

MINIMUM DESCRIPTORS OF CASHEW

(*Anacardium occidentale* L.)

GERMPLASM ACCESSIONS

CATALOGUE - I



**CASHEW RESEARCH STATION, MADAKKATHARA
KERALA AGRICULTURAL UNIVERSITY
ALL INDIA COORDINATED RESEARCH PROJECT ON CASHEW
ICAR - DIRECTORATE OF CASHEW RESEARCH, PUTTUR**

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MESSAGE

Cashew Research Station, Madakkathara under Kerala Agricultural University since its inception in 1973 has played a pivotal role in cashew research as a center of All India Coordinated Research Programme on Cashew under DCR, Puttur. The station is presently conserving 148 germplasm accessions including exotic collections.

Characterization of cashew germplasm has been taken up at Cashew Research Station, Madakkathara adopting the Minimum descriptor of cashew germplasm accessions by DCR, Puttur. A set of 73 accessions have been characterized and presented as '**Minimum Descriptors of Cashew Germplasm Accessions-Catalogue I**' with well depicted colourful descriptor states along with clustering of accessions according to the group characters of DUS testing.

I appreciate the effort made by the Scientists of Cashew Research Station, Madakkathara to bring out this publication in a perceptible form.

Dr. J. Dinakara Adiga



Dr. Madhu Subramanian

Director of Research
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PREFACE

The Cashew Research Station, Madakkathara under Kerala Agricultural University has been a pioneer in developing a range of technologies for production and processing of cashew. The station has been supporting cashew farmers of the state with new varieties, technology recommendations and agri-business opportunities for nearly five decades. The germplasm of 73 cashew accessions maintained at CRS, Madakkathara as part of its research initiatives includes native and exotic genotypes with diverse traits that are of immense value in genetic improvement of the crop.

It is worthwhile to mention that utilization of the above germplasm has culminated in the release of 11 high yielding varieties of cashew suitable for Kerala conditions.

Cashew Research Station, Madakkathara, through this publication titled "**Minimum Descriptors of Cashew Germplasm Accessions-Catalogue 1**", describes the characteristic features of the 73 accessions being maintained in the station. I am sure that the catalogue will be very useful to the scientists, research scholars and students involved in cashew research.

I congratulate the editorial team of CRS, Madakkathara in coming on to with a commendable publication.

A handwritten signature in black ink, appearing to be 'Madhu'.

Dr. Madhu Subramanian

ACKNOWLEDGEMENT

The authors wish to express their sincere thanks to the eminent scientists who have been associated in the maintenance of germplasm at Cashew Research Station, Madakkathra. We acknowledge the support of Directorate of Cashew Research, Puttur for supplying the valuable accessions and obtaining the IC numbers.

We express our gratitude to Dr. J. Dinakara Adiga, Director, ICAR-Directorate of Cashew Research, Puttur, for the encouragement and advice given to us. The constant inspiration and guidance by Dr. Mohana G.S., Principal Scientist (Genetics and Cytogenetics) & In-charge, Project Coordinating Cell, ICAR-Directorate of Cashew Research, Puttur, in the preparation of **Minimum Descriptors of Cashew Germplasm Accessions - Catalogue 1**, a description of characteristic features of 73 diverse germplasm accessions is gratefully acknowledged.

The hard work of labourers of cashew Research Station, Madakkathara is also acknowledged. The support by the alma mater, Kerala Agricultural University, is remembered herewith.

Introduction

Cashew (*Anacardium occidentale* L.), the perennial fruit tree, is well known for its delicious nut. Portuguese first introduced cashew in the Malabar coast during the 16th century and presumed to have dispersed to other parts of the country and also to South East Asia. Though cashew is a native of Brazil, it is well acclimatized to Kerala conditions over four centuries. Cashew is a highly cross pollinated heterozygous polyploid having great variability in vigour, productivity, sex ratio and fruiting behaviour. Wide genetic variability exists in this crop due to seedling populations. Kerala can even be considered as the secondary centre of origin with respect to genetic divergence in cashew prevailing in this area.

In Kerala, cashew research was started in 1952, with the setting up of a research station at Kottarakkara under ICAR *ad hoc* project. This scheme continued till 1962. When ICAR terminated financial support to the scheme, the state government decided to have a full-fledged Cashew Research Station at Anakkayam in 1963 under a scheme included in the third five year plan.

Cashew Research Station, Anakkayam was one of the four centres of the All India Coordinated Spices and Cashewnut Improvement Project of the ICAR, which was started in 1971. The station was brought under the Kerala Agricultural University, when it was established in 1972. When the Cashew Research Station at Madakkathara was started under the Kerala Agricultural University on the 1st of May 1973, the centre of AICS & CIP was shifted to this station from Anakkayam.

During 1978-79, several research programmes were conducted at the Cashew Research Stations at Anakkayam and Madakkathara under the Kerala Agricultural Development Project (KADP), Vellanikkara. During the VIII five year plan, the World Bank aided Multi State Cashew Research Programme (MSCRP) was implemented at Madakkathara from 1982 to 1986.

Germplasm survey and collection of indigenous types was the initial research programme in Kottarakkara. The accessions collected were later transferred to research stations at Anakkayam and Madakkathara. At present cashew germplasm in Kerala Agricultural University is maintained at CRS, Madakkathara. This germplasm includes indigenous collections, collections from other states and exotic collections from Brazil, Indonesia, Tanzania and Republic of Panama.

Characterization and cataloguing of cashew germplasm

As new accessions are collected, it is important to characterise and catalogue them so that the breeders can utilize them for further crop improvement programmes. The book entitled, “Minimum Descriptors of cashew germplasm accessions-Catalogue I” has been prepared by incorporating the descriptive details of 73 accessions with IC number obtained from NBPGR, New Delhi. Preliminary evaluation and characteri-zation of accessions planted during the years between 1988 and 1993 were done after six annual harvests using the minimum descriptors published by DCR, Puttur. These accessions were collected from Brazil (5), Andhra Pradesh (2), Maharashtra (1), Karnataka (6), and different cashew growing districts of Kerala viz., Malappuram (24), Kollam (16), Thrissur (16) and Kannur (3) (Table 2). Accessions were grown under rainfed conditions by adopting the recommended package of practices of KAU. The data field (68) recorded are listed in Table 1 with corresponding numerical code of the character as shown in the IBPGR “Cashew Descriptors”.



Table 1: Descriptors listed with data field number, descriptor name and descriptor code from IBPGR descriptor list

Data Field	Descriptor	Descriptor state	IBPGR Code
01	Accession number		1.1
02	Donor name		1.2
03	Donor identification number		1.3
04	Scientific name		1.5
05	Type of maintenance	1 Vegetative 2 Tissue culture	1.11
06	Age of tree (years)		3.4
07	Tree habit	3 Upright and compact 5 Upright and open 7 Spreading	4.1.1
08	Internode length of twig (cm)	3 Short (< 1.0 cm) 5 Medium (1.0 – 2.0 cm) 7 Long (> 2.0 cm)	4.1.2
09	Leaf shape	1 Oblong 2 Obovate (club-shaped) 3 Oval	4.1.3
10	Tree height (m)	3 Dwarf (< 2.5 m) 5 Semi tall (2.5 – 4 m) 7 Tall (> 4.0 m)	6.1.1
11	Tree spread (m)	3 Low (< 3.0 m) 5 Intermediate (< 3.0 – 6.0 m) 7 High (> 6.0 m)	6.1.2
12	Crack on trunk bark	0 Absent (smooth) + Present (Rough/ Scaly)	6.1.3
13	Crotch angle of main branches	3 Acute (< 90°) 7 Obtuse (> 90°)	6.1.5
14	Ease of peeling bark from twigs	3 Difficult 7 Easy	6.1.6

Data Field	Descriptor	Descriptor state	IBPGR Code
15	Extension growth of twigs (cm)	3 Short (< 9.0 cm) 5 Intermediate (9.0 – 19.0 cm) 7 Long (> 19.0 cm)	6.1.7
16	Branching pattern	1 Extensive 2 Intensive	6.1.8
17	Twig diameter (mm)	3 Thin (< 4.5 mm) 5 Intermediate (4.5 – 9.0 mm) 7 Thick (> 9.0 mm)	6.1.9
18	Number of leaves per twig	3 Low (< 9) 5 Medium (9 - 19) 7 High (> 19)	6.1.10
19	Colour of young leaves	1 Red 2 Yellow red 3 Green Yellow 4 Purple	6.1.11
20	Colour of mature leaves	1 Light Green 2 Green 3 Dark Green 4 Purple	6.1.12
21	Odour of leaves	1 Mango like 2 Turpentine like	6.1.13
22	Leaf margins	1 Smooth 2 Wavy	6.1.14
23	Leaf apex shape	1 Pointed 2 Rounded 3 Indented (slight notch)	6.1.15
24	Leaf size (m ²)	3 Small (< 60 cm ²) 5 Intermediate (60 – 120 cm ²) 7 Large (> 120 cm ²)	6.1.16

Data Field	Descriptor	Descriptor state	IBPGR Code
25	Brittleness of leaf	3 Leathery 7 Brittle	6.1.17
26	Angle of leaf petiole	3 Acute (< 90°) 7 Obtuse (>90°)	6.1.18
27	Leaf cross-section	1 Level 2 Reflexed 3 Incurved 4 Twisted	6.1.19
28	Season of flowering	3 Early (Nov - Dec) 5 Mid (Dec - Jan) 7 Late (Jan - Feb)	4.2.1
29	Inflorescence shape	3 Narrowly pyramidal 5 Pyramidal 7 Broadly pyramidal	4.2.2
30	Flower colour	1 White 2 Cream 3 Pink	4.2.3
31	Mature cashew apple colour	1 Yellow 2 Red 3 Yellow Red 4 Red Purple	4.2.4
32	Cashew apple shape	1 Cylindrical 2 Conical - obovate 3 Round 4 Pyriform	4.2.5
33	Colour of mature nut shell	1 Buff 2 Grey 3 Purple	4.2.6
34	Nut shape	3 Small (< 60 cm ²) 5 Intermediate (60 – 120 cm ²) 7 Large (> 120 cm ²)	4.2.7

Data Field	Descriptor	Descriptor state	IBPGR Code
35	Nut weight (g)	3 Low (< 5g) 5 Intermediate (5-7g) 7 High (> 7g)	4.2.8
36	Colour of boot leaf	1 Light green 2 Green	6.2.1
37-1	Inflorescence size -Length (cm)		6.2.2
37-2	Inflorescence size- width (cm)		6.2.2
38	Compactness of inflorescence	3 Loose 4 Compact	6.2.3
39	Type of inflorescence branching	1 All around main axis 2 Two sided	6.2.4
40	Sex ratio	3 Low (< 0.06) 5 Medium (0.06 – 0.13) 7 High (> 0.13)	6.2.6
41	Secondary flowering	0 Absent + Present	6.2.7
42-1	Size of cashew apple – Length (cm)		6.2.8
42-2	Size of cashew apple – width (cm)		6.2.8
43	Weight of cashew apple (g)	3 Low (> 27 g) 5 Medium (27 – 52 g) 7 High (> 52 g)	6.2.9
44	Shape of cashew apple base	1 Angular 2 Rounded 3 Flattened 4 Obliquely flattened	6.2.10
45	Ridges on cashew apple	0 Absent 1 Broken 2 Entire	6.2.11
46	Cashew apple apex	1 Level 2 Oblique	6.2.12

