



## RESEARCH ARTICLE

# Comparative performance of maize varieties under tropical conditions in Abraka, Delta State, Nigeria

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### ABSTRACT

Environmental and geographical conditions play a pivotal role in determining the performance of maize varieties, making varietal selection critical for optimizing yield under specific agro-ecological settings. This study evaluated the morphological, reproductive, and yield traits of two maize varieties, Oba Super-6 (early maturing) and Suwan-1-SR (medium maturing), over two consecutive cropping seasons (2023 and 2024) at the experimental farm of the Faculty of Agriculture, Delta State University, Abraka, Nigeria. The experiment was laid out in a randomized complete block design (RCBD) with three replications. Data were collected on plant height, leaf number, days to tasseling and silking, cob length, number of grains per cob, and grain yield. Statistical analysis revealed significant differences ( $P < 0.05$ ) between the two varieties across all measured parameters. Oba Super-6 consistently outperformed Suwan-1-SR in both seasons, exhibiting superior vegetative growth, earlier reproductive maturity, and higher grain yield. These findings suggest that Oba Super-6 is better adapted to the agro-climatic conditions of Abraka and holds greater economic potential for farmers in the region. Its early maturity and robust yield performance make it a suitable candidate for cultivation in tropical environments prone to climatic variability. The study recommends Oba Super-6 for widespread adoption in similar agro-ecological zones to enhance maize productivity and ensure food security.

**Keywords:** maize varieties; growth; tasseling; *zea mays*; yield, Tropical area

## INTRODUCTION

Maize (*Zea mays* L.) remains a staple crop and a fundamental food source for nearly half of the population in Sub-Saharan Africa, contributing significantly to dietary energy, protein, iron, vitamin B, and essential minerals (Olaniyan, 2015). Its versatility allows for consumption in fresh, green, or dried forms, and it is traditionally

processed through wet and dry milling techniques to produce a wide range of food products. Despite its importance, projections indicate a widening gap between maize production and demand in Africa by 2050, driven by rapid population growth and diminishing arable land (Grote et al., 2021). In Nigeria and other tropical regions, maize productivity is constrained by factors such as suboptimal varietal selection, poor agronomic practices, declining soil fertility, and climate variability (Adebayo et al., 2020; Iken & Amusa, 2004).

The selection of high-yielding maize varieties is critical, particularly those capable of producing large, well-filled ears under prevailing environmental conditions (Mukarumbwa & Taruvinga, 2023). However, varietal performance is often environment-specific, necessitating localized evaluation. Studies by Badu-Apraku et al. (2015) and Hongwei et al. (2022) have highlighted significant genetic variability among maize cultivars in West and Central Africa, influencing traits such as leaf area, chlorophyll content, stem diameter, biomass accumulation, and harvest index. Similarly, Akinwale et al. (2014) emphasized the importance of genotype-by-environment interactions in determining yield stability across diverse agro-ecological zones.

Given these challenges and opportunities, this study aims to assess the morphological, reproductive, and yield responses of two maize varieties under the agro-climatic conditions of Abraka, Delta State, Nigeria, to identify the most suitable cultivar for enhanced productivity.

## MATERIALS AND METHODS

A field study was conducted in 2023 and 2024 on the experimental farm of the Faculty of Agriculture, Delta State University, Abraka, Nigeria (Latitude 5°47' N and longitude 6° 6' N). The study area is the tropical rainforest zone with a bimodal rainfall spanning from April to October, with peaks in July and September. The two maize varieties used for the study, [Oba super-6 (early maturing and hybrid) and Suwan-1-SR (medium maturity and open-pollinated)] were sourced from the International Institute of Tropical Agriculture (IITA), Ibadan. The experiment was conducted as a randomized complete block design (RCBD) with three replications. A land area measuring 126 m<sup>2</sup> was prepared with a cutlass and hoe and demarcated into three blocks (replications). Each plot measured 4 m x 4 m, with a 1 m pathway between plots and 1 m between blocks. A total of 6 plots were used for this experiment. Maize varieties were planted at a distance of 90 cm x 30 cm. A 300kg/ha blanket application of NPK was made for all the plots. The experimental plots were kept weed-free with a hoe. At the same time, Tamex insecticide (*Chlorpyrifos* 480g/L) at 50 ml or 50 g of pesticide in 100 L of water was applied when pest infestation was observed. The maize plants were allowed to reach physiological maturity (husk colour turns pale brown after tasseling) before harvest.

