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The Yield, Proximate, Minerals Composition of Centrosema Pascuorum Fertilized with Different Sources of Animal Manure in Makurdi, Benue State, Nigeria

Emmanuella Ma'andik Doeko'os
Department of Animal Production, Federal University of Agriculture, Makurdi, Benue State, Nigeria
Abel Ibrahim
Department of Animal Production, Federal University of Agriculture, Makurdi, Benue State, Nigeria
Okwori
Department of Animal Production, Federal University of Agriculture, Makurdi, Benue State, Nigeria
David Terhemba Shaahu
Department of Animal Production, Federal University of Agriculture, Makurdi, Benue State, Nigeria

Abstract:
To supply the soil nutrient requirement of forages to increase their composition that will meet animal needs in Makurdi, Benue State, a study was conducted to know the nutrients that can be added to Centrosema pascuorum *when fertilized using different sources of animal manures available such as poultry droppings, cattle dung, sheep and goat's droppings and rabbit faeces, arranged in a factorial split plot design. In this trial there were significant differences between the fertilized plots and the control, the fertilized plots recorded the highest values expect for CF % were T_0 recorded more values than T_4 and T_3. The DM % ranged from 93.45 % in (T_0) to 94.04 % in (T_4), ash % from 7.54 % in (T_0) to 9.98 % in (T_1), it was noted that the EE content ranged from 13.25 % in (T_0) to 14.54 % (T_3), the observed varied from CF % 33.84 % in (T_4) to 56.92 % in (T_2), the CP content was ranging from 11.56 % in (T_0) to 16.00 % (T_4), the NDF varied from 37.97 in (T_3) to 72.45 % in (T_1), ADF was lowest with 22.44 % in (T_3) and highest with 36.25 % in (T_1), % P recorded 2.07 in (T_2) to 3.18 % in (T_4), %Na found ranged 0.21 % in (T_3) to 0.50 % in (T_4), it was noted that % Ca was lowest with the value of 0.98% in (T_3) and highest with 1.50 % in (T_0), % Mg 0.05 in (T_1) to 0.80 in (T_0) and % K recorded -0.04 in (T_4) to 0.27 % in (T_2). Based on superior effect of the rabbit faeces on the performance on the nutrient composition of* C. pascuorum*, it may be recommended for forage crop fertilization programme in this zone*

Keywords: *DM yield, proximate and minerals composition,* centrosema pascuorum*, fertilized, animal manure, makurdi, benue state*

1. Introduction

Soil fertility is an important factor in pasture production. It helps determine the yield and quality of the crop and has a direct effect on the species composition of the stand. In addition to water and sun light, maintaining pasture fertility through the input of nutrient is key to support plant growth [1]. Most nutrients are naturally supplied to plant by the soil. However, some nutrient like Nitrogen, Phosphorus and Potassium are often limiting if the soil is deficient. It may be necessary to add nutrients through an application of manure, chemical fertilizer, or by seeding legumes to fix Nitrogen [1]. Manures contribute to the fertility of the soil by adding organic matter and nutrients, such as nitrogen, that are trapped by bacteria in the soil. Higher organisms then feed on the fungi and bacteria in a chain of life that comprises the soil food web. It is also a product obtained after the decomposition of organic matter like cow dung, which replenishes the soil with essential elements and add humus to the soil, [2]. Soil fertility management for forage crops is a continuous process that begins well before the forage crop is established [3]. The quality of forage has a major impact on animal performance and is therefore an important consideration for producers [4].

Hitherto, irrespective of the enormous manure production in livestock farming and processing, very little of available manure is utilized in crop production. In view of these observations there is a need to promote utilization of animal manure. This is done to promote pasture production which can lead to increase in livestock production, thus, solving the problem of protein shortage in the diets of people in Makurdi in particular and, Nigeria in general. The present study was therefore embarked upon to investigate the effect of different sources of animal manure on soil DM yield and nutrient composition of *Centrosema pascuorum*.

