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COMPARISONS OF DIFFERENT MANURE SOURCES ON THE NUTRITIVE QUALITY OF *MUCUNA PRURIENS* AT DIFFERENT AGE OF HARVEST

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ABSTRACT

This study was conducted to determine the influence of manure types and age at harvest on the chemical composition and forage quality indices of *Mucuna pruriens.* The study was a 3 x 2 factorial design in a randomized complete block design comprising of the three (3) manure type (poultry, rabbit and control) and two (2) age at harvest (6 and 12 weeks after sowing (WAS)) replicated three times. Result showed higher significant difference in crude protein contents of the legume fertilized with poultry (17.40 %) and rabbit manures (16.24 %) and harvested at 6 WAS as well as the one fertilized with poultry manure (16.77 %) harvested at 12 WAS above others. Higher NDF content was recorded for legume fertilized with rabbit manure (56.33 %) harvested at 12 WAS, while lower value was recorded for poultry fertilized legume at 6 WAS (41.33 %). Significant difference was recorded for dry matter digestibility of the legume with poultry manure fertilized legume at 6 WAS (2.97 %) having higher value than rabbit manure fertilized legume at 12 WAS (2.15 %). From the study, it can be concluded that, application of poultry manure and harvesting at twelve weeks after sowing (WAS) improved the nutritive quality and the digestibility of *Mucuna pruriens.*

Keywords: *Mucuna pruriens,* Age at harvest, Manure, Nutritive quality.

INTRODUCTION

Ruminant animals rely more essentially on pasture for their nutrient requirement than any other feed resources (McDonald *et al*., 1991). One of the problems of livestock production in Nigeria, especially in the arid semi-arid zone, is the wide variation in availability and quality of feed available for ruminant animals across the grazing season owing to climate change (Hopkins, 2000). Forages can be intentionally cultivated to help meet the ruminants' need for feed. Nonetheless, low productivity is a common feature of many grassland (Adeyemi *et al*., 2021). Factors such as seasonal variations, poor quality soil have been shown to influence the nutritional quality as well as chemical compositions of forage species (Sleugh *et al*., 2000). Hence, over time, manures and fertilizers have been applied to increase the soil's DM content and, as a result, the nutritive quality of the legumes planted on it. Legumes such as *Lablab pupureus*, *Mucuna pruriens* and *Centrosema pascuorum* have been used as feed resources for bovines, sheep and goats due to their high CP content and their highly digestible fiber compared to grasses, they are rich in nutrients needed to supplement ruminant livestock in critical period (Ayala-Burgos *et al*., 2003). Because it provides the nutrients that grassland pastures lack, the availability of high-quality sown fodder, such as leguminous crops, is crucial (Bamikole *et al*., 2004). Therefore, the use of organic manure has been strongly recommended (Gambara *et al*., 2000) as inorganic fertilizers are often linked to reduced crop yield, soil acidity, and nutritional imbalance (Ojeniyi, 2000). Organic manures are noted to improve the soil nutrient status thereby providing plants with better nutrient uptake that is eventually beneficial to animals that feed on such plants for body maintenance and production. Such a profitable use will help in addressing the problem of manure management and disposal (Ojo *et al*., 2013). It

has been reported that a number of animal manures are appropriate for tropical plant nutrient quality enhancement and soil amendment (Ojo *et al*., 2015, Ewetola *et al*., 2016). In the past, some authors (Sodeinde *et al*., 2009, Ahmed *et al*., 2012, Ojo, *et al*., 2015) have reported that pasture plants can benefit from soil amendments containing swine manure, cattle dung, farmyard manure, and chicken droppings. Organic manures have the potential to positively impact the physical, chemical, and microbial characteristics of the soil in addition to increasing the growth of forages (Adesodun *et al*., 2005). Thus, fertilization of pastureland with organic manure sits well within the context of nutrient recycling and environmental protection. Ewetola *et al*. (2016) reported that application of organic manure directly to the soil helped in maintaining adequate level of organic matter, which was a critical component of soil fertility and productivity.