Data Field	Descriptor	Descriptor state	IBPGR Code
47	Grooves on apex of cashew apple	0 Absent 3 Shallow (Notched) 7 Deep (Furrowed)	6.2.13
48	Cavity of apex of cashew apple	0 Absent 3 Shallow	6.2.14
49	Skin of cashew apple	1 Smooth and glossy 2 Rough and dull	6.2.17
50	Attachment of nut to apple	3 Loose 5 Intermediate 7 Tight	6.2.24
51	Shape of nut base	1 Round 2 Flattened 3 Obliquely flattened 4 Angular	6.2.25
52	Suture of nut	1 Round 2 Angular	6.2.26
53	Flanks of nut	3 Flattened 5 Round 7 Bulging	6.2.27
54	Stylar scar on nut	3 Small (Narrow) 7 Large (Wide)	6.2.28
55	Shape of nut apex	1 Round 2 Intermediate 3 Pointed	6.2.29
56	Relative position of suture and apex	1 Suture projection in front of apex 2 Suture projection in line with apex 3 Suture projection behind apex	6.2.30
57	Shell thickness (mm)	3 Thin (< 2.5 mm) 5 Intermediate (2.5 – 4.0 mm) 7 Thick (> 4.0 mm)	6.2.31

Data Field	Descriptor	Descriptor state	IBPGR Code
58	Uniformity of shell thickness	0 Not uniform +Uniform	6.2.32
59-1	Cashew nut dimension–Length (cm)		6.2.33
59-2	Cashew nut dimension–Width (cm)		6.2.33
59-3	Cashew nut dimension–Thickness (cm)		6.2.33
60	Flowering duration (days)	3 Short (< 60 days) 5 Medium (60-90 days) 7 Long (> 90 days)	11.2.1
61	Flowering intensity (%)	3 Low (< 40%) 5 Medium (40 – 70%) 7 High (> 70%)	11.2.2
62	Apple nut ratio	3 Low (< 6.0) 5 Medium (6.0 – 12.0) 7 High (> 12.0)	11.2.3
63	Shelling percentage	3 Low (< 18%) 5 Intermediate (18.0 – 28.0%) 7 High (> 28.0%)	4.3.1
64	Kernel weight	3 Low (< 1.2 g) 5 Intermediate (1.2 – 2.5 g) 7 High (> 2.5 g)	4.3.2
65	Attachment of peel to kernel	3 Loose 5 Tight	4.3.3
66-1	Kernel dimension-Length (cm)		6.3.1
66-2	Kernel dimension-Width (cm)		6.3.1
66-3	Kernel dimension-Thickness (cm)		6.3.1
67	Cotyledonary grooves	3 Shallow 7 Deep	6.3.2
68	Cumulative yield per plant (kg)	3 Low (< 9 kg) 5 Medium (9.0 – 18 kg) 7 High (> 18 kg)	11.1

07. Tree Habit



3. Upright and compact

5. Upright and open

7. Spreading

09. Leaf Shape



1. Oblong

2. Obovate

3. Oval

13. Crotch Angle of Main Branches



1. Acute

2. Obtuse

Photo courtesy: IBPGR, 1986

16. Branching Pattern



1. Extensive



2. Intensive

Photo courtesy: Nayak et al., 2014

19. Colour of young leaves



1. Red



2. Yellow red



3. Green yellow



4. Purple

23. Leaf Apex Shapes

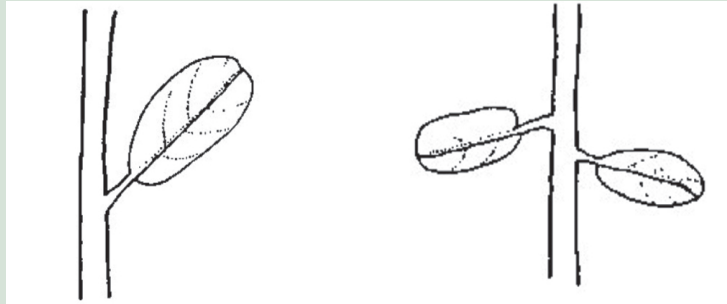


1. Pointed

2. Rounded

3. Indented

26. Angle of Leaf Petiole Relative to Stem



1. Acute

2. Obtuse

Photo courtesy: IBPGR, 1986

27. Leaf Cross Section



1. Level



2. Reflexed



3. Incurved



4. Twisted

29. Inflorescence Shape



3. Narrowly pyramidal



5. Pyramidal



7. Broadly pyramidal

30. Flower Colour



1. White

2. Cream

3. Pink

32. Cashew Apple Shape



1. Cylindrical

2. Conical obovate

3. Round

4. Pyriform

34. Nut Shape



1. Kidney

2. Obliquely ellipsoid

38. Compactness of Inflorescence



3. Loose



7. Compact

44. Shape of Cashew Apple Base



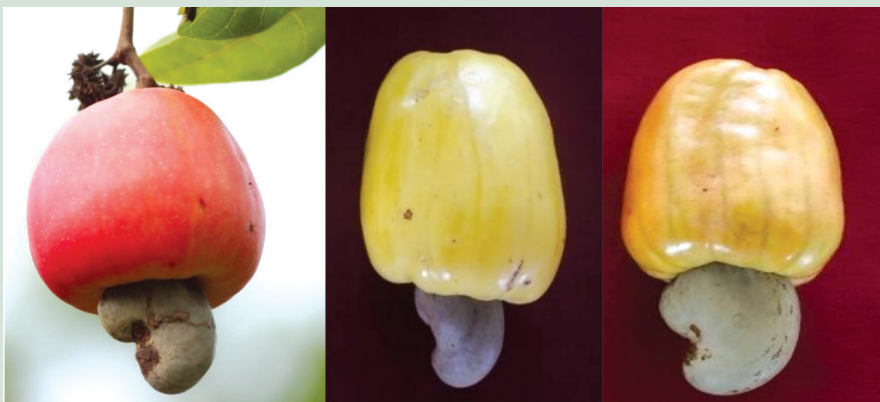
1. Angular

2. Rounded

3. Flattened

4. Obliquely flattened

45. Ridges on Cashew Apple



0. Absent

1. Broken

2. Entire

46. Cashew Apple Apex



1. Level



2. Oblique

47. Grooves on Apex of Cashew Apple



0. Absent

3. Shallow

7. Deep

49. Skin of Cashew Apple



1. Smooth and glossy



2. Rough and dull

51. Shape of Nut Base



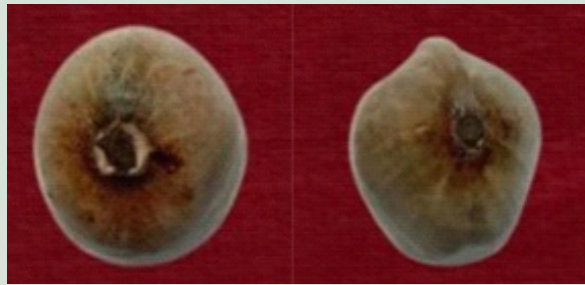
1. Round

2. Flattened

3. Obliquely flattened

4. Angular

52. Suture of Nut



1. Round

2. Angular

55. Shape of Nut Apex



1. Round

2. Intermediate

3. Pointed

56. Relative Position of Suture and Apex



1. Suture projection in front of apex



2. Suture projection in line with apex



3. Suture projection behind apex

All the 73 accessions (100%) had cracks on trunk bark, difficulty in peeling the bark from the twig, thin twig, mid-season of flowering, small leaf, kidney shaped nuts, light green colour of boot leaf, inflorescence branching all around main axis, absence of secondary flowering and medium duration of flowering. Summaries of 48 morphological characters measured on 73 accessions are presented as Figure 1, 2, 3, 4 and 5 and as Table 3, 4, 5, 6, 7,8.

Wide variability was observed in tree and inflorescence characters (Figure 1, Table 3 and 4). Of the 73 accessions, 37 had spreading tree habit (50.7%), 49 had medium inter nodal length of twig (67.1%), 37 had semi tall tree habit (50.7%), 42 had high canopy spread (57.5%), 52 had obtuse crotch angle of main branches (71.2%), 45 had intermediate length of twigs (61.6%), 58 had intensive type of branching (79.4%), 52 had pyramidal shaped inflorescence (71.2%), 45 had high flowering intensity with loose inflorescence (61.6%), 48 had medium sex ratio (65.7%).

The variability in leaf characters of 73 accessions was exhibited in Figure 2, Table 5. Oval shaped leaves were present in 52 accessions. Majority of accessions were having low number of leaves per twig (52), green yellow-coloured young leaves (67), green coloured mature leaves (41), mango like odour of leaves (58), smooth leaf margin (44), round leaf apex shape (59), brittle leaves (48), obtuse angle of leaf petiole relative to stem (62) and reflexed leaf cross section (49).

The morphological characters of cashew apple also showed great variability with respect to colour, shape and weight (Figure 3, Table 6). Forty-four accessions had yellow red coloured mature cashew apple (60.3%), 45 had conical obovate shaped

apple (61.6%), 39 had high apple weight (53.4%), 28 had angular shaped apple base (38.3%), 38 had no ridges on cashew apple (52.1%), 47 had level cashew apple apex (64.4%), 49 had shallow grooves on the apex of cashew apple (67.1%), 55 had shallow cavity at apex of cashew apple (75.3%), 65 had smooth and glossy skin of cashew apple (89.04%).

Nut characters are depicted as Table 7. The frequency distribution of different traits of nut (Figure 4) showed that 63 accessions had grey coloured mature nut shell (86.3%), 44 had tight attachment nut to apple (60.3%), 69 had kidney shaped nuts (94.5%), 48 had high nut weight (65.7%), 63 had round nut base (86.3%), 43 had round suture (58.9%), 39 had round flanks of nut (53.4%), 61 had small styler scar on nut (83.5%), 54 had round shape of nut apex (73.9%), 48 had suture projection in line with apex (65.7%), 36 each had intermediate and thick shell thickness (49.3%), 59 had uniform shell thickness (80.8%), 59 had medium apple to nut ratio (80.8%).

The variability in kernel characters is presented as Figure 5 and Table 8. Intermediate shelling percentage was observed in 54 accessions (73.9%), 50 had medium kernel weight (68.5%), 43 had tight attachment of peel to kernel (58.9%), 44 had shallow cotyledonary grooves (60.3%), 45 had low cumulative yield per plant (61.6%).

