



EFFECT OF COW DUNG ON THE GROWTH, FORAGE YIELD OF TWO VARIETIES OF SORGHUM (*Sorghum bicolor* (L) Moench.) IN EKPOMA, EDO STATE, NIGERIA

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ABSTRACT

A field experiment was carried out during the cropping season of 2023 to study the effect of cow dung on the growth and forage yield of two varieties of sorghum (*Sorghum bicolor* (L) Moench) in Ekpoma, Edo State, Nigeria. Two sorghum varieties (MLSH 151 and Samaru Local Red) were fertilized with cow dung at the rates of 0, 5, 10 and 15 t/ha. The experiment was a 2x4 factorial scheme fitted into a randomized complete block design (RCBD) with three replicates. Data collected included plant height (cm), number of leaves/plant, number of tillers/plant, total leaf area/plant (cm), stem girth (cm), forage and dry matter yield. All data collected were analyzed using analysis of variance (ANOVA) at 5% level of probability and means separated using Duncan's Multiple Ranged Test. The vegetative traits measured were significantly influenced by the applied cow dung: except for number of leaves/plant. Samaru local red fertilized at 15t/ha had the highest plant height (168.80cm) and number of tillers/plant (1.69cm) while the unfertilized MLSH 151 had the least values of 117.60cm and 0.81, respectively. The highest total leaf area (48826.61 cm²) and stem girth (3.47cm) values were recorded in crops that received 10t/ha while control had the least values of 29631.54cm and 2.05cm, respectively. Samaru- Local Red variety of sorghum had higher vegetative characters measured than MLSH 151. The application of cow dung had significant effect on the forage and dry matter yields of sorghum. Forage and dry matter yields of sorghum significantly increased with increasing rates of cow dung application up to 10t/ha and declined thereafter at the highest rate. However, Samaru-Local Red fertilized at 10t/ha PM and unfertilized MLSH 151 recorded the highest (63.97t/ha and 14.46t/ha) and least (14.99t/ha and 7.92t/ha) forage and dry matter yields, respectively. Generally, Samaru-Local Red applied 10t/ha of cow dung is the better variety for forage production for the nutrition of ever increasing ruminant livestock population in this locality.

Keywords: Sorghum, Varieties, Growth, Forage, Yield, Cowdung

INTRODUCTION

Sorghum (*Sorghum bicolor* (L) Moench) belongs to the family *Poaceae* and it is known to originate from West Africa (Remison, 2005). Sorghum is the fifth most important cereal crop, worldwide after wheat, rice, maize and barley (Maughan *et al.*, 2012). In Africa, sorghum ranks in third position after maize and rice. It is an important crop for millions of people in semi-arid regions of Africa and tropical Asia (Remison. 2005). Sorghum is a globally cultivated cereal, unique due to its tolerance to drought, water logging, saline - alkaline, infertile soil and high temperatures (Remison, 2005). Sorghum is well adapted to hot climates with medium to low rainfall, performing best under conditions of light showers followed by bright sunshine during the growing period. When growing conditions are not favourable, sorghum will remain dormant until the desired conditions are available. In Nigeria, sorghum is grown principally in the drought-prone marginal agricultural areas of Northern Provinces. The crop is a C4 photosynthetic plant which increases efficiency of carbon dioxide fixation in plants, that have higher Such plants are well adapted to regions of lower latitude temperatures and are prone to drought (May *et al.*, 2014). Sorghum crop performs well in areas between 500 metres and 1700 metres above sea level, with seasonal rainfall of 300 mm and above (Kinoshita *et al*, 2008). As an indigenous African crop, sorghum could provide food security and become a suitable alternative in many places where maize crop fails. Sorghum is therefore an important subsistence cereal crop in



semi-arid areas for its diverse specie, adaptation to drought and its close relationship in use to maize (Remison, 2005). Sorghum production has dropped worldwide by 0.8% per year, contrary to Africa which report shows an increase by 2.2%. Nevertheless, the crop is not given great priority compared to other cereals like maize, rice, millet and wheat (Snap *et al.*, 2005). In most countries in the world, sorghum is used primarily as animal feed and industrial raw material, but in Africa it is used as human food, where it is a staple food for millions of people. In Nigeria, the grain is mostly for food purpose (55%), consumed in the form of flat bread and porridge. The Stover is an important source of dry season maintenance rations for livestock; it is also an important feed grain (3390) in Southern Nigeria. Sorghum has high levels of iron (greater than 70 g/kg) and zinc (greater than 50 g/kg), hence it may be used to reduce micronutrient malnutrition and hidden hunger. In most families in eastern part of Nigeria, sorghum landraces are used for making fermented and un-fermented porridge. In some cases, the grains are mixed with other grains such as green grams, cowpeas and amaranths and then boiled to make traditional dishes. However, the crop has been neglected due to the perception as food for the poor (Agrama & Tunistra, 2003).

