Scientific Research Publishing

American Journal of Plant Sciences, 2026, 17(1), 109-120
https://www.scirp.org/journal/ajps
ISSN Online: 2158-2750
ISSN Print: 2158-2742

Response of Okra (*Abelmoschus esculentus* (L.) Moench) Cultivars to Nitrogen Fertilization in Buea, Cameroon

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How to cite this paper: Oben, T.T., Nlende, J.M., Douanla, G. and Eneke, E.T. (2026) Response of Okra (*Abelmoschus esculentus* (L.) Moench) Cultivars to Nitrogen Fertilization in Buea, Cameroon. *American Journal of Plant Sciences*, **17**, 109-120.
https://doi.org/10.4236/ajps.2026.171007

Received: October 28, 2025
Accepted: January 25, 2026
Published: January 28, 2026

Abstract

Okra is an important vegetable of tropical countries and most popular in India, Nigeria, Sudan, and Cameroon where it is a staple. Yields of cultivars grown are very low when compared to other countries. Poor soils, bad cultural practices and of utmost importance inappropriate use of nitrogen fertilizers and choice of cultivar are the main limiting production factors. Appropriate use of fertilizers in addition to quality planting material will increase okra productivity in terms of quality and quantity. The objective of this study therefore, is to evaluate the response of two okra cultivars to nitrogen fertilization in Buea. Synchronizing crop cultivar and balance nitrogen supply will increase yield of okra thereby increase the net profit of stakes holders. This study was conducted at the Teaching and Research Farms of the Faculty of Agriculture of the University of Buea in 2022. The experiment was a split plot design with four replications. Treatments were combinations of five nitrogen levels (0 kg N/ha, 50 kg N/ha, 100 kg N/ha, 150 kg N/ha and 200 kg N/ha) and two okra cultivars (Kirikou F1 and Hire). Data for growth and yield parameters were collected fortnightly and analyzed using SPSS (ver.25) and ANOVA. Also, disease incidence was calculated based on symptoms expression on plants. Disease analysis was descriptive. Results showed significant difference in growth and yield parameters for the two cultivars. Nitrogen levels caused significant variations in plant height, numbers of leaves, number of fruits and yield of to 3.5 t/ha was observed with the application of 150 to 200 kgN/ha with Kirikou F1 cultivar ($P < 0.05$). Diseases symptoms on okra include mosaic, chlorosis, blight, leaf spot, stunting, yellowing and browning. Growth and yield parameters increased with the application of nitrogen fertilizer. Rate of 150 kg N/ha is recommended for optimum growth and yield of okra.

