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DISTINCTNESS, UNIFORMITY AND STABILITY DUS TRAITS FOR CHARACTERIZATION OF OKRA (*ABELMOSCHUS ESCULENTUS* L. MOENCH)

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ABSTRACT

The present study was conducted during the spring–summer season of 2025 at the University Farm, Department of Vegetable Science, Post Graduate Institute of Horticultural Sciences (PGIHS), Mulugu, Telangana. Six okra genotypes IC42456 × Kashi Lalima, IC42456 × Parbhani Kranti, EC329370 × Parbhani Kranti, EC329370 × Punjab Suhavani, and IC39136 × Kashi Lalima were evaluated in a Randomized Block Design with three replications. Standard agronomic practices were adopted, including the dibbling of 2–3 seeds per hill at 30 × 45 cm spacing, along with the application of 100:50:50 NPK kg/ha and 20 tons/ha of farmyard manure. Morphological evaluation was conducted based on the 25 qualitative descriptors prescribed in the DUS guidelines of NBPGR (2022). Traits studied included stem colour, thickness, and flowering node; leaf blade features (length, width, serration, pigmentation); petiole colour; floral traits (petal colour, size, anthocyanin pigmentation); fruit descriptors (colour, ridges, pubescence, constriction, apex shape); and seed coat colour.

***Key words*:** Okra, genotypes, Qualitative descriptors, DUS.

Introduction

Okra [*Abelmoschus esculentus* (L.) Moench] is a prominent vegetable crop in India, usually called lady's finger (Maruthi *et al*., 2023). Okra (*Abelmoschus esculentus* L. Moench) is a widely cultivated and consumed vegetable crop that is valued primarily for its tender green pods (Balagoni *et al*., 2023). In India, it is predominantly grown during the summer and rainy seasons, when the country holds a dominant position as the leading global producer, contributing approximately 72.9% of the total world output (Maruthi *et al*., 2025). The crop is cultivated over an estimated 554.49 thousand hectares, with an annual production of 7,288.51 million tons and an average productivity of 13.14 metric tons per hectare (Anon, 2024). It is a polyploid, having chromosomal number 2n=72 or 144 (Balagoni *et al*., 2025). Major okra-producing states in India include Andhra Pradesh, Assam, Bihar, Odisha, Gujarat, Jharkhand, Karnataka, and Tamil Nadu (Anon 2024). Okra is also recognized for its high nutritional value and rich source of vitamins, carbohydrates, minerals, proteins, and unsaturated fatty acids (De Sousa *et al*., 2020). Okra dry seeds serve as a valuable source of edible oil, enriched with high levels of unsaturated fatty acids, particularly oleic and linoleic acids (Sidapara *et al*., 2021). Moreover, bioactive compounds in okra exhibit specific mechanisms of action against various diseases (Elkhalifa *et al*., 2021). It is a nutritious source of carbohydrates, proteins, fat, minerals, vitamins and iodine (Singh *et al*., 2023). Characterization of the germplasm provides details about

the attributes of each genotype, ensuring that end users achieve the best advantage of the germplasm collection (Reddy *et al.*, 2016). Vegetable breeders looking for novel trait genes must morphologically characterize landraces, germplasms, genotypes, and local cultivars (Reddy *et al*., 2016), and there is considerable variation in the chromosome numbers of cultivated okra species. Several researchers have highlighted the potential of improving okra through the exploration and utilization of genetic resources (Oppong-Sekyere *et al.*, 2011). Morphological descriptors help to characterize plant genotypes based on external traits (Joshi *et al*., 2020).

The present study aimed to characterize, assess and compare the morphological traits of okra genotypes to identify their variability and distinctiveness. The primary objective of this study was to provide okra breeders with reliable morphological descriptors that can serve as potential breeding traits for the development of farmer-preferred varieties.