Agriculture remains one of the cornerstones of the Nigeria economy, with the country's economic performance often reflecting the state of agricultural conditions. According to Wrather *et al.*, (2008) livestock production, mainly sheep and beef in the pasture environments, forms an important component of the agricultural economy of the region and depends to a great extent on forages as a source of feed. Rangelands play an important role in the economics of animal production, as it is a key element in the provision of cheap feed for the livestock industry in Nigeria. For the majority of the emerging farming communities, it remains the main and the cheapest source of fodder (Snap *et al.*, 2005). The sustainability of livestock production systems is highly dependent on the effective utilization of forages, for short term benefit, whilst conserving it for future generations (Palmer and Ainslie, 2002). The greatest concern is that the condition of rangeland is deteriorating and the situation is being aggravated by low and unpredictable annual rainfall in most parts of North (Arshad *et al.*, 2007). According to Amodu *et al.* (2005), 60% of pasture land in Nigeria is in a poor condition, while 30% is in a fair condition with only 10% in a good condition. It is generally accepted that low nutritional value and acceptability of the herbage of the pastures in the dormant season has a negative effect on growth and conception rates of livestock (Fales *et al.*, 2007). This results in suboptimal production and reproduction and implies a negative impact on profitability of the livestock enterprise in the long term (Aribido & Bolorunduro, 2004). The strategy for the enhancement of livestock production in South-South Nigeria should therefore be primarily on the increasing of fodder productivity both quantitatively and qualitatively through introduction of high yielding pasture cereals with good nutrition principles.

Manure is an important source of nutrients for many smallholder farmers, with cattle dung being one of the most dominant types. The use of inorganic fertilizer has not been helpful under intensive agriculture because it is often associated with reduced crop yield, soil acidity and nutrient imbalance (Ayoola & Adeniyarn, 2006). This effect may minimize the amounts of chemical fertilizers and improve their application efficiency and subsequently avoiding environmental pollution. Organic manure plays an important role on growth and productivity of plants (Ali, 2006). Hence the present study was conducted to investigate the effects of cow dung on the forage yield and mineral profile of two sorghum varieties.

The overall aim of this study was to determine the effect of cow dung on the forage yield and mineral profile of two varieties of sorghum in a forest-savanna transition zone of Edo State, Nigeria.

The specific objectives were to determine the effect of cow dung on the:

- a) Growth of two varieties of sorghum; and
- b) Forage and dry matter yields of the crops.

MATERIALS AND METHODS

Experimental Location

The field experiment was conducted during 2023 cropping season at the Teaching and Research Farm, Ambrose Alli University, Emaudo Annex, Ekpoma. Ekpoma lies on the coordinate of



latitude 6°45' 30. so North and longitude 6°08' 25.04 East. The area falls within the rain forest-savanna transition zone of Edo state, Nigeria. Ekpoma is located within the northern boundary of the rain forest zone of Nigeria with a mean annual rainfall of about 1200 mnn-1500mm and mean air temperature of 29°C (Ighalo & Remison, 2010).

Soil and Manure Analysis

Prior to planting, representative soil samples were randomly collected from surface soil (0-15 cm depth) in the experimental site using soil auger; to determine routine physico-chemical properties according to the procedure described by Okalebo *et al.*, (2002). This was repeated after cropping with sorghum. The cow dung was analyzed for chemical properties as described by Anderson and Ingram (1993).

Experimental Materials

The seeds of the two varieties of sorghum (MLSH 15 and Samaru Local Red) used were obtained from Institute for Agricultural Research (IAR) Samaru, Zaria, Kaduna State. The cow dung was collected from the Livestock Unit, Teaching and Research Farm. Faculty of Agriculture, Ambrose Alli University, Ekpoma, Edo State.

Experimental Layout

The experiment was a 2x4 factorial scheme fitted into a randomized complete block design (RCBD) with two varieties of sorghum (MLSH 15, and Samaru Local Red) treated with four levels of cow dung (0, 5, 10 and 15t/ha) replicated three times.

Land Preparation and Planting

The land preparation was done manually and planting took place on 14th April, 2023 when the rains became reliable. The organic fertilizer (Cow dung) equivalent to the rates of 0.5, 10 and 15 t/ha equivalent was incorporated into the soil according to the treatments, two weeks before seeds were planted into the field to enable proper degradation of the manure and mineralization of the nutrients. The seeds were planted at a spacing of 25 x 75 cm intra- and inter rows. Twenty four (24) plots with twenty plants (20) each were involved to give a total of four hundred and eighty plants (480) giving an equivalent population density of 53,333 plants/ha. The individual plot size was 1.25 x 3 m, spaced at 1m within plots and between replicates. The total area used was 10 x 9 m to give a dimension of 90.00m² (0.01 ha). Weed control was manually done with hoe at 3 and 7 Weeks after planting while subsequent weed control was done by rouging.

Data Collection

Data were collected at two-week intervals from four to 12 weeks after planting. Four plants from the middle rows of each plot were tagged for data collection. The parameters measured included: Plant height, Number of leaves, Number of tillers, Total leaf area (cm²), Stem girth (cm) Forage yield, Dry matter yield and Dry matter percent (%).

Data Analysis

Data collected were analyzed using analysis of variance (ANOVA) at 5% level of probability and the means were separated using Duncan's Multiple Range Test (DMRT) and SAS (2008) Statistical package.

RESULTS

The results of the physico-chemical properties of soil of the experimental site before and after cropping and the chemical properties of the cow dung are presented in Table I. The textural class of the soils was loamy sand and slightly acidic (Table I). The available phosphorus and total nitrogen were low and had marginal macro-nutrients when compared with the critical levels. The results for the chemical properties of the cow dung showed high organic carbon and were sufficient in total nitrogen available P and he macro-nutrients (Table 1).



