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Morphological Characterization of Finger Millet (*Eleusine coracana* (L.) Gaertn) Accessions Using Qualitative DUS Traits

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Abstract

The study entitled "Morphological Characterization of Finger Millet *(Eleusine coracana (L.) Gaertn)* Accessions Using Qualitative DUS Traits" was conducted during Kharif 2023 to assess morphological diversity among twenty genotypes using seven qualitative descriptors as per PPV&FRA (2007) [6] guidelines. The experiment was laid out in a randomized block design with three replications and observations were recorded on plant growth habit, pigmentation at leaf juncture, glume colour, ear shape, finger branching, leaf sheath pubescence and seed colour. Results revealed considerable variability across all traits, indicating the presence of rich genetic diversity within the germplasm. Growth habit ranged from erect to semi-erect, decumbent and prostrate, with decumbent types being most frequent. Pigmentation at the leaf juncture was largely absent, while glume colour varied from light to dark green and purple hues. Ear shapes displayed clear differentiation among compact, semi-compact, fist and open forms, and finger branching occurred rarely. Leaf sheath pubescence was predominantly present, suggesting adaptive importance and seed colour ranged from copper brown and light brown to dark brown and white. The distinct expression of these qualitative traits highlights their value as stable morphological markers for genotype identification, varietal distinctness testing and seed purity assessment. Overall, the study demonstrates that qualitative DUS traits serve as a reliable and cost-effective tool for physiologists and breeders to characterize variability, select desirable lines and support future finger millet improvement programs through targeted breeding and conservation of diverse morphotypes.

Keywords: Finger millet, *Eleusine coracana*, qualitative traits, DUS characterization, genetic diversity, morphological descriptors, genotype identification, varietal distinctness

Introduction

Finger millet (*Eleusine coracana* L. Gaertn.) is an important small millet crop cultivated predominantly in the semi-arid and tropical regions of Africa and Asia. It is valued for its resilience to harsh environments, high nutritional quality, and exceptional storage life, making it a vital food security crop in rainfed farming systems (Upadhyaya *et al*., 2014) [9]. The crop exhibits considerable morphological diversity, especially in traits such as plant stature, inflorescence shape, earhead branching, and grain characteristics, which provide a strong basis for genotype differentiation and varietal improvement (Jayawardana *et al*., 2019) [3].

Morphological characterization using qualitative Distinctness, Uniformity and Stability (DUS) descriptors is essential for genotype identification, varietal purity testing and registration of new cultivars. Qualitative DUS traits such as seedling color, tiller orientation, earhead shape, finger branching pattern, node pigmentation, and grain color are highly heritable and environmentally stable, making them reliable markers for distinguishing genotypes (UPOV, 2014; PPV&FRA, 2007) [6, 11]. Studying these qualitative traits in twenty finger millet genotypes helps establish their distinct morphological profiles, facilitates selection in breeding programmes, and supports legal protection under plant variety protection systems (Bharathi *et al*., 2017) [2].

Material and Methods

The present investigation on "Morphological Characterization of Finger Millet (*Eleusine coracana* L.) Accessions Using Qualitative DUS Traits" was carried out during Kharif 2023 at the Centre for Advanced Agricultural Sciences and Technology for Climate Smart Agriculture and Water Management (CAAST-CSAWM), MPKV, Rahuri. A total of twenty genotypes, consisting of fourteen test entries and six released checks, were procured from the All India Coordinated Research Project (AICRP) on Small Millets, Zonal Agricultural Research Station (ZARS), Kolhapur. The experiment was conducted in a randomized block design (RBD) with three replications. Each genotype was sown at a spacing of 30 cm × 10 cm under uniform agronomic conditions. All recommended crop management practices including fertilizer application, intercultural operations, plant protection measures and irrigation scheduling were followed to ensure optimum and stress-free crop growth.

