



## EFFECT OF HARVESTING AGE ON THE MACRO AND MICRO MINERALS COMPOSITION OF CONGO GRASS, MULATO II AND GUINEA GRASS

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### ABSTRACT

The experiment was carried out at the Department of Crop Science and Horticulture, Teaching and Research Farm, Federal University Oye Ekiti to determine the effect of harvesting age on the macro and micro minerals concentration of Congo grass, Mulato II and Guinea grass. The experimental site was cleared and demarcated with pegs into 32 plots. Each plot was 4m in length and 4m in (16m<sup>2</sup>). *Brachiaria ruziziensis*, *Brachiaria Mulato II* and *Panicum maximum* seeds were sown directly in the experimental plots with 30cm intra-row spacing and 60cm inter-row spacing with each plot replicated (4) times in a Randomized Complete Block Design (RCBD). The result showed that sodium, calcium and potassium were significantly ( $P<0.05$ ) higher at week 4 post germination in Mulato II (91.6ppm, 185.87ppm and 350ppm respectively) and lowest in Congo grass. These values decreased as Mulato II matures to 78.60ppm, 160.67ppm and 306.33ppm for sodium, calcium and potassium respectively. The calcium, sodium and potassium contents of Mulato II were significantly ( $P<0.05$ ) higher at weeks 4, 6, 8 and 10 post germination than in Congo and Guinea grasses. Copper and Iron were significantly ( $P<0.05$ ) highest in Mulato II at weeks 4, 6, 8 and 10 post germination and lower in Congo and Guinea grasses. Copper and iron were 0.58ppm and 3.17ppm in Mulato II. Copper (0.58ppm) was significantly higher in Mulato II at week 4 and increased to 0.59ppm at week 10. Mulato II had significantly higher sodium, calcium, potassium and sulfur concentrations at all the harvesting ages than Congo and Guinea grasses. Harvesting age significantly affected macro minerals concentration in Congo, Mulato II and Guinea grasses. Harvesting at early stages is recommended to maximize mineral content for optimal livestock nutrition.

**Keywords:** Congo, Mulato II, Guinea, Grass, Harvesting, Age

### INTRODUCTION

The Nigerian livestock sector supporting nearly 15 million households and contributing about 10% to the national GDP, heavily relies on pastures as a primarily feed source (Sani and Abdulmuhmini 2024). In a study reported by Onifade (2024), despite Nigerian having approximately 93 million hectares of land, only 40 million (40,000,000) are designated for grazing with an approximately 3% of over 101 million ruminants animals in Nigeria that are raised under improved pastures. The livestock industry in Nigeria performs a vital role in offering food security, employment opportunities, and contributing to the country's economy. However, livestock production in Nigeria faces numerous demanding problems that avert its growth and improvement (Jimoh and Shittu, 2019). Livestock industry in Nigeria is characterized by a widespread dependence on subsistence farming, constrained access to fashionable technology, and low productivity, because ruminant animal farmers do not go into pasture production. Despite Nigeria being one of the most important country in Africa in cattle population, Nigeria's contribution to global livestock production and exports remains modest (Ibrahim and Adebambo, 2019). Livestock production in Nigeria is dominated by smallholder farmers, who face diverse demanding situations in terms of technical knowhow, infrastructure, and access to credit, animal health offerings, and good processing industries. The high cost of feeds and different inputs is a significant project that detrimentally affects the livestock industry in Nigeria. Feed costs represent an enormous portion of production prices in all categories of livestock (Adebayo *et al.*, 2019; Fakoya and Ewuola, 2020).

Many *Brachiaria* species, including *Bracharia ruziziensis* and *Mulato II*, have been placed by some authors in the *Urochloa* genus, so the taxon *Urochloa ruziziensis* (R. Germ. & C.M. Evrard).