2. Materials and Methods

This trial involved four different manures and the control viz, treatment zero (T_0) – control, treatment one (T_1) – poultry droppings, treatment two (T_2) – cattle dung, treatment three (T_3) – sheep and goat droppings and treatment four (T_4) - rabbit faeces. The forage legume *Centrosema pascuorum* legume was obtained from the National Animal Production Research Institute (NAPRI) Ahmadu Bello University, Shika near Zaria. During August when rainfall had fully established, the seeds were sown (drilled) into plots measuring 1.50 x 2.0 m and replicated three times. Each unit ploy is made of three rows. Thus, the layout was a 5 × 3 factorial arrangement laid out in a randomized complete block design (RCBD). At harvest sub-samples of the fresh herbage were oven dried at 70°C and analyzed.

3. Results

3.1. Proximate Composition, NDF and ADF of Centrosema Pascuorum

The result of the proximate composition, neutral detergent fiber and acid detergent fiber of *C.pascuorum* as influenced by different animal manure sources is presented in Table 1.

The dry matter yield ranged from 2.67 t/ha (T_3) to 1.44 t/ha (T_2). Treatment three (T_3) recorded the highest DM yield (2.67 t/ha) which was significantly (P<0.05) differently from the yields of the remaining four treatments. It was observed that T_4 recorded the second highest DM yield (2.13 t/ha) which showed it was significantly (P<05) different compared to the remaining the remaining three treatments. The yield in treatment T_0 and T_1 had DM value of (1.81 t/ha and 1.78 t/ha) which showed no significant (P>0.05) difference between each other but were significantly different from the yield of treatment two T_2 (1.44 t/ha).

The percent DM ranged from 94.04% [T_4] to 93.45% (T_0). Treatment four (T_4) had the highest DM content of 94.04% but it was not significantly (P>0.05) different from the rest of the four treatments which had records of T_2 (93.87%), T_1 (93.84%), T_3 (93.63%) and T_0 (93.45%).

The percent ash was found to be between 9.98% in T_1 to 7.54% in T_0. The control treatment (T_0) was the highest with 9.98% ash which significantly (P<0.05) different from the remaining four treatments. It was observed that treatment two T2 recorded the second highest in ash (9.41%) that was significantly (P<0.05) different from the remaining three treatments. It was followed by treatment T_4 (9.01%) which was significantly (P<0.05) different from treatment T_3 and T_0 but it was observed that there was no significant (P>0.05) difference between T_3 and T_0.

It was noted that percent EE ranged from 14.54% (T_3) to 13.25% (T_0), with treatment three (T_3) having the highest EE content of 14.54% which was significantly (P<0.05) different with the remaining four treatments. It was observed that treatment T_1 was the second highest treatment with EE of 13.66% which showed no significant difference with treatment T_4 but was significantly (P<0.05) different from the remaining two treatments. Treatment T_4 was the third with EE value of 13.59% that was significantly (P<0.05) different from the remaining two treatments. The Ether extract in treatment T_2 (13.47%) was significantly (P<0.05) different from T_0 (13.25%).

The CF percent varied from 56.92% to 33.84% in T_2 and T_4, respectively. Treatment two had 56.92% which was the highest in percent CF recorded that was significantly (P<0.05) different from the remaining four treatments. The second highest value was in T_1 with 51.64% CF that was significantly (P<0.05) different from the remaining three treatments. The control treatment had 48.23% CF that was also significantly (P<0.05) different from the remaining two treatments. It was observed that the value in treatment T_3 (38.28%) was significantly (P<0.05) different from the value of treatment T_4 (33.84%) which was the least value recorded.

The percent CP ranged from 16.00% (T_4) to 11.56% (T_0). It was observed that treatment four (T_4) had the highest CP of 16.00% which was significantly (P<0.05) different from the other four treatments observed. It was followed by treatment T_3 with 15.06% which value was significantly (P<0.05) different from the remaining three treatments recorded. Treatment T_2 was the third highest percent CP with the value of 13.81% which was significantly (P<0.05) different from the remaining two. The CP in treatment T_1 which is 12.00% was observed to be significantly (P<0.05) different from the T0 (11.56%).

