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EVALUATION OF THE AGRONOMIC CHARACTERISTICS OF SELECTED PEARL MILLET (*Pennisetum glaucum* (L.) R. BR) GENOTYPES FOR FORAGE PRODUCTION IN THE DERIVED SAVANNAH AGRO ECOLOGY OF NIGERIA

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ABSTRACT

Despite the prominence of pearl millet, especially in forage production in Southwestern Nigeria, its full potential remains largely unexplored. This study evaluated ten selected *Pennisetum glaucum* (L.) R. Br. genotypes for forage production in the Derived Savannah agro ecology of Nigeria to determine their herbage yield, chemical composition, and variability in key growth parameters. The experiment employed a randomized complete block design with 3 replicates, consisting of 30 plots measuring 3 x 2.5 m, with 1 m spacing between plots. Ten pearl millet genotypes were randomly planted at 75 x 25 cm, with ten plots per block. Weekly observations were taken on: plant height, number of tillers, crown spread, and leaf area from 2 weeks after planting (WAP). Genotype significantly influenced (P<0.05) plant height, number of leaves, and leaf area. Kankara genotype emerged as the tallest (141.01cm) among the genotypes, up to 10 weeks after planting (WAP), while Bunkure, Mokwa, Maiwa UI 25-2, Maiwa UI 94-2, and Dauro reached maximum heights (275.00 cm to 417.30 cm) at 22WAP. Dauro, Maiwa UI 94-2, Maiwa UI 25-2, and Mokwa genotypes had the highest number of leaves on main and secondary tillers from 8 to 10 WAP. Bunkure genotype produced the highest number of leaves on secondary tillers. The study concluded that the Kankara genotype is ideal for robust and tall pearl millet, while Maiwa UI 25-2 offers superior biomass potential.

Keywords: *Pennisetum glaucum*; Animal feed; Tillers; Genotype; Biomass.

INTRODUCTION

Pearl millet is thought to have originated in sub-Saharan Africa, while finger millet is believed to have originated in the sub-humid uplands of East Africa (Gari *et al*., 2002). In South-Western Nigeria, pearl millet (*Pennisetum glaucum*) stands as a vital crop with multifaceted applications, encompassing both human dietary needs and livestock sustenance. On a global scale, pearl millet holds significant agricultural importance as the sixth-highest-producing crop, trailing behind maize, wheat, rice, barley, and sorghum (Satyavathi *et al.* 2021). It is considered a valuable source of nutrition and income for small-scale farmers (Patel *et al.* 2015), and it plays a crucial role in supporting livelihoods and ensuring food availability. The agricultural significance of pearl millet is underscored by its adaptability to tropical climates and its resilience in the face of varying environmental conditions (Krishnan and Meera, 2018). As a staple in this region, it makes a significant contribution to local economies and dietary practices.

Despite its prominence, the full potential of pearl millet in South-western Nigeria, especially concerning forage production, remains to be comprehensively explored. The nuances of optimizing forage production, a critical aspect for agricultural and livestock sectors, hinge on a detailed understanding of the agronomic characteristics exhibited by different pearl millet genotypes. These characteristics include, but are not limited to, plant height, leaf morphology, and overall biomass yield. Research conducted by Cisse *et al.* (1996), shows that pearl millet stands out due to its rich nutrient profile. It is a good source of energy, providing essential carbohydrates. It contains significant levels of protein, crucial for muscle development and overall body function. Forage production can serve as a strategic solution to mitigate the ongoing conflict between herdsmen and arable farmers by ensuring a sustainable feed supply for livestock (Weckwerth *et al.* 2020). Pearl millet, in addition to its nutritional benefits for human consumption, is a vital source of forage in tropical regions. Its cultivation for fodder can reduce competition over grazing land, minimizing clashes between pastoralists and crop farmers. By promoting dedicated forage production zones, conflicts over land use can be alleviated, fostering peaceful coexistence while enhancing food security and agricultural productivity.

However, there is a wide range of genetic variation among pearl millet genotypes, and some genotypes are more productive than others (Kanfany *et al.,* 2020). Therefore, it is important to evaluate and identify promising pearl millet genotypes for forage production in the tropical regions.

