Original Research Article

Impact of Fertilization on Productivity and Nutritional Quality of Napier Grasses varieties in Southern Mindanao

ABSTRACT

Aims: This study investigates the effects of fertilizer application on the growth performance, proximate composition, and chlorophyll content of three Napier grass varieties (King, Pakchong, and Juncao) in Southern Mindanao, Philippines.
Study design: Utilizing a Randomized Complete Block Design with a 3x2 factorial arrangement.
Place and Duration of Study: The experiment was performed at the University of Southern Mindanao Animal Production Center facilities from January to March 2023.
Methodology: The three Napier grass varieties (King, Pakchong, and Juncao) was the first factor, and fertilizer application (with or without) was were the second factor. Four blocks were prepared, each containing six plots, resulting in 24 plots. The fertilized plots received two applications of 150kg N/ha and 75kg N/ha of the recommended NPK fertilizer, respectively, while non-fertilized plots did not receive any fertilizer.
Results: Fertilizer application generally enhanced crude protein content in King and Pakchong varieties. At the same time, Juncao exhibited higher protein content without fertilizer. Fertilizer application reduced crude fiber and increased ether extracts across all varieties. Notably, Juncao gGrassrass significantly reduced Nitrogen-Free Extract (NFE) levels with fertilization, suggesting unique metabolic interactions. Fertilizer significantly improved plant height, stem diameter, leaf width, and tiller number without varietal differences. Herbage yield increased with fertilization, with King and Juncao showing higher chlorophyll content than Pakchong.
Conclusion: The findings emphasize the necessity of tailored fertilizer management strategies for different Napier grass cultivars to optimize productivity and quality. These results have important implications for sustainable forage production in tropical regions. Further research should explore the underlying physiological mechanisms driving these varietal differences.

Comment [Meku1]: cultivers or varieties?

Keywords: Napier grass, dilution effect, proximate composition, growth performance, chlorophyll content, forage productivity

1. INTRODUCTION

Napier grass, also called Uganda grass or elephant grass (*Pennisetum purpureum*), is a tall, vigorous, and deep-rooted perennial tropical forage known for its rapid growth, high biomass yield, and nutritional value. stems Stems can reach up to 7 meters in height, 3 cm in diameter, and have up to 20 nodes. Napier grass thrives in warm tropical and subtropical environments, performing exceptionally well at 25-40°C (Negawo et al., 2017). Genetic studies have revealed significant diversity among Napier grass genotypes, aiding breeding strategies and conservation efforts (Onjai-Uea et al., 2022; Muktar et al., 2023). Napier grass, widely cultivated in developing countries, is valuable for animal feed and has potential as an energy crop (Okaraonye & Ikewuchi, 2008; Jack et al., 2020).

The performance of Napier grass under various fertilization regimes has shown significant effects on growth, yield, and economic returns. Veraque and Gorne (2023) evaluated different nitrogen levels in Leyte, Philippines, revealing that Napier grass achieved optimal growth and yield at 120 kg N/ha, with the highest economic return observed at 240 kg N/ha. Ebrahim et al. (2020) studied nitrogen rates and cutting heights in Ethiopia, finding that nitrogen application at 161 kg/ha and a cutting height of 15 cm maximized dry matter yield and crude protein content. However, nitrogen recovery was most efficient at a lower 69 kg/ha application rate. Zewdu et al. (2003) highlighted the interaction between cutting height and fertilizer, noting that the highest dry matter yield was achieved with a 1.0 m cutting height and 92 kg N/ha. Bandeswaran et al. (2013) demonstrated that combining organic manures with inorganic nitrogen significantly boosted biomass yield and crude protein content, particularly with the highest nitrogen level (60 kg/acre). Fernando et al. (2023) focused on Red Napier in Sri Lanka, showing that poultry manure led to superior dry matter and crude fiber content compared to other treatments.

Meanwhile, the performance of Napier grass (*Pennisetum purpureum*) varies across climatic and environmental conditions. Kebede et al. (2017) found the highest dry matter (DM) yield in mid-altitude areas of Ethiopia, while crude protein (CP) and digestibility were higher in the highlands. Geren et al. (2020) recommended a 60-day cutting interval for optimal forage yield and quality in Mediterranean regions with irrigation. Tsegaye et al. (2024) reported that Napier grass produced the highest forage yield among three grasses in Ethiopia, with increased DM yield but decreased CP at 120-day cutting. Biradar et al. (2020) observed that the hybrid cultivar DHN-15 had significantly higher green fodder yield and net returns under irrigated conditions in India.