Table 1: Finger millet genotypes studied during experiment

Sr.no.	Genotype	Pedigree line	Sr. no.	Genotype	Pedigree line
1	KIFMG-22-13	IE 4657	11	KIFMG-22-05	IE 2689
2	KIFMG-22-37	IE 2849	12	KIFMG-22-43	IE 5279
3	KIFMG-22-09	IE 2104	13	KIFMG-22-25	IE 8602
4	KIFMG-22-49	IE 6386	14	KIFMG-22-18	IE 5331
5	KIFMG-22-23	IE 5963	15	Phule Kasari (Ch)	Released Variety
6	KIFMG-22-04	IE 633	16	Phule Nachani (Ch)	Released Variety
7	KIFMG-22-47	IE 5837	17	Dapoli-3 (Ch)	Released Variety
8	KIFMG-22-50	IE 6654	18	VL-376 (Ch)	Released Variety
9	KIFMG-22-17	IE 5364	19	GPU-67 (Ch)	Released Variety
10	KIFMG-22-15	IE 5965	20	GPU-28 (Ch)	Released Variety

Morphological characterization was undertaken using qualitative Distinctness, Uniformity and Stability (DUS) descriptors as per PPV&FRA (2007) [6] and UPOV (2014) [11] guidelines for *Eleusine coracana*. Observations were recorded on five randomly selected competitive plants from each plot for the seven qualitative traits: plant growth habit, pigmentation at leaf juncture, glume colour, ear shape, finger branching, leaf sheath pubescence and seed colour. Each trait was visually scored according to the characteristic states specified in the DUS guidelines to assess variability and distinctiveness among genotypes.

Results

Qualitative morphological characterization of twenty finger millet genotypes revealed substantial variability across seven DUS traits, along with the frequency distribution of these qualitative characters as presented in Tables 2 and 3. Plant growth habit showed distinct groupings, with decumbent types being most frequent (47%), followed by erect (40%) and prostrate forms (13%) (Table 3). This distribution reflects the predominance of spreading growth forms in the germplasm, which may aid in weed suppression and moisture conservation under rainfed conditions. Pigmentation at the leaf juncture was mostly absent (75%), indicating that the trait is relatively uncommon, although present in a few genotypes such as KIFMG-22-37, KIFMG-22-04, and KIFMG-22-50, suggesting its potential use as a morphological marker.

Variation in glume colour was evident, with light green glumes occurring in (50 %) of the genotypes, followed by dark green (35%), light purple (10%) and dark purple (5%), indicating a predominance of green-based glume types. Ear shape also exhibited four expression types—compact, semi-compact, fist and open—each represented by multiple genotypes, demonstrating substantial head morphological diversity that may influence grain density and yield. Finger branching was observed in only 15% of the genotypes, confirming its rarity, whereas leaf sheath pubescence was predominantly present (80%), reflecting its adaptive significance for pest protection and reduced transpiration. Seed colour also showed marked diversity, ranging from copper brown (50%) and light brown (30%) to dark brown (15%) and white (5%), indicating strong variation relevant to varietal identification and consumer preference. Overall, the observed differences across qualitative traits highlight considerable morphological diversity within the finger millet germplasm, which can be effectively utilized in classification and breeding programmes.

Discussion

During Kharif 2023, the twenty finger millet genotypes exhibited clear variability across all seven qualitative DUS traits, highlighting substantial morphological diversity. Plant growth habit varied from erect to prostrate, with erect forms being more desirable for better light interception and reduced lodging, similar to observations by Upadhyaya *et al*. (2007) [10]. Pigmentation at the leaf juncture was mostly absent, with limited pigmented genotypes, and this trait is important as an anthocyanin-based marker for genotype identification, as reported by Reddy *et al*. (2009) [8]. Glume colour ranged from green to purple, where glume pigmentation serves as a stable visual descriptor for varietal differentiation, consistent with findings of Kumar *et al*. (2019) [4]. Ear shape displayed wide variation with compact and semi-compact types predominating, and this trait is agronomically important due to its influence on grain density, aligning with results from Patil *et al*. (2019) [5]. Finger branching was largely absent, observed only in a few genotypes, and its relevance lies in contributing to higher grain-bearing capacity, as noted by Ankit *et al*. (2020) [1]. Leaf sheath pubescence was predominantly present and is useful for stress and pest tolerance, similar to the observations of Radha *et al*. (2014) [7]. Seed colour showed considerable diversity, mainly dominated by brown shades, and serves as a key descriptor for consumer preference and varietal purity, as documented by Upadhyaya *et al*. (2007) [10].

