



**FORAGE YIELD AND NUTRITIVE QUALITY OF *BRACHIARIA* MULATO II
INFLUENCED BY NPK FERTILIZER RATES AND AGE OF RE-GROWTH IN
SHIKA NORTHERN GUINEA SAVANNAH OF NIGERIA**

¹Ahmed, S. A., ²Abdu, S. B., ¹Amodu, J. T., ¹Hassan, M. R., ¹Sani, R. T., ²Salisu, S. G. and
³Abdullahi, U.

¹National Animal Production Research Institute, P.M.B 1096,
Ahmadu Bello University, Shika, Zaria, Nigeria.

²Department of Animal Science, Ahmadu Bello University, Shika, Zaria, Nigeria.

³Federal University Gashua, Yobe State.

Corresponding Author's Email: safiyanahmed2@gmail.com, **GSM:** 07069108385

ABSTRACT

Two years agronomic trial were conducted on a one-year-old established *Brachiaria* Mulato II pasture to evaluate the regrowth pattern, seasonal herbage yield (Dry matter yield) and nutritive quality. The treatments consisted of NPK 20:10:10 fertilizer (applied at different rates of 0, 50, 100, 150, and 200 kg/ha) and stages of re-growth (at 8, 10 and 12 weeks respectively) these were laid in a split plot design with 5 x 3 factorial arrangement. The main plots were NPK 20:10:10 fertilizer, while stages of re-growth were allocated to the sub-plots. The result shows that, dry forage yield was significantly ($P < 0.05$) affected by the rates of fertilizer application. The highest yield (6.08t/ha) was recorded at 200 kg/ha⁻¹ rate. Ages of regrowth significantly ($P < 0.05$) affected the Dry forage yield (7.96t/ha) at 12 weeks. Organic matter content was significantly ($P < 0.05$) higher (82.50%) at 150 kg/ha⁻¹ rate of application. Crude protein was significantly ($P < 0.05$) higher (8.33%) at 100 kg/ha⁻¹ rate which was at par with 0 kg/ha⁻¹ (8.30%) and (8.04%) at 200 kg/ha⁻¹ application rates. Age of regrowth showed a significantly ($P < 0.05$) higher Crude protein content at 8 weeks (9.32%) compared to other weeks. The total digestible nutrients (TDN) was significant ($P < 0.05$) difference across the weeks with the highest value recorded at 12 weeks (47.51%) compared to other weeks. Neutral detergent fibre (NDF) was significantly ($P < 0.05$) higher at 10 weeks (64.69%) while acid detergent fibre (ADF) was significantly ($P < 0.05$) higher at 12 weeks (39.77%) compared to the other weeks. Calcium concentration with application of fertilizer ranged between (0.363- 0.527%) and Phosphorus (0.176- 0.188%). With age of regrowth, calcium content of the forage ranged between (0.395-0.517%) while phosphorus had value ranges of 0.128-0.211%. Iron (2698.7ppm) and Cobalt (224ppm) were significantly ($P < 0.05$) higher at 50kg/ha⁻¹ application rate. Age of regrowth significantly ($P < 0.05$) affected both Iron and Cobalt concentration at 12 weeks of age (2555.90 and 225.20 ppm). It was therefore concluded that application of NPK 20:10:10 fertilizer at the rate of 200 kg/ha⁻¹ rate produced the highest Dry matter yield. Harvesting of forage at 8 weeks of regrowth increased the nutritive quality by 39.26%. Also harvesting the forage material at 12 weeks' increases yield and higher mineral concentrations. Pasture producers and livestock farmers can practically apply 200kg/ha⁻¹ NPK (20:10:10) fertilizer (4 bags) on regrowth of *Brachiaria* Mulato II and harvest at 8 weeks for better nutritive quality and 12 weeks for higher dry matter yield and returns.

Keywords: Forage, Yield, Mulato II, Nutritive, Quality, NPK.

