



## Varietal characterization of okra (*Abelmoschus esculentus*) based on morphological descriptions

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### ABSTRACT

A total of 36 cultivars of okra [*Abelmoschus esculentus* (L.) Moench] were grouped for 31 morphological characters (17 visual and 14 quantitative) adopted as per DUS guidelines. All the cultivars showed similar expression for each character over the four consecutive year (*kharif*, 2010, 2011, 2012 and 2013) depicting the stability of cultivars. None of the attributes showed intra-varietal variations. Three cultivars, i.e. Azad Bhindi 3, Kashi Lalima and VROR 159 showed red stem colour while others have green stem colour. No. 315 showed first flower at less than 5 nodes while SB 2, Arka Abhay, Kashi Vibhuti, Kashi Pragati, Kashi Lila and Perkins Long Green exhibited first flower at 5-8 nodes, whereas other cultivars expressed first flower appeared at more than 8 nodes. Cultivars Pusa A-4, Kashi Leela and Punjab Padmini were early in flowering (<35 days) while SB 2, Arka Anamika, Punjab 8, Kashi Pragati, HRB 55, Varsha Uphar, Hisar Naveen and Arka Abhay were medium (35-45 days), whereas other cultivars were late (>45 days) in flowering. Purple leaf vein colour was observed in 7 cultivars, viz. Susthira, Arka Anamika, Azad Bhindi 3, Kashi Lalima, Punjab Padmini, No. 315 and Perkins Long Green and the other cultivars depicted green leaf vein colour. Inside purple base colour of petal was exhibited in eight cultivars, viz. SB 2, No. 136, Susthira, Arka Anamika, Azad Bhindi 2, HRB 55, Azad Bhindi 1 and Punjab 7 while the other cultivars showed both side purple base colour on both side of petal. Light green fruit colour was observed in 8 cultivars, viz. GO 2, GJO 3, Azad Bhindi 2, DI-87-5, Arka Abhay, VRO-3, Pusa Sawani and BO 2, whereas Azad Bhindi 3 and Kashi Lalima had light red fruit colour and rest of cultivars showed green fruit colour. Length of fruit (cm) at marketable stage (four days after anthesis) varied from small to long in the cultivars studied. Only one cultivar SB-2 have small fruit length while Susthira, Varsha Uphar, Kashi Vibhuti, DI-87-5 and No.136 showed long fruit length. Rest cultivars showed medium fruit length. Only three cultivars, viz. Susthira, No. 315, and Kashi Vibhuti exhibited short plant height (<90cm). Majority of the cultivars were classified under medium (90-120cm) and tall (>120cm) plant height group.

**Key words:** Cultivars, DUS test, Morphological characters, Okra, PPV and FRA

Okra [*Abelmoschus esculentus* (L.) Moench] is an economically important vegetable crop grown in tropical, sub-tropical and warmer part of temperate zone of the world (Hammon and Van Sloten 1989) and well distributed in the Indian subcontinent and East Asia (Kochhar 1986). The okra is an important source of minerals, vitamins and crude fiber in human diet (Rashid 1999). Many tools are now available to study relationship among cultivars including various types of molecular markers. However, morphological characterization is the first step in description and classification of the cultivars. It is commonly known that morphological data can be of dubious taxonomic reliability because of environmental interaction and largely unknown mechanisms of genetic control of these traits (Comstock and Moll 1963 and Camussi *et al.* 1983). The PPV and FR Act, 2001 has provision to compare the candidate cultivar with reference/extant cultivars on a set of relevant characteristics prescribed in the Draft National Test

Guidelines for DUS testing of okra and accepted for filing of application for protection. Therefore, the present study was undertaken with the objective to characterize 36 cultivars of okra on the basis of morphological characters and to establish distinctness of candidate cultivar from all other cultivars and also among extant cultivars developed in India.

### MATERIALS AND METHODS

A total of 36 okra cultivars were collected from different ICAR based Institutes, SAUs and other organizations of India (Table 1). The collected cultivars were evaluated at experimental farm of ICAR-Indian Institute of Vegetable Research, Varanasi in a randomized block design with three replications over four years (*kharif* 2010, 2011, 2012 and 2013). The plants were grown at a spacing of 60cm × 30cm with plant population of 60 plants per replication. Genotypes were evaluated for 31 characters, viz. stem colour, intensity of stem green colour, depth of lobbing of leaf blade, number of nodes at first flowering (upto and including the first

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Tabl 1 Cultivars of okra and their developing centres