The response of Napier grass to fertilizers is well-documented, particularly its high demand for nutrients and its positive reaction to both organic and inorganic (NPK) fertilizers, as well as seasonal climatic variations that also significantly affect the total dry matter yield and quality of Napier grass. However, the interaction between different Napier grass cultivars and fertilizer application under specific local conditions still needs to be explored. This study addresses this gap by investigating the effects of fertilizer application on the growth performance, proximate composition, and chlorophyll content of three Napier grass varieties (King, Pakchong, and Juncao) in Southern Mindanao, Philippines. Unlike previous studies, which have typically focused on a single variety or generalized responses to fertilization, this research provides a comparative analysis of multiple cultivars under uniform environmental conditions. This approach identifies cultivar-specific responses to fertilizer application, contributing to more tailored management strategies that optimize productivity and forage quality. We hypothesize that fertilizer application will significantly influence the physical characteristics, nutritional profile, and chlorophyll content of the Napier grass varieties, with potential variations in response among the cultivars. The specific objectives are to evaluate the impact of fertilizer on growth performance, assess its effects on proximate composition, and determine its influence on the chlorophyll content of the three Napier grass varieties.

2. MATERIAL AND METHODS

2.1. Study location

The experiment was performed at the University of Southern Mindanao Animal Production Center facilities from January to March 2023. The center was located at Kabacan, North Cotabato, Southern Mindanao, at 7.1071923 latitude, 124.8403408 longitude, and 31.75 meters above sea level, in a ~~Tropical~~ tropical rainforest climate (Classification: Af). The district's mean annual temperature is 28. 62ºC, 178. Eighty-eight millimeters of precipitation and 242.57 rainy days (66.46% of the time) annually (Weather and Climate, 2023).

2.2. Research design and treatment

The experiment employed a Randomized Complete Block Design (RCBD) with a 3x2 factorial arrangement. The first factor consisted of three Napier grass varieties (King, Pakchong, and Juncao), and the second factor was fertilizer application (with or without). Four blocks were prepared, each containing six plots, resulting in 24 plots. Based on soil test results, fertilized plots received two applications of 150kg N/ha and 75kg N/ha of the recommended fertilizer, respectively, while non-fertilized plots did not receive any fertilizer.

2.3. Napier planting and treatment application

Healthy Napier grass stems with 2-3 nodes were selected as planting materials from the University Forage area. The stems were planted at a 45-degree angle in furrows, with two cuttings per hill and a spacing of 1 m x 1 m. The plots were prepared by plowing and harrowing twice to achieve a friable soil texture and eliminate weeds. Following soil test recommendations, fertilizer was applied twice, 30 and 45 days after planting. Weeding was done manually at 2 and 4 weeks after emergence to prevent competition. Before planting, soil samples from the 0-30 cm layer were collected using a soil auger following the procedures by Adajar & Taer (2020) and analyzed for NPK, pH, and organic matter content at the Department of Agriculture Regional Soils Laboratory. At 60 days after planting, the Napier grasses were harvested by cutting 6 inches from the ground. The fresh weight of the harvested grass was recorded, and 1 kg of samples were dried at 65°C for 72 hours for proximate analysis. Tiller counts were taken from randomly selected plants per plot before harvesting.

2.4. Data collection

Plant height: Measured from the ground to the highest point of the plant.

Stem diameter: Measured at the base of 10 representative plants.

Leaf width: Measured at the broadest part of a representative leaf from 10 plants.

Number of tillers: Counted for ten representative plants per plot.

Herbage yield: Total fresh forage harvested from each plot, with dry matter content calculated by oven-drying samples to a constant weight.

Chlorophyll content: Measured using a Greenseeker Handheld Crop Sensor.

Proximate analysis: Conducted on triplicate 250-300 g samples from each treatment, analyzed at the DA Region XI Feed Analytical Laboratory for moisture, crude protein, crude fiber, ash, nitrogen-free extract (NFE), and ether extract content.

2.5. Statistical analysis

For the 3x2 factorial experiment arranged in an RCBD, data were subjected to a two-way analysis of variance (ANOVA). Significant differences among Napier varieties and the effects of fertilizer application were tested using the Least Significant Difference (LSD) method at the 5% probability level.