INTRODUCTION

The major constraint to livestock production in developing countries such as Nigeria is the scarcity and fluctuating quantity and quality of all year-round feed supply. The poor performance of ruminant in Nigeria has been attributed to large dependence on natural pastures which on several occasions has been reported to be low both in quality and quantity of nutrients composition when compared to those in the temperate region (Tian *et al.*, 2000). Ruminants in the tropics are raised predominantly on grasses which are inherently poor in digestibility, nutritive value and unavailable in the off-season (Babayemi, 2009). *Brachiaria* is a species of grass originating from the savannas of the Eastern part of Africa. The grass species is widely used as livestock feed. *Brachiaria* species are



either annual or perennial grasses, with most of the species lacking rhizomes. The inflorescence has panicle branches composed of racemes and the entire plant usually do not grow higher than 1m. *Brachiaria* belongs to the C4 plants which tolerate drier conditions and more light exposure than many other plants (Watson and Dallwitz, 2008).

Brachiaria is the most important forage grass for pastures in the tropics (Singh, 2009). *Brachiaria* cultivars have impacted the economy of various countries in the tropics because of their ability to grow so well in low fertility acid soils and still able to produce highly nutritious forage for many ruminants. In the past 25-30 years *Brachiaria* cultivation and export has become a major component of sown pastures (Singh, 2009). In South America, Brazil represents the leading user of *Brachiaria* forage. *Brachiaria* grass has a rapid growth especially in the wet season. Its compatibility with *Stylosanthes humilis* and *S. hamata* is highly noted and also its ease of establishment (Miles *et al.*, 1996). *Brachiaria ruziziensis* combines well with other grasses and legumes. *Brachiaria* hybrid CIAT 36087 a high-quality forage grass resistant to spittlebug and adapted to well-drained acid tropical soil. *Brachiaria* are grasses most commonly found in extensive pasture land of tropical Latin America. There are still areas with acid soil of low fertility and poor drainage or that suffer periodic flooding where the establishment of improved cultivars of the type is slow and their use is limited (Miles *et al.*, 2004). These areas are also characterized by adverse topographic and climate condition and high pest and disease incidence with predominance of extensive management system in degraded pasture. In view of the high negative impact of this condition on livestock productivity in the tropic.

The aim of this study is to determine the Influence of NPK (20:10:10) fertilizer rates and Age of regrowth on forage yield and nutritive quality of *Brachiaria* Mulato II.

MATERIALS AND METHODS

Description of the Experimental Site

This research was carried out at the National Animal Production Research Institute (NAPRI) located about 20km along the Zaria-Sokoto road in Kaduna State. The climate is characterized by a well-defined wet season which normally begins in April–May and ends in late September–early October. The dry season lasts from October–April with low relative humidity and dry north-east winds. The total annual rainfall is about 1050 mm.

Experimental Pasture

A one-year old pasture *Brachiaria* Mulato II pasture was used for the experiment, the pasture was established in 2019 through vegetative seedlings propagation and it covered an area of 10,000m². The established pasture was weeded at the onset of raining season and fertilizer was applied at 4 and 6 weeks after the first rain and all agronomic practices were adopted.

Experimental Design and Layout

A total land area of 100 m² was used for the Experiment. The net plot (45m x 15m) was divided into three main plots, these were later subdivided into five sub plots in three replicates in a Split Plot Design with 3 x 5 factorial arrangement. The distance between the main plots was 1m while 0.5m was used for the sub plot respectively. The main plot was NPK 20:10:10 fertilizer applied at different rates of 0, 50, 100, 150, and 200kg/ha respectively while the sub-plots were stages of harvest at 8,10 and 12 weeks. Fertilizer was applied in two split doses at 4 and 6 weeks after weeding.

Forage Yield Data Collection

Sampling of the forage material was carried out by harvesting fresh forage per treatment within each plot in a 0.5m² quadrat at 10cm height above the ground using hand-sickle. Total fresh forage weight was measured and sub-samples were oven-dried at 65°C for 48 hours until constant weight was reached. The study was conducted for two seasons (2020 and 2021). The dried samples were re-weighed to estimate the dry matter yield as reported by Tarawali *et al.* (1995). The weight samples were labeled and put into polythene bags until required for analysis.

