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INFLUENCE OF DIFFERENT FERTILIZERS ON MINERAL ELEMENTS (MG/KG) CONTENT OF *ANDROPOGON GAYANUS* AND *PENNISETUN PEDICELLATUM* AT JANZOMO FARM DURING TWO RAINY SEASONS

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ABSTRACT

The research on the influence of different fertilizers on the mineral elements content of *Andropogon gayanus* Kunth. and*Pennisetum pedicellatum*Trin. was carried out at Janzomo farm, Shagari Local Government Area, Sokoto State during two rainy seasons. Sokoto is located on latitude 12.00^0 and 13.60^0N and Longitude 4.08^0 and 6.50^0E. It involved sole sowing of *A. gayanus*, *P. pedicellatum* and combination of the two grasses, treated with NPK, FYM, combination of the two fertilizers and control in plots of 2.5m x 2.5m under rain fed conditions. Results showed that during the first rainy season NPK treated plants had significantly ($p<0.05$) higher Calcium, Phosphorus, Potassium and Magnesium content. It further revealed that FYM treated plots had significantly ($p<0.05$) higher Sodium, Iron and Copper. Furthermore, during the second rainy season, NPK treated plants had significantly ($p<0.05$) higher Calcium, Phosphorus and Potassium. On the other hand, FYM treated plants had significantly ($p<0.05$) higher magnesium, Iron and Copper. The higher mineral elements content of NPK treated plots may probably be due to increasing level of nitrogen in the soil as the availability of a particular element in the soil may influence its absorption by plants. The low soil nutrients content of unfertilized plots may have affected their absorption from the soil by the plants. The two grasses were comparably lower in certain mineral elements.

INTRODUCTION

The essential mineral elements required by plants for normal growth and development are classified into macro elements that are required in large amounts such as calcium (Ca); phosphorous (P), potassium (K), Sodium (Na) and magnesium (Mg). Then the micro elements that are required in small quantities and include iron (Fe), copper (Cu), Zinc (Zn) and lead (Pb). The mineral elements are believed to have one or more catalystic function in the cells. Calcium and phosphorous are structural components of cell walls and membranes and play an important role in energy transformations and stability of cell membranes. Potassium plays an important role in regulating permeability of cell membranes and aids plants resistance against fungal and bacterial diseases. Sodium helps in assimilation of cellular fluids. Magnesium is a constituent of chlorophyll, chromosomes and helps in carbohydrates metabolism(Hotchkiss and Potter, 1996; Alan Wild, 1996).

Iron is essential for chlorophyll formation and activates a number of important enzymes in plants. Copper is necessary for the formation of growth promoting substances; chlorophyll and enzymes system. Zinc is also related to growth promoting substance auxin, essential for chlorophyll production and stem elongation. Lead concentration in the soil and uptake by plants are very low. It forms lead carbonates (PbCO3) and used by plant (Tom. 1992, Payne, 1994, Biswas and Mukharjee, 1995; Hotchkiss and

Potter, 1996; Alan Wild, 1996). These mineral elements must be readily available to plants in sufficient quantities for normal growth and development. More so, as deficiency of these elements leads to retarded growth, poor root development, delayed maturity, weakening, chlorosis, die back, poor seed production and low yield among others (Chesworth, 1992, Alan Wild, 1996; Hotchkiss and Potter, 1996).

The importance of livestock in the Nigerian economy cannot be over emphasised. Livestock production constitutes about 5% of the nation's Gross Domestic Product, making about 27.4% of the share of the agricultural sector. Meat and other edible animal products like milk, cheese, fat, blood and also provide the much needed protein for the nation's population. The population of goats, sheep and cattle in Nigeria was estimated at 34.5 million, 22.1 million and 13.9 million respectively. Over 90% of these animals are kept under village and pastoral system as reported by Federal Department of Livestock Production Services (FDLPS, 1992). In 2005, the population of goats, sheep and cattle was put at 28 million, 23 million and 15.2 million respectively as stated by Food and Agricultural Organization (FAO, 2006). This is in addition to other livestock in the country. Government in the past had made attempts to improve on their production. The establishment of grazing reserves/rangelands is one of such efforts (Maigandi*et al*., 1994; Shiawoya and Adeyemi, 2003).