Keywords

Okra, Varieties, Nitrogen, Levels, Growth, Yield, Disease Symptoms

1. Introduction

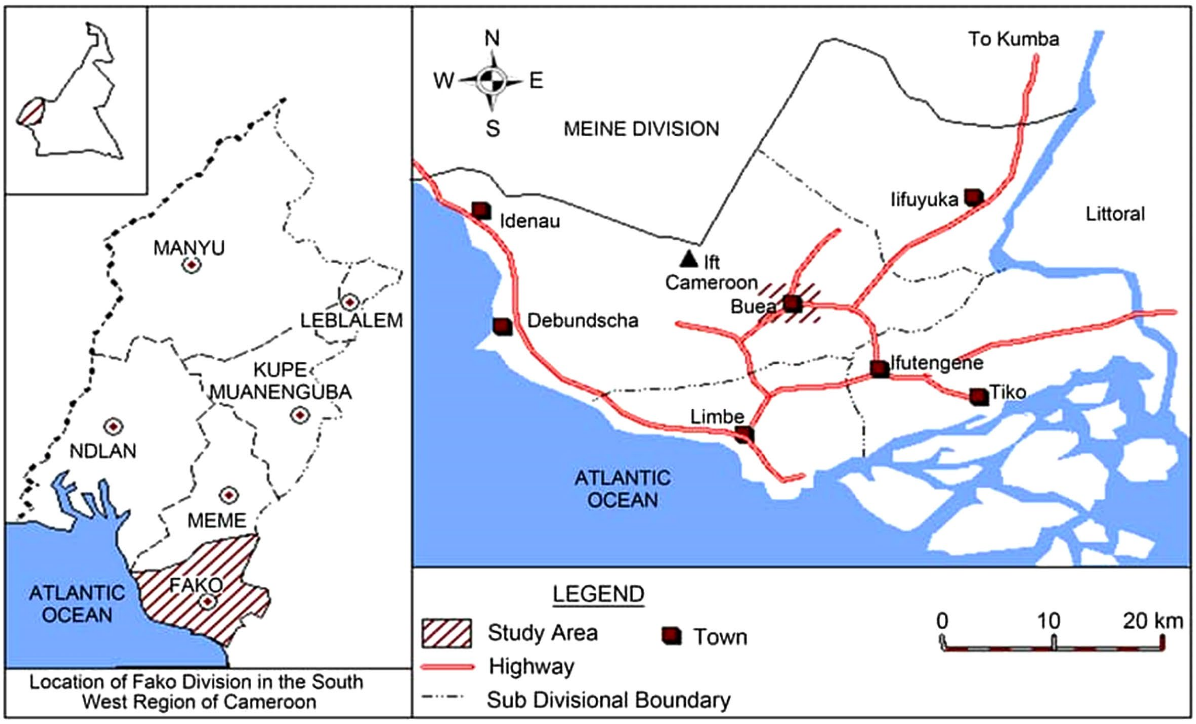
Okra, (*Abelmoschus esculentus* (L.)) Moench originates in Asia and Africa. It is a monoecious perennial often cultivated as an annual crop from the malvaceae which has about 2300 species including cotton (*Gossypium* sp.) and cocoa (*Theobroma cacao*) [1]. 100 g of edible portion of this fruit vegetable contains: Calcium 66.0 mg, Iron 0.35 mg, Potassium 103.0 mg, Phosphorus 56.0 mg, Magnesium 53.0 mg, Sulphur 30.0 mg, Copper 0.19 mg and Sodium 6.9v and vitamins such as: Riboflavin 0.01 mg, Thiamine 0.07 mg, Nicotinic acid 0.06 mg, Vitamin C 13.10 mg, and Oxalic acid 8.0 mg [2]. The fruits are used in the preparation of soups and stews. The ripe seeds of this crop are roasted, ground and used as a substitute for coffee in some countries. Mature fruits and stems containing crude fiber are used in the paper industry. Extracts from the seeds of the crop is an alternative source for edible oil. Industrially, okra mucilage is used for glace paper production and also used as confectionery. Medicinally, this crop helps in plasma replacement or blood volume expander [3]. Its consumption helps the body develop immunity against infectious agents, reduces episodes of cold and cough and protects the body from harmful free radicals [4]. The global area under okra cultivation is reported to be 1148.3 thousand hectares producing 7896.3 tons with India the world's leading producer with 5,507,000 tons from 485,000 hectares while production in Cameroon is 90,780 tons from 33,377 hectares [5].

Yield of 11 tons per hectare can be obtained with a combination of nitrogen, phosphorus and potassium at the rate of 120, 90, 60 kg per hectare [6]. Unfortunately yield per hectare in Buea, is far lower than the estimated productivity. This is due to the use of inadequate planting materials and unbalance use of nitrogen fertilizer which is an important determinant to growth and development of okra [6]. Okra is a fruit vegetable, phosphorus and potassium can influence fruiting and development of fruits but nitrogen plays an important role in chlorophyll, protein, nucleic acid, hormone and vitamin synthesis and also helps in cell division and elongation. Several works have reported linear increase in green pod and yield of okra with the application of nitrogen from 50 to 150 kg/ha [7]. Few scanty information that is not properly investigated on application of nitrogen fertilizers on okra production in Buea is available. The objective of this study therefore, is to investigate the response of okra cultivars to nitrogen fertilization in Buea.

2. Methodology

2.1. Study Site

Field trial was carried out at the Teaching and Research Farms of the Faculty of Agriculture and Veterinary Medicine of the University of Buea. It is located at latitudes 4.1481733N and longitude 9.2794433E and has an elevation of 870 m above sea level [8]. This area is geographically bounded to the North by the tropical rainforest at the foot of Mount Cameroon, to the South-west by Limbe, to the South-east by Tiko, to the East by Muyuka and to the West by Idenau. Buea falls within the humid forest agroecological zone, with mono-modal rainfall pattern [9]. This study area (**Figure 1**) has a humid tropical climate with an average annual rainfall of 3000 to 5000 mm per year, relative humidity of 80% to 85% and a mean annual temperature of 28˚C. Rainy season is from March to October with heavy rainfall between June and August while the dry season starts from November to February. Soil type is derived from weathered volcanic rocks dominated by clay, sand and silt [8].



Source: Lewis Dopgima Levai, 2016.

Figure 1. Location of study area.