Chemical Analysis

Sub-samples of about 500 g from the bulk were obtained per treatment, dried and then ground to pass through a 2 mm sieve for proximate analysis. The samples were analyzed to determine the proximate composition of the forages: Dry matter, Crude Protein, Crude Fiber (CF), Ether Extract (EE)



and Ash using the method of AOAC (2005) and Nitrogen Free Extract (NFE) content by difference. Neutral detergent fibre (NDF), Acid detergent fibre (ADF), Hemicellulose by method of van-Soest *et al.*, (1991). Mineral content Macro (Calcium, Phosphorus) and Micro (Iron and Cobalt) were determined by AOAC (2005) Methods using the Atomic Absorption Spectrophotometer.

Statistical Analysis

All data collected were subjected to Analysis of variance (ANOVA) using Statistical Analysis System. Guide for personal computers. Version 9 (SAS) and Means were separated using Duncan's Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

Influence of NPK (20:10:10) Fertilizer Rates and Age of Regrowth on Dry Forage Yield of *Brachiaria Mulato II*

Influence of NPK fertilizer rates and age of regrowth on dry forage yield of *Brachiaria Mulato II* during 2020 and 2021 growing seasons is presented in Table 1. In 2020 dry forage yield was significantly ($P < 0.05$) affected by the rates of fertilizer application, where 200 kg ha⁻¹ (6.08t/ha) resulted to heavier yield only when compared to the control and applied 150 kg ha⁻¹ that had statistically similar yield in 2020. But in the second year, application of NPK 20:10:10 from 0-100 kg ha⁻¹ gave a progressive yield increase and beyond this rate, forage yield was not increased significantly. In the Combine (Average over the years) increase in NPK 20:10:10 fertilizer from 0-150 kg ha⁻¹ led to heavier yield and substantial significant yield increment was observed only when 200 kg ha⁻¹ NPK 20:10:10 of fertilizer was applied. The interacting factors were not significant in the years and combined.

In this study, the high DM yield by *Brachiaria Mulato II* can be largely attributed to its nature of growth, tillering and leaf number per stan similar to the report of Guiot and Melendez, (2003) for large size leaves (15-20" long) and thick stems (1-1.5" width). However, the leafy nature might be a disadvantage in dry areas where water supply is limited, as it facilitates rapid water loss through transpiration (Mnene, 2006).

In 2021 growing season Dry forage yields also showed a significant difference across the fertilizer application rates (6.62t/ha) the highest was recorded at 100 kg ha⁻¹ rates similar to (6.45t/ha) recorded at 200 kg ha⁻¹ rates and the lowest (5.11t/ha) was obtained at 0 kg ha⁻¹. Cook *et al.* (2005), reported that DM production is strongly influenced by soil fertility and ranges from 7-34 t/ha/year.

IDIAP, (2006). reported a 1456 tha⁻¹ DM achieved with the application of 2 tha⁻¹ limestone and comparable results for production were found in 2004 in Gualaca, Panama (15.6 t ha⁻¹ DM).

Table 1: Influence of NPK (20:10:10) Fertilizer Rates and Age of Regrowth on Dry Forage Yield of *Brachiaria* Mulato II during 2020, 2021 and Combine

NPK (20:10:10) fertilizer rates (kg ha ⁻¹)	2020	2021	Combined (t ha ⁻¹)
0	4.36 ^b	5.11 ^c	4.74 ^c
50	5.48 ^{ab}	5.25 ^b	5.37 ^b
100	4.85 ^{ab}	6.62 ^a	5.74 ^{ab}
150	5.01 ^b	5.99 ^b	5.50 ^b
200	6.08 ^a	6.45 ^{ab}	6.27 ^a
SEM	0.49*	0.52*	0.457*
Age of regrowth			
8	3.52 ^b	4.31 ^c	4.15 ^c
10	3.98 ^b	5.40 ^b	4.46 ^b
12	7.96 ^a	7.94 ^a	7.95 ^a
SEM	0.82*	0.85*	0.76*
Interaction	0.8270 ^{ns}	0.2500 ^{ns}	0.2641 ^{ns}

^{abc}Means with different superscripts along the column differed significantly (P<0.05); SEM= Standard Error of the Mean.

