



**COMPARATIVE EFFECT OF SELECTED BIO AND MINERAL FERTILIZERS ON  
THE GROWTH AND YIELD COMPONENTS OF TWO MAIZE CULTIVARS IN  
ALFISOLS OF SOUTHWESTERN NIGERIA**

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**ABSTRACT**

Field studies were carried out at the Teaching and Research Farm of Joseph Ayo Babalola University, Ikeji-Arakeji, Osun State, Nigeria, to compare the effect of selected biofertilizers and NPK 15:15:15 fertilizer on growth and yield components of two maize cultivars during 2022 rainy and dry seasons. The treatments consisted of three (3) biofertilizers (*Pseudomonas* (P), *Nitrobacter* (N), and *Klesbisiella* (K) at 40 and 50L/ha), NPK 15:15:15 fertilizer (at 250 kg/ha) and a control (CT). The plot of 5m x 5m was used with an alleyway of 0.5m and arranged in a randomized complete block design (RCBD) with four replications. The growth parameters were collected at 50% flowering while the yield parameters were determined at the maturity stage. Both varieties demonstrated reduced growth parameters during the dry seasons compared to the rainy seasons. The overall performance gap between the two varieties remained relatively small across both seasons. SAMAZ-52 had a slight advantage over OBA, but OBA could also perform adequately under varying conditions. In nutrient uptake, all the treatments significantly ( $P < 0.05$ ) increased N, P except K40 and N40, Ca except K40, Mg, Mn, Fe, Cu, and Zn compared with control. SAMAZ significantly increased ( $P < 0.05$ ) N, P, K, and Ca except P50, Mg except K50, NPK and P40, Mn, Fe, and Zn except N50. The increase in grain yield compared with control in OBA Super was 36% for K50, 41% for NPK, 38% for P50, 26% for K40, 33% for N50, 24% for P40, and 38% for N40, while SAMAZ cultivar recorded 37% for K50, 48% for NPK, 40% for P50, 30% for K40, 35% for N50, 36% for P40, and 40% for N40 indicating that *Pseudomonas*, *Nitrobacter* and *Klesbisiella* could be used to increase maize especially SAMAZ-52 variety production in southwestern Nigeria especially P50.

**Keywords:** *Pseudomonas*, *Nitrobacter*, *Klesbisiella*, Fertilizer, Season

**INTRODUCTION**

Presently, organic and chemical fertilizers are the major nutrient management methods for increasing crop productivity (Raman *et al.*, 2018). Organic fertilizers have been used for centuries for improving plant productivity. However, challenges bordering on availability, cost, and management have limited the use of organic fertilizers amongst African farmers. Chemical fertilizers are costly, unsustainable and contribute to environmental pollution and soil structure degradation (Makinde *et al.*, 2011). The several ecological damages caused by the overuse of chemical fertilizers have become increasingly uncontrollable and most times, irreversible, causing significant nutrient loss to African soils. Moreover, the demand for green agriculture and high-quality food supply has suggested a shift or, at least, a reduction in the application of agrochemical inputs. Consequently, the search for an economical, eco-friendly, and sustainable solution for improving plant growth and yield has led to the discovery and use of biofertilizers as an alternative (Makinde *et al.*, 2011, Ayeni *et al.*, 2020). Biofertilizers are biologically active formulations comprising beneficial live microbes in economical carrier materials, which when applied to the soil, plant, and seed improve plant growth and development by enhancing the supply of plant growth-promoting substances or nutrients (Ayeni, 2020). Biofertilizers promote plant growth by improving soil nutrient content. Some of the



biofertilizers can fix nitrogen, solubilize organic and inorganic nutrients such as phosphorus and enhance plant nutrition by establishing symbiotic relationships. The application of biofertilizers is known to impact soil microbial community diversity, which in turn influence the complex microbiome of plants. Biofertilizers is also known to affect the soil physicochemical properties, including soil pH, soil texture, and organic matter, which greatly influence plant growth and development. The groups of microbes mostly used for inoculant production are the arbuscular mycorrhizal (AM) fungi, plant growth-promoting rhizobacteria and nitrogen-fixing rhizobia. (Awodun, 2008) The genera *Gigaspora*, *Glomus*, *Bacillus*, *Pseudomonas*, *Azotobacter*, *Azospirillum*, *Bradyrhizobium* and *Rhizobium*, are commonly used for inoculant formulation (Akinola *et al.*, 2022). These microbes play essential roles in soil ecosystem functions such as restoring and preserving soil nutrient richness. The main and direct purposes of applying biofertilizers to soil are to provide nutrient sources and good soil conditions for the growths of crops when used as a live body; to partially substitute and enhance the function of chemical fertilizer and then subdue the application quantities of fertilizers and still maintain the SAMAZ crop yields and the capital used for making biofertilizers is cheaper than that of chemical fertilizers and to lessen the negative effect aroused from applying chemical fertilizers to soil. Hence, the objective of this study was to determine the effects of biofertilizer types on growth and yield of OBA Super and SAMAZ cultivars of maize.