This study therefore, investigated the nutritive quality of *Mucuna pruriens* as influenced by animal manures application and the harvesting stages.

MATERIALS AND METHODS

Experimental Site.

This study was conducted at the Pasture Unit of the Directorate of University Farms (DUFARMS), Federal University of Agriculture, (FUNAAB) Abeokuta, Ogun State, Nigeria. The experimental site lies within the savanna agro-ecological zone of southwest Nigeria (latitude: 7^{o}N, longitude 3.5^{o}E, with average annual rainfall: 1037 mm).

Land preparation, manure collection and application

The land was cleared, followed by ploughing, after which the land was allowed to rest for a period of two weeks before harrowing. The manures were obtained from the Poultry and Rabbit Sections of the DUFARMS, FUNAAB. The manures were air-dried and were applied at the rate of 120g per 4m^2 plot, based on the chemical composition of the manures prior to sowing.

Table 1: Chemical composition of poultry and rabbit manure

Chemical properties	Rabbit	Poultry
Ph	5.29	7.90
Total nitrogen (%)	3.67	4.88
Organic carbon (%)	35.71	41.30
Organic matter (%)	61.56	71.20
Available P (mg/kg)	2.87	18.98
Sodium (Na)	0.78	41.02
Potassium (k)	1.82	28.02
Calcium (Ca)	9.12	45.94
Magnesium (Mg)	0.89	5.23

Sourcing of planting materials

Mucuna pruriens seeds were sourced from National Animal Production Research Institute Shika, Zaria. The seeds were subjected to germination test. The seeds were later sowed at interval of 50m by 50m with two seeds per hole, on 4m^2 plot size. The plots were well labeled with the treatments indicated and were weeded as at when due.

Experimental design and plot management

The study was laid out in 3 x 2 factorial arrangement in a Randomized Complete Block Design (RCBD) with two manure types, poultry

and rabbit manures and control and two harvesting ages, 6 and 12 weeks after sowing, which were replicated three times.

Harvesting of forage materials

Mucuna pruriens were harvested at 6 and 12 WAS. Sub-samples of about 300 g were taken per treatment and oven-dried at 65^{o}C to a constant weight. The dried samples were taken, weighed, milled, and sieved through a 1mm sieve for analyses to determine the nutritional qualities of the legume.

Chemical Analyses

The content of dry matter (DM), Crude Protein (CP), Ether Extract (EE i.e. fat) and Ash (inorganic minerals) were determined according to Association of Official Analytical Chemists (AOAC 2010), 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) while Hemicellulose (HEM), was calculated as NDF - ADF and Cellulose (CELL) was calculated as ADF-ADL.

The forage quality indices (organic matter, carbohydrate, dry matter digestibility, dry matter intake, relative feed intake, cell content) were determined using the procedure according to Ojo *et al.* (2023).

Statistical analysis

Data collected were subjected to two-ways analysis of variance and the treatment means were separated using Duncan's Multiple Range test using SAS (2014) package.

RESULTS AND DISCUSSION

Table 2 showed the effect of manure type and age at harvest on the proximate composition of Mucuna pruriens. Mucuna fertilized with poultry manure and harvested at 12 weeks recorded the highest (p-value 0.05) dry matter content (DM) of (98.00%) while the lowest DM (93.67%) was recorded Mucuna treated with poultry manure, harvested at six weeks after planting. In contract, the highest CP and ADL (17.40% and 7.90%) were recorded for Mucuna pruriens treated with poultry and harvested at six weeks after planting. CP has the lowest value (10.67 %) recorded for unfertilized mucuna harvested at 12 weeks old while ADL lowest value (4.10 %) was recorded for Mucuna treated with poultry manure and harvested at 12 weeks.