The NDF was varying from 72.45% (T_1) to 37.97% (T_3). Treatment one (T_1) had the highest NDF value of 72.45% which was significantly (P<0.05) different from the remaining four treatments observed. It was noted that the control treatment was the second highest with NDF value of 61.36% that was not significantly (P>0.05) different from T2 (59.56%) but showed significant (P<0.05) difference from the values of treatment T_4 and T_3. The NDF observed in treatment T_2 59.56% was significantly (P<0.05) different from the remaining two treatments. Treatment four (T4) 45.95%was seen to be significantly (P<0.05) different from T_3 with NDF value of 37.97%.

The ADF values were ranging from 36.25% (T_1) to 22.44% (T_3). It was seen that the ADF in treatment T_1 36.25% was the highest recorded value which was not significantly (P>0.05) different from T_4 but it was significantly (P<0.05) from the remaining three treatments values. Treatment T_4 was the second recorded ADF value with 31.09% that was not significantly (P>0.05) different from T_0 (36.25%) and T_2 (25.78%) but it was significantly (P<0.05) different from T_3. The control treatment was the third recorded value with ADF of 27.77% which was not significantly (P>0.05) different from T_0 (5.78%) and T_3 (22.44%).

Treatments	DM (t/ha)	%DM	% Ash	% EE	% CF	% CP	% NDF	% ADF
T_0	1.81^c	93.45	7.54^c	13.25^d	48.23^c	11.56^e	61.36^b	27.77^{bc}
T_1	1.78^c	93.84	9.98^a	13.66^b	51.64^b	12.00^d	72.45^a	36.25^a
T_2	1.44^d	93.87	9.41^b	13.47^c	56.92^a	13.81^c	59.56^b	25.78^{bc}
T_3	2.67^a	93.63	8.58^d	14.54^a	38.28^d	15.06^b	37.97^d	22.44^c
T_4	2.13^b	94.04	9.01^c	13.59^b	33.84^e	16.00^a	45.95^c	31.09^{ab}
SEM	0.17	0.47^{ns}	0.05	0.05	0.08	0.21	1.02	4.66

Table 1: Proximate Composition, Neutral Detergent Fiber and Acid Detergent Fiber of C. pascuorum *as Influenced by Different Animal Manure Sources*
a, b, c, d, e Means in column with different superscript(s) are significantly different at the 5% level of probability
T_0- soil without animal manure
T_1- soil fertilized with poultry droppings
T_2- soil fertilized with cattle dung
T_3- soil fertilized with sheep and goat droppings
T_4- soil fertilized with rabbit faeces

3.2. Minerals Content of Centrosema Pascuorum

The result of the percent minerals content of *C. pascuorum* as influenced by different animal manure sources is presented in Table 2.

The phosphorus percent in *C. pascuorum* was ranging from 3.18% in T_4 to 2.07% in T_2, with treatment four recording the highest phosphorus value of 3.18% which was not significantly (P>0.05) different from the value obtained from T_1 (3.01%) but showed significant (P<0.05) difference from the remaining three treatments. Treatment T_1 had 3.01% value that was significantly (P<0.05) different from the remaining three treatments. The third recorded was the control T_0 2.28% which showed no significant (P>0.05) difference from T_3 (2.23%) and T_2 (3.07%). It was observed that there was also no significant (P>0.05) difference from between treatment T_3 and T_2.

C. pascuorum has sodium content ranging from 0.50% (T_4) to 0.21% (T_3). It was observed that treatment T_4 had the highest sodium content of 0.50% which was significantly (P<0.05) different from the remaining four treatments. Treatment T_1 was the next highest recorded value with 0.41% which was significantly (P<0.05) different from the other remaining three treatments. It was followed by treatment T_0 which had sodium content of 0.36% that was significantly (P<0.05) different from treatment T_2 and T_3. It was also observed that T_2 (0.30%) was significantly (P<0.05) different from T_3 (0.21%).

It was observed that the calcium percent ranged from 1.50% in T_0 to 0.40% in T_4. The highest value recorded was the control (T_0) with 1.50% calcium that was significantly (P<0.05) different from the remaining four treatments. The second highest value was T_2 with 1.18% which was not significantly (P>0.05) different from T_1 but was significantly (P<0.05) different from T_3. The third calcium value recorded was in T_1 (1.18%) which was significantly (P<0.05) different from the remaining two treatments. It was finally observed that there was significant (P<0.05) difference between T_3 (0.98%) and T_4 (0.40%).

