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Evaluation of the Performance early Maize Varieties in Makurdi, Benue State, Nigeria

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ABSTRACT: This study evaluated the growth and yield performance of three maize varieties (SAMMAZ-14, SAMMAZ-26, and SAMMAZ-30) in 2024 and 2025 rainy season under the agro-ecological conditions of Makurdi. The experiment utilized a Completely Randomized Block Design (CRBD) with three maize varieties (SAMMAZ-14, SAMMAZ-26, and SAMMAZ-30) planted in three replicates on prepared soil beds. The experiment measured plant height, leaf length, number of leaves, and yield parameters such as cob length, cob circumference, grain weight, and overall grain yield. Results indicated significant differences in early growth, with SAMMAZ-30 exhibiting superior plant height (52.79 cm) and leaf length (46.92 cm) at 4 Weeks after planting (WAP). Although no significant differences were found in growth parameters at later stages, SAMMAZ-30 consistently outperformed the other varieties in yield parameters, recording the highest

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grain yield of 4.59 t/ha, cob diameter (13.23 cm), and mean cob weight (2.50 kg). Cultivating maize in 2025 rainy season out performed 2024 rainy season cultivation. Soil analysis revealed favorable condition, including loamy texture, moderate organic matter (2.3%), and adequate pH (6.3), conducive to maize production. The study concludes that SAMMAZ-30 is the most suitable variety for optimal maize production in the study location in Makurdi.

Keywords: *Maize, Varieties, Early maturing, Growth and Yield*

INTRODUCTION

Maize (Zea mays L.) is a food security crop which can grow in a wide variety of climates and on diverse kinds of soils. For optimum production, it requires fertile, well-drained loam soil, well- distributed rainfall, and moderate high temperature (Kochhar, 2015). The Semi-Arid Food Grains Research and Development Agency (SAFGRAD) has developed hybrids of intermediate, extra-early and late-maturing maize. These hybrids have proved to be not only high-yielding but disease-resistant and are suited to a range of environments in predominantly lowland West African Savanna (Ado and Usman, 2019). Studies carried out by Ado *et al*., (2019) showed that the extra-early maize is useful to catch up with the season in situations where rainfall starts late. It matures within 78-85 days. Early-maturing hybrids could be used to produce two or more crops in relay, especially where irrigation facilities are available. Because of their early maturity, fewer pesticide applications are carried out. In spite of these advantages, maize hybrids, in general have gained low acceptability by farmers due to high seed cost, time and effort involved in growing them. Their successful cultivation depends largely on the right choice of varieties, the length of the growing season and the purpose for which the crop is grown. The early-maturing hybrids are often expensive and are not readily available to farmers in West Africa. Grain yield is the major objective of any breeding programme. It is quantitatively inherited and its expression is influenced by genotypic and environmental factors. Although the early-maturing varieties of maize are generally recommended under rainfall conditions, a negative correlation between grain yield and maturity may occur (Chopra, 2011). This could be due to grain yield long duration process. With the continued development and release of hybrid maize of different maturity periods, it is necessary to ascertain their potential productivity in different agro-ecologies.

