Available online at www.elixirpublishers.com (Elixir International Journal)

Bio Technology

Elixir Bio Technology 183A (2024) 57079-57085

ISSN: 2229-712X

# Evaluation of Space-Controlled, Fertilized and Air-Dried F1 *Pennisetum purpureum* as a Basal Diet for Lactating Ruminants during Dry Season

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**ARTICLE INFO**

**Article history:**

Received: 12 December 2023;

Received in revised form: 15 January 2024;

Accepted: 26 January 2024;

**Keywords**

*Pennisetum Purpureum*,
Spacing,
Fertilizer,
Minerals,
Dry Season.

**ABSTRACT**

Nutritional value of space-controlled, fertilized and air-dried F1 *Pennisetum purpureum* as basal diet for lactating ruminants in the dry season was investigated. Established paddock of three blocks and four plots, each measuring 4m × 4m, with different spacing of 75cm and 100cm in a 2 x 2 factorial arrangement; using Randomized Complete Block Design (RCBD) was cut back to 20cm above ground level, using a metric tape. Urea fertilizer and Poultry manure analyzed for nitrogen was applied at the rate of 200kgN/ha each; to individual plot in the Experimental Layout labelled T1, T2, T3 and T4, respectively. The treatments were significantly different ($p<0.05$) across the layouts. Proximate composition, micro and macro minerals and microbial load varied among treatments. Crude protein (%) ranged from 12.90 (T1) to 13.31(T4), Ether extract(%); 1.93(T4) - 4.54(T2) and Ash(%); 10.62 (T4) - 12.54(T1). The macro mineral content were not significantly different ($p>0.05$) between TI and T2, likewise T3 and T4, respectively. Micro nutrients recorded significant ($p<0.05$) values ranges of Zinc (Zn) 56.84 Mg/g (T2) to 58.31Mg/g(T3), Manganese (Mn); 31.06 Mg/g (T1) to 34.14 Mg/g (T3), Iron (Fe) value was high in T4 with a record value of 124.18 Mg/g. There was no significant difference ($P>0.05$) in the value of Copper (Cu) for T1, T2 and T3. Total Bacteria, Total Fungal, Total Viral and Total coliform Counts were significantly different ($p<0.05$) among treatments. Space-controlled, fertilized and air-dried F1 *pennisetum purpureum*; based on findings from this study is adjudged nutritious and as such recommended as a basal diet for lactating ruminants during dry season.



## Introduction

One of the factors contributing to low productivity and poor performance of ruminants especially during dry season is availability of quality and nutritious feed resources. To improve livestock production, sustainable solution to seasonal deficiencies in feed availability and quality are required through proper management and utilization of forage crops. Pasture crops being a means of ruminant feeding in the tropics, are of low crude protein and dry matter yield especially in the dry season (Aderinola *et al.*, 2011). Hence; The introduction of forage varieties with good nutritional characteristics. Forages can be conserved to feed livestock during periods of shortage. Forage conservation is an avenue for ensuring continuity in ruminant feed availability. It ensures sustainability of ruminant animal at the crucial period of dry season (Aina, 2012). Conserved forages can take the form of hay, haylage or baleage, and silage. Conservation of high-quality forages with minimum loss of nutrient by drying is termed as hay making. Fresh forage typically has about 75% - 85% moisture concentration, but hay making leads to reduction of moisture content to 10-15%, which inhibits the enzyme activity in the plant to be conserved (Collins ***et al.,*** 2013)

Elephant grass (*Pennisetum purpureum*) is a high yielding tropical grass with great potentials for making silage. It is a very versatile species that can be grown under a wide range of conditions and systems: dry or wet conditions, smallholder or larger scale agriculture. It is found in most parts of the humid tropics where it is usually rejected by ruminants while grazing but readily accepted when chopped and stall-fed. It is a valuable forage and very popular throughout the tropics, notably in cut-and-carry systems (Mannetje, 1992; FAO, 2015).

Manure is an important source of soil nutrient that is adopted by smallholder farmers due to limited affordability to purchase chemical fertilizers (Olanite *et al.*, 2010). More importantly, inefficient distribution systems, especially in sub-Saharan Africa, often make fertilizers unavailable to farmers, and this necessitate the application of manure to tropical soils with the aim of maintaining soil organic matter to improve soil fertility and productivity (Ewetola *et al.*, 2016). In smallholder pasture production systems, farmyard manure from cattle, swine, sheep and goat (Ewetola *et al.*, 2016) are potentially suitable for enhancing the yield and nutritive quality of tropical plants. In addition, organic manures have a far less reaching adverse effect on soil physicochemical properties compared with mineral fertilizers.