However, these changes remain disputed and many recent papers still refer to *Bracharia ruziziensis* (Torres González *et al.*, 2005). Congo grass is a common pasture grass for ruminants in Central Africa, Thailand and Brazil. Palatability is good, but decreases with age. *In vitro* DM digestibility ranged between 38% (Meale *et al.*, 2012) and 66% (Herrero *et al.*, 2001), but decreased with the stage of growth. DM digestibility of fresh Congo grass averaged 57%, and protein digestibility 53% in sheep (Khanum *et al.*, 2010). Guinea grass used to be known as *Panicum maximum* Jacq. In 2003, the subgeneric name *Megathyrsus* was raised to generic rank and the plant was renamed *Megathyrsus maximus* (Jacq.) B. K. Simon & S. W. L. Jacobs (Simon *et al.*, 2003). However, the name *Panicum maximum* is still found in literature posterior to 2003. Forage mineral elements naturally vary in concentrations due to a multitude of factors including soil fertility, plant phenology, and land management (Smith *et al.*, 2014; Jones and Tracy, 2015). Likely unnoticed, trace mineral deficiencies can cause significant economic impacts to livestock producers. Therefore, supplementation strategies and nutritional management of ruminant animals most especially lactating ewes and does during critical production periods of breeding and gestation are an important consideration. Page *et al.* (2018) found that 33% of sheep producers were not supplementing a complete trace mineral, and of those trace minerals Se and Zinc represented mineral elements most commonly deficient and marginally deficient, thus there is room for improvement in this area.

This study is aimed to determine the effects of harvesting age on the macro and minerals composition of *Brachiaria ruziziensis*, *Brachiaria Mulato II* and *Panicum maximum*.

While various studies have examined forage quality in terms of crude protein, fiber, and dry matter, limited research focuses specifically on how harvesting age affects the macro and micro mineral composition of tropical grasses like Congo grass, Mulato II, and Guinea grass. Most available data emphasize general nutritive value or digestibility, with fewer studies detailing how essential minerals like Ca, Mg, Zn, Fe, and Cu change with plant maturity across different grass species. Additionally, comparisons between improved cultivars (like Mulato II) and indigenous species (like Congo grass) in terms of mineral dynamics are underrepresented in tropical forage research.

Minerals are vital for metabolic functions, growth, reproduction, and immune health in livestock. Understanding how harvesting age impacts mineral availability in grasses can help livestock farmers to optimize feeding strategies and improve the health of their livestock. Grasses differ in terms of minerals; knowledge on their mineral profiles at various growth stages will enable livestock farmers to know species-specific cutting schedules, thereby reducing mineral deficiencies in grazing systems. Harvesting of pasture grasses at the right time based on optimal mineral concentration improves forage quality and land-use efficiency, supporting sustainable ruminant production. For regions like sub-Saharan Africa, especially Nigeria, there is a scarcity of localized, scientific data on both macro and micro mineral composition trends with grass maturity, which this study aimed at addressing.

## **MATERIALS AND METHODS**

### **Experimental Site**

The experiment was carried out at the Department of Crop Science and Horticulture, Teaching and Research Farm, Federal University Oye Ekiti, Ikole Campus. Ekiti State is located between latitude 50°45' East and longitude 40°51' of the Greenwich meridian and latitudes 70°15' and 80°51' north of the Equator. Geographically, Ikole Local Government is entirely within the tropic. It is located between longitude 45° East of Greenwich and latitude 7° – 8° – 15° North of the Equator. Its neighbours are Kwara State to the North, Kogi State to the North east, Ekiti East to the East, Gboyin Local Government in the South and Oye Local government in the West.

### **Land Preparation**

The land was ploughed and harrowed, debris were removed and other obstacles from the land. This was done to improve soil aeration, water infiltration and root growth by providing a uniform seedbed.



### **Forage Production**

The experimental site was cleared and demarcated with pegs into 12 plots. Each plot was 4m in length and 4m in (16m<sup>2</sup>). *Brachiaria ruziziensis* (Congo grass), *Brachiaria Mulato II* and *Panicum maximum* (Guinea grass) seeds were sown directly in the experimental plots with 30cm intra-row spacing and 60cm inter-row spacing with each plot replicated (4) times in a Randomized Complete Block Design (RCBD). *Panicum maximum*, *Brachiaria ruziziensi* and *Brachiaria Mulato II* was grown as sole grasses. Weeding was carried out at week 4 and at week 8 post-germination in all the experimental plots. After 4 weeks post-germination, samples were harvested at about 2cm above the ground level from 4 experimental plots each for Congo, Mulato II and Guinea grasses. Each sample harvested from each of the four (4) plots was oven dried immediately for subsequent minerals determination. The same procedure was repeated at weeks 6, 8 and 10 post-germination.

