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ASSESSMENT OF RELATIONSHIP BETWEEN BIOMASS AND YIELD OF CUCUMBER (*CUCUMIS SATIVUS* L.) CULTIVATED IN OWERRI, IMO STATE, NIGERIA

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ABSTRACT

This study assessed the relationship between biomass accumulation and yield of cucumber (*Cucumis sativus* L.) cultivated in Owerri, Imo State, Nigeria. The study was conducted during the 2021 cropping season at the Teaching and Research Farm, Faculty of Agriculture and Veterinary Medicine, Imo State University, Owerri. The objective was to determine the relationship between cucumber biomass and yield and to evaluate the extent to which variations in biomass influence fruit production. Field data were collected on growth and yield parameters including number of leaves, number of fruits, fruit weight, and fruit yield. Data collected were analyzed using regression and Pearson Product Moment Correlation (PPMC) analysis with Statistical Package for Social Sciences (SPSS) Version 22.0. The results showed that biomass had a positive and statistically significant influence on cucumber yield. Regression analysis revealed that biomass explained 29.5% of the variation in number of fruits produced (Adjusted $R^2 = 0.295$; $F = 7.106$; $p < 0.05$). The regression coefficient further indicated that increases in biomass resulted in corresponding increases in fruit production. Correlation analysis showed a positive and significant relationship between biomass and cucumber yield ($r = 0.462$; $p < 0.05$), while a stronger positive association ($r = 0.684$) was observed among biomass, fruit number, and fruit weight. The study concluded that increased biomass accumulation enhances vegetative growth, improves photosynthetic efficiency, and promotes assimilate allocation toward fruit development, resulting in improved cucumber yield. Therefore, agronomic practices that enhance biomass production should be encouraged to improve cucumber productivity under the agro-ecological conditions of Owerri, Imo State, Nigeria.

Keywords: Biomass, cucumber, fruit yield, regression analysis, correlation, vegetative growth, Owerri.

1.0 INTRODUCTION

Cucumber (*Cucumis sativus* L.) is an economically important vegetable crop cultivated widely across temperate and tropical regions of the world due to its nutritional, medicinal, and commercial value (Ando et al., 2025). It belongs to the family Cucurbitaceae and is recognized as one of the oldest cultivated vegetable crops, with records of cultivation dating back over 5,000 years (Gelaye, 2023). In Nigeria, cucumber is cultivated across virtually all agro-ecological zones, ranging from the coastal rainforest to the savannah regions, due to its adaptability to different climatic conditions and increasing market demand (Zhao et al., 2025). The production and consumption of cucumber have increased considerably in recent years owing to growing awareness of its nutritional and health benefits. According to Kaur and Sharma (2021), cucumber production is becoming increasingly popular in Nigeria because of its nutritional and medicinal importance, as well as its usefulness in pharmaceutical industries. Cucumber fruits contain essential nutrients including carbohydrates, proteins, dietary fibre, vitamins, minerals, and antioxidant compounds that contribute significantly to human nutrition and health (Campos et al., 2021). Nutritionally, cucumber serves as a rich source of vitamins A, C, K, and B-complex vitamins, alongside essential minerals such as potassium, magnesium, phosphorus, copper, and manganese (Subedi et al., 2024). These nutrients support several physiological functions and contribute to disease prevention. Studies have shown that cucumber possesses medicinal properties and has traditionally been used in managing conditions such as urinary tract disorders, digestive complications, jaundice, and inflammatory conditions (Ibrahim et al., 2024). Furthermore, bioactive compounds such as ascorbic acid and caffeic acid found in cucumber contribute to skin protection by reducing irritation and swelling (Otie et al., 2024). Despite its adaptability, cucumber cultivation requires fertile and well-drained soils for optimum growth and fruit development. Soil infertility often results in poor vegetative growth, bitter fruits, and malformed produce that reduce market acceptance and profitability (Aboyeji et al., 2025). Consequently, effective crop management practices that promote vegetative development and biomass accumulation are essential for improving productivity. Plant biomass represents the total dry matter accumulated by a crop during growth and serves as an important indicator of plant vigor, photosynthetic efficiency, and productivity. Biomass accumulation reflects the plant's ability to intercept solar radiation, absorb nutrients, and convert assimilates into economic yield (Banerjee et al., 2024). In cucumber production, vegetative growth characteristics such as leaf area development, stem elongation, and total biomass significantly influence flowering, fruit formation, and final yield. Cucumber plants

