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MORPHOLOGICAL DIVERSITY AND DUS-BASED CHARACTERIZATION OF UNDERUTILIZED CHALANA (CITRULLUS SPP.) GERMPLASM FROM EASTERN INDIA

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ABSTRACT
Chalana (Citrullus spp.), a white-fleshed vegetable watermelon, holds regional importance in eastern India, especially Odisha and West Bengal but remains underutilized in breeding efforts. This study aimed to collect, characterize, and evaluate morphological diversity in locally cultivated Chalana genotypes using Distinctness, Uniformity and Stability (DUS) descriptors for varietal identification and improvement. Twenty-five genotypes from traditional growing areas were assessed in a randomized complete block design with three replications for key vegetative, floral and fruit traits. Considerable phenotypic variation was observed, notably in fruit stripe pattern, veining and shape. The Shannon-Weaver diversity index (H') ranged from 0 to 1.22, with a mean of 0.50, suggesting moderate to high diversity. Traits like leaf colour (0.69), petiole length (1.02), ovary dimensions (0.63), and fruit stripe characteristics (up to 1.22) showed the most variability, making them useful for selection. The study emphasizes the potential of fruit morphological traits in distinguishing genotypes and highlights the need to conserve and utilize regional germplasm for Chalana improvement.

KEYWORDS: Chalana, Shannon-Weaver diversity index, diversity, genotypes

INTRODUCTION
Watermelon (Citrullus lanatus [Thunb.] Matsum & Nakai) is a member of the Cucurbitaceae family. This diploid species with chromosome number of 2n = 22 (Whitaker and Davis, 1962), grows as an annual, trailing vine. Its ability to tolerate drought makes it especially suitable for arid and semi-arid regions of India. The crop adaptability across different agro-climatic zones also makes it a valuable option for small and marginal farmers. It is a warm season crop grows best in temperatures between 25°C and 35°C and is usually cultivated during the spring-summer or early kharif seasons under irrigated conditions.
Mallick and Masui (1986) traced watermelon's origin to Central Africa, where wild forms still exist in the Kalahari (Robinson and Decker-Walters, 1997). The crop reached India around 800 AD and China by 1100 AD (Zhao, 2015; Levi et al. 2017). Reddy et al. (2013) classified cultivated forms as C. lanatus var. lanatus and C. lanatus var. citroides, encompassing red fleshed sweet, seed purpose egusi and white fleshed vegetable types. This study focuses on the white-fleshed vegetable type "Chalana" valued in Odisha and West Bengal (where it is locally known as "Khero."), often consumed immature and cooked for its mild taste and texture.
Chalana fruits are widely used in local cuisine like curries, raita or salads. In West Bengal, the mature form is called 'pand'. Nutritionally, the immature white-fleshed fruits of Chalana are quite similar to watermelon. The water content is high but they are low in calories, making them ideal for light cooking. Although detailed nutritional data on immature fruits is limited, they are known to contain over 91% water along with moderate levels of carbohydrates, vitamin C, potassium and small amounts of essential vitamins like pyridoxine, thiamin and pantothenic acid. Chalana is also a natural source of a beneficial amino acid, Citrulline and its rind contains phenolic compounds and dietary fiber that offer antioxidant benefits.
Botanically, Chalana bears male and female flowers on the same plant but at different nodes. Fruits are generally medium to narrowly elliptic. In the immature stage, the fruit surface is smooth and glossy, ranging from light to dark green and may show thin, thick or no stripes at all. Traits such as rind color, patterns and flesh texture are genetically determined. Mohanta and Mandal (2019) initiated a crop improvement program targeting both immature and mature types, leading to varieties show casing broad genetic diversity. Such initiatives help develop region-specific cultivars suited to local growing conditions and food preferences.

DUS testing, as mandated by the Plant Varieties and Farmers Right Act (PPV & FRA), is essential for varietal registration and identification of crop genotypes without duplication (Das and Kumar, 2012). The collection, characterization, and evaluation of genotypes are fundamental steps in preserving, improving, and certifying crop varieties. Morphological characterization supports genotype identification and quantifies genetic variation. In Chalana, rich diversity exists in the landraces of Odisha and West Bengal, representing vital germplasm for breeding and fundamental research (Dudnik et al., 2019; Mario et al., 2020). Chalana productivity in Odisha remains low due to poor farming practices and low-quality seeds. With limited existing data and genetic utilization, this study aims to collect, characterize and assess diversity among Chalana (Citrullus spp.) genotypes.

MATERIALS AND METHODS

Twenty-five Chalana genotypes (Table 1) were studied during summer 2024 at the Post-Graduate Research Farm, Department of Horticulture, M. S. Swaminathan School of Agriculture, Centurion University, Paralakhemundi, Odisha (18°48'01.9"N, 84°08'39.8"E). The 2.8-acre subtropical site has three seasons: summer/pre-kharif (March–June), rainy (July–October) and winter (November–February). During the experiment (March-July 2024), average temperatures ranged from 24°C to 38°C, rainfall was 3.9 mm and relative humidity averaged 82%. A Randomized Complete Block Design (RCBD) with three replications was followed. Plant spacing was 2.0 m (row) × 0.6 m (plant). Basal FYM (15 t/ha) was applied and fertilizers at 80:60:80 kg N:P_2O_5:K_2O per hectare were used. Standard agronomic practices were followed throughout.

