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DUS CHARACTERIZATION OF CASHEW (*ANACARDIUM OCCIDENTALE* L.) GENOTYPES

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ABSTRACT

The present study assessed qualitative variability in cashew (*Anacardium occidentale* L.) using 65 genotypes comprising 45 F1 hybrids, 17 parents and 3 standard checks maintained at the Cashew Research Station, Bapatla, during 2023-2025. Qualitative traits were recorded for tree, leaf, inflorescence, cashew apple and nut characters using the cashew descriptor guidelines. Distinct variation was observed for major descriptor classes, with upright and compact tree habit predominating, intensive branching being common, whereas clear diversity in flowering season and inflorescence types. Flower colour was largely uniform with pink being dominant, while a few genotypes expressed rare states such as cream flowers and red apple colour. Most genotypes produced yellow apples with conical-obovate shape, whereas round and pyriform apples were limited to a few genotypes. Nut traits were relatively stable for shape (kidney type) but showed useful variation in shell colour, attachment of nut to apple, stylar scar size and related descriptors. Overall, the descriptor-wise distribution identified both predominant and rare qualitative states that can support germplasm documentation, hybrid identification and selection of parents for breeding.

Keywords **:** cashew germplasm, morphological descriptors, Inflorescence, Panicle, sex ratio, Nut, Kernel.

Introduction

Cashew (*Anacardium occidentale* L.) is an important tropical plantation crop belonging to the family Anacardiaceae. It is cultivated widely in India, Brazil, Vietnam and several African countries for its edible kernel which commands high demand in international markets and for the cashew apple, which is a rich source of nutrients and bioactive compounds. India ranks among the major cashew-producing nations contributing nearly one-fifth of the world's output with a cultivated area of 11.99 lakh hectares and an annual production of 7.95 lakh tonnes of raw nuts (DCCD, 2024). Despite its economic importance, productivity remains constrained by the narrow genetic base and limited systematic evaluation of available germplasm.

Morphological characterization of cashew is crucial for germplasm evaluation, hybrid selection and crop improvement. While quantitative traits such as yield and nut weight have been extensively studied, qualitative traits provide equally valuable descriptors for identifying genetic diversity and guiding breeding programmes. Characters such as leaf shape, leaf tip, panicle type, flower colour, flowering season, fruit shape, apple colour and nut shape are heritable, stable and can be used to distinguish genotypes effectively. The Cashew descriptors developed by IPGRI, as mentioned in Minimum descriptors of Cashew (Catalogue-I, 2023) by DCR, Puttur was used for recording the observations.

Earlier studies have reported considerable variation in cashew for qualitative traits including inflorescence type, flowering duration, apple colour and nut shape (Sethi *et al.* 2015, Sreenivas *et al*. 2014, Paikra *et al.,* 2016). Such diversity is important for identifying parental lines with desirable attributes for use in hybridization. However, most work has concentrated on limited sets of genotypes and comprehensive qualitative characterization across hybrids and parents under uniform conditions is relatively scarce.

The present investigation was therefore undertaken to study the qualitative characters of 45 F_1 hybrids, 17 parents and standard checks of cashew maintained at the Cashew Research Station, Bapatla. The aim was to document morphological variation in traits such as leaf, inflorescence, flower, apple and nut descriptors and to identify distinctive features that can support hybrid selection, genetic improvement and future breeding programmes.

Materials and Methods

The present investigation on qualitative traits of cashew (*Anacardium occidentale* L.) was carried out at the Cashew Research Station, Bapatla, Dr. YSR Horticultural University. The experimental material comprised 45 F_1 hybrids (H-445, H-448, H-460, H-461, H-464, H-466, H-467, H-472, H-474, H-483, H-484, H-491, H-492, H-493, H-496, H-656, H-657, H-658, H-660, H-661, H-662, H-663, H-684, H-685, H-686, H-693, H-694, H-695, H-696, H-698, H-701, H-703, H-705, H-706, H-710, H-712, H-713, H-714, H-715, H-716, H-717, H-718, H-719, H-720, H-722), 17 parents (M15/4, T.No.30/1, VRI-3, BPP-9, BPP-3, Priyanka, BPP-8, T.No.228, VRI-2, BPP-5, T.No.2/22, ABT-3, T.No.40/1, Ullal-3, Kankady, BLA39/4, T.No.10/19) and three standard checks (BPP-4, BPP-6, Vengurla 4)**.** These genotypes were established in the field during 2009-2012 and were maintained under uniform management practices during the evaluation period. The experimental design followed the Augmented Block Design (ABD) with checks repeated across blocks for effective comparison. Qualitative characters were documented based on cashew descriptors developed by IPGRI as mentioned in Minimum descriptors of Cashew (Catalogue–I, 2023) by DCR, Puttur .Observations were made on tree, leaf, floral, apple and nut characters at appropriate growth stages.

Results

Qualitative Characters

Tree Habit

Tree habit exhibited distinct variation among the evaluated genotypes. The majority of genotypes (55) expressed an upright and compact growth habit, which is considered desirable for high-density planting and better orchard management. Three genotypes, namely Vengurla-4, Priyanka and T.No.10/19, were characterized by an upright and open growth form, while seven genotypes including H-467, H-695, BPP-8, Kankady, M15/4, T.No.228 and T.No.2/22 showed a spreading habit. Such variability in tree architecture is important for selecting ideotypes suited for intensive cashew cultivation.

Branching Pattern

Branching pattern also varied significantly. Intensive branching was the most frequent, recorded in 61 genotypes. In contrast, only four genotypes (BPP-3, BPP-6, BPP-9, Vengurla 4) showed extensive branching. Intensive branching is often linked to compact canopies and higher fruiting potential, while extensive branching tends to favour wider canopies.

Inflorescence and Flowering Characters

Flowering season also differed as early flowering (October onwards) occurred in 19 genotypes including H-472, H-491, H-663, H-685, H-694, H-696, H-701, M15/4, T.No.30/1, VRI-3, Priyanka, BPP-8, Ullal-3, Vengurla- 4, BPP-9, T.No.228, T.No.2/22, ABT-3, T.No.40/1, Mid-season flowering (December–January) was common in 43 genotypes, while late flowering was restricted to three genotypes (H-720, H-722 and BPP-3). This variability in inflorescence traits and flowering time is useful in breeding programs aimed at extending harvest periods.

