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CHEMICAL COMPOSITION OF *PANICUM MAXIMUM* AS AFFECTED BY PIG MANURE RATES, PLANTING METHODS AND HARVESTING STAGES IN THE NORTHERN GUINEA SAVANNA OF NIGERIA.

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ABSTRACT

Effects of Pig manure application, planting methods and harvesting stages on chemical composition of *Panicum maximum* were evaluated during the rainy season of 2018 at the Feed and Nutrition Research Program of the National Animal Production Research Institute, Shika, Zaria, Nigeria. The experiment was laid in a Split Plot Design with 4×2×3 factorial arrangement replicated three times. The manure rates were 0, 5, 10 and 15t/ha, planting methods were; drilling and broadcasting methods while the harvesting stages were 6, 9 and 12 weeks after planting. The results indicated a higher ($P<0.05$) (93.76%) forage dry matter (DM) at 9th week of harvest while the CP content increased ($P<0.05$) with increasing rate of manure application (8.46-12.62%) while there was a decline in CP content as the harvesting stage advanced (10.85-13.00%). Acid Detergent Lignin (ADL) was significantly ($P<0.05$) affected by pig manure rates (3.49-6.45%). Phosphorus content of the forage was significantly affected by manure application (0.11-0.17%) while the harvesting stage had a significant ($P<0.05$) effect on Zn, Cu and Fe with 9th week of harvest having the highest values for the micro-nutrients evaluated. It was hence concluded that the chemical composition of *Panicum maximum* was affected by the treatments. Therefore, pig manure can be applied at 15t/ha using broadcasting method of planting. *Panicum maximum* forage can be harvested at 9th week after sowing for better mineral composition in Northern Guinea Savannah of Nigeria.

Keywords: Forage, manure, mineral, sampling, sowing

INTRODUCTION

Ruminant animals rely on pasture plants for their nutrition than any other feed resources (Aderinola *et al.*, 2007). All plants depend on soil for their nutrient supply and grazing ruminants derive virtually all their nutrients from plants growing on such soils. Unfortunately, most of the tropical soils are characterized with low nutrient quality, translating to the poor nutrient quality of forage grown on them (Aregheore, 2002). Fertilizers are needed to improve soil chemical and biological properties which is reflected on phytonutrient content and palatability of herbage plants (Alalade *et al.,* 2013). Application of farm yard manure has resulted in the improvement of both the productivity and quality of tropical crops (Ahmed *et al*., 2012).

Pig manure is a very good source of organic matter which plays a vital role in improving the physical, chemical and biological properties of the soil, by activating the activities of soil microorganisms, thereby enhancing the slow release of plant nutrients with a resultant environmental harmony (Sharma and Mitta, 1991). Efficient and effective use of pig manure ensure sustainable crop productivity, because soil organic matter is maintained, nutrients are released more slowly, stored for a longer time in the soil, improved root development and high crop yield (Sharma and Mitta, 1995). Use of pig manure will lead to improvement in productivity of livestock and economic status of the farmers, thereby preventing further environmental degradation due to indiscriminate use of inorganic fertilizers by the farmers (Hassan *et al*., 2016). Despite its availability in appreciable quantity, its use as a source of crop nutrient has not received adequate research attention (Giwa and Ojeniyi, 2004).

Panicum maximum is propagated by seed and tillers and considered to be the most valuable fodder plant in the area where it is found naturally, it has high seed and leaf production and very palatable to game and livestock. It is widely cultivated as pasture and used for making good quality hay (Gibbs *et al.*, 1990). It grows rapidly and occurs in abundance when grown on a well-drained fertile soil (Botha and Botha, 1996). Animal fattening implies controlling what livestock such as cattle, sheep, and goats eat by using high quality feeds in order to generate faster weight gains. It is a strategic feeding option which produces a quick result within 2-3 months and it is technically simple. High quality grasses and agro-industrial by-products can be used as feed sources. In this regard, *ad libitum* feeding will result in increased daily weight gains of up to 700g per day. This is rarely achievable with low quality and quantity feed. Besides, *Panicum maximum* is often considered as one of the best species for beef production. However, there are vast differences between guinea grass cultivars in terms of potential production, quality of the herbage and reaction to Nitrogen fertilization (Aganga and Tshwenyane, 2004). Hence, this study evaluated the effect of single application of graded levels of dried pig manure on growth component and forage yield of *Panicum maximum* during wet season in Northern Guinea Savannah of Nigeria.