## **MATERIAL AND METHOD**

### **The Study Location**

The field study was carried out in the Teaching and Research Farms of Joseph Ayo Babalola University, Ikeji-Arakeji, Osun State, Nigeria. The university is located between latitudes 07°18'N and longitudes 05°09' and 05°11'E. The study area is situated in the tropical forest zone of Nigeria. It has an annual average rainfall of between 1500 and 1800 and a relative humidity of between 80 and 85% annually. The vegetation of the area was originally classified as a lowland rainforest (Hapstead, 1974). The site was dominated with shrubs such as *Chromolaena odorata*, *Tithonia diversifolia*, and *Aspilia Africana*.

### **Treatment and Experimental Design**

The treatments consisted of three (3) biofertilizers (*Pseudomonas* (P), *Nitrobacter* (N), and *Klebsiella* (K) at 40 and 50L/ha), NPK 15:15:15 fertilizer (at 250 kg/ha) and a control (CT). The plot of 5m x 5m was used with an alleyway of 0.5m and arranged in a randomized complete block design (RCBD) with four replications. A 30m x 42m land size was used for the experiment. There were eight treatments replicated four times, making a total of 32 plots. The site was cleared of all debris and weeds manually. The plots were uniformly ploughed and harrowed in April 2022.

### **Sources of Planting Materials and Inoculum**

The seeds of two maize varieties were acquired from Premiere Seed Company, Dugbe Ibadan, Southwestern Nigeria. SAMAZ-2 and OBA Super 6 maize varieties were used as test crops. The inoculants used as Treatments were *Klebsiella*, *Pseudomonas*, and *Nitrosomonas*. Seed inoculation with *Klebsiella*, *Pseudomonas*, and *Nitrosomonas* was carried out by using a 10% sugar solution carrier. The sugar solution was prepared by adding 100 g of sugar in 1 liter of water and boiled. After cooling the solution, maize seeds were put in the solution pot and taken out, and the inoculants were thoroughly mixed with the maize seeds and kept in a shade before planting.

### **Planting of Test Crop**

Planting was done after 24 hours of inoculation of maize seeds with biofertilizers. The seeds were re-picked for effective germination. Two seeds were planted per hole at a spacing of 25 cm x 75 cm. Supplying was done two (2) weeks after planting. Maize Seedlings were thinned to one (1) plant per hole, which resulted in a plant population of 53,333 plants/ha.

### **Crop Management**

Weeding was carried out three times manually using hoe at three weeks intervals during the cropping season. There were manifestations of fall armyworm. At three (3) weeks after germination, sharp shooter+DD force insecticides were applied at 50 mL/15 liters of water to prevent full-blown invasion.



N.P.K 15:15:15 fertilizer was applied at two (2) weeks after planting using the ring method of application at a distance of 5 cm radius away from the plant root.

#### **Data Collection**

The growth parameters collected were plant height, stem girth, number of leaves, and leaf area. This was done at 50% flowering. Five (5) maize plants were selected at random from each plot and tagged for growth.

Data for yield and yield components were collected at maturity. Parameters such as fresh root biomass (FTB), dry root biomass (DRB), fresh stem biomass (FST), dry stem biomass (DST), total fresh biomass husked (TFBH), ear weight (EA), dehusked ear weight (DEW), ear diameter (ED), ear length (EL), number of teeth (NT), and weight of 1000 dry grains.

#### **Data Analysis**

The collected data were subjected to Analysis of Variance (ANOVA) at 5% probability using Genstat statistical package and means were separated using Duncan's Multiple Range Test. (DMRT).

### **RESULTS**

The effect of biofertilizer types and NPK 15:15:15 fertilizer on the growth parameter of OBA Super and the SAMAZ variety of maize grown during the wet season is shown in Table 1. Relative to control, application of NPK 15:15:15 (NPK), Klebsiella applied at 50 ml (K50) and 40 ml (K40), Nitrosomonas applied at 50 (N50) significantly increased ( $P>0.05$ ) plant height, stem diameter, and leaf area of OBA Super maize variety (Table 2). All the treatments applied to SAMAZ variety of maize significantly increased plant height (except N50), stem diameter (except N50 and P50), and number of leaves (except P50 and K50 and leaf area except N50, P50, and K50 compared with control. Generally, the application of N50 and K50 did not have a significant effect on stem diameter, number of leaves, leaf area index, and leaf area of SAMAZ Variety of maize. Application of K50, P50, K40, P40, and N40 compared favorably with NPK to OBA Super in terms of plant height, number of leaves, leaf area index, and leaf area except N50. On SAMAZ variety, K40, P40 and N40 compared favorably with NPK in terms of plant height, stem diameter, number of leaves, leaf area index, and leaf area.