INFLUENCE OF NPK (20:10:10) FERTILIZER RATES AND AGE OF REGROWTH ON PROXIMATE COMPOSITION OF *BRACHIARIA* MULATO II

Influence of NPK fertilizer rates and age of regrowth on proximate composition of *Brachiaria* Mulato II during the growing seasons presented in Table 2, 3 and 4. Table 2. shows that organic matter and hemicellulose contents are significantly higher with application of fertilizer from 0 – 50 kg ha⁻¹ NPK and beyond this rate the contents were not significantly increased. Each level of applied NPK fertilizer from 0 – 100 kg ha⁻¹ gave a progressive increment of crude protein, however higher application of 150 kg ha⁻¹ NPK recorded higher ash content when compared to all other fertilizer levels. Application of NPK 20:10:10 fertilizer had no significant influence on DM, EE and ADF. Total digestible nutrient was not affected (P>0.05) by the rate of fertilizer application. NDF was significantly higher (P<0.05) at 150 kg ha⁻¹ rates (64.15%) compared to other application rates. ADF showed no significant difference across the fertilizer treatment rates. Age of regrowth in 2020 significantly affected the dry matter content of the forage where 12 weeks recorded the highest (P<0.05) value (92.14%) and the lowest value (90.33%) was obtained at 8 weeks. Organic matter was significantly higher (P<0.05) (83.11%) at 12 weeks and (79.89%) the lowest at 8 weeks. Crude protein content of the forage was significantly higher (P<0.05) at 8 weeks (9.32%) compared to other weeks. TDN in 2020 season showed a significant (P<0.05) difference across the weeks where the highest was recorded at 12 weeks (47.51%) compared to the other weeks.

NDF showed a significantly (P<0.05) higher content at 10 weeks (64.69%) compared to the rest where ADF showed a significantly (P<0.05) higher content at 12 weeks (39.77%) compared to the other weeks. In 2021 season (Table 4.7), organic matter was significantly (P<0.05) higher (88.21%) at 12 weeks and the lowest (86.22%) at 8 weeks of age, crude protein showed a higher (P<0.05) value 6.24% at 8 weeks of age and the lowest (4.48%) was recorded at 12 weeks. Neutral detergent fibre (71.29%) was significantly (P<0.05) higher at 10 weeks of age compared to the other weeks. In the combine season, crude protein was significantly (P<0.05) higher (7.78%) at 8 weeks of age and the lowest (5.40%) at 12 weeks. Neutral detergent fibre showed a significantly (P<0.05) higher percentage (67.99%) at 10 weeks of age and the lowest (63.39%) at 8 weeks.

Organic matter content and crude protein were significantly higher in this study as a result of fertilizer applications, Whitehead (2000), found that the CP content of grasses depends on soil N availability and that N fertilization increases it. Crude protein (CP) and digestible dry matter (DDM) are the most important components of a feed (Afzal and Ullah, 2007). Fertilizing with nitrogen generally increases the crude protein level of grasses, but fertilization usually has little or no effect on the digestible energy of forage (Ball *et al.*, 2001). The CP content recorded in this study (7.78%) was within the range of the minimum requirement (6-8%) reported by NRC, (2007). These values were lower than those reported by Mutimura and Everson (2012). Vega *et al.* (2006) stated that other factors like the maturity of the grass can be the source of declining CP. Nutrients in forages vary



according to many factors such as forage species and climate (Baron and Belanger, 2007). This trend of lesser CP content has been reported by other workers such as by Tessema *et al.* (2002) and is mainly attributable to dilution of the CP contents of the forage crops by the rapid accumulation of cell wall carbohydrates at the latter stages of growth (Van Soest, 1994).

