Selection of cashew mother trees based on nut characteristics of clones

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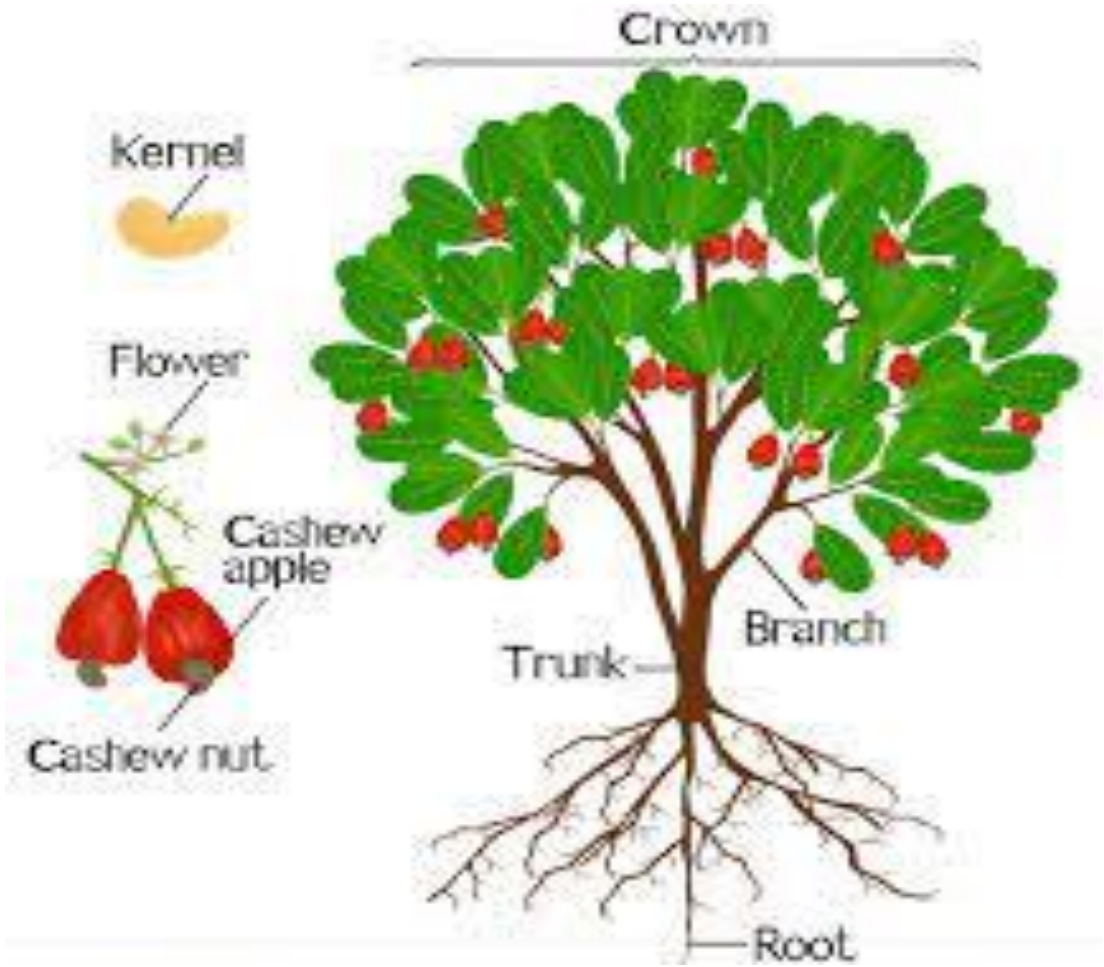
INTRODUCTION

- Cashew (*Anacardium occidentale* L.) is a multipurpose tree
- Source of income, foreign exchange and employment opportunities
- Nutritious with numerous health benefits



INTRODUCTION

- Product of commerce of the cashew tree- Nut
- Increasing demand for high quality cashew nuts and kernel
- Preference for larger nuts and kernel which attracts higher premium in the world market

MOTHER TREE SELECTION

Important traits in mother tree selection:

- **Tree**- size, canopy, yield, disease & pest resistant
- **Apple**-colour, size, taste, juice yield
- **Nut** –shape, size, shell thickness, shelling %
- **Kernel**- size, tester peel ability, KOR

Nut and kernel characteristics

- Assessment of nut & kernel size, weight, and shell thickness play a pivotal role in determining the:

- quality and market value of cashew nuts
- selection of cashew mother tree for improved cultivars

- Morphological evaluation of cashew nuts involves analysis of size, shape, color, texture, and weight (Sanchez *et al.,* 2024)

MATERIALS AND METHODS

- Matured dried nuts of 13 clonal accessions (KD102, YS103, OCJ5, EU202, BEL36, YS203, OCJ9, OCJ2, EN103, CR102, ORO9, BEL22, and ORO3) planted at zones 3 and 4 of the Cocoa Research Institute of Nigeria, Ibadan (7.2254ºN, 3.8678ºE) were used in the study

- Completely randomized design according to the methods of Adewale *et al*., 2010 was used

- Eighty (80) nuts in four replicates were randomly chosen per clonal accession for analysis

MATERIALS AND METHODS

Data collection:

- Weight of nut, kernel and shell taken in grams (sensitive weighing balance WT-H Zhongxin, China)

- Length, width, thickness/girth of nut measured in millimeters (Vernier caliper TONE DC-150)

(The kernel and shell was separated using a hand operated steel cashew nut cutter)

MATERIALS AND METHODS

Data analysis-

- Means of traits subjected to Analysis of variance (ANOVA) to ascertain the variability in nut characteristics among the different clones

- Correlation among the studied traits was done using the Analyst option in SAS

- A dendrogram was constructed based on the dissimilarity coefficient using Dice's approach

RESULTS AND DISCUSSION

- The thirteen accessions differed significantly ($P < 0.01$) for the six morphological traits studied (Table 1)
- Clone OCJ9 produced the largest nut weight (11.34 g), followed by YS203 (11.22 g) and ORO9 (11.15 g)
- Same trend was observed in kernel weight; clone OCJ9 had the largest (3.75 g), followed by, YS203 (3.44 g) and ORO9 (2.83 g)
- Clone OCJ9 was largest in nut weight (11.34 g), nut width (2.99cm), and kernel weight (3.75g)

RESULTS AND DISCUSSION

- Clone ORO9 had the highest mean value of 2.24 cm and 7.97 g for nut girth and shell weight respectively
- The highest nut length (3.99cm) was observed in YS203
- Clone EU202 gave the least mean value for nut weight (4.27g), nut length (2.55cm), nut Girth (1.13cm), kernel weight (1.50g), and shell weight (2.73g)
- Clone KD102 had the least value of 1.91cm for nut width

RESULTS AND DISCUSSION

- Generally, the nuts fell in 3 categories of large (8-11 g), medium (6-7 g), and small (2-5 g) which constitute the largest proportion of nut sizes grown in Nigeria

- Earlier study, showed excess of shell in the jumbo nuts compared with extra-large nuts (Adeigbe *et al*., 2016), however in this study the nut size is proportionate with the kernel size

- Kernel sizes range of 1.50 to 3.75g observed compared favorably well with 1.43 to 2.15g in some Benin cashew mother trees (N' Djolossè et al., 2020)