**Table 1:** Effect of Bio and Mineral Fertilizer on Growth Parameters of Maize varieties during Rainy Season

Variety	OBA SUPER					SAMAZ 2				
Parameters Treatments	Plant height (cm)	Stem Number	Number of leaves	Leaf index	Leaf area Cm <sup>2</sup>	Plant height (cm)	Stem Number	Number of leaves	Leaf area index	Leaf area cm <sup>2</sup>
CT	251.99ab	3.58a	14.00a	20.07a	771.69a	227.18ab	3.02ab	12.83c	17.98b	660.97bc
K5O	276.40ab	3.68a	13.83a	21.25a	760.05a	261.31ab	3.65a	13.83ab	20.80ab	773.53a
NPK	192.53a	2.51b	12.00b	16.36bc	496.46b	237.33ab	3.66a	14.00a	19.45ab	740.45ab
P5O	235.94b	3.67a	13.83a	18.87ab	727.99a	228.81a	3.25ab	13.00c	19.03ab	735.58abc
K4O	173.96c	2.48b	11.50bc	15.26c	498.56b	270.67a	3.64a	14.00a	20.18a	721.86abc
N5O	277.59a	3.74a	13.83a	20.69a	783.50a	267.74ab	3.54a	14.00a	20.50a	762.67a
P4O	182.66c	3.59a	11.33bc	14.81c	485.26b	251.51ab	3.62a	14.00a	19.79ab	707.12abc
N4O	168.29a	2.49b	11.17c	14.58c	455.99b	218.39b	3.26ab	13.17bc	17.92b	646.12c
LS	<u>0.001</u>	<u>0.003</u>	<u>0.001</u>	<u>0.00</u>	<u>0.008</u>	<u>0.002</u>	<u>0.008</u>	<u>0.002</u>	<u>0.003</u>	<u>0.002</u>
SE±	16.21	0.21	0.46	0.99	52.78	7.08	0.09	0.18	0.38	16.06

Means with the same superscript along the same column are not significantly different ( $P>0.05$ ) based on Duncan's Multiple Range Test (DMRT)



The dry season production of OBA Super and SAMAZ varieties as affected by the application of biofertilizer types and NPK is shown in Table 3 below. The application of K50, K40, N50, and P40 to OBA Super significantly increased ( $P>0.05$ ) plant height while all the treatments significantly increased stem diameter, number of leaves, and leaf index except P40, leaf area except N40 compared with control. On SAMAZ maize variety, K50, P50, and N50 significantly increased plant height and stem diameter compared with control. Only N50 significantly increased leaf area compared with control. Application of K50, K40, N50 and P40 to OBA Super compared favourably with NPK in relation to plant height stem diameter number of leaves and leaf index (Table 2) during the dry season. On SAMAZ variety, compared with NPK, K50, P50, N50 and control (CT) performed well in term of plant height, stem diameter, number of leaves, leaf index and leaf area. Application of K50 to OBA super variety of maize recorded the highest plant height, stem diameter of leaves and leaf index while CT recorded the lower plant height, stem diameter, leaf index and leaf area. Application of K40 recorded the highest plant height, stem diameter, number of leaves and leaf index while, CT recorded the lowest plant height, stem diameter, leaf index and leaf area.



**Table 2:** Effect of Bio and Mineral Fertilizer on Growth Parameters of Maize Varieties during Dry Season

Variety Parameters Treatments	Plant height	Stem Number	Oba super Number of leaves	Leaf area index	Leaf area	Samaz 2 Plant height	Stem Number	Number of leaves	Leaf area index	Leaf area
CT	187.44b	2.34b	11.67c	15.93b	481.77c	164.91cd	2.34b	11.67b	15.53b	534.82b
K5O	276.16a	3.66a	13.83ab	21.15a	739.35ab	174.95cd	2.34b	11.67b	15.63b	493.03b
NPK	231.11ab	3.69a	13.83ab	19.80a	775.85a	235.86ab	3.43a	13.50ab	19.53a	767.14a
P5O	245.85a	3.18a	13.00b	19.04a	722.68ab	200.78bc	2.73b	11.67b	15.53b	568.03b
K4O	257.03a	3.51a	14.00a	19.23a	770.96a	278.32a	3.62a	14.00a	20.41a	737.04a
N5O	236.54ab	3.28a	13.17ab	18.84a	664.23b	147.23d	2.61b	11.50b	16.62b	478.53b
P4O	251.51ab	3.60a	14.00a	19.08a	744.91ab	260.82a	3.63a	14.00a	20.89a	778.39a
N4O	246.80ab	3.63a	14.00a	19.23a	768.03a	248.13ab	3.61a	14.00a	19.53a	742.25a
LS	<u>0.008</u>	<u>0.002</u>	<u>0.007</u>	<u>0.002</u>	<u>0.001</u>	<u>0.004</u>	<u>0.008</u>	<u>0.003</u>	<u>0.002</u>	<u>0.008</u>
SE±	9.10	0.16	0.29	0.51	34.80	17.19	0.21	0.43	0.83	46.11

