



EFFECT OF HARVESTING AGE ON THE PROXIMATE AND MINERALS COMPOSITION OF *PANICUM MAXIMUM*

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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, Ikole Campus to determine the effect of harvesting age on the proximate and minerals compositions of Panicum maximum. The experimental site was cleared and demarcated with pegs into 12 plots. Fresh herbage samples were collected at three (3) different plots in a randomized manner at week 4 post-germination. The same procedure was repeated at weeks 6, 8 and 10 post-germinations. All representative samples of the herbage harvested at week 4, 6, 8, 10 and 12 post-germinations were analyzed for proximate, macro minerals and micro minerals compositions. Results indicated that dry matter was significantly (p<0.005) highest at week 10 (97.25) and lowest at week 4 (93.61). Highest Crude protein was obtained at weeks 4 and 8 (10.25 and 10.04 respectively) and least values was at week 10 (8.89). Crude fibre (30.56), ash (15.30), acid detergent fibre (32.49), neutral detergent fibre (73.26) and nitrogen free extract (32.62) were significantly higher at week 19 post-germination and least at weeks 4 and 6. Furthermore, results revealed significantly (p<0.005) highest macro minerals compositions at week 4. Similarly, calcium (175.60ppm), magnesium (37.02ppm), potassium (315.23ppm), sodium (73.77ppm), chlorine (14.34ppm) and phosphorus (71.70ppm) were significantly highest at week 4 and lowest at week 10. The zinc content significantly decreases with maturity of the grass. It decreases from 3.52ppm at week 4 to 2.91ppm at week 10. The copper content is lower at early stage of growth and as high as 0.45ppm at week 10. The iron content slightly decreases from 2.63ppm at weeks 4 to 2.49ppm at week 10. It is concluded that nutritional quality, macro and micro minerals compositions decreases as Panicum maximum matures It is recommended that *Panicum maximum* should be harvested between 46 weeks for the best nutritional and mineral composition.

Keywords: Harvesting, Macro, Minerals, Age

INTRODUCTION

Guinea grass used to be known as *Panicum maximum* (Jacq). In 2003, the subgeneric name *Megathyrsus* was raised 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. Guinea grass (*Megathyrsus maximus* (Jacq.) B. K. Simon & S. W. L. Jacobs) is a major pantropical grass used throughout the tropics for pasture, cut-and-carry, silage and hay. It is a fast growing and leafy grass, which is palatable to livestock with a good nutritional value. However, it is generally recommended to supplement it with sources of protein in order to meet nutritional requirements or improve animal performance. Guinea grass is a large tufted, fast-growing perennial grass. It has a broad morphological and agronomic variability, ranging in height from 0.5 to 3.5 m, with stems of 5 mm to 10mm diameter. There are two main types: a tall/medium tussock type, taller than 1.5m at flowering, and a short tussock type (Cook *et al.*, 2005). The root is a short creeping rhizome; culms are erect, hirsute at the nodes. Leaves are blade-shaped, glabrous to pubescent up to 35 mm broad. Inflorescence is a panicle, 15 to 50cm long. Spikelets are 3-4 mm green to purple (Ecoport, 2009).

Guinea grass is well suited for cut-and-carry systems and can be used for making silage and hay. Guinea grass can be managed as a long-term pasture grass if grazed consistently, but it should not be grazed under 35 cm height, nor under very wet conditions (FAO, 2009). As the grass restperiod affects animal performance, a good rest-period is to wait for regrowth of 2.5 leaves/tiller (Candido *et al.*, 2005). For silage and hay, a good cutting height is 60-90 cm, but for higher yields of





acceptable quality it can be cut at up to 1.5 m, as it does not become coarse even if left to grow to that height (Hongthong Phimmasan, 2005). Better quality silage is obtained if Guinea grass is cut during pre-anthesis or anthesis (Sarwatt et al., 1989). Ensiled Guinea grass has a good texture and it was possible to mix grass of different ages with no effect on silage quality (Babayemi et al., 2009). Guinea grass yields an average of 30 t DM/ha/year (Cook et al., 2005). The yields depend on the cultivar and fertilizer application. For instance, unfertilized Guinea grass yields around 7t DM/ha while N-fertilized pastures can yield up to 42t/ha (Hongthong Phimmasan, 2005). Guinea grass produces around 1.7-3.1 million seeds/kg (Ecoport, 2009). According to a Federal Ministry of Agriculture and Rural Development (FMARD, 2017) report, the number of livestock animals produced annually in Nigeria was as follows - 180 million poultry birds; 76 million goats, 43.4 million sheep, 18.4 million cattle, 7.5 million pigs, 1.4 million Equids (horses, donkeys, etc.). Of these numbers, the majority of the animals were reportedly raised in free-range production systems which comprise of smallholders and nomadic herders.Small ruminants represent the dominant ruminant livestock species in the zone, and their production is mainly by smallholder farmers. The importance of these animals in the zone is shown by their widespread distribution in villages and farmer households, and in their use as a major animal protein source and means of investment and savings by farmers.