Table 1 : Qualitative characters of Cashew Hybrids, Parents and Checks

	Characteristic	Code	Group	Number of Genotypes	Genotypes
C01	Tree Habit	3	Upright and Compact	55	H-445, H-448, H-460, H-461, H-464, H-466, H-472, H-474, H-483, H-484, H-491, H-492, H-493, H-496, H-656, H-657, H-658, H-663, H-660, H-661, H-662, H-684, H-685, H-686, H-693, H-694, H-696, H-698, H-701, H-703, H-705, H-706, H-710, H-712, H-713, H-714, H-722, H-715, H-716, H-717,

					H-718, H-719, H-720, T.No.30/1, VRI-3, BPP-9, BPP-3, VRI-2, BPP-5, ABT-3, T.No.40/1, Ullal-3, BLA39/4, BPP-4, BPP-6
		5	Upright and Open	3	Vengurla 4, Priyanka, T.No.10/19
		7	Spreading	7	H-467, H-695, M15/4, BPP-8, Kankady, T.No.228, T.No.2/22
C02	Branching Pattern	1	Extensive	4	BPP-3, BPP-6, BPP-9, Vengurla 4
		2	Intensive	61	H-445, H-448, H-460, H-461, H-464, H-466, H-467, H-472, H-474, H-483, H-484, H-491, H-492, H-493, H-496, H-656, H-657, H-658, H-663, H-660, H-661, H-662, H-684, H-685, H-686, H-693, H-694, H-695, H-696, H-698, H-701, H-703, H-705, H-706, H-710, H-712, H-713, H-714, H-722, H-715, H-716, H-717, H-718, H-719, H-720, M15/4, T.No.30/1, VRI-3, Priyanka, T.No.228, VRI-2, BPP-5, T.No.2/22, ABT-3, T.No.40/1, Ullal-3, Kankady, BLA39/4, T.No.10/19 ,BPP-8 ,BPP-4,
C03	Colour of Young Leaves	1	Red	3	H-467, BPP-8, T.No.30/1
		2	Yellow red	62	H-445, H-448, H-460, H-461, H-464, H-466, H-472, H-474, H-483, H-484, H-491, H-492, H-493, H-496, H-656, H-657, H-658, H-663, H-660, H-661, H-662, H-684, H-685, H-686, H-693, H-694, H-695, H-696, H-698, H-701, H-703, H-705, H-706, H-710, H-712, H-713, H-714, H-722, H-715, H-716, H-717, H-718, H-719, H-720, M15/4, VRI-3, BPP-9, BPP-3, Priyanka, T.No.228, VRI-2, BPP-5, T.No.2/22, ABT-3, T.No.40/1, Ullal-3, Kankady, BLA39/4, T.No.10/19, BPP-4, BPP-6, Vengurla 4
		3	Green Yellow	0	
		4	Purple	0	
C04	Colour of Mature Leaves	1	Light green	1	H-484
		2	Green	62	H-445, H-448, H-460, H-461, H-464, H-466, H-467, H-472, H-474, H-483, H-491, H-496, H-656, H-657, H-658, H-663, H-660, H-661, H-662, H-684, H-685, H-686, H-693, H-694, H-695, H-696, H-698, H-701, H-703, H-705, H-706, H-710, H-712, H-713, H-714, H-722, H-715, H-716, H-717, H-718, H-719, H-720, M15/4, T.No.30/1, VRI-3, BPP-9, BPP-3, Priyanka, BPP-8, T.No.228, VRI-2, BPP-5, T.No.2/22, ABT-3, T.No.40/1, Ullal-3, Kankady, BLA39/4, T.No.10/19, BPP-4, BPP-6, Vengurla 4
		3	Dark green	2	H-492, H-493
		4	Purple	0	
C05	Leaf Shape	1	Oblong	2	VRI-2, VRI-3
		2	Obovate	62	H-445, H-448, H-460, H-461, H-464, H-466, H-467, H-472, H-474, H-483, H-484, H-491, H-492, H-493, H-496, H-656, H-657, H-658, H-663, H-660, H-661, H-662, H-684, H-685, H-686, H-693, H-694, H-695, H-696, H-698, H-701, H-703, H-705, H-706, H-710, H-712, H-713, H-714, H-722, H-715, H-716, H-717, H-718, H-719, H-720, M15/4, T.No.30/1, BPP-9, BPP-3, Priyanka, BPP-8, T.No.228, BPP-5, T.No.2/22, ABT-3, T.No.40/1, Ullal-3, Kankady, BLA39/4, T.No.10/19, BPP-4, BPP-6
		3	Ovate	1	Vengurla 4
C06	Leaf apex shape	1	Pointed	3	VRI-2, H-492, H-493
		2	Rounded	61	H-445, H-448, H-460, H-461, H-464, H-466, H-467, H-472, H-474, H-483, H-484, H-491, H-496, H-656, H-657, H-658, H-663, H-660, H-661, H-662, H-684, H-685, H-686, H-693, H-694, H-695, H-696, H-698, H-701, H-703, H-705, H-706, H-710, H-712, H-713, H-714, H-722, H-715, H-716, H-717, H-718, H-719, H-720, M15/4, T.No.30/1, BPP-9, BPP-3, Priyanka, BPP-8, T.No.228, BPP-5, T.No.2/22, ABT-3,

