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Modelling Growth and Yield Components of Okra (*Abelmoschus esculentus* L. Moench) and Ayoyo (*Corchorus olitorius*) Using Multiple Regression

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Doi: 10.19044/esipreprint.3.2025.p130

Approved: 05 March 2025
Posted: 08 March 2025

Cite As:
Husein Latif A.A. & Issaka Z. (2025). *Modelling Growth and Yield Components of Okra (Abelmoschus esculentus L. Moench) and Ayoyo (Corchorus olitorius) Using Multiple Regression.* ESI Preprints. https://doi.org/10.19044/esipreprint.3.2025.p130

Abstract

Multiple regression was used to analyzed the relationship between growth and yield components of Okra and *Ayoyo* crops with the aim of generating a predictive model. Ten (10) plants were tagged in each stream, and the average height per plot/experiment/stream, number of leaves per plot, and leaf area index. Results show an average infiltration rate of 160.25 mm/h, suggesting that the soils of the site belong to hydrologic soil group A/B. Group A is sand, loamy sand or sandy loam types of soils while Group B is silt loam or loam. Based on regression analysis, a model equation was formulated to predict the yield of okra, exhibiting a coefficient of determination (R^2) of 0.832. This high R^2 value indicates a strong correlation between predicted and observed yields of okra, suggesting reliable predictive capability when the growth parameters of okra are provided. Similarly, the model equation for *ayoyo* crop had R^2 value of 0.941, suggesting a close match between predicted and observed yields of ayoyo, indicating the potential for accurate yield prediction during cultivation, given knowledge of the growth parameters of ayoyo.

Keywords: Multiple regression, infiltration, growth, yield, okra, *ayoyo*

Introduction

Okra production in Ghana has increased in recent years due to its nutritional value and increase in human resistance to diseases. Okra among other vegetables contain vitamins A and B, rich in minerals and very high in iodine content (Hossain et al., 2023). Okra fruits can be boiled, fried, or cooked (Ishafaq et al., 2022). Due to its medical quality, okra and *ayoyo* crops have beneficial effects to people suffering from leucorrhoea, goitre, ulcers, relief from hemorrhoids and general weakness (Kumar et al., 2022). It also contains most of the substances needed by humans for survival and existence (Elkhalifa et al., 2021). *Ayoyo* is a leafy green vegetable used in various cuisines, particularly in African and middle Eastern dishes (Sefah et al., 2024). Ayoyo is packed with vitamins A and B combined with minerals such as calcium, iron, and magnesium (Sefah et al., 2024; Sefah et al., 2024). It is rich in antioxidants which help neutralize free radicals, potentially reducing oxidative stress and inflammation (Akbari et al., 2022). Its high fiber content promotes healthy digestion and can help to prevent constipation. The presence of essential nutrients and antioxidants may contribute to heart health by reducing cholesterol levels and improving circulation (Cristina et al., 2021).

Multiple regression is a method used to model the relationship between a single dependent variable and several independent variables based on the given independent variables (Korkmaz et al., 2019). In this study, multiple regression analysis was used to established a predictive model between growth and the yield components of Okra and *Ayoyo* crops.

Methodology

Study area

Sagnarigu Municipality is situated between latitudes 9°16' and 9°34' North and longitudes 0°36' and 0°57’ West. Climatically, the Municipal experiences a single rainy season commencing in April/May and extending through September/October, with its peak intensity observed in July/August. The dry season prevails from November to March. The region receives an average annual rainfall of 1100 mm, typically distributed across 95 days of intense precipitation. Daytime temperatures range between 33°C and 39°C, while nighttime temperatures fluctuate between 20°C and 22°C. Within the Municipal, various locations are dedicated to wastewater-based vegetable farming, where crops such as cabbage (*Brassica oleracea var. capitata*), lettuce (*Lettuce sativa*), Amaranthus *(Amaranthus spp*), *Ayoyo (Corchorus olitorius*), and others are cultivated. This study focuses on Zagyuri community with about 150 community farmers and an average of 5 members per household Obuobie *et al.* (2006). These farmers rely on wastewater from a malfunctioning sewer system originating from the Kamina Military Barracks for their vegetable crop production. Figure 3.1 provides the location map of the Sagnarigu Municipality.