### **Determination of Mineral Composition**

The mineral composition was determined using Atomic Absorption Spectrophotometer (Okalebo *et al.*, 2002). The minerals determined were sodium (Na), potassium (K), calcium (Ca), magnesium (Mg), zinc (Zn), copper (Cu), Sulfur and Chlorine (Cl), while iron (Fe) and phosphorus (P) were determined using calorimetric procedures described by Mohammed *et al.* (2011). The samples materials were collected washed, shade-dried to preserve bioactive compounds, and ground into fine powder. One gram of the powdered sample was digested using concentrated nitric acid (HNO<sub>3</sub>) and perchloric acid (HClO<sub>4</sub>) until clear solutions were obtained. The digested samples were analyzed for mineral content using a flame photometer (Sherwood Model 360), measuring concentrations of the minerals in parts per million (ppm).

### **Statistical Analysis**

Data collected on proximate composition, macro and micro minerals compositions of *Panicum maximum* were subjected to General Linear Model of Analysis of Variance (ANOVA) with Type III Sum of Squares (SAS, 2010). Differences among means were separated using Tukey's honestly significant difference (HSD).

## **RESULT AND DISCUSSION**

### **Minerals Composition of Congo, Mulato II and Guinea Grass at different Harvesting Age**

Result of macro minerals analysis of Congo and Mulato II at different Harvesting Age is presented in Table 1. The result showed that sodium, calcium and potassium were significantly ( $P < 0.05$ ) higher at week 4 post germination in Mulato II (91.6ppm, 185.87ppm and 350ppm respectively and lowest in Congo grass 985.5ppm, 160.9ppm and 305.97ppm respectively. These values decreased as Mulato II matures to 78.60ppm, 160.67ppm and 306.33ppm for sodium, calcium and potassium respectively. These findings are in line with that of Dandara *et al.*, (2024), who reported a decrease in minerals composition of grasses as the plant matures. The calcium, sodium and potassium contents of Mulato II were significantly ( $P < 0.05$ ) higher at weeks 4, 6, 8 and 10 post germination than in Congo and Guinea grass. A significant decreased in the contents of these minerals observed in this study is in line with the result observed by Dandara *et al.* (2024). In a study reported by Bacorro *et al.* (2018) suggested that Mulato II harvested at 30-day intervals possessed higher calcium and phosphorus concentration compared to those harvested at 45-day intervals. The results from this study aligned with the findings of Bacorro *et al.* (2025), who suggested that earlier harvesting ages preserves calcium, potassium, and sodium concentrations of Congo grass, Mulato II and Guinea grass. Chlorine (Cl) was significantly ( $P < 0.05$ ) highest in Guinea grass at weeks 4 (14.34ppm), 6 (14.27ppm), 8 (10.98) and 10 (11.64ppm) and lowest in Mulato II which ranges from 6.95ppm at week 4 to 6.85ppm, 6.93ppm and 7.06ppm at weeks 6, 8 and 10 post germination respectively. Marschner (2012) stated that the decline in chlorine content of grasses as they mature is primarily due to physiological and structural changes in the plant. The result further revealed that Magnesium and phosphorus were not significantly ( $P < 0.05$ ) different at week 4 post germination in Congo grass, Mulato II and Guinea grass. In a study reported by Dandara *et al.* (2024) phosphorus content in Congo grass decreased significantly with advancing maturity of the grass. The sulfur concentration of the grasses in this study also followed the same trend. The sulfur decreases as the



grasses matured, though it is higher in Mulato II (35.13ppm) and Congo grass (31.32ppm) than in Guinea grass (24.43ppm) at week 4 post germination, but it was only significantly ( $P<0.05$ ) higher in Mulato II at weeks 6, 8 and 10 post germination (39.51ppm, 33.81ppm, and 30.52ppm respectively). Different authors had reported that variations in the macro minerals (sodium, calcium, potassium, chlorine, magnesium and phosphorus) compositions of grasses at different harvesting ages is influenced by plant physiology and maturity, mineral mobility and environmental conditions among others (Suttle 2010; Marschner 2012). They further stated that as grasses matured, cell wall development increases, therefore younger plant tissues have higher metabolic activity which resulted in a greater minerals accumulation. Macro minerals are crucial for ruminants nutrition, supporting various bodily functions which include bone formation, energy metabolism, nucleic acid synthesis, muscle and nerve functions and maintaining electrolyte balance in livestock animals (Garg *et al.* 2009).

