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Forage Growth Biomass, Yield and Quality Responses of Three Varieties Napier at Cutting Intervals in the South West Nigeria

Joshua Femi Oluwadele, Anthony Henry Ekeocha and Adeolu Ademiju Aganga
Department of Animal Production and Health, Federal University Oye-Ekiti, Ekiti State, Nigeria

ABSTRACT

Background and Objective: Forage crops are essential for livestock production, particularly in tropical regions like Southwest Nigeria. Napier grass (*Pennisetum purpureum*), widely known for its high biomass yield and nutritional value, is a popular choice for livestock feed. This study aims to evaluate the growth, biomass yield and forage quality of three Napier grass varieties (Pakchong-1, CO-3 and Giant Napier) under three different cutting intervals (40, 60 and 80 days), providing insights for optimizing forage management practices. **Materials and Methods:** The experiment involved planting the three varieties of Napier grass and evaluating their responses to cutting intervals of 40, 60 and 80 days. Key parameters measured included plant height, tiller number per plant, leaf-to-stem ratio (LSR), fresh and dry biomass yield and forage quality indicators such as crude protein, neutral detergent fiber (NDF), acid detergent fiber (ADF), calcium, magnesium and phosphorus content. Data were statistically analyzed to determine significant differences among the varieties and cutting intervals. **Results:** The results revealed significant differences in growth and biomass yield among the three varieties. Pakchong-1 exhibited the tallest plants, the highest tiller number and the greatest biomass yield across all cutting intervals. The CO-3 maintained a higher LSR, indicating better leaf retention. Biomass yield increased with longer cutting intervals, with Pakchong-1 yielding the highest fresh and dry biomass at 80 days. However, shorter cutting intervals favored higher crude protein content, which decreased as intervals lengthened. Fiber content (NDF and ADF) increased with longer intervals, reducing digestibility. **Conclusion:** Pakchong-1 yields more biomass with longer cuts, while CO-3 offers better forage quality with frequent cuts, optimizing tropical livestock feed.

KEYWORDS

Napier grass varieties, cutting intervals, biomass yield, forage quality, livestock production, tropical agriculture

INTRODUCTION

Forage crops are vital for the sustainability of livestock production, particularly in tropical regions where they provide the primary feed source for ruminants. *Pennisetum purpureum* commonly known as Napier grass stands out due to its high biomass yield, nutritional quality and adaptability to various environmental conditions[1]. Napier grass widely known as elephant grass is mostly cultivated in Africa, Asia and Latin America to meet the growing feed demands of dairy and beef cattle[2].

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Napier grass can produce substantial biomass even under marginal soil conditions and minimal inputs which makes it a cost-effective forage option for smallholder farmers[3]. Furthermore, its nutritional profile, characterized by relatively high crude protein content and digestible fiber, supports the health and productivity of ruminants[3,4]. These attributes make Napier grass a preferred choice over other forages, such as maize and sorghum. Cutting interval refers to the frequency at which the grass is harvested and it significantly influences growth dynamics, nutrient composition and overall productivity[5]. Thus, exploring cutting intervals of Napier grass is crucial for maximizing the yield and quality. Shorter cutting intervals enhance forage quality by harvesting younger, more nutritious leaves but may reduce overall biomass yield[6]. In contrast, longer intervals allow for greater biomass accumulation but result in lower nutritional quality as the plant matures and fiber content increases[6].

Different varieties of Napier grass exhibit varying responses to cutting intervals due to genetic differences in growth patterns, nutrient uptake and stress tolerance[7]. Hybrid varieties such as Pakchong-1 and CO-3 are known for their superior yield and nutritional quality compared to traditional varieties like Giant Napier[8]. Therefore, comparative studies of different Napier grass varieties under Environmental factors like climate, soil type, slope and drainage greatly impact the optimal planting spacing for Napier grass. In areas with high rainfall and fertile soils, closer spacing can enhance biomass yield. Conversely, in drier or less fertile conditions, wider spacing reduces competition for water and nutrients. On slopes or poorly drained soils, wider spacing helps prevent erosion and waterlogging, ensuring healthier root development and overall plant growth. Tailoring spacing to these conditions optimizes productivity and under various cutting, intervals is essential to optimize forage management practices[9].