Undersander, (2003) reported that Neutral detergent fiber (NDF) has traditionally been used as a predictor of forage intake, while acid detergent fibre (ADF) has been used as a predictor of forage digestibility. These relationships often hold true for mixed diets, but they can be misleading when forage is fed alone. These relationships are used to calculate relative feed value (RFV). The values for ADF and NDF obtained in this study were in line with the ADF range of 34-43% and NDF range of 46-62% reported by Roberts (2003) for ideal grass hay. The variation in the fibre contents (fractions) at the early stage of growth in the plant and in the late stage might be due to the difference in maturity, stage of growth and lignin content of the plant (Fadiyimu *et al.*, 2011).

Stage of growth, is the principal factor responsible for declining forage nutritive value, as the plant advances in growth with advancing maturity, one of the main chemicals deposited internally in the plant cell walls is lignin (Adesogan, 2006). In addition, digestibility of the forage declines like crude protein (CP) does in the forage tissue. This decline is more pronounced and sudden in warm season perennial grasses especially in plant tissue older than 35-40 days. Total digestible nutrient (TDN) is the nutrient available to the animal and is inversely related to acid detergent fibre (ADF) concentration of the forage. As the acid detergent fibre (ADF) increase, the total digestible nutrient (TDN) declines which means that the animals will not be able to utilize the nutrient that are present in the forages.



Table 2: Influence of NPK (20:10:10) Fertilizer Rates and Age of Regrowth on Chemical Composition of *Brachiaria* Mulato II during 2020 Growing Season.

Parameter	NPK fertilizer rates (kg ha ⁻¹)					SEM	Age of regrowth (weeks)			SEM	FxA
	0	50	100	150	200		8	10	12		
Dry matter	90.86	91.53	91.59	91.53	91.77	0.304 ^{ns}	90.33 ^b	91.90 ^a	92.14 ^a	0.507*	0.2420 ^{ns}
Organic matter	81.38 ^c	82.09 ^{ab}	81.74 ^b	82.50 ^a	81.87 ^b	0.349*	79.89 ^c	82.75 ^b	83.11 ^a	0.583*	0.2478 ^{ns}
Crude protein	8.30 ^a	7.45 ^c	8.33 ^a	7.55 ^b	8.04 ^a	0.476*	9.32 ^a	8.16 ^b	6.31 ^c	0.793*	0.3330 ^{ns}
TDN	45.22	46.96	46.21	46.50	47.04	1.412 ^{ns}	46.56 ^{ab}	45.09 ^b	47.51 ^a	1.882*	0.9571 ^{ns}
Ether extract	3.15 ^a	3.12 ^a	3.23 ^a	3.15 ^a	3.03 ^b	0.164*	3.33 ^a	3.28 ^a	2.79 ^a	0.273*	0.8636 ^{ns}
Ash	9.04 ^a	9.43 ^a	9.85 ^a	9.03 ^b	9.91 ^a	0.288*	10.21 ^a	9.15 ^b	9.01 ^c	0.57*	0.4323 ^{ns}
NDF	63.36 ^b	62.93 ^b	61.93 ^c	64.15 ^a	61.86 ^c	1.183*	60.83 ^c	64.69 ^a	62.92 ^b	1.94*	0.8523 ^{ns}
ADF	39.89	38.34	39.79	37.16	38.48	1.070 ^{ns}	38.35 ^b	38.07 ^c	39.77 ^a	1.783*	0.7135 ^{ns}
Hemicellulose	23.46 ^b	25.12 ^a	22.51 ^c	26.47 ^a	22.51 ^c	1.476*	22.48 ^c	26.99 ^a	23.01 ^b	2.459*	0.5401 ^{ns}

^{abc}Means with different superscripts along the row differed significantly (P<0.05); SEM= Standard Error of the Mean. NDF=Neutral detergent fibre, ADF=Acid detergent fibre, ADL=Acid detergent lignin, TDN = Total digestible nutrient * = Significantly different means; ns = Not significant, FxA= Interaction between Fertilizer and age.