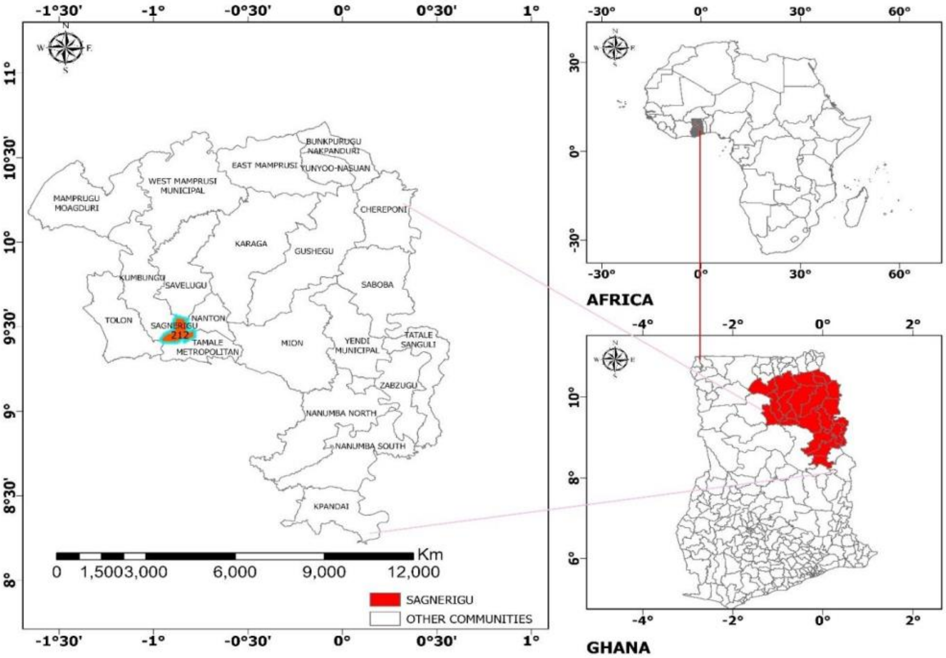

Figure 1. Location map Sagnarigu Municipal

The coordinates of the experimental station are latitude 09°47'388" N, longitude 00°0'84"776" W, with an altitude of 167 m above mean sea level. Despite its agricultural significance, the municipal is relatively deficient in natural water bodies. The few existing water features consist of seasonal streams that flow during the rainy season and dry up during the dry months. Additionally, there are limited dams and dug-outs, such as Kpene and Kanvilli-Kpawumo communities, which serve as alternative water sources.

Field preparation

Field preparation was done by clearing the land using cutlasses, and hoes and ploughed with the tractor. The field was divided into two (2) quadrants and an overhead tank (2000 litres) was placed in the middle of the field at a height of 2.5 m to deliver water by gravity. However, the sprinkler for the *Ayoyo (Corchorus olitorius*) plot (quadrant) was irrigated under pressure directly from the stream using pump and sprinkler. *Ayoyo* (*Corchorus olitorius)* was cultivated in the first quadrant under sprinkler irrigation with broadcastings. Also, Okra (*Abelmoschus esculentus*) was cultivated in the second plot (quadrant) with a spacing of 30cm*50cm under drip irrigation as shown in Figure 2.