$Y_{ijk} = \mu + B_i + C_j + B_i*C_j + Block_k + e_{ijk}$

Where; Y_{ijk}=all dependent variables (morphological data and DM yield), μ = overall mean, B_i= the fixed effect of i^{th} grass varieties (i=King, Pakchong, and Juncao), C_j = the effect of j^{th}

fertilizer application (j= with and without), B_i*C_j = interaction effect between fertilizer application and varieties and E_{ijk} = residual error

3. RESULTS AND DISCUSSION

3.1. Soil test results, recommendations and climatic data

Soil test results indicated a moderately acidic pH of 6.00, moderate organic matter (OM) content at 3.29%, higher phosphorus (P) levels measuring at 41.95 ppm, while very high potassium (K) levels notably at 1337.01 ppm. Given the nutrient requirements 60-0-0, fertilizer recommendations are derived from the soil test outcomes. According to the tests and recommendations, the fertilizer used was Ammosol at 1. 5 – 3 bags/ha for the first application and UREA at a rate of 0. 75 – 1. 25 bags/ha for the second application. The temperature, relative humidity, and rainfall for January 2023 to March 2023 were calculated as 32. 51 oC, 76. 49 %, 101. 02 mm.

3.2. Growth performance

Fertilized plants exhibited greater plant height, improved stem diameter, and higher leaf width and tiller number than non-fertilized plants. Fertilized plants had a height of 107.17 cm, taller than the 76.32 cm observed in non-fertilized plants. The fertilized Pakchong hybrid showed the largest stem width of 22.60 cm, followed by the King grass and Juncao hybrid at 22.20 cm and 22.10 cm, respectively. Pakchong and Juncao hybrids have broader leaves (3.85 cm and 3.74 cm, respectively) than King Napier grass (3.53 cm). Additionally, fertilized Napiers exhibited more tillers, ranging from 26.96 to 29.70, in contrast to non-fertilized Napiers, which ranged from 16.89 to 18.75. The growth results emphasize the critical role of nitrogen in enhancing growth performance metrics of Napier grass. The improved plant height in fertilized grasses highlights the importance of nitrogen in synthesizing amino acids, enzymes, and proteins essential for vertical growth, consistent with findings from Gioseffi et al. (2012) and Tatsumi et al. (2021). Increased stem diameter in fertilized plants indicates a positive correlation between nitrogen application and vascular development, likely due to efficient nitrogen remobilization and allocation (Lebedev et al., 2021; Souza & Tavares, 2021). The broader leaves observed in Pakchong and Juncao hybrids can be attributed to their hybrid nature, which includes traits such as drought tolerance and adaptability from pearl millet (Bisht et al., 2019; Kaur et al., 2019). Additionally, the higher tiller numbers in fertilized plants reflect nitrogen's role in promoting cell enlargement and division through its influence on cytokinin levels (Singh et al., 2016). This clear distinction in growth performance under fertilized conditions suggests that targeted fertilizer application can significantly enhance Napier grass productivity. The variation in response among different varieties indicates a potential for optimizing specific cultivars for maximum growth and yield, tailored to their genetic and physiological characteristics. Further research should investigate the long-term effects of continuous fertilization and explore the underlying genetic mechanisms driving these responses.

Table 1. Growth performance of Napier grass varieties with and without fertilizer application

Parameter		Plant height (cm)	Stem diameter (cm)	Leaf width (cm)	No. of tillers
Fertilizer application	With	107.17[a]	5.58[a]	3.85[a]	34.11[a]

Varieties of Napier	Without	76.32[b]	5.38[b]	3.55[b]	21.64[b]
	Kind grass	86.13	5.45	3.53[b]	26.96
	Pakchong	98.55	5.50	3.85[a]	29.7
	Juncao	90.55	5.50	3.74[a]	26.98
P-Value	Fertilizer	0.000**	0.000**	0.0023**	0.00**
	Variety	0.1308	0.4134	0.0198*	0.154
	Fertilizer x Variety	0.0943	0.0918	0.2451	0.108
CV		12.7	1.54	5.55	10.99

Column means with the same letter are not significantly different at 0.05 level
**Highly significant

