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Morphological characteristics of selected coarse cereals and pulses from tribal areas of Andhra Pradesh

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Abstract

The present study aimed to evaluate the morphological characteristics of selected coarse cereals and pulses collected from tribal areas of Andhra Pradesh. The agricultural heritage of these regions reflects a rich diversity of indigenous crops that have evolved through long-term traditional cultivation and farmer-led selection, contributing to a resilient and nutritionally balanced food system. Visual assessment of the grains revealed noticeable variations between control and tribal varieties with respect to shape, surface texture, size, and overall external appearance. Tribal samples exhibited greater diversity in grain morphology and distinct structural features, which may be attributed to genetic variability and traditional agronomic practices. These morphological characteristics are important as they influence consumer acceptance, market value, storage stability, and post-harvest processing behaviour. The findings highlight the importance of documenting traditional grain traits, not only as a baseline for varietal identification and conservation of indigenous crops, but also for understanding their potential contribution to food and nutritional security in tribal regions.

Keywords: Coarse cereals, pulses, morphological characteristics, tribal agriculture

Introduction

Coarse cereals and pulses constitute an essential component of the traditional diet in tribal regions due to their nutritional richness, adaptability to marginal soils, and resilience to climatic stress. These crops contribute significantly to daily food intake while also supplying vital nutrients such as proteins, dietary fibre, minerals, and bioactive compounds. Morphological characteristics such as grain shape, size, surface texture, and overall appearance are important quality attributes that directly influence consumer preference, storage behaviour, processing suitability, and market demand. These external grain traits are often linked with varietal identity and reflect the genetic makeup as well as the growing environment of the crop. Tribal farmers traditionally cultivate indigenous varieties that exhibit unique morphological features, developed through generations of selection and adaptation to local agro-ecological conditions. These native crops represent valuable genetic resources that remain under-documented and

underutilized in modern agricultural systems.

Cereals, belonging to the family *Poaceae* (*Gramineae*), and pulses, from the family *Leguminosae* (*Fabaceae*), are two major food groups that form the dietary base for a large segment of the global population. In many developing regions, cereals and pulses serve as primary staples; however, traditional post-harvest practices and limited diversification may affect their nutritional contribution (Shadan *et al.*, 2014) [8].

In the tribal regions of Andhra Pradesh, coarse cereals and pulses form the backbone of both agriculture and food culture. Indigenous varieties grown by tribal communities display distinctive morphological traits that influence grain quality and usability. Therefore, a systematic evaluation of their morphological characteristics is essential for quality assessment, conservation planning, and the promotion of these nutritionally important crops for sustainable food systems.

Materials and Methods

Sample Collection

The raw materials required for the present study were collected from six tribal mandals, namely Seethampeta, Gummalakshmipuram, Gudem Madugula, Maredumilli, Hukumpeta, and Dumbriguda, with the support of the respective Krishi Vigyan Kendras (KVKs) and Regional Agricultural Research Stations (RARS) located in tribal districts of Andhra Pradesh - Alluri Sitarama Raju, Parvathipuram Manyam. These centers facilitated access to coarse cereals and pulses that were traditionally grown and consumed in the respective tribal regions. The samples were

selected based on their local availability, cultural relevance, and nutritional importance to the tribal communities. Representative samples were collected in their whole (seed) form and brought to the laboratory for further processing. The collected materials were stored in clean, dry, airtight containers until further analysis.

A detailed visual and scientific documentation of the cereals and pulses collected from the tribal regions of Andhra Pradesh, including their scientific names, common names, and representative plant and grain images, is presented below figure 1.

Region (or) District	Grain	Scientific Name	Local Name	Plant Image	Whole Grain Image
Alluri Sitarama Raju District	Kidney beans	<i>Phaseolus vulgaris</i>	Rajma (or) Tamtamalu		
	Red gram	<i>Cajanus cajan</i>	Kandulu		
	Cow pea	<i>Vigna unguiculata</i>	Kuwa Jonna		
	Finger millet	<i>Eleusine coracana</i>	Mandiya (or) Cholu		
	Little millet	<i>Panicum sumatrense</i>	Suwva (or) Samalu		
	Rice	<i>Oryza sativa</i>	Biyyam		
Maredumilli region	Green gram	<i>Vigna radiata</i>	Pesalu		