Table 2. Details of cashew accessions used for characterization

YOP	IC No	DF 01	DF 02	DF 03	DF 04	DF 05	DF 06
1988	302045	CRS 15	Cashew farm, Kottarakkara	Brazil-2	<i>A. occidentale</i>	1	10
1988	302046	CRS 16	Brazil	Brazil-3	<i>A. occidentale</i>	1	10
1988	302047	CRS 18	Brazil	Brazil-239	<i>A. occidentale</i>	1	10
1988	250062	CRS 19	Brazil	Brazil-241	<i>A. occidentale</i>	1	10
1988	302049	CRS 21	Brazil	Brazil-248(m)	<i>A. occidentale</i>	1	10
1988	302050	CRS 22	Brazil	Brazil-248	<i>A. occidentale</i>	1	10
1988	302051	CRS 23	Kollam	KTR-27	<i>A. occidentale</i>	1	10
1988	302052	CRS 24	Puruthiyara, Kollam	Puruthiyara	<i>A. occidentale</i>	1	10

YOP	IC No	DF 01	DF 02	DF 03	DF 04	DF 05	DF 06
1988	302053	CRS 25	Vapala, Kollam	Vapala	<i>A. occidentale</i>	1	10
1988	249809	CRS 30	CRS Madakkathara	H-3-13	<i>A. occidentale</i>	1	10
1989	302056	CRS 32	CRS Madakkathara	H-680	<i>A. occidentale</i>	1	10
1989	302057	CRS 33	CRS Madakkathara	H-682	<i>A. occidentale</i>	1	10
1989	302058	CRS 34	CRS Madakkathara	H-718	<i>A. occidentale</i>	1	10
1989	302059	CRS 35	CRS Madakkathara	H-719	<i>A. occidentale</i>	1	10
1989	302060	CRS 36	CRS Madakkathara	H-856	<i>A. occidentale</i>	1	10
1989	302061	CRS 37	CRS Madakkathara	H-1588	<i>A. occidentale</i>	1	10
1989	302062	CRS 38	CRS Madakkathara	H-1589	<i>A. occidentale</i>	1	10
1989	302064	CRS 41	CRS Madakkathara	H-1596	<i>A. occidentale</i>	1	10
1989	302067	CRS 45	CRS Madakkathara	H-1602	<i>A. occidentale</i>	1	10
1989	250128	CRS 46	CRS Madakkathara	H-1608	<i>A. occidentale</i>	1	10
1989	302068	CRS 47	CRS Madakkathara	H-1610	<i>A. occidentale</i>	1	10
1989	302069	CRS 48	CRS Madakkathara	M 1-2	<i>A. occidentale</i>	1	10
1989	302070	CRS 49	CRS Madakkathara	A 26-2	<i>A. occidentale</i>	1	10
1989	302044	CRS 50	CRS Madakkathara	PTR 1-1	<i>A. occidentale</i>	1	10
1989	302071	CRS 51	CRS Madakkathara	A-6-1	<i>A. occidentale</i>	1	10
1989	249949	CRS 52	NRCC, Karnataka	Puttur-1	<i>A. occidentale</i>	1	10
1989	249950	CRS 53	NRCC, Karnataka	Puttur-2	<i>A. occidentale</i>	1	10
1989	249951	CRS 54	NRCC, Karnataka	Puttur-4	<i>A. occidentale</i>	1	10
1989	249952	CRS 55	NRCC, Karnataka	Puttur-6	<i>A. occidentale</i>	1	10
1989	249953	CRS 56	NRCC, Karnataka	Puttur-7	<i>A. occidentale</i>	1	10
1989	249954	CRS 57	NRCC, Karnataka	Puttur-8	<i>A. occidentale</i>	1	10
1989	302072	CRS 58	CRS, Bapatla	Rajamundiri	<i>A. occidentale</i>	1	10

YOP	IC No	DF 01	DF 02	DF 03	DF 04	DF 05	DF 06
1989	302073	CRS 60	CRS, Anakkayam	Brazil-18	<i>A. occidentale</i>	1	10
1989	302074	CRS 61	CRS, Anakkayam	K 3-1	<i>A. occidentale</i>	1	10
1989	302075	CRS 62	CRS, Anakkayam	K 3-2	<i>A. occidentale</i>	1	10
1989	302076	CRS 63	CRS, Anakkayam	K 4-1	<i>A. occidentale</i>	1	10
1989	302077	CRS 64	CRS, Anakkayam	K 4-2	<i>A. occidentale</i>	1	10
1989	302078	CRS 65	CRS, Anakkayam	K 10-1	<i>A. occidentale</i>	1	10
1989	302080	CRS 67	CRS, Anakkayam	K 16-1	<i>A. occidentale</i>	1	10
1989	302081	CRS 68	CRS, Anakkayam	K 18-2	<i>A. occidentale</i>	1	10
1989	249789	CRS 69	CRS, Anakkayam	K 19-1	<i>A. occidentale</i>	1	10
1989	302082	CRS 70	CRS, Anakkayam	K 19-2	<i>A. occidentale</i>	1	10
1989	302083	CRS 71	CRS, Anakkayam	K 30-1	<i>A. occidentale</i>	1	10
1989	302084	CRS 72	CRS, Anakkayam	H 3-4	<i>A. occidentale</i>	1	10
1989	302085	CRS 73	CRS, Anakkayam	H 3-9	<i>A. occidentale</i>	1	10
1989	302086	CRS 74	CRS, Anakkayam	H 7-6	<i>A. occidentale</i>	1	10
1989	302087	CRS 75	CRS, Anakkayam	H 8-1	<i>A. occidentale</i>	1	10
1989	302088	CRS 76	CRS, Anakkayam	H 8-6	<i>A. occidentale</i>	1	10
1989	302090	CRS 78	CRS, Anakkayam	H 8-8	<i>A. occidentale</i>	1	10
1989	302091	CRS 79	CRS, Anakkayam	H 8-10	<i>A. occidentale</i>	1	10
1989	302092	CRS 80	CRS, Anakkayam	H 8-15	<i>A. occidentale</i>	1	10
1989	302093	CRS 81	CRS, Anakkayam	H 9-3	<i>A. occidentale</i>	1	10
1989	302094	CRS 82	CRS, Anakkayam	BLA-256-4	<i>A. occidentale</i>	1	10

YOP	IC No	DF 01	DF 02	DF 03	DF 04	DF 05	DF 06
1992	302095	CRS 83	Payam, Malappuram	Payam-1	<i>A. occidentale</i>	1	10
1992	302096	CRS 84	Payam, Malappuram	Payam-2	<i>A. occidentale</i>	1	10
1992	302097	CRS 85	Kiliyanthara, Malappuram	Kiliyanthara	<i>A. occidentale</i>	1	10
1992	302098	CRS 86	Kelokam, Kannur	kilokom 1	<i>A. occidentale</i>	1	10
1992	302099	CRS 87	Kelokam, Kannur	kilokam-2	<i>A. occidentale</i>	1	10
1992	302100	CRS 88	Kottiyur, Kannur	Ambayathode	<i>A. occidentale</i>	1	10
1992	302101	CRS 89	Kottarakkara, Kollam	Ulikkal-1	<i>A. occidentale</i>	1	10
1992	302102	CRS 90	Kottarakkara, Kollam	Ulikkal-2	<i>A. occidentale</i>	1	10
1992	302103	CRS 91	Pottamparambil, Kollam	Ulikkal-3	<i>A. occidentale</i>	1	10
1992	302104	CRS 92	Aryalinkal, Kollam	Ulikkal-4	<i>A. occidentale</i>	1	10
1992	302105	CRS 93	Vaniakizhakkal, Kollam	Ulikkal-5	<i>A. occidentale</i>	1	10
1992	302106	CRS 94	Ulikkal, Kollam	Ulikkal-6	<i>A. occidentale</i>	1	10
1992	302107	CRS 95	Anandapilly, Kollam	Anadapally	<i>A. occidentale</i>	1	10
1992	302108	CRS 96	Anchal, Kollam	Kottarakkara	<i>A. occidentale</i>	1	10
1992	302109	CRS 97	Anchal, Kollam	Anakkara	<i>A. occidentale</i>	1	10
1993	302110	CRS 98	Vengurla, Maharashtra	Vetore 56	<i>A. occidentale</i>	1	10
1993	302111	CRS 100	Kottarakkara, Kollam	KTR-1-254	<i>A. occidentale</i>	1	10
1993	302112	CRS 101	Kottarakkara, Kollam	K1	<i>A. occidentale</i>	1	10
1993	302113	CRS 102	Kottarakkara, Kollam	KTR-1-306	<i>A. occidentale</i>	1	10
1991	302116	CRS 120	Bapatla	Rajapalayam	<i>A. occidentale</i>	1	10

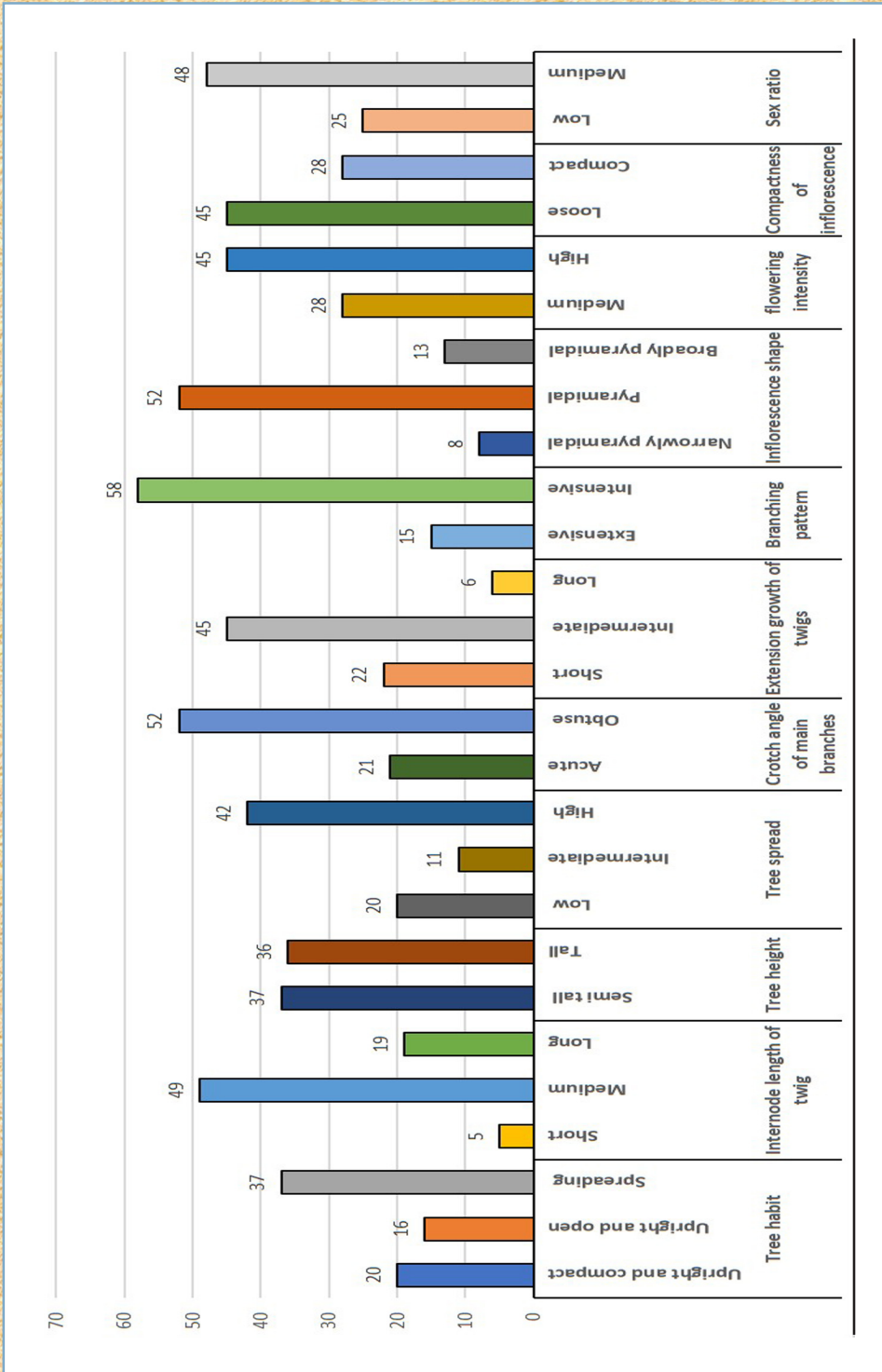


Figure 1. Variability in tree and inflorescence characters of 73 accessions of cashew

Table 3. Tree characters of 73 accessions of cashew conserved at CRS, Madakkathara