Table 1: Physico-chemical properties of the soil before cropping of sorghum and the chemical properties of the cow dung

Properties	Values	Poultry manure
pH (1.20 soil and water)	5.57	8.14
Clay (%)	9.80	0.00
Silt (%)	5.7	0.00
Sand (%)	84.5	0.00
Texture	Loamy sand	
Organic carbon (%)	0.81	3.80
Nitrogen (%)	0.03	0.82
Available phosphorus (mg/kg)	10.51	73.30
Available phosphorus (mg/kg)	10.51	73.30
Calcium (cmol/kg)	2.02	3.23
Magnesium (cmol/kg)	1.20	1.93
Potassium (cmol/kg)	0.37	0.79
Sodium (cmol/kg)	1.24	1.20
Cation exchange capacity (cmol/kg)	4.83	-
Exchangeable acidity (cmol/kg)	0.41	-
Effective cation exchange capacity (cmol/kg)	5.24	-
Base saturation (%)	92.18	-

Plant Height

Varieties sown had no significant effect on the height of sorghum throughout the weeks after planting. The height increased with age from 2-12 WAP. At 12WAP, plant height ranged significantly from 114.50 - 184.60 cm in Samaru- Local Red and from 120.8-161.0 cm in MLSH 151. Samaru-Local Red was taller with an average height of 153,90cm than MLSH 151 (146.00 cm). Crops treated at 15 t/ha had the tallest plants while untreated crops had the least. Plant height was significantly ($P<0.05$) influenced by the interaction between variety and cow dung from 2-12 WAP.

Table 2: Effect of cow dung on the plant height (cm) of two varieties of sorghum

Crop variety	Cow dung (t/ha)				
	0	5	10	15	Mean
2WAP					
Samaru local red	2.80 ^c	3.38 ^b	2.88 ^c	3.70 ^{ab}	3.19
MLSH-151	2.21 ^d	2.84 ^c	3.44 ^b	3.97 ^a	3.11
Mean	2.51 ^c	3.11 ^b	3.16 ^b	3.83 ^a	
SEM±	v=0.26 ^{ns}	CD=0.22*	VxCD=0.22*		
4WAP					
Samaru local red	10.46 ^{bd}	12.41 ^b	9.7 ^d	16.86 ^a	12.36
MLSH-151	8.92 ^d	10.07 ^{cd}	12.19 ^{bc}	12.07 ^{bc}	10.81
Mean	9.69 ^b	11.24 ^b	10.95 ^b	14.47 ^a	
SEM±	V=1.06 ^{ns}	CD=1.18*	VxCD=0.98*		
6WAP					
Samaru local red	13.95 ^c	25.19 ^b	23.12 ^{bcd}	30.33 ^a	23.1
MLSH-151	19.47 ^d	20.89 ^{cd}	23.31 ^{cd}	22.61 ^{bd}	21.6
Mean	16.71 ^b	23.04 ^a	23.21 ^a	26.47 ^a	
SEM±	V=2.05 ^{ns}	CD=2.01*	VxCD=1.60*		
8WAP					
Samaru local red	34.71 ^c	55.43 ^b	52.48 ^{bc}	74.38 ^a	54.30
MLSH-151	34.22 ^c	41.59 ^{de}	45.75 ^{cd}	55.53 ^b	44.30
Mean	34.46 ^c	48.51 ^b	49.3 ^b	64.96 ^a	
SEM±	V=5.36 ^{ns}	CD=4.84*	VxCD=4.19*		
10WAP					
Samaru local red	85.83 ^{cd}	98.05 ^{abc}	105.92 ^{ab}	108.63 ^a	99.60
MLSH-151	73.25 ^d	90.63 ^{bc}	103 ^{ab}	110.67 ^a	94.40
Mean	79.54 ^c	94.34 ^b	104.46 ^{ab}	109.65 ^a	
SEM±	V=6.10 ^{ns}	N=5.22*	VxCD=7.34*		
12WAP					
Samaru local red	114.5 ^c	160 ^{ab}	156 ^{ac}	184.6 ^a	153.90
MLSH-151	120.8 ^{bc}	149.2 ^{ac}	161.0 ^{ab}	152.9 ^{ac}	146.00
Mean	117.6 ^b	154.6 ^a	158.80 ^a	168.8 ^a	
SEM±	V=12.10 ^{ns}	CD=12.87*	VxCD=18.48*		

Means with same letter(s) in column are not significantly different; 2. Means with same letter (s) in rows are significantly different; 3. Mean with same letter(s) in column and rows are not significantly different using DMRT at 5% level of probability; V = variety, CD = Cow dung,; ns = not significant; *, significant

Number of Leaves per Plant

There was no significant difference or the number of leaves plant in line with variety sown throughout the weeks of sampling (Table 3). Number of leaves/plant of the two varieties of Sorghum was significantly influenced by cow dung x variety interaction except at 12WAP, but the main effect of cow was not significant with time except at 2, 8 and 10WAP, Number of leaves increased from 2 WAP up o 12 WAP among treatments. At 12 WAP, he mean varied from 13,17- 14.13 in Samaru-Local Red and 12,90 - 13.39 in MISH 1S1. Generally, Samaru- Local Red had higher number of leaves than ML SH I51. The mean number of leaves per plant for Samaru- Local Red was 13.75 while that of MLSH 1S1 was 13.33. Crops planted fertilized at 10ttha had the highest number of leaves/plant while control crops had the least.