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Benue State, located in the fertile agricultural belt of Nigeria, has long been renowned for its significant contribution to the nation's maize production. Maize, or corn, holds a pivotal role in the state's agricultural landscape, serving as a staple food crop for its populace and a key driver of economic activity. In recent years, the cultivation of early-maturing varieties of maize has emerged as a promising strategy for farmers in Benue State. These varieties offer several advantages, including reduced crop maturity periods, enhanced resilience to climatic variations, and improved yields. As a result, they have garnered considerable attention and adoption among farmers seeking to optimize their agricultural practices and mitigate risks associated with seasonal fluctuations. This study seeks to explore some of the early-maturing varieties of maize that have gained prominence in Benue State, shedding light on their characteristics, cultivation practices, and the impact they have made on the local agricultural sector. By examining the experiences of farmers and the broader agricultural community, we seek to underscore the significance of these varieties in bolstering food security, increasing incomes, and fostering sustainable agricultural development in the region. Through a comprehensive examination of early-maturing maize varieties in Benue State, this study seeks to provide insights into their agronomic performance, adoption dynamics, and implications for smallholder farmers. By elucidating the opportunities and challenges associated with their cultivation, we aim to inform policymakers, agricultural stakeholders, and development practitioners on strategies to promote their wider adoption and maximize their benefits for rural communities. While maize cultivation remains a cornerstone of agriculture in Benue State, the sector faces numerous challenges that threaten its sustainability and productivity. One significant issue is the impact of climate change, which manifests in erratic rainfall patterns, prolonged dry spells, and increasing temperatures, all of which can adversely affect maize yields and production cycles (Abah, 2019). In light of these challenges, there is a pressing need to identify and promote maize varieties that are resilient to climatic stresses, have shorter maturity periods, and exhibit improved resistance to pests and diseases. Early-maturing maize varieties hold particular promise in this regard, as they offer farmers the opportunity to mitigate the risks associated with uncertain weather patterns and optimize their cropping calendars to enhance productivity and profitability.

The investigation into early-maturing maize varieties in Benue State is of paramount importance for addressing key challenges in the agricultural sector, enhancing food

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security, and promoting sustainable rural development. By identifying and promoting resilient varieties that can withstand climatic stresses such as erratic rainfall and temperature fluctuations, the study contributes to building farmers' adaptive capacity and mitigating the adverse impacts of climate change (Abah, 2019). Objective of the Study: To determine the performance of three different varieties of early maize on growth parameters and yield attributes.

3.0 MATERIALS AND METHODS

3.1 Location

The research was conducted in 2024 and 2025 rainy season at Agronomy Research Farm, Joseph Sarwuan Tarka University Makurdi the Benue state capital, the area lies between latitude 7°55°N and longitude 8°32°E at an elevation of 97m above sea level. This Agro-ecological zone of Nigeria is characterized by seasonal rainfall, the state covers an area of about 34.059 Sq km (Nigeria population census, 2006) and experience a tropical climate with two distinct seasons (wet and dry). The wind from the south west of Nigeria that brings rain within the state has an annual rainfall between 900-1200mm and a temperature ranging between 23oc and 32oc within the year, from June October, 2023.

3.2 Design of Experimental Field and Treatment

The experimental design was established using RCBD (Randomized Complete Block Design) arranged in a factorial pattern with three replicates. The three hybrid varieties of maize used in the experiment were obtained from the Agronomy research farm store house, Joseph Sarwuan Tarka University Makurdi. The hybrids, which were distributed in three maturity classes include SAMMAZ-14, SAMMAZ-26 and SAMMAZ-30. Experimental site was cultivated, harrowed and six ridges of 5mx1m in each plot were constructed and planting was carried out on the same day. The experimental plots were separated by 0.5 m within the plots and 1 m between the blocks. Maize seeds were planted at a spacing of 0.7 m x 0.2 m. Two seeds were sown per hole.

3.3 Fertilizer and Herbicide application

A blanket application of Vestrazine and Parae force (170 g ha-1) was applied using a knapsack sprayer at both plots to control weeds. Fertiliser NPK (15:15:15) was applied to

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all the plots at the rate of 80N kg ha-1, 60P kg ha-1 , 60K kg ha-1 at 2 weeks after sowing (WAS) and top dress at 6 weeks after planting (WAS). This was equivalent to 120 g per plot. The plots were earthed up (roots and lower parts of the stems were covered with heaped-up earth to prevent lodging) at 6 weeks after planting.