2.2. Soil Characteristics

Current analysis of the experimental field at 0 - 20 cm depth reveals a silty clay loam, and clay loam at 20 - 40 cm depth (**Table 1**). The soil chemical properties at 0 - 20 cm and 20 - 40 cm depths both had the same pH values 4.9 in H_2O; potassium is 0.632 and 0.411 cmol·kg^{-1} at 0 - 20 cm and 20 - 40 cm depth, respectively (**Table 2**). The organic carbon content 1.76% was higher at the depth of 20 - 40 cm, compared to that of 0 - 20 cm (0.23%). There was a variation in total Nitrogen (0.268% and 0.196%) between the different soil depths of 0 - 20 cm and 20 - 40 cm respectively. Soils at a depth of 0 - 20 cm had a lower C/N ratio 8.68 compared to C/N ratio 8.97 at a depth of 20 - 40 cm. Calcium was higher in the soils at the depth of 0 - 20 cm (4.62 cmol/kg) compared to the depth of 20 - 40 cm (4.56 cmol/kg). Magnesium was higher at soil depth of 0 - 20 cm (2.85 cmol/ kg) as compared to 20 - 40 cm depth (2.76). Potassium (K^+) in the soil at the depth of 0 - 20 cm (0.632) was higher than that of 20 - 40 cm depth (0.411). Sodium (Na) was higher at the soil depth of 20 - 40 cm (0.07 cmol·kg^{-1}) as compared to 0 - 20 cm depth (0.051 cmol·kg^{-1}). Bray phosphorus was higher at the soil depth 0 - 20 cm (6.448 ug/g) as compared to 20 - 40 cm depth (3.651 ug/g) (Table 1 and Table 2) (Personal communication).

Table 1. Chemical properties of Pre-soil samples collected at a depth of 0 - 20 cm and 20 - 40 cm.

Soil depth (cm)	pH H_2O	Calcium	Magnesium	Potassium	Sodium	Organic carbon	Total nitrogen	Carbon/ Nitrogen	Bray phosphorus
		------------------ cmol·kg^{-1}--------------------				-----------%-----------			mg/kg
0 - 20	4.97	4.62	2.85	0.632	0.051	0.23	0.268	8.68	6.448
20 - 40	4.92	4.52	2.76	0.411	0.07	1.76	0.196	8.98	3.651

Table 2. Physical properties of pre-soil samples collected at a depth of 0 - 20 cm and 20 - 40 cm.

Soil depth (cm)	Sand	Clay	Silt
		-------------%-----------------	
0 - 20	27.46	45.26	27.28
20 - 40	21.54	55.26	23.21

2.3. Treatments and Experimental Design

The treatments were combinations of 5 nitrogen rates (0 kg N/ha, 50 kg N/ha, 100 kg N/ha, 150 kg N/ha and 200 kg /N/ha) and 2 okra cultivars (Kirikou F1 and Hire). The experiment was a split plot design with modalities randomized with main plots for cultivars (Kirikou F1 and Hire) and sub-plots for nitrogen levels (0 kg/ha, 50 kg/ha, 100 kg/ha, 150 kg/ha and 200 kg/ha) with 4 replications. The different modalities on each plot were randomized using random number table and the treatments replicated 4 times while a distance of 1 m was provided all-round the experimental unit (Figure 2). Quantity of urea applied to the different treatments are shown in Table 3.

Table 3. Quantity of urea applied on okra for the different treatments.

SN	Experimental nitrogen rates	Corresponding quantity of urea per experimental unit of 10 m^2	Corresponding quantity of urea per ha
1	0 kg/ha	0.0 g	0.0 kg/ha
2	50 kg/ha	108.5 g	108.5 kg/ha
3	100 kg/ha	217.0 g	217.0 kg/ha
4	150 kg/ha	325.5 g	325.5 kg/ha
5	200 kg/ha	434.0 g	434.0 kg/ha

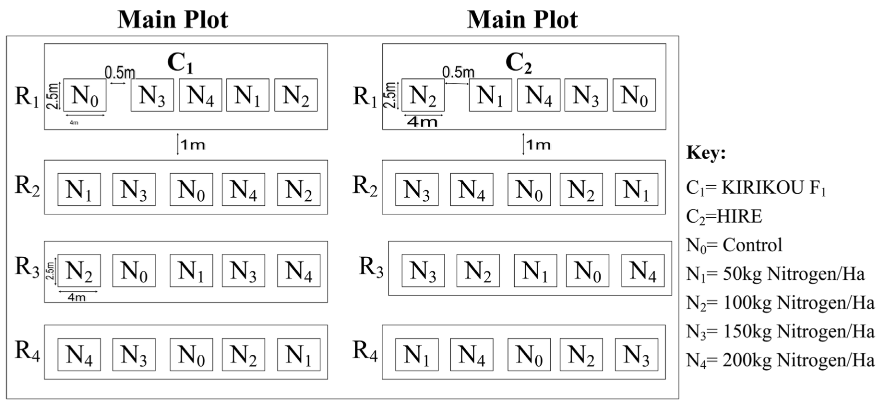


Figure 2. Split Plot design.