MATERIALS AND METHODS

The research was carried out at the Organic Research Unit and the Forage Laboratory of Pasture and Range Management, Federal University of Agriculture, Abeokuta (FUNAAB). The land was ploughed twice and harrowed once after a week. Soil samples were subsequently collected randomly using a soil auger to assess the soil nutrient status. The physicochemical properties of the composite soil samples at a 0–15 cm depth indicated a loamy-sand texture with moderate fertility, balanced cations, and a slightly neutral pH (Table 1). The total land area used was 555 m^2, which was divided into three blocks of 185 m^2 each, with a 1m spacing between blocks. Each block was sub-divided into ten plots of 3 x 2.5m. Ten pearl millet genotypes were evaluated: Ex-Bunkure, Ex-Kankara, and Ex-Mokwa, Millet Sosat and Millet Zatib, Maiwa UI 94-2, Maiwa UI 28-1, Maiwa UI 25-2, Dauro and Gero. The experiment was a randomized complete block design. Organic manure (poultry droppings) was applied at a rate of 300 kg N/ha to enhance soil fertility. Data collection commenced two weeks after planting (WAP) and was repeated weekly till nine weeks. Measurements were taken from six randomly selected plants, tagged for subsequent weekly measurements. Plant height (cm), number of leaves on the primary and secondary tillers, and Leaf area (cm^2) were determined. Plant height (cm) was measured using a metre rule from the ground level. Number of leaves per plant was determined by counting the number of leaves borne on both the main and secondary tillers. Leaf area (cm^2) was determined from leaf length multiplied by the width x 0.68 (Rouphael *et al.* 2010). All agronomic data collected were subjected to two-way ANOVA, using a statistical package (SAS, 1999) while significant differences were identified using Duncan's Multiple Range Tests at 5% significant level.

Table 1: Physico-chemical characteristics of the composite soil samples taken from the experimental site at 0-15cm depths before planting

Property	0-15cm
pH (H_2O)	7.03
Total Nitrogen (%)	0.11
Organic Carbon (%)	1.29
Organic Nitrogen (%)	2.22
Acidity ($cmolkg^{-1}$)	0.13
Exchangeable cations (cmol/kg)	
Sodium (Na^+)	0.80
Potassium (K^+)	1.50
Calcium (Ca^{2+})	2.77
Magnesium (Mg^{2+})	2.72
Particle size (%)	
Sand	77.93
Silt	17.33
Clay	4.73
Textural class	Loamy – sand

RESULTS

There were significant differences in the herbage yield and chemical composition of pearl millet genotypes (Table 2). Dry matter yield ranged from 1.74 to 4.45 t/ha for all the genotypes of pearl millet. Highest dry matter yield per hectare (4.45 t/ha) was recorded for Dauro, while the least (1.74 t/ha) was from Gero. Crude protein content also varied significantly among the genotypes, ranging from 6.50 to 9.03%. The highest value (9.03%) was observed in Maiwa 94-2, while the lowest (6.50%) was found in Bunkure and Gero. The ash content of the pearl millet genotypes ranged from 10.75% to 17.0%; the highest value (17.0%) was observed in Mokwa. Fibre contents varied significantly among the genotypes. The highest crude fibre (49.0%) and neutral detergent fibre (72.0%) contents were from Mokwa, while the least crude fibre (31.0%) was recorded from Dauro, and the least neutral detergent fibre (55.0%) was from Maiwa 25-2 (Table 2). The acid detergent fibre content of the genotypes ranged from 35.00 to 50.00%. The highest ADF content (50.0%) was from Mokwa, while the least (35.0%) was from Maiwa 25-2. The highest acid detergent lignin (17.0%) was observed in Gero, while the least (12.0%) was from Dauro (Table 2).

The lowest values in growth performance

were recorded for all parameters at 2 weeks after planting (WAP). Plant height was 11.03 cm, number of tillers was 1.36, primary leaves were 4.15, secondary leaves were 3.47, leaf area was 19.56 cm^2, and crown spread was 27.90 cm (Table 3). Growth parameters increased progressively with age. Maximum plant height was attained at 10 WAP (179.56 cm), which was not significantly different from that at 9 WAP (176.24 cm). Average number of primary leaves reached its peak at 9 WAP (11.18), which was slightly higher than at 8 WAP (10.94). The highest number of tillers (2.47) and secondary leaves (8.45) were recorded at 6 WAP. The crown spread was widest at 8 WAP (110.86 cm), although it was not significantly higher than the values at 9 WAP (107.89 cm) and 10 WAP (106.23 cm). Leaf area showed a sharp increase and peaked at 9 WAP (295.36 cm^2), before declining slightly at 10 WAP (206.32 cm^2) - Table 3.