Livestock keeping often represents a way of life as well as providing beef, milk and other amenities. It is only when modern Agriculture and industrialization emerged that increased demands for meat, milk and milk products, wool and other animal products aroused. These forced changes in livestock keeping and prompts consideration of intensified animal and pasture/rangeland management (Chheda and Crowder, 1982).

Gefu (1998) reported that some of the factors that contributed to the problem of inadequate feeding for livestock in the Savanna zones of Nigeria include the increasing demand of land for uses other than those related to livestock production. This had considerably reduced the number of grazing reserves/rangelands in the country; including the traditional grazing lands, fallows and marginal lands, through their conversion into non-pastoral uses.

The problem of inadequate feed availability for the ruminants (and other livestock) is more severe in the semi-arid environment where the animals are able to make appreciable weight gains during the short wet season only. There is usually the abundance of good quality pasture in the grazing reserves/rangelands during this period which provides adequate nutrition (Nuru, 1982). On the other hand, in the long dry season the pasture becomes reduced both in quantity and quality and the animals are unable to meet their nutritional requirements for maintenance which lead to serious weight loss. Thus, the animals' overall annual productivity is low (Steinbach, 1997). More so as feeds and feeding occupy central position among the factors that militate against the improved and sustainable livestock production in Nigeria. Therefore, forage production is vital for actualising sustainable livestock production, particularly in Sokoto, a semi-arid zone of Nigeria. Hence, the urgent need to increase the feed availability (in terms of quality and quantity) for the livestock so as to improve the productivity of livestock production in the state (Maigandi and Owanikin, 2002).

*A. gayanus*belongs to the poaceae family and tribe Andropogoneae. It is commonly called Gamba grass, Blue stem and Rhodesian Andropogon (Bodgan, 1977; Purseglove, 1979 and Pagot, 1993). It is indigenous and widely distributed throughout the savanna zone in Nigeria and the rest of tropical Africa. It is a perennial grass that is tall, erect and tufted/tussock with stems 2-4 metres high. It has vigorous tillers and abundant foliage especially during the rainy season. It is propagated vegetatively by splitting the tufts and by seeds can also be drilled in rows or broadcasted.. The field emergence of seeds usually occurs after 5-10 days of sowing (Chheda and Crowder, 1982 and Pagot, 1993).Gamba grass is relatively free from major pests and diseases and is resistant to burning and grazing. These features make it useful grass for supporting large numbers of cattle in Northern Nigeria. It is also one of the highly yielding grasses in West Africa.

*P. pedicellatum*belongs to the tribe Paniceae. It is annual and commonly known as Kyasuwa grass, Annual kyasuwa grass and Hairy fountain grass. It is also indigenous and occurs naturally in tropical and subtropical Africa but practically absent in tropical East Africa (Bogdan, 1977).The stem height ranges from 40-150 cm or more in some cases and may have up to 10 nodes. The stem is smooth, cylindrical, jointed and encircled by the leaf sheath. The leaves are borne on sheaths which arise at the nodes. They are flat and up to 40 cm long and 4-16 mm wide

It grows in relatively dry or moderately humid areas. It requires a rainy season of 4-6 months with an average annual rain fall of 500-1000 mm and well moistured soil during the period of active growth. It grows on poor soils but gives much higher yields on fertile, well-drained loams. It is propagated by seeds that are either drilledor broadcasted and reseeds itself (Bogdan, 1977).

P. pedicellatum, though annual, regenerates easily after cutting. It has been under trial and also under large scale cultivation for a number of years, at first in Nigeria then in other West African countries and eventually in India where it became a popular grass. The initial growth is fast and grass can be utilized some 3.5 months after sowing. The main uses of the grass are fodder, hay, grazing and it can also serve as silage. It is a high yielding and productive species (Magaji*et al*., 1998).

MATERIALS AND METHODS

The study was conducted at Janzomo Farm in Shagari Local Government Area of Sokoto state. The farm is located along Sokoto-Jega road, about 55 km south-west of Sokoto town, Sokoto state Nigeria. Sokoto is located on latitude 12.00^0 and 13.60^0N and Longitude 4.08^0 and 6.50^0E. It also lies at an altitude of 350m above the sea level (Kowal and Knabe, 2002). The study area is shown in figure 1 below. Sokoto state falls within the Sudan Savanna and is found in the Northwest geopolitical zone of Nigeria. It is characterized by distinct wet and dry seasons that may vary in their duration and intensity from year to year. The wet season lasts from May/June to September/October with an average annual rainfall of 500-700mm. Plant growth essentially takes place during this period. The remaining part of the year consists of long dry season that can be distinguished by cool hamattan winds from November to February followed by hot and dry period from March to May. The mean monthly temperature ranges between 15^0C in December and 40^0C in April. The mean annual temperature averaged 27^0C (Mamman*et al.*, 2000). It follows that the coolest months are November to January while the hottest months are March to May. The vegetation of the area, being Sudan Savanna type is composed of scattered trees, many shrubby plants with dominant grasses and herbs.