**Table1:** Minerals Composition of Congo, Mulato II and Guinea Grass at different Harvesting Age

Week	Parameter (ppm)	Treatment			P-value	SEM
		Congo	Mulato II	Guinea		
Week 4	Na	85.5 <sup>b</sup>	91.6 <sup>a</sup>	73.77 <sup>c</sup>	0.001	0.095
	Ca	160.9 <sup>b</sup>	185.87 <sup>a</sup>	175.6 <sup>ab</sup>	0.010	2.176
	K	305.97 <sup>b</sup>	350.2 <sup>a</sup>	315.23 <sup>b</sup>	0.001	1.940
	Cl	10.29 <sup>b</sup>	6.95 <sup>c</sup>	14.34 <sup>a</sup>	0.001	0.220
	Mg	31.59	37.73	37.02	0.081	0.976
	P	76.35	77.77	71.71	0.070	0.884
	S	31.32 <sup>a</sup>	35.13 <sup>a</sup>	24.43 <sup>b</sup>	0.006	0.855
Week 6	Na	77.57 <sup>b</sup>	87.5 <sup>a</sup>	68.33 <sup>c</sup>	0.001	0.188
	Ca	158.17 <sup>c</sup>	175.57 <sup>a</sup>	167.40 <sup>b</sup>	0.01	0.085
	K	303.53 <sup>b</sup>	336.60 <sup>a</sup>	295.70 <sup>c</sup>	0.002	0.065
	Cl	9.16 <sup>b</sup>	6.85 <sup>c</sup>	14.27 <sup>a</sup>	0.03	0.002
	Mg	30.75 <sup>c</sup>	32.81 <sup>b</sup>	34.39 <sup>a</sup>	0.05	0.008
	P	71.9 <sup>a</sup>	68.27 <sup>b</sup>	65.98 <sup>c</sup>	0.001	0.002
	S	35.37 <sup>b</sup>	39.51 <sup>a</sup>	30.72 <sup>c</sup>	0.001	0.002
Week 8	Na	70.63 <sup>b</sup>	81.77 <sup>a</sup>	63.27 <sup>c</sup>	0.002	0.051
	Ca	146.50 <sup>c</sup>	169.3 <sup>a</sup>	155.6 <sup>b</sup>	0.05	0.093
	K	287.57 <sup>b</sup>	312.47 <sup>a</sup>	260.4 <sup>c</sup>	0.01	0.066
	Cl	9.36 <sup>b</sup>	6.93 <sup>c</sup>	10.98 <sup>a</sup>	0.001	0.002
	Mg	28.15 <sup>b</sup>	30.28 <sup>a</sup>	30.14 <sup>a</sup>	0.05	0.005
	P	64.51 <sup>a</sup>	60.22 <sup>b</sup>	58.14 <sup>c</sup>	0.001	0.007
	S	31.79 <sup>b</sup>	33.81 <sup>a</sup>	26.21 <sup>c</sup>	0.001	0.005
Week 10	Na	66.47 <sup>b</sup>	78.60 <sup>a</sup>	60.50 <sup>c</sup>	0.003	0.087
	Ca	141.53 <sup>c</sup>	160.67 <sup>a</sup>	152.20 <sup>b</sup>	0.02	0.068
	K	276.57 <sup>b</sup>	306.33 <sup>a</sup>	247.73 <sup>c</sup>	0.05	0.054
	Cl	9.31 <sup>b</sup>	7.06 <sup>c</sup>	11.64 <sup>a</sup>	0.001	0.005
	Mg	25.59 <sup>c</sup>	27.37 <sup>b</sup>	28.75 <sup>a</sup>	0.01	0.004
	P	61.83 <sup>a</sup>	57.32 <sup>b</sup>	52.71 <sup>c</sup>	0.02	0.004
	S	26.63 <sup>b</sup>	30.52 <sup>a</sup>	25.90 <sup>c</sup>	0.001	0.003

<sup>abc</sup> means with different superscripts are significantly ( $P<0.005$ ) different. Na = Sodium; Ca = Calcium; K = Potassium; Cl = Chlorine; Mg = Manganese; Phosphorus = P; Sulfur = S.

