

Effect of Organic Manures Sourced from Different Animal Wastes on Re-Growth Potential of *Panicum maximum* and *Brachiaria decumbens* in South Western Nigeria

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ABSTRACT

The potential of animal manures as materials for soil amendment in the tropics have been widely reported. The study was carried out at Organic Research Site of the Directorate of University Farms (DUFARMS), Federal University of Agriculture, Abeokuta to investigate the effect of animal manures on re-growth potential of *Panicum maximum* and *Brachiaria decumbens* in South Western Nigeria. Four animal manures (Cattle, Sheep and Goat, Swine and Poultry) with no manure control, and three grasses (*Panicum maximum* Ntchisi, *Panicum maximum* Local and *Brachiaria decumbens*) were combined. The experiment was a 5 x 3 factorial arrangement laid out in a split-plot design with three replicate. The grasses were planted at 0.5m x 0.5m spacing and manure types were allotted to main plots measuring 15m x 15m each and grass species were allotted to sub-plots measuring 4m x 15m each and there were fifteen treatment combinations. The plots were managed in 2010 growing season and the accumulated biomass of the grasses got dried up on the field. During second year of application, the plots were grazed at three irregular intervals by the migrant Fulani cattle in between early March 2011 and mid-March 2011. In late March 2011 the plots were cut back to a uniform height of about 15 cm. Agronomic data on re-growth parameters such as plant height, number of leaf, crown diameter and tiller density were taken. This was done five times at an interval of two weeks, and it commenced two weeks after cutting back for both early rainy and mid-rainy seasons. The results shows that crown diameter, tiller density, leaf number and plant height were significantly affected ($P < 0.05$) by the manure types and grass species with increasing values as the plants matured. *Panicum maximum* (Ntchisi) fertilized with swine manure had the best performance in both the early rainy and mid-rainy season.

Key words: animal manures, re-growth potential, *Panicum maximum* Ntchisi, *Panicum maximum* Local and *Brachiaria decumbens*

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INTRODUCTION

Several organic materials have been reported as being suitable for soil amendments for increased crop production. The potential of cow dung, poultry droppings, refuse compost and farmyard manure as materials for soil amendment in the tropics has been reported (Adeleye *et al.*, 2010). Apart from enhancing crop growth, organic fertilizers also improve the physical, chemical and microbial properties of the soil (Adesodun *et al.*, 2005, Lombin *et al.*, 2004). The use of organic manure to fertilize agricultural land has positive impacts from the perspective of a recycling economy. Application of organic manure to soils directly helps in maintaining an adequate level of soil organic matter, a critical component of soil fertility and productivity. The use of animal manure is preferred over commercial fertilizers owing to increasing awareness of the negative impacts of commercial fertilizers on the environment (Malhi *et al.*, 2002).

High initial application to build up the organic pool during the season of application and reduction in subsequent years would be appropriate in allowing the manure releases its nutrients overtime. The effectiveness and amount of manure applied could be calculated based on the rate of N applied and the rate of organic N mineralization in the subsequent year of application that would supply the required amount of nitrogen for the affected soil (Cabrera *et al.*, 1994).

Therefore, examining the likely effect of animal manures after first year of application on re-growth potential of tropical grass species will play significant role in adoption of sown pasture in South-West Nigeria.

MATERIALS AND METHODS

Experimental site: The study was carried out at Organic Research Site of the Directorate of University Farms (DUFARMS), Federal University of Agriculture, Abeokuta. The Research Site is located in the derived savannah zone of South Western Nigeria with rainfall ranges of 120 mm (May) to 195 mm (September) and mean monthly temperature range of 22.5°C-33.7°

The relative humidity in the rainy (late March-October) and dry (November – early March) season ranges between 63-96 % and 55-84 % respectively.

Experimental design and procedure: Four animal manures (Cattle, Sheep and Goat, Swine and Poultry) with no manure (control), and three grasses (*Panicum maximum* Ntchisi, *Panicum maximum* Local and *Brachiaria decumbens*) were combined to constitute the treatments. The experiment was a 5 x 3 factorial arrangement laid out in a randomized complete block design with three replicate. The grasses were planted at 0.5m x 0.5m spacing and manure types were allotted to main plots measuring 15m x 15m each and grass species were allotted to sub-plots measuring 4m x 15m each and there were fifteen treatment combinations. The experimental plots were kept weed free throughout the 2010 growing season and the grasses were allowed to grow and accumulate sufficient biomass which got dried up on the field.

History of the plots: During the second year, the plots were subjected to unsolicited severe burning at the beginning of February, 2011. The fire burnt off all the accumulated dry materials leaving the field bare. Following early rains in late February 2011, the grasses re-grew rapidly. The plots were then re-pegged and labelled with the inter-plot spaces clearly demarcated. The plots were however grazed at three irregular intervals by the migrant Fulani cattle in between early March 2011 and mid-March 2011. In late March 2011, the plots were cut back to a uniform height of about 15 cm above soil level to ensure uniform re-growth.

Data Collection: Agronomic data on re-growth parameters such as plant height, number of leaves, crown diameter and tiller density were taken. This was done five times at an interval of two weeks, and it commenced two weeks after cut back for both early rainy and mid-rainy seasons.