MATERIALS AND METHODS

Experimental site

The experiment was carried out at the experimental field of the Feeds and Nutrition Research Programme of National Animal Production Research Institute, Shika, Zaria, Kaduna State, Nigeria. Shika is located on Latitude 11^0 12'N, Longitude 07 ^{0} 33'E at an altitude of 660m above the sea level, along Zaria-Funtua characterized by a defined wet and dry season. Wet season starts from late April to early May and ends in late September to early October while the dry season is from October to April. The total annual rainfall ranges from1110-1580mm with a long term average of 1058.60mm. Maximum air temperature of 30^0C were recorded in May, Minimum air temperature of 18.23^0 C in October and relative humidity of approximately 70% during the rainy season (IARMS, 2018). Weather observations at Shika during the experimental period in 2018 are presented in table 3.1. The maximum and minimum air temperatures of 35.16^0C and 18.23^0C were recorded in May and October respectively during the rainy days which were slightly below previous records. The total annual rainfall of 992.6mm over a period of 5 months was recorded in 2018. The numbers of rainy days in Shika was 67 days. A mean relative humidity of 67.92% and mean sunshine of 6.75 hours was observed during the rainy season.

Soil Sample of the Experimental Site

Soil samples were collected for nutrient analysis from the experimental site with the aid of Soil auger at four corners and centre of the plots at 0-15cm and 15-30cm depth to make a composite for soil analysis at the beginning of experiment so as to ascertain the level of Nitrogen in the soil as well as determining the nutrient requirement. The soil sample was analyzed for physical and chemical properties as described by A.E.S (1998). The analysis was carried out at the chemical laboratory of the Department of Soil Science, Faculty of Agriculture, Ahmadu Bello University, Zaria.

Table 1. Physico-chemical properties of soil at the experimental site

Soil properties	0-15cm	15-30 cm
Particle size (%)		
Clay	28.00	24.00
Silt	26.00	24.00
Sand	46.00	52.00
Textural class	Loam	Sandy-loam
Chemical properties		
Total Nitrogen (%)	0.18	0.18
Organic carbon (%)	0.58	0.48
Available phosphorus(ppm)	4.53	5.28
pH (H_2O)	6.36	6.27
pH (0.01M $CaCl_2$)	5.30	5.36
Exchangeable cation (meq/100g of soil)		
Ca^{2+}	3.90	7.90
Mg^{2+}	0.67	2.99
K^+	0.33	0.18
Na^+	0.70	0.65
Exchangeable Acidity (H-Al^{3+})	0.40	0.60
Cation Exchange Capacity (CEC)	6.40	12.60

Manure Collection, Analysis and Application

Dried and crumbled pig manure was sourced from the Swine Unit of the Ahmadu Bello University Teaching and Research Farm in Zaria. The manure was analyzed for its chemical composition in order to determine the nutrient content. The manure was applied by manual broadcasting with immediate incorporation into the soil and levelling of the seed beds using hoes to ensure efficient mineralization while the land was left for two weeks before the seeds were planted on the soil. Results obtained from the laboratory analysis of the pig manure are shown in Table 2.

Table 2: **Chemical composition of pig manure applied to *Panicum maximu***

Parameter	Value
N total (%)	1.93
P (%)	1.094
K (%)	1.50
P/N	0.57
K/N	0.78
Micro mineral (g/kg)	
Fe	6800
Cu	183.50
Mn	352.25
Zn	307.25

N= Nitrogen, P= phosphorus, K= Potassium, Fe= iron, Cu= Cupper, Mn = Manganese, Zn= Zinc.

Source of Planting Materials and Planting

Seeds of *Panicum maximum* used for the establishment were sourced from the Seed Store of the Feeds and Nutrition Research Programme of the National Animal Production Research Institute, Shika, The seeds were treated against insect attack using insecticide (Apron plus) at 5g/kg. Drilling and broadcasting methods were used; for the drilling, 1cm depth was maintained with an inter-row space of 1m apart. While the seeds were broadcasted together with sand mix to reduce wind interference after which rolling was done to enhance germination and establishment of seedlings for the broadcasting method. Seed rate of 5kg/ha was used. Weeds were kept under control in order to prevent invasion and interference during the experimental period.