Table 3: Effect of cow dung on the number of leaves/plant of two varieties of sorghum

Crop variety	Cow dung (t/ha)				
	0	5	10	15	Mean
2WAP					
Samaru local red	4.25 ^{abc}	4.46 ^{ab}	5.12 ^a	4.5 ^{ab}	4.58
MLSH-151	3.36 ^c	4.1 ^{bc}	4.1 ^{bc}	5.08 ^a	4.16
Mean	3.803 ^b	4.278 ^{ab}	4.612 ^a	4.788 ^a	
SEM±	V=0.28 ^{ns}	CD=0.36*	VxCD=0.41*		
4WAP					
Samaru local red	9.25 ^a	9.25 ^a	8 ^{ab}	8.52 ^a	8.76
MLSH-151	6.87 ^b	8.92 ^a	8.35 ^{ab}	9.34 ^a	8.37
Mean	8.058	9.083	8.175	8.93	
SEM±	V=0.45 ^{ns}	CD=06 ^{ns}	VxCD=0.70*		
6WAP					
Samaru local red	8.817	9.817	10.35	9.767	9.69
MLSH-151	10.433	9.177	10.893	7.957	9.61
Mean	9.625	9.497	10.622	8.862	
SEM±	V=0.66 ^{ns}	CD=0.89 ^{ns}	VxCD=1.26 ^{ns}		
8WAP					
Samaru local red	10.58 ^{bc}	11.92 ^{abc}			
MLSH-151	11.3 ^{abc}	10.52 ^{bc}	13.42 ^a	9.83 ^c	11.27
Mean	10.94 ^b	11.22 ^b	13.02 ^a	10.02 ^b	
SEM±	V=0.70 ^{ns}	CD=0.75*	VxCD=1.10*		
10WAP					
Samaru local red	13.39 ^b	13.88 ^b	13.97 ^b	13.25 ^b	13.62
MLSH-151	12.04 ^c	13.04 ^b	14.88 ^a	11.59 ^c	12.89
Mean	12.72 ^b	13.46 ^{ab}	14.42 ^a	12.42 ^b	
SEM±	V=0.44 ^{ns}	CD=0.48*	VxCD=0.40*		
12WAP					
Samaru local red	13.17	13.91	14.13	13.78	13.75
MLSH-151	12.9	13.63	13.99	13.38	13.48
Mean	13.04	13.77	13.80	13.58	
SEM±	V=0.32 ^{ns}	CD=0.46 ^{ns}	VxCD=0.70 ^{ns}		

Means with same letter(s) in column are not significantly different; 2. Means with same letter (s) in rows are significantly different; 3. Mean with same letter(s) in column and rows are not significantly different using DMRT at 5% level of probability; V = variety, CD = Cow dung; ns = not significant; *, significant

Total Leaf Area/plant

The application of cow dung had no significant effect on the total leaf area plant of sorghum except at 4 and 12WAP (Table 4). Total leaf area per plant increased from 2-12 WAP in both varieties (Table 4). Total leaf area/plant was significantly affected by variety x cow dung interaction except at 2 and 6WAP. At 12WAP, the mean varied significantly from 30357.12- 47216.46 cm² and 28905.87-50436.76 cm² in Samaru-Local Red and MISH 151, respectively. In all, Samaru-Local Red significantly ($P<0.05$) had a higher total leaf area (40358.42 cm) than MLSH 151 (35833.50 cm²). Crops fertilized with cow dung at 10t/ha and control gave the highest and least total leaf area/plant.

Table 4: Effect of cow dung on the total leaf area/plant (cm²) of two varieties of sorghum

Crop variety	Cow dung (t/ha)				
	0	5	10	15	Mean
2WAP					
Samaru local red	35.83	47.22	91.44	72.19	61.67
MLSH-151	66.42	49.57	70.53	58.41	61.23
Mean	51.13	48.39	80.98	65.3	
SEM±	V=12.30 ^{ns}	CD=16.18 ^{ns}	V _x CD=23.69 ^{ns}		
4WAP					
Samaru local red	1735.56 ^c	2467.8 ^b	3198.28 ^a	2597.95 ^b	2499.9
MLSH-151	1277.49 ^c	2343.65 ^b	3198.28 ^a	2597.95 ^b	2499.9
Mean	1506.53 ^c	2405.72 ^b	3326.68 ^a	2451.94 ^b	
SEM±	V=353.16 ^{ns}	CD=192.21 [*]	V _x CD=260.97 [*]		
6WAP					
Samaru local red	7529.02 ^{bc}	9943.74 ^{abc}	14803.93 ^a	12772.06 ^{ab}	11262.18
MLSH-151	7061.02 ^{bc}	8252.74 ^{abc}	8711.93 ^{bc}	7694.73 ^{bc}	7930.27
Mean					
SEM±	V=1317.72 ^{ns}	CD=1977.91 ^{ns}	V _x CD=2312.49 ^{ns}		
8WAP					
Samaru local red	23993.96 ^{ab}	32457.31 ^a	22739.76 ^{ab}	30027.37 ^a	27304.6
MLSH-151	15338.85 ^b	23793.07 ^{ab}	26297.47 ^a	21749.13 ^{ab}	21794.63
Mean	19666.4	28125.19	24518.62	2588.25	
SEM±	V=2607.77 ^{ns}	CD=3770.44 ^{ns}	V _x CD=4477.06 [*]		
10WAP					
Samaru local red	34459.23 ^{abc}	40258.44 ^{ab}	37524.82 ^{abc}	40831.67 ^a	38266.54
MLSH-151	23539.71 ^d	29454.67 ^{cd}	39234.7 ^{abc}	30003.16 ^{bcd}	05583.06
Mean	28999.47	34856.55	38379.76	35417.42	
SEM±	V=2578.92 ^{ns}	CD=4173.15 ^{ns}	V _x CD=4398.13 [*]		
12WAP					
Samaru local red	30357.21 ^{bc}	40549.78 ^{abc}	47216.46 ^{ab}	43310.22 ^{abc}	40358.42
MLSH-151	28905.87 ^c	35029.39 ^{abc}	50436.76 ^a	28962.00 ^c	35833.5
Mean	29631.54 ^b	32693.3 ^b	48826.61 ^a	36136.11 ^b	
SEM±	V=4615.08 [*]	Cd=564.37 [*]	V _x Cd=7435.83 [*]		