Experimental Model

$$Y_{ijkl} = \mu + M_i + S_j + (MS)_{ij} + \sum_{ijk}$$

μ = Population mean,

M_i = effect of residual animal manures

S_j = effect of species

$(MS)_{ij}$ = Interaction effects of residual animal manures and species

\sum_{ijk} = Residual error estimate

The agronomic data collected were subjected to analysis of variance using SAS (1999) package and significant means were separated using Duncan's Multiple Range Test (Duncan, 1955) at 5 % level of significance.

RESULTS AND DISCUSSION

The results shows that crown diameter, tiller density, number of leaves and plant height were significantly affected ($P < 0.05$) by the manure types and grass species with increasing values as the plants matured. *Panicum maximum* (Ntchisi) fertilized with swine manure had the best performance in both the early rainy and mid-rainy season. Meanwhile, *Bracharia decumbens* fertilized with small ruminant manure during the mid-rainy period recorded the highest values for tiller density, while *Panicum maximum* (Ntchisi) fertilized with swine manure recorded the highest values in other parameters estimated except in two weeks re-growth where *Panicum maximum* (Ntchisi) fertilized with poultry manure had the highest value. Table1 expresses the residual effects of animal manures and grass species on two weeks re-growth during the early and mid-rainy season. It was observed that *Panicum maximum* (Ntchisi) fertilized with small ruminant manure recorded the highest value (95.45 cm) and *Bracharia decumbens* fertilized with cattle manure had the lowest value (36.80 cm) in the early rainy season (ERS) for crown diameter (CD); while *Panicum maximum* (Ntchisi) fertilized with poultry manure recorded the highest value (53.15 cm) and *Panicum maximum* (Local) fertilized with small ruminant had the

lowest value (34.95 cm) in the mid-rainy season (MRS) for CD. This also indicates that the values observed in the ERS were slightly higher than that of MRS for this parameter. Considering the tiller density (TD), *Panicum maximum* (Ntchisi) fertilized with swine manure had the highest value (1197.00 no of tillers/m²) and *Bracharia decumbens* fertilized with the same manure recorded the lowest value (213.00 no of tillers/m²) in the ERS. Meanwhile, in the MRS *Bracharia decumbens* fertilized with small ruminant manure recorded the highest value (1059.00 no of tillers/m²) while unfertilized *Panicum maximum* (Local) recorded the lowest value (327.00 no of tillers/m²) although, the value was higher than that of ERS. For the number of leaves, *Panicum maximum* (Ntchisi) fertilized with swine manure had the highest value (430.50) and *Panicum maximum* (Local) fertilized with small ruminant manure recorded the lowest value (85. 00) in the ERS. However, in the MRS *Panicum maximum* (Ntchisi) fertilized with cattle manure recorded the highest value (482.50) whereas that of *Panicum maximum* (Local) without fertilizer had the least value (116.00). *Panicum maximum* (Ntchisi) fertilized with poultry manure had the highest value (35.10 cm) and *Bracharia decumbens* fertilized with swine manure recorded the lowest value (9.65 cm) for plant height (PH) in the ERS. *Panicum maximum* (Ntchisi) fertilized with swine manure had the highest value (49.45 cm) and *Bracharia decumbens* fertilized with the same manure had the lowest (29.65 cm) for PH in the MRS. Nonetheless, the values observed were slightly greater than that of ERS.

Table 1: Residual effects of animal manures and grass species on two weeks re-growth during the early and mid-rainy seasons