3.4 Sampling and Data Collection

Parameters measured include: Plant Height: Five plants were sampled from each plot at random, the length of each of which was measured from the ground level to the flag-leaf, using a metre-rule. Cob length: Five cobs were randomly sampled at harvest from each plot, the length of each of which was measured from the base to the tip. This was divided by five to give the mean cob length. Cob circumference: The circumference of each of the five sampled cobs in each plot was measured at the widest part and recorded. This was divided by five to give the mean cob circumference. Cob weight: The five sampled ears in each plot were weighed using the digital electronic balance (Model LP 502A). This was divided by five to give the mean ear weight. Seed per cob: The number of seed in the five sampled plants in each plot was counted. This was divided by five to obtain the mean number of seed per cob. One hundred seed weight: One hundred seed were taken per plot after shelling. These were weighed using the digital electronic balance. Total grain yield: All the grains in each plot were weighed and the weight was converted to tonnes per hectare. Grain yield was calculated at 13% moisture content, at which figure it is believed to store more satisfactorily.

3.5 Data Analysis

Data was analyzed using the analysis of variance (ANOVA) to determine variability among the varieties. The Statistical Analysis Software (SAS) (Version 9.1) was used to analyze the data. Means were separated using the least significance difference (LSD) at 5% probability level.

RESULTS AND DISCUSSION

Table 1 is the performance of three maize varieties (SAMMAZ-14, SAMMAZ-26, and SAMMAZ-30) across two cropping seasons (2024 and 2025) in Makurdi, Nigeria, measuring key vegetative growth parameters over time. Field experiments were conducted

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to evaluate plant height (cm), leaf length (cm), and number of leaves per plant at 4, 8, and 12 weeks after planting (WAP). Data were analyzed to determine the effects of variety (V), season (S), and their interaction (V \times S), with mean comparisons evaluated using Fisher's Least Significant Difference (F-LSD at p \le 0.05).

Plant Height: Significant differences ($p < 0.05$) among varieties were observed early in development at 4 WAP, with SAMMAZ-30 achieving the greatest average height (52.79 cm), compared to SAMMAZ-26 (51.59 cm) and SAMMAZ-14 (50.03 cm). However, differences in plant height became statistically non-significant (NS) at 8 WAP and 12 WAP. This finding aligning with previous studies which emphasize the role of varietal differences in early maize growth (Adejare et al., 2020; Babajide and Funmi, 2019). The higher initial growth could be attributed to the genetic make-up of SAMMAZ-30, which likely promotes early vigor, an important trait for better crop establishment and competitiveness (Iken and Amusa, 2014). Seasonal effects were also significant at 4 WAP (50.21 cm in 2025 vs. 49.23 cm in 2024), but showed no significant effect in later growth stages. This collaborate with the work of (Odiaka et al., 2025) who stated that seasonal effects such as rain fall pattern might have cause the observed effects.

Leaf Length: Varietal and seasonal differences significantly ($p < 0.05$) influenced leaf length across all sampling stages (4, 8, and 12 WAP). At 12 WAP, SAMMAZ-30 produced the longest leaves (82.52 cm), followed by SAMMAZ-26 (78.74 cm) and SAMMAZ-14 (75.77 cm). Similarly, the 2025 season consistently outperformed the 2024 season in leaf length development (74.32 cm vs. 72.43 cm at 12 WAP).

Number of Leaves: Varietal and seasonal variations significantly ($p < 0.05$) affected leaf number only during early vegetative growth at 4 WAP, led by SAMMAZ-30 (7.56) and the 2025 season (7.12). No significant differences were observed at 8 WAP or 12 WAP. This finding agrees with the work of (NASCR). (2010). Who reported that leaf length and leaf number is caused by the inherent genetic make-up and available nutrient for plant absorption, (Madina et al., 2020) who reported the same trend, starting most vigorous growth by plant is attributed to crop environment, weather, genetic make-up of the crop variety and nutrient availability and ability of the plant pick up the nutrient.

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Interaction Effects: The variety \times season (V x S) interaction was non-significant (NS) for all evaluated parameters across all sampling periods, indicating that varietal performance trends remained consistent across both seasons. While variety selection and seasonal variations significantly influence early crop establishment (4 WAP) and total canopy leaf expansion (leaf length up to 12 WAP), overall mature plant height and leaf production converge as crops reach full maturity. SAMMAZ-30 demonstrated superior vegetative vigor, making it a promising candidate for leaf surface area development in the Makurdi region.