DF 01	DF 07	DF 08	DF 10	DF 11	DF 12	DF 13	DF 14	DF 15	DF 16
CRS 15	7	5	5	7	+	7	3	5	2
CRS 16	5	5	5	7	+	7	3	5	2
CRS 18	7	5	5	7	+	7	3	5	2
CRS 19	7	5	5	7	+	7	3	5	2
CRS 21	7	5	5	7	+	7	3	5	2
CRS 22	7	5	5	7	+	7	3	5	2
CRS 23	3	5	7	3	+	7	3	5	2
CRS 24	5	7	5	3	+	3	3	3	2
CRS 25	7	3	5	7	+	7	3	5	2
CRS 30	7	5	7	3	+	3	3	5	2
CRS 32	7	5	5	7	+	7	3	5	2
CRS 33	5	5	5	7	+	7	3	5	2
CRS 34	7	5	5	7	+	7	3	5	2
CRS 35	7	5	5	7	+	7	3	5	2
CRS 36	7	5	7	7	+	7	3	5	2
CRS 37	5	5	7	7	+	7	3	5	2
CRS 38	7	7	5	7	+	3	3	5	2
CRS 41	7	3	7	7	+	7	3	5	2
CRS 45	5	5	7	7	+	7	3	5	2
CRS 46	7	5	7	7	+	7	3	5	2
CRS 47	7	7	5	7	+	7	3	5	2
CRS 48	5	7	5	5	+	3	3	3	2
CRS 49	7	7	5	7	+	7	3	5	2
CRS 50	3	7	5	5	+	7	3	3	2
CRS 51	7	5	5	3	+	7	3	3	2
CRS 52	5	5	5	3	+	7	3	3	2
CRS 53	3	5	7	3	+	7	3	3	1
CRS 54	7	5	7	7	+	7	3	3	2
CRS 55	7	5	7	7	+	7	3	3	2
CRS 56	7	5	7	7	+	7	3	3	2
CRS 57	7	5	7	7	+	7	3	3	2
CRS 58	7	5	5	5	+	7	3	3	2
CRS 60	7	7	5	5	+	7	3	3	2
CRS 61	7	5	7	7	+	7	3	5	2
CRS 62	3	5	5	5	+	3	3	3	2

DF 01	DF 07	DF 08	DF 10	DF 11	DF 12	DF 13	DF 14	DF 15	DF 16
CRS 63	7	7	5	5	+	3	3	3	2
CRS 64	7	7	5	7	+	7	3	3	2
CRS 65	7	5	5	7	+	7	3	7	2
CRS 67	7	5	5	7	+	7	3	3	2
CRS 68	3	5	5	5	+	3	3	3	2
CRS 69	5	5	5	3	+	3	3	3	2
CRS 70	7	5	7	7	+	7	3	3	2
CRS 71	3	5	5	3	+	3	3	3	2
CRS 72	3	5	5	5	+	7	3	3	2
CRS 73	3	5	5	5	+	7	3	3	2
CRS 74	3	5	7	7	+	7	3	5	2
CRS 75	3	5	7	3	+	7	3	7	2
CRS 76	3	5	7	3	+	7	3	7	2
CRS 78	3	5	7	7	+	7	3	7	2
CRS 79	3	5	7	7	+	7	3	7	2
CRS 80	7	5	7	7	+	7	3	7	2
CRS 81	5	5	7	7	+	7	3	5	2
CRS 82	7	5	5	7	+	7	3	5	2
CRS 83	7	5	7	7	+	7	3	5	1
CRS 84	7	5	7	7	+	7	3	5	1
CRS 85	3	5	7	7	+	3	3	5	1
CRS 86	3	5	5	3	+	7	3	5	2
CRS 87	3	5	5	3	+	7	3	5	2
CRS 88	3	5	5	5	+	3	3	5	2
CRS 89	5	7	7	3	+	3	3	5	1
CRS 90	5	7	7	3	+	3	3	5	1
CRS 91	5	7	7	3	+	3	3	5	1
CRS 92	5	7	7	3	+	3	3	5	1
CRS 93	5	7	7	3	+	3	3	5	1
CRS 94	5	7	7	3	+	3	3	5	1
CRS 95	3	3	7	3	+	3	3	5	1
CRS 96	7	7	5	7	+	3	3	5	2
CRS 97	7	7	7	7	+	7	3	5	1
CRS 98	5	5	7	3	+	3	3	5	1
CRS 100	7	7	5	7	+	7	3	5	2
CRS 101	7	7	7	7	+	7	3	5	1
CRS 102	3	3	7	7	+	7	3	5	2
CRS 120	3	3	7	5	+	3	3	5	1

Table 4. Inflorescence characters of 73 accessions of cashew conserved at CRS, Madakkathara

DF 01	DF 28	DF 29	DF 30	DF 36	DF 37-1	DF 37-2	DF 38	DF 39	DF 40	DF 41	DF 60	DF 61
CRS 15	5	5	2	1	23.8	23.8	3	1	5	0		5
CRS 16	5	5	2	1	20.8	22.8	7	1	5	0	5	5
CRS 18	5	5	2	1	16.5	13.8	3	1	5	0	5	5
CRS 19	5	5	2	1	18	24.4	7	1	5	0	5	5
CRS 21	5	5	2	1	17	22	3	1	5	0	5	5
CRS 22	5	5	2	1	15.2	18.2	3	1	5	0	5	7
CRS 23	5	5	2	1	20.2	24.6	7	1	5	0	5	7
CRS 24	5	7	2	1	18.3	21.2	3	1	5	0	5	5
CRS 25	5	5	2	1	17.8	27.6	3	1	5	0	5	7
CRS 30	5	5	2	1	14.8	17.5	7	1	5	0	5	7
CRS 32	5	5	2	1	17.8	24	3	1	5	0	5	7
CRS 33	5	5	2	1	17.8	23.84	7	1	5	0	5	7
CRS 34	5	5	2	1	17.8	19	7	1	5	0	5	7
CRS 35	5	5	2	1	17.3	17	7	1	5	0	5	7
CRS 36	5	5	2	1	16.8	21.8	7	1	5	0	5	7
CRS 37	5	7	2	1	21.3	24.5	7	1	5	0	5	7
CRS 38	5	5	2	1	20.5	23.5	7	1	5	0	5	7
CRS 41	5	5	2	1	13.8	17.2	3	1	5	0	5	7
CRS 45	5	5	2	1	14.1	14.4	7	1	5	0	5	7
CRS 46	5	7	2	1	15	16.4	7	1	5	0	5	7
CRS 47	5	7	2	1	18	18.3	7	1	5	0	5	7
CRS 48	5	5	2	1	16	21	7	1	5	0	5	7
CRS 49	5	5	2	1	18.3	24.5	7	1	3	0	5	7
CRS 50	5	5	2	1	13.8	18.5	7	1	5	0	5	7
CRS 51	5	5	2	1	15.5	18	3	1	5	0	5	7
CRS 52	5	5	2	1	18	25.6	3	1	3	0	5	5
CRS 53	5	5	2	1	13.9	20.1	3	1	3	0	5	7
CRS 54	5	5	2	1	16.5	24.4	3	1	3	0	5	7
CRS 55	5	5	2	1	17.5	24.9	3	1	3	0	5	5
CRS 56	5	5	2	1	16.2	20	3	1	3	0	5	7
CRS 57	5	5	2	1	18.3	22.4	3	1	3	0	5	5
CRS 58	5	5	2	1	17.5	19	3	1	3	0	5	5
CRS 60	5	5	2	1	16.5	20.8	3	1	5	0	5	5
CRS 61	5	5	2	1	20	27.8	7	1	5	0	5	7
CRS 62	5	7	2	1	18.5	28.5	7	1	3	0	5	7
CRS 63	5	7	2	1	16.3	19	7	1	3	0	5	7

DF 01	DF 28	DF 29	DF 30	DF 36	DF 37-1	DF 37-2	DF 38	DF 39	DF 40	DF 41	DF 60	DF 61
CRS 64	5	7	2	1	16.5	24	7	1	5	0	5	7
CRS 65	5	3	2	1	22.3	32	3	1	5	0	5	7
CRS 67	5	5	2	1	18.8	28.3	3	1	3	0	5	7
CRS 68	5	7	2	1	22	25	7	1	3	0	5	7
CRS 69	5	5	2	1	18.3	24	7	1	5	0	5	7
CRS 70	5	5	2	1	15.3	21	7	1	5	0	5	7
CRS 71	5	5	2	1	21.5	22.8	7	1	5	0	5	7
CRS 72	5	5	2	1	19.8	27	3	1	5	0	5	7
CRS 73	5	7	2	1	19	24.3	3	1	3	0	5	7
CRS 74	5	5	2	1	17	17.3	3	1	3	0	5	7
CRS 75	5	5	2	1	16.3	19	3	1	3	0	5	7
CRS 76	5	5	2	1	18.3	20.5	3	1	3	0	5	7
CRS 78	5	5	2	1	15	17.5	3	1	3	0	5	7
CRS 79	5	5	2	1	23.8	30	3	1	3	0	5	7
CRS 80	5	5	2	1	18.3	22.5	3	1	5	0	5	7
CRS 81	5	5	2	1	18	25.3	3	1	3	0	5	7
CRS 82	5	5	2	1	27	23	3	1	5	0	5	5
CRS 83	5	5	2	1	15.5	20.5	3	1	3	0	5	5
CRS 84	5	5	2	1	17	21.5	3	1	5	0	5	5
CRS 85	5	7	2	1	17.8	24.8	7	1	5	0	5	5
CRS 86	5	7	2	1	16	14.5	3	1	3	0	5	5
CRS 87	5	7	2	1	14.7	21	3	1	3	0	5	5
CRS 88	5	5	2	1	16.3	22.3	3	1	3	0	5	5
CRS 89	5	3	2	1	16.3	24	3	1	3	0	5	5
CRS 90	5	3	2	1	16.5	22	3	1	3	0	5	5
CRS 91	5	3	2	1	17	21	3	1	5	0	5	5
CRS 92	5	3	2	1	15.5	18.5	3	1	5	0	5	5
CRS 93	5	3	2	1	16.5	20.5	7	1	5	0	5	5
CRS 94	5	3	2	1	18	27.3	3	1	5	0	5	5
CRS 95	5	3	2	1	21.5	27	3	1	5	0	5	5
CRS 96	5	5	2	1	19	28	3	1	5	0	5	7
CRS 97	5	5	2	1	18.3	27	7	1	5	0	5	5
CRS 98	5	7	2	1	13.8	18	3	1	5	0	5	7
CRS 100	5	5	2	1	15.5	20.5	7	1	5	0	5	7
CRS 101	5	5	2	1	16	23	3	1	5	0	5	7
CRS 102	5	5	2	1	16	21	3	1	5	0	5	5
CRS 120	5	5	2	1	18.5	24.3	3	1	5	0	5	5