Certified seeds of two grass species were sourced from the National Animal Production Research Institute (NAPRI), Shika Zaria, Nigeria.

There were twenty four (24) study sub plots which consisted of treatments of *A. gayanus*Kunth, *P. pedicellatum*Trin and the mixture of the two species. Each was drilled, broadcasted and replicated three times. The experiments were laid out in a Randomised Complete Block Design RCBD) as outlined by Gumez and Gumez(1984).The randomization method used was that of Random numbers from the Random Number Table.The experiment consisted of three blocks of 24 plots measuring 2.5m x 2.5m each and an alley of 50cm. Therefore, the gross size of experimental block was 18.5m x 12.5m ($231.25m^2$).The block was replicated three times, bringing the total number of plots to 72 with gross size of $693.75m^2$. The layout of the experimental site is shown in figure 2.

The study plots were subjected to application of both farm yard manure (FYM) sourced at Janzomo farm, Shagari and inorganic compound fertilizer (NPK 15:15:15) and Urea from Sokoto Agricultural and Rural Development Authority. Farm yard manure was applied to the selected drilled and broadcasted study plots at the rate of 15,000 kg/ha. ($1.5kg/m^2 = 9.38kg/6.25m^2$) Similarly, inorganic compound fertilizer, Nitrogen, phosphorus and potassium (NPK) was applied to other selected plots (drilled and broadcasted) at the ratio of 125:30:30 kg/ha (Urea $20.65g/m^2 = 129g/6.25m^2$ and NPK $20g/m^2 = 125g /6.25m^2$) respectively.

Furthermore, half rate of both FYM and NPK were also determined by dividing the total rate into 2. Therefore, FYM was 7500kg/ha ($750g/m^2 = 4.69kg/6.25m^2$) and NPK at the ratio of 62.5-15-15kg/ha (Urea 10.33g/m2 = $64.56kg/6.25m^2$ and NPK $10g/m^2 = 62.5g/6.25m^2$) and applied to selected plots. The fertiliser (NPK) was applied before sowing at the ratio of 30:30:30 and the remaining were applied after four weeks. There was control in which no any form of fertiliser (organic and inorganic) was applied (Muhammad and Abubakar, 2004)

Seeds of the two grass species were sown by drilling and broadcasting in the respective study plots. The seeds were drilled in rows (50cm apart) at the depth of 3 – 5 cm and covered with soil. The seeds were also broadcasted evenly and thinly covered with soil. The seed rate was as recommended by Pagot (1993) and Kallah (1999). The selected areas of 15cm/15cm^{2}quadrat, were harvested at 5cm above ground level. The biomass content were determined by drying the fresh materials in an oven (Plus II Gallen Kamp Oven) to a constant weight to determi(using the above named balance at 60^{0}C (Krishna and Ranjhan, 1980; Payne, 1994).

Biomass samples were analysed in the laboratory for the determination of mineral elements content viz: Calcium (Ca); Phosphorus (P); Potassium (K), Sodium (Na) and Magnesium (Mg) by using the methods, materials, reagents and procedures as recommended by Krishna and Ranjhan (1980), Udo and Ogunwale (1986) and Payne (1994). Trace elements, namely Iron (Fe), Zinc (Zn), Copper (Cu) and Lead (Pb) were determined using Atomic Absorption Spectrophotometer (AAS) Model Sens AA GBC Scientific Equipment.

The results on mineral elements contents of the two grass species were subjected to analysis of variance (ANOVA) procedure by using Statistical Analysis System (SAS, 2002) Statview Statistical Package. Significant differences in the means were separated by using the Least Significant Difference (LSD) test.