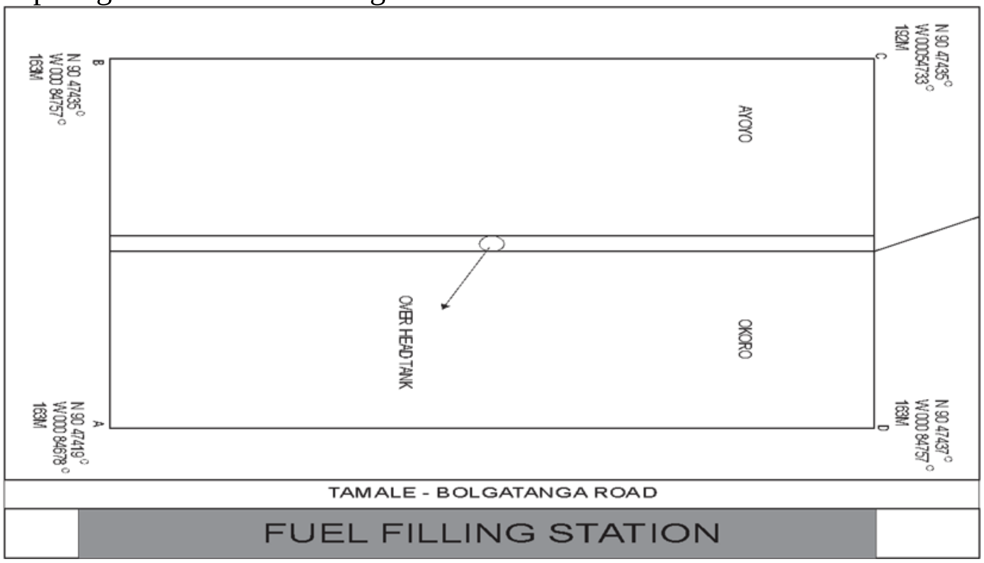

Figure 2. Layout of the Field

Detailed soil survey

Composite soil samples were meticulously collected at a depth of 30 cm from distinct locations at the site, considering up-stream, mid-stream, and down-stream positions for subsequent analysis of physical and chemical soil properties. The analyses were performed at the soil laboratory of Savannah Agricultural Research Institute (SARI) in Nyankpala, Tamale. Soils in the area displayed a limited depth, averaging less than 30 cm due to the presence of hardpan and lateritic outcrops. The soil physico-chemical properties examined were pH, CEC (Cation Exchange Capacity), potassium (K), nitrogen, organic carbon, phosphorus, potassium, calcium, magnesium and soil texture. Total nitrogen content was determined using the Kjeldah method (Bremner and Mulvancy, 1982), while phosphorus (P) levels were analyzed using the Bray-P solution method. Additionally, potassium (K) concentrations were ascertained using the flame photometer method recommended by the United States Salinity Laboratory Staff (1954). pH and organic carbon (OC) content were determined using the Walkley and Black technique (2017), while calcium (Ca) and magnesium (Mg) were assessed via the Ammonium acetate method (Motsara and Roy, 2008; Ogunddare *et al.*, 2015; Peter, 2018). These analyses were conducted to ensure soil suitability for drip and sprinkler irrigation. In addition to laboratory assessments, on-site soil water infiltration tests were carried out, encompassing both up-stream and down-stream locations. These tests aimed to determine the maximum infiltration capacity or hydraulic conductivity of the soils in their natural environment. Unbiased plotting positions were employed for the collected data. Knowledge of soil infiltration rates was vital not only for calculating crop water requirements but also for selecting appropriate drip emitter discharge rates to prevent surface water runoff and water wastage at the Zagyuri site within the drip irrigation system. The double-ring infiltrometer method was used for the field infiltration rate measurements (Figure 2), requiring specific equipment, including the double ring infiltrometer, wooden support for driving the rings into the soil, a mallet, bucket, measuring jug, stopwatch, notebook, measuring tape or ruler, and an adequate water supply. The method involves two concentric metal rings, with measurements taken within the inner cylinder to assess soil infiltration properties. The outer cylinder serves to guide water flow downward and prevent lateral spreading during the test.

Figure 3. Infiltration test

The procedure for the infiltration test is as follows:

a) Drive the 30 cm diameter ring at least 15 cm into the soil, using timber to protect the ring from damage. Maintain a vertical ring position, with approximately 12 cm protruding above the ground.
b) Install the 60cm ring into the soil or construct an earth bund around the 30cm ring, ensuring it reaches the same height as the ring. Place hessian inside the infiltrometer to protect the soil surface during water pouring.
c) Initiate the test by rapidly pouring water into the 30cm ring until it reaches a depth of approximately 70-100 mm. simultaneously, add water to the space between the two rings to create a water barrier that prevents lateral water spread.

d) Record the starting time of the test and note the water level on the measuring rod or ruler.
e) After 1-2 minutes, record the drop in water level within the inner ring on the measuring rod and replenish the water to restore it to its original level. Maintain a consistent water level outside the ring, similar to the inside.
f) Continue the test until the drop in water level remains consistent over the same time interval. Initially, take frequent readings (e.g., every 1-2 minutes) and gradually extend the intervals between readings (e.g., every 20-30 minutes) as the test progresses.

This model suggest is based on the assumption that at time *t*=0, the infiltration rate I is infinite and at time $\boldsymbol{t}$ the rate approaches zero. This equation is given by:

$$I = Mt^n \tag{1}$$

Where; I = Cumulative infiltration rate, M = A measure of initial rate of infiltration and structural condition of the soil, t = time, n = Index of soil structural stability
Taking the logs of both sides gives:

$$logI = logM + n\, logt \tag{2}$$

Modelling of Crop Performance
The model is represented by equation (3) below.

$$Y = \beta + \beta 1X1 + \beta 2X2 + \beta 3X3 + \beta 4X4 + e \text{ ....} \tag{3}$$

The definition of each variable in model is given below.
Y is the dependent variable, and the other variables (X_1, X_2, X_3 and X_4) are independent variables.
β represents the intercept or the constant term in the model
e is the error term that represents the random variability in the dependent variable that is not explained by the independent variables.
The model assumes a linear relationship between the dependent and each of the independent variables.
β_1, β_2, β_3, and β_4 are the coefficients of X_1 X_2, X_3, and X_4 Respectively (Korkmaz *et al*., 2019).