Trait Recording and Scoring

Sixteen morphological traits were recorded using PPVFRA and UPOV guidelines for DUS testing (Tables 2–4). Qualitative traits were standardized for diversity analysis and to avoid redundancy.

Table 1: Details of Chalana (Citrullus spp.) genotypes and their site of collection

Sl. No.	Genotypes	Place of Collection
1	VC-38	Bolpur, West Bengal
2	VC-35	
3	VC- 37	
4	VC-29	Illambazar, West Bengal
5	VC-30	
6	VC-11	Sriniketan, West Bengal
7	VC-10	
8	VC-18	
9	VC-13	
10	VC-12	
11	VC-17	
12	VC-14	
13	VC-23	Ghuskara, West Bengal
14	VC-22	
15	VC-28	Raipur, West Bengal
16	VC-27	
17	VC-24	
18	VC-106	Joydev, West Bengal
19	VC-32	
20	GOS-1	Gosani, Odisha
21	GOS-2	
22	VC-6	Visva Bharati University, West Bengal
23	VC-9	
24	VC-8	
25	VC-3	

Figure 1: Frequency distribution of Chalana (Citrullus spp.) genotypes for plant growth traits

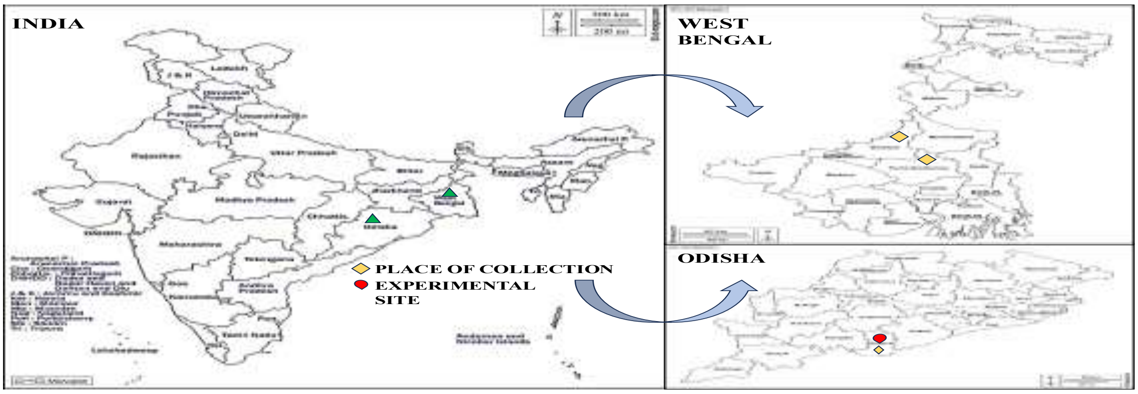


Table 2. List of morpho-phenological traits and assigned scale for different qualitative traits in the study

Traits	Acronyms	Description with Scale
Primary lobing	PL	Recorded during vegetative stage when the plant has 4 to 6 fully developed true leaves Weak=3, Medium=5 and Strong = 7
Secondary lobing	SL	Observed at 6 to 8 leaf stage when leaves are fully expanded. Weak=3, Medium=5 and Strong = 7
Leaf blade colour	LBC	Intensity of green colour was recorded for fully developed leaves, when the plant had one fruit set. Light green, green and dark green

Leaf blade length	LBL	Longitudinal length of leaf blade was recorded for fully developed, when the plant had one fruit set. Short =<10, medium = 10-14 and long = >14
Leaf blade width	LBW	Equatorial width of leaf blade was recorded for fully developed, when the plant had one fruit set. Narrow = <9, medium = 9-12 and broad= >12
Length of internodes	LI	Recorded during the active vegetative phase, between the 4th and 7th nodes from the base. Short =<7, medium = 7-8.5 and long = >8.5
Petiole length	PTL	Recorded in fully mature leaves during the vegetative stage. Short =<7, medium = 7-9 and long = >9
Ovary length	OL	Measured at the time of anthesis on freshly opened female flowers. Short =<1, medium = 1-2 and long = >2
Ovary width	OW	Measured at the time of anthesis on freshly opened female flowers. Narrow = <0.8 and broad =>0.8
Ovary colour	OC	Measured at the time of anthesis on freshly opened female flowers. Yellow, green and dark green.
Ovary pubescence	OP	Hairiness or smoothness of ovary was recorded at the time of anthesis on freshly opened female flowers. Sparse and dense
Fruit stripes	FS	Presence or absence of stripes in fruit surface was recorded in rind of fruits that attained edible maturity. Absent, weak, diffused and clearly defined.
Shape in longitudinal section	SLS	Recorded in edible tender fruits. Circular, broad elliptic, medium elliptic and narrow elliptic.
Conspicuousness of stripes	CS	Recorded in rind of edible tender fruits. Inconspicuous, weak, medium, strong and very strong.
Width of stripes	WS	Recorded in rind of edible tender fruits. Very narrow, narrow, medium, broad and very broad.
Conspicuousness of veining	CV	Recorded in rind of edible tender fruits. Inconspicuous, weak, medium, strong and very strong.