2.4. Land Preparation and Maintenance Operations

A 600 m^2 was cleared and plot sizes of 4 m × 2.5 m were constructed. Distances within the plots was 50 cm to minimized variation within blocks and 100 cm between blocks to maximized variation.

A pre-germination test was carried out two weeks before planting and on planting, seeds were soaked in clean tap water for 24 hours to achieve uniform germination. Two seeds per stand were sown at 0.75 m × 0.75 m spacing with a seeding depth of 2 cm to 3 cm. After seedlings emergence thinning was done to one plant per stand and weeding manually every two weeks. For plots receiving 50 and 100 kg N/ha, urea was applied 3 weeks after planting using ring application method. Plots receiving 150 and 200 kg N/ha, the application was done twice using the same application method. Phosphorus and potassium were equally applied at the rate of 80 and 60 kg /ha respectively.

Disease symptom types was recorded on the two cultivars fortnightly until flowering.

2.5. Data Collection

Five plants were randomly selected from middle rows in each plot and tagged for determination growth and yield parameter at two weeks intervals until maturity. For plant height, measurement was done at ground level to the terminal bud of the plant using a meter rule calibrated in cm. Number of fully opened leaves from the lower stem to the top of the plant were counted and recorded. Leaf area was obtained with the use of a meter rule, positioned at three different points in the middle of the broadest leaf to the edge, to get an average and using the formula, estimated leaf area = πr^2. Number of fruits per plant were counted on tagged plants. Fresh fruit weight per unit area was done by adding the total number of harvested fruits on each plot from week 8 to 12 and the information collected was converted to tons per ha.

2.6. Disease Observation

Plants were observed fortnightly, a week after planting for disease symptoms like chlorosis, mosaic, leaf spot, blight, stunting, vein clearing and yellowing. Disease Incidence for each symptom was calculated according to Oben *et al.,* 2021.

$$\text{Disease incidence} = \frac{\text{number of plants showing symptoms of diseases}}{\text{total number of plants}} \times 100 \quad (1)$$

2.7. Statistical Analysis

All data sets were analysed using SPSS (ver.25), while Microsoft Excel was used to create graphs and tables. The dependent variables (vegetative and yield parameters) were subjected to a factorial analysis of variance (ANOVA, $P < 0.05$) to test the effect of treatments and to determine the degree of interaction between independent variables. Significant means were further separated by posthoc Tukey's HSD Test ($P < 0.05$). Evaluation of diseases on plants was done using descriptive analysis.

3. Result

3.1. Germination Percentage

Result of the germination percentage is presented on (**Table 4**). Kirikou F1 had a higher germination percentage when compared to Hire (89.6% against 74.2%).

Table 4. Percentage germination of okra cultivars.

Variety	Kirikou f1	Hire
Germination (%)	89.6	74.2

3.2. Vegetative Growth Parameters

3.2.1. Plant Height

The effect of nitrogen rate on plant height of okra cultivars is presented on **Table 5**. Plant height ranged from 3.6 to 57.46 cm across nitrogen fertilizer rates with a significant difference noticed at week 6 and 8. Also, higher plant height (57.46 cm) was obtained with cultivar Kirikou F1 where 200 kg N/ha was applied.

Table 5. Mean plant height response to two okra cultivars under 5 nitrogen fertilizer rates.