Materials and Methods

The experimental material consisted of six okra crosses, namely IC42456 × Kashi Lalima, IC42456 × Parbhani Kranti, EC329370 × Parbhani Kranti, EC329370 × Punjab Suhavani, IC39136 × Kashi Lalima. The experiment was conducted during the spring-summer season of 2025 at the University Farm, Department of Vegetable Science, Post Graduate Institute for Horticultural Sciences (PGIHS), Mulugu, Siddipet district, Telangana. The study was conducted in a Randomized Block Design (RBD) with three replications, maintaining a spacing of 30 cm × 45 cm between rows and plants. Seeds were sown by dibbling 2–3 seeds per hill, and a recommended fertilizer dose of 100:50:50 NPK kg/ha, along with 20 tons/ha of farmyard manure (FYM), was applied to the crop. The genotypes were evaluated and observations were recorded for 25 qualitative traits ., Stem colour, Stem: Node number at which the first flower opens, Stem: Diameter at 10 cm above ground level (cm), Leaf blade: Sinus depth of terminal lobe (cm), Leaf blade: Length (cm), Leaf blade: Width (cm), Leaf blade: Serration of margin, Leaf blade: Colour between veins, Vein: Colour, Petiole: Length (cm), Piko: Colour (the point of junction between the leaf blade and the petiole on the lower surface), Flowering: Days to 50% flowering at the time of anthesis, Flower: Petal colour at anthesis, Flower: Colour of petal base (red purple), Flower: Length of fully opened flower (cm), Flower: Diameter of fully opened flower (cm), Male sterility, Fruit: Colour, Fruit: Length at marketable stage on the main stem (cm), Fruit: Ridges, Fruit: Surface between ridges, Fruit: Pubescence (trichomes), Fruit: Constriction at the basal part, Fruit: Shape of apex, and Seed coat: Colour. These traits were assessed according to the minimal descriptors based on the DUS guidelines (Table 1) (Fig. 1) of NBPGR (2022) to characterize the bhindi genotypes during the course of the investigation.

Results and Discussion

The study revealed significant morphological diversity among okra genotypes, encompassing vegetative, floral, fruit and seed traits, thereby offering valuable descriptors for genotype differentiation and breeding purposes. (Table 2).

Stem colour exhibited three distinct classes: dark green (Cross-1), light green (Cross-2), and bicolour (Cross-5), while Cross-3 and Cross-4 maintained a uniform green colour. Such pigmentation differences are reliable morphological markers for genotype identification (Reddy *et al*., 2016). Stem thickness at 10 cm above ground level varied from thin (Cross-3, Cross-5) to thick (Cross-1), reflecting differences in vigour. Earliness was indicated by the node of first flower appearance, with Cross-2 and Cross-4 classified as early, while Cross-1, Cross-3, and Cross-5 were medium, aligning with reports that earliness is a highly heritable trait in okra (Oppong-Sekyere *et al*., 2011). Leaf morphology demonstrated pronounced polymorphism. Leaf blade length ranged from short (Cross-1, Cross-5) to medium (Cross-2–4), while leaf width was narrow in Cross-2 and Cross-4 and medium in the others. Serration patterns further differentiated genotypes as dentate-serrate (Cross-1), doubly serrate (Cross-2, Cross-5) and simple serrate (Cross-3, Cross-4). Interveinal pigmentation also varied, with Cross-1 showing red-purple, Cross-2, Cross-3 and Cross-5 exhibiting light green and Cross-4 displaying dark green. These traits could serve as rapid field-based markers for genotype discrimination.

Floral traits also revealed considerable diversity. Petiole colour alternated between red-purple (Cross-1, Cross-5) and green (Cross-3, Cross-4). Flowering behaviour was early in Cross-1 and Cross-5, while medium in the other genotypes. Petal colour showed marked differences: light red-purple (Cross-1), dark yellow (Cross-2–4), and deep red-purple (Cross-5). Notably, all genotypes exhibited stable red-purple pigmentation at the petal base (Devi *et al*., 2017). Flower size varied moderately, with Cross-1 and Cross-4 producing smaller flowers, whereas others were medium. Floral traits such as petal colour and flower size are important for pollinator attraction and reproductive efficiency, while the absence of male sterility across all genotypes suggests the need for additional interventions

Table 1: Okra descriptors (as per the DUS guidelines for 2022).