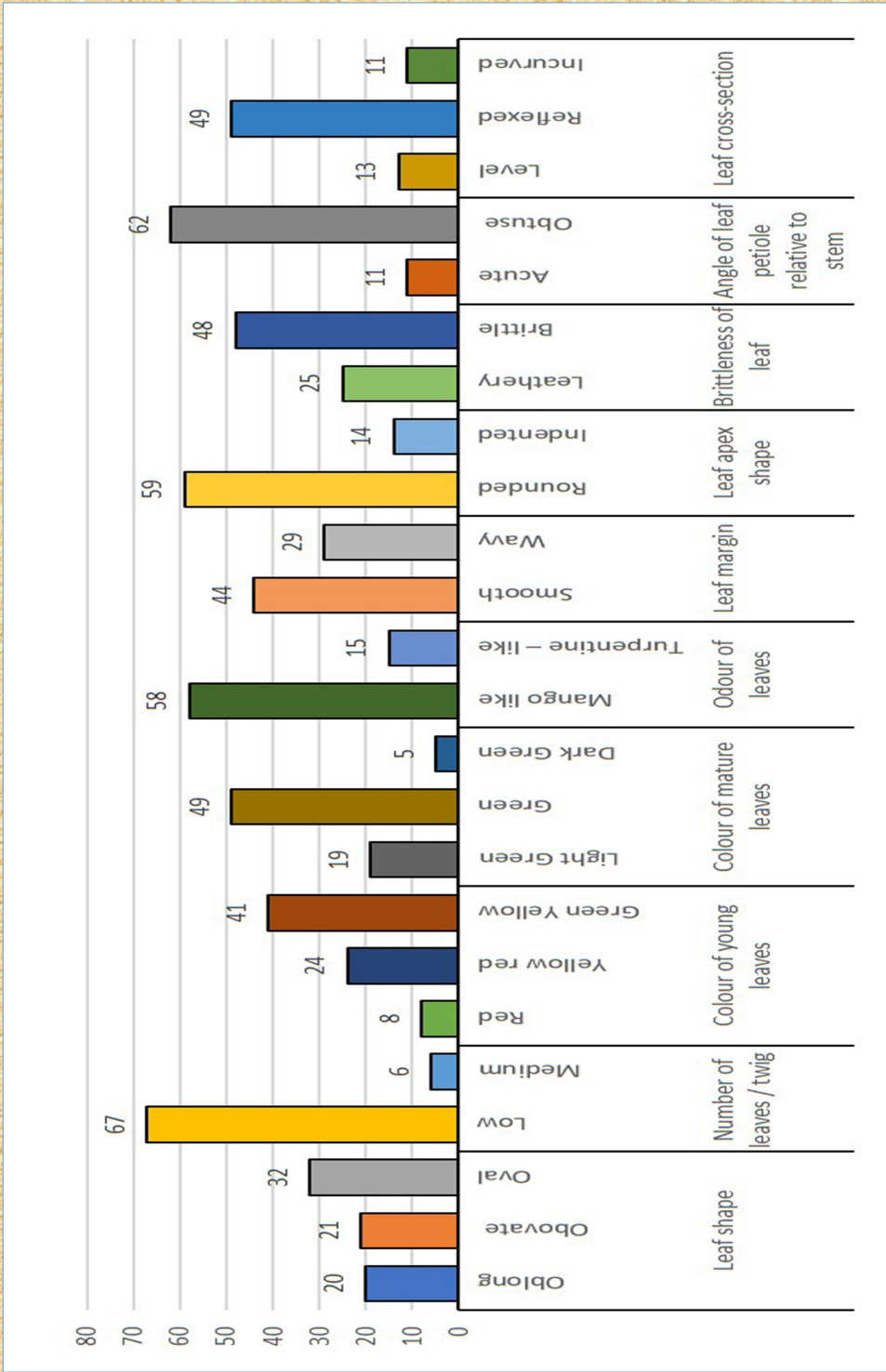


Figure 2. Variability in leaf characters of 73 accessions of cashew

Table 5. Leaf characters of 73 accessions of cashew conserved at CRS, Madakkathara

DF 01	DF 09	DF 17	DF 18	DF 19	DF 20	DF 21	DF 22	DF 23	DF 24	DF 25	DF 26	DF 27
CRS 15	1	3	3	3	2	2	1	3	3	7	7	2
CRS 16	3	3	3	3	2	2	1	3	3	7	7	2
CRS 18	2	3	3	3	2	1	2	2	3	3	7	3
CRS 19	2	3	3	2	2	1	2	2	3	3	7	3
CRS 21	1	3	5	2	2	1	2	2	3	7	7	2
CRS 22	1	3	5	2	2	1	2	2	3	7	7	3
CRS 23	1	3	3	3	2	1	2	2	3	7	3	2
CRS 24	3	3	3	3	2	1	2	2	3	7	7	2
CRS 25	1	3	3	3	2	1	2	2	3	7	7	3
CRS 30	2	3	3	3	2	1	1	2	3	7	3	2
CRS 32	2	3	5	2	2	1	2	2	3	7	7	2
CRS 33	2	3	5	2	2	1	2	2	3	7	7	2
CRS 34	1	3	5	2	2	1	2	2	3	3	7	3
CRS 35	1	3	3	2	2	1	1	2	3	3	7	3
CRS 36	1	3	3	3	2	1	1	3	3	7	7	2
CRS 37	1	3	3	3	1	2	1	3	3	7	3	2
CRS 38	3	3	3	2	2	1	1	2	3	7	7	2
CRS 41	1	3	3	3	2	1	2	2	3	7	7	3
CRS 45	3	3	3	2	2	1	1	2	3	7	7	2
CRS 46	1	3	3	2	2	1	1	3	3	7	7	2
CRS 47	2	3	3	2	2	1	1	2	3	7	7	2
CRS 48	2	3	3	3	3	1	1	2	3	7	7	2
CRS 49	2	3	3	1	3	1	2	2	3	7	7	3
CRS 50	3	3	5	3	3	1	1	2	3	7	7	1
CRS 51	3	3	3	1	1	1	1	2	3	7	7	1
CRS 52	1	3	3	2	2	1	2	2	3	7	7	2
CRS 53	2	3	3	2	2	1	2	2	3	7	7	2
CRS 54	3	3	3	2	2	1	1	2	3	7	7	2
CRS 55	3	3	3	2	2	1	1	2	3	7	7	3
CRS 56	3	3	3	2	2	1	1	2	3	3	7	2
CRS 57	2	3	3	2	2	1	1	2	3	7	7	2
CRS 58	3	3	3	3	2	1	1	2	3	7	7	2
CRS 60	1	3	3	2	2	1	2	2	3	7	7	2
CRS 61	3	3	3	3	2	1	1	2	3	7	7	1
CRS 62	3	3	3	3	1	1	1	2	3	7	3	2
CRS 63	3	3	3	2	1	1	1	2	3	3	7	2

DF 01	DF 09	DF 17	DF 18	DF 19	DF 20	DF 21	DF 22	DF 23	DF 24	DF 25	DF 26	DF 27
CRS 64	2	3	3	2	1	1	1	3	3	3	7	2
CRS 65	3	3	3	2	1	2	1	2	3	3	7	2
CRS 67	1	3	3	3	2	2	1	2	3	7	7	2
CRS 68	3	3	3	3	1	2	1	2	3	7	7	2
CRS 69	2	3	3	3	2	2	1	2	3	7	7	2
CRS 70	3	3	3	3	2	2	1	2	3	3	3	1
CRS 71	2	3	3	3	2	2	1	2	3	7	7	1
CRS 72	3	3	3	3	2	2	1	2	3	7	7	1
CRS 73	1	3	3	3	2	2	1	3	3	7	7	2
CRS 74	3	3	3	1	2	1	2	2	3	7	7	2
CRS 75	2	3	3	1	3	1	2	2	3	3	7	2
CRS 76	1	3	3	1	3	1	2	2	3	7	7	2
CRS 78	2	3	3	3	2	1	1	2	3	7	3	3
CRS 79	2	3	3	1	2	1	2	2	3	7	7	2
CRS 80	2	3	3	1	1	2	1	2	3	3	7	2
CRS 81	2	3	3	1	2	1	2	3	3	7	7	2
CRS 82	2	3	3	3	2	2	1	2	3	7	7	2
CRS 83	3	3	3	3	2	2	1	2	3	3	7	2
CRS 84	3	3	3	3	2	2	1	2	3	3	7	2
CRS 85	1	3	3	3	2	1	2	2	3	7	7	2
CRS 86	3	3	3	3	1	1	2	2	3	3	7	2
CRS 87	3	3	3	3	1	1	2	2	3	3	7	2
CRS 88	3	3	3	2	1	1	1	2	3	7	7	2
CRS 89	3	3	3	3	1	1	2	3	3	3	3	1
CRS 90	3	3	3	3	1	1	2	3	3	3	7	1
CRS 91	3	3	3	3	1	1	2	3	3	3	7	1
CRS 92	3	3	3	3	1	1	2	3	3	3	3	1
CRS 93	3	3	3	3	1	1	2	3	3	3	7	1
CRS 94	3	3	3	3	1	1	2	3	3	3	3	1
CRS 95	3	3	3	3	2	1	1	2	3	3	7	2
CRS 96	3	3	3	2	1	1	1	2	3	3	3	2
CRS 97	1	3	3	2	1	1	1	2	3	3	7	1
CRS 98	1	3	3	3	2	1	1	2	3	7	7	2
CRS 100	2	3	3	3	2	1	1	2	3	7	7	3
CRS 101	2	3	3	3	2	1	1	2	3	7	3	2
CRS 102	1	3	3	3	2	1	1	2	3	7	7	2
CRS 120	3	3	3	3	2	1	1	2	3	3	7	2

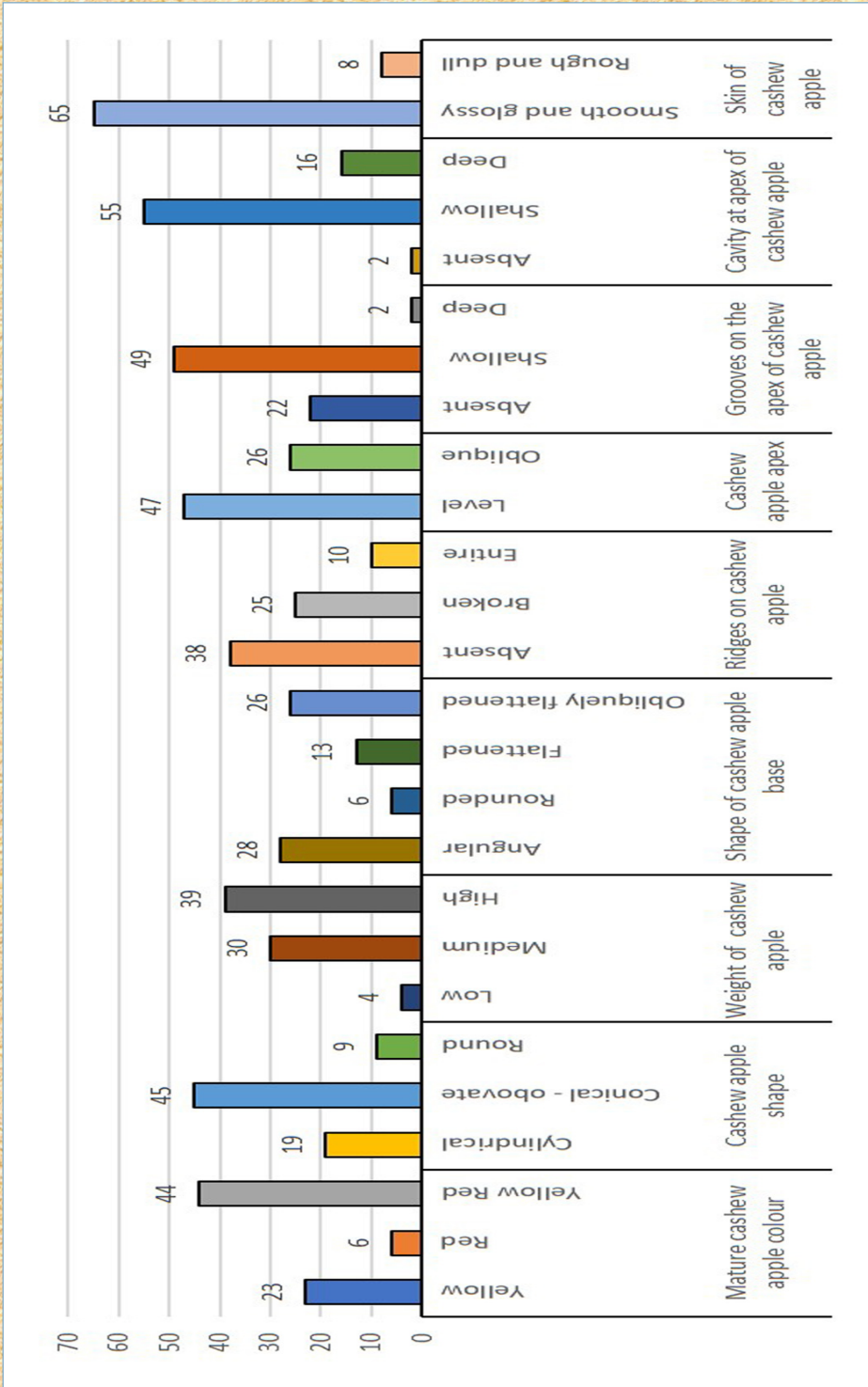


Figure 3. Variability in apple characters of 73 accessions of cashew

Table 6. Apple characters of 73 accessions of cashew conserved at CRS, Madakkathara