Results and Discussion

The results shown in Table 1 indicated that during first season, sole NPK treated plants had significantly (P<0.05) higher amount of Ca, P, K and Mg than sole FYM, combination of the two fertilizer sources and control. On the other hand, plants applied with sole FYM had significantly (P<0.05) higher content of Na, Fe and Cu compared with other fertilizer sources and control. The results also showed that combined application of NPK and FYM produced plants with significantly (P<0.05) higher amount of P and K than sole FYM and control. The results of the second rainy season in Table 2 revealed that NPK treated plants had significantly (P<0.05) higher amount of Ca, P and K compared with FYM solely applied, combination of the two fertilizer sources and control. However, plots where FYM was solely applied had significantly (P<0.05) higher content of Na, Mg, Fe, and Cu compared with other fertilizer sources and control. Furthermore, combined application of NPK and FYM produced plants with significantly (P<0.05) higher amount of P and K than sole application of FYM and control.

The nutrients content of fertilized plants were significantly (P<0.05) higher than unfertilized plants. Umunna and Orji (1991) reported that low nutrients contents of forage are the most critical constraint to livestock production in Nigeria. Control plants had significantly (P<0.05) lower mineral elements content than other fertilizers possibly due to lower mineral elements content in the soil which could have been absorbed and converted into plant nutrients (REF). Higher amounts of Ca and Mg were observed in plots in which NPK was solely applied probably due to nitrogen level in the soil which increased Mg content. Adeoye (1988) reported increase in amount of Mg with increasing level of nitrogen in the soil. The mineral elements Ca, P, K, Mg and Na are required by plants in large amounts. Therefore, deficiency in the soil will lead to deficiency in plants. These grasses absorbed the mineral elements from the soil which were converted into plant products as reported by Alan (1996) and Hotchiss and Potter (1996). Thus, the availability of a particular element in the soil may influence its absorption by plants (Fitzpatrick, 1994). *A. gayanus* had significantly (P<0.05) higher Fe and Zn while *P. pedicellatum* had higher Ca, P, K, Na and Cu. Mineral elements are inorganic substances derived by plants from the soil through their roots. The mineral elements absorbed by plants are converted into plant products which are then converted into animal products when fed to the animals (Payne, 1994 and Elizabeth and Roberts, 2000). Control had the least mineral elements content compared with other fertilizer types. The low soil nutrients content of unfertilized plots may have affected their absorption from the soil by plants. This led to the lower mineral elements composition of unfertilised (control) plants. The mineral elements content of control were found to be deficient compared with what was reported by Mc Donald *et al*. (1988) and Alan (1996).

However, the two grasses were generally deficient in mineral elements such as Ca, Mg, K, Cu, Fe and Zn (Alan, 1996 and Mc Donald *et al*. 1998). The deficiency of the mineral elements content of the grasses was attributed to their deficiency in the soil (Donahue *et al*., 1990 and Biswas and Mukherjee, 1995).

Table 1: The influence of different fertilizers on the mineral elements (mg/Kg) content of the shoot of *Andropogongayanus*and *Pennisetumpedicellatum* at JanzomoFarm during the first rainy season

		Mineral	elements (mg/Kg)		First	Season			
Fertilizer source	Ca	P	K	Na	Mg	Fe	Cu	Zn	Pb
NPK	0.635a	150.21a	992.40a	78.05b	5.17a	76.24b	7.37b	7.42	0.003
NPK/FYM	0.582	142.50b	924.35b	75.71	4.02b	74.32b	8.11	7.83	0.003
FYM	0.541	130.40c	711.24c	83.47a	4.25b	87.02a	9.02a	7.41	0.003
CTR	0.450b	112.12d	601.22d	72.57c	1.00c	64.29c	6.89b	7.67	0.002
LSD	0.150	4.20	68.16	4.67	0.734	9.23	1.30	1.97	0.002
Sign	Ns	*	*	*	*	*	*	ns	Ns

Means in a column followed by same letter (s) are not significantly different (P<0.05) at 5% level using LSD. * = Significant. ns = Not significant.

Table 2: The influence of different fertilizers on the mineral elements (mg/Kg) content of the shoot of *Andropogongayanus*and *Pennisetumpedicellatum* at JanzomoFarm during the second rainy season.