Table 3: Influence of NPK (20:10:10) Fertilizer Rates and Age of Regrowth on Chemical Composition of *Brachiaria* Mulato II during 2021 Growing Season.

Parameter	NPK fertilizer rates (kg ha ⁻¹)					SEM	Age of regrowth (weeks)			SEM	FxA
	0	50	100	150	200		8	10	12		
Dry matter	93.68	93.45	93.54	93.45	93.13	0.291 ^{ns}	93.21	93.73	93.45	0.485 ^{ns}	0.7816 ^{ns}
Organic matter	87.86	87.45	87.68	87.15	86.88	0.403 ^{ns}	86.22 ^b	87.77 ^a	88.21 ^a	0.672*	0.0428*
Crude protein	4.55	5.35	5.48	5.00	5.08	0.385 ^{ns}	6.24 ^a	4.56 ^b	4.48 ^b	0.641*	0.1934 ^{ns}
TDN	41.51	43.01	44.54	44.02	44.68	1.245 ^{ns}	44.82 ^a	41.45 ^b	44.39 ^a	2.075*	0.0849 ^{ns}
Ether extract	2.20	2.06	2.35	2.09	2.15	0.128 ^{ns}	2.62 ^a	1.63 ^c	2.26 ^b	0.213*	0.1006*
Ash	5.82	6.00	5.86	6.35	6.25	0.273 ^{ns}	6.99 ^a	5.96 ^b	5.23 ^c	0.456*	0.0071*
NDF	70.82	67.55	67.46	68.86	66.99	1.409 ^{ns}	65.96 ^b	71.29 ^a	67.76 ^b	2.348*	0.1782 ^{ns}
ADF	45.51	45.59	41.21	41.17	42.73	1.605 ^{ns}	41.33	44.74	43.65	2.674 ^{ns}	0.0593 ^{ns}
Hemicellulose	25.32 ^{ab}	21.96 ^b	26.25 ^{ab}	27.69 ^a	24.26 ^{ab}	1.818*	24.64	26.55	24.11	3.029 ^{ns}	0.1633 ^{ns}



Table 4: Influence of NPK (20:10:10) Fertilizer Rates and Age of Regrowth on Chemical Composition of *Brachiaria* Mulato II during the Two Growing Seasons.

Parameter	NPK fertilizer rates (kg ha ⁻¹)					SEM	Age of regrowth (weeks)			SEM	FxA
	0	50	100	150	200		8	10	12		
Dry matter	92.27	92.49	92.565	92.49	92.45	0.297 ^{ns}	91.77	92.82	92.80	0.496 ^{ns}	0.5118 ^{ns}
Organic matter	84.62	84.77	84.71	84.83	84.38	0.376 ^{ns}	83.06	85.26	85.66	0.628 ^{ns}	0.1453 ^{ns}
Crude protein	6.43	6.40	6.91	6.28	6.56	0.431 ^{ns}	7.78 ^a	6.36 ^a	5.40 ^b	0.717*	0.2632 ^{ns}
TDN	43.37	44.99	45.38	45.26	45.86	1.329 ^{ns}	45.69	43.27	45.95	1.979 ^{ns}	0.5210 ^{ns}
Ether extract	2.68	2.59	2.79	2.62	2.59	0.146 ^{ns}	2.98	2.45	2.53	0.243 ^{ns}	0.4821 ^{ns}
Ash	7.43	7.72	7.86	7.69	8.08	0.281 ^{ns}	8.60	7.56	7.12	0.513 ^{ns}	0.2197 ^{ns}
NDF	67.09	65.24	64.69	66.50	64.42	1.296 ^{ns}	63.39 ^b	67.99 ^a	65.34 ^{ab}	2.144*	0.5153 ^{ns}
ADF	42.70	41.97	40.50	39.16	40.60	1.338 ^{ns}	39.84	41.41	41.71	2.229 ^{ns}	0.3864 ^{ns}
Hemicellulose	24.39	23.54	24.38	27.08	23.38	1.647 ^{ns}	23.56	26.77	23.56	2.744 ^{ns}	0.3517 ^{ns}