Manure T	Treatments Grass species	Parameters							
		Early rainy season				Mid-rainy season			
		CD (cm)	T D ((tiller no/m ²))	No of Leaves	PH (cm)	CD (cm)	T D ((tiller no/m ²))	No of Leaves	PH (cm)
Cattle	<i>P. maximum</i> (Ntchisi)	83.15 ^b	825.00 ^{bc}	275.00 ^{bc}	21.30 ^{c-f}	48.45 ^{ab}	976.50 ^a	482.50 ^a	46.50 ^{ab}
	<i>P. maximum</i> (Local)	65.30 ^d	576.00 ^{de}	192.00 ^{de}	18.60 ^{c-g}	39.15 ^{bc}	445.50 ^{cd}	199.00 ^{cde}	34.80 ^{ef}
	<i>Brachiaria decumbens</i>	36.80 ^f	303.00 ^g	151.50 ^{efg}	12.80 ^{gh}	47.80 ^{ab}	613.50 ^{bcd}	272.50 ^{bc}	38.00 ^{cde}
Swine	<i>P. maximum</i> (Ntchisi)	77.95 ^{bc}	1197.00 ^a	430.50 ^a	32.15 ^{ab}	52.95 ^a	966.00 ^a	429.50 ^a	49.45 ^a
	<i>P. maximum</i> (Local)	82.15 ^b	681.00 ^{cd}	227.00 ^{cd}	25.30 ^{bcd}	48.60 ^{ab}	579.00 ^{bcd}	257.00 ^{bcd}	41.95 ^{bc}
	<i>Brachiaria decumbens</i>	39.95 ^f	213.00 ^g	106.50 ^g	9.65 ^h	53.15 ^a	960.00 ^a	426.50 ^a	29.65 ^f
Small R.	<i>P. maximum</i> (Ntchisi)	95.45 ^a	957.00 ^b	319.00 ^b	21.10 ^{cde}	48.30 ^{ab}	964.50 ^a	428.50 ^a	40.50 ^{cd}
	<i>P. maximum</i> (Local)	54.95 ^c	240.00 ^g	85.00 ^g	16.80 ^{c-h}	34.95 ^c	378.00 ^{cd}	160.00 ^{cde}	34.50 ^{ef}
	<i>Brachiaria decumbens</i>	40.45 ^f	360.00 ^g	182.00 ^{def}	18.95 ^{c-g}	48.65 ^{ab}	1059.00 ^a	472.00 ^a	37.30 ^{cde}
Poultry	<i>P. maximum</i> (Ntchisi)	69.15 ^{cd}	765.00 ^c	265.00 ^{bc}	35.10 ^a	53.15 ^a	844.5 ^{ab}	375.50 ^{ab}	41.50 ^{cd}
	<i>P. maximum</i> (Local)	68.15 ^{cd}	439.50 ^{ef}	146.50 ^{efg}	22.80 ^{c-f}	36.15 ^c	394.50 ^{cd}	131.50 ^{de}	33.15 ^{ef}
	<i>Brachiaria decumbens</i>	40.65 ^f	372.00 ^g	186.50 ^{def}	19.60 ^{c-g}	47.30 ^{ab}	831.00 ^{ab}	370.00 ^{ab}	36.30 ^{de}
Control	<i>P. maximum</i> (Ntchisi)	71.65 ^{cd}	847.50 ^{bc}	282.50 ^{bc}	26.45 ^{bc}	51.60 ^a	645.00 ^{bc}	286.50 ^{bc}	38.45 ^{cde}
	<i>P. maximum</i> (Local)	50.60 ^e	306.00 ^g	102.00 ^g	15.30 ^{gh}	36.30 ^c	327.00 ^d	116.00 ^e	34.95 ^e
	<i>Brachiaria decumbens</i>	37.80 ^f	231.00 ^g	115.50 ^g	17.65 ^{d-g}	52.45 ^a	852.00 ^a	379.50 ^{ab}	34.80 ^{ef}
SEM		2.81	40.18	16.68	2.00	2.61	69.16	28.65	1.21

a-h: means on the same column with different superscripts are significantly different (P < 0.05) SEM= standard error of mean T= Types, CD=Crown diameter, TD= Tiller density, No=Number, PH= Plant height, R=Ruminant

The residual effects of animal manures and grass species on four weeks regrowth during the early and mid-rainy seasons were revealed in the table 2. In the ERS, *Panicum maximum* (Ntchisi) fertilized with small ruminant manure had the highest value (106.80 cm) and *Panicum maximum* (Local) fertilized with swine manure recorded the lowest value (37.80 cm) for CD. In contrast, in the MRS, *Panicum maximum* (Ntchisi) fertilized with poultry manure recorded the highest value (60.80 cm) which is lower than the value obtained in the ERS, and *Panicum maximum* (Local) fertilized with small ruminant manure had the lowest value (40.45 cm) which does not vary too much from the lowest value observed in the ERS. For the TD in the early rainy season, *Panicum maximum* (Ntchisi) fertilized with swine manure had the highest value (1366.00 no of tillers/m²) and *Panicum maximum* (Local) fertilized with small ruminant manure recorded the lowest (285.00 no of tillers/m²). *Bracharia decumbens* fertilized with the same manure recorded the highest value (1126.50 no of tillers/m²) in the MRS, but that of *Panicum maximum* (Local) without fertilizer recorded the lowest value (388.50 no of tillers/m²) which is greater than that of ERS. With respect to number of leaves, *Panicum maximum* (Ntchisi) fertilized with swine manure had the highest value (537.50) and *Panicum maximum* (Local) fertilized with small ruminant manure had the lowest value (101.50) in the ERS. But *Panicum maximum* (Ntchisi) fertilized with cattle manure had the highest value (535.00) and *Panicum maximum* (Local) without manure had the lowest value (139.00) in the MRS. Meanwhile, this value was greater than that of lowest value recorded during ERS. In addition, *Panicum maximum* (Ntchisi) fertilized with swine manure had the highest value (41.00 cm) and *Bracharia decumbens* fertilized with the same manure recorded the lowest value (13.15 cm) during ERS. In the MRS, *Panicum maximum* (Ntchisi) fertilized with swine manure had the highest value (57.95 cm)

Table 2: Residual effects of animal manures and grass species on four weeks re-growth during the early and mid-rainy seasons