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are characterized by vigorous vegetative growth and are commonly managed through pruning and training systems to improve canopy architecture, optimize light interception, enhance ventilation, and reduce pest and disease incidence (Samba et al., 2024). Proper canopy management also enables higher plant densities and improved fruit quality (Anthony & Minas, 2025). According to Chatzieffraimidis et al. (2025), pruning reduces intra-plant competition and enhances photosynthetic efficiency, resulting in improved growth performance and increased yield. Similarly, Sahoo et al (2025), noted that appropriate pruning practices improve marketable yield through increases in fruit size and fruit weight. Although several studies (Onyia, 2012; Okafor & Yaduma, 2021; Munonye et al., 2023; Abua et al., 2025), have examined agronomic practices affecting cucumber productivity, limited attention has been given to understanding how variations in plant biomass influence yield performance under local environmental conditions in Nigeria. Since biomass production serves as an indicator of crop growth efficiency and potential yield, evaluating the relationship between biomass accumulation and yield becomes essential for developing appropriate management strategies for cucumber cultivation. Therefore, this study seeks to assess the relationship between biomass and yield of cucumber cultivated in Owerri, Imo State, with a view to generating empirical evidence that can improve production efficiency and support sustainable vegetable farming practices.

2.0 SPECIFIC OBJECTIVES

1. To determine the relationship between biomass accumulation of cucumber plants and the yield produced.
2. To determine the influence of variations in plant biomass on cucumber yield.

3.0 MATERIALS AND METHODS

3.1 Experimental Location

The field experiment was conducted during the 2021 cropping season at the Teaching and Research Farm, Faculty of Agriculture and Veterinary Medicine, Imo State University, Owerri, Nigeria. Owerri is located between latitudes 5°10′N and 6°00′N and longitudes 6°35′E and 7°00′E, at an altitude of approximately 91 m above sea level. The study area lies within the humid rainforest agro-ecological zone of southeastern Nigeria. The rainfall pattern of the area is bimodal, characterized by two peak periods occurring in July and September, separated by a short dry spell commonly referred to as the "August break." The rainy season typically commences in March and extends to October or early November, although annual variations in rainfall distribution may occur. According to the Nigerian Meteorological Agency [(Nigerian Meteorological Agency (NiMET), 2020)], the area records an average annual rainfall of approximately 2,500 mm, an average temperature of 27°C, and a relative humidity of about 75%, making it suitable for cucumber cultivation.

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3.1.1 Experimental Materials

The materials used for the study included cucumber seeds, farm implements, and organic manure. The farm tools comprised hoe, cutlass, rake, spade, hand trowel, measuring tape, and both manual and electronic weighing balances. The cucumber seeds used for planting were obtained from the Imo State Agricultural Development Programme (ADP), Owerri. Organic manure applied during the experiment was sourced from the Teaching and Research Farm of the Faculty of Agriculture, Imo State University, Owerri.

3.2 Land Preparation

The experimental site was cleared manually to remove existing vegetation and field debris. After clearing, the area was mapped out and manually prepared into seed beds. Each bed measured 2 m × 2 m (4 m^2), with a spacing of 0.5 m between adjacent beds to facilitate movement, field management, and data collection activities. Routine cultural practices were carried out throughout the cropping period. Weed control was performed manually at two-week intervals to minimize competition for nutrients, moisture, and sunlight.

3.3 Data Collection

Number of Leaves

The number of leaves per plant was determined by manually counting all fully expanded leaves produced by each sampled cucumber plant. Data were collected before the flowering stage.

Number of Fruits per Plot

The number of fruits per plot was determined by manually counting all harvested fruits obtained from each plot at harvest.

Fruit Yield (t/ha)

Fruit yield per hectare was estimated using the method described by Sheferie et al. (2023), and expressed in tons per hectare. Fruit yield (t/ha) was calculated as:

Fruit Yield (t/ha) = (Fruit weight per plot (kg) × 10,000 m^2) ÷ (Area of plot (m^2) × 1,000)

where:

i. Fruit weight per plot = total harvested fruit weight (kg)
ii. Plot area = area occupied by each experimental unit (m^2)
iii. 10,000 = conversion factor from square metres to hectares
iv. 1,000 = conversion factor from kilograms to tonnes

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3.4 Data Analysis

Data collected were subjected to descriptive and inferential statistical analyses. Correlation analysis was used to determine the degree of relationship between cucumber biomass and yield, while regression analysis was employed to evaluate the extent to which variations in biomass influenced yield performance. All statistical analyses were conducted using Statistical Package for Social Sciences (SPSS), Version 22.0 (IBM SPSS Statistics, 2013). Statistical significance was tested at the 5% probability level ($P \leq 0.05$)

4.0 RESULTS

4.1 Relationship between Biomass and Number of Fruits of Cucumber

Table 1 presents the regression model summary showing the relationship between biomass and number of fruits produced by cucumber plants. The coefficient of determination (Adjusted R^2 = 0.295) indicates that approximately 29.5% of the variation in the number of fruits produced was explained by variations in plant biomass, while the remaining 70.5% could be attributed to other environmental, genetic, and management-related factors not included in the model. The regression model was statistically significant ($F = 7.106$; $df_1 = 1$; $df_2 = 17$; $p = 0.016$), indicating that biomass significantly influenced fruit production in cucumber under the prevailing experimental conditions. The estimated regression equation was: Number of Fruits = 0.950 + 0.029 (Biomass). This implies that for every unit increase in biomass, the number of fruits increased by approximately 0.029 units, suggesting a direct positive effect of biomass accumulation on fruit formation.