Cultivars	Developing organization
Arka Abhay (IIHR Sel4), Arka Anamika (IIHR10)	ICAR-IIHR, Bengaluru
Azad Bhindi 1, Azad Bhindi 2, Azad Bhindi 3	CSAUA&T, Kanpur
BO 13, BO 2 (Utkal Gaurav) D1-87-5	OUA&T, Bhubaneswar BAU, Sabour
GJO 3 (JOK-2K19)	JAU, Junagadh
GO 2 (Gujarat Okra 2)	AAU, Anand
Hisar Naveen (HRB 107-4), HRB 55 (Hisar Unnat), HRB 231, Varsha Uphar (HRB 9-2)	CCS HAU, Hisar
Parbhani Kranti, Phule Utkarsh (GK V-333)	MPKV, Rahuri
Punjab Padmini, Punjab-7, Punjab-8	PAU, Ludhiana
Pusa Makhmali, Pusa Sawani, Pusa A-4, Perkins Long Green	ICAR-IARI, New Delhi
Susthira (AE 286-1)	KAU, Vellanikkara
VRO3 (Kashi Mohini), VRO 4 (Kashi Mangali), VRO 5 (Kashi Vibhuti), VRO 6 (Kashi Pragati), SB8 (VRO 22, Kashi Kranti), Kashi Satdhari (IIVR 10), Kashi Lalima, Kashi Leela (IIVR 11), VROR 159, No. 136, No. 315, SB 2	ICAR-IIVR, Varanasi

flowering node), flowering time (50% of the plants with at least one open flower), leaf blade length (cm), leaf blade width (cm), serration of margin of leaf blade, colour between veins of leaf blade, intensity of colour between veins of leaf blade, vein colour, petiole length (cm), petal colour, petal base colour (purple), flower length (cm), flower diameter at the top of flower (cm), fruit colour, fruit length

(cm) at marketable stage (four days after anthesis), fruit diameter at mid length (cm), surface between ridges of fruit, fruit pubescence, fruit constriction at basal part, shape of apex of fruit, number of locules of fruit, number of branches, stem diameter at 10 cm above ground level (cm), plant height (cm), fruit length of physiologically mature fruit (cm), fruit diameter at mid length (cm), seed colour and seed hairiness characters according to Distinctiveness Uniformity Stability guideline descriptors (IPGRI 1991 or UPOV 2006). The observations were recorded on 10 plants in each replication at specified stage of crop growth period when the characters under study had full expression. One character was measured by a single observation of a group of plants or parts of plants (MG), 13 characters were measured by a number of individual plant or parts of plants (MS), 15 characters were visual assessment by a single observation of a group of plants or parts of plants (VG), whereas 2 characters were visual assessment by observations of individual plant or parts of plants (VS)

## RESULTS AND DISCUSSION

The identity/profiles of 36 okra cultivars were established by using a set of morphological characteristics prescribed in the DUS test guidelines of okra. These characters are useful to establish distinctiveness, uniformity and stability of a cultivar, based on which the cultivar is given protection (Table 2). Out of the 31 morphological characters DUS descriptor studied, 14 characters were measured and 17 characters were visually assessed. These characteristics did not show any variation in their state of expression over four years study. Further, no off type plants were observed hence, these characters were considered to be uniform. Expression of each characteristic was found to be stable in four years for the respective cultivars, thus confirming their consistency and stability.

Table 2 Morphological characteristics of okra cultivars

Characteristic	States	No. of cultivars	Per cent of cultivars	Cultivars	Type of assessment
Stem: Colour	Green	33	91.67	SB 2, SB 8, No. 136, Phule Utkarsha, Pusa A-4, Susthira, Varsha Uphar, Hisar Naveen, GO 2, GJO 3, Arka Anamika, Kashi Vibhuti, Azad Bhindi 2, D1-87-5, Punjab 8, BO 13, HRB 231, VRO 4, VRO 3, Kashi Pragati, Kashi Leela, Parbhani Kranti, Pusa Sawani, BO 2, HRB 55, Azad Bhindi 1, Arka Abhaya, Punjab Padmini, Pusa Makhmali, Lashi Satdhari, Punjab 7, No.15, Perkins Long Green	VG
	Red	3	8.33	VROR 159, Azad Bhindi 3, Kashi Lalima	
Stem: Intensity of green colour	Light	11	30.56	Phule Utkarsha, Pusa A-4, Susthira, Hisar Naveen, Arka Anamika, BO 13, HRB 23, Kashi Pragati, Parbhani Kranti, BO 2, Kashi Satdhari	VG
	Medium	11	30.56	D1-87-5, Kashi Leela, Kashi Lalima, Pusa Sawani, HRB 55, Arka Abhay, Punjab Padmini, Pusa Makhmali, Punjab 7, No-315, Perkins Long Green	
	Dark	14	38.89	SB 2, SB 8, No 136, VROR 159, Varsha Uphar, GO 2, GJO 3, Kashi Vibhuti, Azad Bhindi 2, Azad Bhindi 3, Punjab 8, VRO 4, VRO 3, Azad Bhindi 1	

contd.