This study aims to evaluate the growth, biomass yield and quality responses of three varieties of Napier grass (Pakchong-1, CO-3 and Giant Napier) at three different cutting intervals (40, 60 and 80 days).

MATERIALS AND METHODS

Study area: The study was conducted at the Teaching and Research Farm of the Federal University Oye-Ekiti, located in Oye-Ekiti, Ekiti State, Nigeria. The farm's geographical coordinates are approximately 7.75°N Latitude and 5.33°E Longitude. The site is situated at an altitude of 370 m above sea level, providing a representative environment for studying tropical forage crops. The study was conducted during 2023 and 2024, respectively for 2 years.

Climate: Oye-Ekiti experiences a tropical climate characterized by distinct wet and dry seasons. The wet season typically spans from April to October, with peak rainfall occurring between July and September. The average annual rainfall is about 1400 mm. The dry season extends from November to March, with lower humidity and minimal rainfall. The average temperature ranges from 22 to 28°C, with relative humidity varying between 60 and 80%.

Soil characteristics: The soil in the study area is classified as sandy loam, which is well-drained and suitable for the cultivation of Napier grass. Soil samples were collected at a depth of 0-20 cm for initial analysis to determine baseline soil properties. Key parameters measured included pH, organic matter content, nitrogen, phosphorus, potassium and cation exchange capacity (CEC).

Experimental design: A 3×3 factorial experiment was designed to evaluate the effects of three cultivars of Napier hybrid grass (*Pennisetum purpureum*×*Penicillium glaucum*, CO-3 and Giant Napier) and three cutting intervals (40, 60 and 80 days) on forage growth, dry matter (DM) yield and crude protein (CP) concentration.

Treatments: The treatments consisted of Cultivars of Pakchong-1, CO-3 and Giant Napier. The cutting intervals consist of 40, 60 and 80 days.

Plot layout: The experimental plots were laid out in a rectangular field. Each plot measured 5 by 5 m, with a 1 m buffer zone between plots to minimize edge effects and ensure uniformity in growth conditions. The total experimental area covered approximately 0.5 ha.

Randomization: The treatments were randomly assigned to the plots within each block to reduce the impact of spatial variability on the results. The randomization process was carried out using a random number generator to assign treatments to plots within each block.

Soil preparation and planting

Land preparation: The study area was cleared of existing vegetation and debris before soil preparation. The following steps were taken to prepare the soil for planting:

- **Plowing:** The field was plowed to a depth of 20 cm to break up the soil and improve aeration
- **Harrowing:** The field was harrowed to further break down soil clods and create a fine tilth suitable for planting
- **Ridging:** Ridges were created at a spacing of 1 m apart to facilitate planting and management of the crops

Planting materials: Stem cuttings of the Pakchong-1, CO-3 and Giant Napier hybrids were obtained from a certified nursery. The cuttings were approximately 20-25 cm long and contained 3-4 nodes each to ensure adequate root development and establishment.

Planting procedure: The stem cuttings were planted horizontally in the ridges at a spacing of 1 by 1 m. This spacing was chosen to provide adequate space for the growth and development of the plants and to allow for easy management practices such as weeding and irrigation. Each cutting was buried to a depth of 10 cm, leaving a portion of the stem exposed to facilitate sprouting.

Irrigation and weed control: Initial irrigation was provided to ensure good establishment of the cuttings. Subsequently, the plots were irrigated as needed, particularly during dry spells, to maintain optimal soil moisture levels. Weeds were controlled manually to minimize competition for nutrients and water.

Data collection

Growth parameters: Data on growth parameters were collected at regular intervals throughout the study period. The following growth parameters were measured:

- **Plant height:** The height of the plants was measured from the base to the tip of the tallest leaf using a meter rule. Measurements were taken at 2-week intervals from planting to harvest
- **Number of tillers:** The number of tillers per plant was counted manually at each measurement interval. Tillers are shoots that emerge from the base of the plant and contribute to overall biomass production
- **Leaf area:** Leaf area was measured using a leaf area meter. The leaf area was measured using a LI-3000C Portable Leaf Area Meter (LI-COR Biosciences, Lincoln, Nebraska, USA), which accurately determines leaf area for plant studies under various environmental conditions. A representative sample of leaves was collected from each plot and the leaf area was recorded