					T.No.40/1, Ullal-3, Kankady, BLA39/4, T.No.10/19, BPP-4, BPP-6, Vengurla 4
		3	Indented	1	VRI-3
C07	Leaf Cross section	1	Level	61	H-445, H-448, H-460, H-461, H-464, H-466, H-467, H-472, H-474, H-483, H-484, H-491, H-492, H-493, H-496, H-656, H-657, H-658, H-663, H-660, H-661, H-662, H-684, H-685, H-686, H-693, H-694, H-695, H-696, H-698, H-701, H-703, H-705, H-706, H-710, H-712, H-713, H-714, H-722, H-715, H-716, H-717, H-718, H-719, H-720, M15/4, VRI-3, BPP-9, BPP-3, Priyanka, BPP-8, T.No.228, BPP-5, T.No.2/22, ABT-3, T.No.40/1, Ullal-3, Kankady, BLA39/4, BPP-4, BPP-6
		2	Reflexed	0	
		3	Incurved	4	Vengurla 4, VRI-2, T.No.10/19, T.No.30/1
		4	Twisted	0	
C08	Leaf margins	1	Smooth	65	H-445, H-448, H-460, H-461, H-464, H-466, H-467, H-472, H-474, H-483, H-484, H-491, H-492, H-493, H-496, H-656, H-657, H-658, H-663, H-660, H-661, H-662, H-684, H-685, H-686, H-693, H-694, H-695, H-696, H-698, H-701, H-703, H-705, H-706, H-710, H-712, H-713, H-714, H-722, H-715, H-716, H-717, H-718, H-719, H-720, M15/4, T.No.30/1, VRI-3, BPP-9, BPP-3, Priyanka, BPP-8, T.No.228, VRI-2, BPP-5, T.No.2/22, ABT-3, T.No.40/1, Ullal-3, Kankady, BLA39/4, T.No.10/19, BPP-4, BPP-6, Vengurla 4
		2	Wavy	0	
C09	Odour of the leaves	1	Mango like	1	H-467
		2	Turpentine like	64	H-445, H-448, H-460, H-461, H-464, H-466, H-472, H-474, H-483, H-484, H-491, H-492, H-493, H-496, H-656, H-657, H-658, H-663, H-660, H-661, H-662, H-684, H-685, H-686, H-693, H-694, H-695, H-696, H-698, H-701, H-703, H-705, H-706, H-710, H-712, H-713, H-714, H-722, H-715, H-716, H-717, H-718, H-719, H-720, M15/4, T.No.30/1, VRI-3, BPP-9, BPP-3, Priyanka, BPP-8, T.No.228, VRI-2, BPP-5, T.No.2/22, ABT-3, T.No.40/1, Ullal-3, Kankady, BLA39/4, T.No.10/19, BPP-4, BPP-6, Vengurla 4
C10	Season of flowering	3	Early	19	H-472, H-491, H-663, H-685, H-694, H-696, H-701, M15/4, T.No.30/1, VRI-3, Priyanka, BPP-8, Ullal-3, Vengurla 4, BPP-9, T.No.228, T.No.2/22, ABT-3, T.No.40/1
		5	Mid	43	H-445, H-448, H-460, H-461, H-464, H-466, H-467, H-474, H-483, H-484, H-492, H-493, H-496, H-656, H-657, H-658, H-660, H-661, H-662, H-684, H-686, H-693, H-695, H-698, H-703, H-705, H-706, H-710, H-712, H-713, H-714, H-715, H-716, H-717, H-718, H-719, VRI-2, BPP-5, Kankady, BLA39/4, T.No.10/19, BPP-4, BPP-6
		7	Late	3	H-720, H-722, BPP-3
C11	Inflorescence shape	3	Narrowly pyramidal	10	H-684, H-685, H-686, H-714, H-718, H-722, VRI-2, BPP-5, ABT-3, BLA39/4
		5	Pyramidal	42	H-445, H-460, H-464, H-466, H-472, H-484, H-492, H-493, H-496, H-656, H-657, H-658, H-663, H-660, H-661, H-662, H-693, H-694, H-696, H-701, H-703, H-706, H-710, H-712, H-713,H-716, H-717, H-719, H-720, M15/4, T.No.30/1, VRI-3, BPP-9, BPP-3, T.No.228,T.No.2/22, T.No.40/1, Ullal-3, Kankady, BPP-4, BPP-6, Vengurla 4
		7	Broadly pyramidal	13	H-448, H-461, H-467, H-474, H-483, H-491, H-695, H-698, H-705, H-715, Priyanka, BPP-8, T.No.10/19
C12	Compactness of inflorescence	3	Loose	55	H-445, H-448, H-460, H-461, H-464, H-466, H-467, H-472, H-474, H-483, H-484, H-491, H-492, H-493, H-496, H-656, H-657, H-658, H-663, H-660, H-661, H-662, H-693, H-694, H-695, H-696, H-698, H-701, H-703, H-705, H-706, H-710, H-712, H-713, H-715, H-716, H-717, H-719, H-720, M15/4, T.No.30/1, VRI-3, BPP-9, BPP-3, Priyanka, BPP-8,