Table 2 (Continued)

Characteristic	States	No. of cultivars	Per cent of cultivars	Cultivars	Type of assessment
Leafblade: Depth of lobing	Shallow	6	16.67	SB 2, SB 8, No 136, VRO 3, No. 135, Perkins Long Green	VG
	Medium	10	27.78	Kashi Vibhuti, Azad Bhindi 2, Azad Bhindi 3, Kashi Pragati, Parbhani Kranti, HRB 55, Azad Bhindi 1, Punjab Padmini, Punjab 7, Perkins Long Green	
	Deep	19	52.78	VROR 159, Phule Utkarsha, Pusa A-4, Susthira, Varsha Uphar, Hisar Naveen, GO 2, GJO 3, Arka Anamika, D1-87-5, Punjab 8, BO 13, HRB 231, VRO 4, Kashi Leela, Kashi Lalima, Pusa Sawani, BO 2, Arka Abhay, Pusa Makhmali, Kashi Satdhari	
Stem: Number of nodes at first flowering (upto and including the first flowering node)	Few (<5)	1	2.78	No. 135	MS
	Medium (5-8)	6	16.67	SB 2, Arka Abhay, Perkins Long Green, Kashi Pragati, Kashi Vibhuti, Kashi Leela	
	Many (>8)	29	80.56	SB 8, No-136, VROR 159, Phule Utkarsha, Pusa A 4, Susthira, Varsha Uphar, Hisar Naveen, GO 2, GJO 3, Arka Anamika, Azad Bhindi 2, Azad Bhindi 3, D1-87-5, Punjab 8, BO 13, HRB 231, VRO 4, VRO 3, Parbhani Kranti, Kashi Lalima, Pusa Sawani, BO 2, HRB 55, Azad Bhindi 1, Pusa Makhmali, Kashi Satdhari, Punjab 7, Punjab Padmini	
Flowering: Time (50% of the plants with at least on open flower)	Early (<35 days)	3	8.33	Pusa A 4, Punjab Padmini, Kashi Leela	MG
	Medium (35-45 days)	9	25.00	SB 2, Arka Anamika, Punjab 8, Kashi Paragati, HRB 55, Arka Abhay, SB 8, Varsha Uphar, Hisar Naveen	
	Late (>45 days)	24	66.67	No 136, VROR 159, Phule Utkarsha, GO 2, GJO 3, Kashi Vibhuti, Azad Bhindi 2, Azad Bhindi 3, D1-87-5, BO 13, HRB 231, VRO 4, VRO 3, Parbhani Kranti, Kashi Lalima, Pusa Sawani, BO 2, Azad Bhindi 1, Pusa Makhmali, Kashi Satdahri, Punjab 7, No. 315, Perkins Long Green, Susthira	
Leafblade: Length (cm)	Small (<15)	2	5.56	Susthira, Punjab Padmini	MS
	Medium (15-25)	9	25.00	SB 2, Phule Utkarsha, Pusa A 4, Hisar Naveen, Azad Bhindi 3, Pusa Makhmali, Punjab 7, No.315, Perkins Long Green	
	Large (>25)	25	69.44	SB 2, No. 136, VROR 159, Varsha Uphar, GO 2, GJO 3, Arka Anamika, Kashi Vibhuti, Azad Bhindi 2, D1-87-5, Punjab 8, BO 13, HRB 231, VRO 4, VRO 3, Kashi Pragati, Kashi Leela, Parbhani Kranti, Kashi Lalima, Pusa Sawani, BO 2, Azad Bhindi1, Arka Abhay, Kashi Satdhari	
Leafblade: Width (cm)	Small (<15)	1	2.78	Punjab Padmini	MS
	Medium (15-25)	4	11.11	SB 2, Susthira, Punjab 7, Perkins Long Green	
	Large (>25)	31	86.11	SB 8, No 136, VROR 159, Phule Utkarsha, Pusa A-4, Varsha Uphar, Hisar Naveen, GO 2, GJO 3, Arka Anamika, Kashi Vibhuti, Azad Bhindi 2, D1-87-5, Punjab 8, BO 13, HRB 231, VRO 4, VRO 3, Kashi Pragati, Kashi Leela, Parbhani Kranti, Kashi Lalima, Pusa Sawani, BO 2, Azad Bhindi 1, Arka Abhay, Pusa Makhmali, Kashi Satdhari, No. 315, Azad Bhindi 3	
Leafblade: Serration of margin	Weak	5	13.89	Susthira, Arka Anamika, Azad Bhindi3, Kashi Lalima, Punjab Padmini	VS
	Medium	8	22.22	SB 2, D1-87-5, Pusa Sawani, BO 2, Pusa Makhmali, Punjab 7, No.315, Perkins Long Green	
	Strong	23	63.89	SB 8, No. 136, VROR 159, Phule Utkarsha, Pusa A 4, Varsha Uphar, Hisar Naveen, GO 2, GJO 3, Kashi Vibhuti, Azad	

contd.