Forages have always provided the base upon which ruminant nutrition is built. Ruminants can utilize a wide range of feed resources but the bulk of their feed comes from forages hence they are primarily considered as forage consumers. In the tropics the natural pasture which supply the bulk of ruminants' feed becomes dry and of low nutritive value during the dry season leading to a marked decrease in voluntary intake and digestibility. Over the years, significant improvements in forage cell wall digestibility have been achieved through forage breeding programs and agronomic advances. Despite these improvements, low forage digestibility continues to limit the intake of available energy by ruminants and correspondingly contribute to excessive nutrient excretion by livestock (Beauchemin et al., 2003). The nutritive value of the natural pastures varies according to season. Protein content is between 8 and 12% of DM at the start of the rainy season but drops to 2% in the 6 -7 month dry season (Fajemisin et al., 2010). The grasses grow rapidly during the wet season, later becoming fibrous, coarse, and highly lignified rendering it indigestible. Their quality declines further during the dry season when they become standing hay. This results in loss of palatability and ineffective utilisation of the pastures by the animals (Babayemi et al., 2003). Performance of animals fed crop residues is limited by poor intake, low nitrogen contents and poor digestibility. Hence, this study aims to determine the effect of harvesting age on the proximate and mineral composition of Panicum maximum.

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°451' East and longitude 40°51' of the Greenwich meridian and latitudes 70°151' and 80°51' north of the Equator. Geographically, Ikole Local Government is entirely within the tropic. It is located between longitude 450 East of Greenwich and latitude $7^{\circ} - 8^{\circ} - 15^{\circ}$ 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 (People and culture, 2021). **Forage Production**

The experimental site was cleared and demarcated with pegs into 12 plots. Each plot was 4m in length and 4m in (16m²). 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 (3) times in Completely Randomized Design (CRD). Panicum maximum was grown as a sole grass. Weeding was carried out at week 4 and at week 8 post-germination. After 4 weeks post-germination, samples were harvested from 3 experimental plots. Each sample harvested from each of the four (3)





plots was oven dried immediately for subsequent proximate and minerals determination. The same procedure was repeated at weeks 6, 8 and 10 post-germinations.

Determination of Proximate Composition

All representative samples of the herbage harvested at week 6, 8, 10 and 12 post-germinations were analyzed for moisture, dry matter (DM), ash and crude protein (CP) according to the procedures of AOAC (1990). Crude protein was estimated by determining the total organic nitrogen using the macro-Kjeldhal method and multiplying the value by 6.35 (Koyuncu *et al.*, 2014). Nitrogen Free Extract was calculated using the formula; %NFE = 100 - (% moisture + %CF + % fat + %CP + %EE + %Ash). Dry Matter (DM) percentage of the forage plants was determined from oven-dried samples at 65°C for 72 hours following the AOAC (2005) method. The procedure described by Van Soest and Robertson (1994) to determine the neutral detergent fibre (NDF) and acid detergent fibre (ADF)

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).

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'shonestly significant difference (HSD).