					T.No.228, T.No.2/22, T.No.40/1, Ullal-3, Kankady, T.No.10/19, BPP-4, BPP-6, Vengurla 4
		7	Compact	10	H-684, H-685, H-686, H-714, H-718, H-722, VRI-2, BPP-5, ABT-3, BLA39/4
C13	Flower colour	1	White	0	
		2	Cream	2	H-663, H-712
		3	Pink	63	H-445, H-448, H-460, H-461, H-464, H-466, H-467, H-472, H-474, H-483, H-484, H-491, H-492, H-493, H-496, H-656, H-657, H-658, H-660, H-661, H-662, H-684, H-685, H-686, H-693, H-694, H-695, H-696, H-698, H-701, H-703, H-705, H-706, H-710, H-713, H-714, H-722, H-715, H-716, H-717, H-718, H-719, H-720, M15/4, T.No.30/1, VRI-3, BPP-9, BPP-3, Priyanka, BPP-8, T.No.228, VRI-2, BPP-5, T.No.2/22, ABT-3, T.No.40/1, Ullal-3, Kankady, BLA39/4, T.No.10/19, BPP-4, BPP-6, Vengurla 4
C14	Mature cashew apple colour	1	Yellow	46	H-491, H-492, H-493, H-496, H-656, H-657, H-658, H-663, H-660, H-661, H-662, H-684, H-685, H-686, H-693, H-694, H-698, M15/4, T.No.30/1, H-701, H-703, H-705, H-706, H-710, H-712, H-713, H-714, H-722, H-715, H-716, H-717, H-718, H-719, H-720, BPP-9, BPP-8, T.No.228, VRI-2, BPP-3, BPP-5, T.No.2/22, ABT-3, Kankady, BLA39/4, T.No.10/19, BPP-4, BPP-6
		2	Red	4	H-484, T.No.40/1, Ullal-3, Vengurla 4
		3	Yellow red	15	H-445, H-448, H-460, H-461, H-464, H-466, H-467, H-472, H-474, H-483, H-663, H-695, H-722, Priyanka ,VRI-3
		4	Red purple	0	
C15	Cashew apple shape	1	Cylindrical	1	H-464
		2	Conical obovate	59	H-445, H-448, H-460, H-461, H-466, H-467, H-474, H-483, H-484, H-491, H-492, H-493, H-496, H-656, H-657, H-658, H-663, H-660, H-661, H-662, H-684, H-685, H-686, H-693, H-694, H-695, H-696, H-701, H-703, H-706, H-710, H-712, H-713, H-714, H-716, H-717, H-718, H-719, H-720, M15/4, T.No.30/1, VRI-3, BPP-9, BPP-3, Priyanka, BPP-8, T.No.228, VRI-2, BPP-5, T.No.2/22, ABT-3, T.No.40/1, Ullal-3, Kankady, BLA39/4, T.No.10/19, BPP-4, BPP-6, Vengurla 4
		3	Round	4	H-472, H-698, H-705, H-715
		4	Pyriform	1	H-722
C16	Shape of cashew apple base	1	Angular	1	H-722
		2	Rounded	64	H-445, H-448, H-460, H-461, H-464, H-466, H-467, H-472, H-474, H-483, H-484, H-491, H-492, H-493, H-496, H-656, H-657, H-658, H-663, H-660, H-661, H-662, H-684, H-685, H-686, H-693, H-694, H-695, H-696, H-698, H-701, H-703, H-705, H-706, H-710, H-712, H-713, H-714, , H-715, H-716, H-717, H-718, H-719, H-720, M15/4, T.No.30/1, VRI-3, BPP-9, BPP-3, Priyanka, BPP-8, T.No.228, VRI-2, BPP-5, T.No.2/22, ABT-3, T.No.40/1, Ullal-3, Kankady, BLA39/4, T.No.10/19, BPP-4, BPP-6, Vengurla 4
		3	Flattened	0	
		4	Obliquely flattened	0	
C17	Ridges on cashew apple	0	Absent	1	H-715
		1	Broken	64	H-445, H-448, H-460, H-461, H-464, H-466, H-467, H-472, H-474, H-483, H-484, H-491, H-492, H-493, H-496, H-656, H-657, H-658, H-663, H-660, H-661, H-662, H-684, H-685, H-686, H-693, H-694, H-695, H-696, H-698, H-701, H-703, H-705, H-706, H-710, H-712, H-713, H-714, H-722, H-716, H-717, H-718, H-719, H-720, M15/4, T.No.30/1, VRI-3, BPP-9, BPP-3, Priyanka, BPP-8, T.No.228, VRI-2, BPP-5, T.No.2/22, ABT-3, T.No.40/1, Ullal-3, Kankady, BLA39/4, T.No.10/19, BPP-4, BPP-6, Vengurla 4

		2	Entire	0	
C18	Cashew apple apex	1	Level	65	H-445, H-448, H-460, H-461, H-464, H-466, H-467, H-472, H-474, H-483, H-484, H-491, H-492, H-493, H-496, H-656, H-657, H-658, H-663, H-660, H-661, H-662, H-684, H-685, H-686, H-693, H-694, H-695, H-696, H-698, H-701, H-703, H-705, H-706, H-710, H-712, H-713, H-714, H-722, H-715, H-716, H-717, H-718, H-719, H-720, M15/4, T.No.30/1, VRI-3, BPP-9, BPP-3, Priyanka, BPP-8, T.No.228, VRI-2, BPP-5, T.No.2/22, ABT-3, T.No.40/1, Ullal-3, Kankady, BLA39/4, T.No.10/19, BPP-4, BPP-6, Vengurla 4
		2	Oblique	0	
C19	Grooves on apex of cashew apple	0	Absent	0	
		3	Shallow	65	H-445, H-448, H-460, H-461, H-464, H-466, H-467, H-472, H-474, H-483, H-484, H-491, H-492, H-493, H-496, H-656, H-657, H-658, H-663, H-660, H-661, H-662, H-684, H-685, H-686, H-693, H-694, H-695, H-696, H-698, H-701, H-703, H-705, H-706, H-710, H-712, H-713, H-714, H-722, H-715, H-716, H-717, H-718, H-719, H-720, M15/4, T.No.30/1, VRI-3, BPP-9, BPP-3, Priyanka, BPP-8, T.No.228, VRI-2, BPP-5, T.No.2/22, ABT-3, T.No.40/1, Ullal-3, Kankady, BLA39/4, T.No.10/19, BPP-4, BPP-6, Vengurla 4
		7	Deep	0	
C20	Cavity at apex of cashew apple	0	Absent	0	
		3	Shallow	65	H-445, H-448, H-460, H-461, H-464, H-466, H-467, H-472, H-474, H-483, H-484, H-491, H-492, H-493, H-496, H-656, H-657, H-658, H-663, H-660, H-661, H-662, H-684, H-685, H-686, H-693, H-694, H-695, H-696, H-698, H-701, H-703, H-705, H-706, H-710, H-712, H-713, H-714, H-722, H-715, H-716, H-717, H-718, H-719, H-720, M15/4, T.No.30/1, VRI-3, BPP-9, BPP-3, Priyanka, BPP-8, T.No.228, VRI-2, BPP-5, T.No.2/22, ABT-3, T.No.40/1, Ullal-3, Kankady, BLA39/4, T.No.10/19, BPP-4, BPP-6, Vengurla 4
C21	Shape of nut	1	Kidney	65	H-445, H-448, H-460, H-461, H-464, H-466, H-467, H-472, H-474, H-483, H-484, H-491, H-492, H-493, H-496, H-656, H-657, H-658, H-663, H-660, H-661, H-662, H-684, H-685, H-686, H-693, H-694, H-695, H-696, H-698, H-701, H-703, H-705, H-706, H-710, H-712, H-713, H-714, H-715, H-716, H-717, H-718, H-719, H-720, H-722, M15/4, T.No.30/1, VRI-3, BPP-9, BPP-3, Priyanka, BPP-8, T.No.228, VRI-2, BPP-5, T.No.2/22, ABT-3, T.No.40/1, Ullal-3, Kankady, BLA39/4, T.No.10/19, BPP-4, BPP-6, Vengurla 4
		2	Oblong ellipsoid	0	
C22	Colour of mature nut shell	1	Buff	2	H-492, H-493
		2	Grey	63	H-445, H-448, H-460, H-461, H-464, H-466, H-467, H-472, H-474, H-483, H-484, H-491, H-496, H-656, H-657, H-658, H-663, H-660, H-661, H-662, H-684, H-685, H-686, H-693, H-694, H-695, H-696, H-698, H-701, H-703, H-705, H-706, H-710, H-712, H-713, H-714, H-722, H-715, H-716, H-717, H-718, H-719, H-720, M15/4, T.No.30/1, VRI-3, BPP-9, BPP-3, Priyanka, BPP-8, T.No.228, VRI-2, BPP-5, T.No.2/22, ABT-3, T.No.40/1, Ullal-3, Kankady, BLA39/4, T.No.10/19, BPP-4, BPP-6, Vengurla 4
		3	Purple	0	
C23	Attachment of nut to apple	3	Loose	7	H-484,H-493, H-496, H-694,H-717,Priyanka, VRI-3
		5	Intermediate	56	H-445, H-448, H-460, H-461, H-464, H-466, H-467, H-472, H-474, H-491, H-492, H-656, H-657, H-658, H-663, H-660, H-661, H-662, H-684, H-685, H-686, H-693, H-695, H-696, H-701, H-703, H-705, H-706, H-710, H-712, H-713, H-714, H-722, H-715, H-716, H-718, H-719, H-720, M15/4, T.No.30/1, BPP-9, BPP-3, BPP-8, T.No.228, VRI-2, BPP-5,