Treatments, Experimental Design and Lay-Out

A gross land area measuring 40m×20m (0.18ha) was used for the trial. The land was ploughed and harrowed once with tractor coupled implements and seed beds were prepared to meet a better condition for germination and early establishment of seeds. The experiment was laid-out in a 4×2×3 factorial arrangement with four pig manure rates (0, 5, 10 and 15t/ha) being the main plot factor, while two Planting methods (drilling and broadcasting) methods and three stages of harvest (6, 9 and 12 weeks) after planting were the sub-plot factors. The treatments were replicated thrice, making a total number of 24 plots with each plots having a dimension of 6m × 4m. The space between the replicates was 1m while another 1m was maintained between the treatments.

Sample Collection and Preparation

Samples of *Panicum maximum* forage were harvested at 6, 9 and 12 weeks after planting using sickle at 10cm from the ground level. Fresh samples were weighed immediately using a sensitive hanging scale. Sub samples (250-300g) were taken from bulk samples, packed in separate envelops per treatment and oven dried at 65ºC to a constant weight and subsequently milled to pass 1mm sieve and stored for analysis.

Chemical Analysis

The dry matter content (DM), crude protein (CP), ether extract (EE i.e. fat) and ash (inorganic minerals) were determined according to AOAC (2005) methods, while the neutral detergent fibre (NDF), acid detergent fibre (ADF), acid detergent lignin (ADL), were determined according to the procedure of Van Soest *et al.* (1991).

Mineral Composition Analysis

The milled samples were used for mineral analysis of Calcium (Ca), Potassium (K), Phosphorus (P) and Sodium (Na). The concentration of K was estimated with a flame photometer while the concentrations of Ca, P and Na were determined using atomic absorption spectrophotometry (Fritz and Schenk, 1979) after wet digestion in 15 ml nitric acid and 5 ml hydrochloric acid.

Statistical Analysis

All data collected were subjected to three-way analysis of variance (ANOVA) using General Linear Model (GLM) procedure of SAS (2005). Significant (P<0.05) differences between treatment means were compared using Duncan Multiple Range Test, (Duncan, 1995) of the SAS package.

RESULTS AND DISCUSSION

Table 3 showed the chemical composition of *Panicum maximum* as affected by Pig manure rates, planting methods and harvesting stages in the Northern Guinea Savanna of Nigeria. The dry matter content of *Panicum maximum* was not significantly (P>0.05) affected by the rates of manure application and planting methods. However, the harvesting stages had a significant (P<0.05) effect on the dry matter composition of the grass, ranging from 92.06% in 6th week to 93.76% in the 9th week of harvesting.

The crude protein (CP) of *Panicum maximum* was significantly affected (P<0.05) by rates of manure application and harvesting stage. While there was an increase in the CP content as the levels of manure application increased, ranging from 8.46% in unfertilized grass to 12.62% at 15t/ha level of manure application, there was decrease in the CP content of the grass as the harvesting stages advanced. Higher CP content at 15t/ha of pig manure could be as a result of higher nitrogen availability for plant uptake, leading to increase in tissue protein and leaf nitrogen. The CP contents gotten were all above the critical levels required for proper rumen functioning in ruminant animals. i.e., above the minimum range of 6.50 – 8.00% prescribed for optimal performance of tropical ruminant animals (Minson, 1981). This is in agreement with what was reported by Dele *et al.* (2018) and Kering *et al.* (2011). Meanwhile, decrease in the CP content as the harvesting stage advances could be as a result of higher stem to leaf ratio and increase in structural contents as the plants increased in age.

The ether extract (EE) was also significantly affected (P<0.05) by rate of pig manure application and harvesting stages, while the EE ranged from 0.39% in unfertilized grass to 0.61% at 15t/ha of pig manure application, as the plant age advanced, the EE increased from 6th to 9th week of harvesting, after which there was a decline at 12th week of harvesting. This decline could be connected with the reduction in leaf to stem ratio and replacement of soluble cell content by structural content as the harvesting stage advances.

The Ash content of the grass was not significantly affected (P>0.05) by manure rates of application while it declined as the harvesting stage advanced. The decline in Ash content of *Panicum maximum* as harvesting stage increased was reported by Dele *et al.* (2018; 2012), and Onyeonagu *et al*. (2012) who reported that with advancement in age, total ash content decreased. This could be as a result of decrease in silicic acid, the major Ash component which reduces with decline in water uptake by the plants, thereby reducing the total Ash content of the plants (Quigley and Anderson, 2014).