The Kankara genotype recorded the tallest plants at 141.01 cm, while the shortest plants were from Maiwa UI 25-2 (70.89 cm), which were not significantly shorter than those of Maiwa UI 94-2 (76.97 cm) and Maiwa UI 28-1 (78.22 cm) - Table 4. The highest number of tillers (2.88) was observed in Maiwa UI 25-2, which also had the highest number of leaves on secondary tillers (9.21). However, this genotype produced the lowest number of leaves on primary tillers (7.13) among the pearl millet genotypes. Gero had the lowest number of tillers (1.24), secondary leaves (2.35), and crown spread (72.50 cm). The highest number of leaves on the primary tiller was recorded in Sosat (9.23), Mokwa (9.38), and Dauro (9.26), while the lowest values were observed in Maiwa UI 28-1 (8.42) and Maiwa UI 94-2 (7.92). Leaf area varied significantly across the genotypes, with the lowest observed in Sosat (91.36 cm^2), which was not significantly lower than from Gero (96.62 cm^2). The highest leaf area (198.34 cm^2) and crown spread (95.53 cm) were both observed in Dauro, indicating its superior vegetative growth performance among the tested genotypes (Table 3).

There were significant differences in plant height among the pearl millet genotypes up to 10 weeks after planting (Figure 1). Kankara consistently recorded the tallest plants, ranging from 2 WAP (25.70 cm) to 10 WAP (231.17 cm), with no significant differences observed across these stages. At 6 WAP, Zatib (125.42 cm), Gero (135.83 cm), and Sosat (97.92 cm) were not significantly different, and a similar trend was observed at 8 WAP (201.92, 218.08, and 206.67 cm, respectively), 9 WAP (214.39, 225.44, and 207.89 cm, respectively), and 10 WAP (214.78, 221.17, and 208.44 cm, respectively). By 10 WAP, Gero, Zatib, and Kankara reached their maximum heights of 221.17 cm, 214.78 cm, and 231.17 cm, respectively, after which growth plateaued and flowering commenced. In contrast, Bunkure showed continued growth beyond 10 WAP, attaining 355.25 cm at 20 WAP and peaking at 417.30 cm at 22 WAP, the tallest recorded among all genotypes. This final height was not significantly different between Dauro (386.25 cm), Mokwa (382.25 cm), and Maiwa UI 28-1 (336.25 cm), which also continued vegetative growth up to 22 WAP before flowering. The lowest plant heights during early growth stages (3–5 WAP) were recorded for Maiwa UI 28-1 (19.80–54.25 cm) and Maiwa UI 94-2 (25.40–54.25 cm) while at 6, 8, 9, and 10 WAP, Maiwa UI 25-2 consistently showed the least heights (70.25, 106.75, 111.67, and 116.56 cm, respectively). Overall, Gero, Zatib, and Kankara completed vegetative growth by 10 WAP while Maiwa UI 25-2, Maiwa UI 94-2, Maiwa UI 28-1, Dauro, Bunkure, and Mokwa continued growth up to 22 WAP when they transitioned into flowering (Figure 1).

There were significant differences in the number of tillers per plant among the pearl millet genotypes from 2 to 8 WAP, while no significant differences were observed at 9 and 10 WAP (Figure 2). At 2 WAP, Maiwa UI 94-2 recorded the highest number of tillers (2.18), which was similar to those of Mokwa (1.66), Dauro (1.75), Zatib (1.58), and Maiwa UI 25-2 (1.50), but significantly higher than Sosat (0.96) and Gero (0.00). By 3 WAP, Maiwa UI 28-1 (2.75) and Dauro (2.65) produced more tillers compared to Sosat (1.15) and Gero (1.00), while other genotypes were intermediate. At 4 WAP, Dauro (3.75) had the highest number of tillers, followed closely by Maiwa UI 25-2 (2.67) and Maiwa UI 94-2 (2.92). In contrast, Sosat (1.60) and Gero (1.50) had the lowest numbers. At 5 WAP, Maiwa UI 25-2 (3.50) and Mokwa (3.25) produced significantly more tillers than Sosat (1.33) and Gero (1.50). Similarly, at 6 WAP, the Maiwa UI 25-2 recorded the highest value (3.83), which was higher than that of Sosat (2.75), Gero (1.42), and Kankara genotypes (2.50). Other genotypes, such as Dauro (2.75) and Zatib (2.42), remained intermediate. At 7 and 8 WAP, Maiwa UI 25-2 consistently maintained the highest number of tillers (3.50 and 3.45, respectively), followed by Dauro (1.67 and 2.08) and Maiwa UI 28-1 (2.42 and 2.33). However, Sosat (1.58), Kankara (1.92), and Gero (1.17–1.67) recorded the lowest tiller counts. Beyond 8 WAP, no significant differences were observed among genotypes, with most showing slight declines or stagnation in tiller production. Gero consistently produced the fewest tillers across all stages of growth, averaging below 2.0 from 2 to 10 WAP.