					T.No.2/22, ABT-3, T.No.40/1, Ullal-3, Kankady, BLA39/4, T.No.10/19, BPP-4, BPP-6, Vengurla 4
		7	Tight	2	H-483, H-698
C24	Shape of nut base	1	Round	65	H-445, H-448, H-460, H-461, H-464, H-466, H-467, H-472, H-474, H-483, H-484, H-491, H-492, H-493, H-496, H-656, H-657, H-658, H-663, H-660, H-661, H-662, H-684, H-685, H-686, H-693, H-694, H-695, H-696, H-698, H-701, H-703, H-705, H-706, H-710, H-712, H-713, H-714, H-722, H-715, H-716, H-717, H-718, H-719, H-720, M15/4, T.No.30/1, VRI-3, BPP-9, BPP-3, Priyanka, BPP-8, T.No.228, VRI-2, BPP-5, T.No.2/22, ABT-3, T.No.40/1, Ullal-3, Kankady, BLA39/4, T.No.10/19, BPP-4, BPP-6, Vengurla 4
		2	Flattened	0	
		3	Obliquely flattened	0	
		4	Angular	0	
C25	Shape of nut apex	1	Round	47	H-445, H-448, H-460, H-461, H-464, H-466, H-467, H-472, H-474, H-491, H-496, H-656, H-657, H-658, H-663, H-660, H-661, H-662, H-684, H-685, H-686, H-693, H-694, H-695, H-696, H-698, H-701, H-703, H-705, M15/4, T.No.30/1, VRI-3, BPP-9, BPP-3, Priyanka, BPP-8, T.No.228, VRI-2, BPP-5, T.No.2/22, ABT-3, T.No.40/1, Ullal-3, Kankady, BLA39/4, T.No.10/19, BPP-4, BPP-6, Vengurla 4
		2	Intermediate	18	H-483, H-484, H-492, H-493, H-684, H-685,H-706, H-710, H-712, H-713, H-714, H-722, H-715, H-716, H-717, H-718, H-719, H-720
		3	Pointed	0	
C26	Suture of nut	1	Round	4	T.No.30/1, VRI-2, T.No.10/19, Vengurla 4
		2	Angular	61	H-445, H-448, H-460, H-461, H-464, H-466, H-467, H-472, H-474, H-483, H-484, H-491, H-492, H-493, H-496, H-656, H-657, H-658, H-663, H-660, H-661, H-662, H-684, H-685, H-686, H-693, H-694, H-695, H-696, H-698, H-701, H-703, H-705, H-706, H-710, H-712, H-713, H-714, H-722, H-715, H-716, H-717, H-718, H-719, H-720, M15/4, VRI-3, BPP-9, BPP-3, Priyanka, BPP-8, T.No.228, BPP-5, T.No.2/22, ABT-3, T.No.40/1, Ullal-3, Kankady, BLA39/4, BPP-4, BPP-6
C27	Flanks of nut	3	Flattened	0	
		5	Round	64	H-445, H-448, H-460, H-461, H-464, H-466, H-467, H-472, H-474, H-483, H-484, H-491, H-492, H-493, H-496, H-656, H-657, H-658, H-663, H-660, H-661, H-662, H-684, H-685, H-686, H-693, H-694, H-696, H-698, H-701, H-703, H-705, H-706, H-710, H-712, H-713, H-714, H-722, H-715, H-716, H-717, H-718, H-719, H-720, M15/4, T.No.30/1, VRI-3, BPP-9, BPP-3, Priyanka, BPP-8, T.No.228, VRI-2, BPP-5, T.No.2/22, ABT-3, T.No.40/1, Ullal-3, Kankady, BLA39/4, T.No.10/19, BPP-4, BPP-6, Vengurla 4
		7	Bulging	1	H-695
C28	Stylar scar on nut	3	Small	58	H-445, H-448, H-460, H-464, H-466, H-472, H-474, H-483, H-484, H-492, H-493, H-496, H-656, H-657, H-658, H-663, H-660, H-661, H-662, H-684, H-685, H-686, H-693, H-694, H-695, H-696, H-701, H-703, H-705, H-706, H-710, H-712, H-713, H-714, H-722, H-716, H-717, H-718, H-719, H-720, M15/4, T.No.30/1, VRI-3, BPP-9, BPP-3, BPP-8, T.No.228, VRI-2, BPP-5, T.No.2/22, ABT-3, T.No.40/1, Ullal-3, BLA39/4, T.No.10/19, BPP-4, BPP-6, Vengurla 4
		7	Large	7	H-461, H-467, H-491, H-698, H-715, Priyanka, Kankady
C29	Relative position of suture and apex	1	Suture projection in front of apex	0	