Means with the same superscript along the same column are not significantly different ( $p>0.05$ ) based on Duncan's Multiple Range Test (DMRT)





Table 3 shows the agronomic parameters of OBA and SAMAZ maize varieties grown on soil fertilized with biofertilizer types and NPK 15:15:15 fertilizer. Compared with control, K50, P50, and N50 significantly ( $P \leq 0.05$ ) increased the height of the OBA Super variety. Control (CT) competed favorably with K50, P50 and N50 when fertilized in the soil used to grow OBA Super variety in relation to height, plant diameter, leaf index, and leaf area.

Compared with Control (CT), plant height, and plant diameter were significantly increased by the application of K50 and N50 on SAMAZ maize varieties (Table 4). Nitrosomonas applied to SAMAZ maize at 50L recorded the highest leaf area. The experiment performed better than the soils fertilized with biofertilizer types and NPK in relation to the number of leaves, leaf index, and leaf area of SAMAZ variety.

Nitrosomonas applied at 50L recorded the highest plant height, stem diameter, and number of leaves, and leaf area in both OBA Super and SAMAZ varieties compared NPK with biofertilizer types on the growth parameters of SAMAZ variety biofertilizer, such as K50, P50, N50, and CT significantly increased plant height, stem diameter, and number of leaves and leaf area than NPK fertilizer during the second season. SAMAZ variety fertilized with K50 recorded the highest values of plant height, while N40 recorded the least value of plant height. Nitrosomonas applied to SAMAZ variety at N50 recorded the highest value of stem diameter, leaf index, and leaf area, while N40 recorded the least value of stem diameter, number of leaves, leaf index and leaf area.

The effect of biofertilizer types and NPK fertilizer in yield components of SAMAZ maize Variety is shown in Table 4. Compared with control, all the biofertilizer types and NPK fertilizer significantly increased fresh root biomass (FRB), fresh shoot biomass (FSH), dry root biomass (DSB), ear weight husked (EWH), ear weight dehusked (EWD), ear diameter (ED) and ear length (EL). Application of N50 recorded the highest increase in FRB, DRB, FSB, DSB, EWH, EWD, and EL. The SAMAZ variety of maize that was fertilized with K50, P50, K40, N50, P40, and N40 compared favorably with NPK in relation FRB, DRB, FSB, DSB, EWH, ED, and EL. On the effect of biofertilizer types and NPK fertilizer on yield components of OBA Super maize increased FRB, DRB, FSB, and FSB except P40, DSB except significantly EWH, EWD ED and EL except N40.

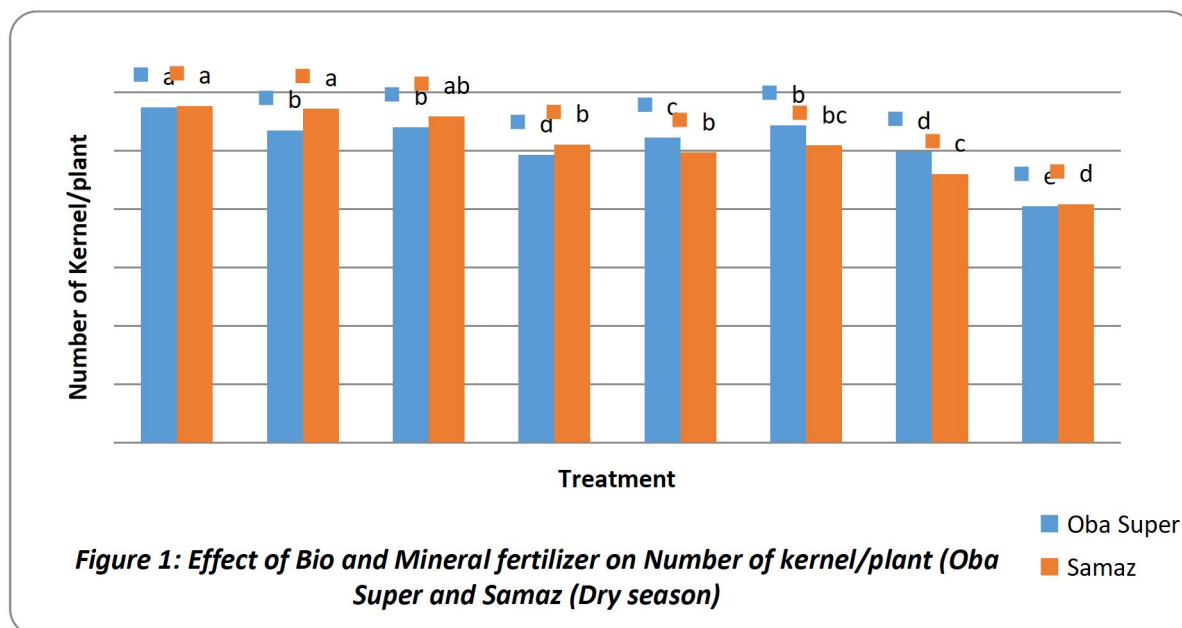
All the biofertilizer types compared favorably with NPK in terms of FRB, DRB, FSB, DSB, EWH, ED, and EL in OBA Super maize variety. NPK Fertilizer recorded the highest FRB, DRB, FSB, DSB, EWH, ED, and EL.