Table 2: Herbage yield and chemical composition of pearl millet genotypes

Genotypes	Fresh weight (g)	DMY /ha (tons)	DM (%)	CP (%)	CF (%)	ASH (%)	NDF (%)	ADF (%)	ADL (%)
Sosat	6.50^{b}	2.03^{b}	30.41^{abc}	7.10^{b}	33.0^{c}	10.75^{e}	59.00^{cd}	45.0^{ab}	13.5^{ab}
Bunkure	11.46^{ab}	3.60^{ab}	31.40^{abc}	6.50^{b}	44.0a^{b}	15.5^{ab}	68.0^{ab}	36.00^{cd}	14.5^{ab}
Mokwa	11.24^{ab}	3.57^{ab}	29.94^{abc}	7.05^{b}	49.0^{a}	17.0^{a}	72.0^{a}	50.00^{a}	13.0^{ab}
Kankara	10.41^{ab}	3.31^{ab}	24.54^{c}	7.35^{ab}	45.0^{ab}	12.5^{cde}	64.00^{bc}	43.0^{abc}	13.0^{ab}
Zatib	8.21^{b}	2.86^{ab}	35.88^{a}	6.95^{b}	40.0^{abc}	12.0^{de}	63.00^{bc}	43.00^{abc}	16.0^{a}
Maiwa 25-2	6.50^{b}	1.81^{b}	28.14^{bc}	7.60^{ab}	33.0^{c}	13.0^{cde}	55.00^{d}	35.00^{d}	13.0^{ab}
Maiwa 94-2	6.50^{b}	1.84^{b}	27.85^{bc}	9.03^{a}	39.0^{abc}	14.0^{bcd}	66.00^{abc}	45.00^{ab}	16.5^{a}
Dauro	14.51^{a}	4.45^{a}	30.19^{abc}	6.85^{b}	31.0^{c}	14.5^{bc}	62.00^{bc}	43.00^{abc}	12.0^{b}
Maiwa 28-1	9.83^{ab}	3.20^{ab}	32.29^{ab}	6.65^{b}	36.0^{bc}	16.25^{ab}	63.00^{bc}	40.00^{bcd}	15.0^{ab}
Gero	6.46^{b}	1.74^{b}	25.04^{c}	6.50^{b}	39.0^{abc}	11.00^{e}	61.00^{bcd}	44.0^{ab}	17.0^{a}
SEM	0.59	0.22	0.75	0.20	1.18	0.35	0.86	0.88	0.41

$^{a-e:}$ Means in the same column with different superscript are significantly different (P<0.05); SEM= Standard Error of Mean

Table 3: Variations in growth parameters across pearl millet genotypes

Weeks	PH(cm)	NT	PLV	SLV	LA (cm^2)	CS (cm)
2	11.03^{h}	1.36^{c}	4.15^{g}	3.47^{d}	19.56^{d}	27.90^{g}
3	31.21^{g}	1.93^{b}	5.40^{f}	4.92^{cd}	30.93^{d}	47.35^{f}
4	51.46^{f}	2.37^{a}	7.39^{e}	6.40^{bc}	42.21^{d}	64.87^{e}
5	68.50^{e}	2.42^{a}	8.03^{d}	7.15^{ab}	97.58^{c}	78.17^{d}
6	99.89^{d}	2.47^{a}	9.71^{c}	8.45^{a}	129.59^{c}	97.26^{c}
7	143.79^{c}	2.10^{ab}	10.54^{b}	6.60^{abc}	181.57^{b}	103.75^{b}
8	168.19^{b}	2.16^{ab}	10.94^{ab}	6.05bc	203.56^{b}	110.86^{a}
9	176.24^{a}	1.98^{b}	11.18^{a}	5.55^{bc}	295.36^{a}	107.89^{ab}
10	179.56^{a}	1.92^{b}	10.58^{b}	5.27^{bcd}	206.32^{b}	106.23^{ab}
SEM	0.36	0.02	0.03	0.13	3.06	0.29

$^{a-g:}$ Means in the same column with different superscript are significantly different ($P<0.05$)
Legend: PH: plant height; NT: number of tillers; PLV: primary leaves; SLV: secondary leaves; LA: leaf area; CS: crown spread.