Table 2 (Continued)

Characteristic	States	No. of cultivars	Per cent of cultivars	Cultivars	Type of assessment
Leafblade: Colour between veins	Green	34	94.44	Bhindi 2, Punjab 8, BO 13, HRB 231, VRO 4, VRO 3, Kashi Pragati, Kashi Leela, Parbhani Kranti, HRB 55, Azad Bhindi 1, Arka Abhay, Kashi Satdhari	VS
	Red	2	5.56	No 136, VROR 159, Phule Utkarsh, Pusa A-4, Susthira, Varsha Uphar, Hisar Naveen, GO 2, GJO 3, Arka Anamika, Kashi Vibhuti, Azad Bhindi 2, Azad Bhindi 3, D187-5, Punjab8, BO 13, HRB 231, VRO 4, VRO 3, Kashi Pragati, Kashi Leela, Parbhani Kranti, Pusa Sawani, BO 2, HRB 55, Azad Bhindi 1, Arka Abhay, Pusa Makhmali, Punjab 7, No.315, Perkins Long Green, SB 2, SB 8, Kashi Satdhari	
Leafblade: Intensity of colour between veins	Light	10	27.78	Punjab Padmini, Kashi Lalima	VG
	Medium	18	50.00	No 136, VROR 159, Arka Anamika, D1-87-5, HRB 231, VRO 4, VRO 3, Pusa Sawani, Pusa Makhmali, Kashi Satdhari	
	Dark	8	22.22	SB 2, SB 8, Susthira, Varsha Uphar, Hisar Naveen, GO 2, GJO 3, Azad Bhindi 2, BO 13, Kashi Pragati, Kashi Leela, Parbhani Kranti, Kashi Lalima, Azad Bhindi 1, Arka Abhaya, Punjab 7, No 315, Perkins Long Green	
Vein: Colour	Light Green	29	80.56	SB 2, Phule Utkarsha, Pusa A 4, Kashi Vibhuti, Azad Bhinid 3, Punjab 8, BO 2, HRB 55	VG
	Purple	7	19.44	SB 8, No.136, VROR 159, Phule Utkarsha, Pusa A 4, Varsha Uphar, Hisar Naveen, GO 2, GJO 3, Kashi Vibhuti, Azad Bhindi 2, D1-87-5, Punjab 8, BO 13, HRB 231, VRO 4, VRO 3, Kashi Pragati, Kashi Leela, Parbhani Kranti, Pusa Sawani, BO 2, HRB 55, Azad Bhindi 1, Arka Abhay, Punjab Padmini, Pusa Makhmali, Kashi Satdhari, Punjab 7	
Petiole: Length (cm)	Short (<20)	5	13.89	Susthira, Arka Anamika, Azad Bhindi 3, Kashi Lalima, Punjab Padmini, No 315, Perkins Long Green	MS
	Medium (20-30)	15	41.67	Susthira, Varsha Uphar, Hisar Naveen, GO 2, GJO 3	
	Long (>30)	16	44.44	SB 2, Phule Utkarsh, Pusa A 4, Azad Bhindi 3, D1-87-5, BO 13, VRO 3, Kashi Pragati, Kashi Leela, Parbhani Kranti, Pusa Makhmali, Kashi Satdhari, Punjab 7, No. 15, Perkins Long Green	
Flower: Petal colour	Cream	4	11.11	SB 8, No. 136, VROR 159, Arka Anamika, Kashi Vibhuti, Azad Bhindi 2, Punjab 8, HRB 231, VRO 4, Kashi Lalima, Pusa Sawani, BO 2, HRB 55, Azad Bhindi 1, Arka Abhay, Punjab Padmini	VG
	Yellow	32	88.89	SB 2, SB 8, Susthira, No. 315	
	Purple	0	0	No. 136, VROR 159, Phule Utkarsh, Pusa A 4, Varsha Uphar, Hisar Naveen, GO 2, GJO 3, Arka Anamika, Kashi Vibhuti, Azad Bhindi 2, Azad Bhindi 3, D1-87-5, Punjab 8, BO 13, HRB 231, VRO 4, VRO 3, Kashi Pragati, Kashi Leela, Parbhani Kranti, Kashi Lalima, Pusa Sawani, BO 2, HRB 55, Azad Bhindi 1, Arka Abhay, Pusa Makhmali, Kashi Satdhari, Punjab 7, Perkins Long Green, Punjab Padmini	
Flower: Petal base colour (purple)	Inside only	8	22.22	SB 2, No. 136, Susthira, Arka Anamika, Azad Bhindi 2, HRB 55, Azad Bhindi 1, Punjab 7	VG
	Both sides	28	77.78	VROR 159, Phule Utkarsh, Pusa A 4, Varsha Uphar, Hisar Naveen, GO 2, GJO 3, Kashi Vibhuti, Azad Bhindi 3, D1-87-5, Punjab 8, BO 13, HRB 231, VRO 4, VRO 3, Kashi Pragati, Kashi Leela, Parbhani Kranti, Kashi Lalima, Pusa Sawani, BO 2, Arka Abhaya, Punjab Padmini, Pusa Makhmali, Kashi Satdhari, No 315, Perkins Long Green, SB 8	

contd.