Acid detergent fibre (ADF) was significantly affected (P<0.05) by pig manure application rates and harvesting stages, the ADF content was higher in unfertilized grass (39.95%) while all other levels of manure application were statistically similar and at par. As the harvesting stage advanced, there was an increase in ADF contents. This increasing trend of ADF could be linked with increase in stem to leaf ratio of the grass as well as increasing cell wall content as the harvesting stage increases. This coincides with the report of Jimoh *et al.* (2019) who reported increase in fibre fraction as the time of cutting advanced.

Pig manure application rates had no significant effect (P>0.05) on the Neutral Detergent Fibre (NDF) while as the stage of harvesting advanced, NDF also increased due to increase in structural carbohydrate content of the grass and general peculiarity of plants that cell wall materials increases with increase in age. The values ranged between 59-76% in weeks 6 and 12 of harvesting. These values are higher than the reported values of Dele *et al*. (2018) but similar to those of Olanite *et al*. (2006) and Jimoh *et al.* (2019).

Acid Detergent Lignin (ADL) was significantly (P<0.05) affected by pig manure rates and harvesting stages. While ADL decreased with increase in pig manure rates, advancement in harvesting stage increased its content. Increase in ADF and lignin as the plant matures indicates that as the plant matures, the fibre content of the grasses increase. The values of ADF in this study is below that of Dele *et al.* (2018) whose values of ADF ranged between (41-44%). Meanwhile, the pig manure rates had no effects on the NDF content but ranged between (69-70%) which coincides with the values reported by Akinola, (2018) who reported 75.1%; Jimoh *et al.* (2019) reported 75.3% NDF with swine manure fertilization when comparing chemical composition of two varieties of *Panicum maximum* as affected by manure types but disagree with the reported values of Dele *et al.* (2018) which might be due to difference in manure types used.

Table 3. Effects of pig manure rates, planting methods, harvesting stages, and their Interactions on Proximate Composition (%) of *Panicum maximum*

Treatment	DM	CP	EE	ASH	ADF	NDF	ADL
Pig manure rate (t/ha)							
0	91.91	8.46^{d}	0.39^{c}	8.36	39.95^{a}	68.63	6.45^{a}
5	93.13	10.68^{c}	0.49^{b}	8.41	39.56^{b}	69.94	4.66^{b}
10	93.18	11.80^{b}	0.53^{ab}	8.75	39.25^{b}	69.85	3.65^{c}
15	92.98	12.62^{a}	0.61^{a}	8.85	38.32^{b}	69.36	3.49^{d}
SEM	0.52	0.19	0.04	0.22	0.17	0.08	0.05
LOS	NS	*	*	NS	*	NS	*
Planting methods							
Drilling	92.65	12.06^{a}	0.54^{a}	8.77	39.38	69.67	5.05
Broadcasting	92.95	11.71^{b}	0.47^{b}	8.42	39.18	69.36	4.97
SEM	0.52	0.19	0.04	0.22	0.17	0.08	0.05
LOS	NS	*	*	NS	NS	NS	NS
Stage of harvest (WAP)							
6	92.06^{b}	13.00^{a}	0.51^{b}	11.86^{a}	30.71^{c}	58.94^{c}	3.12^{c}
9	93.76^{a}	10.85^{c}	0.65^{a}	7.58^{b}	42.46^{b}	73.65^{b}	5.71^{b}
12	92.57^{b}	11.80^{b}	0.34^{c}	6.34^{c}	44.66^{a}	75.95^{a}	6.20^{a}
SEM	0.52	0.19	0.04	0.22	0.17	0.08	0.05
LOS	*	*	*	*	*	*	*
Interactions							
M x P	0.10	0.0001	0.02	0.40	<0.0001	0.63	<0.0001
M x H	0.39	0.004	0.0003	0.11	<0.0001	0.003	0.0008
H x P	0.46	<.0001	0.04	0.17	0.03	0.0007	0.51
M x H x P	0.13	<.0001	0.0003	0.0008	<0.0001	0.31	0.0006
SEM	0.52	0.19	0.04	0.22	0.17	0.08	0.05
LOS	NS	NS	***	NS	NS	NS	***