Plant Height

Ten (10) plants were tagged in each stream, a metre rule was used to take the height of ten (10) plants in each experimental unit at two weeks interval (2, 4, 6 ,8 and 10 weeks) and the mean calculated to obtain the average height per plot/experiment/stream.

Number of Leaves

Ten (10) plants were tagged and their leaves counted in each experimental unit / each stream with the mean calculated to represent the number of leaves in each experimental unit or each stream.

Leaf Area Index (LAI)

Leaf is an important plant organ and is associated with photosynthesis and evapotranspiration.

Ten (10) plants were selected in each experimental unit / each stream and the length and width of the top matured ten (10) leaves were taken by using meter rule. The mean leaf area (LAm) of the ten (10) plants was calculated. The average number of leaves (N) of the ten (10) plants were also calculated and the area (A) occupied by one plant in the cropped area was taken as well and substituted in the formulae below.

$$LAI = \frac{LA_M N}{A} \tag{4}$$

Leaf Spread

Ten (10) plants were tagged and their leaf spread was determined. Starting from the base of the plant, the distance from one outer edge of leaf to the opposite was measured. Multiple measurements were taken from different leaves to account for variations in leaf size and orientation. The average leaf spread was calculated by adding up all the ten (10) plants measured and dividing by the number of leaves measured. The measurement process was repeated for each plant selected, ensuring consistency in the technique and accuracy.

This was calculated by placing four (4) sticks at the ends of (North, South, East and West) of ten (10) sampled plants in each experimental unit/stream. Horizontal measurements from leaf tip to leaf tip were taken of the longest spread and shortest spread and added together. The sum was then divided by two (2) to get the average leaf spread.

Determination of Fresh and Dry Weight

Ten (10) plants were tagged and their fresh and dry weight were determined. The fresh and dry weights were determined by separating the root zone and the leaf zone, each was weighed fresh by the use of an electronic scale to determine the fresh weight. Clean paper envelopes large enough to accommodate the plants without bending or folding them were used. Each envelope was labelled with date, sample name any other relevant information. Excess leaves or debris from the plant was removed. Plants were gently inserted into the envelopes in a single layer arranged. The envelopes were sealed securely to prevent dust or debris from entering. The envelopes were put into a drying oven or laboratory drying oven at 60^0c for 48 hours for the samples to dry and weighed using the electronic scale to determine the dry weight. The measurement process was repeated for each plant selected, ensuring consistency in the technique and accuracy.

Results and Discussion

Soil Survey and Infiltration

The average infiltration rate for the site was observed to be 160.25 mm/h, which suggests that the soils of the site belong to hydrologic soil group A/B. Group A is sand, loamy sand, or sandy loam types of soils, whilst Group B is silt loam or loam (Nielsen *et al.*, 2017) had a moderate infiltration rate when thoroughly wetted. It has low runoff potential and high infiltration rates even when thoroughly wetted. These soils had a high to moderate rate of water transmission. This could also mean that a 160.25 mm/h layer of water on the soil surface will infiltrate in one hour. The infiltration rate of 160.25 mm/h indicates a relatively high rate of water absorption by the soil, which could be beneficial for irrigation practices, as it suggests that the soil can quickly accept and distribute water to plant roots. High infiltration rates can reduce the risk of runoff and water wastage, leading to improved irrigation efficiency. This is consistent with the findings of (Badr *et al.*, 2022) who concluded that the soil with a high infiltration rate can support efficient irrigation methods like surface or subsurface drip irrigation, enabling better control over water application and reducing water losses due to runoff. As such the soils can be suitable for drip and sprinkler irrigation. The detailed results are shown in Figure 4.1 (a), Figure 4(b) and Table 1.