Table 2 (Continued)

Characteristic	States	No. of cultivars	Per cent of cultivars	Cultivars	Type of assessment
Flower: Length (cm)	Small (<3)	4	11.11	SB 2, SB 8, GJO 3, VRO 4	MS
	Medium (3-5)	10	27.78	Phule Utkarsha, Hisar Naveen, Arka Anamika, Azad Bhindi 2, BO 13, Kashi Leela, BO 2, Azad Bhindi 1, Kashi Satdhari, Punjab 7	
	Large (>5)	22	61.11	No 136, VROR 159, Pusa A-4, Susthira, Varsha Uphar, GO 2, Kashi Vibhuti, Azad Bhindi 3, D1-87-5, Punjab 8, HRB 231, VRO 3, Kashi Pragati, Parbhani Kranti, Kashi Lalima, Pusa Sawani, HRB 55, Arka Abhay, Pusa Makhmali, No. 315, Perkins Long Green	
Flower: Length (cm)	Small (<3)	2	5.56	SB 8, Punjab Padmini	MS
	Medium (3-5)	11	30.56	SB 2, Hisar Naveen, Azad Bhindi 2, Azad Bhindi 3, BO 13, VRO 4, Kashi Lalima, Kashi Satdhari, Punjab 7, No. 315, Perkins Long Green	
	Large (>5)	23	63.89	No 316, VROR 159, Phule Utkarsh, Pusa A-4, Susthira, Varsha Uphar, GO 2, GJO 3, Arka Anamika, Kashi Vibhuti, D1-87-5, Punjab 8, HRB 231, VRO 3, Kashi Pragati, Kashi Leela, Parbhani Kranti, Pusa Sawani, BO 2, HRB 55, Azad Bhindi 1, Arka Abhay, Pusa Makhmali	
Fruit: Colour	Light green	8	22.22	GO 2, GJO 3, Azad Bhindi 2, D1-87-5, Arka Abhay VRO 3, Pusa Sawani, BO 2	VG
	Green	27	75.00	Kashi Vibhuti, SB 2, No.136, Phule Utkarsh, Pusa A-4, Susthira, Varsha Uphar, Hisar Naveen, Arka Anamika, Punjab 8, BO 13, HRB 231, VRO 4, Kashi Pragati, Kashi Leela, Parbhani Kranti, HBR 55, Azad Bhindi 1, Pusa Makhmali, Kashi Satdhari, Punjab7, No. 315, Perkins Long Green, SB 8, VROR 159, Punjab Padmini	
	Light red	2	5.56	Azad Bhindi 3, Kashi Lalima	
	Red	0	0		
	Purple	0	0		
Fruit: Length (cm) at marketable stage (four days after anthesis)	Small	1	2.78	SB 2	MS
	Medium	30	83.33	VROR 159, Phule Utkarsh, Pusa A-4, Hisar Naveen, GO 2, GJO 3, Arka Anamika, Azad Bhindi 2, Azad Bhindi 3, Punjab 8, BO 13, HRB 231, VRO 4, VRO 3, Kashi Pragati, Kashi Leela, Parbhani Kranti, Kashi Lalima, Pusa Sawani, BO 2, HRB 55, Azad Bhindi 1, Arka Abhay, Punjab Padmini, Pusa Makhmali, Kashi Satdhari, Punjab 7, No. 15, Perkins Long Green, SB 8	
	Long	5	13.89	Susthira, Varsha Uphar, Kashi Vibhuti, D1-87-5, No.136	
Fruit: Diameter (at mid length) (cm)	Small (<1.0)	1	2.78	No 136	MS
	Medium (1.0-1.5)	28	77.78	Punjab 8, Kashi Leela, SB 2, VROR 159, Phule Utkarsh, Pusa A-4, Varsha Uphar, Hisar Naveen, GO 2, GJO 3, Arka Anamika, Azad Bhindi 2, D1-87-5, BO 13, HRB 231, VRO 4, VRO 3, Kashi Pragati, Parbhani Kranti, Kashi Lalima, HRB 55, Azad Bhindi 1, Arka Abhay, Punjab Padmini, Pusa Makhmali, Kashi Satdhari, Punjab 7, Azad Bhindi 3, SB 8	
	Long (>1.5)	6	16.67	Susthira, Kashi Vibhuti, Pusa Sawani, BO 2, No 315, Perkins Long Green	
Fruit: Surface between ridges	Concave	8	22.22	SB 2, Hisar Naveen, Punjab 8, BO 13, Pusa Sawani, Arka Abhay, Punjab 7, No 315	VG
	Flat	27	75.00	No 136, VROR 159, Phule Utkarsh, Pusa A-4, Varsha Uphar, GO 2, GJO 3, Arka Anamika, Kashi Vibhuti, Azad Bhindi 2, Azad Bhindi 3, D1-87-5, HRB 231, VRO 4, VRO 3, Kashi Pragati, Kashi Leela, Parbhani Kranti, Kashi Lalima, BO 2,	

contd.

