



### REVIEWER'S REPORT

Manuscript No.: IJAR- 58096

**Title: Character Association, Components of Bean Yield and Compositional Description of Some Early-bearing Cacao (Theobroma cacao L.) Hybrids in Nigeria.**

**Recommendation:**

Accept as it is .....

**Accept after minor revision.....**

Accept after major revision

Do not accept (*Reasons below*)

Rating	Excel.	Good	Fair	Poor
Originality		✓		
Techn. Quality		✓		
Clarity			✓	
Significance			✓	

Reviewer Name: **ANAPANA GOPAL**

**Reviewer's Comment for Publication.**

**General Comments**

This manuscript evaluates nine early-bearing cacao hybrids developed in Nigeria with respect to bean yield components, character association, proximate composition, and phytochemical properties. The study employs correlation analysis, stepwise regression, ANOVA, and mean separation techniques to identify traits contributing to cocoa bean yield and nutritional quality. The topic is relevant to cacao breeding, crop improvement, and sustainable cocoa production, particularly in West Africa where productivity enhancement remains a major research priority.

The manuscript contains useful data and potentially valuable breeding information. However, several methodological, statistical, literature, and presentation issues require substantial improvement before publication.

**Content and Originality**

**Strengths**

- The study addresses an important agricultural problem: identification of high-yielding and nutritionally superior cacao hybrids.
- Evaluation of both yield-related traits and nutritional composition provides a comprehensive assessment of hybrid performance.
- Focus on early-bearing hybrids is practically relevant for reducing juvenile periods and increasing farmer profitability.
- The work contributes information on recently developed Nigerian cacao germplasm.

**Weaknesses**

- The novelty of the study is not clearly articulated.
- Similar correlation and yield-component analyses have previously been reported in cacao breeding literature.
- The manuscript does not sufficiently explain how these hybrids differ genetically or agronomically from previously released CRIN hybrids.

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- Nutritional analyses appear descriptive and are not integrated into breeding recommendations.

### Technical Quality

#### Strengths

##### 1. Appropriate Experimental Design

The use of a Randomized Complete Block Design (RCBD) with replications across agro-ecological locations is appropriate for varietal evaluation.

##### 2. Multiple Trait Evaluation

The study assesses:

- Yield traits
- Pod characteristics
- Bean traits
- Proximate composition
- Phytochemical properties

This provides broad characterization of the hybrids.

##### 3. Statistical Analysis

The application of:

- Correlation analysis
- Stepwise regression
- ANOVA
- Duncan Multiple Range Test (DMRT)

is appropriate for the stated objectives.

### Minor Concerns

#### 1. Limited Sample Size and Representation

Although 270 plants were established, only five sampled plants per replicate and fifteen pods per hybrid were used for detailed analysis.

Concerns:

- Small fruit sample size may not adequately represent hybrid variability.
- No power analysis is provided.
- Sampling justification is absent.

The authors should explain why this sample size is sufficient.

#### 2. Multi-location Data Not Properly Utilized

The manuscript states that trials were established at:

- Ibadan
- Owena

However, only Owena-derived early-bearing hybrids appear to have been analyzed.

Questions:

- Were data combined across locations?
- Were genotype  $\times$  environment interactions assessed?
- Why was one location apparently excluded?

This issue requires clarification.

#### 3. Use of Stepwise Regression

The reliance on stepwise regression is problematic.

Known limitations include:

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- Variable selection bias.
- Overfitting.
- Inflated R<sup>2</sup> values.
- Instability across datasets.

The reported R<sup>2</sup> value of 97.89% is unusually high and may indicate overfitting.

The authors should:

- Justify the use of stepwise regression.
- Consider path coefficient analysis or multivariate approaches commonly used in plant breeding.

### 4. Absence of Genetic Parameters

A breeding-focused manuscript would benefit from reporting:

- Heritability
- Genetic advance
- Genotypic coefficient of variation
- Phenotypic coefficient of variation

Without these parameters, breeding recommendations remain incomplete.