		2	Suture projection in line of apex	62	H-445, H-448, H-460, H-461, H-466, H-467, H-472, H-474, H-483, H-484, H-491, H-492, H-493, H-496, H-656, H-657, H-658, H-663, H-660, H-661, H-662, H-684, H-685, H-686, H-693, H-694, H-695, H-696, H-701, H-703, H-706, H-710, H-712, H-713, H-714, H-722, H-715, H-716, H-717, H-718, H-719, H-720, M15/4, T.No.30/1, VRI-3, BPP-9, BPP-3, Priyanka, BPP-8, T.No.228, VRI-2, BPP-5, T.No.2/22, ABT-3, T.No.40/1, Ullal-3, Kankady, BLA39/4, T.No.10/19, BPP-4, BPP-6, Vengurla 4
		3	Suture projection behind apex	3	H-464, H-705, H-698

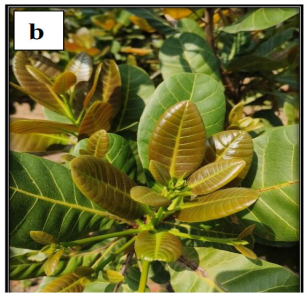

Plate 1 - Colour of young leaves : a. Red b. Yellow Red

Plate 2 - Flower Colour : c. Cream d. Pink

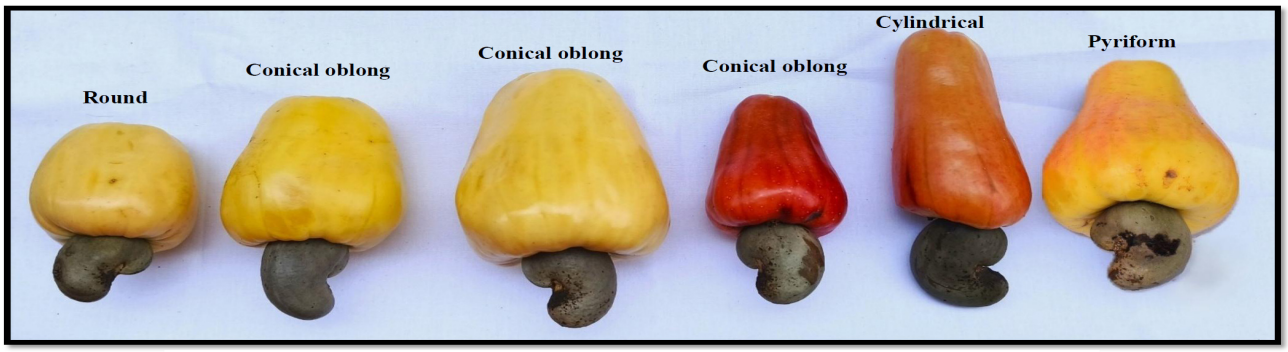

Plate 3 - Variation in Cashew apple colour, size and shape

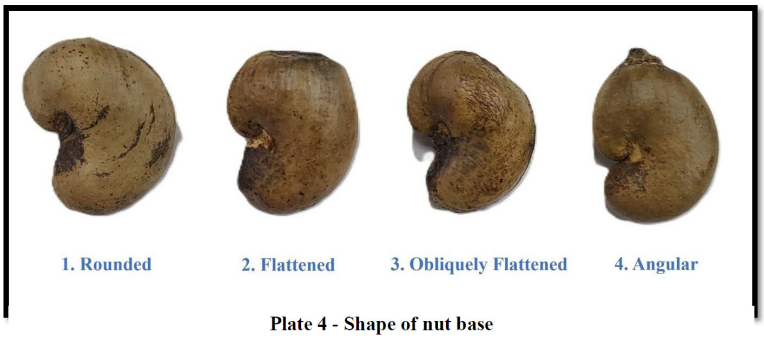

Plate 4 - Shape of nut base

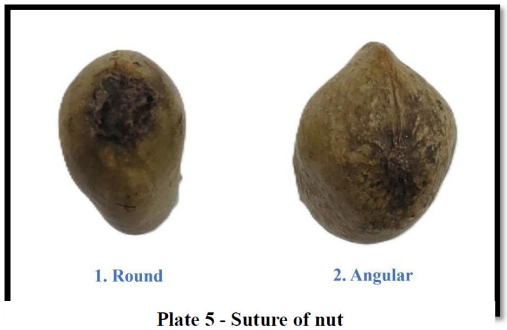

Plate 5 - Suture of nut

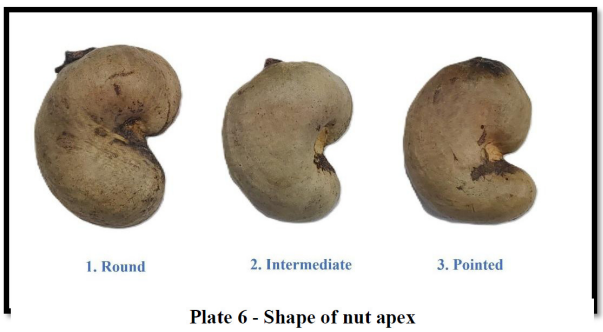

Plate 6 - Shape of nut apex

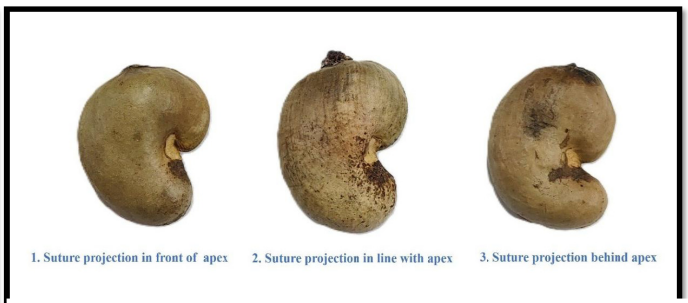

Plate 7 - Relative position of suture and apex

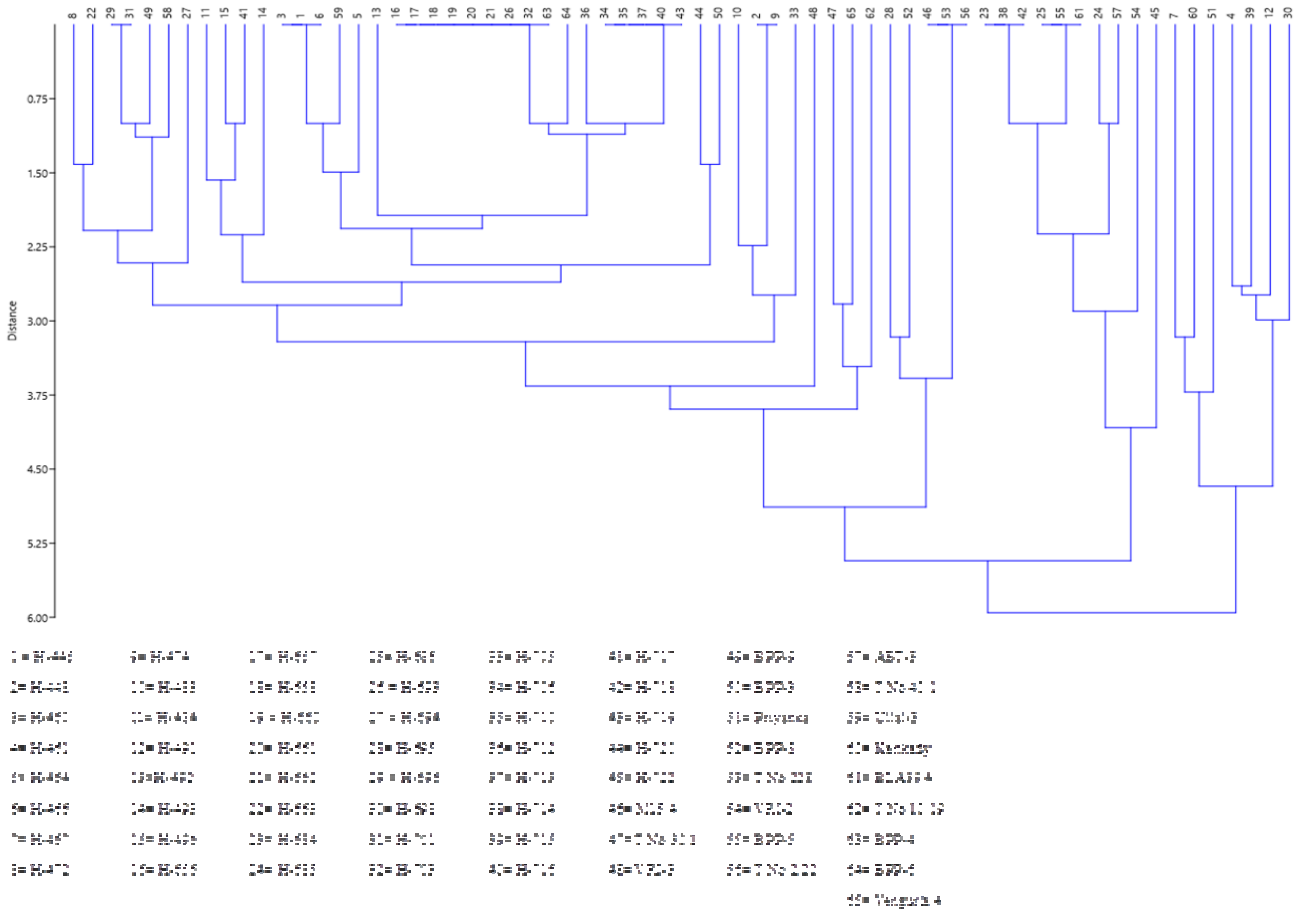

Fig. 1: Dendrogram based on similarity coefficient among 65 genotypes of cashew

Marked diversity was recorded in inflorescence and flowering traits. Inflorescence shape was predominantly pyramidal (42 genotypes), while 13 genotypes including H-448, H-461, H-467, H-474, H-483, H-491, H-695, H-698, H-705, H-715, Priyanka, BPP-8, T.No.10/19 exhibited broadly pyramidal forms. A smaller group (10 genotypes) such as H-684, H-685, H-686, H-714, H-718, H-722, VRI-2, BPP-5, ABT-3, BLA39/4 showed narrowly pyramidal inflorescences. With respect to compactness, most genotypes (55) had loose inflorescences, whereas compact inflorescences were confined to 10 genotypes H-684, H-685, H-686, H-714, H-718, H-722, VRI-2, BPP-5, ABT-3, BLA39/4.