1. Means with same letter(s) in column are not significantly different; 2. Means with same letter (s) in rows are significantly different; 3. Mean with same letter(s) in column and rows are not significantly different using DMRT at 5% level of probability; V = variety, CD = Cow dung; ns = not significant; *, significant

Number of Tillers per Plant

Tillering started at 6 WAP among varieties of sorghum (Table 5). Although the number of tillers was higher in Samaru-Local Red than MLSH 151 but there was no significant difference throughout the weeks after planting (Table 4). Number of tillers increased from 6 WAP until 12 WAP for both varieties. At 12 WAP, the number of tillers varied from 0.83 - 2.00 in Samaru-Local Red and 0.38 - 1.38 in ML.SH 151. Crops treated at 15t/ha had the highest number of tillers/plant while untreated had the least.

Table 5: Effect of cow dung on the number of tillers/plant (cm²) of two varieties of sorghum

Crop variety	Cow dung (t/ha)				Mean
	0	5	10	15	
6WAP					
Samaru local red	0.83 ^{abc}	1.58 ^a	0.52 ^{bc}	1.33 ^{ab}	1.07
MLSH-151	0.42 ^{bc}	0.25 ^c	0.63 ^{abc}	0.85 ^{abc}	0.54
Mean	0.63	0.92	0.57	1.09	
SEM±	V=0.24 ^{ns}	CD=0.37 ^{ns}	V _x CD=0.44*		
8WAP					
Samaru local red	1.0 ^{ab}	1.5 ^a	0.75 ^{ab}	1.58 ^a	1.21
MLSH-151	0.42 ^b	0.75 ^{ab}	0.96 ^{ab}	1.13 ^{ab}	0.81
Mean	0.71	1.13	0.86	1.36	
SEM±	V=0.23 ^{ns}	CD=0.32 ^{ns}	V _x CD=0.43*		
10WAP					
Samaru local red	1.25 ^{ab}	1.71 ^a	0.83 ^{bc}	1.75 ^a	1.39
MLSH-151	0.38 ^c	1.04 ^{abc}	1.07 ^{abc}	1.38 ^{ab}	0.97
Mean	0.81 ^b	1.38 ^{ab}	0.95 ^{ab}	1.56 ^a	
SEM±	V=0.23 ^{ns}	CD=0.30*	V _x CD=0.37*		
12WAP					
Samaru local red	1.25 ^{bc}	1.88 ^{ab}	0.83 ^{cd}	2.00 ^a	1.49
MLSH-151	0.38 ^d	1.38 ^{abc}	1.17 ^c	1.38 ^{abc}	1.07
Mean	0.81 ^b	1.63 ^a	1.00 ^b	1.69 ^a	
SEM±	V=0.23 ^{ns}	CD=0.27*	V _x CD=0.28*		

1. Means with same letter(s) in column are not significantly different; 2. Means with same letter (s) in rows are significantly different; 3. Mean with same letter(s) in column and rows are not significantly different using DMRT at 5% level of probability; V = variety, CD = Cow dung; ns = not significant; *, significant

Stem Girth

The variety planted had no significant effect on the Stem girth of sorghum with time. Except at 2 and 6WAP, the main effects of cow dung had significant effect on the stem girth of sorghum (Table 6). The stem girth increased from 2 down to 12 WAP or both varieties. The interaction between variety and cow dung had significant effect on the stem girth of sorghum with time sampling except at 2WAP. At 12 WAP, the stem girth ranged from 2.39-3.28 cm in Samaru-Local Red and 1.72- 3.66 cm in MLSH 151. Although Samaru-Local Red produced bigger stems than MLSH 151 but was significantly different. Both varieties had similar girth size approximately 3 cm. Crops treated at 10vha had the biggest girth and was significantly different from other rates and the control.