Table 4: Maximum Growth of Pearl millet genotypes

Genotypes	PH(cm)	NT	PLV	SLV	LA(cm^2)	CS(cm)
Sosat	118.15^{c}	1.69^{d}	9.23^{a}	5.05^{cd}	91.36^{c}	71.32^{f}
Bunkure	96.60^{d}	2.06^{cd}	9.15^{ab}	6.02^{bcd}	173.76^{ab}	88.32^{b}
Mokwa	99.71^{d}	2.07^{cd}	9.38^{a}	6.02^{bcd}	167.11^{ab}	88.48^{b}
Kankara	141.01^{a}	1.77^{d}	8.71^{bcd}	4.45^{d}	117.89^{bc}	84.12^{bcd}
Zatib	126.14^{b}	1.91^{d}	8.45^{cd}	5.35^{cd}	127.49^{bc}	78.54^{e}
Maiwa UI 25-2	70.89^{f}	2.88^{a}	7.13^{f}	9.21^{a}	118.73^{bc}	82.30^{cde}
Maiwa UI 94-2	76.97^{e}	2.39^{bc}	7.92^{e}	6.61^{bcd}	124.86^{bc}	80.31^{de}
Dauro	97.25^{d}	2.32^{bc}	9.26^{a}	7.86^{ab}	198.34^{a}	95.53^{a}
Maiwa UI 28-1	78.22^{e}	2.45^{b}	8.42^{d}	6.92^{bc}	124.59^{bc}	85.57^{bc}
Gero	130.23^{b}	1.24^{e}	8.91^{abc}	2.35^{e}	96.62^{c}	72.50^{f}
SEM	0.40	0.02	0.03	0.14	3.40	0.32

$^{a-g:}$ Means in the same column with different superscripts are significantly different ($P<0.05$)
Legend: PH: plant height; NT: number of tillers; PLV: primary leaves; SLV: secondary leaves; LA: leaf area; CS: crown spread.

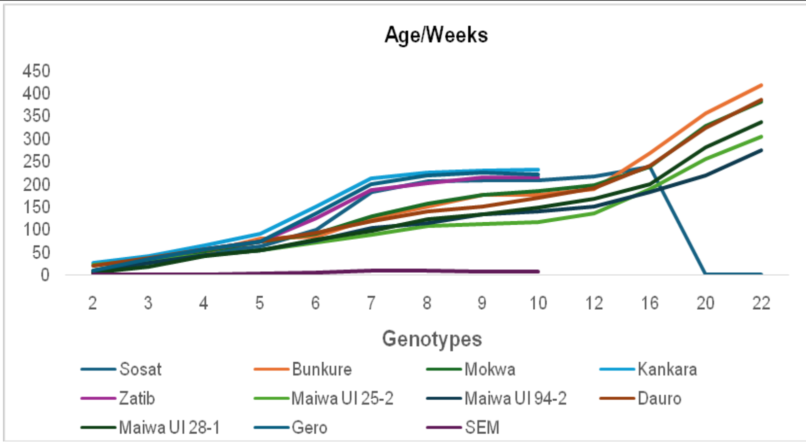

Fig 1: Plant height (cm) of pearl millet genotypes at different stages of growth

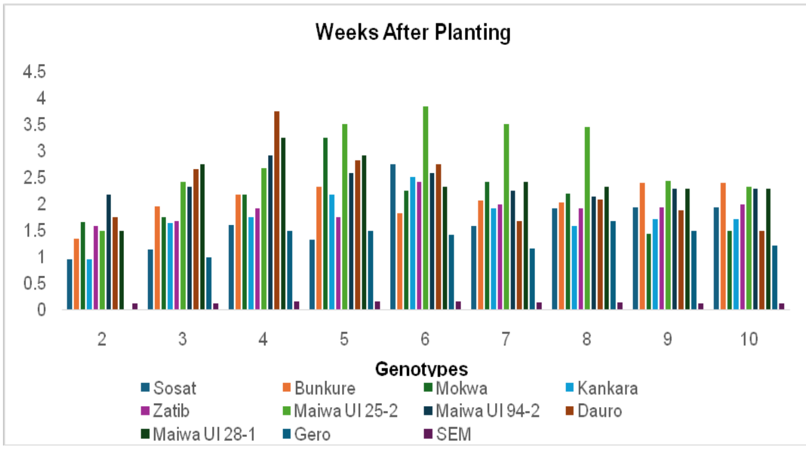

Fig2: Average number of tillers of pearl millet genotypes at different stages of growth