The high dry matter (DM) contents recorded in this study showed that low moisture content (<15%) was achieved which favoured feed storage as high moisture content could aid microbial activities (Hassan et al., 2005). The result from this study shows that the crude protein (CP) content of *Mucuna pruriens* under the influence of manure type was above the 7% minimum requirement for maintenance of ruminant animals (Minsonm, 1990). These values were also above the minimum range of 6.5 - 8.00% prescribed for optimal performance of tropical ruminant animals (Minsonm, 1990). The interaction effect of manure age at harvest observed on the CP content of *Mucuna pruriens* agrees with the results of Assefa and Ledin (2001) and Chaves et al., (2006) that fertilizer, age at harvest and variety rank among the factors that determined the quality of forage. However, proportional change in plant nutrient composition is an important consideration when pastures are managed for production of high quality fodder (Chaves et al., (2006). The ash content of mucuna reported by Mulnga *et al*. and Nyambati and Sollenberger, (2003) were 6.8% and 9.4% similar to the result obtained in this study. The ash content indicate that the samples contained higher number of mineral elements. Akintayo (2004), animal feed materials that have ash content > 2.5% cannot be used independently, but rather mixed with feed materials with low ash content.

Table 2: Effect of manure type and age at harvest on the proximate composition of Mucuna pruriens

Factors		Dry matter	Crude protein	Ether extract	Ash	Non-fibre carbohydrate
Manure types	Age at harvest (WAS)			(%)		
Poultry	Week 6	93.67^{b}	17.40^{a}	5.00^{ab}	9.00^{ab}	27.27^{ab}
Rabbit	week 6	96.67^{ab}	16.24^{a}	3.67^{ab}	8.90^{ab}	26.83^{ab}
Control	Week 6	95.00^{ab}	12.40^{bc}	6.67^{a}	9.30^{a}	24.97^{ab}
Poultry	week 12	98.00^{a}	16.77^{a}	4.00^{ab}	6.33^{b}	21.90^{ab}
Rabbit	week 12	97.67^{ab}	12.92^{b}	3.67^{ab}	8.33^{ab}	17.50^{b}
Control	week 12	97.33^{ab}	10.67^{c}	1.67^{b}	9.00^{ab}	33.33^{a}
SEM		0.57	0.65	0.55	0.38	1.69
P-value		0.178	0.000	0.160	0.228	0.105

^{abc} Means in the same column with different superscripts are significantly different (P <0.05), SEM: Standard error of mean, WAS: Weeks after sowing

The effect of manure type and age at harvest on the fibre fractions of Mucuna pruriens are presented on Table 3. Result revealed that the parameters are significantly ($p<0.05$) different except acid detergent fibre (ADF), hemicelluloses and cellulose (Table 2). The fibre contents (NDF, ADF, Lignin, cellulose and hemicellulose) have implications for the digestibility of plants. The NDF which is a measure of the plants' cell wall constituent, is the chemical component of the feed that determines its rate of digestion and it is inversely related to the plants' digestibility (McDonald et al., 1995; Gillespie, 1998). The higher the NDF, the lower the plant's digestible energy. The NDF and ADF of the legume differ at 6 and 12 weeks of age and this could be premised on increase in the cell wall content and a decrease in the leaf-stem ratio of the legumes which consequently lead to accumulation of lignin (Moore and Jung, 2001). This shows that, the legume harvested at 6 weeks of growth is of higher nutritional value which promote better intake. Values recorded for Acid Detergent Fiber (ADF) under the influence of manure types were slightly above the range of 29.78% - 32.52% reported by Okukenu et al. (2007). The observed difference could be attributed to difference in manure applied. The level of NDF in the animal ration influence the bulk or feed effect, rumination has a negative effect on the feed intake. The increase in ADF value causes low digestibility of forage and nutrients availability in animals. The indigestible fibre portion in forage is called lignin. The increase in acid detergent fibre, result to decrease animal feed intake and digestibility and poor animal performance

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Table 3: Effect of manure type and age at harvest on the fibre fractions of Mucuna pruriens