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Therefore, the application of organic manures to pasture crops enhances nutrient recycling, environmental protection, and sustainability of the farming system (Dele *et al.*, 2016).

Following the chronicles of *Pennisetum purpureum* as one of the most important tropical forages for grazing system improvement in the tropics, this study therefore was carried out to investigate and evaluate methods to improve its biomass yield and nutritional qualities as well as preservation method(s) to mitigate scarcity of quality feed to ruminants; especially lactating does in the dry season.

## Material and Method

### Experimental Site

This study was carried out at sheep and goat unit, Ladoke Akintola University of Technology (LAUTECH) Teaching and Research Farm Ogbomoso, it lies on 80101 North of the equator and longitude 40101 East of the Greenwich Meridian within the derived savannah region of Nigeria. The altitude is between 300m and 600m above sea level while the mean temperature and rainfall are 27°C and 1247mm respectively (Ayinla and Adetoye, 2015).

### Preparation of Experimental Site, Treatment and Design

An already established pasture paddock consisting of 3 blocks and 4 individual plots, each measuring 4m × 4m, with two different plants spacing of 75cm and 100cm in a 2 x 2 factorial arrangement; using Randomized Complete Block Design (RCBD) was cut back to height of 20cm above ground level, using a metric tape, weeding was done within and around each bed and plot, proper fencing was established with the use of barb wire fence. Urea fertilizer and Poultry manure analyzed for nitrogen was applied at the rate of 200kgN/ha each; to individual plot in the Experimental Layout labelled T1, T2, T3 and T4, respectively.

The biomass yield was assessed with the aid of a quadrant with dimension of 1m × 1m randomly thrown into the replicates on two blocks. The vegetation inside the quadrant was trimmed using a forage knife, leaving it at a height of 20cm above the ground level.

### Soil Analysis

Prior to the commencement of the experiment, soil sample was randomly collected using a soil auger at thee (3) different locations within each of our replicates. The sampling was done at depth of 0-15cm and subsequent analysis was performed on the collected samples (AES 1991).

### Experimental Layout

Treatment 1: F1 *Pennisetum purpureum* harvested from plots of 75cm plant spacing with Poultry manure.

Treatment 2: F1 *Pennisetum purpureum* harvested from plots of 75cm plant spacing with Urea

Treatment 3: F1 *Pennisetum purpureum* harvested from plots of 100cm plant spacing with Poultry manure.

Treatment 4: F1 *Pennisetum purpureum* harvested from plots of 100cm plant spacing with Urea fertilizer

### Data collection

Treatments samples were collected and taken to the laboratory for proper analysis.

### Chemical Analysis

Samples were analyzed for proximate composition using the official analytical methods of (AOAC, 2000). Selected Macro (Ca, P, K and Mg) and Micro (Zn, Mn, Fe and Cu) mineral contents were analyzed using Atomic absorption spectrophotometer as described by (AOAC, 2000).

### Microbial Load Determination

Microbial load was determined using DNA sequencing (Oliveira *et al.*, 2017) to understand the diversity and composition of microorganisms associated with the plant. Determination of total bacterial count (TBC), Coliform count (TCC), Fungal count (TFC) and Microbial count (TMC) was carried out as described by Kinley (2009). Samples were serially diluted using 0.1% sterile peptone water. Aliquos of each dilution was spread-plate onto plate count Agar for determination of total bacterial count (TBC), MacConkey agar plates for total coliform count (TCC) and Saboraud's Dextrose Agar containing 0.5mg of chloramphenicol for total fungal counts (TFC). Plate were incubated at $37^0$c for 24hrs for total bacterial and coliform count, at room temperature for 3-5 days for fungi. After, those fungal were purified then undergo microscopical staining and identification using Lactophenol Cotton Blue stain according to Quinn *et al*. (1994). Bacterial and fungal counts were reported as CFU/g.

### Statistical Analysis

The data obtained was subjected to Analysis of Variance (ANOVA). The significant treatment means was separated by Duncan Multiple Range Test (DMRT).