**Table 3. Effect of Bio and Mineral Fertilizers on Yield and Yield Parameters during Dry season of 2022.**

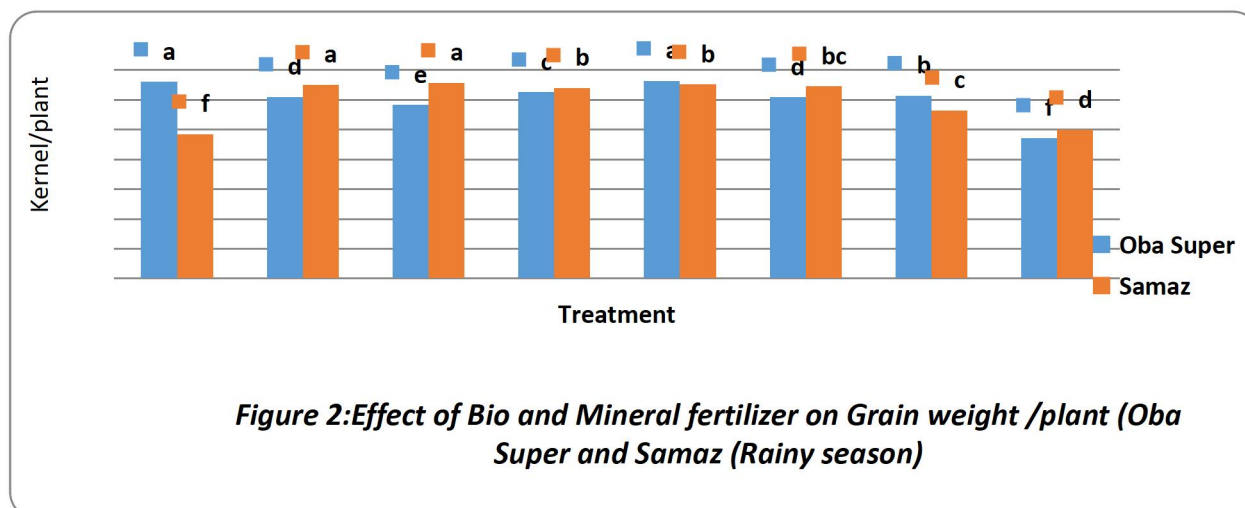
Variety	FRB	DRB	DSB	EWH	EWD	ED	EL
	-----kg-----					-----mm	
CT	2.02c	0.26a	3.15b	2.01e	1.80d	1.10b	16.15d
K50	2.55 <sup>ab</sup>	0.34a	3.80a	2.39bc	2.47abc	1.47a	22.88a
NPK	2.60a	0.36a	3.58ab	2.66a	2.83a	1.72a	22.83a
P50	2.58ab	0.35b	3.47ab	2.67a	2.62ab	1.53a	22.38a
K40	2.43ab	0.33a	3.52ab	2.27cd	2.43bc	1.52a	20.83b
N50	2.38ab	0.32a	3.53ab	2.60ab	2.45abc	1.52a	20.55b
P40	2.32abc	0.26a	3.10b	2.28cd	2.25bc	1.60a	19.12c
N40	2.23bc	0.32a	3.38ab	2.05de	2.13cd	1.57a	18.48c
LS	0.008	0.02	0.001	0.009	0.002	0.05	0.009
SE±	0.07	0.01	0.08	0.09	0.11	0.06	0.84

Means with the same superscript along the same column are not significantly different ( $p > 0.05$ ) based on Duncan's Multiple Range Test (DMRT)

Figures 1, 2, and 3 respectively show the effect of biofertilizer types and NPK on the number of kernels, 1000 GW, and CT in both OBA variety and SAMAZ variety. Compared with control, all the treatments significantly increased the number of kernels per plant in both OBA Super and SAMAZ. Application of K50 to both OBA Super and SAMAZ recorded the highest number of kernels. NPK fertilizer compared favorably with K50 when applied to SAMAZ cultivar while OBA Super was significantly lower than NPK during the dry season (Fig. 1).