DF 01	DF 31	DF 32	DF 43	DF 44	DF 45	DF 46	DF 47	DF 48	DF 49
CRS 15	3	3	7	1	0	1	3	7	1
CRS 16	1	1	7	3	0	1	0	3	1
CRS 18	3	2	5	3	1	1	0	3	1
CRS 19	3	2	7	1	0	1	3	3	1
CRS 21	1	2	7	1	0	2	0	3	2
CRS 22	2	2	5	4	0	2	3	3	1
CRS 23	3	1	7	4	0	2	3	3	1
CRS 24	3	2	5	1	2	1	3	3	1
CRS 25	3	3	7	1	0	1	3	7	1
CRS 30	3	2	5	2	0	2	3	3	1
CRS 32	3	2	7	1	1	2	3	3	1
CRS 33	3	2	5	4	0	1	0	7	1
CRS 34	1	2	5	4	0	1	0	3	2
CRS 35	2	3	5	2	2	2	0	3	1
CRS 36	1	1	7	4	2	1	0	3	2
CRS 37	3	1	7	4	1	7	0	7	2
CRS 38	3	1	5	1	0	2	3	3	1
CRS 41	3	2	5	1	0	2	3	3	1
CRS 45	3	1	5	4	2	2	0	7	2
CRS 46	1	1	7	4	0	1	0	7	1
CRS 47	1	1	7	4	0	2	3	3	1
CRS 48	1	3	7	2	0	1	3	3	1
CRS 49	2	2	3	4	1	1	3	7	1
CRS 50	2	2	5	4	0	1	0	7	1
CRS 51	3	2	5	1	0	1	3	7	1
CRS 52	1	2	7	4	1	1	7	3	1
CRS 53	1	1	7	4	1	2	3	3	1
CRS 54	1	2	5	1	1	1	3	0	1
CRS 55	1	2	7	4	1	1	3	3	1
CRS 56	1	1	7	4	1	1	7	7	1
CRS 57	1	1	7	2	1	1	3	3	1
CRS 58	1	1	5	4	0	1	0	3	2
CRS 60	3	2	7	1	1	1	3	3	1
CRS 61	1	1	5	1	1	1	3	3	1
CRS 62	1	2	5	1	0	1	3	3	1
CRS 63	1	2	7	4	0	1	3	3	1

DF 01	DF 31	DF 32	DF 43	DF 44	DF 45	DF 46	DF 47	DF 48	DF 49
CRS 64	2	2	7	1	1	2	0	3	1
CRS 65	3	1	7	4	1	1	0	3	1
CRS 67	1	1	7	1	1	2	0	0	1
CRS 68	3	2	7	3	1	1	3	3	1
CRS 69	3	1	3	4	0	2	3	3	1
CRS 70	3	2	5	4	0	1	3	3	1
CRS 71	3	2	5	4	0	1	3	3	1
CRS 72	1	3	5	1	1	1	3	3	1
CRS 73	1	2	7	1	1	1	0	3	1
CRS 74	1	1	5	3	2	1	3	7	1
CRS 75	3	2	3	1	1	2	3	7	1
CRS 76	3	2	5	1	1	2	3	3	1
CRS 78	3	2	7	4	0	2	3	3	1
CRS 79	3	2	7	1	1	2	3	3	1
CRS 80	2	2	7	3	0	2	0	3	1
CRS 81	3	2	5	1	1	2	3	3	1
CRS 82	1	3	3	1	2	2	3	3	1
CRS 83	3	3	5	3	0	1	3	7	1
CRS 84	3	2	7	1	0	2	0	7	1
CRS 85	3	2	7	1	0	1	3	3	1
CRS 86	3	2	7	4	0	1	3	3	1
CRS 87	3	2	7	4	0	1	3	3	1
CRS 88	3	2	7	1	0	1	3	3	1
CRS 89	3	2	7	1	1	2	3	3	1
CRS 90	3	3	7	2	2	2	3	3	1
CRS 91	3	2	5	3	0	1	3	3	1
CRS 92	3	3	5	1	1	1	3	3	1
CRS 93	3	2	7	3	0	1	3	3	1
CRS 94	3	2	7	3	2	1	3	7	1
CRS 95	3	2	5	4	2	1	3	3	1
CRS 96	3	2	5	4	0	1	3	3	1
CRS 97	3	1	7	3	0	1	0	3	1
CRS 98	3	1	5	3	0	1	0	3	2
CRS 100	3	2	7	3	0	2	0	3	1
CRS 101	3	2	5	2	0	1	0	3	1
CRS 102	3	2	5	3	2	1	3	7	2
CRS 120	1	2	7	1	1	1	3	3	1

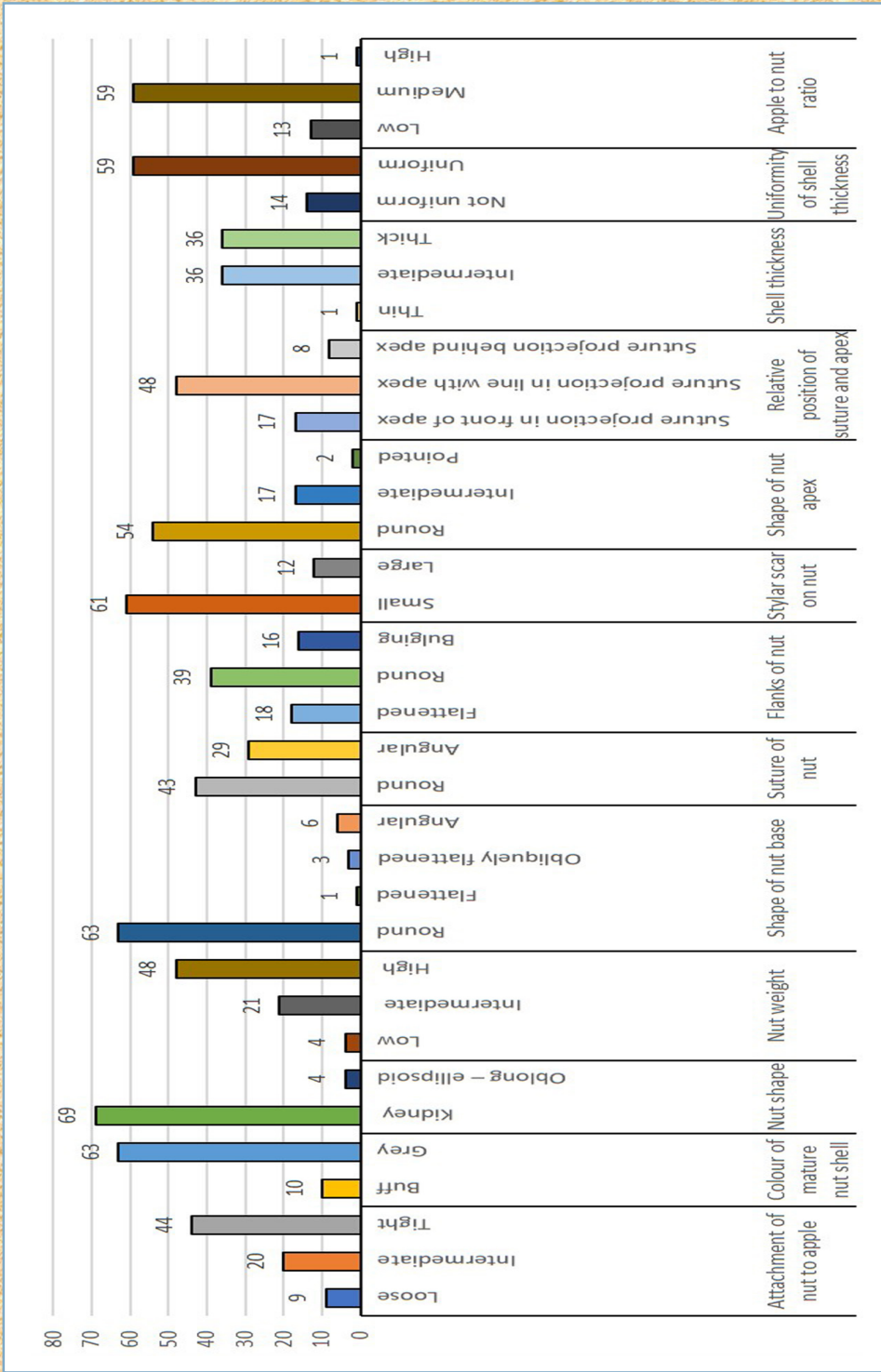


Figure 4. Variability in nut characters of 73 accessions of cashew

Table 7. Nut characters of 73 accessions of cashew conserved at CRS, Madakkathara

DF 01	DF 33	DF 34	DF 35	DF 50	DF 51	DF 52	DF 53	DF 54	DF 55	DF 56	DF 57	DF 58
CRS 15	2	1	7	7	1	2	3	3	1	2	7	+
CRS 16	2	1	7	3	1	3	3	3	1	2	7	+
CRS 18	2	1	7	7	1	2	5	3	1	2	7	+
CRS 19	2	1	5	7	1	2	5	3	1	2	7	+
CRS 21	1	1	7	7	1	2	5	3	1	2	5	+
CRS 22	1	1	7	7	1	2	5	3	1	2	7	+
CRS 23	1	1	7	7	1	2	5	3	1	2	5	+
CRS 24	2	2	5	7	4	2	7	3	3	3	7	+
CRS 25	1	1	7	7	1	1	7	3	1	2	7	+
CRS 30	2	1	5	5	1	2	7	3	1	1	5	0
CRS 32	2	1	5	5	1	1	5	3	1	1	7	+
CRS 33	2	1	3	3	1	1	5	7	1	2	7	+
CRS 34	1	1	5	3	1	1	5	3	1	2	7	+
CRS 35	2	1	7	7	3	2	5	7	2	2	5	+
CRS 36	1	1	7	3	1	1	7	7	1	1	7	+
CRS 37	2	1	7	3	1	1	3	3	1	2	5	+
CRS 38	2	1	7	5	1	2	5	3	2	1	5	0
CRS 41	2	1	7	7	1	1	7	3	1	2	7	+
CRS 45	1	1	7	3	4	1	3	3	1	3	7	+
CRS 46	2	1	7	5	3	1	3	3	1	1	7	+
CRS 47	2	1	7	5	1	2	3	3	1	1	5	+
CRS 48	2	1	5	7	1	2	5	3	1	1	5	+
CRS 49	2	1	5	7	4	2	5	3	1	1	5	+
CRS 50	2	2	3	7	4	1	7	7	1	3	7	+
CRS 51	2	1	5	7	1	2	7	3	2	2	7	+
CRS 52	2	1	7	5	1	1	3	3	2	3	5	0
CRS 53	2	1	7	3	1	1	5	3	2	2	5	0
CRS 54	2	1	7	5	1	2	5	7	1	2	5	0
CRS 55	2	1	7	5	1	2	3	3	2	2	5	0
CRS 56	2	1	7	7	1	1	5	3	2	2	5	0
CRS 57	2	1	7	7	1	2	5	3	1	2	5	0
CRS 58	2	1	5	5	1	1	3	3	1	2	7	+
CRS 60	2	1	5	5	1	1	3	3	1	2	5	+
CRS 61	2	1	7	7	1	1	3	3	1	2	5	+
CRS 62	1	1	7	5	1	1	5	3	1	2	7	+