Table 1. Performance of thirteen cashew clonal accessions for nut traits

Accessions	Ntwt (g)	NtL (cm)	Ntwth (cm)	NtGth (cm)	Kwt (g)	Swt (g)
KD102	4.78^{bc}	2.68^{bc}	1.91^{e}	1.45^{bcd}	1.65^{c}	3.11^{e}
YS103	5.50^{bc}	2.94^{bc}	2.12^{cde}	1.29^{cd}	1.77^{c}	3.65^{cde}
OCJ5	7.19^{bc}	3.15^{b}	2.23^{cde}	1.56^{bcd}	2.34^{bc}	4.80^{cde}
EU202	4.27^{c}	2.55^{c}	1.97^{de}	1.13^{d}	1.50^{c}	2.73^{e}
BEL36	7.04^{bc}	3.08^{b}	2.28^{cde}	1.50^{bcd}	1.99^{c}	4.95^{cde}
YS203	11.22^{a}	3.99^{a}	2.52^{bc}	1.72^{bc}	3.44^{ab}	7.70^{ab}
OCJ9	11.34^{a}	3.79^{a}	2.99^{a}	1.84^{ab}	3.75^{a}	7.15^{ab}
OCJ2	8.43^{ab}	3.19^{b}	2.43^{bcd}	1.57^{bcd}	2.41^{bc}	5.96^{abc}
EN103	5.67^{bc}	2.87^{bc}	1.95	1.42^{bcd}	2.18^{bc}	3.42^{de}
CR102	6.86^{bc}	3.05^{b}	2.17^{cde}	1.49^{bcd}	2.23^{bc}	4.58^{cde}
ORO9	11.15^{a}	3.69^{a}	2.79^{ab}	2.24^{a}	2.83^{abc}	7.97^{a}
BEL22	8.17^{ab}	3.17^{b}	2.36^{bcde}	1.55^{bcd}	2.52^{abc}	5.56^{bcd}
ORO3	7.17^{bc}	3.12^{b}	2.19^{cde}	1.47^{bcd}	2.18^{bc}	4.81^{cde}
F. sign	**	***	**	*	*	**

RESULTS AND DISCUSSION

- Nut weight had positive and significant (P<0.001) correlation with nut length, nut width, nut girth, kennel weight, shell weight at r values of 0.96, 0.93, 0.67, 0.95, and 0.99 respectively (Table 2)

- Generally, positive and significant correlation exist among all the nut traits assessed. Thus, any of the nut trait is a good determinant of the other traits

- In the cashew clones used in this experiment, nut weight and girth is a reliable assessment of kernel weight as was also observed in Adeigbe *et. al*., 2015

Table 2. Correlation between nut traits measured

	Nut weight	Nut length	Nut width	Nut girth	Kernel weight	Shell weight
Nut weight	-	0.96***	0.93***	0.67***	0.95***	0.99***
Nut length	-	-	0.88***	0.66***	0.92***	0.96***
Nut width	-	-	-	0.69***	0.89***	0.92***
Nut girth	-	-	-	-	0.57***	0.69***
Kernel weight	-	-	-	-	-	0.91***
Shell weight						

*** - significance at $p \leq 0.001$

RESULTS AND DISCUSSION

- The total genetic variation among the 13 accessions was accounted for by 4 PC axes, with variance proportions ranging from 91.73% (PC1) to 1.11% (PC4) (Table 3)

- The eigenvalues for each axes followed the descending trend as the variance proportion

- Total variations (98.62%) among the thirteen accessions as explained by the first three PC axes were 91.73%, 4.93% and 1.97% respectively

- By decreasing magnitude, prominent traits with high eigenvector loadings in PC1 were: nut weight (0.42), shell weight (0.42) nut length (0.41), nut width (0.40), and kernel weight (0.40). Nut girth (0.80) was the most discriminatory in PC2

Table3. **Eigenvalues, variance proportions and eigenvectors showing the prominence of each trait to each PC axes**

Characters	PC1	PC2	PC3	PC4
Nut weight	0.4249	-0.0595	0.0679	-0.1883
Nut length	0.4141	-0.2744	0.4117	-0.3040
Nut width	0.4064	0.0509	-0.8672	-0.0144
Nut girth	0.3796	0.8029	0.2523	0.3694
Kernel weight	0.4012	-0.5206	0.0852	0.6996
Shell weight	0.4217	0.0529	0.0550	-0.4960
Eigenvalues	5.5038	0.2951	0.1183	0.0667
Variance	91.73	4.93	1.97	1.11
Cumulative	91.73	96.65	98.62	99.73

RESULTS AND DISCUSSION

- A dendrogram (Figure 1) constructed on the basis of Dice's dissimilarity coefficient broadly separated the 13 cashew clones into 3 main clusters at dissimilarity coefficient of 1.75, and 2 main clusters at 3.53 dissimilarity coefficient