Manure T.	Grass species	Parameters							
		Early rainy season			Mid-rainy season				
		CD (cm)	T D (tiller no/m ²)	No of Leaves	Plant H (cm)	CD (cm)	T D (tiller no/m ²)	No of Leaves	Plant H (cm)
Cattle	<i>P. maximum</i> (Ntchisi)	92.65 ^{ab}	919.50 ^{bc}	306.50 ^{bc}	28.10 ^{bcd}	54.80 ^{ab}	1083.00 ^a	535.00 ^a	53.95 ^{ab}
	<i>P. maximum</i> (Local)	74.65 ^{cde}	700.50 ^d	233.50 ^{cde}	23.80 ^{cde}	45.65 ^{bc}	562.50 ^{de}	250.50 ^{efg}	39.65 ^{fg}
	<i>Brachiaria decumbens</i>	44.15 ^f	348.00 ^{ef}	174.00 ^{efg}	17.00 ^{ef}	53.50 ^{ab}	706.50 ^{cd}	361.50 ^{b-c}	43.65 ^{def}
Swine	<i>P. maximum</i> (Ntchisi)	87.10 ^{bc}	1366.00 ^a	537.50 ^a	41.00 ^a	60.80 ^a	1095.00 ^a	517.50 ^a	57.95 ^a
	<i>P. maximum</i> (Local)	37.80 ^f	789.00 ^{cd}	285.50 ^{bcd}	30.30 ^{bc}	57.30 ^a	673.50 ^{cde}	250.50 ^{efg}	50.65 ^{bc}
	<i>Brachiaria decumbens</i>	46.65 ^f	318.00 ^f	159.00 ^{efg}	13.15 ^f	58.15 ^a	1023.00 ^{ab}	454.50 ^{abc}	35.30 ^g
Small R.	<i>P. maximum</i> (Ntchisi)	106.80 ^a	1062.00 ^b	364.00 ^b	28.80 ^{bcd}	54.00 ^{ab}	1039.50 ^a	462.00 ^{abc}	45.95 ^{cde}
	<i>P. maximum</i> (Local)	59.15 ^{ef}	285.00 ^f	101.50 ^g	21.95 ^{e-f}	40.45 ^c	423.00 ^{de}	185.00 ^f	40.80 ^{efg}
	<i>Brachiaria decumbens</i>	46.10 ^f	435.00 ^{ef}	218.00 ^{de}	24.00 ^{cde}	53.30 ^{ab}	1126.50 ^a	500.50 ^{ab}	41.30 ^{efg}
Poultry	<i>P. maximum</i> (Ntchisi)	79.80 ^{bcd}	858.00 ^{cd}	311.00 ^{bc}	36.30 ^{ab}	60.80 ^a	912.00 ^{bc}	405.50 ^{cd}	47.45 ^{cd}
	<i>P. maximum</i> (Local)	47.80 ^{ef}	519.00 ^e	175.00 ^{efg}	26.50 ^{b-c}	41.45 ^c	432.00 ^{de}	169.00 ^{gh}	38.45 ^{fg}
	<i>Brachiaria decumbens</i>	46.10 ^f	409.00 ^{ef}	204.50 ^{def}	25.95 ^{cde}	53.60 ^{ab}	927.00 ^{bc}	412.00 ^{cd}	40.30 ^{efg}
Control	<i>P. maximum</i> (Ntchisi)	79.95 ^{bcd}	952.50 ^{bc}	320.50 ^{bc}	31.13 ^{bc}	54.95 ^a	720.00 ^{b-c}	320.50 ^{cde}	42.30 ^{def}
	<i>P. maximum</i> (Local)	68.45 ^{de}	363.00 ^{ef}	123.50 ^{fg}	19.30 ^{def}	41.10 ^c	388.50 ^e	139.00 ^h	38.15 ^{fg}
	<i>Brachiaria decumbens</i>	45.95 ^f	313.00 ^f	157.00 ^{efg}	21.30 ^{e-f}	56.65 ^a	931.50 ^{abc}	414.50 ^{abcd}	39.00 ^{fg}
SEM		3.76	42.74	20.21	2.47	2.20	73.38	33.74	1.38

a-h: means on the same column with different superscripts are significantly different ($P < 0.05$) SEM= standard error of mean

T= Types, CD=Crown diameter, TD= Tiller density, No=Number, PH= Plant height, R=Ruminant

while *Bracharia decumbens* fertilized with the same manure recorded the lowest value (35.30 cm) indicating that the plant advanced in growth during this period.

Table 3 shows the residual effects of animal manures and grass species on six weeks re-growth during the early and mid-rainy seasons, it was observed that *Panicum maximum* (Ntchisi) fertilized with small ruminant manure and swine manure had the highest values (114.10 cm and 68.80 cm respectively) for CD during ERS. *Bracharia decumbens* without fertilizer had the lowest value (51.15 cm) during ERS while *Panicum maximum* (Local) fertilized with small ruminant manure recorded the lowest value (44.95 cm) for CD during MRS. Considering TD in the early rainy season, *Panicum maximum* (Ntchisi) fertilized with swine manure had the highest value (1530.00 no of tillers/m²) and *Panicum maximum* (Local) fertilized with cattle manure recorded the lowest value (307.20 no of tillers/m²). Furthermore, *Bracharia decumbens* fertilized with the same manure recorded the highest value (1203.00 no of tillers/m²) in the MRS and *Panicum maximum* (Local) without manure had the lowest value (427.50 no of tillers/m²). The lowest value obtained during MRS was higher than that of ERS, this indicate that *Panicum maximum* (Local) without fertilizer performed better than the one that was fertilized with cattle manure during MRS. *Panicum maximum* (Ntchisi) fertilized with swine manure had the highest values (753.00 and 605.00) for both periods, indicating that the same trend was maintained although the value was slightly reduced during MRS. In the MRS, *Panicum maximum* (Local) fertilized with small ruminant manure and that without manure had the lowest values (115.50 and 177.00 respectively) for number of leaves. In the case of PH, *Panicum maximum* (Ntchisi) fertilized with swine manure had the highest values (48.45 cm and 64.45 cm) for both periods, while *Bracharia decumbens* fertilized with swine manure recorded the lowest values (20. 10 cm and 39.80 cm) during both periods. It was shown in the values obtained that there was a better