There were significant differences in leaf area among the pearl millet genotypes at different sampling dates (Figure 3). At 2 WAP, Kankara recorded the highest leaf area (42.36 cm²), which was significantly higher than Maiwa UI 28-1 (9.37 cm²) but statistically similar to Sosat (23.52 cm²), Zatib (23.65 cm²), and Dauro (22.37 cm²). At 3 WAP, Kankara again maintained the highest value (53.64 cm²), followed by Dauro (42.37 cm²) while Maiwa UI 28-1 had the lowest (12.37 cm²). By 4 WAP, leaf area increased across all genotypes, with Dauro (62.95 cm²) and Kankara (60.30 cm²) producing the largest leaves, significantly higher than Maiwa UI 28-1 (18.16 cm²) and Maiwa UI 94-2 (23.48 cm²).At 5 WAP, Kankara reached 132.34 cm², significantly higher than Maiwa UI 94-2 (55.73 cm²) and Maiwa UI 28-1 (70.96 cm²), while Mokwa (116.22 cm²) and Dauro (116.14 cm²) remained intermediate. By 6 WAP, Sosat (156.77 cm²), Mokwa (155.47 cm²), and Zatib (161.69 cm²) recorded the highest leaf areas, while Maiwa UI 28-1 (97.42 cm²) and Maiwa UI 94-2 (101.91 cm²) were the lowest. At 7 WAP, Dauro produced the largest leaves (264.46 cm²), followed by Mokwa (219.53 cm²), whereas Sosat (143.25 cm²) and Gero (147.93 cm²) were significantly lower.From 8 to 10 WAP, Bunkure and Dauro dominated. At 8 WAP, Mokwa (306.72 cm²) and Dauro (348.94 cm²) recorded the highest values, while Zatib (116.08 cm²) and Sosat (126.33 cm²) were the lowest. At 9 WAP, Bunkure (339.99 cm²), Dauro (385.09 cm²), Mokwa (306.59 cm²), and Maiwa UI 94-2 (285.39 cm²) showed no significant differences. By 10 WAP, Bunkure attained the maximum leaf area (430.09 cm²), which was statistically similar to Dauro (399.56 cm²) but significantly higher than Sosat (101.01 cm²) and Zatib (114.94 cm²).

Significant differences were observed in crown spread among pearl millet genotypes across growth stages (Table 5). At 2 WAP, Dauro (40.64 cm²) had the widest crown, while Sosat (22.36 cm²) and Gero (22.34 cm²) were narrowest. By 3 WAP, Dauro (59.37 cm²) and Kankara (57.35 cm²) were highest, whereas Maiwa UI 94-2 remained lowest (35.36 cm²). At 6 WAP, Dauro maintained the widest crown (114.42 cm²). At 7 WAP, Mokwa (120.25 cm²) led but did not differ significantly from Maiwa UI 94-2 (112.97 cm²), Dauro (112.42 cm²), Bunkure (112.36 cm²), and Maiwa UI 28-1 (111.25 cm²). Similarly, at 8 WAP, Mokwa (131.61 cm²) was highest but comparable to Bunkure, Dauro, and Maiwa UI 25-2. By 10 WAP, Bunkure (129.67 cm²) led, statistically similar to Dauro, Maiwa UI 28-1, and Maiwa UI 94-2. Sosat and Gero consistently had the narrowest crowns (Table 5).

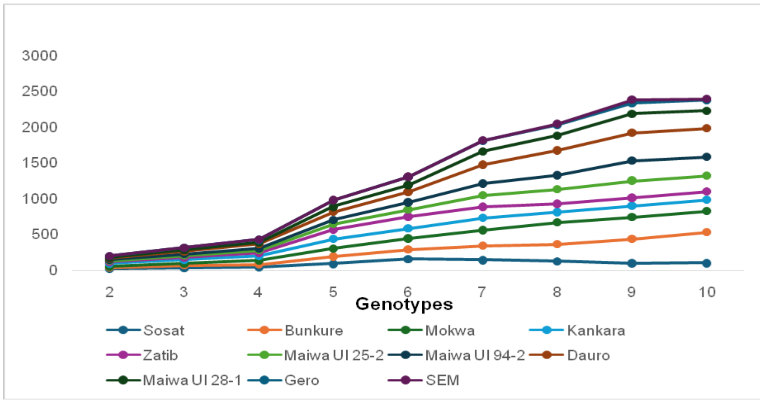

Figure 3: Leaf area (cm²) of genotypes across the specified sampling dates

Table 5: Crown spread (cm²) of genotypes at different stages of growth (WAP)