S.no	Characteristics	States	Codes	Type of assessment
1.	Stem colour	Green	G	VG
		Red Purple	RP	
		Bicolour	BI	
		Light Green	LG	
		Dark Green	DG	
		Light red Purple	LRP	
		Dark red Purple	DRP	
2.	Stem: Node number at which first flower opens	Early	E	MS
		Medium	M	
		Late	L	
3.	Stem: Diameter at 10 cm above ground level (cm)	Thin	T	MS
		Medium	M	
		Thick	TH	
4.	Leaf blade: Sinus depth of terminal lobe (cm)	Shallow	S	MG
		Medium	M	
		Deep	D	
5.	Leaf blade: Length (cm)	Short	S	MS
		Medium	M	
		Long	L	
6.	Leaf blade: Width (cm)	Narrow	N	MS
		Medium	M	
		Broad	B	
7.	Leaf blade: Serration of margin	Dentate serrate	DES	VS
		Serrate	S	
		Doubly serrate	(DOS)	
8.	Leaf blade: Colour between veins	Green	G	VS
		Red purple	RP	
		Light green	LG	
		Dark green	DG	
		Light red purple	LRP	
		Dark red purple	DRP	
9.	Vein: Colour	Green	G	VS
		Red purple	RP	
10.	Petiole: Length	Short	S	MS
		Medium	M	
		Long	L	
11.	Piko: Colour (The point of junction between the leaf blade and the petiole on the lower surface)	Green	G	MS
		Red purple	RP	
12.	Flowering: Days to 50 % flowering with at least one open flower	Early	E	VG
		Medium	M	
		Late	L	
13.	Flower: Petal colour at the time of anthesis	Yellow	Y	VG
		Dark yellow	DY	
		Light red purple	LRP	
		Dark red purple	DRP	
14.	Flower: Colour of petal base (Red Purple)	Inside only	I	VG
		Both sides	BS	
15.	Flower: Length (fully opened flower) (cm)	Short	S	MS
		Medium	M	
		Long	L	

Continue ...1

16.	Flower: Diameter from the top of the fully opened flower (cm)	Small	S	MS
		Medium	M	
		Long	L	
17.	Male Sterility	Absent	A	VS
		Present	P	
18.	Fruit: Colour	Light green	LG	VG
		Green	G	
		Dark green	DG	
		Light red purple	LRP	
		Dark red purple	DRP	
19.	Fruit: Length at marketable stage on main stem (cm)	Short	S	MS
		Medium	M	
		Long	L	
20.	Fruit: Ridges	Absent	A	MS
		Present	P	
21.	Fruit: Surface between ridges	Concave	C	VS
		Flat	F	
		Convex	CO	
22.	Fruit: Pubescence (Trichome)	Absent	A	VS
		Weak	W	
		Medium	M	
		Strong	S	
23.	Fruit: Constriction at basal part.	Absent	A	VG
		Weak	W	
		Strong	S	
24.	Fruit: Shape of apex	Narrow	N	VG
		Acute	A	
		Blunt	B	
25.	Seed Colour	Green	G	VG
		Olive green	OG	

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 plant

for hybrid breeding.

Fruit characteristics provided distinct differentiation. Fruit colour ranged from light red-purple (Cross-1, Cross-5) to green (Cross-2, Cross-3) and dark green (Cross-4). Fruit length was short in Cross-1–4 but medium in Cross-5, an attribute associated with consumer acceptance and yield potential. Ridge morphology also varied: flat (Cross-1, Cross-5), convex (Cross-2) and concave (Cross-3, Cross-4). Weak pubescence was observed uniformly, while basal constriction appeared only in Cross-4. Apex shape distinguished genotypes into blunt (Cross-1, Cross-5) and narrow (Cross-2–4). Seed coat colour segregated into two categories: green (Cross-1, Cross-5) and olive green (Cross-2–4).