RESULT AND DISCUSSION

Evaluation and characterization of Chalana (Citrullus spp.) genotypes using qualitative traits

Growth and floral morphological attributes

These traits serve as key indicators in selection and breeding programs aimed at improving genetic performance and varietal enhancement. Eleven qualitative traits were observed in 25 Chalana genotypes using DUS descriptors (Table 3), with frequency distributions in Table 4. Singh et al. (2022) studied 25 watermelon genotypes and found substantial amount of variability for qualitative traits like leaf blade length and internodal length. Choudhary et al. (2016) researched to develop DUS testing guidelines for ten varieties of watermelon (Citrullus lanatus) where results revealed great variation in qualitative traits.

Primary Lobing

All Chalana genotypes exhibited strong primary lobing (100%) (Table 3). No medium or weak lobing was observed. This contrasts with Choudhary et al. (2016), who reported a range from weak to strong lobing in varieties like Durgapura Lal and Arka Manik**.**

Secondary Lobing

Uniformity in Chalana genotypes for secondary lobing was noted where 100% of genotypes showed strong lobing (Table 3). This is in contrast with Solmaz et al. (2010), who observed 42% weak, 47% medium and 11% strong lobing in watermelon genotypes. Sahin (2024) found high variability in watermelon genotypes, with lobing ranging from very weak to strong.

Leaf Colour

Among the 25 Chalana genotypes, 52% had green leaves and 48% dark green. No light green foliage was observed (Table 3). Solmaz et al. (2010) found 72% greyish-green and 28% green among Turkish watermelon genotypes. Choudhary et al. (2016) observed uniform green leaf color in watermelon varieties.

Leaf Blade Length

No Chalana genotype had short leaves. Medium-length (10–14 cm) was observed in 20%, while 80% had long leaves (>14 cm) (Table 3). Szamosi et al. (2009) and Alimari et al. (2017) revealed wide diversity for leaf length. Parveen et al. (2025) found similar variation among 16 genotypes.

Leaf Blade Width

All Chalana genotypes had broad leaves (>12 cm), showing no variation (Table 5). Sahin (2024) found variation in width (19.96 to 28.23 cm) in watermelon genotypes. Parveen et al. (2025) also reported high diversity in this trait in watermelon genotypes.

Internode Length

Internodes in Chalana genotypes were uniformly medium (7 to 8.5 cm) in all genotypes (Table 3). Mohanta and Mandal (2019) reported moderate variability (5 to 15 cm) in watermelon genotypes. Singh et al. (2022) observed a range from 7.39 to 14.62 cm in watermelon genotypes.

Petiole Length

Petiole length varied in Chalana genotypes as 16% short (<7 cm), 44% medium (7 to 9 cm) and 40% long (>9 cm) (Table 5). Alimari et al. (2017) and Sahin (2024) reported petiole variability in different genotypes and varieties in watermelon genotypes.

Ovary Length

Medium-length ovaries (1 to 2 cm) in Chalana genotypes were observed in 68%, while 32% were longer (>2 cm) (Table 4). Choudhary et al. (2016) observed ovary length variation from short (Arka Manik) to long (Charleston Grey). Kara et al. (2024) reported a range of 4.74 to 17.97 mm in haploid watermelon genotypes.

Ovary Width

Narrow ovaries (<0.8 cm) in Chalana genotypes were found in 68% and broad ones (>0.8 cm) in 32% of genotypes (Table 4). Choudhary et al. (2016) observed ovary width variation from narrow (Sugar Baby) to broad (Durgapura Kesar) and Kara et al. (2024) reported widths between 3.22 mm and 12.18 mm in watermelon genotypes.