Table 2 (Continued)

Characteristic	States	No. of cultivars	Per cent of cultivars	Cultivars	Type of assessment
Fruit: Pubescence	Convex	1	2.78	HRB 55, Azand Bhindi 1, Punjab Padmini, Pusa Makhamali, Kashi Satdhari, Perkins Long Green, SB 8	VG
	Absent	2	5.56	Susthira	
	Weak	12	33.33	SB 2, SB 8	
	Medium	14	38.89	VROR 159, Phule Utkarsh, Pusa A-4, Susthira, HRB 231, VRO 4, VRO 3, Kashi Pragati, Pusa Sawnai, Arka Abhay, Punjab Padmini, Punjab 7	
	Strong	8	22.22	Varsha Uphar, Hisar Naveen, GJO 3, Arka Anamika, Azad Bhindi 2, Azad Bhindi 3, Kashi Leela, Parbhani Kranti, Kashi Lalima, BO 2, Azad Bhindi 1, Kashi Satdhari, No. 15, Perkins Long Green	
Fruit: Constriction of basal part	Absent	5	13.89	No 316, GO 2, Kashi Vibhuti, D1-87-5, Punjab 8, BO 13, HRB 55, Pusa Makhmali	VG
	Weak	22	61.11	SB 8, No 316, VROR 159, Phule Utkarsh, Punjab 8	
	Strong	9	25.00	SB 2, Pusa A-4, Susthira, Varsha Uphar, Hisar Naveen, GO 2, Arka Anamika, Azad Bhindi 2, Azad Bhindi 3, D1-87-5, VRO 4, VRO 3, Kashi Pragati, Kashi Leela, Kashi Lalima, Pusa Sawani, HRB 55, Azad Bhindi 1, Arka Bhindi 1, Arka Abhay, Punjab Padmini, Kashi Satdhari, No 315	
Fruit: Shape of apex	Narrow acute	15	41.67	SB 8, GJO 3, Kashi Bibhuti, BO 13, HRB 231, Parbhani Kranti, BO 2, Pusa Makhamali, Perkins Long Green	VG
	Acute	17	47.22	SB 2, VROR 159, Phule Utkarsh, Susthira, Hisar Naveen, GO 2, Arka Anamika, Azad Bhindi 2, HRB 231, VR O3, Kashi Pragati, Kashi Leela, Kashi Lalima, BO 2, Arka Abhay	
Fruit: Number of locules	Blunt	4	11.11	SB 8, No 136, Pusa A-4, Pusa Sawani, Varsha Uphar, Kashi Vibhuti, Azad Bhindi 3, D1-87-5, Punjab 8, BO 13, VRO 4, Parbhani Kranti, BO 2, HRB 55, Azad Bhindi 1, Punjab Padmini, Punjab 7, Perkins Long Green, Kashi Satdhari	MS
	<6	34	94.44	SB 2, GJO 3, Pusa Makhmali, No. 315	
	6 to 7	1	2.78	No 136, VROR 159, Phule Utkarsh, Pusa A-4, Susthira, Varsha Uphar, Hisar Naveen, GO 2, GJO 3, Arka Anamika, Kashi Vibhuti, Azad Bhindi 2, Azad Bhindi 3, D1-87-5, Punjab 8, BO 13, HRB 231, VRO 4, VRO 3, Kashi Pragati, Kashi Leela, Parbhani Kranti, Kashi Lalima, Pusa Sawani, BO 2, HRB 55, Azad Bhindi 1, Arka Abhay, Punjab Padmini, Pusa Makhamli, Punjab 7, Perkins Long Green, SB 2, SB 8	
	>8	1	2.78	Kashi Satdhari	
Plant: Number of branches	Few (<2)	7	19.44	No.315	MS
	Medium (2-4)	25	69.44	SB 2, Phule Tukarsh, Susthira, Hisar Naveen, GJO 3, BO 13, VRO 3	
	Many (>4)	4	11.11	No 136, Pusa A-4, Varsha Uphar, GO 2, Arka Anamika, Kashi Vibhuti, Azad Bhindi 2, Azad Bhindi 1, D1-87-5, Punjab 8, HRB 231, VRO 4, Kashi Pragati, Kashi Leela, Kashi Lalima, Pusa Sawani, BO 2, HRB 55, Azad Bhindi 1, Arka Abhay, Punjab Padmini, Pusa Makhamli, Kashi Satdhari, Punjab 7, SB 8	
Stem: Diameter (at 10 cm above ground level) (cm)	Small (<1)	2	5.56	VROR 159, Parbhani Kranti, No 315, Perkins Long Green	MS
	Medium (1-1.5)	23	63.89	SB 2, SB 8	
	Many (>1.5)	4	11.11	No 136, Phule Utkarsh, Pusa A-4, Susthira, Varsha Uphar, Hisar Naveen, GO 2, GJO 3, Arka Anamika, Kashi Vibhuti, Azad Bhindi 2, Azad Bhindi 3, BO 13, HRB 231, VRO 4, VRO 3, Kashi Pragati, Kashi Leela, Kashi Lalima, BO 2,	

contd.