3.2. Yield and chlorophyll content

Fertilizer application to Napiers showed a significantly higher average yield of 20.25 tons per hectare than non-fertilized, which yielded 15.14 tons per hectare. Pakchong produced the highest herbage of 19.25 tons, followed by Juncao, then King grass at 17.50 tons and 16.75 tons, among Napier varieties. Regarding chlorophyll, there is a significantly higher content of chlorophyll for fertilized Napeirs (0.57) compared to non-fertilized plants (0.52) (Table 2). King grass and Juncao hybrid Napier grass had higher chlorophyll content (0.56 and 0.57, respectively) compared to Pakchong hybrid (0.51). However, there were no significant interactions between the variety and fertilizer application for yield. The observed increase in herbage yield with fertilizer application can be attributed to the essential role of nitrogen in plant growth, particularly in protein synthesis and photosynthesis (Chebotarev & Brovarova 2021). The significant yield differences among the varieties suggest inherent genetic potential influencing productivity under fertilized conditions. The results of the current study align well with the findings from previous research. Veraque and Gorne (2023) similarly observed that increasing nitrogen levels led to significant improvements in Napier grass yield, with optimal growth occurring at 120 kg N/ha. This supports our observation that nitrogen fertilization enhances herbage yield due to its critical role in plant metabolic processes. Pakchong's superior yield performance highlighting its robust growth characteristics (Lu & Tian 2017; Tokpa et al. 2020).

Chlorophyll content is a critical indicator of photosynthetic efficiency and overall plant health. The higher chlorophyll content in fertilized plants reflects improved nitrogen availability, which is crucial for chlorophyll synthesis (Aguirre-Arcos et al., 2022). The variation in chlorophyll content among the varieties could be linked to genetic differences in nutrient uptake and utilization efficiency (Przygocka-Cyna et al., 2016). The lack of significant interaction between fertilizer application and variety for yield implies a consistent positive response to fertilization across different genetic backgrounds (Riedell, 2010). This finding underscores the universal benefit of fertilizer application for enhancing Napier grass productivity, although the degree of response may vary among varieties. Further research is needed to explore the underlying genetic mechanisms that contribute to these differential responses and to optimize fertilizer management practices for each Napier grass variety (Chien & Menon, 1996).

Table 2. Yield characteristics and chlorophyll content of napier grass varieties with and without fertilizer application

Parameter	Yield (tons/ha/year)	Chlorophyll content

Fertilizer application	With	20.25[a]	0.57[a]
	Without	15.14[b]	0.52[b]
Varieties of Napier	Kind grass	16.75	0.56[a]
	Pakchong	19.25	0.51[b]
	Juncao	17.50	0.57[a]
P-Value	Fertilizer	0.001**	0.0016**
	Variety	0.249	0.0077**
	Fertilizer x Variety	0.98	0.805
CV		16.48	6.57

Column means with the same letter are not significantly different at 0.05 level
**Highly significant

3.3. The moisture content of Napier

King Grass exhibited a significant response to fertilizer application, with an increase of 1.72% in moisture content. In contrast, the Pakchong and Juncao varieties showed a decrease in moisture content under the same fertilized conditions. Overall, applying fertilizer increased the moisture level of all grass varieties from 11.25% to 11.79%. Interestingly, the highest moisture content was observed in fertilized Juncao Grass and unfertilized King Grass, suggesting potential intrinsic differences in water retention or varied responses to fertilizer regarding water usage among the Napier grass varieties. Moisture content in King Grass following fertilizer application could be linked to enhanced water uptake and retention capabilities due to improved root development and overall plant health. The differential responses observed among the varieties suggest that genetic factors may be crucial in how each variety manages water under fertilized conditions. When fertilized, the decrease in moisture content in Pakchong and Juncao varieties could indicate a trade-off between rapid biomass accumulation and water retention capabilities. The overall increase in moisture content with fertilizer application aligns with previous studies that have shown nutrient supplementation can enhance the water-holding capacity of plants (Rattan et al., 2022; Sobrinho & Barbosa, 2020). However, the fact that the observed differences did not reach statistical significance suggests that these effects might not be robust or consistently reproducible under similar conditions. This highlights the need for further research to clarify the precise mechanisms by which fertilizer affects water content in different Napier grass varieties and to determine the consistency of these responses under varying environmental conditions. This understanding could help optimize fertilizer application strategies to balance growth and moisture retention, thereby improving Napier grass's overall resilience and productivity.