Ovary Colour

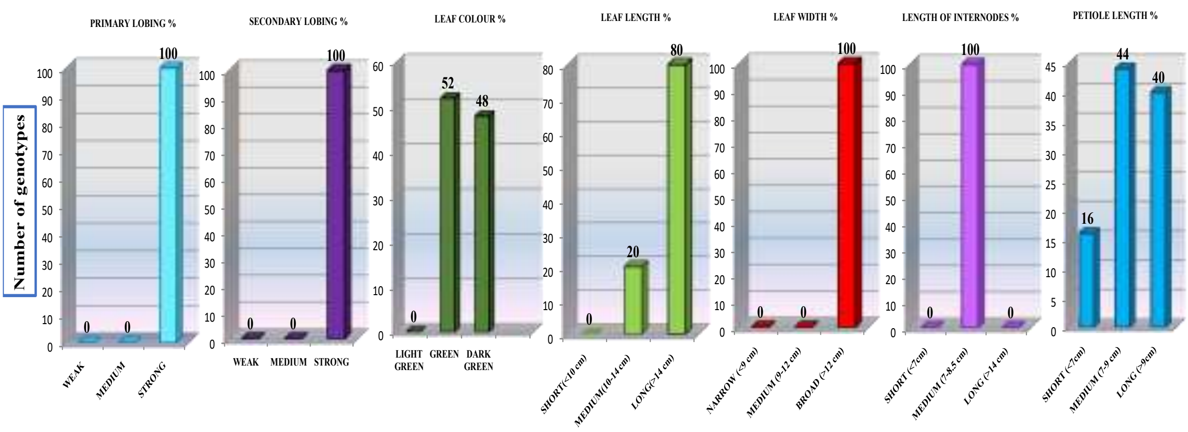
Most genotypes in Chalana genotypes had green ovaries (96%), with only one (4%) showing yellow pigmentation (Table 4). Chaudhary et al. (2012) and Choudhary et al. (2016) documented ovary color diversity ranging from yellow (Kasi Pitambar) to green (Sugar Baby).

Ovary Pubescence

All Chalana genotypes exhibited sparse pubescence (100%), with no dense forms recorded (Table 4). Limited studies have documented this trait in watermelon, highlighting the novelty of these findings.

Fruit Morphological Attributes

Evaluating fruit morphological traits is key to understanding varietal diversity, market appeal, and consumer preferences. These traits assist in identifying superior genotypes for breeding and yield improvement. Five fruiting traits were recorded across the same 25 Chalana (Citrullus spp.) genotypes using PPVFRA and UPOV descriptors (Table 5). Their frequency distribution is presented in Table 6. Singh et al. (2017) observed significant differences in qualitative fruit traits among 38 watermelon landraces. Gichimu et al. (2009) noted variation in rind pattern, shape and flesh color among commercial watermelon cultivars. Bhagyalekshmi (2019) reported diversity in DUS traits including rind color, shape and stripes among watermelon cultivars.



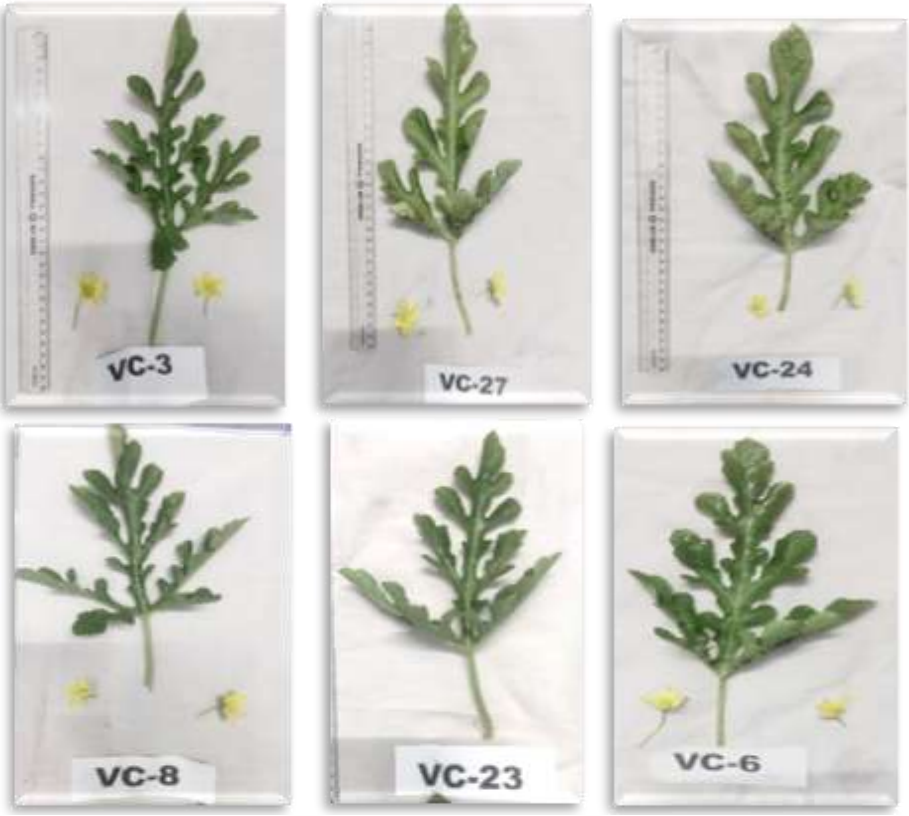


Figure 2: Different leaf length in *Chalana* (*Citrullus* spp.)

Fruit Stripes
Rind striation among Chalana genotypes showed high variability: 8% lacked stripes, 20% had weak, 8% diffused and 64% clearly defined stripes (Table 5). Gichimu et al. (2009) reported high variability in rind pattern among six watermelon accessions. Choudhary et al. (2016) found moderate stripe variation from weak (Sugar Baby) to clearly defined (Thar Manik) in watermelon genotypes.