The magnesium percent varied from 0.08% (T_0) and 0.07% (T_1). The control (T_0) had the highest magnesium content of (0.08%) which was significantly (P<0.05) from the remaining four. Treatment T_2 with the magnesium content of 0.07% was the second recorded value which was also significantly (P<0.05) from the remaining three. It was observed that T_4 (0.06%) was not significantly (P>0.05) different from T_3 (0.06%) but they were significantly (P<0.05) different from T_1 (0.05%).

It was observed that the potassium percent ranged from 0.27% in T_2 to -0.04% in T_4. Treatment T_4 with the value of 0.27% was observed to have high potassium percent which was not significantly (P>0.05) different from T_1, T_2 and T_3 but was it was noted to be significantly (P<0.05) different from T_4. The second highest value was found in treatment T_1 (0.23%) which was not significantly (P>0.05) different from T_0 (0.11%), T_3 (-0.01%) and T_4 (-0.04%). The third value recorded was T_0 and it was not significantly (P>0.05) different from the remaining two treatments recorded. It was observed that there was no significant (P>0.05) difference between T_3 and T_4.

Treatment	% P	% Na	% Ca	% Mg	% K
T_0	2.28^b	0.36^c	1.50^a	0.08^a	0.11^{ab}
T_1	3.01^a	0.41^b	1.18^b	0.05^d	0.23^{ab}
T_2	2.07^b	0.30^d	1.18^b	0.07^b	0.27^a
T_3	2.23^b	0.21^d	0.98^c	0.06^c	-0.01^{ab}
T_4	3.18^a	0.50^a	0.40^d	0.06^c	-0.04^b
SEM	0.19	0.01	0.01	0.004	0.17

Table 2: Percent Minerals Content of C. Pascuorum *as Influenced by Different Animal Manure Sources*

a, b, c, d, e Means in column with different superscript(s) are significantly different at the 5% level of probability
T_0- soil without animal manure
T_1- soil fertilized with poultry droppings
T_2- soil fertilized with cattle dung
T_3- soil with fertilized sheep and goat droppings
T_4- soil fertilized with rabbit faeces

4. Discussion

Organic nutrient solution had a positive effect on a dry matter accumulation of all the forage biotypes. Treatment three [T_3] recorded the highest dry matter yield compared to the other three organic sources treatments and the control which could be as the result of the N, P, K content of the sheep and goat's faeces. The finding in this study is similar with the works of [5] reported that the increasing doses of nitrogen fertilizer resulted in progressive increase in dry matter (DM) and of cowpea forage. It is also in agreement with the findings of [6] and [7] who found higher DM when extra N fertilizer was applied to the land. [8] reported that dry matter increased with increase in fertilizer level applied and age at harvest.

The high dry matter percent recorded was in agreement with the findings of [9] who reported that the percent dry mater (DM) did not differ between grass species (*Cenchrus ciliaris* and *Panicum maximum*) and fertilizer. It was noted that there was no significant difference (P>0.05) between the values recorded for all the treatments which could be as the result of their nutrient uptake, nutrients available, decomposition rate, age of harvest and topographical location of the research area. [10] reported that maximum dry matter percentage was obtained when crop was fertilized.

The ash content was observed to increase with fertilizer application in which is in agreement with the findings of [11] that reported increase in the ash content of *Andropogon tectorum* with age and increased fertilizer application respectively. [12] recorded 10.20% highest ash content of maize fodder fertilized with cattle slurry was (10.20%). [13] reported ash contents (8.97%) on forage sorghum with the recommended dose of NP. [14] observed that the effect of nitrogen application on ash % contents show significant effect on sorghum forage. [15] recorded maximum percent ash in forage oat fertilized with inorganic and organic fertilizer than the control treatment.

The percent EE content were higher in the treatments fertilized with manure and lower in the control treatment and this in in-line with the findings of [16] who noted maximum (2.12 %) and minimum (1.01%) EE content of teosinte fodder was recorded with the application of 160 kg N ha-1 and control respectively. [17] Reported that EE content of Sorghum fodder increased significantly (P<0.01) with application of phosphorus fertilizer. [18] Minimum forage oat ether extractable fat percentage was recorded in the control treatment.