	Black gram	<i>Vigna mungo</i>	Minumulu		
	Cowpea	<i>Vigna unguiculata</i>	Alasandalu		
	Sorghum	<i>Sorghum bicolor</i>	Jonnalu		
	Finger millet	<i>Eleusine coracana</i>	Cholu		
	Foxtail millet	<i>Setaria italica</i>	Korralu		
Manyam	Red gram	<i>Cajanus cajan</i>	Kandulu		
	Moth bean	<i>Vigna aconitifolia</i>	Alasandalu		
	Black gram	<i>Vigna mungo</i>	Mitta- Minumulu		
	Little millet	<i>Panicum sumatrense</i>	Samalu		
	Finger millet	<i>Eleusine coracana</i>	Pedda Cholu (or) Ragulu		

	Foxtail millet	<i>Setaria italica</i>	Korralu		
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Assessment of Morphological Characteristics

The cereal and pulse samples were visually examined to record their morphological characteristics, including grain shape, surface texture, size, and overall external appearance. Observations were carried out under natural daylight by spreading the samples on a clean white surface. Special attention was given to characteristics such as smoothness, glossiness, uniformity, and general structural features of each grain type (Baryeh, 2002)^[2].

Results and Discussion

The morphological characteristics of selected coarse cereals and pulses collected from the tribal and control regions of three districts of Andhra Pradesh exhibited noticeable variations in terms of grain shape, surface texture, size and uniformity (Tables 1-3). These variations are mainly attributed to differences in genetic diversity, agro-climatic conditions, and traditional cultivation practices followed by tribal communities.

Tribal pulses showed distinct variations in colour and physical appearance across the three districts. In Alluri Sitarama Raju district, kidney bean exhibited a dark red, shiny and smooth surface, red gram displayed a deep reddish brown colour with smooth, oval-shaped grains, and cowpea presented a cream colour with a black eye and smooth, oval form (Table 1). In Mareduhilli district, green gram maintained a green to light green hue with smooth, shiny, small oval-shaped grains, black gram appeared black and smooth, and cowpea was brown to reddish-brown with light speckles, a dry surface, and an oval to round shape (Table 2). In Parvathipuram Manyam district, red gram showed a brown mixed with pale cream colour and oval shape, moth bean exhibited light green to brownish cream with orange eye spots, smooth surface and small oval grains, and black gram ranged from black to dark grey with a smooth matte surface, cylindrical to oval in shape with a visible hilum (Table 3).

Among cereals, distinct variations were also observed across the districts. In Alluri Sitarama Raju district, finger

millet appeared dark reddish brown, small, round, and smooth with a matte finish, little millet displayed a light tan to pale yellow colour with small round to oval-shaped grains, and rice exhibited off-white to cream colour with a smooth, opaque surface (Table 1). In Mareduhilli district, sorghum showed a cream to pale yellow colour with a smooth, uniform round shape and slight sheen, finger millet appeared dark reddish brown and round with a smooth surface, and foxtail millet presented a golden yellow hue with a semi-glossy, smooth texture (Table 2). In Parvathipuram Manyam district, little millet displayed a light tan to pale yellow colour with small round to oval-shaped grains, finger millet was dark reddish brown, small, round, and smooth, and foxtail millet exhibited a golden yellow colour with a semi-glossy and smooth surface (Table 3).

These variations in pulses and cereals reflect genetic and environmental influences, consistent with earlier reports that kidney beans display diverse colours from white to mottled brown and pinkish black (Singh & Chandra, 2020)^[9], pigeon pea exhibits a wide spectrum of pigmentation in seeds and pods (Sameer Kumar *et al.*, 2017)^[7], cowpea genotypes differ in testa colour and texture patterns (Arya *et al.*, 2021)^[1], and finger millet grains are small, round, and smooth (Ramappa *et al.*, 2011)^[6]. Oo *et al.* (2022)^[5] also reported considerable variation among 46 cowpea genotypes in seed colour, shape, and eye colour, grouped as brown, creamy, and black seeds; rhomboid, ovoid, and crowder shapes; and tan/brown, greenish, reddish brown, and black eyes. Such diversity, also noted in *Vigna radiata* by Katiyar *et al.*, 2008^[3] and Kaur *et al.*, 2017^[4], and in Indian mustard by Yadav *et al.*, 2013^[11], highlights the genetic variability influencing seed quality and market preference. In cereals, pericarp pigmentation affects the visual appearance and consumer preference (Wang *et al.*, 2023)^[10]. Overall, this diversity in tribal pulses and cereals is important for sensory quality, consumer acceptance, and market preference.