Table 3: Residual effects of animal manures and grass species on six weeks re-growth during the early and mid-rainy seasons

Manure T.	Grass species	Parameters									
		Early rainy season					Mid-rainy season				
		CD (cm)	TD (tiller no/m ²)	No of Leaves	Plant H (cm)	CD (cm)	TD (tiller no/m ²)	No of Leaves	Plant H (cm)		
Cattle	<i>P. maximum</i> (Ntchisi)	100.65 ^a	1006.5 ^{bcd}	335.50 ^b	35.15 ^{b-e}	62.80 ^{ab}	1165.50 ^a	578.00 ^{ab}	58.80 ^{ab}		
	<i>P. maximum</i> (Local)	82.30 ^{cd}	307.20 ^b	256.00 ^{cd}	30.30 ^{c-g}	53.45 ^{bc}	622.50 ^{de}	278.00 ^{fg}	45.10 ^{c-h}		
	<i>Brachiaria decumbens</i>	51.95 ^f	456.00 ^{efg}	223.00 ^{cd}	22.65 ^{gh}	58.80 ^{ab}	763.50 ^{cd}	391.00 ^{c-f}	48.65 ^{def}		
Swine	<i>P. maximum</i> (Ntchisi)	94.95 ^{ab}	1530.00 ^a	753.00 ^a	48.45 ^a	68.80 ^a	1164.0 ^a	605.00 ^a	64.45 ^a		
	<i>P. maximum</i> (Local)	99.00 ^a	877.50 ^d	327.00 ^b	37.80 ^{bc}	66.80 ^a	744.00 ^{cd}	330.50 ^{efg}	55.95 ^{bc}		
Small R.	<i>Brachiaria decumbens</i>	52.50 ^f	426.00 ^{eh}	213.00 ^{cd}	20.10 ^h	64.30 ^{ab}	1098.00 ^{ab}	493.00 ^{a-d}	39.80 ^a		
	<i>P. maximum</i> (Ntchisi)	114.10 ^a	1131.10 ^b	385.00 ^b	34.30 ^{b-f}	61.30 ^{ab}	1104.00 ^{ab}	522.50 ^{abc}	51.30 ^{de}		
	<i>P. maximum</i> (Local)	63.80 ^{ef}	322.50 ^{gh}	115.50 ^f	26.60 ^{de}	44.95 ^c	474.00 ^{de}	210.00 ^{gh}	44.80 ^{e-h}		
Poultry	<i>Brachiaria decumbens</i>	53.80 ^f	540.00 ^{ef}	270.50 ^c	30.30 ^{c-g}	58.30 ^{ab}	1203.00 ^a	560.00 ^{ab}	46.45 ^{efg}		
	<i>P. maximum</i> (Ntchisi)	85.65 ^{bc}	936.00 ^{cd}	344.00 ^b	41.95 ^{ab}	67.60 ^a	979.50 ^{abc}	440.50 ^{b-e}	53.10 ^{bcd}		
	<i>P. maximum</i> (Local)	78.60 ^{cd}	567.00 ^e	201.00 ^{de}	31.15 ^{c-g}	58.45 ^{ab}	984.00 ^{abc}	442.50 ^{b-e}	45.80 ^{e-h}		
Control	<i>Brachiaria decumbens</i>	51.50 ^f	505.50 ^{ef}	253.00 ^{cd}	30.65 ^{c-g}	60.45 ^{ab}	784.50 ^{bcd}	349.50 ^{ab-g}	48.15 ^{g-h}		
	<i>P. maximum</i> (Ntchisi)	85.65 ^{bc}	1045.50 ^{bc}	353.00 ^b	36.65 ^{b-e}	60.45 ^{ab}	784.50 ^{bcd}	349.50 ^{ab-g}	48.15 ^{g-h}		
	<i>P. maximum</i> (Local)	71.95 ^{de}	429.00 ^{eh}	148.50 ^{ef}	24.65 ^{fgh}	45.80 ^c	427.50 ^e	177.00 ^b	41.65 ^{gh}		
SEM	<i>Brachiaria decumbens</i>	51.15 ^f	406.50 ^{fgh}	203.50 ^{de}	24.95 ^h	63.15 ^{ab}	987.00 ^{abc}	440.00 ^{b-e}	43.95 ^{fgh}		
		3.32	33.56	14.87	2.45	2.84	78.11	37.19	1.45		