According to Reddy *et al*., (2016) incorporating qualitative traits is essential for the proper characterization, identification, and description of diversity among okra genotypes. Similar evaluations of bhindi germplasm using qualitative attributes have also been reported by Islam (2022), Mohammad *et al*., (2022), Roy (2022) and Pranay (2022). Morphological characterization serves as a key tool for detecting diagnostic features that distinguish genotypes, thereby assisting breeders in selecting promising lines with desirable traits for crop improvement (Chavan *et al*., (2018); Pallakki *et al*., (2022); Koundinya *et al*., (2013); Reddy *et al*., (2022); Verma *et al*., (2018). Systematic evaluation of genetic resources enables differentiation and selection of accessions based on

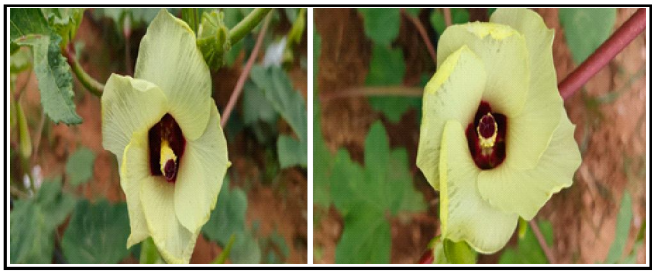

Fig. 1: Flower: Petal colour at the time of anthesis.

Table 2: Morphological characterization of okra genotypes based on qualitative traits.

Cross	C1	C2	C3	C4	C5
1. Stem Colour	DG	LG	G	G	BC
2. Stem node number at which flower open.	M	E	M	E	M
3. Stem: Diameter at 10 (cm) above ground level	TH	M	T	M	T
4. Leaf blade Sinus depth of terminal lobe (cm)	M	M	M	S	M
5. Leaf blade Length (cm)	S	M	M	M	S
6. Leaf blade: Width (cm)	M	N	M	N	M
7. Leaf blade: Serration of margin	DES	DOS	S	S	DOS
8. Leaf blade: Colour between veins	RP	LG	LG	DG	LG
9. Vein: Colour	G	G	RP	G	RP
10. Petiole: Length (cm)	S	S	S	S	S
11. Piko: Colour (The point of junction between the leaf blade and the petiole on the lower surface)	RP	G	G	G	RP
12. Flowering: Days to 50 % flowering with at least one open flower	E	M	M	M	E
13. Flower: Petal colour at the time of anthesis	LRP	DY	DY	DY	DRP
14. Flower Colour of petal. base (Red Purple)	I	I	I	I	I
15. Flower: Length (fully opened flower) (cm)	M	M	M	M	M
16. Flower: Diameter from the top of the fully opened flower (cm)	S	M	M	S	S
17. Male Sterility	A	A	A	A	A
18. Fruit: Colour	LRP	G	G	DG	LRP
19. Fruit: Length at marketable stage on main stem (cm)	S	S	S	S	M
20. Fruit: Ridges	P	P	P	P	P
21. Fruit: Surface between ridges	Flat	Convex	Concave	Concave	Flat
22. Fruit: Pubescence (Trichome)	Weak	Weak	Weak	Weak	Weak
23. Fruit: Constriction at basal part	A	A	A	W	A
24. Fruit: Shape of apex	B	N	N	N	B
25 Seed Colour	G	OG	OG	OG	G

C1: Cross-1 (IC42456 × KashiLalima); **C2:** Cross-2(IC42456 × Parbhani Kranti); **C3:** Cross-3 (EC329370 × Parbhani Kranti); **C4:** Cross-4(EC329370 × Punjab Suhawani); **C5:** Cross-5(IC39136 x Kashi Lalima)

distinct traits, while qualitative traits provide critical insights into genetic variability. Such information is invaluable for crop development, effective utilization of plant genetic resources, and their conservation (Reddy *et al*., 2023).

Conclusion

The comprehensive morphological characterization of okra genotypes revealed considerable diversity in vegetative, floral, fruit and seed traits. This variability ensures distinctness and uniformity for cultivar recognition while also providing a valuable genetic base for breeding. Key traits such as earliness, fruit colour, length, ridge morphology, and seed coat colour offer practical markers for selection. The observed diversity has direct implications for breeding programs, enabling the development of cultivars tailored to consumer preferences, market demands, and agro-ecological adaptation. Furthermore, the identified morphological markers can facilitate rapid genotype discrimination, germplasm conservation, and targeted improvement strategies, thereby supporting the development of high-yielding, climate-resilient okra varieties.

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