Table 2 evaluated the main effects of maize varieties (SAMMAZ-14, SAMMAZ-26, and SAMMAZ-30) and cropping seasons (2024 and 2025) on the yield and yield parameters of maize in Makurdi. Parameters assessed included cob length, cob circumference, number of grain lines per cob, number of cobs per plant, weight of 100 grains, individual cob weight, and grain yield per hectare. Varietal Performance: Significant differences (F-LSD < 0.05) were recorded among the varieties for cob circumference, 100-grain weight, cob weight, and overall yield. SAMMAZ-30 produced the highest values across all parameters, achieving a grain yield of 5.59t/ha, compared to 4.61 t/ha for SAMMAZ-26 and 4.00 t/ha for SAMMAZ-14. Cob length (14.52 cm to 14.87 cm), number of lines per cob (10.93 to 12.01), and number of cobs per plant (2.00) showed no significant variation (NS) among varieties. This aligns with findings from Chikoye et al. (2015) who indicated that maize varieties often exhibit comparable growth rates in the later stages of development when environmental factors, such as temperature and nutrient availability, stabilize. Seasonal Effect: The 2025 cropping season significantly outperformed 2024 in cob circumference (8.34 cm} vs. 7.84 cm), 100-grain weight (98.32 g vs. 95.34 g), cob weight (141.67 g vs. 134.12 g), and grain yield (5.43 t/ha} vs. 4.32 t/ha). Differences in cob length, lines per cob, and cobs per plant were not statistically significant between seasons. Variety x Season Interaction (V x S): A significant interaction (*) was recorded for cob circumference, 100-grain weight, cob weight, and overall yield per hectare, indicating that varietal performance varied significantly across the two growing seasons. No significant interaction was detected for cob length, lines per cob, or cobs per plant. SAMMAZ-30 exhibited superior yield parameters and grain productivity over SAMMAZ-26 and SAMMAZ-14 under the agro-ecological conditions of Makurdi, with performance significantly influenced by seasonal variability.

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Table 3 evaluated the interactive effects of cropping seasons (2024 and 2025) and maize varieties (SAMMAZ-14, SAMMAZ-26, and SAMMAZ-30) on yield and yield-contributing parameters. Across both seasons, significant differences (F-LSD < 0.05) were observed among varieties for cob circumference, 100-grain weight, cob weight, and total grain yield per hectare.

Cob Circumference & Weight: SAMMAZ-30 consistently produced the highest cob circumference (9.09 cm in 2024; 9.34 cm in 2025) and highest cob weight (142.50 g in 2024; 145.67 g in 2025), whereas SAMMAZ-14 recorded the lowest values across both seasons. 100-Grain Weight: The 100-grain weight ranged from 87.48 g (SAMMAZ-14, 2024) to 98.32 g (SAMMAZ-30, 2025). Overall Grain Yield: Grain yield per hectare peaked with SAMMAZ-30 at 5.59 t/ha (2024) and 5.73 t/ha (2025), followed by SAMMAZ-26 (4.61 t/ha and 4.82 t/ha), while SAMMAZ-14 produced the lowest yield (4.00 t/ha and 4.34 t/ha). These findings are consistent with the results of Iken and Amusa (2014), Nigerian Seed Portal Initiative. (2023), who noted that cob characteristics, particularly diameter and grain weight, are major contributors to final yield which is mostly influence by inherent characteristics of crop and nutrient uptake.

The 2025 cropping season generally outperformed the 2024 season across all tested parameters. The findings demonstrate that SAMMAZ-30 exhibits superior yield potential and yield components compared to SAMMAZ-26 and SAMMAZ-14 under the trial conditions. Despite the differences in yield, the number of cobs per plant was uniform across varieties. This suggests that the differences in yield were not due to the number of reproductive units but rather the size and weight of the individual cobs which is affected by seasonal effects. This is consistent with the findings of Edeme et al. (2018), who reported that cob size and kernel weight are often more important determinants of yield than the number of cobs per plant based on the effects of rainfall, relative humidity and wind.