a-h: means on the same column with different superscripts are significantly different (P < 0.05) SEM= standard error of mean T= Types, CD=Crown diameter, TD= Tiller density, No=Number, PH= Plant height, R=Ruminant

growth during MRS than ERS as the values recorded in MRS were slightly greater than those of ERS. The residual effects of animal manures and grass species on eight weeks re-growth during the early and mid-rainy seasons were presented in the table 4. It was revealed that *Panicum maximum* (Ntchisi) fertilized with small ruminant manure and swine manure had the highest values (121.15 cm and 77.65 cm) for both ERS and MRS respectively. Although the same trend that was observed for CD in the previous weeks was maintained. While, *Bracharia decumbens* fertilized with cattle manure had the lowest value (56.59 cm) during ERS and *Panicum maximum* (Local) fertilized with small ruminant manure recorded the lowest value (50.00 cm) for CD during MRS. For the TD in the early rainy season, *Panicum maximum* (Ntchisi) fertilized with swine manure had the highest value (1679.50 no of tillers/m²) and *Panicum maximum* (Local) fertilized with small ruminant manure recorded the lowest (436.50 no of tillers/m²). *Bracharia decumbens* fertilized with the same manure recorded the highest value (1270.50 no of tillers/m²) in the MRS and *Panicum maximum* (Local) without manure had the lowest value (465.00 no of tillers/m²). *Panicum maximum* (Ntchisi) fertilized with swine manure had the highest values (670.50 and 652.50) during both periods for the number of leaves and *Panicum maximum* (Local) fertilized with small ruminant manure recorded the lowest value (145.50) in the ERS. *Panicum maximum* (Local) without fertilizer had the least value (206.50) during MRS which is slightly higher than that of the value recorded in the ERS. Also, in the case of PH, *Panicum maximum* (Ntchisi) fertilized with swine manure had the highest values (54.95 cm and 70.15 cm) for both periods, while *Bracharia decumbens* fertilized with swine manure recorded the lowest value (26.30 cm) during ERS and that of *Panicum maximum* (Local) without manure had the lowest value (45.45 cm) during MRS.

Table 4: Residual effects of animal manures and grass species on eight weeks re-growth during the early and mid-rainy seasons

Manure T.	Grass species	Parameters											
		Early rainy season						Mid-rainy season					
		CD (cm)	T D ((tiller no/m ²))	No of Leaves	Plant H (cm)	CD (cm)	T D ((tiller no/m ²))	No of Leaves	Plant H (cm)				
Cattle	<i>P. maximum</i> (Ntchisi)	108.95 ^b	1090.50 ^{bcd}	429.00 ^b	42.30 ^{bcd}	71.60 ^{abc}	1240.50 ^a	615.50 ^a	65.50 ^b				
	<i>P. maximum</i> (Local)	89.30 ^{ad}	840.50 ^e	281.00 ^{cde}	37.15 ^{b-f}	61.15 ^{cde}	688.50 ^{cde}	306.00 ^{c-f}	51.10 ^b				
	<i>Brachiaria decumbens</i>	56.59 ^f	561.00 ^{fg}	303.00 ^{cde}	28.65 ^{fg}	64.60 ^{bc}	814.50 ^{bcd}	417.50 ^{b-e}	53.00 ^b				
Swine	<i>P. maximum</i> (Ntchisi)	104.80 ^b	1679.50 ^a	670.50 ^a	54.95 ^a	77.65 ^a	1233.00 ^a	652.50 ^a	70.15 ^a				
	<i>P. maximum</i> (Local)	106.45 ^b	954.00 ^{dc}	356.00 ^{bcd}	45.30 ^{bc}	75.30 ^{ab}	810.00 ^{bcd}	360.00 ^{d-g}	61.80 ^b				
	<i>Brachiaria decumbens</i>	59.15 ^f	522.00 ^{fg}	268.50 ^{de}	26.30 ^g	71.30 ^{abc}	1176.00 ^a	522.50 ^{a-d}	45.80 ^b				
Small R.	<i>P. maximum</i> (Ntchisi)	121.15 ^a	1201.50 ^b	419.00 ^b	40.15 ^{b-e}	69.00 ^{abc}	1174.50 ^a	561.50 ^{ab}	57.10 ^b				
	<i>P. maximum</i> (Local)	71.30 ^e	436.50 ^g	145.50 ^f	32.30 ^{d-f}	50.00 ^e	520.50 ^{de}	231.50 ^g	49.15 ^b				
	<i>Brachiaria decumbens</i>	59.45 ^f	618.00 ^f	309.00 ^{cde}	36.30 ^{c-g}	63.45 ^{bed}	1270.50 ^a	597.00 ^a	51.80 ^b				
Poultry	<i>P. maximum</i> (Ntchisi)	93.95 ^c	1002.00 ^{cd}	373.00 ^{bc}	47.30 ^{ab}	74.30 ^{ab}	1045.50 ^{ab}	488.00 ^{a-d}	58.95 ^b				
	<i>P. maximum</i> (Local)	84.65 ^{cd}	618.00 ^f	228.50 ^{ef}	35.95 ^{c-g}	52.15 ^{de}	517.50 ^{de}	233.50 ^{fg}	47.10 ^b				
	<i>Brachiaria decumbens</i>	57.65 ^f	585.00 ^{fg}	292.50 ^{cde}	35.80 ^{c-g}	63.65 ^{bed}	1048.50 ^{ab}	531.00 ^{abc}	51.80 ^b				
Control	<i>P. maximum</i> (Ntchisi)	91.50 ^e	1134.00 ^{bc}	435.50 ^b	42.15 ^{bcd}	68.80 ^{abc}	849.00 ^{bc}	385.50 ^{c-f}	54.95 ^b				
	<i>P. maximum</i> (Local)	78.45 ^{de}	474.00 ^{fg}	168.00 ^f	30.15 ^{c-g}	50.15 ^e	465.0 ^f	206.50 ^f	45.45 ^b				
	<i>Brachiaria decumbens</i>	57.00 ^f	537.00 ^{fg}	268.50 ^{de}	32.30 ^{d-g}	68.95 ^{bc}	1038.00 ^{ab}	501.50 ^{cd}	49.30 ^b				
SEM		3.42	33.27	21.92	2.50	3.04	77.76	37.17	2.70				