- The best 3 clones were grouped together in the same cluster

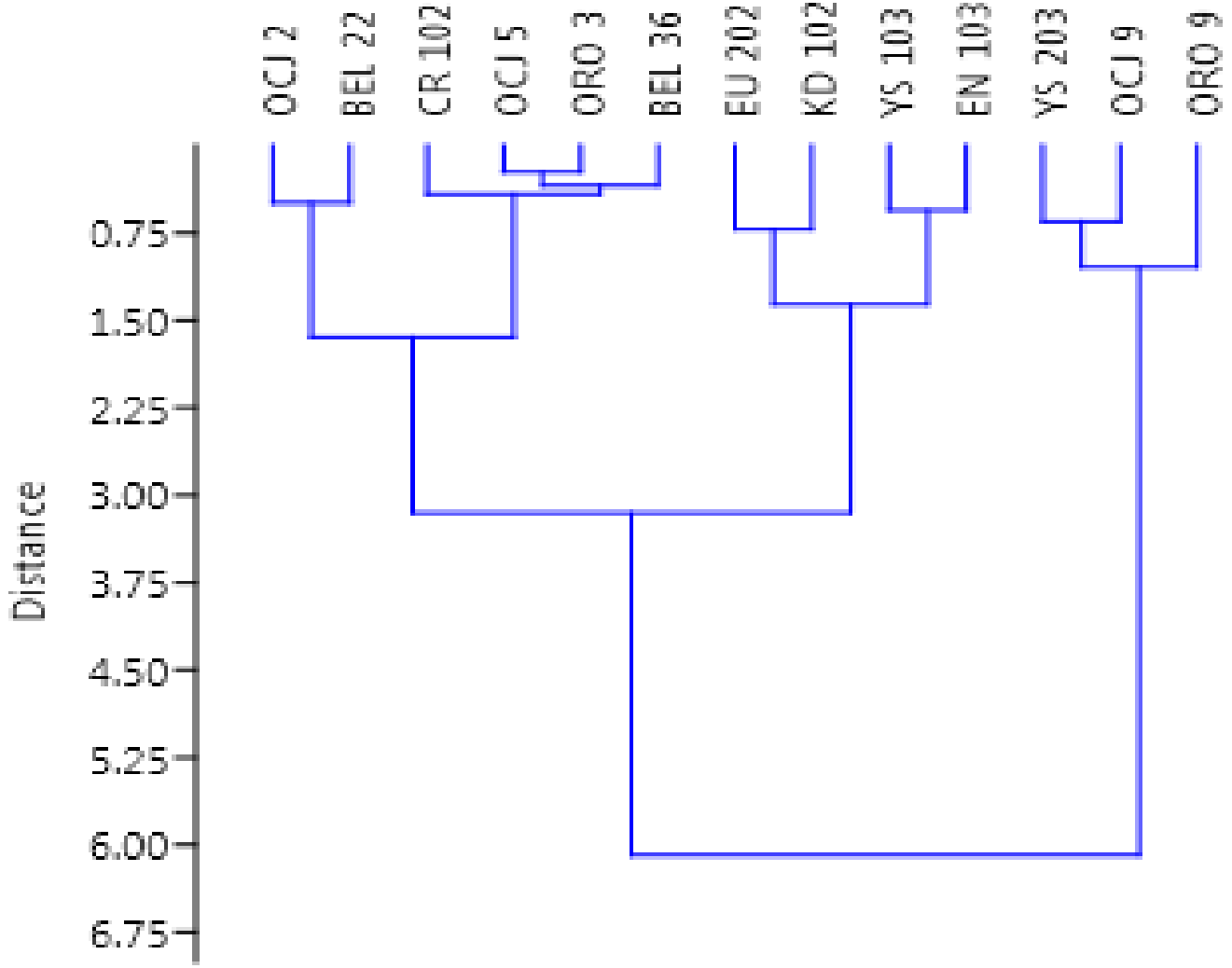


Figure 1. A dendrogram separating cashew clones into two main clusters

CONCLUSION

In this preliminary study:

- Three cashew clones; Clone OCJ9, YS203 and ORO9 were identified with desirable traits of large nut size positively correlated with large kernel size
- These would be advanced for further assessment (yield over years and disease & pest resistance)
- They could be used as mother tree for developing improved planting materials for farmers