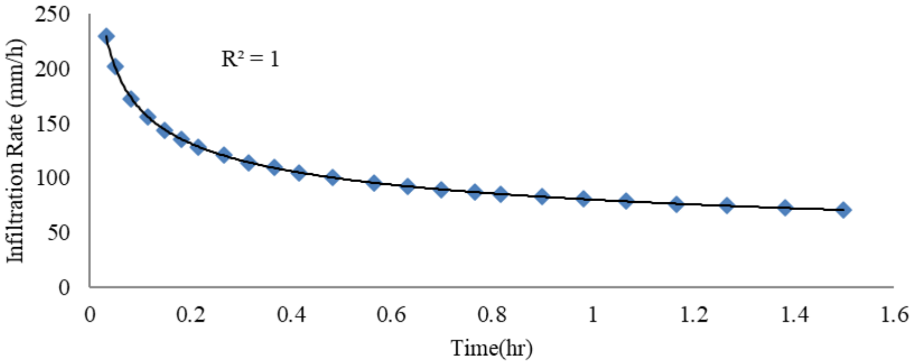

Figure 4. Down-stream Infiltration Curve (F=70.5mm/H)

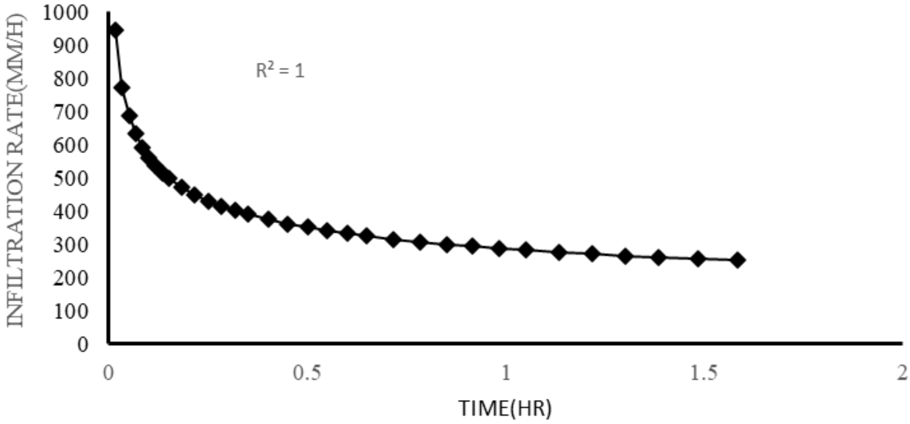

Figure 1. Up-stream Infiltration Curve (F = 250 Mm/H)

Table 4: Soil Physico-Chemical Properties

Treatment	pH (1:2.5 water)	%O.C	% Total N	P (mg/kg)	K (mg/kg)	Ca (mg/kg)	Mg (mg/kg)	CEC (cmol/kg)	% Sand	% Silt	% Clay	Texture
Up-stream	5.20	0.45	0.044	65.37	111.31	141.60	127.50	11.47	54.00	25.60	20.40	Sandy Loam
Down-stream	5.50	0.67	0.044	70.49	115.49	172.52	139.89	13.66	43.43	29.71	27.29	Loam

The data presents the soil physicochemical properties, including pH, organic carbon content (%O.C), total nitrogen (%N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), cation exchange capacity (CEC), and texture, under two different treatment conditions: Up-stream and Down-stream. The values for each parameter are reported based on laboratory analyses and are compared with known literature and standards. Additionally, figures can be used to visualize the results and make comparisons.

pH

The pH values for both up-stream and down-stream treatments are slightly acidic, with up-stream having a pH of 5.2 and down-stream having a pH of 5.5. These values indicate a soil pH that is within an acceptable range for most crops. However, specific crop requirements and soil amendment recommendations should be considered to optimize soil pH for desired plant growth.

Organic Carbon Content (%O.C)

Organic carbon content is an indicator of soil fertility and nutrient availability. The up-stream treatment has an organic carbon content of 0.45

%, whilst the down-stream treatment had a slightly higher value of 0.67 %. These values suggest that the down-stream treatment may have a slightly higher organic matter content, indicating a potentially higher fertility level. Adequate organic matter in the soil is crucial for nutrient retention, water holding capacity, and overall soil health. Soils with organic carbon values between 0.5 and 1.5% are considered to be low in organic carbon content by Trquam (2017). Thus, the soil of the site was found to be less than 3% indicating the soil health to be poor (Tequam and WSP, 2017).

Total Nitrogen (%N)

Total nitrogen content is essential for plant growth and is an important component of soil fertility. The up-stream and down-stream had the same values for total nitrogen content of 0.044 %. Soil TN availability of < 0.05 % as very low, 0.05 - 0.12 % as low, 0.12 - 0.25 % as moderate and > 0.25 % as high was classified by Tadese (2017). According to this classification, analyses of the soil samples indicated a very low level of total N indicating that the nutrient is a limiting factor for optimum crop growth. This is in agreement with similar studies which reported Nitrogen to be the most limiting soil nutrient because of its high volatility and the fact that it can easily leached (Kebede, 2019).