The following morphological parameters were measured: plant height, leaf area, stem girth at 4, 6, 8 and 10 weeks after planting (WAP); reproductive parameters: Number of days to 50% silking, number of days to 50% tasseling, number of days to 100% silking, number of days to 100% tasseling, and tassel-silk interval; and yield parameters: plant biomass before tasseling, Plant biomass at maturity, Harvest index, Cob weight per hectare, shelling percentage, Grain weight per hectare, and 100 seed weight. Data collected were subjected to analysis of variance (ANOVA) using the GenStat eleventh edition package for statistical analysis. Means were separated using Fisher's least significant difference (F- LSD) at 5% probability level. Tassel-silk interval: The tassel-silk interval was calculated as described by Chukwudi et al. (2021).

## RESULTS AND DISCUSSION

The soil physicochemical properties before planting are shown in Table 1. The soil is sandy loam in texture and moderately acidic. It contains a low amount of organic matter, total nitrogen, and exchangeable bases, but exhibits relatively average values for cation exchange capacity (CEC) and available phosphorus. The low fertility level of this soil is typical of many tropical soils because of their advanced weathering processes and significant leaching tendencies (Onwudiwe *et al.*, 2013).

Plant height progressively increased from 4 to 10 weeks after planting (WAP) for both early and Suwan-1-SR varieties in 2023 and 2024 (Table 2). In 2023, no significant ( $P > 0.05$ ) difference was observed at 4 WAP, although the Oba super-6 variety had a higher mean value. At 6 WAP, the Oba super-6 variety recorded significantly greater plant height than the Suwan-1-SR variety. At 8 WAP, there was no significant difference, although the Suwan-1-SR variety had slightly taller plants. Similarly, at 10 WAP, no significant difference was detected, but the Oba super-6 variety maintained a higher mean plant height. In 2024, no significant difference occurred at 4 WAP, with the Oba super-6 variety having a slightly higher mean. At 6 WAP, Oba super-6 variety again exhibited significantly greater plant height. However, no significant differences were observed at 8 WAP

and 10 WAP, though Oba super-6 variety consistently maintained higher plant heights. This finding aligns with Enujeke (2013), who reported that hybrid variety 9022-13 demonstrated greater plant height, more leaves, wider stem girth, and larger leaf area than other varieties. Similarly, Anjorin and Adebayo (2024) observed superior plant height in the OBASUPER-1 hybrid compared to open-pollinated varieties at higher plant densities. The rapid early growth of Oba Super-6 seen here reflects its robust hybrid vigor, as described by Badu-Apraku et al. (2022), who found that early-maturing hybrids consistently demonstrated superior morphological or vegetative growth due to accumulated genetic gains.

**Table 1.** Physicochemical characteristics of the soil prior to planting

Parameters	Values
<i>Physical properties</i>	
Clay	18
Silt	14
Coarse sand	20
Fine sand	48
Textural	Sandy loam
<i>pH</i>	
H <sub>2</sub> O	5.4
KCl	4.9
OM (%)	2.8
N (%)	0.04
CEC	5.8
Base Saturation	30.04
<i>Exchangeable Bases (cmol/kg)</i>	
Na <sup>+</sup>	0.05
K <sup>+</sup>	0.38
Ca <sup>2+</sup>	0.80
Mg <sup>2+</sup>	1
P (ppm)	3.80
<i>Exchangeable acidity (cmol/kg)</i>	
Al <sup>3+</sup>	0.4
H <sup>+</sup>	2.4
Fine sand	48
Textural	Sandy loam

**Table 2.** Effect of variety on plant height of maize at 4, 6, 8 and 10 weeks after planting in 2023 and 2024 cropping seasons

Variety	2023				2024			
	4 WAP	6 WAP	8 WAP	10 WAP	4 WAP	6 WAP	8 WAP	10 WAP
Oba super-6	78.3	103.27	142.49	165.36	99.6	121.7	150.5	184.2
Suwan-1-SR	76.17	126.62	144.98	159.03	97.1	146.8	154.8	178.4
FLSD (0.05)	10.093	8.133	6.307	8.533	10.21	8.19	6.23	9.02

Stem girth consistently increased with plant age in both years. In 2023, the Oba super-6 variety had significantly larger stem girth than the Suwan-1-SR variety at 4 WAP (Table 3). However, no significant differences were recorded at 6, 8, and 10 WAP, although Suwan-1-SR variety had slightly higher girths at 6 and 8 WAP, while Oba super-6 variety had higher girths at 10 WAP. In 2024, Oba super-6 variety also exhibited significantly greater stem girth at 4 and 8 WAP. However, at 6 and 10 WAP, the differences were not significant. Oba super-6 variety had higher girths at 6 WAP, while Suwan-1-SR variety overtook slightly at 10 WAP. The wider stem girth of Oba Super-6 reflects a sturdier plant morphology capable of supporting the heavier cobs observed later in development. This trait has also been reported in the hybrid varieties evaluated by Orebo *et al.* (2021), where early maturing varieties demonstrated enhanced stem thickness and greater biomass accumulation under adequate fertilization.