The percent of CF was higher in some of the fertilized treatments than the control which could be as a result of the availability of nitrogen in the manure, this work is in-line with the findings of [18] recorded maximum percent crude fiber in forage oat fertilized with inorganic and organic fertilizer than the control treatment. [16] Recorded maximum value of (32.06%) crude fiber on forage sorghum with fertilizer and the control.

It is also established that crude protein content of forage is increased by increased level of N-fertilizer [5]. In this study it was observed that the lowest crude protein percent was in the control treatment [T_0]. This work is similar with the findings of [19] who recorded an increased in the crude protein content when fertilizer was applied in the cenchrus forages. [20] reported that Forage crude protein concentration increased linearly with N fertilizer application on pearl millet, Crude protein concentration ranged from 13.15% with the control to 16.78% when N was applied at 120 lb/a. The unfertilized plots [N0] had significantly lower crude protein content than the fertilized plots. (21) Noted that the highest crude protein contents (15.45%) were achieved at the highest nitrogen doses (200 kg ha-1) while the lowest values (13.47%) were determined in control treatments in sudangrass plants. The CP percent are within the range for small ruminants as recommended by [22] which is 9%-16% varying for growth, pregnancy, lactation and maintenance.

NDF was higher in fertilized treatment than the control treatment. This is in contrast with the works of [12] who reported the NDF value of maize ranging from 55.93% to 57.22%, application of fertilizer on treatments showed a non-significant effect on NDF content. The highest value of NDF was in treatment fertilized (57.22%) and the lowest value in control treatment (55.93%). This may vary because of stage of maturity of forages, topography, seasonal effect etc.

The ADF content found in this trial is in contrast with the studies of [12] were the ADF ranged from 34.11% to 35.37% and application of cattle slurry did not show a significant effect on ADF content in maize and [23] reported that the effect of phosphorus and nitrogen fertilization on ADF content of jumbo grass was statistically non-significant (P>0.05).

The phosphorus (P) content of the forages was increased substantially by fertilizer application in treatment T_4. This agrees with the previous work of [4] on alfalfa, [24] and [8] on *P. maximum cv Ntchisi* which recorded higher values in fertilized treatments than the control.

The sodium percent was higher in treatments which are richer in NPK content and this is in-line with the study of [25] which reported that sodium content was highest in amaranths with NPK treatment than the control.

The calcium percent was higher in the control than the fertilized treatments. This could be as the result of the topography of the research site, decomposition level of the manure and nutrient uptake by the forages. This agrees with the study of [26] which reported that the Ca content of forage decreased significantly when P dose increased from 0 to 11 kg/ ha in clover dominant meadow and in contrast with the findings of [25] reported that calcium content was highest in amaranths with NPK treatment than the control.

Magnesium percentage decreased with the application of animal manure This agrees with the findings of [26] which reported that Mg content of forage decreased significantly when P dose increased from 0 to 11 kg/ ha in clover dominant meadow. And this disagrees with the work of [27] which observed N fertilization increased forage Mg in midland Bermuda grass than the control treatment. Mg content of forage is lower than the level for maintenance of ruminants which is 2100 mg kg-1[28]. The potassium percent increased with the application of fertilizer in treatment. This agrees with the finding of [24] and [8] on *P. maximum* in which the potassium content increased with increase in fertilizer and age at harvest.

5. Conclusion

This work has demonstrated that organic manure has influenced on the nutrient composition of *Centrosema pascuorum*. The highest recorded values for each parameter and treatment were; dry matter 94% in T_4, ash 9.98% in T_1, ether extract 14.54% in T_3, crude fiber 56.92% in T_2, crude protein 16.00% in T_4, NDF 72.45% in T_1, ADF 36.25% in T_1, Phosphorus 3.18% in T_4, Sodium 0.50% in T_4, calcium 1.50% in T_0, Magnesium 0.80% in T_0 and potassium 0.27% in T_2. It seems that organic fertilization can increase mobilization of unavailable nutrients and improve soil physical properties which can support nutrient content of forages. Rabbit faeces is recommended amidst other animal manure sources used base on the result obtained.

6. References

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