3.4. Crude protein

The crude protein content data revealed that fertilizer application generally enhanced crude protein in King Grass and Pakchong Grass. However, Juncao Grass exhibited higher crude protein content without fertilizer, revealing a significant interaction between fertilizer application and Napier varieties (Table 3). King Grass significantly declined in crude protein content when fertilizer was withheld, decreasing from 14.05% to 11.68%. Pakchong Grass showed a similar trend, with crude protein decreasing from 14.89% to 11.03% without fertilizer. In contrast, Juncao Grass increased crude protein from 12.57% to 13.22% under non-fertilized conditions. Fertilizer application can augment crude protein content in some Napier grass varieties, Juncao Grass exhibits a unique response, maintaining higher crude

protein without fertilizer. This distinct behavior may be attributed to inherent differences in nutrient uptake and utilization or specific interactions between the Juncao Grass variety and the applied fertilizer (Lu & Tian 2017; Tokpa et al. 2020). Studies have corroborated the role of fertilizers in increasing crude protein content in forage crops, with nitrogen being a key component in amino acid and protein synthesis (Chebotarev & Brovarova 2021; AL-Hassan 2019; Maheswari et al. 2017). However, the contrasting response of Juncao Grass in maintaining higher crude protein content without fertilizer suggests that genetic regulation, environmental factors, and specific fertilizer-variety interactions may play a crucial role in determining crude protein levels (Guan & Lazar, 2022; Aitken et al., 2022). This phenomenon might be influenced by the climatic conditions recorded during the study period. The average temperature of 32.51°C, relative humidity of 76.49%, and the rainfall patterns from January 2023 to March 2023 could have interacted with the genetic traits of Juncao Grass to modulate its response to fertilizer. High temperatures and humidity levels can affect nutrient uptake and metabolism differently (Oliveira et al., 2023) across grass varieties, potentially explaining why Juncao Grass displayed higher crude protein levels without additional fertilization compared to King and Pakchong Grass. Additionally, studies have shown that differences in climatic conditions, such as humidity, can impact the uptake of cations in fruit-vegetable crops like tomato, cucumber, and sweet pepper, altering the concentrations of nutrients like potassium, calcium, and magnesium in plant tissues (Janket et al., 2020). Further research should investigate the interaction between climatic variables and genetic factors to optimize fertilization strategies under varying environmental conditions.

3.5. Crude fiber

The crude fiber content varied among the Napier grass varieties and fertilizer application. Pakchong exhibited the highest (29.95) and differed significantly ~~to~~ from King grass (29.40) and Juncao (29.15) crude fiber. Additionally, fertilizer application significantly affected crude fiber content, with a decrease observed in the fertilized group (29.05%) compared to the non-fertilized group (29.95%). Pakchong Grass has a higher crude fiber content than King and Juncao Grass, aligning with findings from previous studies on fodder crops' nutritional profiles (Liu et al., 2022). The observed decrease in crude fiber content due to fertilizer application may be explained by the "dilution effect," where increased overall growth and the direct impact of nitrogen in the fertilizer on plant physiology led to a reduction in the proportion of structural compounds like cellulose, hemicellulose, and lignin (Trowell, 1976; Aguirre-Arcos et al., 2022). Nitrogen's influence on enzyme activity involved in lignin synthesis, a crucial component of plant fiber, could also contribute to this reduction (Botero-Londoño et al., 2021; Amin, 2011). This suggests that while fertilization promotes growth, it may also impact the forage's structural integrity and nutritional quality by altering fiber composition.

3.6. Ash content

There were no significant differences in ash content among varieties, with an average of 13.63% to 14.67%. The fertilized group showed an average ash content of 13.92% compared to 14.21% in the non-fertilized group, showing a trend of reduced ash content with fertilization but no statistical significance overall. The ash content, representing the mineral content of the Napier grass, did not significantly vary with fertilizer application. The trend of lower ash content in the fertilized group could be due to the "dilution effect," where the increase in overall plant biomass with fertilization results in a lower concentration of minerals per unit of biomass (Riedell, 2010; Przygocka-Cyna et al., 2016). This is consistent with findings in other crops where fertilization leads to increased growth but relatively lower mineral concentration, as seen in studies on maize and onion (Chien & Menon, 1996). The

consistently lower ash content in Pakchong Grass suggests inherent genetic differences in mineral uptake or utilization among the varieties. However, the lack of significant differences implies that the relative mineral composition remained largely stable across the different varieties and treatment conditions, highlighting the inherent mineral properties of each variety.