Fruit Shape in Longitudinal Section
No Chalana genotypes were round, oval or flat-globed. Most (88%) displayed narrow elliptical/oblong shapes, while 12% were medium elliptical/elongated globe (Table 5). Yilmaz et al. (2021) noted moderate shape variability in 32 melon accessions. Tembo & Maphosa (2025) found in watermelon that most of the elliptical shapes were recorded for genotypes 185, 2766 and 378, while 177, 2660 and 60 genotypes showed a predominance of flat shapes in fruits.

Conspicuousness of Veining
Veining in Chalana genotypes varied where 8% inconspicuous, 20% weak, 48% medium and 24% strong (Table 5). Sahin (2024) reported 56.52% of genotypes with inconspicuous veining, while 17.39% exhibited strong venation in Citrullus lanatus L.

Width of Stripes
Stripe width in Chalana genotypes varied where 8% had none, 33% had very narrow, and 60% had narrow stripes. No broad or very broad stripes were noted (Table 5). Assefa et al. (2020) observed stripe width diversity (0.0–29.8 mm) in C. lanatus. Elbekkay et al. (2021) found variation ranging from 4.5 mm to 22.5 mm among watermelon cultivars.

Conspicuousness of Stripes
Stripe visibility was 8% weak, 32% medium, and 60% strong; no genotypes showed inconspicuous or very strong expression (Table 5). Sahin (2024) found 39.13% of genotypes with medium conspicuousness and 17.39% with strong stripe visibility.

Genetic Diversity Analysis Using Shannon-Weaver Index (H')
The Shannon-Weaver Index (Shannon & Weaver, 1949), ranging from 0 (no diversity) to 4.6 (maximum diversity), was applied to evaluate phenotypic variation in Chalana (Citrullus spp.). The mean H' value was 0.50, indicating moderate to high diversity among genotypes. Traits such as primary lobing, secondary lobing, leaf

width, internode length, and ovary pubescence recorded H’ = 0, denoting no variation. Conversely, conspicuousness in veining showed the highest diversity (1.22), followed by petiole length (1.02), fruit stripes (1.01), width of stripes (0.87), conspicuousness of stripes (0.87), ovary length and width (0.63 each), and leaf color (0.69). Low to moderate diversity was observed for ovary color (0.17), fruit shape (0.37), and leaf length (0.50). This range highlights traits with both breeding potential and those with conserved expression.

Fruit morphological traits, such as stripe-related attributes and veining, exhibited the greatest variability, reflecting possible selection pressures or traditional preferences. In contrast, traits like lobing and internode length were uniform, possibly due to genetic fixation or adaptive significance. High H’ values suggest multiple well-represented trait expressions suitable for selection. Low H’ values reflect dominant phenotypes, limiting genetic improvement in those traits.

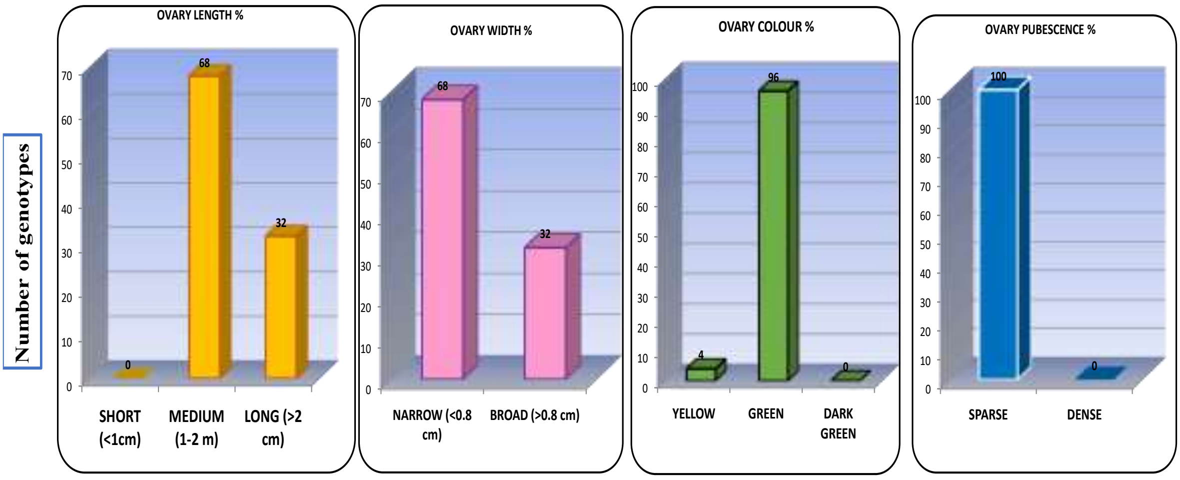


Figure 4: Frequency distribution of *Chalana* (*Citrullus spp.*) genotypes for flowering traits

Figue 5: Ovary Colour in studied *Chalana* (*Citrullus* spp.)

Figue 6: Ovary Pubescence in studied *Chalana* (*Citrullus* spp.)