Table 1: Effect of different varieties of Maize on Growth Parameters in Makurdi

	Plant Height (cm)			Leaf Length (cm)			Number of Leaves		
Variety (V)	**4WAP**	**8WAP**	**12WAP**	**4WAP**	**8WAP**	**12WAP**	**4WAP**	**8WAP**	**12WAP**
SAMMAZ-14	50.03	94.91	125.67	44.96	62.53	75.77	7.11	13.44	16.44
SAMMAZ-26	51.59	94.21	124.06	46.97	61.51	78.74	7.00	13.67	15.89
SAMMAZ-30	52.79	97.02	122.44	46.92	63.43	82.52	7.56	14.22	16.56

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F-LSD (0.05)	1.37	NS	NS	1.17	1.46	2.05	0.60	NS	NS
Season (S)									
2024	49.23	93.82	123.32	43.32	60.12	72.43	6.84	13.21	15.43
2025	50.21	94.21	125.65	44.65	62.21	74.32	7.12	14.01	16.34
F-LSD (0.05)	1.12	NS	NS	1.11	1.12	2.01	0.89	NS	NS
Interaction									
V x S	NS	NS	NS	NS	NS	NS	NS	NS	NS

NS= not significant at 5% level of Probability, WAP= Weeks after Planting,

Table 2: Main effect of different varieties of Maize on the Yield Parameters in Makurdi

Variety	Cob Length (cm)	Cob circumference	No. of lines/ cob	No. of Cob/Plant	Weight 100 grains (g)	Cob weight(g)	Yield (t/ha)
SAMMAZ-14	14.52	7.10	10.93	2.00	87.48	122.48	4.00
SAMMAZ-26	14.57	8.68	11.00	2.00	91.30	132.10	4.61
SAMMAZ-30	14.87	9.09	12.01	2.00	97.55	142.50	5.59
F-LSD (0.05)	NS	1.04	NS	NS	2.40	5.33	0.34
Season (S)							
2024	14.45	7.84	11.23	2.21	95.34	134.12	4.32
2025	14.52	8.34	12.21	2.32	98.32	141.67	5.43
F-LSD (0.05)	NS	1.01	NS	NS	1.23	5.01	0.94
Interaction							
V x S	NS	*	NS	NS	*	*	*

NS= not significant at 5% level of Probability, WAP= Weeks after Planting,

Table 3: Interaction between season and varieties of Maize on the Yield Parameters

Season	Variety	Cob circumf.	Weight 100 grains (g)	Cob weight(g)	Yield (t/ha)
2024	SAMMAZ-14	7.10	87.48	122.48	4.00
	SAMMAZ-26	8.68	91.30	132.10	4.61
	SAMMAZ-30	9.09	97.55	142.50	5.59
2025	SAMMAZ-14	7.04	88.40	124.33	4.34
	SAMMAZ-26	8.84	93.34	134.12	4.82
	SAMMAZ-30	9.34	98.32	145.67	5.73
	F-LSD (0.05)	1.01	1.23	5.01	0.94

NS= not significant at 5% level of Probability, WAP= Weeks after Planting,

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Table 4: Physico-chemical properties of Experimental site, 2023

Parameter	2024	2025	Method of Analysis
Organic matter	2.3 %	2.4%	Walkley-black method
Nitrogen	0.12 %	0.13%	Kjeldahl method
P_2O_5	10.5 ppm	11.00 ppm	Flame photometric
K	0.19 %	0.21%	Oxidation method
Ca	4.2 meq/100%	4.8 meq/100%	A.A. S
Mg	1.40 meq/100%	1.65 meq/100%	A.A. S
pH (H_2O)	6.3	6.2	pH meter
pH ($CaCl_2$)	5.3	5.5	pH meter

Type of soil: Loamy soil ppm: parts per million A.A.S: Atomic absorption spectrophotometer

Table 4 evaluated the physicochemical properties of loamy soil at the experimental site across two consecutive years (2024 and 2025) to assess variations in soil nutrient status and chemical characteristics.