3.7. Ether extract

Among the Napier grass varieties, Pakchong Grass exhibited the highest increase in ether extract (crude fat) content, rising from 0.73% without fertilizer to 0.92% with fertilizer, representing a 0.19% increase. Juncao Grass showed the smallest growth in ether extract content, from 0.78% to 0.83%, with and without fertilizer application. These findings indicate that fertilizer application generally augmented the mean ether extract content across all three Napier grass varieties. The observed increase in ether extract content following fertilizer application suggests that fertilization can enhance the crude fat content of Napier grass forage. This increase in ether extract content across the varieties, particularly in Pakchong Grass, aligns with the idea that certain nutrients in fertilizers can boost the synthesis of fatty acids within plant tissues (Zapletalová et al., 2021; Ogunyemi et al., 2018). However, the relationship between fertilization and increased crude fat content is not always direct or consistent. Various factors, including the nutrients the fertilizer supplied and the particular growth conditions, can influence fatty acid synthesis differently. This variability indicates that while fertilization holds the potential to improve crude fat content, its effect can be influenced by multiple interacting factors and may not be as straightforward as its impact on other nutritional components like protein content.

Table 3. Proximate composition of Napier grass varieties with and without fertilizer application

Parameter		Moisture	Crude protein	Crude fiber	Ash	NFE	Ether extract
Fertilizer application	With	11.79	13.83	29.05[b]	13.63	30.86	0.83
	Without	11.25	11.98	29.95[a]	14.67	31.65	0.56
Varieties of Napier	Kind grass	11.64	12.87	29.40[b]	15.49	29.93 [c]	0.67
	Pakchong	11.08	12.96	29.95[a]	11.98	33.20 [a]	0.83
	Juncao	11.84	12.9	29.15[b]	14.68	30.63 [b]	0.81
P-Value	Fertilizer	0.072	0.423	0.021*	0.402	0.55	0.22
	Variety	0.809	0.215	0.015*	0.065	0.035*	0.62
	Fertilizer x Variety	0.904	0.043*	0.673	0.132	0.645	0.865
CV		3.91	3.32	1.00	14.91	6.26	3.93

Column means with the same letter are not significantly different at 0.05 level
*Significant

3.8. Nitrogen-free extract

The data revealed that Pakchong Grass had the highest NFE content, significantly higher than that of Juncao Grass and King Grass. Interestingly, the NFE values were higher under non-fertilized conditions than the fertilized group across all varieties (Table 3). This indicates that a more significant proportion of digestible carbohydrates was present in the non-fertilized plants. Specifically, the NFE content in non-fertilized Pakchong Grass was notably higher than in its fertilized counterpart, reflecting a trend consistent across all tested varieties. The higher NFE content observed in non-fertilized conditions suggests a complex

interaction between nutrient availability and carbohydrate allocation within the plants. Typically, fertilization promotes overall plant growth and biomass, potentially leading to a "dilution effect" where the proportion of digestible carbohydrates (NFE) decreases relative to the total biomass (Trowell, 1976; Riedell, 2010). This dilution effect might result from an increased allocation of resources to structural components such as cellulose and lignin, which are less digestible than carbohydrates (Przygocka-Cyna et al., 2016; Aguirre-Arcos et al., 2022). Consequently, while fertilization enhances growth, it might simultaneously reduce the relative concentration of nitrogen-free extracts, impacting the forage's overall energy value. Understanding these dynamics is crucial for optimizing fertilization strategies to effectively balance growth and nutritional quality (Chien & Menon, 1996; Liu et al., 2022). Further research is needed to explore these mechanisms and develop approaches that maximize yield and nutritional content in forage crops.

4. CONCLUSION

This study investigated the effects of fertilizer application on growth performance, proximate composition, and chlorophyll content of three Napier grass varieties (King, Pakchong, and Juncao) under Southern Mindanao conditions. Key findings revealed that fertilizer generally enhanced crude protein in King and Pakchong, but Juncao exhibited higher protein without fertilizer. Crude fiber decreased with fertilization, indicating a "dilution effect" favoring digestible components. Ether extract increased across varieties with fertilizer application. Surprisingly, Nitrogen-Free Extract (NFE) was higher without fertilizer, potentially due to plant stress responses. Regarding growth, fertilizer significantly improved plant height, stem diameter, leaf width, and tiller number, with no varietal differences. Herbage yield increased with fertilization, while King and Juncao had higher chlorophyll content than Pakchong. These results indicate that fertilization impacts proximate composition, growth, yield, and chlorophyll across Napier cultivars. However, Juncao's contrasting crude protein and NFE responses suggest complex interactions between genetics, physiology, and fertilizer effects. Understanding these nuances is crucial for optimizing productivity and quality under local conditions. Further research should explore the underlying mechanisms driving varietal differences and the long-term sustainability of fertilizer regimes on Napier grass production systems.

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