a-h: means on the same column with different superscripts are significantly different (P < 0.05) SEM= standard error of mean T= Types, CD=Crown diameter, TD= Tiller density, No=Number, PH= Plant height, R=Ruminant

The residual effects of animal manures and grass species on ten weeks re-growth during the early and mid-rainy seasons were expressed in the table 5. In the ERS, *Panicum maximum* (Ntchisi) fertilized with swine manure had the highest value (128.35 cm) and *Bracharia decumbens* without manure recorded the lowest value (62.65 cm) for CD. On the other hand, in the MRS, *Panicum maximum* (Ntchisi) fertilized with swine manure recorded the highest value (85.15 cm) which is lower than the value obtained for ERS and *Panicum maximum* (Local) fertilized with small ruminant manure had the lowest value (54.80 cm) which slightly differ from the lowest value observed in the ERS. For the TD in the early rainy season, *Panicum maximum* (Ntchisi) fertilized with swine manure had the highest values (1821.50 no of tillers/m² and 1314.00 no of tillers/m²) for both periods and *Panicum maximum* (Local) fertilized with small ruminant manure and poultry manure recorded the lowest values (502.50 no of tillers/m² and 561.00 no of tillers/m²) respectively during both periods. In the case of number of leaves, *Panicum maximum* (Ntchisi) fertilized with swine manure had the highest values (721.00 and 701.00) for both periods and *Panicum maximum* (Local) fertilized with small ruminant manure had the lowest value (174.00) in the ERS. Moreover, *Panicum maximum* (Local) fertilized with poultry manure recorded the lowest value (251.00) in the MRS. Meanwhile, this value was greater than that of the lowest value recorded during ERS. *Panicum maximum* (Ntchisi) fertilized with swine manure had the highest value (56.95 cm) and *Bracharia decumbens* fertilized with the same manure recorded the lowest value (32.65 cm) during ERS. In the MRS, *Panicum maximum* (Ntchisi) fertilized with swine manure had the highest value (75.30 cm) while *Bracharia decumbens* fertilized with the same manure recorded the lowest value (50.95 cm) indicating that the plant advanced in growth better during this period.

Table 5: Residual effects of animal manures and grass species on ten weeks re-growth during the early and mid-rainy seasons