### Micro Minerals Content of Congo, Mulato II and Guinea Grass at different Harvesting Age

The results as presented in Table 2 revealed a significant difference in terms of micro minerals copper, iron and zinc analyzed. The result further showed that, all the micro minerals contents of Congo grass, Mulato II and Guinea grass were significantly ( $P<0.05$ ) affected by harvesting age after germination. Copper and iron were affected at weeks 4, 6, 8 and 10 post germination, while zinc was only significant at week 10. Mulato II had significantly ( $P<0.05$ ) the highest values in all the affected parameters across the harvesting ages except on zinc at week 6 and 10 which indicated that Guinea





grass recorded the highest values of 3.48 and 2.91 respectively. Copper (Cu) and Iron (Fe) were significantly ( $P < 0.05$ ) highest in Mulato II at weeks 4, 6, 8 and 10 post germination and lower in Congo and Guinea grasses. Copper and iron were 0.58ppm and 3.17ppm in Mulato II. The copper and iron in all the three grasses increases at week 6, then start to decreases subsequently at weeks 8 and 10. Copper 0.50ppm, 0.58ppm and 0.46ppm at week 4 in Congo grass, Mulato II and Guinea grass respectively, and then increased to 0.58ppm, 0.62ppm and 0.51ppm at week 6 for Congo, Mulato II and Guinea grasses respectively. This indicated that mineral content of pasture grasses decrease with increase in harvesting age. The result of this study lend support from the findings of Dele *et al.* (2024) who found that harvesting age affected micro minerals concentrations as Congo grass matured. He further stated that as Congo grass matured, iron copper and zinc concentrations decreases significantly. This report is similar to the findings of the current study, where copper and zinc concentrations decreases with age significantly from weeks 6 to a lower concentrations at weeks 8 and 10 post germinations. The findings of Bacorro *et al.* (2018) also agreed with the findings of this study, who reported a decrease in micro minerals concentrations of grasses as they mature. Across these studies, a consistent pattern emerges, as forages matured, micro minerals concentrations declined due to factors like dilution from increased biomass and reduced metabolic activity.

**Table2:** Micro Minerals Content of Congo, Mulato II and Guinea Grass at different Harvesting Age

Week	Parameter (ppm)	Congo	Treatment Mulato II	Guinea	P-value	SEM
Week 4	Cu	0.50 <sup>b</sup>	0.58 <sup>a</sup>	0.46 <sup>b</sup>	0.000	0.006
	Fe	2.31 <sup>b</sup>	3.17 <sup>a</sup>	2.63 <sup>b</sup>	0.004	0.063
	Zn	3.33	3.72	3.52	0.076	0.056
Week 6	Cu	0.53 <sup>b</sup>	0.62 <sup>a</sup>	0.51 <sup>c</sup>	0.01	0.002
	Fe	2.33 <sup>c</sup>	3.47 <sup>a</sup>	3.05 <sup>b</sup>	0.05	0.033
	Zn	3.17 <sup>c</sup>	3.25 <sup>b</sup>	3.48 <sup>a</sup>	0.05	0.002
Week 8	Cu	0.52 <sup>b</sup>	0.60 <sup>a</sup>	0.49 <sup>c</sup>	0.001	0.002
	Fe	2.18 <sup>c</sup>	3.26 <sup>a</sup>	2.80 <sup>b</sup>	0.001	0.002
	Zn	2.98	2.72	3.06	0.002	0.002
Week 10	Cu	0.50 <sup>b</sup>	0.59 <sup>a</sup>	0.45 <sup>c</sup>	0.05	0.002
	Fe	2.04 <sup>c</sup>	3.17 <sup>a</sup>	2.49 <sup>b</sup>	0.001	0.003
	Zn	2.60 <sup>b</sup>	2.43 <sup>c</sup>	2.91 <sup>a</sup>	0.04	0.013

<sup>abc</sup> means with different superscripts are significantly ( $P < 0.005$ ) different. Cu = Copper; Fe = Iron; Zn = Zinc

## CONCLUSION AND RECOMMENDATION

Mulato II had significantly higher sodium, calcium, potassium and sulfur concentrations at all the harvesting ages than Congo and Guinea grasses. Harvesting age significantly affected macro minerals concentration in Congo, Mulato II and Guinea grasses. Harvesting at early stages is recommended to maximize mineral content for optimal livestock nutrition.

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