[abc]Means with the same superscript along the columns are not significantly different, (<P0.05). M= Manure rate, H= Harvesting stage, P= Planting method, SEM=Standard Error of the Means, LOS= Level of Significance, DM=Dry Matter, CP= Crude Protein, EE= Ether Extract, ADF= Acid Detergent Fibre, NDF= Neutral Detergent Fibre, ADL= Acid Detergent Lignin

Table 4. Effect of Rates of Pig Manure Application, Planting Methods, Harvesting Stage and their Interactions on Mineral Composition (%) of *Panicum maximum*

Treatment	Ca	K	Na	P	Zn	Cu	Fe
Rates of pig manure application (t/ha)							
0	0.56	2.51	0.65	0.11^{c}	10.58	0.02	533.38
5	0.56	2.76	0.74	0.14^{bc}	9.96	0.02	510.12
10	0.55	2.78	0.77	0.17^{a}	5.89	0.02	510.98
15	0.56	2.76	0.68	0.15^{ab}	6.52	0.02	533.14
SEM	0.01	0.04	0.02	0.00	0.69	0.68	9.69
LOS	NS	NS	NS	*	NS	NS	NS
Planting methods							
Drilling	0.55	2.64^{b}	0.68^{b}	0.15	8.37	17.41	516.88^{b}
Broadcasting	0.56	2.77^{a}	0.74^{a}	0.14	8.11	16.61	526.94^{a}
SEM	0.01	0.04	0.02	0.00	0.69	0.68	9.69
LOS	NS	*	*	NS	NS	NS	*
Stage of harvest (WAP)							
6	0.07^{c}	3.89^{a}	2.08^{a}	0.25^{a}	7.21^{b}	2.79^{c}	68.93^{b}
9	0.86^{a}	2.20^{b}	0.02^{b}	0.13^{b}	10.55^{a}	25.48^{a}	758.52^{a}
12	0.74^{b}	2.02^{b}	0.02^{b}	0.05^{c}	6.96^{c}	22.76^{b}	738.27^{c}
SEM	0.01	0.04	0.02	0.00	0.69	0.68	9.69
LOS	*	*	*	*	*	*	*
Interactions							
M x P	0.51^{c}	0.84^{a}	0.94^{b}	0.69^{b}	0.33	0.65	0.58
M x H	0.81^{a}	0.45^{b}	0.32^{c}	0.29^{d}	0.85	0.88	0.34
H x P	0.57^{b}	0.45^{b}	0.26^{d}	0.42^{c}	0.89	0.2	0.70
M x H x P	0.31^{d}	0.43^{b}	0.99^{a}	0.71^{a}	0.33	0.44	0.10
SEM	0.01	0.04	0.02	0.00	0.69	0.68	9.69
LOS	*	*	*	*	NS	NS	NS

[abc]Means with the same superscript along the columns are not significantly different, (<P0.05). M= Manure rate, H= Harvesting stage, P= Planting method, SEM=Standard Error of the Means, LOS= Level of Significance. WAP= Weeks after planting

Table 4 shows the results of mineral content of *Panicum maximum* as affected by pig manure rates, planting methods and harvesting stages. Calcium content of *Panicum maximum* was not significantly (P>0.05) affected by pig manure application rates. The values of Ca obtained however were within the normal range of the ruminant animal requirement for calcium. While the calcium concentration during the stages of harvesting was higher (P<0.05) at 9th week of harvesting, followed by the 12th week of harvesting, all within the normal concentration, with the exception of the 6th week harvesting stage falling below the normal range of calcium concentration.

The K content of the grass was not (P>0.05) significantly affected by the levels of manure application as well as the planting methods but a significantly higher (P<0.05) K content was observed at the 6th week of harvest followed by week 9 and 12 which were at par and lower than the 6th week. The potassium concentration observed in this study is above the 0.8% recommended for grazing animals (Underwood, 1981; Dele *et al.* 2018). High K content in grasses ascertain water balance and osmotic pressure regulation, acid-base balance, and muscle contraction for ruminants (Dele *et al*., 2018). Farhad (2012) reported that high potassium forages and low sodium chloride diets appeared to contribute more to reproductive losses in herbivores but it has also been suggested that ruminants with high producing ability in terms of milk and other animal products may require K level above 1% under stress particularly heat stress (McDowell, 1985) and (Dele, 2018) reported that excess K in forages lead to deficiency of other minerals, with attendant suppression of immunity.