Table 1: Model Summary and Parameter Estimates for Relationship between Biomass and Number of Fruits

Dependent Variable	Equation	R^2	F	df_1	df_2	Sig.	Constant	b_1
Number of Fruits	Linear	0.295	7.106	1	17	0.016	0.950	0.029

Independent Variable: Biomass

The findings indicate that biomass contributed significantly to fruit development and yield formation in cucumber.

4.2 Relationship between Biomass and Number of Fruits of Cucumber

Figure 1 illustrates the linear relationship between biomass and number of fruits produced by cucumber plants.

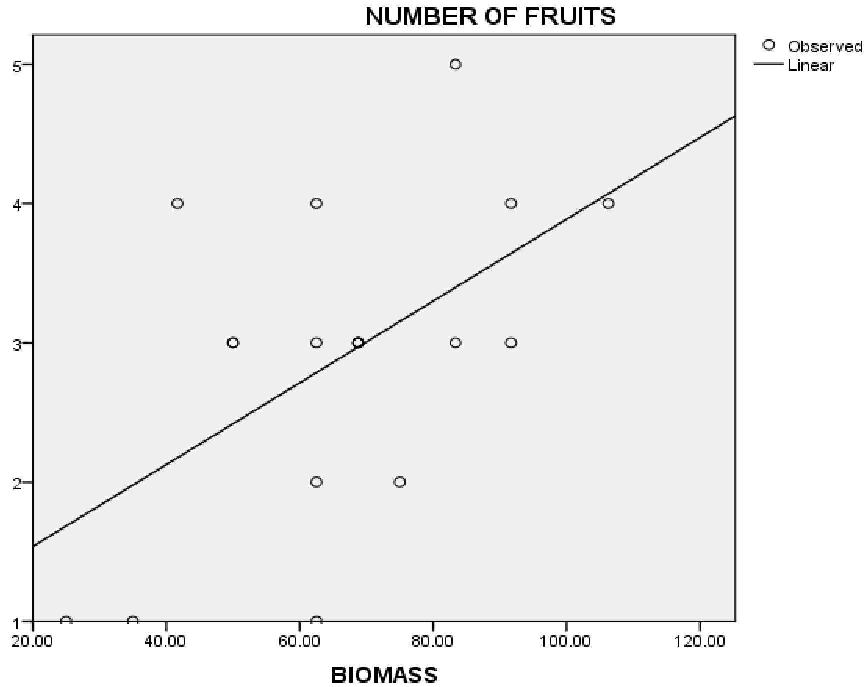

Figure 1: Relationship between Biomass and Number of Fruits of Cucumber Plant

The graphical representation demonstrated a positive linear relationship between biomass and fruit number. As biomass increased, the number of fruits produced also increased. This suggests that greater vegetative development enhances assimilate production and allocation toward reproductive structures, thereby improving fruit set.

4.3 Relationship between Biomass and Fruit Weight of Cucumber

Figure 2 presents the relationship between biomass and fruit weight of cucumber.

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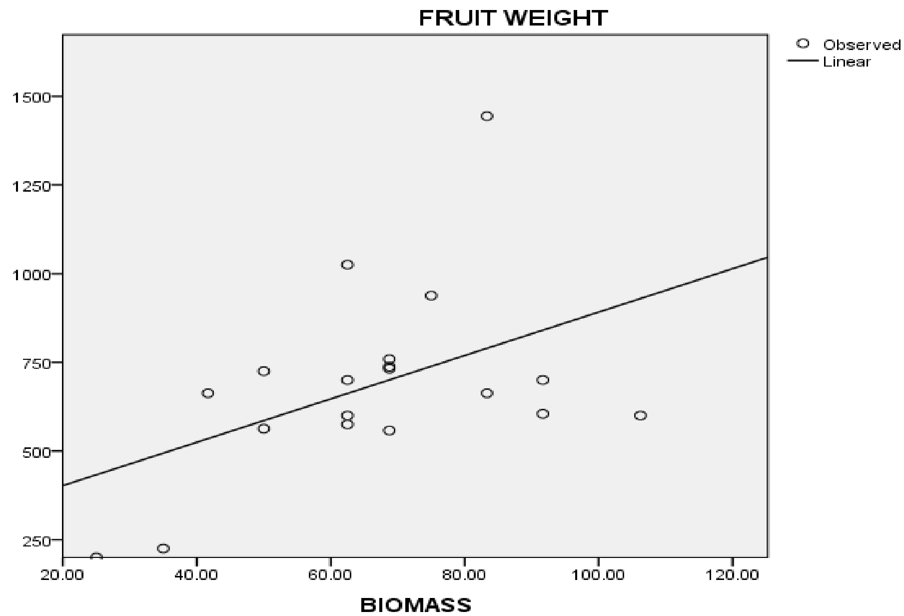