		Mineral	elements (mg/Kg)		Second	season			
Fertilizer source	Ca	P	K	Na	Mg	Fe	Cu	Zn	Pb
NPK	0.660a	152.00a	997.35a	75.13b	4.81b	74.40b b	7.16b	7.88	0.002
NPK/FYM	0.573	141.75b	926.54b	73.47b	4.27b	69.58b	7.24b	7.87	0.003
FYM	0.553	131.85c	717.34c	83.71a	5.65a	83.75a	9.11a	8.64	0.002
CTR	0.461b	110.14d	605.15d	72.57b	4.02b	63.86b	6.85b	7.50	0.003
LSD	0.159	4.34	66.45	4.45	0.810	9.30	0.40	1.73	0.002
Sign	Ns	*	*	*	*	*	*	ns	Ns

Means in a column followed by same letter (s) are not significantly different (P<0.05) at 5% level using

LSD. * = Significant. ns = Not significant.

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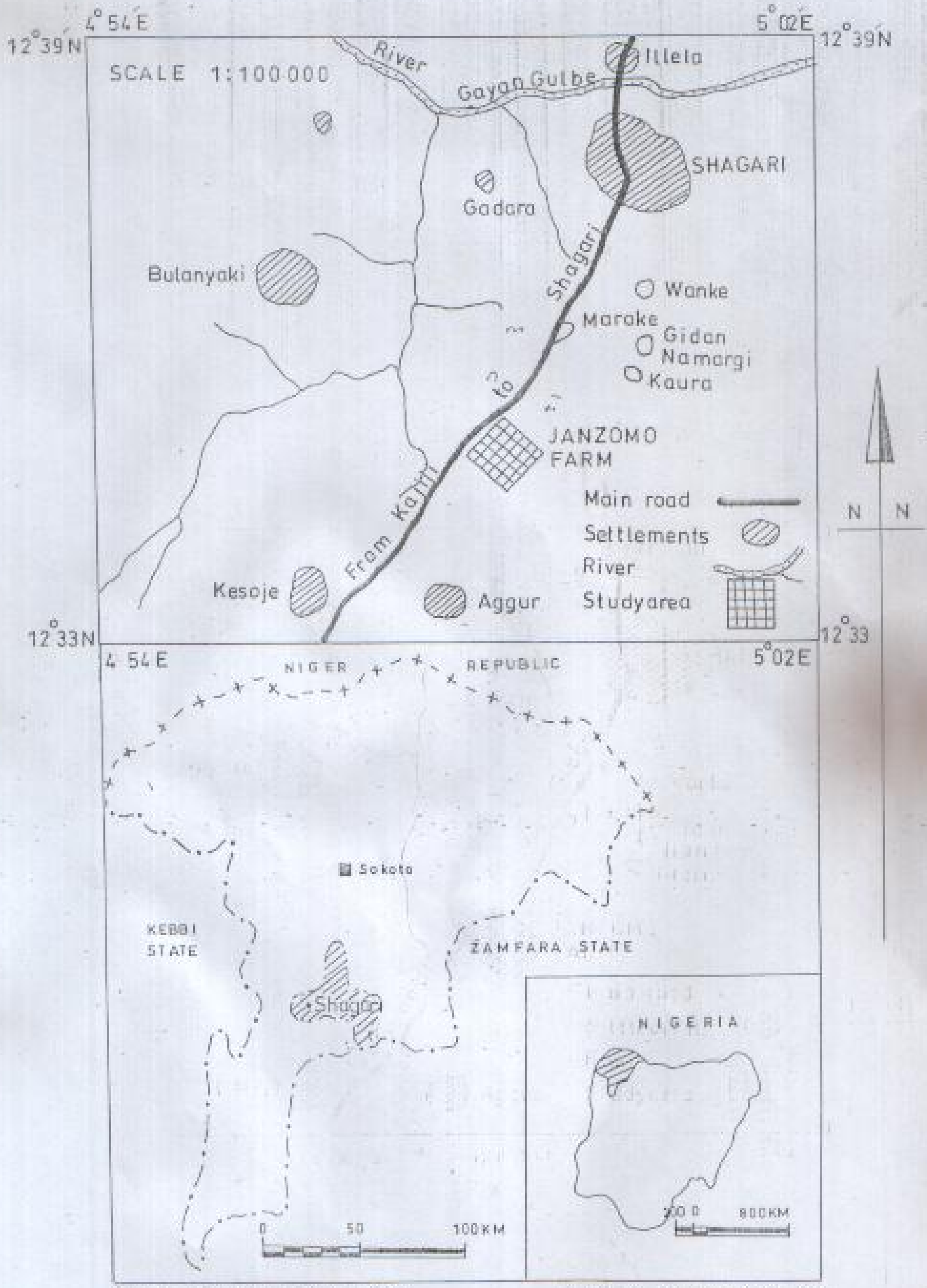