Period of Observation	Nitrogen rates					
	cultivars	0 kgN/ha	50 kgN/ha	100 kgN/ha	150 kgN/ha	200 kgN/ha
WEEK 2	Kirikou F1	5.95 ± 2.61aA	5.83 ± 2.36aA	6.29 ± 2.69aA	4.34 ± 1.35aA	5.06 ± 2.90aA
	Hire	4.55 ± 0.84abB	3.65 ± 0.43bA	4.21 ± 1.09abA	5.39 ± 0.55aA	4.82 ± 0.57abA
WEEK 4	Kirikou F1	17.00 ± 3.05aA	20.44 ± 3.14aA	19.26 ± 1.00aA	19.54 ± 1.31aA	21.48 ± 1.93aA
	Hire	17.03 ± 2.81aA	19.16 ± 3.45aA	17.68 ± 1.38aA	18.15 ± 0.67aA	18.90 ± 0.77aB
WEEK 6	Kirikou F1	26.25 ± 8.57bA	.29.25 ± 5.19abA	26.45 ± 8.47bA	33.88 ± 4.62abA	44.10 ± 9.34aA
	Hire	18.49 ± 5.58cA	24.76 ± 1.39bcA	27.21 ± 4.93abA	29.33 ± 3.88abA	33.52 ± 3.03aA
WEEK 8	Kirikou F1	27.22 ± 7.32bA	31.61 ± 4.78bA	36.80 ± 3.96bA	50.98 ± 7.39aA	57.46 ± 4.85aA
	Hire	19.34 ± 4.57dA	27.14 ± 0.98cA	31.08 ± 2.68cB	35.94 ± 0.40bB	44.94 ± 1.35aB

Means within rows with the same lower-case letters are not significantly different at Turkey's HSD, $P < 0.05$; means within columns with the same upper-case letters within the same period of observation are not significantly different.

3.2.2. Number of Leaves

The effect of nitrogen rate on the number of leaves of okra cultivars is presented on Table 6. Number of leaves ranged from 4 to 10 across nitrogen fertilizer rates with a significant different on both cultivars at week 2, 4 and 6 where nitrogen was applied at the rate of 50,100 and 150 kgN/ha respectively. Both Kirikou F1 and Hire produced the highest number of leaves (10) at week 6 and 8 with the nitrogen application of 150 kgN/ha and 200 kgN/ha respectively.

Table 6. Mean Number of leaves response to two okra cultivars under 5 nitrogen fertilizer rates.

Period of observation		Nitrogen rates				
		0 kgN/ha	50 kgN/ha	100 kgN/ha	150 kgN/ha	200 kgN/ha
WEEK 2	Kirikou F1	4 ± 0.91aA	4 ± 1.15aA	5 ± 0.86aA	4 ± 0.46aB	4 ± 1.18aB
	Hire	4 ± 0.47aB	4 ± 0.56aB	4 ± 0.85aB	4 ± 0.16aA	4 ± 0.63aA
WEEK 4	Kirikou F1	5 ± 1.10aA	6 ± 1.10aA	6 ± 0.87aA	6 ± 1.06aA	7 ± 1.04aA
	Hire	5 ± 0.82aA	6 ± 0.20aB	5 ± 0.68aB	6 ± 0.09aB	6 ± 0.43aB
WEEK 6	Kirikou F1	7 ± 0.80bA	8 ± 1.20abA	7 ± 1.31bA	9 ± 0.65abA	10 ± 1.26aA
	Hire	6 ± 1.18bA	7 ± 0.41abB	7 ± 0.85abA	8 ± 0.89abB	9 ± 0.83aA
WEEK 8	Kirikou F1	7 ± 0.41bA	9 ± 1.06abA	9 ± 1.09abA	10 ± 0.68aA	10 ± 0.93aA
	Hire	7 ± 0.72cA	9 ± 0.53bA	9 ± 0.62bA	9 ± 0.28bB	10 ± 0.30aA

Means within rows with the same lower-case letters are not significantly different at Turkey's HSD, $P < 0.05$; means within columns with the same upper-case letters within the same period of observation are not significantly different.

3.2.3. Leaf Area

The effect of nitrogen rate on leaf area of okra cultivars is presented on Table 7. Leaf area ranged from 13.30 to 456.25 cm^2 across nitrogen fertilizer rates and cultivars. A significant difference was observed at week 8 with the application of 50, 100, 150 kgN/ha.

Table 7. Mean Leaf area response to two okra cultivars under 5 nitrogen fertilizer rates.