Table 2 (Concluded)

Characteristic	States	No. of cultivars	Per cent of cultivars	Cultivars	Type of assessment
Plant: Height (cm)	Large(>1.5)	11	33.33	HRB 55, Punjab Padmini Pusa Makhmali VROR 159, D1-87-5, Punjab 8, Parbhani Kranti, Pusa Sawani, Azad Bhindi 1, Arka Abhya, Kashi Satdhari, Punjab 7, No 315, Perkins Long Green	MS
	Short (<90)	3	8.33	No 315, Susthira, Kashi Vibhuti	
	Medium (90-120)	9	25.00	Punjab 7, Pusa Makhmali, BO 2, Varsha Uphar, HRB 55, D1-87-5, Pusa Sawani, BO 13, Pusa A-4	
	Tall (>120)	24	66.67	No 136, Phule Utkarsha, Hisar Naveen, GO 2, GJO 3, Arka Anamika, Azad Bhindi 2, Azad Bhindi 3, Punjab 8, HRB 231, VRO 4, VRO 3, Kashi Pragati, Kashi Leela, Parbhani Kranti, Azad Bhindi 1, Arka Abhay, Punjab Padmini, Kashi Satdhari, Perkins Long Green, VROR 159, Kashi Lalima	
Fruit: Length of physiologically mature fruit (cm)	Short (<10)	2	5.56	SB 2, SB 8	VG
	Medium (10-15)	5	13.89	Pusa A-4, Azad Bhindi 3, HRB 55, Azad Bhindi 1, Pusa Makhmali	
	Long (>15)	29	80.56	No. 136, VROR 159, Phule Utkarsh, Susthira, Varsha Uphar, Hisar Naveen, GO 2, GJO 3, Arka Anamika, Kashi Vibhuti, Azad Bhindi 2, D1-87-5, Punjab 8, BO 13, HRB 231, VRO 4, VRO 3, Kashi Pragati, Kashi Leela, Parbhani Kranti, Kashi Lalima, Pusa Sawani, BO 2, Arka Abhay, Punjab Padmini, Kashi Satdhari, Punjab 7, No 315, Perkins Long Green	
Fruit: Diameter at mid length (cm)	Small (<1.5)	2	5.56	SB 8, No. 136	MS
	Medium (1.5-2.5)	31	86.11	VROR 159, Phule Utkarsh, Pusa A-4, Susthira, Varsha Uphar, Hisar Naveen, GO 2, GJO 3, Arka Anamika, Azad Bhindi 2, Azad Bhindi3, D1-87-5, Punjab 8, BO 13, HRB 231, VRO 4, VRO 3, Kashi Pragati, Kashi Leela, Parbhani Kranti, Kashi Lalima, Pusa Sawani, HRB 55, Azad Bhindi 1, Arka Abhay, Punjab Padmini, Pusa Makhmali, Kashi Satdhari, Punjab 7, No 315, Perkins Long Green	
	Large(>2.5)	3	8.33	SB 2, Kashi Vibhuti, No 315	
Seed: Colour	Green	24	66.67	SB 8, No 136, VROR 159, Phule Utkarsh, Pusa A4, Varsha Uphar, Hisar Naveen, GJO 3, Arka Anamika, D1-87-5, Punjab 8, HRB 231, VRO 4, VRO 3, Kashi Pragati, Parbhani Kranti, Kashi Lalima, BO 2, HRB 55, Arka Abhay, Punjab Padmini, Pusa Makhmali, Punjab 7, Perkins Long Green	VG
	Brown	12	33.33	SB 2, Susthira, GO 2, Kashi Vibhuti, Azad Bhindi 2, Azad Bhindi 3, BO 13, Kashi Leela, Pusa Sawani, Azad Bhindi 1, Kashi Satdhari, No 315	
Seed: Hairiness	Absent	28	77.78	VROR 159, Phule Utkarsha, Susthira, Varsha Uphar, Hisar Naveen, GJO 3, Arka Anamika, Kashi Vibhuti, Azad Bhindi 2, Azad Bhindi 3, Punjab 8, BO 13, HRB 231, VRO 4, Kashi Pragati, Kashi Leela, Kashi Lalima, Pusa Sawani, BO 2, Arka Abhay, Punjab Padmini, Pusa Makhmali, Kashi Satdhari, Punjab 7, No 315, Perkins Long Green	VG
	Present	8	22.22	No 136, Pusa A-4, GO 2, D1-87-5, VRO 3, Parbhani Kranti, HRB 55, Azad Bhindi 1	

(\*) Grouping trait. MG : Measurement by a single observation of a group of plants or parts of plants, MS : Measurement of a number of individual plant 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 plant or parts of plants

#### Stem and leaf characters

Most of the cultivars recorded green stem colour (91.67%) except VROR 159, Azad Bhindi 3 and Kashi Lalima (8.33%) which have red stem colour. Intensity of stem green

colour was grouped as light in 11 cultivars (30.56%), medium in 11 cultivars (30.56%) and dark in 14 cultivars (38.89%). Leaf depth of lobing was shallow in six cultivars (16.67%); medium in 10 cultivars (27.78%) while rest of cultivars