Source; Sokoto State Survey Division

Drawn– by Abubakar Salah 2010

Figure. 1 Map of Nigeria showing Sokoto State, Sokoto State showing Shagari Local Govt. and the study area. (Janzomo farm)

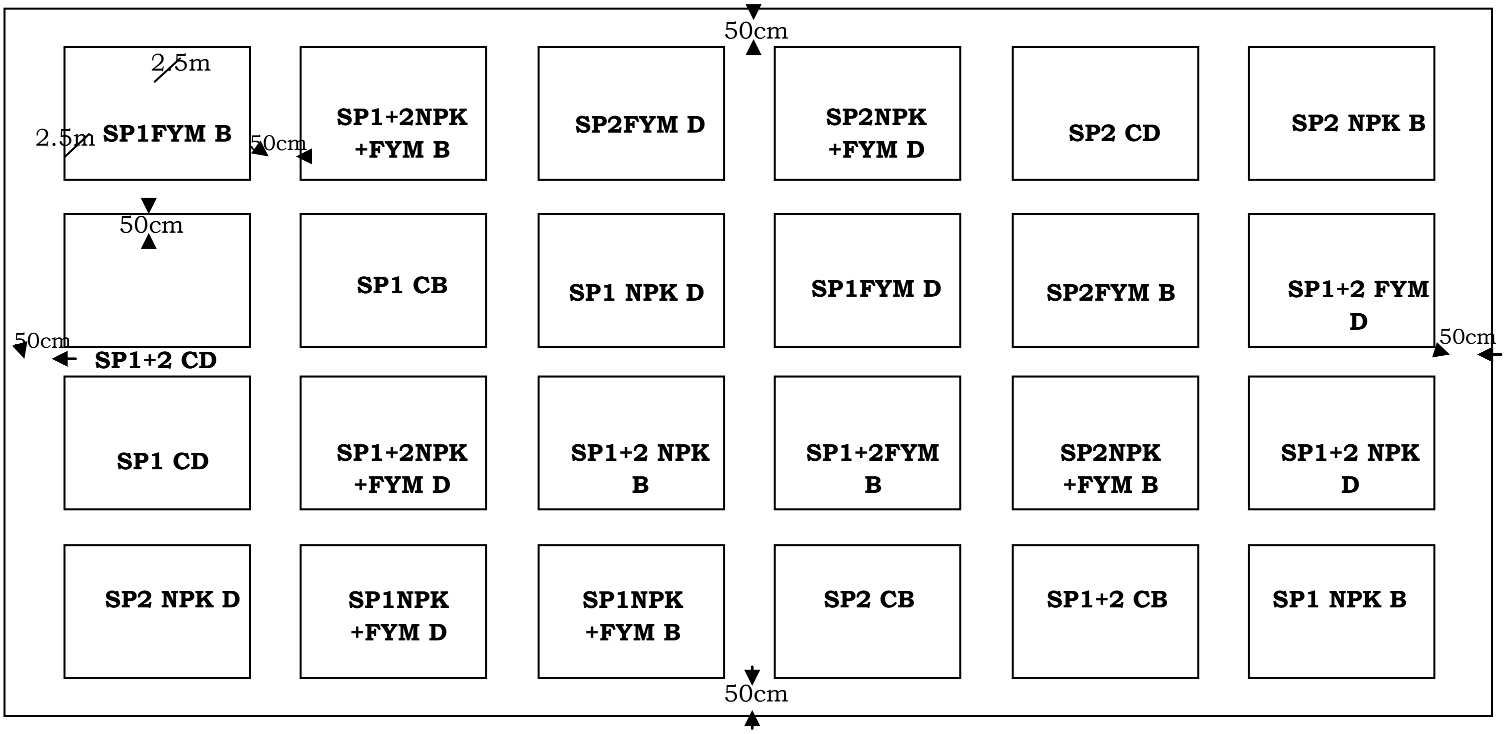

Figure 2: Layout of the experimental site.

Key:

SP1 – *Andropogongayanus* FYM-Farm yard manure

SP2 – *Pennisetumpedicellatum* C-Control (No any form of fertilizer)

NPK – Nitrogen Phosphorus and Potassium D-Drilled

(Compound fertilizer) B-Broadcasted