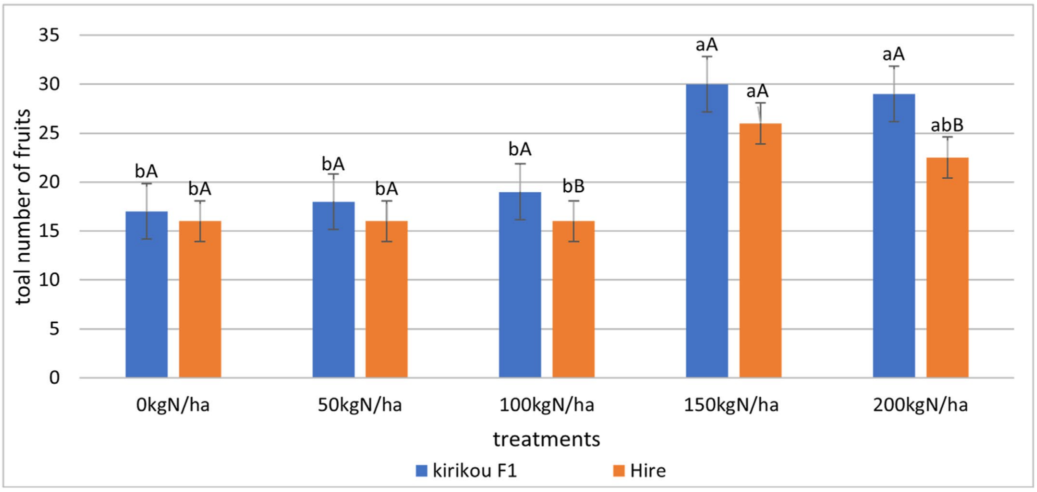
		Nitrogen rates				
Period of observation	Cultivars	0 kgN/ha	50 kgN/ha	100 kgN/ha	150 kgN/ha	200 kgN/ha
WEEK 2	Kirikou F1	24.73 ± 13.33aA	28.75 ± 18.26aA	25.95 ± 11.25aA	17.51 ± 5.11aA	31.26 ± 30.80aA
	Hire	17.05 ± 4.56aA	13.30 ± 3.32aA	16.16 ± 7.36aA	17.18 ± 1.67aA	23.77 ± 15.22aA
WEEK 4	Kirikou F1	181.97 ± 82.77aA	261.53 ± 85.78aA	286.96 ± 53.79aA	248.00 ± 66.43aA	286.01 ± 76.90aA
	Hire	188.00 ± 81.07aA	219.53 ± 82.90aA	227.77 ± 60.58aA	253.28 ± 24.61aA	224.21 ± 35.26aA
WEEK 6	Kirikou F1	241.76 ± 92.18aA	347.16 ± 170.73aA	233.71 ± 111.20aA	322.86 ± 58.92aA	301.18 ± 71.51aA
	Hire	184.30 ± 96.69bA	282.12 ± 19.66abA	331.42 ± 126.60abA	239.13 ± 65.08abA	378.42 ± 19.32aA
WEEK 8	Kirikou F1	288.82 ± 86.56aA	317.96 ± 26.71aA	297.44 ± 115.94aA	416.07 ± 19.76aA	406.73 ± 85.73aA
	Hire	202.16 ± 93.86bA	365.20 ± 52.44abA	417.72 ± 135.69aA	303.58 ± 59.96abA	456.25 ± 19.95aA

Means within rows with the same lower-case letters are not significantly different at Turkey's HSD, $P < 0.05$; means within columns with the same upper-case letters within the same period of observation are not significantly different.

3.3. Yield Parameters

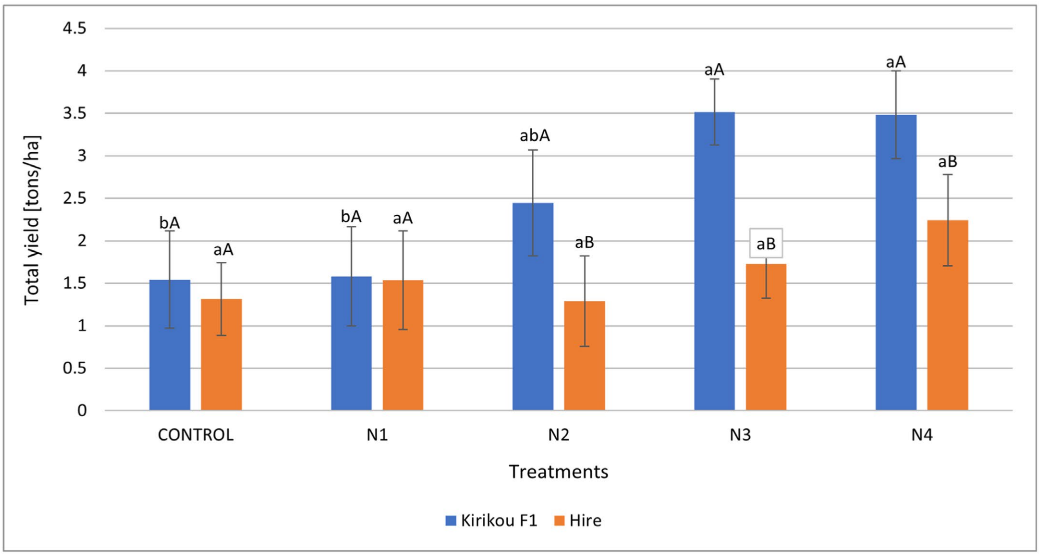
3.3.1. Number of Fruits

The comparative evaluation of the effect of nitrogen rates on the number of fruits is presented in Figure 3. It revealed significant variation that ranged from 16 to 30 fruits across cultivars with application 100 and 200 kg N/ha ($P < 0.05$). The rate 150 kg N/ha produced the highest number of fruits (30) with Kirikou F1 cultivar.