^{abc} means with different superscripts along the row differed significantly ($P < 0.05$); SEM= Standard Error Mean. NDF=Neutral detergent fibre, ADF=Acid detergent fibre, ADL=Acid detergent lignin, TDN = Total digestible nutrient * = Significantly different means; ns = Not significant, FxA= Interaction between Fertilizer and age.

INFLUENCE OF NPK (20:10:10) FERTILIZER RATES AND AGES OF REGROWTH ON MINERAL COMPOSITION OF *BRACHIARIA* MULATO II

In 2020 growing season both calcium and phosphorus were not significantly ($P>0.05$) affected by fertilizer rates and age of regrowth (Table 4.9). Calcium concentration with application of fertilizer ranged between (0.363- 0.527%) and phosphorus (0.176- 0.188%) with age of regrowth calcium ranged between (0.395-0.517%) and phosphorus (0.128-0.211%). Iron (2698.7ppm) was significantly ($P<0.05$) higher at 50kg ha^{-1} application rate and the lowest (1616.9ppm) at 0 kg ha^{-1} . Cobalt (224ppm) was significantly ($P<0.05$) higher at 50kg ha^{-1} application rate and (173.78ppm) the lowest was recorded at 0 kg ha^{-1} rate. Age of regrowth significantly ($P<0.05$) affected both Iron and Cobalt concentration at 12 weeks of age (2555.9 and 225.20 ppm) and the lowest concentration (1385.2 and 129.47ppm,) respectively at 8 weeks of age.

In 2021 phosphorus was significantly ($P<0.05$) higher (0.204%) at 0 kg ha^{-1} rate and the lowest (0.140%) was obtained at 150 kg ha^{-1} . Iron was higher ($P<0.05$) 2453.1ppm at 100 kg ha^{-1} rate which was at par with (2309.8ppm) recorded at 150 kg ha^{-1} rate and the lowest (1202.7ppm) at 0 kg ha^{-1} rate. Cobalt was significantly ($P<0.05$) higher (220.00ppm) at 100 kg ha^{-1} rate which was at par with (214.0ppm) at 150 kg ha^{-1} application rates, the lowest concentration (157.11ppm) was obtained at 0 kg ha^{-1} rate. Age of regrowth significantly ($P<0.05$) affected Iron and Cobalt concentration (2250 and 218ppm) at 10 and 8 weeks of regrowth, respectively, the lowest concentration for Iron (1584.4ppm) and Cobalt (188.40ppm) was recorded at 12 weeks of age.

The combine season showed that phosphorus (0.196%), Iron (2406.0ppm) and Cobalt (213.44ppm) were significantly higher with application of fertilizer at 0 and 50 kg ha^{-1} respectively. The lowest concentration for phosphorus (0.158%) was recorded at 150 kg ha^{-1} , Iron (1409.8ppm) and Cobalt (170.44ppm) at 0 kg ha^{-1} rate. Age of regrowth significantly ($P<0.05$) affected phosphorus concentration (0.193%) at 8 weeks Iron (2280ppm) and Cobalt (206.8ppm) at 10 and 12 weeks of age, respectively, the lowest concentration for phosphorus, Iron and Cobalt were recorded at 12 weeks (0.159%), (1799ppm) and (173.9ppm) at 8 weeks of regrowth. The Ca content in the tested grass was high, and was similar to the results of Collins and Fritz (2003) who reported that the Ca content in Orchard grass (*Dactylis glomerata* L) was 2.3%. In addition, researchers on tropical grasses found that Ca content in the grasses was sufficient to meet cattle and sheep's requirement for Ca (Youssef and Braithwaite, 1987). However, according to McDowell and Valle (2000), some forage grasses and legumes collected from different regions of Latin America and Africa showed low concentrations of Ca ($<0.3\%$). Also Nguku *et al.* (2015) reported that *B. brizantha* cultivars showed higher calcium (0.104-0.267%) DM content than other *Brachiaria* cultivars (with an exception of *Brachiaria mulato* II) as the production phase progressed. Calcium concentration obtained in this study was higher than reported values by the aforementioned authors.