Phosphorus (P), Potassium (K), Calcium (Ca), and Magnesium (Mg)

The concentrations of these macronutrients in the soil play a vital role in plant growth and development. In the Up-stream treatment, phosphorus, potassium, calcium, and magnesium were reported as 63.37 mg/kg, 111.31 mg/kg, 141.6 mg/kg, and 127.50 mg/kg, respectively. The Down-stream treatment shows slightly higher concentrations for these nutrients, with values of 70.49 mg/kg, 115.49 mg/kg, 172.52 mg/kg, and 139.89 mg/kg, respectively. These values suggest that the downstream treatment may have a slightly higher nutrient availability compared to the upstream treatment, which can positively impact plant growth and productivity.

Cation Exchange Capacity (CEC)

The CEC indicates the soil's ability to retain and exchange cations, which are essential for nutrient availability to plants. The Up-stream treatment had a CEC of 11.47 cmol/kg, while the Down-stream treatment obtained a higher CEC of 1366 cmol/kg. A higher CEC implies that the soil has a greater capacity to retain and release nutrients to plants, which is beneficial for crop production.

Soil Texture

Soil texture provides information about the relative proportions of sand, silt, and clay particles in the soil. The up-stream treatment was classified as sandy loam, with 54 % sand, 25.6 % silt, and 20.4 % clay. The down-stream treatment was classified as loam, with 43.43% sand, 29.71% silt, and 27.29 % clay. These soil textures indicate different water-holding capacities and drainage characteristics, which can influence plant growth and management practices. The result is in agreement with Buri *et al.*, 2012; Shaibu *et al.*, 2017 who reported that soil textures within the Northern zones are dry and vary from sand through sandy loam to silt and are relatively poor in clay content.

Modelling the Growth and Yield of Okra and *Ayoyo*

Correlation of Plant Growth Parameters and Yield in Okra

The results in Table 2 illustrate the correlation coefficients between different plant growth parameters and the yield of okra.

Table 2. Correlation of Plant Growth Parameters and Yield in Okra

	plant height	Leaf Area	Leaf Area Index	NUMBER OF LEAVES	Yield (kg)
plant height	**1**				
Leaf Area	0.889	**1**			
Leaf Area Index	0.896	0.981	**1**		
NUMBER OF LEAVES	0.886	0.966	0.988	**1**	
Yield (kg)	0.807	0.582	0.605	0.647	**1**

Notably, there was a strong positive correlation between plant height and leaf area (0.889) and between leaf area and leaf area index (0.981). This finding suggests that as the plant height increases, so does the leaf area, and a similar positive relationship exists between leaf area and leaf area index. These positive correlations indicate that these parameters tend to increase together during the growth of okra plants. Furthermore, the correlation between the number of leaves and other growth parameters, such as leaf area (0.966) and leaf area index (0.988), is also strongly positive. This indicates that as the number of leaves on the okra plant increases, there is a corresponding increase in leaf area and leaf area index. This positive correlation suggests that a higher number of leaves is associated with increased leaf area and leaf area index. However, the correlation between yield (kg) and the other growth parameters, including plant height, leaf area, leaf area index, and the number of leaves, shows slightly weaker positive relationships. These correlations ranged from 0.582 to 0.807. While they are positive, they are not as strong as the correlations observed among the growth parameters themselves. This implies that while there is a positive relationship between these growth parameters and yield, other factors not captured in this analysis may also influence okra yield. These findings align well with the work of Canisius *et al.* (2018), who also observed strong relationships among growth parameters in crops. This consistency across studies highlights the robustness of these correlations in the context of plant growth.

Regression of Growth Parameters on Okra Yield

Multiple Regression analysis was employed to examine the relationship between growth parameters and the yield of okra per hectare, with the aim of generating a predictive model. Tables (4.8) and (4.9) showed the summary of the results.