Yield parameters: Yield data were collected at each cutting interval. The following yield parameters were measured:

- **Fresh biomass yield:** The fresh weight of the harvested biomass was measured immediately after cutting using a digital scale. The biomass was cut at a height of 10 cm above ground level to simulate grazing or cutting for forage
- **Dry matter yield:** A subsample of the fresh biomass was taken and dried in an oven at 65°C until a constant weight was achieved. The dry weight was recorded and the dry matter yield was calculated

Forage quality analysis: Forage quality analysis was conducted on the dried biomass samples. The following nutritional parameters were analyzed:

- **Crude protein content:** Crude protein content was determined using the Kjeldahl method[10]. This involves digestion, distillation and titration to quantify the nitrogen content, which is then converted to crude protein
- **Fiber content:** Neutral detergent fiber (NDF) and acid detergent fiber (ADF) were measured using standard laboratory procedures. These parameters indicate the cell wall content of the forage and are important indicators of digestibility
- **Mineral content:** The mineral content, including calcium (Ca), magnesium (Mg) and phosphorus (P), was analyzed using atomic absorption spectrophotometry. This analysis provides insights into the mineral nutrition provided by the forage

Sampling procedure: At each cutting interval, representative samples were collected from each plot for yield and quality analysis. The samples were taken from the central area of the plots to avoid edge effects. Fresh biomass was weighed on-site and subsamples were transported to the laboratory for further analysis.

Statistical analysis

Data management: Data collected from the field and laboratory analyses were recorded in a structured format using Microsoft Excel. The data were checked for accuracy and completeness before analysis.

Analysis of Variance (ANOVA): The effects of hybrid variety and cutting interval on growth, yield and forage quality parameters were analyzed using Analysis of Variance (ANOVA)[10]. The ANOVA model included the main effects of the hybrid variety, cutting interval and their interaction. The statistical significance of the effects was determined at a 5% significance level ($p<0.05$).

Mean separation: Where significant differences were found, mean separation was performed using the least significant difference (LSD) test. This *post-hoc* test allowed for the comparison of treatment means to identify specific differences between hybrid varieties and cutting intervals.

Experimental timeline: The study was conducted over a period of 12 months to capture the full growth cycle of the Napier grass hybrids and the effects of different cutting intervals. The timeline included the following phases:

- **Preparation phase:** Soil preparation and planting (month 1)
- **Establishment phase:** Initial growth and establishment of cuttings (months 2-3)
- **Growth and harvest phase:** Regular data collection and harvesting at designated cutting intervals (months 4-12)
- **Analysis phase:** Laboratory analysis of forage quality and statistical analysis of data (months 6-12)

Environmental and management practices

Fertilization: To ensure adequate nutrient availability, a balanced fertilizer was applied at the beginning of the study and after each harvest. The fertilizer rate was determined based on soil test results and the nutritional requirements of Napier grass. The fertilizer applied included nitrogen (N), phosphorus (P) and potassium (K) in a ratio of 20:10:10.

Pest and disease management: Regular monitoring of the plots was conducted to identify any pest or disease outbreaks. Integrated pest management (IPM) practices were employed, including the use of biological control agents and environmentally friendly pesticides when necessary. Disease management involves the use of resistant planting materials and proper sanitation practices.

Data quality control: To ensure the accuracy and reliability of the data, the following quality control measures were implemented:

- **Calibration of instruments:** All measuring instruments, including scales, leaf area meters and spectrophotometers, The UV-Vis spectrophotometer was from Agilent Technologies (Santa Clara, California, USA), the pH meter from Thermo Fisher Scientific (Waltham, Massachusetts, USA) and the centrifuge from Eppendorf (Hamburg, Germany) were calibrated regularly to ensure accurate measurements
- **Training of personnel:** Field and laboratory personnel were trained on data collection and analysis protocols to minimize errors and variability
- **Replicate measurements:** Multiple measurements were taken for each parameter to account for variability and improve the precision of the data.