Table 3: Morphological characterization of 25 Chalana (Citrullus spp.) genotypes

SL. NO.	Genotypes	PL	SL	LC	LL	LW	IL	PtL	OW
1	**VC-29**	Strong	Strong	Green	Long	Broad	Medium	Long	Narrow
2	**VC-11**	Strong	Strong	Green	Medium	Broad	Medium	Medium	Narrow
3	**VC-23**	Strong	Strong	Dark Green	Medium	Broad	Medium	Short	Narrow
4	**VC-38**	Strong	Strong	Dark Green	Long	Broad	Medium	Medium	Narrow
5	**VC-22**	Strong	Strong	Green	Medium	Broad	Medium	Long	Narrow
6	**VC-28**	Strong	Strong	Dark Green	Long	Broad	Medium	Medium	Narrow
7	**VC-27**	Strong	Strong	Green	Long	Broad	Medium	Medium	Broad
8	**VC-10**	Strong	Strong	Green	Long	Broad	Medium	Long	Broad
9	**VC-6**	Strong	Strong	Dark Green	Long	Broad	Medium	Medium	Broad
10	**VC-106**	Strong	Strong	Dark Green	Long	Broad	Medium	Medium	Narrow
11	**VC- 18**	Strong	Strong	Dark Green	Long	Broad	Medium	Medium	Broad
12	**VC- 32**	Strong	Strong	Green	Medium	Broad	Medium	Long	Broad
13	**VC- 9**	Strong	Strong	Dark Green	Long	Broad	Medium	Long	Narrow
14	**VC- 30**	Strong	Strong	Green	Medium	Broad	Medium	Long	Narrow
15	**VC-24**	Strong	Strong	Green	Long	Broad	Medium	Short	Narrow
16	**VC-13**	Strong	Strong	Green	Long	Broad	Medium	Long	Broad
17	**VC- 12**	Strong	Strong	Green	Long	Broad	Medium	Long	Narrow
18	**VC- 17**	Strong	Strong	Dark Green	Long	Broad	Medium	Medium	Narrow
19	**VC- 14**	Strong	Strong	Dark Green	Long	Broad	Medium	Long	Narrow
20	**VC- 8**	Strong	Strong	Dark Green	Long	Broad	Medium	Short	Narrow
21	**GOS- 1**	Strong	Strong	Green	Long	Broad	Medium	Medium	Broad
22	**GOS- 2**	Strong	Strong	Green	Long	Broad	Medium	Long	Broad
23	**VC- 3**	Strong	Strong	Dark Green	Long	Broad	Medium	Medium	Narrow
24	**VC- 35**	Strong	Strong	Green	Long	Broad	Medium	Short	Narrow

25	**VC- 57**	Strong	Strong	Dark Green	Long	Broad	Medium	Medium	Narrow
Note: PL= Primary lobing, SL= Secondary lobing, LC= Leaf Colour, LL= Leaf Length, LW= Leaf Width, IL= Internode length, PtL= Petiole Length, OW= Ovary Width									

Table 3: Continued

SL. NO.	**Genotypes**	**OC**	**OP**	**OL**	**FS**	**SLS**	**CV**	**WS**	**CS**
1	**VC-29**	Green	Sparse	Medium	Clearly defined	Narrow elliptical	Medium	Narrow	Strong
2	**VC-11**	Green	Sparse	Medium	Clearly defined	Medium elliptical	Strong	Very narrow	Strong
3	**VC-23**	Green	Sparse	Medium	Clearly defined	Narrow elliptical	Weak	Very narrow	Strong
4	**VC-38**	Green	Sparse	Medium	Weak	Narrow elliptical	Weak	Very narrow	Medium
5	**VC-22**	Green	Sparse	Medium	Clearly defined	Narrow elliptical	Weak	Narrow	Strong
6	**VC-28**	Green	Sparse	Medium	Clearly defined	Narrow elliptical	Strong	Narrow	Strong
7	**VC-27**	Green	Sparse	Long	Clearly defined	Narrow elliptical	Medium	Narrow	Strong
8	**VC-10**	Green	Sparse	Long	Diffused	Narrow elliptical	Strong	Narrow	Strong
9	**VC-6**	Green	Sparse	Long	Clearly defined	Narrow elliptical	Medium	Very narrow	Medium
10	**VC-106**	Green	Sparse	Medium	Clearly defined	Narrow elliptical	Weak	Narrow	Strong
11	**VC- 18**	Green	Sparse	Long	Clearly defined	Narrow elliptical	Medium	Narrow	Strong
12	**VC- 32**	Green	Sparse	Long	Weak	Narrow elliptical	Medium	Narrow	Strong
13	**VC- 9**	Yellow	Sparse	Medium	Clearly defined	Narrow elliptical	Medium	Very narrow	Strong
14	**VC- 30**	Green	Sparse	Medium	Clearly defined	Narrow elliptical	Medium	Very narrow	Medium
15	**VC-24**	Green	Sparse	Medium	Clearly defined	Narrow elliptical	Strong	Narrow	Strong
16	**VC-13**	Green	Sparse	Long	Clearly defined	Narrow elliptical	Strong	Narrow	Medium
17	**VC- 12**	Green	Sparse	Medium	Weak	Narrow elliptical	Medium	Narrow	Medium