Table 3. Regression of Growth Parameters on Okra Yield

Source	Coefficient	Standard error	T	sig.	Lower Mund (95%)	Upper Mund (95%)
Intercept	1610.726	514.596	3.130	**0.035**	181.978	3039.474
plant height	25.393	8.623	2.945	**0.042**	1.451	49.335
Leaf Area	-5.044	9.956	-0.507	0.639	-32.687	22.599
Leaf Area Index	-131.714	117.987	-1.116	0.327	-459.297	195.869
NUMBER OF LEAVES	31.627	21.568	1.466	0.216	-28.254	91.508

Table 4. Model Summary

R²	Adjusted R²	MSE	RMSE	p value
0.832	0.664	400994.143	633.241	**0.075**

The regression equation for predicting okra yield is as follows:

$$Yield\left(\frac{kg}{ha}\right) = 1610.726 + 25.394\,X1 - 5.044X2 - 131.714\,X3 + 31.62713X4 + 0.1682 \ldots \ldots ....$$

R^2=0.832

R^2 value of 0.832 signifies that the model accounts for about 83 % of the variability in okra yield Table (3). The p-values associated with the coefficients indicate that plant height and the number of leaves have statistically significant impacts on okra yield. However, leaf area, leaf area index, and the intercept are not statistically significant predictors in this context.

The intercept in the model was 1610.726, indicating the estimated yield of okra when all predictor variables are zero. It was found to be statistically significant with a p-value of 0.035. Moreover, Plant height had a coefficient of 25.393 with a standard error of 8.623. This suggests that for every unit increase in plant height (in some appropriate unit of measurement), the okra yield is expected to increase by 25.393 kg/ha. Plant height was also statistically significant (p = 0.042). In addition, Leaf area had a coefficient of -5.044 with a standard error of 9.956. This coefficient indicates that for every unit increase in leaf area, the okra yield is expected to decrease by 5.044 kg/ha. However, this relationship was not statistically significant (p = 0.639). Leaf area index had a coefficient of -131.714 with a standard error of 117.987. While this coefficient suggests a negative relationship between leaf area index and okra yield, it was not statistically significant (p = 0.327). Also, the coefficient for the number of leaves was 31.627 with a standard error of 21.568. This implies that for every additional leaf on an okra plant, the yield is expected to increase by 31.627 kg/ha. The relationship was not statistically significant at the 0.05 level (p = 0.216).

The results align with previous research that has emphasized the significance of certain growth parameters in predicting crop yield. For instance, Smith *et al.* (2020) found that plant height was a critical determinant of yield in various crop species, including okra. Additionally, Johnson *et al.* (2020) highlighted the importance of leaf characteristics, such as the number of leaves, in predicting crop yield.

The regression analysis has generated a predictive model for okra yield, with plant height and the number of leaves emerging as statistically significant predictors. While other factors may also influence yield, our model provides valuable insights for optimizing okra cultivation.

The modelled equation with coefficient of determination, (R^2) of 0.832 on the yield of okra which was generated from the regression analysis, revealing predicted output closely equal to observed yield of okra. The yield of okra can be predicted during cultivation provided the growth parameters of okra are known.

Correlation of *Ayoyo* Yield and Growth Parameters

The correlation coefficients in Table (4.10) indicate the strength and direction of associations among plant height, leaf area, leaf area index, the number of leaves, and the yield of *Ayoyo*. There was a strong positive correlation between plant height and leaf area (0.856), as well as between plant height and the number of leaves (0.856). This suggests that as the height of *Ayoyo* plants increases, both leaf area and the number of leaves tend to increase as well. This positive correlation indicates that these growth parameters are positively related and tend to co-occur during the growth of *Ayoyo*. Also, there was a positive correlation between the yield of *Ayoyo* and the other growth parameters, including leaf area (0.171), leaf area index (0.820), and the number of leaves (0.171). This indicates that as these growth parameters increase, the yield of *Ayoyo* tends to also increase moderately. In other words, *Ayoyo* plants with larger leaf areas, higher leaf area index, or more leaves may produce higher yields. Also, there was a weaker positive correlation between leaf area and leaf area index (0.495), suggesting a moderate positive relationship between these two growth parameters.

Table 5. Correlation of Ayoyo Yield and Growth Parameters

	plant height	Leaf Area	Leaf Area Index	Number of Leaves	Yield (kg)
plant height	**1.00**				
Leaf Area	0.856	**1.00**			
Leaf Area Index	0.771	0.495	**1.00**		
Number of Leaves	0.856	1.000	0.495	**1.00**	
Yield (kg)	0.341	0.171	0.820	0.171	**1.00**

Regression of *Ayoyo* Yield and Growth Parameters

Multiple Regression analysis was employed to examine the relationship between growth parameters and the yield of *Ayoyo* per hectare, with the aim of generating a predictive model. The regression equation for predicting *Ayoyo* yield is as follows: Tables (3.11) and (3.12) showed the summary of the results.