Table 6: Effect of cow dung on the stem girth (cm) of two varieties of sorghum

Crop variety	Cow dung (t/ha)				
	0	5	10	15	Mean
2WAP					
Samaru local red	0.48 ^{ab}	0.6a	0.4 ^{abc}	0.48 ^{ab}	0.489
MLSH-151	0.26 ^c	0.3 ^{bc}	0.32 ^{bc}	0.29 ^{bc}	0.291
Mean	0.37	0.45	0.36	0.39	
SEM±	V=0.05 ^{ns}	CD=0.09 ^{ns}	VxCD=0.09 ^{ns}		
4WAP					
Samaru local red	1.02 ^c	1.20 ^{bc}	1.29 ^b	1.74 ^a	1.31
MLSH-151	1.04 ^c	1.03 ^c	1.65 ^a	1.40 ^b	1.28
Mean	1.03 ^b	1.12 ^b	1.47 ^a	1.57	
SEM±	V=0.12 ^{ns}	CD=0.10*	VxCD=0.09*		
6WAP					
Samaru local red	2.01 ^a	2.19 ^a	2.03 ^a	1.94 ^a	2.04
MLSH-151	1.52 ^b	1.8 ^{ab}	2.12 ^a	2.16 ^a	1.90
Mean	1.763	2.00	2.08	2.05	
SEM±	V=0.12 ^{ns}	CD=0.16 ^{ns}	VxCD=0.18*		
8WAP					
Samaru local red	2.13 ^{bc}	2.22 ^{bc}	2.28 ^b	2.04 ^c	2.17
MLSH-151	1.41 ^d	2.20 ^{bc}	2.53 ^a	2.22 ^{bc}	2.09
Mean	1.77 ^b	2.21 ^a	2.41 ^a	2.13 ^a	
SEM±	V=0.14 ^{ns}	CD=0.14*	VxCD=0.09*		
10WAP					
Samaru local red	1.69 ^c	2.41 ^b	2.92 ^a	2.64 ^{ab}	2.415
MLSH-151	2.3 ^b	2.31 ^b	2.5 ^b	2.41 ^b	2.378
Mean	1.99 ^b	2.36 ^a	2.71 ^a	2.52 ^a	
SEM±	V=0.16 ^{ns}	CD=0.16*	VxCD=0.16*		
12WAP					
Samaru local red	2.39 ^c	2.94 ^{bc}	3.28 ^{ab}	2.5 ^c	2.78
MLSH-151	1.72 ^d	2.69 ^{bc}	3.66 ^a	2.73 ^{bc}	2.70
Mean	2.05 ^c	2.82 ^b	3.47 ^a	2.61 ^b	
SEM±	V=0.27 ^{ns}	CD=0.23*	VxCD=0.29*		

Means with same letter(s) in column are not significantly different; 2. Means with same letter (s) in rows are significantly different; 3. Mean with same letter(s) in column and rows are not significantly different using DMRT at 5% level of probability; V = variety, CD = Cow dung; ns = not significant; *, significant

Forage Weight

The application of cow dung and their interaction with variety had significant effect on the forage yield of sorghum (Table 7). Variety sown had significant effect on the sorghum crops. The forage yield varied from 20.24 - 63.97 t/ha in Samaru Local Red and 1499- 841 aha in MLSH 151. Samaru Local Red had significantly higher (44 12 t/ha) forage yield than MI SH 151 (3754 t/ha). Crops fertilized at 10 ha gave the highest forage yield while the control had least.

Dry Matter Yield

The results of dry mater yield of the two varieties of sorghum showed significant difference in relation to cow dung and variety x cow dung interaction (Table 7). However, varieties did not affect the dry muter of sorghum significantly. The value ranged 7.92-14.46 t/ha md 9.2-10.77 t/ha in Samaru-Local red and MLSH 151 respectively. Samaru Local red had higher dry matter yield than MLSH 151. Samaru-Local red had 11.40 t/ha dry matter yield while MLSH 151 had 9.85 t/ha. Crops fertilized at 10t/ha had the highest dry matter yield and was significantly different from the untreated

Dry Matter %

Dry matter % decreased significantly with cow dung application from 15t/ha (Table7. The dry matter % varied from 17.09-38.9 % and 2283-61 36 % in Semars-Local red and MLSIH 151, respectively. On the whole, MLSH 151 had higher dry mater % (33.) than Samaru-Local red (28.77 %).

The highest and least dry matter % was obtained from untreated crops and those treated at 10t/ha, respectively.

Table 7: Effect of cow dung on the forage and dry matter yield% of two varieties of sorghum

Crop variety	Cow dung (t/ha)				Mean
	0	5	10	15	
Forage dung (t/ha)					
Samaru local red	20.24 ^{bc}	44.64 ^{ab}	63.97 ^a	47.63 ^a	44.12 ^a
MLSH-151	14.99 ^c	40.62 ^{abc}	48.41 ^a	46.12 ^{ab}	37.54 ^b
Mean	17.62 ^b	42.63 ^a	56.19 ^a	46.88 ^a	
SEM±	V=8.12*	CD=7.79*	VxCD=11.64*		
Dry matter yield (t/ha)					
Samaru local red	7.92 ^b	13.2 ^{ab}	14.46 ^a	10.02 ^{ab}	11.4 ^{ns}
MLSH-151	9.2 ^{ab}	9.33 ^{ab}	10.77 ^{ab}	10.09 ^{ab}	9.85
Mean	8.56 ^b	11.26 ^a	12.62 ^a	10.06 ^{ab}	
SEM±	V=11.40 ^{ns}	CD=2.80*	VxCD=2.48*		
Dry matter (t/ha)					
Samaru local red	38.9 ^b	29.56 ^{bc}	17.09 ^c	29.53 ^{bc}	28.77 ^{ns}
MLSH-151	61.36 ^a	23.61 ^c	22.83 ^c	25.4 ^{bc}	33.3
Mean	50.13 ^a	26.59 ^b	19.96 ^b	27.47 ^b	
SEM±	V=6.20 ^{ns}	CD=5.47*	VxCD=5.91*		