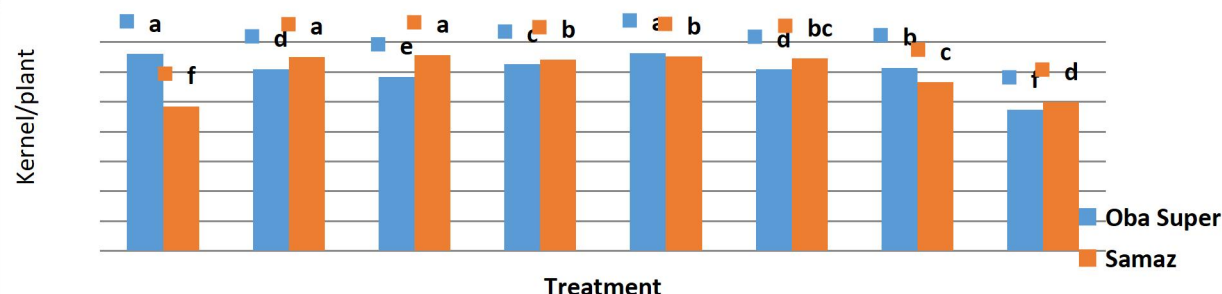
During the rainy season, all the treatments applied to the maize Cultivars were significantly higher than the control. NPK fertilizer recorded lower number of kernels/plant when compared with K50, K40, N50, and N40 when applied to OBA Super, but only P50 compared favorably with NPK in terms of SAMAZ during the dry season (Fig. 2).



Compared with control, all the Treatments significantly increased the yield of maize in both OBA and SAMAZ cultivars. OBA Super that was fertilized with N40 compared favorably with NPK while SAMAZ fertilized with P40 compared favorably with NPK. The cumulative percentage increase in grain yield compared with control in the yield of OBA Super as influenced by biofertilizers and NPK were 36% for K50, 41% for NPK, 38% for P50, 26% for K40, 33% for N50,



24% for P40, and 38% for N40, while SAMAZ cultivar recorded 37% for K50, 48% for NPK, 40% for P50, 30% for K40, 35% for N50, 36% for P40, and 40% for N40 (Fig. 3).



**Figure 2: Effect of Bio and Mineral fertilizer on Grain weight /plant (Oba Super and Samaz (Rainy season))**

The cumulative effect of biofertilizers and NPK on nutrients uptake of OBA Super maize cultivar is shown in Table 4 below. Compared with control, all the treatments significantly increased N, P except K40 and N40, C a except K40, Mg, Mn, Fe, Cu and Zn. The maize that was fertilized with NPK 15:15:15 fertilizer absorbed more N, P and K than the maize fertilized with the biofertilizers under study.

The cumulative effect of the biofertilizer types and NPK on nutrients uptake by SAMAZ is shown in Table 5. Compared with the control, all the treatments significantly increased N,P, K, Ca except P50, Mg except K50, NPK and P40, Mn, Fe and Zn except N50.

**Table 4: Cumulative Effect of Bio and Mineral Fertilizer on Nutrient Uptake of OBA Super Maize Variety**

Treatment	N	P	K	Na	Ca	Mg	Mn	Fe	Cu	Zn
CT	0.35d	0.03c	1.25d	0.27b	0.22d	0.13e	28.25d	165.33d	16.35c	21.73b
K50	1.17a	1.54a	3.60a	0.30d	1.81b	1.23b	63.33a	229.32c	21.86ab	28.20a
NPK	1.28a	2.21a	3.64a	0.47bc	3.03a	1.49a	63.79a	235.83b	24.19a	28.27a
P50	0.51cd	0.10b	1.74bc	0.25d	1.58b	0.48d	49.79bc	279.83a	24.71a	32.86a
K40	0.59c	0.07c	1.83b	0.32cd	0.31d	0.33de	56.28ab	296.69a	23.82ab	31.07a
N50	1.26a	2.07c	3.11a	0.38d	3.91a	1.25b	49.49bc	236.66b	22.24ab	29.53a
P40	1.12a	2.13a	3.02a	0.34cd	2.63a	1.74a	69.71a	285.40a	22.66ab	32.79a
N40	0.87b	0.15b	1.66bc	0.57ab	1.59b	1.18b	50.48bc	232.18b	21.56b	28.62a
LS	0.001	0.001	0.001	0.001	0.002	0.001	0.02	0.05	0.006	0.01
SE±	0.13	0.37	0.34	0.04	0.45	0.21	4.53	14.90	0.92	1.25

Means with the same superscript along the same column are not significantly different ( $p>0.05$ ) based on Duncan's Multiple Range Test (DMRT).