			Age (Weeks)				
Genotypes	2	3	4	5	6	7	8
Sosat	22.36^{b}	41.33^{abc}	61.17^{abc}	73.92^{cde}	96.58^{ab}	91.08^{c}	89.08^{e}
Bunkure	33.66^{ab}	57.23^{ab}	77.93^{a}	90.00^{ab}	91.50^{b}	112.36^{ab}	123.42^{ab}
Mokwa	28.56^{ab}	48.23^{abc}	66.07^{abc}	80.08^{bcd}	100.83^{ab}	120.25^{a}	131.61^{a}
Kankara	36.32^{ab}	57.35^{ab}	78.30^{a}	94.50^{a}	104.33^{ab}	95.42^{c}	102.47^{cde}
Zatib	25.37^{ab}	47.56^{abc}	65.27^{abc}	77.67^{b-e}	103.83^{ab}	92.33^{c}	93.42^{de}
Maiwa UI 25-2	23.67^{ab}	39.37^{bc}	54.77^{c}	69.33^{de}	87.92^{b}	98.33^{bc}	124.50^{ab}
Maiwa UI 94-2	21.37^{b}	35.36^{c}	50.29^{c}	64.75e	84.75^{b}	112.97^{ab}	117.47^{abc}
Dauro	40.64^{a}	59.37^{a}	73.94^{ab}	84.17^{abc}	114.42^{a}	112.42^{ab}	126.17^{ab}
Maiwa UI 28-1	24.69^{ab}	44.56^{abc}	61.96^{abc}	74.67^{cde}	99.83^{ab}	111.25^{ab}	109.50^{bcd}
Gero	22.34^{b}	43.13^{abc}	59.00^{bc}	72.67^{cde}	88.58^{b}	91.08^{c}	91.00^{e}
SEM±	1.85	2.03	2.19	1.97	2.28	2.30	3.17

$^{a-e:}$ Means in the same column with different superscripts are significantly different (P<0.05)

DISCUSSION

Evaluation of pearl millet genotypes for forage production in Nigeria's Derived Savannah agro ecology revealed significant variations in herbage yield and composition. Fresh weight ranged from 6.50–14.51 t/ha, while DMY/ha varied between 1.74 and 4.45 t/ha. Dauro produced the highest fresh weight and DMY/ha, attributable to its superior stem vigor, higher leaf-to-stem ratio and favorable crude protein content, which support both biomass accumulation and nutritive quality. These attributes align with Kumar *et al.* (2016), who linked high DMY to deep rooting and efficient water use. In contrast, some genotypes with lower yields likely lacked these traits, limiting forage potential. The significant SEM values confirm robust genotypic differences, consistent with Singh and Singh (2012) in similar agro-ecologies.

The high Crude protein (CP) of Maiwa UI 94-2 exceeds the 7–8% CP threshold required for maintaining ruminant health (Blümmel *et al.,* 2012), making it valuable for smallholder dairy farmers. However, its low yield necessitates intercropping or supplemental feeding to meet bulk forage demands. The CP content varied significantly among genotypes. Its lower DMY/ha suggests it can be considered for forage quality and yield, a trait observed mostly in dual-purpose pearl millet systems (Blümmel *et al.,* 2012). On the other hand, the CP and DM values of Zatib aligns with the results of Rai *et al.* (2008), who observed the same nutrient contents in genotypes characterized by high herbage production and good nutritional value. This is in agreement with reports by Ajeigbe *et al.* (2013), who observed that these genotypes have been found to be suitable for grain and fodder production in agro-pastoral systems.

The low NDF of Maiwa UI 25 suggests its suitability for poultry, which cannot tolerate fibre levels above 15–20% (FAO, 2019). However, Mokwa's high NDF limits its use to ruminants but aligns with findings by Maiti *et al.* (2011), who noted that high-fibre forages improve rumen function in cattle and Blümmel *et al.* (2012) for forage utility in mixed crop-livestock systems. Genotypic variance was further exhibited in ash content and crude fiber. Mokwa's high ash content indicates mineral-rich forage, potentially beneficial for livestock grazing on nutrient-depleted soils (FAO, 2019). However, Gero's low DM and high ADL highlight its limitations in both yield and digestibility, emphasizing the need for multi-trait selection in breeding programs, as noted by Ajeigbe *et al.* (2013).

Evaluation of the growth characteristics of the ten genotypes of pearl millet revealed significant genotypic differences in height, tillering ability, number of leaves, leaf area, crown spread, and fodder yield. The study showed that plant height is highest in Bunkure, Mokwa, Maiwa UI 25-2, Maiwa UI 94-2, Dauro, and Maiwa UI 28-1 at 22 weeks after planting (WAP), indicating this as the peak growth stage. No further measurements beyond 22 WAP were recorded, suggesting growth stabilized thereafter. Genetic factors influencing stem elongation and internode length (Zhang *et al.*, 2018) contributed to these differences, underscoring the role of genotypic variation in determining height performance across pearl millet genotypes. The genetic makeup of Bunkure, Mokwa, Maiwa UI 25-2, Maiwa UI 94-2, Dauro, and Maiwa UI 28-1 likely includes combinations of these genes that promote plant height. The low values in plant height initially recorded for Sosat, Bunkure, Mokwa, Zatib, Maiwa UI 94-2, and Maiwa UI 28-1 at 2 weeks after planting (WAP) may be due to the combination of genes that temporarily suppress early shoot growth. A study conducted by Begcy *et al.* (2018) suggests that variations in genes related to seed germination, early shoot elongation, and overall seedling vigor can contribute to differences in early plant height. Early growth patterns and responses to external stimuli, known as phenotypic plasticity, can contribute to variations in plant height among genotypes (Fusco and Minelli, 2010).