Means with same letter(s) in column are not significantly different; 2. Means with same letter (s) in rows are significantly different; 3. Mean with same letter(s) in column and rows are not significantly different using DMRT at 5% level of probability; V = variety, CD = Cow dung; ns = not significant; *, significant

DISCUSSION

Cow dung contributed immensely to the vegetative growth of the two varieties of sorghum. Crops sown at higher rates had significant influence during the initial growth most importantly for plant height. Number of leaves and leaf area/plant and stem girth due to crop nutrients applied. Generally, crops treated at 10t/ha significantly had the highest vegetative characters measured. This is in line with the reports of Omoregie *et al.* (2021) that higher rates of cow dung will supply higher nutrients which may result to vigorous growth. This significant increase in height, number of leaves/plant leaf area/plant and stem girth by 10t/ha treated crops may be as a result of available nutrients and its utilization. These results are in line with those of Ighalo and Remison (2010) who reported higher vegetative characters in sorghum due to cow dung application. Although Samaru-Local red treated at 10 t/ha with the biggest stems, showed higher resistance to lodging conditions than MLSH 151 at other rates and control which were observed to be more susceptible to lodging. Nwajei *et al.* (2019): Omoregie *et al.* (2021) reported that crops with bigger stems show high resistance to lodging effects in cereals. This was also observed in this study. The significant differences expressed in crops treated at 10 and 15t/ha rates were due to nutrient released for tissue growth and development of component parts. This was also observation by the work of Remison. (2013),

Forage and dry matter yields were influenced significantly by cow dung as well as is interaction with varieties. Both varieties of sorghum were comparable statistically. Samaru-Local Red treated at 10 t/ha significantly gave the highest forage and dry matter yields, respectively, compared to the other variety and cow dung. Generally, Treatment at 10t/ha cow dung rate significantly gave higher forage and dry matter yields than lowest rate and control. This may be attributed to the available nutrients which gave better vegetative growth. These higher rates of cow dung had favourable conditions which facilitated nutrient release for more and better photosynthetic tissue and dry matter accumulation. This result agrees with the earlier finding by Ighalo and Remison (2010) that low rates of the applied organic manure yielded least sorghum forages.



CONCLUSIONS AND RECOMMENDATION

This study was carried out to determine the effect of cow dung on the growth. Forage yield and mineral composition of two varieties of sorghum in a forest savanna transition zone of Edo State. The results obtained from the study are concluded as follows:

1. The soil of the experimental site analyzed prior to planting showed it to be loamy sand in texture, slightly acidic with moderate organic carbon and deficient in total N, available P and some macro-nutrients.
2. The vegetative traits measured were significantly influenced by the applied cow dung: except for number of leaves/plant.
3. Samaru-Local Red fertilized at 15t/ha had the highest plant height and number of tillers/plant while unfertilized Samaru- Local Red and MLSIH 151 had the least.
4. The highest and least total leaf area/plant and stem girth were recorded in MLSH 151 that received 10 and 0t/ha.
5. Samaru-Local Red variety of sorghum had higher vegetative characters measured than in MLSH 151.
6. The application of cow dung had significant positive effect on the forage and dry matter yields of sorghum.
7. Forage and dry matter yield of sorghum significantly increased with increasing rates of cow dung up to 10t/ha and declined thereafter at the highest rate.
8. Samaru-Local Red fertilized at 10t/ha cow dung and unfertilized MLSH 151 recorded the highest (63.97t/ha and 14.46t/ha) and least (14.99t/ha and 7.92t/ha) forage and dry matter yield respectively.

Based on the results obtained, the following recommendations could be made:

1. Samaru-Local Red treated at 10t/ha was better for forage production in the trial Zone.
2. The two varieties can be sown for dry matter production to feed livestock animals in the area of study.