DF 01	DF 33	DF 34	DF 35	DF 50	DF 51	DF 52	DF 53	DF 54	DF 55	DF 56	DF 57	DF 58
CRS 63	2	1	7	5	1	1	5	3	1	2	5	+
CRS 64	2	1	7	7	1	1	7	3	1	3	7	+
CRS 65	2	1	7	7	1	1	7	3	1	2	7	+
CRS 67	2	1	7	7	1	1	7	3	1	1	7	+
CRS 68	2	1	7	7	1	1	5	3	1	1	7	+
CRS 69	1	1	3	5	1	2	3	3	1	2	5	+
CRS 70	2	1	5	5	1	2	3	3	1	2	5	+
CRS 71	2	1	7	5	1	2	3	3	1	2	5	+
CRS 72	2	1	7	7	1	2	3	3	1	1	5	0
CRS 73	2	1	7	7	1	1	3	3	1	3	5	0
CRS 74	2	1	7	7	4	1	5	3	1	3	7	+
CRS 75	2	1	7	7	1	1	5	3	1	1	7	0
CRS 76	2	1	7	7	1	1	7	3	1	2	7	+
CRS 78	2	1	7	7	1	2	7	7	2	2	5	+
CRS 79	2	1	7	7	1	1	5	3	1	2	7	+
CRS 80	2	1	7	7	1	1	7	3	1	1	7	+
CRS 81	2	2	7	7	4	2	5	7	3	2	5	0
CRS 82	2	1	5	7	2	2	7	7	2	1	5	+
CRS 83	2	1	5	7	1	1	5	3	1	2	5	+
CRS 84	2	2	7	7	1	1	5	3	2	2	7	+
CRS 85	2	1	7	5	1	1	3	3	1	2	7	+
CRS 86	2	1	7	7	1	1	5	3	1	2	5	0
CRS 87	2	1	7	7	1	1	5	3	1	2	5	0
CRS 88	2	1	5	7	1	2	5	3	1	2	7	+
CRS 89	2	1	7	7	1	1	7	7	1	2	7	+
CRS 90	2	1	7	7	1	1	5	7	2	2	5	+
CRS 91	2	1	5	7	1	2	5	3	2	2	5	+
CRS 92	2	1	7	5	3	1	5	3	1	1	5	+
CRS 93	2	1	7	5	1	2	5	7	2	2	5	+
CRS 94	2	1	7	3	1	1	5	3	1	2	5	+
CRS 95	2	1	5	7	1	1	7	3	2	3	7	+
CRS 96	2	1	5	3	1	2	5	7	2	2	7	+
CRS 97	2	1	5	7	1	1	5	3	2	2	7	+
CRS 98	2	1	5	5	1	1	5	3	2	1	3	+
CRS 100	2	1	7	7	1	1	5	3	1	2	7	+
CRS 101	2	1	3	7	1	1	5	3	1	2	7	+
CRS 102	1	1	5	5	1	1	5	3	1	2	5	+
CRS 120	2	1	5	7	1	2	3	3	1	1	5	+

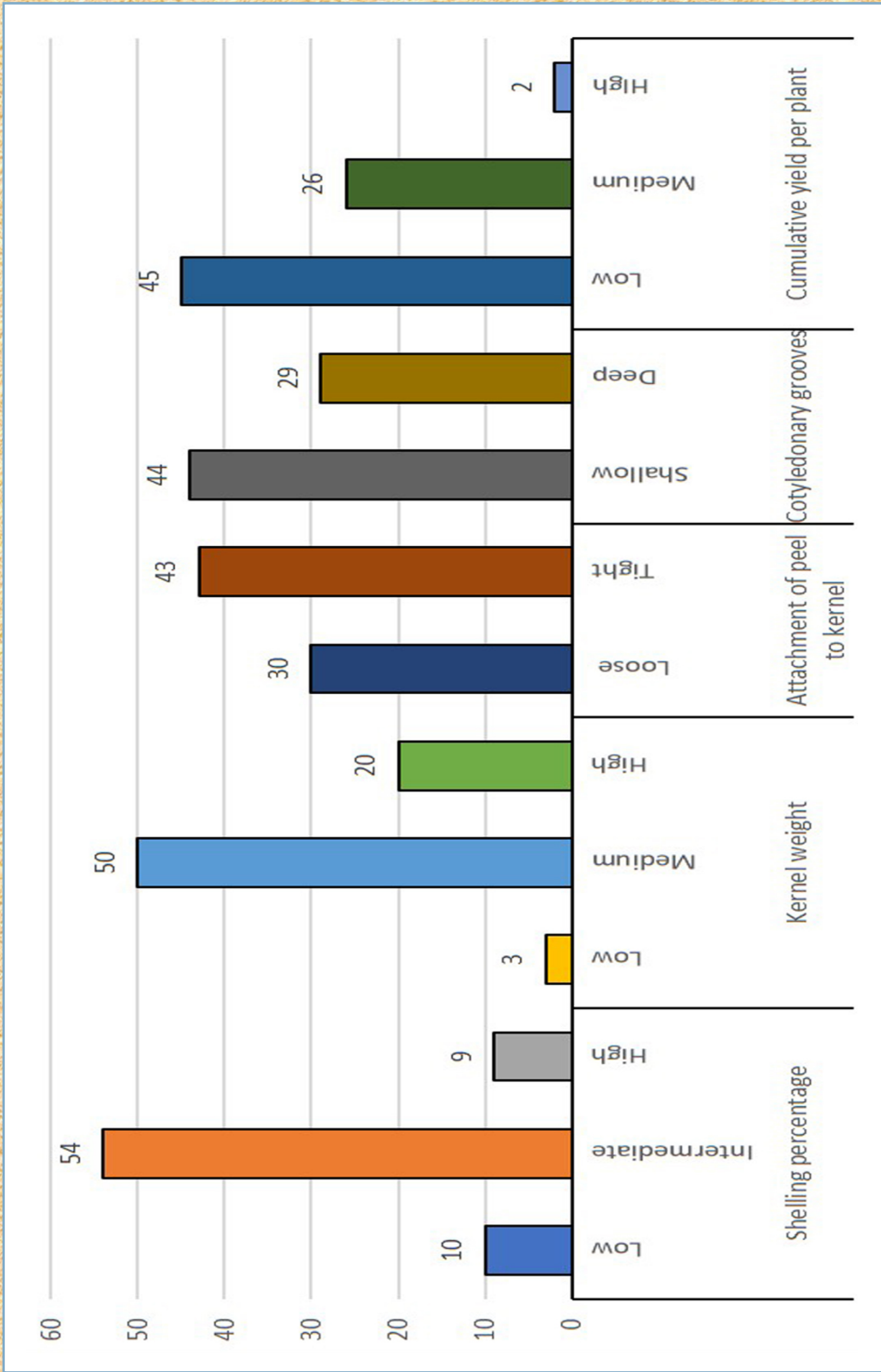


Figure 5. Variability in Kernel characters of 73 accessions of cashew

Table 8. Kernel characters of 73 accessions of cashew conserved at CRS, Madakkathara

DF 01	DF 59-1	DF 59-2	DF 59-3	DF 62	DF 63	DF 64	DF 65	DF 67	DF 68
CRS 15	3.5	2.6	1.8	5	3	7	3	3	5
CRS 16	3.7	2.5	1.5	5	5	5	3	3	5
CRS 18	4	3	1.9	5	3	5	7	7	3
CRS 19	3.4	2.4	1.7	5	3	5	3	3	3
CRS 21	3	2.3	1.7	5	3	5	7	3	3
CRS 22	3	2.5	1.8	5	3	7	7	3	5
CRS 23	3.3	2.5	1.7	5	3	5	3	3	3
CRS 24	3.5	2.6	1.8	5	5	5	7	3	3
CRS 25	3.3	2.5	2.3	5	3	7	3	7	5
CRS 30	2.9	2.1	1.8	5	3	5	3	7	5
CRS 32	3	2.1	1.7	5	5	5	7	3	5
CRS 33	2.7	2	1.7	5	5	5	7	3	5
CRS 34	3	2.2	1.7	3	5	5	7	3	5
CRS 35	2.7	1.9	1.4	5	7	5	3	7	7
CRS 36	3.7	2.6	2	3	7	7	7	3	5
CRS 37	2.9	2.2	1.4	5	7	5	3	7	5
CRS 38	4.1	2.9	2.1	5	3	7	7	3	7
CRS 41	3.1	2.3	1.5	5	5	7	3	7	5
CRS 45	3.8	2.6	1.8	3	7	7	7	7	5
CRS 46	3.3	2.6	1.8	5	5	5	7	7	5
CRS 47	3.8	2.8	1.9	5	5	5	3	7	5
CRS 48	2.9	2.4	1.5	5	5	7	7	7	5
CRS 49	3.3	3.5	1.7	3	5	5	3	3	5
CRS 50	3.1	2.9	1.7	5	5	5	3	3	3
CRS 51	3.3	2.4	1.9	5	5	3	7	3	5
CRS 52	3.8	2.8	1.9	5	7	5	3	3	3
CRS 53	3.9	3.1	1.7	5	5	5	7	7	3
CRS 54	3.6	2.7	2.1	3	5	5	7	7	3
CRS 55	4.1	3	2	3	5	5	3	3	3
CRS 56	3.7	2.7	2	5	5	5	3	3	3
CRS 57	3.9	2.8	2	5	7	7	3	3	3
CRS 58	2.9	2	1.6	5	5	5	3	3	3
CRS 60	3.2	2.5	1.9	5	5	5	3	3	3
CRS 61	3.1	2.2	1.4	5	5	7	7	7	3
CRS 62	3	2.4	1.5	5	5	5	7	3	3
CRS 63	3.2	2.6	1.3	5	5	5	7	3	5