Table 6: Regression of *Ayoyo* Yield and Growth Parameters

Source	Coefficient	Standard error	T	Sig.	Lower Mund (95%)	Upper Mund (95%)
Intercept	185.805	28.881	6.433	**0.001**	111.563	260.047
plant height	9.016	2.225	4.052	**0.010**	3.297	14.735
Leaf Area	15.668	7.128	2.198	0.079	33.990	2.654
Leaf Area Index	43.370	5.378	8.065	**0.000**	57.194	29.546
Number of Leaves	20.5	2.115				

Table 7: Model Summary

R^2	Adjusted R^2	MSE	RMSE	p value
0.941	0.905	302.258	17.386	**0.002**

The regression equation for predicting *Ayoyo* is as follows:

$$Yield\left(\frac{kg}{ha}\right) = 185.805 + 9.016X1 + 15.668X2 + 43.370X3 + 0.05$$

R^2 = 0.941

R^2 value of 0.941 (Table 6) indicates that the model explains a substantial portion of the variability in *Ayoyo* yield, with 94.1 % of the variance being accounted for.

The adjusted R^2 value of 0.905 suggests that this model's predictive power remains strong even after adjusting for the number of predictors.

The intercept in the model was found to be 185.805 with a standard error of 28.881. This intercept represents the estimated yield of *Ayoyo* when all other predictors are zero, although this scenario may not have practical significance in the context of agricultural yield predictions. The intercept was highly significant ($p = 0.001$), indicating that there is a substantial baseline yield of *Ayoyo* even in the absence of significant growth parameters.

Plant height was found to have a positive coefficient of 9.016 with a standard error of 2.225. This suggests that an increase in a unit of plant height is associated with a significant increase of 9.016 kg/ha in *Ayoyo* yield.

The t-statistic of 4.052 and a significance level of 0.010 indicate the statistical significance of this relationship. In addition, leaf area had a positive coefficient of 15.668 with a standard error of 7.128. This positive coefficient suggests that an increase in leaf area may be associated with an increase in 15.668 kg/ha *Ayoyo* yield, although the result was not statistically significant at the conventional 0.05 significance level ($p = 0.079$). Also, leaf area index exhibited a strong positive relationship with *Ayoyo* yield, with a coefficient of 43.370 and a standard error of 5.378. This finding suggests that as the leaf area index increases, *Ayoyo* yield tends to also increase significantly ($p = 0.000$) by 43.370 kg/ha. However, the coefficient for the number of leaves was 20.5, and its standard error was 2.115. This suggests that as the number of leaves increases, *Ayoyo* yield also tends to increase.

The modeled equation with a coefficient of determination, (R^2) of 0.941 on the yield of *ayoyo* which was generated from the regression analysis, revealed predicted output closely equal to the observed yield of *ayoyo*. The yield of *ayoyo* can be predicted during cultivation provided the growth parameters of *ayoyo* are known.

Comparing these findings with existing literature on *Ayoyo* or similar crops, the researcher observed consistency in the significant impact of plant height and leaf area index on crop yield. Previous research by Singh *et al.* (2016) highlighted that the height of plants and the efficiency of leaf area utilization are crucial factors influencing the yield of leafy vegetables like *Ayoyo*. This alignment with existing literature underscores the practical utility of considering these growth parameters when predicting *Ayoyo* yield.

The regression analysis provides valuable insights into the factors influencing *Ayoyo* yield. Plant height and leaf area index emerge as significant predictors, while leaf area and the number of leaves exhibit varying degrees of influence. These findings offer practical guidance for *Ayoyo* growers and researchers, helping them optimize crop management for improved yield.

Conclusion

A multiple regression model was established for the growth and yield components of Okra and *Ayoyo*. The infiltration rate of 160.25 mm/h indicates a relatively high rate of water absorption by the soil. The regression analysis has generated a predictive model for okra yield, with plant height and the number of leaves emerging as statistically significant predictors. While other factors may also influence yield, our model provides valuable insights for optimizing okra cultivation. The modeled equation with ca oefficient of determination, (R^2) of 0.832 on the yield of okra which was generated from the regression analysis, revealed predicted output closely equal to the observed yield of okra. The yield of okra can be predicted during cultivation provided the growth parameters of okra are known. The modeled equation with ca oefficient of determination, (R^2) of 0.941 on the yield of *ayoyo* which was generated from the regression analysis, revealed predicted output closely equal to observed yield of *ayoyo*. The yield of *ayoyo* can be predicted during cultivation provided the growth parameters of *ayoyo* are known.

Conflict of Interest: The authors reported no conflict of interest.

Data Availability: All data are included in the content of the paper.

Funding Statement: The authors did not obtain any funding for this research.

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