(52.78%) showed deep leaf lobing. First flower appeared in less than 5 nodes in No. 315; 5-8 nodes in 3 cultivars (8.33%) and rest of the cultivars (88.89%) more than 8 nodes. Earliness is another trait of economic importance and the cultivars were classified into three group, viz. early (<35 days), medium (35-45 days) and late (>45 days) on the basis of days to 50% flowering. Most of the cultivars belonged to the late group (63.89%). Pusa A-4, Kashi Leela and Punjab Padmini were early in flowering (8.33%) while rest of the cultivars (27.78%) were medium late in flowering. On the basis of leaf blade length, the cultivars were characterized in three groups (small, medium, large) where most of the cultivars had large (69.44%) and medium (25%) leaf blade length except Susthira and Punjab Padmini which depicted small leaf blade length. Most of cultivars had strong (63.89%) and medium (22.22%) leaf blade serration of margin except Susthira, Arka Anamika, Azad Bhindi 3, Kashi Lalima and Punjab Padmini which exhibited weak leaf blade serration of margin. The 80.56% cultivars exhibited light green vein colour while 7 cultivars (19.44%) had red vein colour. Petiole length was another trait with good variability which grouped into short, medium and long category. Most of cultivars were in medium (41.67%) and long petiole length (44.44%) category except Susthira, Varsha Uphar, Hisar Naveen, GO-2 and GJO-3 with short petiole length. These results agreed with the findings of Martin and Rhodes (1983), Lotilo (1989), Gondane and Bahatia (1995) and Hazra and Basu (2000).

#### *Flower and fruit characters*

Flower petal colour was cream in SB 2, SB 8, Susthira and No.315, while yellow in rest of the cultivars (88.89%). A proportionate distribution of cultivars (77.78%) in both side petal purple base colour and inside only purple base colour were observed with few cultivars like SB 2, No. 136, Susthira, Arka Anamika, Azad Bhindi 2, HRB 55, Azad Bhindi-1 and Punjab 7. On the basis of flower length and diameter, the cultivars are classified into, small, medium and large groups. Most of the cultivars fall belong to large and medium groups. There were few cultivars with short flowers length (SB 2, SB 8, GJO 3 and VRO 4) and width (SB 8 and Punjab Padmini). Fruit colour varied from light green, green, light red, red and purple and most of the cultivars (75%) had green fruit colour. Eight cultivars (22.22%) had light green while only 2 cultivars (5.56%) had light red fruit colour. Fruit length at marketable stage (four days after anthesis) is an important trait of economic importance and the studied cultivars were grouped into small, medium and long. Most of the cultivars were in medium (83.33%) and long (13.89%) group. Only one cultivar (SB 2) had small fruit length. The cultivars were also classified on the basis of fruit surface between ridges in three groups, i.e. concave, flat and convex. Most of the cultivars had concave (22.22%) or flat (75%) except Susthira which depicted convex surface between ridges of fruit. On the basis of fruit shape of apex, the cultivars were classified into three groups, i.e. narrow acute, acute and blunt. Most of the cultivars recorded

narrow acute (41.67%) and acute (44.44%) while rest of the cultivars (13.89%) blunt fruit shape of apex. 99.44% cultivars had less than 6 locules except Kashi Satdhari and No. 315 which had seven locules. Considerable variation was also observed for number of branches and observed few number of branches in seven cultivars (19.44%), 25 cultivars (69.44%) showed medium number of branches while, rest of the cultivars (11.11%) showed many number of branches. In this study, the cultivars were classified into three groups on the basis of plant height, viz. short (<90cm), medium (90-120 cm) and tall (>120cm). A proportionate distribution of cultivars in medium (25%) and tall (66.67%) group were observed while, few cultivars (8.33%) like No. 315, BO2, Susthira and Kashi Vibhuti had short plant height. These results were in consonance with the earlier reports of Panda and Singh (1997), Dhankar and Dhankar (2002) and Mehta *et al.* (2006) in okra. Cultivars were also characterized on the basis of seed colour and seed hairiness. On the basis of seed colour the cultivars were classified into two groups, viz. green and brown. Twenty four cultivars (66.67%) showed green seed colour while others (33.33%) had brown seed colour. On the basis of seed hairiness, the cultivars were group into two categories, viz. absent and present. Most of the cultivars (77.78%) were without seed hair except No. 136, Pusa A-4, GO 2, DI-87-5, VRO 3, Parbhani Kranti, HRB55 and Azad Bhindi 1 with seed hair. Similar results were reported by Jaiprakashnarayan and Mulge (2004) and Sarkar *et al.* (2004) in okra.

On the basis of present investigation, 36 cultivars were grouped into different categories for 31 characters observed all of many could be used as reference cultivar. More than one reference cultivar for a state of expression of characteristic is desirable in case the cultivar deteriorates for the given character and/or it does not get expressed due to in some growing condition and areas. However, a strict adherence to the maintenance breeding procedures to maintain the varietal purity would be of utmost importance.

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