DF 01	DF 59-1	DF 59-2	DF 59-3	DF 62	DF 63	DF 64	DF 65	DF 67	DF 68
CRS 64	3	2.1	1.3	3	5	7	7	7	3
CRS 65	2.9	2.8	2.1	5	5	3	7	3	5
CRS 67	3.4	2.6	2.1	5	5	5	7	3	3
CRS 68	3.2	2.5	1.9	3	5	5	7	3	3
CRS 69	2.1	2.4	1.9	5	5	5	3	7	3
CRS 70	3	2.4	1.9	5	5	5	3	7	3
CRS 71	4	2.9	2.3	5	5	5	3	7	3
CRS 72	3.4	2.6	1.6	5	5	7	7	7	3
CRS 73	2.9	2.3	2	5	5	7	7	3	5
CRS 74	3.4	2.7	2	5	5	7	7	7	5
CRS 75	3	2.3	1.6	3	5	7	7	7	5
CRS 76	2.9	2.4	1.3	3	5	5	3	7	5
CRS 78	3.2	2.4	1.4	5	5	5	7	7	3
CRS 79	3.7	2.8	2.1	3	5	5	7	3	3
CRS 80	3.2	2.3	1.5	5	7	5	7	3	5
CRS 81	3.2	2.3	1.8	5	7	7	3	7	5
CRS 82	3	2.2	1.9	5	7	5	3	7	5
CRS 83	2.9	2.4	1.7	5	5	5	7	3	3
CRS 84	3	2.9	1.7	5	5	5	7	3	3
CRS 85	3.2	2.4	1.9	5	3	7	7	7	3
CRS 86	3.7	2.8	1.9	5	5	5	7	3	3
CRS 87	3.6	3.1	1.7	5	5	5	7	3	3
CRS 88	3.2	2.7	2.1	5	5	5	7	3	3
CRS 89	2.9	3	2	7	5	7	3	3	3
CRS 90	2.1	2.7	2	5	5	5	3	7	3
CRS 91	3.2	2.8	2	5	5	5	3	7	3
CRS 92	2.9	2	1.6	3	5	3	7	3	3
CRS 93	3	2.5	1.9	5	5	5	3	7	3
CRS 94	2.9	2.2	1.8	3	5	7	7	7	3
CRS 95	2.8	2.4	1.7	5	5	5	7	3	3
CRS 96	2.4	2.2	1.9	5	5	5	3	3	3
CRS 97	2.9	2	1.6	5	5	5	7	3	3
CRS 98	3	2.5	1.9	5	5	7	3	3	3
CRS 100	2.9	2.2	1.4	5	5	5	7	3	3
CRS 101	2.8	2.4	1.5	5	5	5	7	3	3
CRS 102	3	2.6	1.8	5	5	5	7	3	3
CRS 120	3.1	2.7	1.9	5	5	5	7	3	3

Grouping of cashew accessions

The accessions need to be grouped to facilitate the assessment of distinctness. The characters *viz.*, colour of young leaves, leaf shape, colour of mature apple, cashew apple shape, nut weight and shelling percentage, which are known from experience not to vary, or to vary slightly, within a variety and which in their various states are evenly distributed across all varieties in the collection were selected for grouping the accessions as per DUS guidelines.

The genetic associations among the accessions were estimated by Jaccard's similarity coefficients (Jaccard, 1908) using NTSYS pc version 2.1 (Rohlf, 1992). Cluster analysis was performed based on the similarity matrix and dendrograms were constructed by unweighted pair-group method (UPGMA) (Sneath and Sokal, 1973). The 73 accessions used in the present study were grouped into 12 clusters at 60 percent similarity level (Figure 6). Twelve clusters obtained along with the accessions included in each cluster are presented in Table 9.

Table 9. Grouping of 73 accessions of cashew into clusters based on similarity matrix

Cluster No.	No. of accessions	Accession number (CRS)	Cluster description
Cluster I	6	15, 23, 25, 36, 37, 85	Oblong leaf shape, green yellow colour of young leaves, yellow and yellow red colour of mature apple, cylindrical, conical obovate and round shape of apple, high nut weight, low and high shelling percentage
Cluster II	4	21, 22, 35, 52	Oblong leaf shape, yellow red colour of young leaves, yellow and red colour of mature apple, conical obovate and round shape of apple, high nut weight, low and high shelling percentage
Cluster III	11	16, 61, 56, 74, 62, 72, 54, 55, 63, 58, 120	Oval leaf shape, red, yellow red and green yellow colour of young leaves, yellow colour of mature apple, cylindrical, conical obovate and round shape of apple, intermediate and high nut weight, intermediate shelling percentage
Cluster IV	5	46, 67, 47, 53, 57	Oblong and obovate leaf shape, yellow red and green yellow colour of young leaves, yellow colour of mature apple, cylindrical shape of apple, high nut weight, intermediate and high shelling percentage

Cluster No.	No. of accessions	Accession number (CRS)	Cluster description
Cluster V	3	38, 45, 61	Oval leaf shape, yellow red colour of young leaves, yellow red colour of mature apple, cylindrical shape of apple, high nut weight, low, intermediate and high shelling percentage
Cluster VI	4	18, 30, 19, 32	Obovate leaf shape, yellow red and green yellow colour of young leaves, yellow red colour of mature apple, conical obovate shape of apple, intermediate and high nut weight, low and intermediate shelling percentage
Cluster VII	3	33, 101, 69	Obovate leaf shape, yellow red and green yellow colour of young leaves, yellow red colour of mature apple, cylindrical and conical obovate shape of apple, low nut weight, intermediate shelling percentage
Cluster VIII	24	24, 70, 91, 95, 88, 96, 51, 102, 68, 84, 93, 94, 86, 89, 87, 71, 100, 78, 83, 90, 92, 41, 76, 73	Oblong, obovate and oval leaf shape, red, yellow red and green yellow colour of young leaves, yellow and yellow red colour of mature apple, conical obovate and round shape of apple, intermediate and high nut weight, intermediate shelling percentage
Cluster IX	1	50	Oval leaf shape, green yellow colour of young leaves, red colour of mature apple, conical obovate shape of apple, low nut weight, intermediate shelling percentage
Cluster X	4	34, 60, 97, 98	Oblong leaf shape, yellow red and green yellow colour of young leaves, yellow and yellow red colour of mature apple, cylindrical and conical obovate shape of apple, intermediate nut weight, intermediate shelling percentage

Cluster No.	No. of accessions	Accession number (CRS)	Cluster description
Cluster XI	6	49, 64, 75, 79, 81, 80	Obovate leaf shape, red and yellow red colour of young leaves, red and yellow red colour of mature apple, conical obovate shape of apple, inter-mediate and high nut weight, intermediate and high shelling percentage
Cluster XII	2	48, 82	Obovate leaf shape, green yellow colour of young leaves, yellow colour of mature apple, round shape of apple, intermediate nut weight, intermediate and high shelling percentage

While collection, preference should be given to accessions with high nut weight, apple weight, apple to nut ratio, yield, sex ratio, kernel weight and shelling percentage (Mohana et al., 2017). Germplasm accessions with specific combination of characters can be selected based on breeding objectives. Germplasm with some combinations of three desirable quantitative characters have been identified (Table 10) for further breeding programmes.

Table 10. Some combinations of three characters

Particulars	Accessions
Nut weight > 7g Shelling percentage > 28% Cumulative yield > 18 kg/plant	CRS 35
Nut weight >7g Kernel weight > 2.5 g Shelling percentage >28%	CRS 36, CRS 81, CRS 45, CRS 57

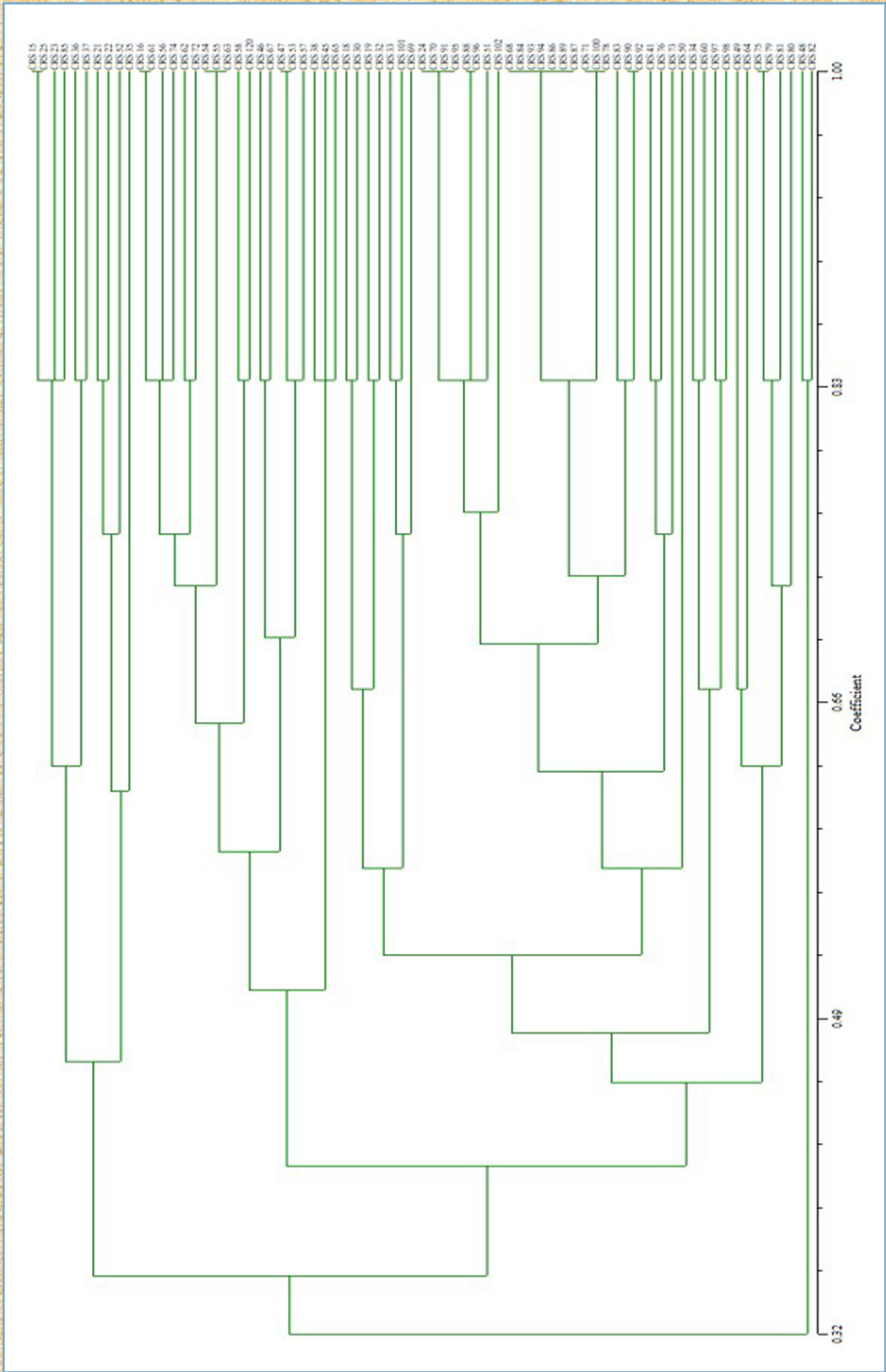


Figure 6. Dendrogram based on similarity coefficient among 73 accessions of cashew

References

- IBPGR. 1986. Cashew Descriptors. International Board for Plant Genetic Resources (*Presently, International Plant Genetic Resources Institute*), Rome, Italy. 33p.
- Nayak MG, Mohana GS, Bhat PS, Saroj PL, KRM Swamy and MG Bhat. 2014. Minimum Descriptor of Cashew (*Anacardium occidentale* L.) Germplasm Accessions-V. ICAR-Directorate of Cashew Research, Puttur, Karnataka. 50p.
- Mohana GS, Nayak MG and Eradasappa E. 2017. Genetic Architecture of Cashew Germplasm Accessions. *Journal of Plantation Crops*. 45(1): 57-65.





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