REFERENCES

- Agrama, H.A. and Tuinstra, M.R. (2003). Phylogenetic diversity and relationships among sorghum accessions using SSRs and RAPDs. *African Journal of Biotechnology*, **2**: 334-340.
- Ali, E. A. (2006). Grain yield and nitrogen use efficiency of pearl millet as affected by plant density, nitrogen rate, and splitting in sandy soil. *American-Eurasian Journal of Agricultural and Environmental Science*, **7**: 327-335.
- Amodu, A. E., Akinrinde, A. I., & Ogunyemi, S. O. (2005). Status of pastureland in Nigeria: Distribution, condition, and management. *Tropical Grasslands*, **39**(4), 192-196.
- Anderson, J. M., & Ingram, J. S. (1993). *Tropical soil biology and fertility: A handbook of soil methods*. Information and Press Eynsham. pp. 23-45.
- Aribido, S. O., & Bolorunduro, B. I. (2004). Implications of ecological changes on sustainable livestock production in the Lake Chad Basin of Nigeria. *Tropical Journal of Animal Science*, **7**(1): 45-52.
- Arshad, M., Wajid, A., Maqsood, M., Hussain, K., Aslam, M., & Ibrahim, M. (2007). Response of growth, yield, and quality of different cotton cultivars to sowing date. *Pakistan Journal of Agricultural Science*, **44**: 208-212.
- Ayoola, O. T., & Adeniyi, O. N. (2006). Influence of poultry manure and NPK fertilizer on yield components of crops under different cropping systems in south-west Nigeria. *African Journal of Biotechnology*, **5**: 1386-1392.
- Clatworthy, J. N. (1998). *Planted pastures for beef production manual*. Cattle Producer Association. Harare, Zimbabwe. pp. 67-78.
- Fales, S. L., Hess, J. R., & Wilhelm, W. W. (2007). Convergence of agriculture and energy: II. Producing cellulosic biomass for biofuel. Commentary QTA 2007-2. *Council for Agricultural Science and Technology*, Ames, IA, USA.
- Ighalo, S. O., & Remison, S. U. (2010). Effect of weeding frequency and nitrogen application on the vegetative growth of rice. *Nigerian Journal of Agriculture and Forestry*, **2**: 219-232.



- Kinoshita, Y., Kiminami, L., & Koh, B. (2008). Comparative analysis of rice consumption and buying behavior among Japan, China, and South Korea: Possibilities on opening up new markets for Japanese rice. In H. Yagi (Ed.), *Economic interdependence and agriculture in North-East Asia: Competition and cooperation under the formation of regional economic zones* (pp. 194-205). Tokyo: University of Tokyo Press.
- Maughan, M., Voigt, T., Parrish, A., Bollero, G., Rooney, W., & Lec, D. K. (2012). Forage and energy sorghum responses to nitrogen fertilization in central and southern Illinois. *Agronomy Journal*, **104**: 1032-1040.
- May, A., De Souza, V. F., Gravina, G. D., & Fernandes, P. G. (2014). Plant population and row spacing on biomass sorghum yield performance. *Ciência Rural*, 67-89, pp.
- Nwajei, S. E., Omoregie, A. U., & Ogedegbe, F. O. (2019). Effects of planting dates on the growth and yield of two indigenous varieties of pearl millet (*Pennisetum glaucum* (L.) R. Br.) in a forest-savanna transition zone of Edo State, Nigeria. *Acta Agriculturae Slovenica*, **114**: 169-181.
- Okalebo, J. R., Gathua, K. W., & Woomer, P. (2002). *Laboratory methods of soil and plant analysis: Working manual* (2nd ed.). Sacred Africa, Nairobi, Kenya. pp. 22-77.
- Omorie, A. U., Nwajei, S. E., & Ehigior, O. S. (2021). Effects of stage of growth on the forage yield, quality, and nutrient uptake of three varieties of sorghum (*Sorghum bicolor* L. Moench) in a humid zone of Edo State, Nigeria. *Journal of Current Opinion in Crop Science*, **2**: 118-125.
- Omorie, A. U., Nwajei, S. E., & Oviarobo, C. A. (2021a). Evaluation of the growth and grain yield of sorghum cultivars (*Sorghum bicolor* L. Moench) in Ekpoma, Nigeria. *Journal of Current Opinion in Crop Science*, **2**(2): 208-215.
- Omorie, A. U., Nwajei, S. E., & Oviarobo, C. A. (2021b). Comparative investigation of the forage, mineral composition, and nutrient uptake of five varieties of sorghum (*Sorghum bicolor* L. Moench) at Ekpoma, Edo State, Nigeria.
- Omorie, A. U., & Nwajei, S. E. (2015). Evaluation of some varieties of millet (*Pennisetum typhoides*) in a forest-savanna transition zone of Edo State, Nigeria. In S. L. Omeje, C. C. Emosairue, C. C. Chukwujú, L. Bratte, J. O. Isikwenu, R. A. Iaiorhovoja, & M. O. Agbogidi (Eds.), *Agriculture: The Nigerian economy beyond oil* (Proceedings of the 49th Annual Conference of the Agricultural Society of Nigeria, pp. 1346-1349). Delta State University, Asaba Campus, Nigeria.
- Palmer, T., & Ainslie, A. (2002). *Country pasture/forage resource profiles: Grassland and pasture crops*.
- Remison, S. U. (2013). *Basic principles of crop physiology*. Sadoh (Nig. Ltd). 179 pp.
- Remison, S. U. (2005). *Arable and vegetable crops of the tropics*. Gift Print Associates. Benin City. pp. 247.
- SAS Institute Inc. (2008). *Statistical Analysis System user's guide: Statistics version 8.0*. Cary, NC, USA.
- Snapp, S. S., Swinton, S. M., Labarta, R., Mutch, D., Black, J. R., Leep, R., Nyiraneza, J., & O'Neil, K. (2005). Evaluating cover crops for benefits, costs, and performance within cropping system niches. *Agronomy Journal*, **97**: 322-332.
- Wrather, J. A., Phipps, B. J., Stevens, W. E., Phillips, A. S., & Vories, E. D. (2008). Cotton planting date and plant population effect on yield and fiber quality in the Mississippi Delta. *Journal of Cotton Science*, **12**: 1-7.