18	**VC- 17**	Green	Spars e	Mediu m	Weak	Narrow elliptica l	Weak	Very narrow	Mediu m
19	**VC- 14**	Green	Spars e	Mediu m	Clearly defined	Narrow elliptica l	Strong	Narro w	Strong
20	**VC- 8**	Green	Spars e	Mediu m	Weak	Narrow elliptica l	Medium	Narro w	Mediu m
21	**GOS- 1**	Green	Spars e	Long	Absent	Medium elliptica l	Inconspicuou s	No stripes	Weak
22	**GOS- 2**	Green	Spars e	Long	Absent	Medium elliptica l	Inconspicuou s	No stripes	Weak
23	**VC- 3**	Green	Spars e	Mediu m	Clearly defined	Narrow elliptica l	Medium	Narro w	Strong
24	**VC- 35**	Green	Spars e	Mediu m	Diffuse d	Narrow elliptica l	Medium	Very narrow	Mediu m
25	**VC- 57**	Green	Spars e	Mediu m	Clearly defined	Narrow elliptica l	Medium	Narro w	Strong
Note: OW= Ovary Width, OC= Ovary Colour, OP= Ovary Pubescence, OL= Ovary Length, FS= Fruit Stripes, SLS= Fruit Shape in Longitudinal Section, CV= Conspicuousness in Veining, WS= Width of Stripes, CS= Conspicuousness of Stripes									

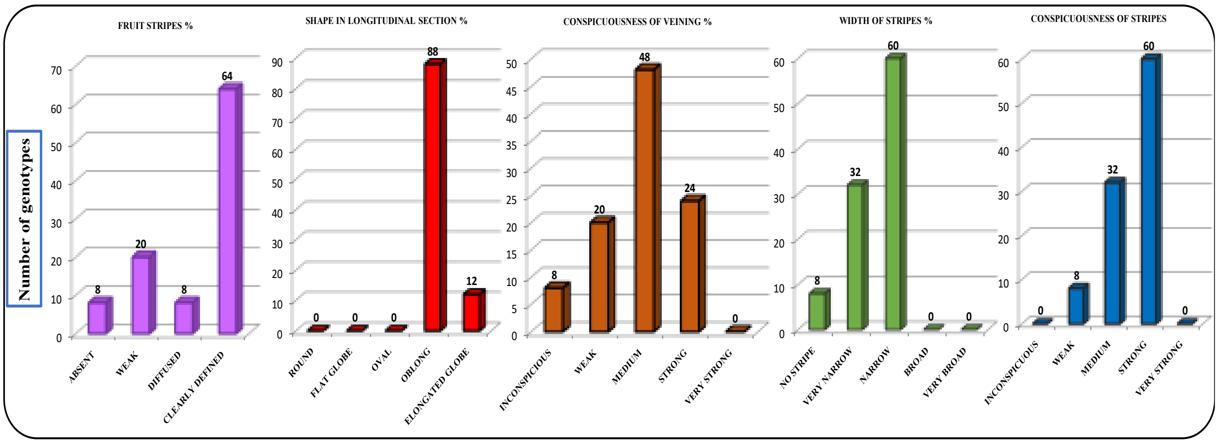


Figure 7: Frequency distribution of *Chalana* (*Citrullus* spp.) genotypes for fruiting traits