**Table 5: Cumulative Effect of Bio and Mineral Fertilizers Nutrient Uptake of SAMAZ Maize Variety**

Treatment	N	P	K	Na	Ca	Mg	Mn	Fe	Cu	Zn
<b>CT</b>	0.38b	0.01f	1.05c	0.2b	0.2c	0.14b	35.12c	174.00e	18.76a	26.44ab
<b>K50</b>	1.56 <sup>a</sup>	0.12d	1.49b	0.2b	1.26b	0.21b	43.00c	227.00c	20.3a	29.1a
<b>NPK</b>	1.17a	2.11a	3.23a	0.39b	2.90a	1.42a	61.62a	229.36c	24.47a	28.41a
<b>P50</b>	1.58a	1.06b	1.82b	0.24b	0.28c	0.18b	50.71b	247.02b	25.03a	30.25a
<b>K40</b>	1.16a	2.02a	1.92b	0.65a	1.29b	0.97ab	61.29a	315.00a	21.59a	29.3a
<b>N50</b>	1.12a	0.45e	1.99b	0.63a	1.20b	1.01a	52.71b	242.10b	21.73a	25.55b
<b>P40</b>	1.43a	2.27a	1.84b	0.44a	2.74a	0.19b	48.53b	312.62a	23.15a	33.01a
<b>N40</b>	1.30a	2.22a	1.76b	0.51a	2.00a	1.31a	45.62b	218.22d	20.39a	31.09a
<b>LS</b>	0.02	0.002	0.01	0.001	0.05	0.01	0.022	0.03	0.01	0.051
<b>SE</b>	0.13	0.35	0.22	0.06	0.36	0.20	3.17	16.80	0.77	0.85

*Means with the SAMAZ superscript along the SAMAZ column are not significantly different ( $p > 0.05$ ) based on Duncan's Multiple Range Test (DMRT).*

## DISCUSSION

This study presents a comparative analysis of growth and yield parameters between the two maize varieties, viz OBA Super 6 (OBA) and SAMAZ-52 (SAMAZ) over two growing seasons, revealing significant differences in their performance. During the rainy season, the growth patterns of the two cultivars did not follow a definite pattern. SAMAZ-52 consistently outperformed OBA Super 6 in key growth parameters, particularly during the dry seasons, indicating its potential suitability for environments where maximizing crop performance is essential. Both varieties demonstrated reduced growth parameters during the dry seasons compared to the rainy seasons, reflecting typical responses to increased environmental stress. Despite this, the overall performance gap between the two varieties remained relatively small across both seasons. This suggests that while SAMAZ-52 may have a slight advantage, OBA could also perform adequately under varying conditions. The analysis of yield parameters further illustrates distinct performance trends.

The cumulative effect showed that OBA performed better than SAMAZ in number of kernel per plant but SAMAZ performed better than OBA in term of yield of maize per hectare showing that the size of SAMAZ grain were bigger than the size of OBA grains. NPK 15:15:15 fertilizer proved to be the most effective for boosting both growth and yield, with the *Pseudomonas* and *Nitrobacter* applied at 50 and 40L respectively also showing notable potential performance. This is in agreement with Farnia and Torkaman (2015) who observed that biofertilizers significantly enhanced biomass yield, primarily through an increase in shoot dry weight during the pre-tasseling stage. These findings underscore the critical role of effective nutrient management in enhancing maize productivity. These results suggest that precise nutrient applications are crucial for optimizing maize yield. Research has consistently shown a strong correlation between the availability of both macronutrients and micronutrients in the soil and improved nutrient uptake by maize plants (Magodia, 2024).