**Table 3.** Effect of variety on stem girth of maize at 4, 6, 8 and 10 weeks after planting in 2023 and 2024 cropping seasons

Variety	2023				2024			
	4 WAP	6 WAP	8 WAP	10 WAP	4 WAP	6 WAP	8 WAP	10 WAP
Oba super-6	2.54	2.95	3.43	3.73	5.45	6.584	8.4	9.55
Suwan-1-SR	2.13	3.04	3.47	3.64	4.803	6.411	7.82	10.18
FLSD (0.05)	0.117	0.23	0.187	0.177	0.3315	0.3979	0.416	0.817

**Table 4.** Leaf area at different growth stages in 2023 and 2024

Variety	2023				2024			
	4 WAP	6 WAP	8 WAP	10 WAP	4 WAP	6 WAP	8 WAP	10 WAP
Oba super-6	360.65	446.96	643.57	1075.28	360.70	447	646	1076
Suwan-1-SR	217.46	252.12	513.19	766.08	217.50	252.10	515	766
FLSD (0.05)	17.399	20.873	50.037	76	17.4	20.87	50	77.9

**Table 5.** Reproductive characteristics in 2023 and 2024

Variety	2023					2024				
	N50S	N50T	N100S	N100 T	TSI	N50S	N50T	N100S	N100T	TSI
Oba super-6	26	22.84	26.71	25.42	1.36	27	22.84	26.71	25.41	1.35
Suwan-1-SR	28.07	25.29	27.93	26.73	1.22	28.07	25.30	27.93	26.74	1.21
FLSD (0.05)	0.51	0.5	0.339	0.344	0.522	0.53	0.5	0.338	0.33	0.51

N50% S = number of days to 50% silking, N50T= number of days to 50% tasseling, N100S = number of days to 50% silking, N100T = number of days to 100% tasseling, TSI=tassel-silk interval

The leaf area increased progressively from 4 WAP to 10 WAP in both varieties. Oba super-6 variety consistently exhibited significantly larger leaf areas than the Suwan-1-SR variety at every growth stage in 2023 and 2024 (Table 4). At 4 WAP, the Oba super-6 variety had a leaf area of 360 cm<sup>2</sup>, greater than the value (217 cm<sup>2</sup>) obtained from the Suwan-1-SR variety in 2023 and 2024. Oba Super-6 consistently produced broader leaves and greater total leaf area throughout the growth stages. This morphological parameter increases light capture and higher photosynthetic activity, which is crucial for biomass accumulation and grain production. These findings agree with the observations of Chukwudi et al. (2021) and Yang et al. (2022), who demonstrated that larger leaf area and higher SPAD values in hybrids grown under optimal conditions resulted in superior photosynthetic efficiency and yield formation.

The reproductive data for the two years were presented in Table 5. Similar flowering patterns were observed for 2023 and 2024. For the number of days to 50% silk appearance, Oba super-6 variety flowered significantly earlier (26 days) compared to Suwan-1-SR variety (28.07 days). The early reproductive development of Oba Super-6 likely allowed it to escape late-season moisture stress. This observation supports the findings of Garba et al. (2019), who found that early-maturing varieties such as TZEE completed flowering earlier and produced stable yields under limited water availability compared to later-maturing varieties. Similarly, Oba super-6 variety reached 50% tassel appearance significantly earlier (22.84 days) than Suwan-1-SR variety (25.29 days). For 100% silk appearance, Oba super-6 variety again flowered significantly earlier (28 days) than Suwan-1-SR variety (27.93 days). The trend was similar for 100% tassel appearance, where Oba super-6 variety (25.41 days) matured significantly earlier than Suwan-1-SR variety (26.74 days). However, there was no significant difference in tassel-silk interval between the varieties, though Oba super-6 variety had a slightly longer interval (1.35 days) than Suwan-1-SR variety (1.21 days). The early flowering and shorter tassel-silking interval observed in Oba Super-6 are critical indicators of better synchrony between pollen shed

and silk receptivity, which enhances successful fertilization and kernel development. This phenomenon has been reported by Zhang *et al.* (2018), who observed that lower TSI is strongly associated with improved grain set and yield stability, especially under high plant densities. The consistent early flowering of Oba Super-6 demonstrated in this study echoes its reproductive advantages in the study area.