Pearl millet appears to be susceptible to excessive rainfall, especially at the initial stage of growth. Gero, Kankara, Sosat, and Zatib had their growth completed at 10WAP, as it coincided with maturity, which prevented further growth of the plant. The plant height values for Bunkure, Mokwa, and Kankara in this study were higher than those observed by Kitaw (2024) and Haussmann (2006) which could be due to variations in environmental conditions and genotypic differences.

The tillering capacity of pearl millet was higher in Maiwa UI 28-1, Dauro, Mokwa, and Maiwa UI 25-2 from 2 WAP till the 8 WAP. This ability to produce more tillers than other genotypes would contribute to their forage yield potential through increased leaf production and the ability to intercept light for active internode elongation, as noted by Capstaff (2018). However, there was no increase in the number of tillers after 8WAP for Sosat, Gero, Zatib, Kankara, Maiwa UI 28-1, Maiwa UI 94-2, Maiwa UI 25-2, and Dauro. This decrease could partly result from competition for nutrients, energy substrates, moisture, and light by the pearl millet. Also, genetic variation in the initiation of flowering may play a role, as differences in flowering time can influence resource allocation and overall plant performance. The average number of leaves on primary and secondary tillers ranged from 4 to 14 throughout the weeks. The highest number of primary leaves was initially observed in Sosat and Gero; however, due to less photosynthetic activity resulting from mature leaves turning yellow in the later weeks of growth, the number of leaves reduced. This reduction could also be attributed to genetic variations.

Dauro, Maiwa UI 94-2, Maiwa UI 25-2, and Mokwa exhibited the highest number of leaves, as well as primary and secondary tillers, from 8 to 10 WAP. This suggests that a longer growth period promotes increased leaf production. Differences in photoperiod sensitivity and growing degree days (GDD) among genotypes might account for this trend.

Variations in nutrient use efficiency could also be a contributing factor, influencing overall plant development and productivity. Bunkure had the highest number of leaves, although it produced fewer primary tiller leaves and had strong potential for forage production due to its secondary leaves. Similar variations in the number of leaves on tillers have been reported for different varieties of pearl millet by Faridullah *et al.* (2010) and Muhammad *et al.* (1994).

There were variations in the leaf area values across genotypes evaluated. The leaf area of Bunkure, Dauro, Mokwa, Maiwa UI 28-1, and Maiwa UI 94-2 increased throughout the study, whereas the leaf area of 7 WAP Sosat, Kankara, Zatib, and Gero had decreased. The reduction in leaf area could be a result of the age of the leaves, which led to the withering of the basal leaves and decreased photosynthetic activity. A similar variation in leaf area values was observed by Faridullah *et al.* (2010) and Muhammad *et al.* (1994). Maiwa UI 25-2, Maiwa UI 28-1, and Maiwa UI 94-2 exhibited high crown spread at 10 WAP, likely due to vigorous tillering and a broader leaf area, which enhanced canopy expansion. Conversely, Gero and Sosat recorded the least crown spread. Wider crowns improve weed suppression, erosion control, and soil shading (Kumar *et al.*, 2016).

CONCLUSION

This study underscores the existence of substantial genotypic variability in the agronomic traits of pearl millet under the Derived Savannah agro ecology of Nigeria. Differences observed in plant height, tillering ability, leaf production, leaf area, and crown spread highlight the potential for identifying genotypes with desirable attributes suited for forage production. Genotypes with greater height demonstrate suitability for farmers seeking robust plants with higher above-ground biomass, while those with prolific tillering and leaf production present opportunities for enhanced forage yield through increased vegetative growth. Similarly, wider crown spread and expansive leaf area reflect genotypes with greater canopy coverage, which can contribute to effective weed suppression, soil protection, and improved forage quality. These variations suggest the potential to select genotypes that align with specific production objectives, such as maximizing biomass accumulation, improving forage quality, or enhancing resilience in varying field conditions. The findings therefore, provide a useful foundation for targeted genotype selection and breeding interventions aimed at optimizing forage production in the region.

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