Figure 2: Relationship between Biomass and Fruit Weight of Cucumber Plant

The result showed a positive association between biomass and fruit weight, indicating that plants with greater biomass produced heavier fruits. Increased vegetative growth likely improved photosynthetic efficiency and nutrient accumulation required for fruit enlargement and development.

4.4 Correlation between Biomass and Cucumber Yield

Pearson Product Moment Correlation (PPMC) analysis was used to determine the degree and direction of association between biomass and cucumber yield components. The Pearson correlation coefficient obtained ($r = 0.462$) indicated a moderate positive relationship between biomass and cucumber yield. Since the significance value was less than 0.05 ($p < 0.05$), the relationship was statistically significant. This result implies that increases in biomass were associated with corresponding increases in cucumber yield and that the observed relationship was unlikely to have occurred due to random variation alone.

5.0 DISCUSSION, CONCLUSION AND RECOMMENDATION

5.1 Discussion

The relationship among biomass, number of fruits, and fruit weight was evaluated using Pearson Product Moment Correlation (PPMC) and regression analysis. The findings revealed a statistically significant positive association among these variables. Specifically, the correlation coefficient (r =

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0.684) indicated a strong positive relationship, suggesting that increases in biomass contributed substantially to improvements in fruit number and fruit weight. The positive association observed supports the physiological principle that increased vegetative growth enhances photosynthetic surface area, thereby increasing assimilates production and allocation to reproductive organs (Zhang et al., 2025). Biomass accumulation is considered a critical indicator of crop productivity because it reflects efficient utilization of nutrients, water, and solar radiation. The regression result (R^2 = 0.295) further showed that biomass explained approximately 29.5% of variation in fruit production. Although significant, this also indicates that additional factors such as soil fertility, moisture availability, genotype, pruning intensity, and environmental conditions may contribute to cucumber yield performance. The findings agree with the report of Bayoumi et al. (2021), who observed that improved vegetative growth enhanced flowering and fruit yield in cucumber production systems. Similarly, Trivedi et al. (2026), reported that increased vine development significantly improved fruit weight and overall yield performance in cucumber. The observed positive relationship also corresponds with the findings of Roch et al. (2020), who reported that biomass accumulation was positively associated with vine development, fruit number, and fruit weight in cucumber production. Likewise, Dhurve and Joseph (2025), demonstrated that improved canopy management enhanced photosynthetic activity and resulted in increased fruit production. Therefore, the results suggest that cucumber yield can be improved through agronomic practices that promote biomass accumulation and efficient canopy development.

5.2 Conclusion

This study assessed the relationship between biomass accumulation and yield performance of cucumber cultivated in Owerri, Imo State. The findings revealed that biomass had a positive and statistically significant relationship with major yield components, particularly the number of fruits and fruit weight. The regression and correlation analyses showed that increased biomass contributed to improved fruit production, indicating that vegetative growth plays an important role in determining cucumber yield performance. Increased biomass likely enhanced photosynthetic activity, nutrient utilization efficiency, and assimilates translocation to reproductive organs, thereby supporting fruit initiation, development, and enlargement. Although biomass explained a considerable proportion of yield variation, the results also suggest that other environmental and management factors may influence productivity. Overall, the study establishes biomass accumulation as an important indicator and predictor of cucumber yield and highlights its relevance in improving sustainable cucumber production under the agro-ecological conditions of Owerri, Imo State.

5.3 Recommendation

Based on the findings of this study, the following recommendations are made:

1. Farmers should adopt agronomic practices that promote biomass accumulation, including proper nutrient management and timely field operations.
2. Since cucumber is a climbing crop with vigorous vegetative growth, appropriate pruning and support systems should be employed to enhance canopy development and fruit productivity.
3. Organic manure and other soil fertility improvement strategies should be encouraged to increase biomass production and optimize yield.
4. Further studies should evaluate additional variables influencing cucumber yield, including soil characteristics, irrigation, and genotype performance.

Conflicts of Interest

The authors declare no conflict of interest.

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