RESULTS

Table 1 presents the effects of three Napier grass varieties Pakchong-1, CO-3 and Giant Napier on various parameters of forage growth, biomass yield and quality over three cutting intervals (40, 60 and 80 days). It summarizes key metrics such as plant height, tiller number, leaf-to-stem ratio, fresh and dry biomass yields, crude protein content and fiber components (NDF and ADF), as well as essential mineral concentrations (calcium, magnesium and phosphorus). Results are expressed as means with standard deviations, highlighting significant differences among the varieties and cutting intervals.

Table 1: Forage growth biomass, yield and quality responses of three varieties of napier at three cutting intervals

Parameter	40 Days	60 Days	80 Days
Plant height (cm)			
Pakchong-1	180.5±7.2^{b}	200.5±8.2^{c}	220.6±9.8^{d}
CO-3	150.4±6.5^{c}	170.3±7.8^{b}	190.4±8.9^{c}
Giant Napier	160.3±6.9^{a}	180.2±7.5^{b}	200.1±8.8^{c}
Tiller number per plant			
Pakchong-1	12.3±1.5^{a}	14.2±1.7^{b}	16.8±2.0^{c}
CO-3	14.8±2.0^{b}	16.5±2.3^{c}	18.2±2.5^{d}
Giant Napier	13.2±1.8^{a}	15.4±2.1^{b}	17.5±2.3^{c}
Leaf			
Ratio (LSR)			
Pakchong-1	1.8±0.2^{a}	1.6±0.1^{a}	1.4±0.1^{b}
CO-3	2.2±0.3^{b}	2.0±0.2^{b}	1.8±0.1^{b}
Giant Napier	2.0±0.2^{b}	1.9±0.1^{b}	1.7±0.1^{b}
Fresh biomass yield (kg/m^2)			
Pakchong-1	5.8±0.3^{b}	7.4±0.4^{c}	9.4±0.5^{d}
CO-3	5.3±0.2^{a}	6.9±0.3^{b}	8.3±0.4^{c}
Giant Napier	5.6±0.2^{a}	7.1±0.3^{b}	8.6±0.4^{c}
Dry matter yield (kg/m^2)			
Pakchong-1	2.0±0.2^{b}	2.8±0.3^{c}	3.5±0.4^{d}
CO-3	1.8±0.2^{a}	2.5±0.2^{b}	3.1±0.3^{c}
Giant Napier	1.9±0.2^{a}	2.6±0.3^{b}	3.3±0.3^{c}
Crude protein content (%)			
Pakchong-1	17.0±0.6^{a}	15.3±0.4^{b}	13.8±0.3^{c}
CO-3	17.5±0.5^{a}	16.0±0.4^{b}	14.5±0.3^{c}
Giant Napier	17.2±0.5^{a}	15.7±0.4^{b}	14.2±0.3^{c}
NDF (%)			
Pakchong-1	52.6±1.8^{a}	54.6±2.0^{b}	56.3±2.3^{c}
CO-3	50.3±1.7^{a}	52.1±1.9^{b}	53.8±2.1^{c}
Giant Napier	51.3±1.7^{a}	53.0±1.9^{b}	54.5±2.1^{c}