Manure T.	Grass species	Parameters									
		Early rainy season					Mid-rainy season				
		CD (cm)	T D (tiller no/m ²)	Leaves	Plant H (cm)	CD (cm)	T D (tiller no/m ²)	Leaves	No of Leaves	Plant H (cm)	
Cattle	<i>P. maximum</i> (Ntchisi)	116.65 ^b	1141.50 ^{bc}	452.00 ^b	49.65 ^{a-d}	80.80 ^a	1312.50 ^a	678.50 ^a	72.05 ^{ab}		
	<i>P. maximum</i> (Local)	97.95 ^d	912.00 ^d	371.50 ^{bcd}	44.60 ^{c-g}	67.80 ^{abc}	745.50 ^{bcd}	333.50 ^{de}	57.10 ^{d-g}		
	<i>Brachiaria decumbens</i>	62.95 ^b	636.50 ^{ef}	348.50 ^{b-e}	34.30 ^b	70.30 ^{abc}	870.00 ^{bcd}	446.50 ^{b-e}	58.15 ^{d-g}		
Swine	<i>P. maximum</i> (Ntchisi)	111.65 ^{bc}	1821.50 ^a	721.00 ^a	56.95 ^a	85.15 ^a	1314.00 ^a	701.00 ^a	75.30 ^a		
	<i>P. maximum</i> (Local)	113.80 ^b	1085.00 ^{cd}	416.50 ^{bc}	52.50 ^{abc}	83.80 ^a	874.50 ^{bcd}	393.50 ^{cde}	67.15 ^{abc}		
	<i>Brachiaria decumbens</i>	65.45 ^{gh}	669.00 ^{ef}	334.50 ^{b-e}	32.65 ^b	78.45 ^{ab}	1258.50 ^{ab}	636.50 ^{ab}	50.950 ^g		
Small R.	<i>P. maximum</i> (Ntchisi)	128.35 ^a	1267.50 ^b	455.00 ^b	45.65 ^{b-f}	76.15 ^{ab}	1237.50 ^{ab}	597.00 ^{abc}	62.65 ^{cde}		
	<i>P. maximum</i> (Local)	76.30 ^{fg}	502.50 ^f	174.00 ^e	37.45 ^{gh}	54.80 ^c	568.50 ^d	252.00 ^e	53.65 ^{efg}		
	<i>Brachiaria decumbens</i>	66.95 ^{gh}	718.50 ^e	362.00 ^{bcd}	38.65 ^{g-h}	69.15 ^{abc}	1335.00 ^a	652.50 ^{ab}	57.30 ^{d-g}		
Poultry	<i>P. maximum</i> (Ntchisi)	100.95 ^{cd}	1071.00 ^{cd}	409.50 ^{bc}	54.10 ^{ab}	80.15 ^b	1116.00 ^{abc}	534.50 ^d	65.15 ^{bcd}		
	<i>P. maximum</i> (Local)	89.45 ^{de}	663.00 ^{ef}	254.50 ^{cde}	41.50 ^{d-h}	58.30 ^c	561.00 ^d	251.00 ^e	52.00 ^{d-g}		
	<i>Brachiaria decumbens</i>	63.15 ^h	663.00 ^{ef}	651.50 ^a	41.30 ^{d-h}	68.55 ^{abc}	1107.00 ^{abc}	560.00 ^{abc}	57.15 ^{d-g}		
Control	<i>P. maximum</i> (Ntchisi)	98.45 ^d	1203.00 ^{bc}	478.50 ^b	47.65 ^{d-e}	75.95 ^{ab}	915.00 ^{bcd}	424.00 ^{cde}	61.00 ^{e-f}		
	<i>P. maximum</i> (Local)	84.15 ^{ef}	546.00 ^{ef}	188.50 ^{de}	35.50 ^{gh}	61.85 ^{bc}	638.00 ^d	289.67 ^c	53.43 ^{efg}		
	<i>Brachiaria decumbens</i>	62.65 ^h	642.00 ^{ef}	326.00 ^{b-e}	38.65 ^{g-h}	69.69 ^{abc}	946.10 ^{u-d}	456.13 ^{b-e}	53.51 ^{efg}		
SEM		3.25	39.61	30.47	2.25	4.19	92.55	45.78	2.29		

a-h: means on the same column with different superscripts are significantly different ($P < 0.05$) SEM= standard error of mean

DISCUSSION

The outstanding performance of the swine manure might be due to its ability to release high amount of nitrogen after mineralization of the organic contents. Olsen and Papworth (2000) reported a positive effect on forage yield when swine manure was applied to a grown crop. Similarly, Asadu *et al.* (2004) reported that organic manure improves the soil's physical characteristics, chemical fertility and enhanced crop performance. This also conforms to the findings by Olanite *et al.* (2010) that plants that received higher N levels generally performed better than the control. Among other studies which support findings in this study is Qamar Bilal *et al.* (2000) which reported that the application of N and farm yard manure increased the number of tillers and plant height significantly over the control treatment at all stages of growth in all cutting regimes, and crops fertilized at 300 kgN ha⁻¹ produced the tallest plant along with maximum tiller numbers. Similarly, Adenawoola and Adejoro (2005) confirmed that poultry manure increased growth and yield of *Corchorus olitorus*. The low performance of grasses fertilized with cattle manure can be linked to the fact that the manure produced from cattle dung depends on the cattle diet and constituents like the microbial remains. Such diet containing material with large proportions of high molecular weight, recalcitrant carbon compounds which lead to high lignin contents in manures and this prevent the soil microbes which aid decomposition of organic manure from actively degrading the manure to release N.

The observation of *P. maximum* Ntchisi in the plots that received swine manure for crown diameter (CD), tiller density (TD), number of leaf (LN) and plant height were higher than *P. maximum* local and *B. Decumbens*, this might be attributed to the ability of *P. maximum* (Ntchisi) to fully utilize its genetic potentials as a result of favourable improved soil condition. The organic matter content of plots amended with manure might have enhanced the water retention capacity of the soil and leading to reduced soil temperature and improved soil physical properties (Adesodun *et al.* 2005; Aluko and Oyeleke, 2005). However, the values recorded for tiller density in

B. decumbens during the mid rainy period were higher than the early rainy period. This could be linked to higher competitive ability of *B. decumbens* which spreads on the soil surface which is enhanced due to higher moisture availability during the mid-rainy period than early rainy period.

CONCLUSIONS

Considering the re-growth parameters examined, *P. maximum* (Ntchisi) had better performance than other grass species used in this study during early rainy season which was more pronounced in the plots that received swine manure.

Similar to our observation during early rainy season, *P. maximum* (Ntchisi) had better performance for re-growth parameters than other grass species used in this study during mid-rainy season. However, there was an improvement in the re-growth of *B. decumbens* during this period as compared to early rainy season.

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