Table 1: Morphological characteristics of selected coarse cereals and pulses from Alluri Sitharama Raju District.

Grain Type	S. No	Variety	Treatment	Seed Traits
Pulses	1	Kidney Bean	Control	Light brown with reddish speckles, smooth and oval-shaped grains.
			Tribal	Dark red, shiny and smooth
	2	Red Gram	Control	Reddish orange, smooth and oval-shaped grains.
			Tribal	Deep Reddish brown, smooth surface, oval-shaped grains.
	3	Cowpea	Control	Light brown with dark brown speckles, smooth and oval-shaped grains.
			Tribal	Cream with black eye, smooth and oval
Cereals	4	Finger Millet	Control	Reddish brown, small round grains with a smooth matte surface.
			Tribal	Dark reddish brown, smooth and round, with a matte finish.
	5	Little Millet	Control	Pale yellow to cream, small round to oval-shaped grains with a smooth surface
			Tribal	Light tan to pale yellow, small round to oval-shaped grains.
	6	Rice	Control	Creamy white, medium slender grains with a smooth and slightly translucent surface.
			Tribal	Off-white to cream, smooth with opaque appearance

Table 2: Morphological characteristics of selected coarse cereals and pulses from Mareduhilli Region.

Grain Type	S. No	Variety	Treatment	Seed Traits
Pulses	1	Green Gram	Control	Green to light green, smooth and shiny surface, small oval-shaped grains
			Tribal	Green to light green colour, smooth and shiny surface, small oval-shaped grains
	2	Black Gram	Control	Black in colour, smooth and oval-shaped grains.
			Tribal	Black in colour, smooth and oval-shaped grains
	3	Cowpea	Control	Light brown in colour with a narrow eye, smooth and oval-shaped grains.
			Tribal	Brown to reddish-brown with light speckles, dry surface, and oval to round shape
Cereals	4	Sorghum	Control	Pale yellow to creamy white, round grains with a slightly rough surface.
			Tribal	Cream to pale yellow color, smooth and uniform round shape with a slight sheen
	5	Finger Millet	Control	Copper-brown to dark brown, small round grains with smooth, consistent surface.
			Tribal	Dark reddish brown, smooth and round grains.
	6	Foxtail Millet	Control	Pale golden-yellow, small round grains with a smooth texture and consistent color.
			Tribal	Golden yellow, semi-glossy and smooth

Table 3: Morphological characteristics of selected coarse cereals and pulses from Parvathipuram Manyam District

Grain Type	S. No	Variety	Treatment	Seed Traits
Pulses	1	Red Gram	Control	Reddish orange, smooth and oval-shaped grains.
			Tribal	Brown mixed with pale cream, oval-shaped grains.
	2	Moth Bean	Control	Light brown to yellowish brown, small oval-shaped grains with a smooth and uniform appearance.
			Tribal	Light green to brownish cream with orange eye spots, smooth surface, small oval-shaped grains.
	3	Black Gram	Control	Black in colour, smooth and oval-shaped grains
			Tribal	Black to dark grey in color, smooth matte surface, cylindrical to oval shape with visible hilum (eye).
Cereals	4	Little Millet	Control	Pale yellow to creamy golden, smooth, small round to oval grains.
			Tribal	Light tan to pale yellow, small round to oval-shaped grains.
	5	Finger Millet	Control	Copper to dark reddish-brown, small round grains with a smooth surface.
			Tribal	Dark reddish brown, smooth and round grains.
	6	Foxtail Millet	Control	Bright yellow to golden, smooth and tiny round grains.
			Tribal	Golden yellow, semi-glossy and smooth.

Conclusion

The evaluation of coarse cereals and pulses across three tribal districts of Andhra Pradesh revealed distinct variations in grain morphology and surface texture between tribal and control varieties. Tribal grains consistently exhibited greater diversity, reflecting the rich genetic variability maintained through traditional cultivation practices. These morphological differences carry practical significance for varietal identification, market preference, and potential nutritional quality. Documenting such traits offers a valuable foundation for conservation initiatives, promotes the utilization of indigenous varieties, and guides future research on their nutritional and functional potential.

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