Figure 8: Different fruit stripes in *Chalana* (*Citrullus* spp.) genotypes

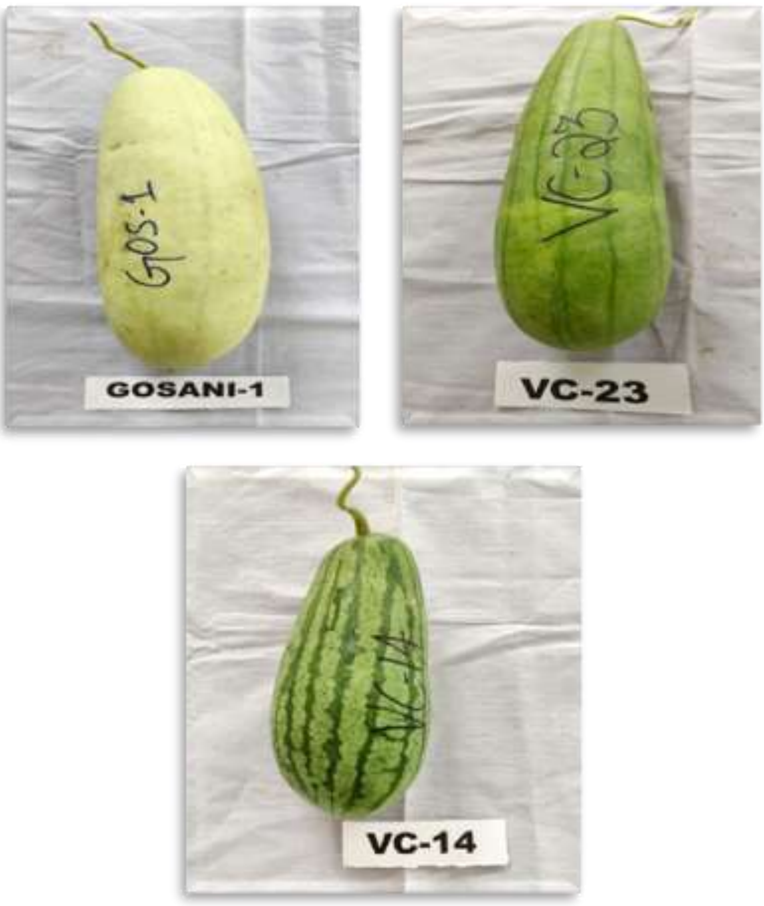


Figure 9: Different width of fruit stripes in *Chalana* (*Citrullus* spp.) genotypes

Table 6: Frequency distribution, proportion and Shannon-Wiener diversity index (H') of qualitative traits of 25 Chalana (Citrullus spp.) genotypes

Characters	Morphological description	Frequency distribution		H'-index
		No. of genotypes in the group	Percent (%)	
Primary Lobing	Weak	0	0	**0**
	Medium	0	0	
	Strong	25	100	
Secondary Lobing	Weak	0	0	**0**
	Medium	0	0	
	Strong	25	100	
Leaf Colour	Light Green	0	0	**0.69**
	Green	13	52	
	Dark Green	12	48	
Leaf Length	Short	0	0	**0.50**
	Medium	5	20	
	Long	20	80	
Leaf Width	Narrow	0	0	**0**
	Medium	0	0	
	Broad	25	100	
Internode Length	Short	0	0	**0**
	Medium	25	100	
	Long	0	0	
Petiole Length	Short	4	16	**1.02**
	Medium	11	44	
	Long	10	40	
Ovary Length	Short	0	0	**0.63**
	Medium	17	68	
	Long	8	32	
Ovary Width	Narrow	17	68	**0.63**
	Broad	8	32	

Characters	Morphological description	Frequency distribution		H'-index
		No. of genotypes in the group	Percent (%)	
Ovary Colour	Yellow	1	4	**0.17**
	Green	24	96	
	Dark Green	0	0	
Ovary Pubescence	Sparse	25	100	**0**
	Dense	0	0	
Fruit Stripes	Absent	2	8	**1.01**
	Weak	5	20	
	Diffused	2	8	
	Clearly Defined	16	64	
Fruit Shape in Longitudinal Section	Round	0	0	**0.37**
	Flat Globe	0	0	
	Oval	0	0	
	Narrow Elliptical	22	88	
	Medium Elliptical	3	12	
Conspicuousness in Veining	Inconspicuous	2	8	**1.22**
	Weak	5	20	
	Medium	12	48	
	Strong	6	24	
Width of Stripes	No Stripes	2	8	**0.87**
	Very Narrow	8	32	
	Narrow	15	60	
	Broad	0	0	
	Very Broad	0	0	
Conspicuousness in Stripes	Inconspicuous	0	0	**0.87**
	Weak	2	8	
	Medium	8	32	
	Strong	15	60	
	Very Strong	0	0	

CONCLUSION

The present investigation on DUS characterization of Chalana (Citrullus spp.) genotypes marks a significant step toward varietal identification, genetic resource management and future crop improvement strategies. A diverse array of qualitative traits documented substantial phenotypic variability.

Significant variability was evident in characteristics such as leaf color (green in 52%, dark green in 48%), petiole length (16% short to 40% long) and ovary morphology (majority exhibiting medium-length and narrow-width ovaries). A dominant green ovary color (96%) and sparse pubescence were recorded across genotypes. Fruit stripe pattern varied from absent to clearly defined, with 64% showing well-marked stripes. Fruit shape was predominantly oblong (88%), with a minority (12%) exhibiting an elongated globe form. Additional variation was observed in fruit veining conspicuousness and stripe width, with strong veining (24%) and strong stripe conspicuousness (60%) being dominant.

The uniformity observed in traits such as leaf lobing, internode length, ovary pubescence and leaf breadth underscores their reliability for establishing baseline descriptors. Meanwhile, the observed phenotypic variability in reproductive and fruit traits highlights the rich genetic base within Chalana genotypes. This research delivers a comprehensive morphological database for Chalana, particularly for genotypes from Odisha. It supports variety registration under DUS criteria and offers a crucial reference for breeding programs aiming to improve productivity, stability, and local adaptability.

Statements and Declarations

Authors' contributions

Conceptualization of article (Samikhya Jena, Smaranika Mohanta, Kartik Pramanik); Collection of research data and interpretation (Samikhya Jena, Vishal Kumar Gupta, Chinmaya Jena); Preparation of the manuscript (Samikhya Jena, Ashutosh Kumar, Jyostnarani Pradhan, Joydip Mandal). Language editing (Jyostnarani Pradhan and B. Pavan Kumar Naik). All authors read and approved the final manuscript.

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