Standard analytical techniques were employed: Organic matter: Walkley-Black method, Total Nitrogen: Kjeldahl method. P2O5: Flame photometric method. Potassium (K): Oxidation method. Calcium (Ca) & Magnesium (Mg): Atomic Absorption Spectrophotometry (A.A.S.), pH (H2O and CaCl2): pH meter. Overall, soil nutrient levels showed a slight upward trend from 2024 to 2025: Organic Matter: Increased from 2.3% to 2.4%. Nitrogen: Increased from 0.12% to 0.13%. Phosphorus P2O5): Increased from 10.5 ppm to 11.00 ppm. Potassium (K): Increased from 0.19% to 0.21%. Exchangeable Cations: Ca increased from 4.2 meq/100g to 4.8 meq/100g. Mg increased from 1.40 meq/100g to 1.65 meq/100g. Soil Reaction: pH slightly decreased from 6.3 to 6.2, while pH (CaCl2) increased from 5.3 to 5.5, maintaining a slightly acidic to moderately acidic soil environment. The results indicate that the experimental loamy soil experienced a marginal improvement in fertility parameters and essential cation concentrations over the two-year period, alongside stable acidic soil reaction conditions suitable for general crop cultivation.

The physico-chemical properties of the soil at the experimental site (Table 3) show that the soil is loamy, with a pH of 6.3 (in H2O) and moderate organic matter content (2.3%).

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The nitrogen content (0.12%) is relatively low but within the acceptable range for maize, suggesting that nitrogen fertilization might have been necessary to optimize growth. The availability of phosphorus (P_2O_5 at 10.5 ppm) and potassium (K at 0.19%) are also critical for maize growth, with phosphorus playing a key role in root development and potassium enhancing drought resistance and disease tolerance (Stewart et al., 2020). According to Brady and Weil (2016), these nutrients are essential for maximizing maize productivity, especially in tropical soils like those found in Makurdi.

The results indicate that SAMMAZ-30 is the best-performing maize variety in terms of both growth and yield under the experimental conditions in Makurdi. This variety demonstrated superior early growth, larger cob dimensions, and higher grain yield, making it a suitable choice for farmers in the region. The soil conditions at the experimental site were also favorable for maize production, with adequate levels of key nutrients and a loamy texture conducive to growth. Further research could explore the interaction between these maize varieties and different soil fertility levels to optimize maize production in the region.

Conclusion

The study clearly indicates that SAMMAZ-30 and 2024 rainy season is the superior in both growth and yield parameters under the conditions in Makurdi. The early vigor and better plant height observed in this variety at 4 weeks after planting (WAP) contribute to its overall advantage in terms of crop establishment and competitiveness. Additionally, SAMMAZ-30 showed superior cob characteristics, such as greater cob length, circumference, and diameter, all of which are critical factors in determining higher grain yield in all the planting seasons. These findings underscore the importance of selecting the right variety, as SAMMAZ-30 demonstrated a higher resource-use efficiency, which translated to better performance even in the face of relatively similar environmental conditions.

The loamy soil with adequate pH, organic matter content, and sufficient levels of phosphorus and potassium was favorable for maize production in 2025 rainy season, suggesting that these soil characteristics supported the overall productivity of the varieties tested. However, while SAMMAZ-30 showed clear superiority. In doing so, farmers in the

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region could further optimize maize production, leading to improved food security and economic gains for maize producers in Makurdi and similar agro-ecological zones.

Recommendations

Farmers in Makurdi and similar agro-ecological zones should adopt SAMMAZ-30 for its superior growth, yield performance, and resource-use efficiency to maximize maize production.

Farmers should adopt best agronomic practices like timely planting and proper spacing for SAMMAZ-30.

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