Factors		Neutral detergent fibre	Acid detergent fibre	Acid detergent lignin	Hemicellulose	Cellulose
Manure types	Age at harvest (WAS)			(**%**)		
Poultry	Week 6	41.33[b]	23.00	7.90[a]	18.33	15.10
Rabbit	week 6	44.33[ab]	24.67	5.13[b]	19.67	19.53
Control	Week 6	46.67[ab]	27.67	4.30[b]	19.00	23.37
Poultry	week 12	51.00[ab]	30.30	4.10[b]	20.70	26.20
Rabbit	week 12	56.33[a]	32.20	7.20[a]	24.13	25.00
Control	week 12	45.33[ab]	29.03	4.27[b]	16.30	24.77
SEM		1.72	1.51	0.39	1.37	1.59
P-value		0.124	0.553	0.000	0.747	0.335

[abc] Means in the same column with different superscripts are significantly different (P <0.05), SEM: Standard error of mean, WAS: Weeks after sowing

The effects of manure type and age at harvest on the forage quality indices of Mucuna pruriens was presented on Table 4. The organic matter had the highest percentage of 93.67% on legume fertilized with poultry manure at week 12WAS. Highest value was recorded for carbohydrate content was recorded for unfertilized Mucuna. The result further revealed that the Dry Matter Intake, Relative Feed Intake and Cell content had the highest percentage of 2.97%, 164.63% and 58.67% respectively on Mucuna fertilized with poultry manure at week 6 WAS and lowest percentage of 2.15%, 106.25% and 43.67% respectively were recorded in legume fertilized with rabbit manure at week 12 WAS.

The mean estimated DMD compared favourably with mean value of 67 % reported by Okunade *et al.* (2014) for browse plants as well as 65.07 % reported by Hanlin et al. (2011) for several tropical legumes in China. The values of RFV for all the treatments were within the range of 116.76 to 202.94 reported by Okunade *et al.* (2014) for different browse plants investigated. As the results all the treatments considered in this study can be regarded as having high relative feed value for ruminants.

An increase in NDF contents in Mucuna based on the treatment in this study led to decline in dry matter intake. This corroborate the report of Isah *et al*. (2012) that there was increase in predicted dry matter intake value as NDF for browses investigated declines. This is in line with this study. The implication of this is that, as the percentage of NDF increases in forage, animals will consume less (Schroeder, 1994). The Mucuna based on different treatments in this study may be regarded as having high nutritive quality indices for ruminants' diets.

Table 4: Effect of manure type and age at harvest on the forage quality indices of Mucuna pruriens

Factors		Organic Matter	Carbohydrate	Dry Matter Digestibility	Dry Matter Intake	Relative Feed Intake	Cell Content
Manure types	Age at harvest (WAS)			(**%**)			
Poultry	Week 6	91.00^{ab}	68.60^{c}	70.98	2.97^{a}	164.63^{a}	58.67^{a}
Rabbit	week 6	91.10ab	71.67bc	69.69	2.72ab	147.47ab	55.67ab
Control	Week 6	90.70^{b}	71.63^{bc}	67.35	2.67^{ab}	140.67^{ab}	53.33^{ab}
Poultry	week 12	93.67^{a}	72.90^{bc}	65.30	2.36^{ab}	119.17^{ab}	49.00^{ab}
Rabbit	week 12	91.67^{ab}	75.08^{ab}	63.82	2.15^{b}	106.25^{b}	43.67^{b}
Control	week 12	91.00^{ab}	78.67^{a}	66.28	2.65^{ab}	136.36^{ab}	54.67^{ab}
SEM		0.38	0.91	1.18	0.10	7.10	1.72
P-value		0.228	0.005	0.563	0.193	0.206	0.124

^{abc} Means in the same column with different superscripts are significantly different (P <0.05), SEM: Standard error of mean, WAS: Weeks after sowing

CONCLUSION

From the study, it can be concluded that, application of poultry manure and harvesting at twelve WAS improved the nutritive quality and the digestibility of *Mucuna pruriens.*

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