Bars with different lowercase letters across varieties are significantly different (Tukey's HSD, $P < 0.05$). Bars with different uppercase letters across nitrogen rates are significantly different (Tukey's HSD, $P < 0.05$).

Figure 3. Effect of nitrogen rates on the number of fruits of two okra cultivars.



Bars with different lowercase letters across varieties are significantly different (Tukey's HSD, $P < 0.05$). Bars with different uppercase letters across nitrogen rates are significantly different (Tukey's HSD, $P < 0.05$).

Figure 4. Effect of nitrogen rates on the total yield of two okra cultivars.

3.3.2. Yield in Tons/Ha

The comparative evaluation of the effect of five nitrogen levels and two okra cultivars on the total yield per hectare is shown in Figure 4 and revealed significant variation ($P < 0.05$) which ranged from 1.3 to 3.5 t/ha across treatment. For nitrogen rate comparison a significant difference was observed with the application of 100, 150 and 200 kg N/ha. The yields of the two cultivars were significantly different where 0, 50 and 100 kg N/ha were applied. However, the highest yield of 3.5 t/ha was obtained with Kirikou F1 with the application of 150 and 200 kg N/ha respectively.

3.3.3. Disease Observation

Foliar and stem symptoms observed on leaves were yellowish spots with central brownish points that enlarge to dark brown spots, browning of the leaflets spreading from the leaf tip with sharply defined boundaries between healthy and disease tissues; yellowing and browning discoloration of leaf in the middle of crown that spread to neighboring leaves; these symptoms are categorized as mosaic, chlorosis, blight according to Nordam [10] (**Figure 5**). Generally, disease incidence was lower for Kirikou F1 cultivar (6.2%) when compared to Hire (12%) (**Table 8**). More plants expressed symptoms of mosaic disease (29 plants) more than the other symptoms.

Table 8. Symptoms type observed for Kirikou F1 and Hire okra plants.

Disease symptoms	Total number of plants	Total number of symptomatic plants	Kirikou F1	Hire	Incidence Kirikou F1 (%)	Incidence Hire (%)
Blight	360	16	7	9	1.9%	2.5%
Chlorosis	360	14	3	11	0.8%	3%
Mosaic	360	29	11	18	3%	5%
Others (browning, yellowing and stunting)	360	9	2	5	0.5%	1.4%
Total	360	68	23	43	6.2%	12%

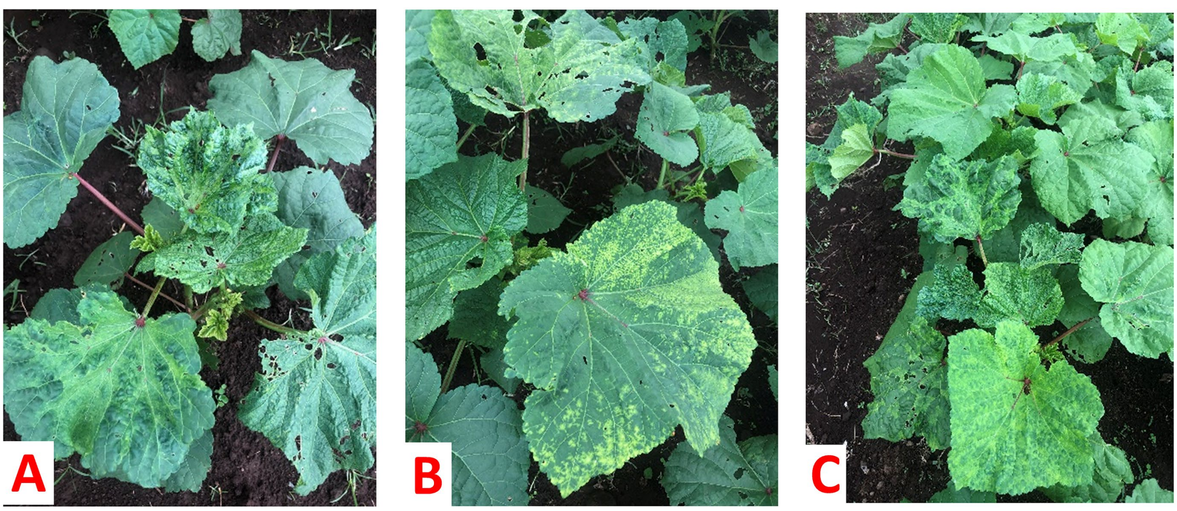


Figure 5. Okra plant showing symptoms of: (A) = stunting/leaf distortion; (B) = mosaic; (C) = completely mishappen plants.