RESULTS AND DISCUSSION

Effect of Harvesting Age on the Proximate Composition of Panicum Maximum

Table 1 showed the effect of harvesting ages (4, 6, 8 and 10 weeks post germination) on the /proximate composition of Guinea grass. The results revealed significant differences (p<0.005) in the means across all the harvesting ages. The moisture content decreases with age, from 16.90% in week 4 to 12. 16% in week 10 which agreed with the findings of Phipps and Pellett (2004) who reported that as plants mature, the moisture content decreases, making the forages more suitable for preservation. Dry matter was significantly (p<0.005) highest at week 10 (97.25) and lowest at week 4 (93.61). Dry matter increases with age of the grass which is similar to findings of Sani et al., (2019) who revealed an increase in the dry matter of Congo grass with age of the forage. Increase in dry matter results in the decrease in moisture content of the forage, thereby decreasing the forage quality for animals (Van Soest, 2006). Lignin which is a tough indigestible fibre increases with age, from 7.15% at week 4 to 8.63% at week 10. This is similar to the report of Silanikove et al., (2001). Silanikove further revealed that lignin decreases digestibility of grasses, as it makes the cell walls of the plants more rigid, thereby negatively affecting the nutritional composition of the forages. Crude protein was significantly (p<0.005) highest at weeks 4 and 8 (10.25 and 10.04 respectively) and lowest at week 10 (8.89). McDonald et al., (2010) stated that as plants mature, their nitrogen content tend to reduce and protein synthesis reduces due to the increasing levels of structural carbohydrates. Crude fibre was highest at week 10 (30.56) and lowest at week 4 (25.16) post-germination. Norton (2003) stated that as forages matures, it becomes coarser and more fibrous. This also agreed with the findings of Sani et al., (2019) who reported that crude fibre increases with age of forages. Fat contents of grasses generally does not fluctuate drastically with age, compared to protein and fibre (Nyambati et al., (2010). The findings of Nyambati (2010) is similar to this study which revealed that ether extract was significantly (p<0.005) the same at weeks 4 and 6 (1.10 and 1.00 respectively) and weeks 8 and 10 (0.48 and 0.47 respectively). Ash was significantly increases with age of the grass from 12.15 in week 4 to 15.30 in week 10. Acid detergent fibre significantly increases from 29.83% in week 4 to 32.49% at week 10. ADF is the measure of the lignin and cellulose in a forage which form the least digestible components of a plant. The findings revealed as the grass (Panicum maximum) matures, the crude protein decreases, moisture decreases thereby increasing the crude fibre, dry matter and also the acid detergent fibre and neutral detergent fibre contents of the forage. The NDF increases



NFE

34.44^a

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significantly with age of the grass from 69.62% in week 4 to 73.26 at week 10. The NDF includes cellulose, hemicelluloses and lignin contents in the forage (*Panicum maximum*). Norton (2003) stated that higher NDF content means less energy and protein are available for grazing animals. Nitrogen free extract decreases with age of the grass. The NFE was 34.44% at week 4 and 37.63 at week 6. This indicated that age causes reduction in soluble carbohydrate like starch and sugars (McDonald *et al.*, 2010).

		Harvesting	weeks		
Parameters	4	6	8	10	S.E.M
Moisture	16.90ª	14.14 ^b	12.52°	12.16 ^d	0.000
Dry matter	93.61 ^d	93.77°	96.73 ^b	97.25ª	0.007
Lignin	7.15 ^d	7.79°	8.33 ^b	8.63ª	0.010
Crude protein	10.25ª	10.04 ^a	9.34 ^{ab}	8.89 ^b	0.029
Crude fibre	25.16 ^b	25.30 ^b	30.56 ^a	30.56 ^a	0.017
Ether extract	1.10 ^a	1.00 ^b	0.48°	0.47°	0.000
Ash	12.15°	11.89°	14.91 ^b	15.30 ^a	0.024
ADF	29.83 ^d	30.39°	31.77 ^b	32.49 ^a	0.088
NDF	69.62ª	70.20 ^b	73.26ª	73.26ª	0.072

Table 1: Effect of Harvesting Age on the Proximate Composition of Panicum maximum

^{*abc*} Means on the same row with different superscripts were significantly (P<0.005) different. ADF = Acid detergent fibre, NDF = Neutral detergent fibre and NFE = Nitrogen free extract