Table 5: Influence of NPK (20:10:10) Fertilizer Rates and Ages of Regrowth on Mineral Composition of *Brachiaria* Mulato II during the 2020, 2021 and combine

Parameter Treatments	2020				2021				Combine			
	Ca (%)	P (%)	Fe (ppm)	Co (ppm)	Ca (%)	P (%)	Fe (ppm)	Co (ppm)	Ca (%)	P (%)	Fe (ppm)	Co (ppm)
NPK fertilizer rates (kg ha ⁻¹)												
0	0.44	0.19	1616.90 ^c	173.78 ^b	0.38	0.20 ^a	1202.70 ^b	167.11 ^b	0.411	0.196 ^a	1409.80 ^b	170.44 ^b
50	0.53	0.19	2698.70 ^a	224.00 ^a	0.35	0.18 ^{ab}	2113.30 ^a	202.89 ^{ab}	0.437	0.184 ^{ab}	2406.00 ^a	213.44 ^a
100	0.45	0.18	2265.10 ^{ab}	189.56 ^b	0.56	0.19 ^{ab}	2453.10 ^a	220.00 ^a	0.504	0.185 ^{ab}	2359.10 ^a	204.78 ^a
150	0.36	0.18	1755.80 ^{bc}	174.67 ^b	0.37	0.14 ^b	2309.80 ^a	214.00 ^a	0.364	0.158 ^b	2032.80 ^a	194.33 ^a
200	0.37	0.18	2048.00 ^{bc}	182.67 ^b	0.37	0.17 ^{ab}	2036.40 ^a	203.78 ^{ab}	0.368	0.176 ^{ab}	2032.80 ^a	193.22 ^a
SEM	0.042 ^{ns}	0.008 ^{ns}	101.607 [*]	6.330 [*]	0.041 ^{ns}	0.010 [*]	119.072 [*]	7.282 [*]	0.029 ^{ns}	0.006 [*]	77.420 [*]	4.315 [*]
Age of regrowth (weeks)												
8	0.40	0.21 ^a	1385.20 ^b	129.47 ^b	0.35	0.18	2234.10 ^a	218.27 ^a	0.37	0.19 ^a	1799.70 ^b	173.90 ^b
10	0.52	0.21 ^a	2309.60 ^a	212.13 ^a	0.42	0.17	2250.70 ^a	198.00 ^{ab}	0.49	0.19 ^a	2280.10 ^a	205.10 ^a
12	0.38	0.13 ^b	2555.90 ^a	225.20 ^a	0.45	0.19	1584.40 ^b	188.40 ^b	0.41	0.16 ^b	2070.10 ^{ab}	206.80 ^a
SEM	0.069 ^{ns}	0.010 [*]	169.345 [*]	10.551 [*]	0.068 ^{ns}	0.016 ^{ns}	198.454	12.135 [*]	0.048 ^{ns}	0.010 [*]	129.040 [*]	7.175 [*]
FxA	0.1079 ^{ns}	0.2720 ^{ns}	0.0001 [*]	0.0001 [*]	0.0847 ^{ns}	0.5012 ^{ns}	0.0148 ^{ns}	0.9650 ^{ns}	0.2274 ^{ns}	0.7360 ^{ns}	0.0002 ^{ns}	0.0007 ^{ns}

^{abc} means with different superscripts along the column differed significantly (P<0.05); SEM= Standard Error Mean, FxA= Interaction between Fertilizer and age.



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