Ghaffari *et al.*, (2015) indicated that several studies have been conducted on biofertilizers and their various benefits in sustainable agriculture, especially in promoting plant nutrition. Some of these benefits include nitrogen fixation, nutrient solubilisation and mobilization, phytohormone production, microbial community diversification, and soil physicochemical property improvement. *Klebsiella*, *pseudomonas* and *rhizobium* that are used as biofertilizers are root associated bacteria that have an important role as plant growth promoting rhizobacteria (PGPRA). They fix N and solubilise phosphorus. In a research conducted by Suliash and Widawali (2019) showed that *rhizobium* contained 88.69ppm Indole Acetic Acid (IAA), 0.83 ppm inorganic P and phosphatase (0.11 acid and 0.11 alkaline) while *Klebsiella* contained 104.96 ppm IAA, 1.57ppm inorganic P and phosphate (0.74 acid and 0.50 alkaline). Both *Klebsiella* and *rhizobium* were positive in  $N_2$  fixation, ACC deaminase and phosphorus solubilisation. According to Zarrin and Sobhanipour (2012), *Pseudomonas* improves plant height and shoot growth by producing plant growth promoting substances such as auxin and



cytokinin. The bacterium also produces rhizobiotoxin which reduces ethylene content in plant. This condition promotes the development of plant root system so plant can use higher soil volume as the source of water and nutrients; increasing water and nutrients absorption efficiency.

Different researchers have studied the effects of *Pseudomonas* on crops growth and yield. Waller and Cook (1982) reported that inoculating wheat seeds with *Pseudomonas* fluorescent increased wheat yield by 147% in sterile soil and by 27% in unsterile soils. In another experiment, application of some *P. fluorescent* strains increased wheat yield by 17% (Duffy *et al.*, 1996) and supported by Oyebamiji *et al.*, (2018).

It was found that there were increases in agronomic parameters of the maize cultivars in the wet season than the dry season. Hossein and Farshad, (2013) observed that microbial fertilizers can clean the environment, enhance the productive capacity of land and reduce the amount of chemical fertilizer consumption and improve plant growth and health (Raaijmakers *et al.*, 2002). Markovic *et al.* (2017) demonstrated that maize grain yield is predominantly influenced by the availability of water and nitrogen, with both factors significantly affecting yield. Application of K50 to both OBA Super and SAMAZ recorded the highest number of kernel. This is in line with the work of Tarang *et al.* (2013) that application of biofertilizer had significant effects on number of grains per row.

The results showed that the maize fertilized with *Klesbisiella*, *Pseudomonas* and *Nitrobacter* absorbed more micronutrients such as Fe, Cu, Zn and Mn than the maize fertilized with NPK. This might be as a result of mycorrhiza activities of the biofertilizers. Sharma *et al* (2003) and; Zarrin and Adeleh (2012) observed that *Pseudomonas* bacteria produce siderophores under Fe deficiency conditions. Siderophores are organic molecules that bound  $Fe^{3+}$  and acted like chelates, transporting Fe into the plant roots. Siderophore production is a very important mechanism against low available Fe conditions. The results could also be attributed to the more availability and supply of nutrients, especially the fixing of N and phosphates released from the soil by the biofertilizers, which might have increased the production and enhanced the transfer of assimilates in the plants as previously observed by Anees *et al.*, (2016). This work also corroborates the opinion of Wong *et al.* (2015) who highlighted that phytohormones produced by biofertilizers can stimulate plant growth by enhancing nitrogen fixation and facilitating phosphorus solubilization, thereby improving plant nutrient availability Satish *et al.* (2022) also observed that soil microorganisms play significant roles in regulating the dynamics of organic matter decomposition and the availability of plant nutrients such as N, P and S. The results also showed that the maize that was fertilized with NPK 15:15:15 fertilizer absorbed more N, P and K than the maize fertilized with the biofertilizers. Dubey *et al.* (2012) reported that applying 100 % of the recommended NPK fertilizers significantly boosts crop yields and increases the availability of phosphorus (P), potassium (K), and total nitrogen (N).

## CONCLUSION AND RECOMMENDATION

This study presents a comparative analysis of growth and yield parameters between the two maize varieties, OBA Super 6 and SAMAZ-52 over two growing seasons, revealing significant differences in their performance. SAMAZ-52 consistently outperformed OBA Super 6 in yield, particularly indicating its potential suitability for environments where optimum crop performance is essential.

Both varieties demonstrated reduced growth parameters during the dry seasons compared to the rainy seasons, reflecting typical responses to increased environmental stress. Despite this, the overall performance gap between the two varieties remained relatively small across both seasons. This suggests that while SAMAZ-52 may have a slight advantage, OBA could also perform adequately under varying conditions.

While OBA Super 6 and SAMAZ-52 are likely to yield better in favorable conditions, This highlights the importance of both varietal characteristics and seasonal influences in maize productivity. In order to optimize growth and yield effectively, there is a critical need for tailored nutrient management strategies that consider the specific traits of each variety. By understanding and leveraging these differences, agricultural practices can be refined to enhance maize production, ultimately contributing to improved food security and sustainability in diverse agricultural settings.



*Pseudomonas*, *Nitrobacter* and *Klesbisiella* could be used to increase maize production especially SAMAZ-52 in southwestern Nigeria..Hence, *Pseudomonas* applied at 50L is recommended

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