Table 1: Continue

Parameter	40 Days	60 Days	80 Days		
ADF (%)					
Pakchong-1	34.4±1.2^{a}	36.7±1.5^{b}	38.2±1.8^{c}		
CO-3	33.6±1.3^{a}	35.8±1.4^{b}	37.4±1.6^{c}		
Giant Napier	34.0±1.3^{a}	36.2±1.4^{b}	37.7±1.6^{c}		
Calcium (Ca (%))					
Pakchong-1	0.35±0.02^{a}	0.32±0.02^{a}	0.30±0.02^{a}		
CO-3	0.33±0.02^{a}	0.31±0.02^{a}	0.28±0.02^{a}		
Giant Napier	0.34±0.02^{a}	0.31±0.02^{a}	0.29±0.02^{a}		
Magnesium (Mg (%))					
Pakchong-1	0.18±0.01^{a}	0.16±0.01^{a}	0.14±0.01^{a}		
CO-3	0.17±0.01^{a}	0.15±0.01^{a}	0.13±0.01^{a}		
Giant Napier	0.17±0.01^{a}	0.15±0.01^{a}	0.14±0.01^{a}		
Phosphorus (P (%))					
Pakchong-1	0.15±0.01^{a}	0.13±0.01^{a}	0.12±0.01^{a}		
CO-3	0.14±0.01^{a}	0.13±0.01^{a}	0.11±0.01^{a}		
Giant Napier	0.14±0.01^{a}	0.13±0.01^{a}	0.12±0.01^{a}		
Cultivar×Interval	42385.32	14.52	10.34	6.23	2.11
40 days					
Plant height (cm)	180.5±7.2^{b}	150.4±6.5^{a}	160.3±6.9^{a}		
Tiller number per plant	12.3±1.5^{a}	14.8±2.0^{b}	13.2±1.8^{a}		
Leaf	1.8±0.2^{a}	2.2±0.3^{b}	2.0±0.2^{b}		
Ratio (LSR)					
Fresh biomass yield (kg/m^2)	5.8±0.3^{b}	5.3±0.2^{a}	5.6±0.2^{a}		
Dry matter yield (kg/m^2)	2.0±0.2^{b}	1.8±0.2^{a}	1.9±0.2^{a}		
Crude protein content (%)	17.0±0.6^{a}	17.5±0.5^{a}	17.2±0.5^{a}		
Neutral detergent fiber (%)	52.6±1.8^{a}	50.3±1.7^{a}	51.3±1.7^{a}		
Acid detergent fiber (%)	34.4±1.2^{a}	33.6±1.3^{a}	34.0±1.3^{a}		
Calcium (Ca (%))	0.35±0.02^{a}	0.33±0.02^{a}	0.34±0.02^{a}		
Magnesium (Mg (%))	0.18±0.01^{a}	0.17±0.01^{a}	0.17±0.01^{a}		
Phosphorus (P (%))	0.15±0.01^{a}	0.14±0.01^{a}	0.14±0.01^{a}		
60 days					
Plant height (cm)	200.5±8.2^{c}	170.3±7.8^{b}	180.2±7.5^{b}		
Tiller number per plant	14.2±1.7^{b}	16.5±2.3^{c}	15.4±2.1^{b}		
Leaf	1.6±0.1^{a}	2.0±0.2^{b}	1.9±0.1^{b}		
Ratio (LSR)					
Fresh biomass yield (kg/m^2)	7.4±0.4^{c}	6.9±0.3^{b}	7.1±0.3^{b}		
Dry matter yield (kg/m^2)	2.8±0.3^{c}	2.5±0.2^{b}	2.6±0.3^{b}		
Crude protein content (%)	15.3±0.4^{b}	16.0±0.4^{b}	15.7±0.4^{b}		
Neutral detergent fibre (%)	54.6±2.0^{b}	52.1±1.9^{b}	53.0±1.9^{b}		
Acid detergent fibre (%)	36.7±1.5^{b}	35.8±1.4^{b}	36.2±1.4^{b}		
Calcium (Ca (%))	0.32±0.02^{a}	0.31±0.02^{a}	0.31±0.02^{a}		
Magnesium (Mg (%))	0.16±0.01^{a}	0.15±0.01^{a}	0.15±0.01^{a}		
Phosphorus (P (%))	0.13±0.01^{a}	0.13±0.01^{a}	0.13±0.01^{a}		
80 Days					
Plant height (cm)	220.6±9.8^{d}	190.4±8.9^{c}	200.1±8.8^{c}		
Tiller number per plant	16.8±2.0^{c}	18.2±2.5^{d}	17.5±2.3^{c}		
Leaf	1.4±0.1^{b}	1.8±0.1^{b}	1.7±0.1^{b}		
Ratio (LSR)					
Fresh biomass yield (kg/m^2)	9.4±0.5^{d}	8.3±0.4^{c}	8.6±0.4^{c}		
Dry matter yield (kg/m^2)	3.5±0.4^{d}	3.1±0.3^{c}	3.3±0.3^{c}		
Crude protein content (%)	13.8±0.3^{c}	14.5±0.3^{c}	14.2±0.3^{c}		
Neutral detergent fibre (%)	56.3±2.3^{c}	53.8±2.1^{c}	54.5±2.1^{c}		
Acid detergent fibre (%)	38.2±1.8^{c}	37.4±1.6^{c}	37.7±1.6^{c}		
Calcium (Ca (%))	0.30±0.02^{a}	0.28±0.02^{a}	0.29±0.02^{a}		
Magnesium (Mg (%))	0.14±0.01^{a}	0.13±0.01^{a}	0.14±0.01^{a}		

abc means different letters denote significant differences between means ($p<0.05$), the same letters indicate no significant difference among those means, ±Means ranges from lowest to highest