Table 2: Qualitative DUS characterization of morphological traits in twenty Finger millet genotypes during *kharif*-2023

	Genotypes	Plant growth habit	Plant pigmentation at leaf juncture	Glume colour	Ear shape	Finger branching	Leaf sheath pubescence	Seed colour
1	KIFMG-22-13	Decumbent	Absent	Light Green	Semi-compact	Absent	Absent	Copper Brown
2	KIFMG-22-37	Semi-erect	Present	Light Green	Compact	Present	Present	Dark Brown
3	KIFMG-22-09	Erect	Absent	Dark Green	Semi-compact	Absent	Present	White
4	KIFMG-22-49	Prostrate	Absent	Dark Green	fist	Absent	Present	Copper Brown
5	KIFMG-22-23	Erect	Absent	Dark Green	Compact	Absent	Present	Copper Brown
6	KIFMG-22-04	Decumbent	Present	Light Purple	Compact	Absent	Absent	Copper Brown
7	KIFMG-22-47	Erect	Present	Dark Purple	fist	Absent	Present	Dark Brown
8	KIFMG-22-50	Decumbent	Present	Dark Green	fist	Absent	Present	Copper Brown

9	KIFMG-22-17	Decumbent	Present	Light Purple	Open	Absent	Present	Light Brown
10	KIFMG-22-15	Decumbent	Absent	Light Green	Compact	Absent	Present	Light Brown
11	KIFMG-22-05	Prostate	Absent	Light Green	Semi-compact	Absent	Present	Copper Brown
12	KIFMG-22-43	Erect	Absent	Dark Green	Open	Absent	Present	Light Brown
13	KIFMG-22-25	Decumbent	Absent	Light Green	Open	Absent	Present	Copper Brown
14	KIFMG-22-18	Decumbent	Absent	Light Green	fist	Absent	Present	Copper Brown
15	Phule Kasari (C)	Semi-erect	Absent	Light Green	Semi-compact	Present	Present	Light Brown
16	Phule Nachani (C)	Semi-erect	Absent	Light Green	Open	Absent	Present	Light Brown
17	Dapoli-3 (C)	Erect	Absent	Light Green	Semi-compact	Absent	Present	Light Brown
18	VL-376 (C)	Semi-erect	Absent	Light Green	Semi-compact	Present	Absent	Copper Brown
19	GPU-67 (C)	Erect	Absent	Dark Green	Compact	Absent	Absent	Copper Brown
20	GPU-28 (C)	Semi-erect	Absent	Dark Green	fist	Absent	Present	Dark Brown

Note: The above morphological observations were recorded as per the Protection of Plant Varieties and Farmers' Rights (PPV & FRA) Authority guidelines on finger millet (*Eleusine coracana* L.).

Table 3: Frequency distribution of Finger millet genotypes for qualitative characters based on DUS parameters during *kharif*-2023

Sr. No.	Character	State of expression	Number of genotypes	Frequency distribution (%)
1	Plant: Growth habit	Erect	6	40
		Decumbant	7	47
		Prostrate	2	13
2	Plant: Pigmentation at leaf juncture	Absent	15	75
		Present	5	25
3	Glume colour	Light Green	10	50
		Dark Green	7	35
		Light Purple	2	10
		Dark Purple	1	5
4	Ear: Shape	Open	4	21
		Fist	5	27
		Compact	5	26
		Semi-compact	5	26
5	Finger Branching	Absent	17	85
		Present	3	15
6	Leaf sheath pubescence	Absent	4	20
		Present	16	80
7	Seed colour	White	1	5
		Light Brown	6	30
		Dark Brown	3	15
		Copper Brown	10	50

Conclusion

The qualitative characterization of finger millet genotypes during Kharif 2023 confirms the presence of substantial morphological diversity, which is highly valuable for both physiologists and breeders. Variation in growth habit, pigmentation, glume colour, ear shape, finger branching, leaf sheath pubescence and seed colour provides reliable morphological markers for genotype identification, purity testing and maintenance breeding. Such stable, heritable traits are essential for distinguishing closely related genotypes and serve as a foundation for DUS testing and varietal release. For physiologists, these qualitative traits help in associating visible morphological features—such as pubescence, pigmentation, and ear type—with adaptive responses to environmental conditions. For breeders, the diversity observed offers scope for selecting desirable plant types, improving stress tolerance, enhancing yield architecture and developing ideotypes suited to specific production environments. Overall, qualitative trait assessment strengthens germplasm utilization by guiding strategic parental selection and supporting long-term crop improvement programs.

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