32.19°

32.62°

0.005

Effect of Harvesting Age on the Macro Minerals Composition of Panicum maximum

37.63^a

Table 2 outlines the macro minerals content (measured in ppm) of Panicum maximum at different harvesting ages (weeks 4, 6, 8 and 10). The minerals measured include Calcium, Magnesium, Potassium, Sodium, Chlorine, Phosphorus and Sulfur. These are important minerals which are crucial for the health and growth of livestock. The values were reported in ppm of dry matter. It indicated the effect of harvesting age on the macro minerals composition of Panicum maximum.. The results revealed that calcium (Ca) significantly decreases as the grass mature. The Ca was significantly (p<0.005) highest at week 4 (175.60ppm) and decreased to 155.63ppm and 152.20mg/100g at weeks 8 and 10 respectively. Van Soest 2006 stated that in grasses, this decrease was due to the forage increased lignin and fibre content as it matures, thereby reducing the availability of soluble minerals. Magnesium (Mg) and Potassium (K) also decreased with increase in age of the grass. Magnesium was significantly (p<0.005) highest at week 4 (37.02ppm) and lowest at weeks 8 and 10 (30.14ppm/100ppm and 28.75ppm respectively). Potassium declined from 315.23ppm at week 4 to 247.73ppm at week 10 post-germination. High potassium are found in younger grasses which are more succulent and have lower fibre (Silanikove et al., 2010). Sodium (Na) declined from 73.77ppm in week 4 to 60.50ppm at week 10. It is similar to the findings of Silanikove et al., 2010 who reported a decline in Na content of grasses at the forage matures. The result further revealed that the Chlorine content remains slightly stable even though it was significantly higher at weeks 4 and 8 (14.34ppm and 14.27ppm respectively). The phosphorus content in the grass decreases significantly from 71.70ppm at week 4 to 52.71ppm at week 10. The decline in phosphorus content of Guinea grass as it matures can lead to nutrients inbalance in animals (Norton, 2003). The sulfur content showed a moderate decline from weeks 6 (30.72ppm) to week 10. Phipps and Pellett 2004 revealed that legumes have higher minerals composition than Guinea grass. Tropical grasses like Brachiariaruziziensis also shows a decrease in mineral composition of forages as they mature.





		Harvesting			
Parameters	4	6	8	10	S.E.M
(ppm)					
Calcium	175.60 ^a	167.40 ^b	155.63°	152.20°	0.004
Magnesium	37.02 ^a	34.39 ^b	30.14 ^c	28.75°	0.005
Potassium	315.23ª	295.70 ^b	260.40 ^c	247.73 ^d	0.075
Sodium	73.77 ^a	68.33 ^b	63.27°	60.50^{d}	0.005
Chlorine	14.34 ^a	14.27 ^a	10.98 ^b	11.64 ^b	0.001
Phosphorus	71.70 ^a	65.98 ^b	58.14 ^c	52.71 ^d	0.075
Sulfur	24.43 ^b	30.72 ^a	26.21 ^b	25.90 ^b	0.001

 abc Means on the same row with different superscripts were significantly (p<0.005) different Effect of harvesting age on the micro mineral composition of *Panicum maximum*

Table 3 indicated the effect of harvesting age on the micro mineral composition of *Panicum maximum*. The results showed that harvesting age significant (p<0.005) affected zinc, copper and iron compositions of *Panicum maximum*. The result revealed that zinc content significantly decreased with maturity of the grass. It decreases from 3.52ppm at week 4 to 2.91ppm at week 10. This goes in line with the findings of FAO 2003, who reported that grasses with higher fibre content at older growth stages tends to have lower micro minerals such as zinc. Norton (2003) reported that the copper contents of grasses generally decreased as the plants mature. This is similar to the findings of this study which showed that copper content is lower at early stage of growth and as high as 0.45ppm at week 10. The iron content slightly decreases from 2.63ppm at weeks 4 to 2.49ppm at week 10. Despite the slight decrease in iron content of *Panicum maximum*, iron remains one of the most stable minerals in forages. It is not as heavily impacted by plant maturity as other minerals such as zinc or copper (Silanikove *et al.*, 2001).

		Harvesting			
Parameters	4	6	8	10	S.E.M
(ppm)					
Zinc	3.52 ^a	3.48 ^a	3.06 ^b	2.91 ^b	0.002
Copper	0.46^{bc}	0.51ª	0.49 ^{ab}	0.45 ^b	0.003
Iron	2.63°	3.05ª	2.80 ^b	2.49 ^d	0.001

Table 3: Effect of Harvesting Age on the Micro Mineral Composition of Panicum maximum

abc Means on the same row with different superscripts were significantly (p<0.005) different

CONCLUSION AND RECOMMENDATION

The results show a decrease in nutritional quality (as reflected by the drop in crude protein and NFE and the increase in fiber and lignin) as *Panicum maximum* matures. The plant becomes coarser and less digestible over time, with significant changes in key nutritional parameters. To maintain high forage quality, it is recommended that early harvesting of *Panicum maximum* around 4-6 weeks should be practiced since at this stage, the plant will have higher protein, lower fiber, and better overall digestibility.

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