Flower colour was mostly pink, recorded in 63 genotypes, while cream flowers were noted only in H-663 and H-712. None of the genotypes expressed white or purple flowers.

Leaf Characters

Leaf traits also revealed substantial variability. Colour of young leaves was predominantly yellow-red (62 genotypes), while red pigmentation was confined to three genotypes (H-467, BPP-8 and T.No.30/1). Mature leaves were generally green (62 genotypes), though H-492 and H-493 had dark green leaves and H-484 displayed light green foliage.

Leaf shape was mostly obovate (62 genotypes), with only a few exceptions such as Vengurla-4 (ovate) and VRI-2 and VRI-3 (oblong). Leaf apex was rounded in the majority (61 genotypes), while three genotypes (VRI-2, H-492 and H-493) showed pointed apices and VRI-3 displayed an indented apex. Most (61) genotypes exhibited level leaf cross-sections, whereas Vengurla-4, VRI-2 and T.No.10/19 and T.No.30/1 showed incurved types. Leaf margins were smooth in all genotypes. The odour of leaves was turpentine-like in 64 genotypes, while mango-like odour was recorded only in H-467.

Cashew Apple Characters

Cashew apple characters exhibited noticeable variation. Ripe apple colour was most frequently yellow (46 genotypes), followed by yellow-red (15

genotypes such as H-445, H-448, H-460, H-461, H-464, H-466, H-467, H-472, H-474, H-483, H-663, H-695, H-722, Priyanka). Red coloured apples were observed in four genotypes including H-484, T.No.40/1, Ullal-3, Vengurla 4. None of the genotypes exhibited red-purple colouration.