### 5. Lack of Molecular or Genetic Validation

The study repeatedly discusses genetic variability, yet all analyses are phenotypic. No molecular characterization was conducted.

Therefore, statements regarding genetic diversity should be moderated.

## Results and Interpretation

### Strengths

#### Correlation Analysis

The study identifies significant negative relationships between pod index and several yield-related traits including:

- Number of beans per fruit
- Weight of beans per fruit
- Weight of fermented beans
- Dry bean weight

These findings are biologically meaningful because lower pod index reflects higher yield efficiency.

#### Yield Components

The study successfully identifies six variables explaining most variation in pod index.

### Weaknesses

#### Overinterpretation of Regression Results

The authors conclude that these six traits are the primary determinants of yield. However:

- Correlation does not imply causation.
- Regression does not establish biological control mechanisms.

Interpretations should be more cautious.

#### Nutritional Discussion is Weak

The nutritional results are presented descriptively.

The discussion lacks:

- Nutritional significance.

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- Breeding implications.
- Industrial relevance.
- Consumer relevance.

More detailed interpretation is needed.

### Literature Review

#### Strengths

- Relevant background on cocoa production and breeding is provided.
- Several recent references (2022–2024) have been included.

#### Weaknesses

##### Possible Citation Authenticity Concerns

Several recent references appear difficult to verify and should be carefully checked.

Examples include:

- Baumann and Dufour (2022)
- Perez and Smith (2023)
- Williams and Zhang (2021)
- Patel et al. (2023)

The journal should verify that all cited references genuinely exist and are accurately cited.

##### Missing Landmark Breeding Studies

The review would benefit from inclusion of:

- Recent genomic breeding studies.
- Marker-assisted selection studies.
- Genotype × environment studies in cacao.

### Tables and Figures

#### Strengths

- Tables are relevant and informative.
- Correlation matrix is useful for breeders.
- Mean comparison table effectively differentiates hybrids.

#### Weaknesses

##### Figure Quality

The location map is relatively basic and lacks:

- Scale clarity.
- Improved geographic labeling.
- Experimental site details.

##### Table Formatting

Several tables require reformatting:

- Alignment inconsistencies.
- Excessive abbreviations.
- Dense presentation.

Tables 2 and 6 are difficult to read in their current form.

### Language and Presentation

#### Minor Issues

The manuscript contains numerous language problems:

#### Grammar

Examples:

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- "indespesibility" instead of "indispensability".
- Several tense inconsistencies.
- Repeated sentence structures.

### Typographical Errors

Examples:

- "hybidisation" instead of hybridisation.
- "Mocrobiology" instead of Microbiology.
- "Schwam" instead of Schwan.

### Formatting

- Inconsistent spacing.
- Citation style inconsistencies.
- Uneven reference formatting.

Professional English editing is strongly recommended.

### Specific Comments

#### Abstract

- Include sample size and experimental design.
- Mention major numerical findings.
- Provide practical breeding implications.

#### Introduction

- Clearly state research gap.
- Strengthen novelty justification.

#### Materials and Methods

- Clarify why only nine hybrids were selected.
- Explain whether environmental effects were controlled.
- Include ethical and quality-control procedures for laboratory analyses.

#### Results

- Provide confidence intervals where possible.
- Include effect sizes.

#### Discussion

- Compare findings with more international cacao breeding studies.
- Discuss implications for cacao improvement programs in Nigeria.

#### Conclusion

The conclusion should identify:

- Best-performing hybrid(s).
- Most important selection traits.
- Practical recommendations for breeders and farmers.

Current conclusion is too general.

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### **Overall Assessment**

The manuscript presents useful information on yield components and nutritional characteristics of early-bearing cacao hybrids developed in Nigeria. The research topic is relevant and the dataset has value for breeding programs. However, weaknesses in experimental interpretation, statistical methodology, presentation quality, language, and breeding inference reduce the manuscript's current impact. Significant revision is needed before publication.

### **Final Recommendation**

**Minor Revision**