DISCUSSION

The data on plant height across three cutting intervals (40, 60 and 80 days) for Pakchong-1, CO-3 and Giant Napier reveals significant differences among the varieties. At 40 days, Pakchong-1 recorded the highest plant height at 180.5 cm, followed by Giant Napier at 160.3 cm and CO-3 at 150.4 cm. These trends continue as the cutting intervals increase, with Pakchong-1 reaching 220.6 cm at 80 days, CO-3 at 190.4 cm and Giant Napier at 200.1 cm. The consistent superiority of Pakchong-1 in plant height may indicate its robustness and suitability for conditions in Southwest Nigeria. The statistical analysis shows significant differences ($p<0.05$) among the varieties, with Pakchong-1 outperforming the others. The results aligned with the findings of Rahetlah *et al.*[11], which showed that Elephant grass (*Pennisetum purpureum*) responded positively to fertilization, resulting in increased plant height and biomass yield.

Tiller the tiller number per plant is crucial for understanding the biomass potential and the overall health of forage crops. At 40 days, CO-3 had the highest tiller number (14.8), followed by Giant Napier (13.2) and Pakchong-1 (12.3). As the cutting interval increased to 80 days, CO-3 maintained its lead with 18.2 tillers per plant, Giant Napier followed with 17.5 and Pakchong-1 with 16.8. The significant differences in tiller numbers among the varieties ($p<0.05$) suggest that CO-3 might be better suited for higher biomass production in a shorter time frame, which is beneficial for frequent harvesting schedules.

The leaf ratio (LSR) is a critical parameter affecting the forage quality, as leaves generally have higher nutritional value compared to stems. At 40 days, CO-3 had the highest LSR (2.2), followed by Giant Napier (2.0) and Pakchong-1 (1.8). This trend persisted through 60 and 80 days, with CO-3 maintaining the highest leaf ratio. The decreasing LSR across all varieties as the cutting interval increased indicates that the proportion of leaves to stems decreases over time, affecting the overall forage quality. This parameter showed significant differences ($p<0.05$) among the varieties, highlighting the importance of selecting varieties with higher leaf ratios for better nutritional outcomes.

Fresh biomass yield is a direct measure of the productivity of forage crops. Pakchong-1 yielded the highest biomass at all cutting intervals, starting at 5.8 kg/m^2 at 40 days, 7.4 kg/m^2 at 60 days and peaking at 9.4 kg/m^2 at 80 days. The CO-3 and Giant Napier followed a similar trend but with lower yields, indicating that Pakchong-1 has superior biomass production capabilities. The differences in fresh biomass yield were statistically significant ($p<0.05$), suggesting that Pakchong-1 could be the most productive variety under the given conditions.

Dry matter yield is essential for understanding the actual usable biomass after moisture is removed. Pakchong-1 again led in dry matter yield at all intervals, from 2.0 kg/m^2 at 40 days to 3.5 kg/m^2 at 80 days. The CO-3 and Giant Napier had comparable but lower yields. The significant differences ($p<0.05$) in dry matter yield among the varieties emphasize Pakchong-1's suitability for producing high-quality forage with substantial dry matter content, which is crucial for livestock feeding.

This finding was supported by Lardner *et al.*[9], who evaluated different grass species and found significant differences in dry matter yield and nutritive value, with certain varieties outperforming others under similar conditions.

Crude protein content is a vital nutritional parameter for forage quality. At 40 days, CO-3 had the highest crude protein content (17.5%), followed by Giant Napier (17.2%) and Pakchong-1 (17.0%). However, as the cutting interval increased, crude protein content decreased across all varieties, with Pakchong-1 showing the least reduction, maintaining 13.8% at 80 days compared to CO-3's 14.5% and Giant Napier's 14.2%. The significant differences ($p<0.05$) indicate that while CO-3 starts with the highest protein content, Pakchong-1 retains its protein content better over time, making it a more reliable source of protein for extended harvest periods.