Apple shape was predominantly conical-obovate (59 genotypes), while cylindrical (H-464), round (H-472, H-698, H-705, H-715) and pyriform (H-722) forms were rare. The base of apples was rounded in 64 genotypes, with an angular base recorded only in H-722. Ridges on the apple surface were broken in 64 genotypes and were entirely absent only in H-715. Apex of apples was level across all genotypes, with shallow grooves and cavities present in all the genotypes.

Nut Characters

Nut traits also showed distinct qualitative variation. All the evaluated genotypes expressed kidney-shaped nuts. Mature nut shell colour was grey in 63 genotypes, while buff was recorded only in two genotypes, H-492 and H-493.

Attachment of nut to apple was intermediate in the majority (56 genotypes), loose in seven genotypes (H-484, H-493, H-496, H-694, H-717, Priyanka, VRI-3) and tight in two genotypes (H-483 and H-698). Nut base was round in all the evaluated genotypes, whereas the nut apex was round in 47 genotypes and intermediate in 18 genotypes, whereas pointed nut apex was not observed in any genotype. The suture type was angular in 61 genotypes and round in four genotypes (T.No.30/1, VRI-2, T.No.10/19 and Vengurla 4). With respect to the relative position of the suture and apex, 62 genotypes had the suture in line with the apex, whereas in three genotypes (H-464, H-705 and H-698) the suture was positioned behind the apex.

Flanks were generally round (64 genotypes) with H-695 being an exception showing bulging type. Stylar scar was small in 58 genotypes, while large scars were observed in seven genotypes such as H-461, H-467, H-491, H-698, H-715, Priyanka, Kankady. These nut descriptors provide useful markers for genotype differentiation and selection.

Discussions

Tree habit was dominated by upright and compact types (55 genotypes), with only a small proportion showing upright–open or spreading canopy. Intensive branching was also prevalent in most genotypes. This agrees with earlier reports that compact, intensively branched trees are common in improved cashew materials and are preferred for high-density planting, pruning and ease of harvest (Sreenivas *et al*., 2014 and Paikra *et al*., 2016). The small subset of spreading types identified in this study therefore represent useful architectural variants for low-density systems or for use as parents when a wider canopy is desired.

Leaf traits were relatively uniform, with most genotypes showing yellow-red young flushes, green mature leaves, obovate leaf shape, rounded apex, smooth margins and turpentine-like odour. This limited variability supports the view that leaf traits act mainly as supporting descriptors, while rare types such as mango-like odour remain useful for identification. The pattern observed in this study is in line with Sethi *et al.* (2015) and Sreenivas *et al.* (2014), who similarly recorded restricted variation for leaf morphology and noted that reproductive descriptors are more informative for differentiating cashew genotypes.

Inflorescence and flowering characters were more diverse and agronomically important. Pyramidal or broadly pyramidal panicles with loose compactness were common and genotypes were distributed across early, mid and late flowering groups with mid-season flowering dominating. Such variation allows strategic combination of genotypes to extend the flowering and harvesting period under coastal Andhra Pradesh conditions. These results are supported by earlier reports of Sreenivas *et al.* (2014) and Paikra *et al.* (2016) where pyramidal panicles and a wide flowering span were also recorded indicating that the present findings follow the similar results across locations.

Cashew apple traits showed conspicuous diversity in colour and shape. Yellow apples were most frequent followed by yellow-red, while red apples and cylindrical, round or pyriform shapes occurred only in a few genotypes. These distinctive apple colours and shapes have value for visual identification, consumer appeal and selection for table use or processing. The distribution of apple colours and shapes in this material is consistent with the reports of Sethi *et al.* (2015), Sreenivas *et al.* (2014) and the Evaluation of cashew hybrids (2012) and the present article thus reinforces earlier observations that yellow and conical-obovate apples dominate cashew collections with red apples occurring at lower frequency but having high market value.

Nut descriptors were conservative for some traits and variable for others. All genotypes produced kidney-shaped nuts, mostly with buff shells and intermediate attachment to the apple was common whereas buff shells, tight attachment, bulging flanks and large stylar scars were confined to a few entries.

These rare combinations provide useful morphological markers for fingerprinting and varietal description. Similar qualitative patterns for nut shape, shell colour and attachment have been documented by Sreenivas *et al.* (2014), Paikra *et al.* (2016) and Sethi *et al.* (2015) and the present study is in conformity with their findings while highlighting a few additional, distinctive nut types.

Overall, the qualitative variation recorded in this panel broadly agrees with earlier reports, while capturing the specific distribution of descriptor classes in a large set of hybrids, parents and checks maintained under uniform conditions at Bapatla. The predominance of compact trees with loose pyramidal inflorescences, pink flowers, yellow to yellow-red apples and kidney-shaped nuts reflects the ideotypes favoured in past selection and the presence of rare trait states enhances the value of this material for breeding, catalogue development and cashew improvement programmes. Taken together, the present observations substantiate and extend the qualitative variation reported in earlier cashew studies and provide additional support for the usefulness of descriptor-based characterization in hybrid blocks.

Conclusion

The evaluation of qualitative traits in cashew genotypes revealed considerable morphological diversity across tree, leaf, inflorescence, cashew apple and nut descriptors. Tree architecture showed variation in habit and branching pattern, which has direct implications for high-density planting and canopy management. Inflorescence characters such as shape, compactness and flowering season exhibited wide variability, suggesting scope for selecting genotypes with extended flowering duration and desirable floral traits. Leaf characters were largely uniform in margins and odour but showed variability in colour, shape and cross-section, which can be used as distinguishing descriptors. Cashew apple characters displayed diversity in colour, shape and ridging, providing important markers for cultivar identification and value addition in processing. Nut characters were relatively stable in shape but varied in shell colour, attachment, suture alignment and stylar scar size, offering useful indicators for genotype differentiation.

Overall, the wide range of qualitative variability observed in this study underscores the importance of morphological characterization for cashew improvement. These traits can serve as reliable descriptors for genetic resource documentation, hybrid selection and breeding programmes aimed at enhancing yield, adaptability and commercial value of cashew.

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