4. Discussion

The result of this study indicated that the application of nitrogen fertilizer at different levels at a certain stage of growth significantly increased plant height, number of leaves and leaf area of okra. The higher dose of 200 kg N/ha significantly increase plant height and number of leaves this might be due to an increase in cell division and formation of more tissues resulting in luxuriant vegetative growth. Increase in plant height with an increase in nitrogen rates occurred due to the absorption of this nutrient in larger quantities by the crop. Souza *et al.* [11], explained that nitrogen is a fundamental constituent of protoplasm, and chlorophyll during the process of photosynthesis. This author further reiterates that, when nitrogen is applied in adequate amounts, it promotes significant increases in the stages of growth and development of plants, as they participate in their metabolism through enzymes, amino acids, proteins, pigments and nucleic acids.

Among the various level of nitrogen fertilizer, 200 kg N/ha showed overall good results on the growth attributes of the two cultivars of okra under the prevailing conditions of Buea municipality. These results reinforce the importance of N for plant growth and development, as this nutrient is required for the synthesis of several cellular components, especially for chlorophyll molecule and ribulose-1,5-biphosphate carboxylase oxygenase (Rubisco), which are responsible for CO2 assimilation during the photochemical and biochemical phases of photosynthesis [11]. Medeiros *et al.* [12] also reported a significant response of okra leaf area with N fertilization. Other authors like, Souza *et al.* [11], observed positive responses of N fertilization on the plant height and leaf area of several vegetable crop including okra. The maximum Rate of 200 kg N/ha promoted greater cell division and the formation of more tissues, which resulted in greater leaf expansion, increase in the root system, and the relationship between the leaf area and photosynthesis, which consequently influence fruit production [7].

Results for the number of fruits per plot for both cultivars showed that there was an increased in number of fruits at each harvest with an increase in fertilizer rates. These results are similar to those obtained by Oliveira *et al.* [13] in the okra culture of Santa Cruz. 50 fruits per plot was observed with Kirikou F1 at the first harvest with the maximum application of 150 kg N/ha. A decreased in number of fruits from week 10 was observed probably due to the senescence of the crop. Firoz observed a linear increase in the number of fruits of okra, finding a higher value (40 fruits) with the maximum Rate of 120 kg N/ha [6]. Regarding the yield, maximum yield of 3.5 t/ha was observed with kirikou F1 with the application of 150 to 200 kg N/ha. The values verified by Oliveira *et al.* [14] with the okra cultivar Santa Cruz was lower to that of the present work. This author found 2 t/ha with a Rate of 150 kg N/ha. The results observed by Cardoso and Bernin [15] with okra cultivar Dardo were much higher than those found in this study. These authors verified 4.5 t/ha, applying the rate of 120 kg N/ha. This great difference observed between the production is probably related to the genetic characteristics of each cultivar use in the experiment, besides the soil conditions of the of each experimental site, since the work of the authors was not conducted in the same locality as the one of this study. Okra is pruned to several diseases and nitrogen application significantly impact plant diseases, generally increase plant disease incidence and severity for many pathogens but Kirikou F1 was less infected than Hire this explained the higher tolerance of the former cultivar from the later [16] [17].

5. Conclusions & Recommendations

This study has demonstrated that Kirikou F1 cultivars recorded optimal vigour and yield and was the most adaptable cultivar in term of growth and yield due to its genetic potential. The application of nitrogen resulted in increased plant height, number of leaves, fruit size, number of fruits per plant, fruit weight and yield/ha. Among the various rates of nitrogen, 150 kg N/ha showed overall good result; with the highest economic viable yield that cannot cause harm to the environment.

The choice of cultivars and adequate soil fertility are critical to healthy and vigorous plants, especially for maintaining high levels of production. It is therefore recommended that to increase production of okra in Buea, farmers should plant Kirikou F1 cultivar because of its availability, genetic potential and resistance to pest and diseases equally, nitrogen should be applied at the rate of 150 kg/ha to achieve optimum yield.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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