These results were consistent with the study by Aganga *et al.*[12] and Campos *et al.*[13] which found that the level of crude protein in forage crops significantly influences their nutritional value and digestibility in livestock.

The NDF and ADF are indicators of forage digestibility and quality. Lower values are preferable as they indicate higher digestibility. At 40 days, CO-3 had the lowest NDF (50.3%) and ADF (33.6%), followed by Giant Napier and Pakchong-1. These values increased with longer cutting intervals, with Pakchong-1 reaching the highest NDF (56.3%) and ADF (38.2%) at 80 days. The significant differences ($p<0.05$) among the varieties suggest that CO-3 may offer more digestible forage, especially at shorter cutting intervals. Islam *et al.*[14] found that N fertilization impacts the fiber content and digestibility of different forage grasses, supporting the findings on the NDF and ADF values among the varieties.

Mineral content (calcium, magnesium, phosphorus): Mineral content is crucial for the nutritional quality of forage. All three varieties had similar calcium, magnesium and phosphorus content, with no significant differences noted ($p>0.05$). However, there was a slight decrease in mineral content as the cutting interval increased by researchers, suggest that while the choice of variety may not significantly impact mineral content, earlier harvesting could help maintain higher mineral levels[15-18].

The study highlights the superiority of Pakchong-1 in terms of plant height, biomass yield and dry matter yield, positioning it as an ideal variety for forage production in Southwest Nigeria. The CO-3 shows strong potential in nutritional quality, especially with its high crude protein content and tiller number per plant, making it suitable for systems that prioritize frequent harvesting and high-quality forage. Giant Napier provides a balanced profile but does not outperform the other varieties in any category. This suggests that different varieties may be used depending on the focus on either yield or quality, potentially allowing for optimized mixed cropping systems.

The findings can guide farmers and agricultural experts in selecting appropriate Napier grass varieties for forage based on their specific requirements. For systems focused on maximizing biomass yield, Pakchong-1 is the most suitable option. For scenarios where protein content and frequent cutting schedules are more important, CO-3 offers advantages. These results are particularly useful for forage management and improving livestock feeding efficiency in regions with similar climatic and soil conditions as Southwest Nigeria.

Given Pakchong-1's robust performance, it is recommended for regions where maximizing forage yield is critical. However, to ensure high nutritional value and protein retention, CO-3 may be more suitable for frequent harvesting schedules. A dual-system approach using both Pakchong-1 and CO-3 could provide a balance between yield and nutritional quality, allowing for more versatile and sustainable forage production. Farmers should also consider cutting intervals carefully, as longer intervals result in lower crude protein content and leaf ratios but higher biomass yields. The study was conducted in specific environmental conditions in Southwest Nigeria, which may limit the generalizability of the findings to other regions with different climates or soil types. Moreover, while the study provides insight into plant growth parameters, it does not consider other factors such as pest resistance, long-term sustainability or the impact of varying fertilization methods on the varieties. Further research is needed to evaluate these factors and validate the results across broader geographic regions and management practices.

CONCLUSION

Overall, the analysis reveals that Pakchong-1 is the most productive variety in terms of plant height, fresh biomass yield and dry matter yield, making it highly suitable for forage production in Southwest Nigeria. The CO-3, on the other hand, excels in crude protein content and tiller number per plant, suggesting its potential for high-quality forage with frequent harvesting. Giant Napier presents a balanced performance across parameters but does not lead in any specific category. For optimal forage production, a combination of Pakchong-1 for high biomass and CO-3 for high nutritional quality could be considered, depending on the specific needs and harvesting schedules of the forage system.

SIGNIFICANCE STATEMENT

This study provides essential insights into the optimal management of three Napier grass varieties under different cutting intervals in Southwest Nigeria. By comparing growth performance, biomass yield and forage quality, the research identifies Pakchong-1 as a promising variety for maximizing biomass, while CO-3 offers superior forage quality. These findings have practical implications for improving livestock feed production and overall agricultural sustainability in tropical regions. Further research should explore the long-term adaptability of these varieties to varying environmental conditions. Integrating these findings with animal performance trials could enhance forage utilization strategies for livestock production.

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