**Table 6.** Comparison of yield components in 2023 and 2024

	Variety	PBT (Kg/plot)	PBM (Kg/plot)	HI (%)	CW/ha (kg)	SP (%)	GW/ha (kg)	100 SW (g)
2023	Oba super-6	0.26	0.41	43.89	2062	34.44	1638.29	23.73
	Suwan-1-SR	0.25	0.44	40.21	1937.78	34.01	1584.56	21.56
	FLSD (0.05)	0.03	0.057	6.39	254.88	7.726	122.663	1.69
2024	Oba super-6	0.348	0.699	53.7	3635	34.4	1647	23.03
	Suwan-1-SR	0.302	0.607	41.4	2580	34	1585	21.60
	FLSD (0.05)	0.0473	0.056	6.86	527.1	7.73	122.7	1.66

PBT = Plant biomass prior to tassling, PBM = Plant biomass at maturity, HI= Harvest index, CW/ha= Cob weight per hectare, SP= shelling percentage, GW/ha = Grain weight per hectare, 100 SW= 100 seed weight

In 2023, the Oba super-6 variety gave a higher mean than the medium maturity variety in all parameters except for plant biomass at maturity (Table 6). Regarding plant biomass before tasseling, the Oba super-6 variety produced significantly greater biomass than the Suwan-1-SR variety in 2023 and 2024. The difference was insignificant, although plant biomass at maturity was higher for the Suwan-1-SR variety in 2023. In 2024, the Oba super-6 variety recorded significantly higher biomass at maturity. For harvest index, Oba super-6 variety consistently had higher values than Suwan-1-SR variety across both years, but the difference was only significant in 2024. Although the shelling percentage did not differ significantly between the varieties, the Oba super-6 variety generally had slightly higher values. Grain weight per hectare was higher in the Oba super-6 variety than in the Suwan-1-SR variety across both years. Finally, the 100-seed weight was not significantly different in Oba super-6 and Suwan-1-SR varieties in 2023 and 2024. In both seasons, but more markedly in 2024, the hybrid produced significantly greater grain yield per hectare than Suwan-1-SR. The superior yield of Oba super-6 reflects its efficient biomass partitioning into reproductive structures, a trait commonly associated with hybrids as reported by Orebo *et al.* (2021) and Nurgi *et al.* (2023). In their studies, hybrid maize varieties consistently outperformed open-pollinated varieties regarding cob development and final grain yield, primarily when supported by appropriate soil amendments or intercropping systems.

The higher harvest index observed for Oba Super-6 indicates its superior ability to convert vegetative biomass into economic yield, an important trait for resource-limited farming systems. This efficiency was similarly noted by Li *et al.* (2021) and Liu *et al.* (2021), who showed that hybrids with optimal planting densities and fertilization regimes achieved higher nutrient use efficiencies and harvest indices. The significant yield advantage of Oba Super-6 underlines its economic potential for farmers in the region and aligns with the partial budgeting analysis conducted by Egbetokun and Oloyede-Kamiyo (2020), who demonstrated that certain hybrid maize varieties, when adopted at optimal densities, not only yield higher but also offer superior economic returns despite slightly higher input costs.

## CONCLUSION

The study demonstrated consistent and statistically significant differences between the two maize varieties—Oba Super-6 and Suwan-1-SR, across morphological, reproductive, and yield parameters. Oba Super-6 exhibited superior performance in both cropping seasons, reflecting its genetic stability, early maturity, and adaptability to the agro-climatic conditions of Abraka, Delta State. Its enhanced growth traits and higher yield potential affirm its suitability for cultivation in tropical environments characterized by variable field conditions. These findings underscore the economic relevance of Oba Super-6 for smallholder farmers and support its recommendation for widespread adoption in similar agro-ecological zones to improve maize productivity and contribute to regional food security.

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### **AUTHORS CONTRIBUTIONS**

All the authors contributed equally to this research work.

### **CONFLICT OF INTERESTS**

The authors declare no conflict of interest.

### **ETHICAL APPROVAL**

Not applicable.

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### **AVAILABILITY OF DATA AND MATERIALS**

All datasets analyzed and described during the present study are available from the corresponding author upon reasonable request.

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