The phosphorus contents of the *Panicum maximum* was significantly (P<0.05) affected by the levels of manure application with the P content ranging from 0.11% in the control to 0.17% at 10t/ha while the harvesting stage had a pronounced effect (P<0.05) on the P content of the grass, ranging from 0.05 at 12th week of harvesting to 0.25 at 6th week of harvesting. However, the P content as affected by the manure rates, planting methods, and harvesting stages fell below the recommended (0.18-0.48%) requirements for different classes of ruminant animals as reported by Dele (2018) and McDowell (1992; 1997) in the planting methods and the harvesting stages except for the grass harvested at 6th week after planting. This affirms the report of McDowell *et al*. (1984) that forages in Nigeria have been found to be P deficient, probably as a result of higher K content of the soil which antagonizes the uptake of P.

The Na contents varied across the levels of manure application, ranging from 0.65 in the control to 0.77 at 10t/ha while the planting methods had significant (P<0.05) effect on the Na content of the grass ranging from 0.68 in drilling to 0.74 in broadcasting methods whereas, at 6th week of harvest a highly significant (P<0.05) value of Na was observed against the other harvesting stages which were at par. However, the sodium content observed in the levels of manure application and planting methods in this study was lower than the critical level (0.87g/kg) required for grazing ruminant animals, meanwhile, at the 6th week after planting, the Na content recorded was higher than the critical level required. The higher Na content at week 6 could be as a result of active vegetative growth of *Panicum maximum* which enhanced more sodium uptake at this stage of growth.

This widespread deficiency in forage Na is corroborated with some earlier findings that the most prevalent mineral deficiency for grazing animals in pastures is Na (Anderson *et al.,* 2013; Tudsri and Kaewkunya, 2002). In addition, deficiency of this element has been reported in many developing countries (Aregheore, 2002). To meet the need of highly productive animals, forage should contain more than 0.15% sodium. Na deficiency is more likely to occur in animals grazing tropical pasture species and these plants generally accumulate less Na than temperate species (Morrris, 1980). Natural forages low in Na has been reported in numerous tropical countries throughout the world (McDowell, 1985).

Pig manure rates and planting methods had no significant effects on the Zinc content of the *Panicum maximum*, while the harvesting stage showed a significant (P<0.05) effect on the Zinc concentration at the 9th week of harvesting. Zinc (Zn) plays an essential role in animal nutrition as a component of a number of critical enzymes. Meanwhile, the values of Zn recorded in this study is above the critical level (5mg/kg) below which animal performance deteriorate and development of severe Zn deficiency such as loss of appetite, reduced growth and immunocompetence, loss of hair/wool, and keratotic skin lesions sets in (Underwood, 1981). Plant maturity has also been reported to affect Zn concentration of forage and it also depends upon the tissue type of plants (Underwood, 1981; Kabata, 1992).

The manure rates and planting methods had no effects (P>0.05) on the Cu content of the grass while an increment of 90% in Cu content was observed at the 9th week (25.48mg/kg) of harvesting over the 6th week (2.49mg/kg) while it has been suggested that the dietary requirement of ruminants for Cu ranges from 8 to 14 mg/kg (Khan *et al*., 2006; NRC, 1984). The values of Cu gotten from this study is however above the minimum requirement for ruminant animals especially when harvested from 9th week and above after planting.

The iron (Fe) content of the forage was not affected by the rates of manure applications while the broadcasting method and the 9th week of harvesting showed a significant (P<0.05) effect on the Fe content of the grass. The higher Fe content in the broadcasting method could be attributed to the less competition for the soil resources and as such were able to tap the mineral nutrients better than those under drilling method while the 9th week of harvesting was the best stage of harvesting for optimum Fe content in the forage. However, an optimum concentration of 50 mg/kg DM has been proposed as being adequate for grazing animals (Khan *et al.,* 2005; Miles *et al.,* 1983).

CONCLUSION

From the results of this study, it can be concluded that application rate of pig manure of 15t/ha to *Panicum maximum* increased the crude protein (CP) and ether extract (EE) contents of the forage. The CP of the *Panicum maximum* forage declined with advancement in age while the highest EE was observed at 9th week of harvesting. *Panicum maximum* harvested at 9th week after planting produced the highest dry matter percentage, macro-mineral composition was higher at 6th week of harvesting while the micro-mineral content was higher at 9th week of harvesting.

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