of muskmelon (*Cucumis melo* L.) including *C. melo* L. subsp. *cantalupensis* and *C. melo* L. subsp. *reticulatus*. It is concluded that the developed DUS descriptors can be effectively used for identification and grouping of varieties and comparing candidate varieties for registration under PPV&FR Act.

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