## Results and Discussion

Table 1 present the proximate composition of F1 *Pennisetum purpureum* harvested under different plant spacing and fertilizer type. The proximate composition in terms of Crude Protein (CP), Crude Fibre(CF) and Ash were significantly affected (P<0.05) except for Dry Matter and Ether extract which were not significantly affected (P>0.05). The highest Crude Protein(CP) content was recorded at T4(13.31%) and the lowest crude protein (CP) content was recorded at T1(12.9%) which was similar to T2(12.99%) and T3(13.14%). The highest Crude Fibre (CF) content was recorded at T1(31.42%) which is statistically similar to T3(31.03%) and the lowest crude fibre (CF) content was recorded at T2(28.83%). However, the highest Ash content was recorded at T1(12.54%) and the lowest Ash content was recorded at T4(10.62%), whereas T2(11.68%) and T3(11.79%) are statistically similar to T1(12.54%).

The macro minerals composition of F1 *Pennisetum purpureum* harvested under different plant spacing and fertilizer types is presented in Table 2. The analysis result showed that all the parameters taken were significantly affected (P<0.05). T3 and T4 were similarly high while T1 and T2 were statistically lower.

Table 3 Present the micro mineral composition of air dried F1 *Pennisetum purpureum* harvested under different plant spacing and fertilizer type at 12 weeks of age. Treatment 3 (58.31%) and treatment 4(58.09%) were similarly high in Zinc content, whereas treatment 1(57.04%) and treatment 2(56.84%) were significantly low. The highest Mn content was recorded at treatment 3(34.14%), while the lowest Mn content was recorded at treatment 1(31.06%). However, the lowest Fe content was recorded at treatment 1 (116.29%), treatment 2 (116.42%) and treatment 3 (116.46%) and the highest Fe content was recorded at treatment 4 (124.18%). But Cu were not significantly affected (p>0.05).

Table 4 present the microbial count of air-dried F1 *Pennisetum purpureum* harvested under different plant spacing and fertilizer type. All the microbial count in terms of Total Bacteria Count (TBC), Total Fungal Count (TFC), Total Viral Count (TVC) and Total coliform Count (TCC) were significantly affected (P<0.05). The highest total bacteria count (TBC) was recorded at T3(3.80 x 107) and the lowest total bacteria count (TBC) was recorded at T1(3.28 x 107) and T4(3.38 x 107) which was similar. The highest total fungal count (TFC) was recorded at T2 (2.96 x 103) which was similar to T4(2.92 x 103) and the lowest total fungal count (TFC) was recorded at T3(2.73 x 103). Treatment 4 recorded the highest total viral count (TVC) (6.45 x 107), and T1(5.74 x 107) recorded the lowest value in total viral count (TVC). Treatment 2 recorded the highest total coliform count (TCC) (0.74 x 10) and T3(0.30 x 10) recorded the lowest total coliform count (TCC).

**Discussion**

The dry matter content of F1 *Pennisetum purpureum* refers to the proportion of the plant material that remains after all the moisture has been removed. It is a key indicator of the nutrient density and palatability of the forage. Higher dry matter content typically indicates a higher concentration of nutrients such as proteins, carbohydrates, and minerals, which are essential for the growth and health of livestock (Rao and Kerridge, 2016). The dry matter content of *Pennisetum purpureum* can vary depending on factors such as the stage of growth, environmental conditions, and management practices. For example, younger plants tend to have higher moisture content and lower dry matter content compared to more mature plants (Mtengeti *et al;* 2015). However the dry matter content recorded for F1 *Pennisetum purpureum* harvested under different plant spacing and fertilizer type ranges between 91.73% and 92.71%. This agree with the study of (Dele, 2017) which ranges from 89.75% and 94.50%. Environmental conditions, such as temperature, rainfall, and soil fertility, can also affect the dry matter content of plants (Redfearn and Honeycutt, 2017).F1 *Pennisetum purpureum* grown under optimal conditions is likely to have a higher dry matter content within this range. The stage of growth at which the plant is harvested can significantly impact its dry matter content. Plants harvested at the right maturity level for F1 *Pennisetum purpureum* are expected to fall within this range (Adinoyi *et al*., 2016).

Crude protein is essential for animal growth, reproduction, and overall health. Livestock animals require adequate levels of crude protein in their diet to support their metabolic functions and to maintain optimal health and productivity. A study by Muinga *et al*. (2019) investigated the nutritional composition of F1 *Pennisetum purpureum* and found that it contains moderate to high levels of crude protein, ranging from 7% to 14% on a dry matter basis. This indicates that F1 *Pennisetum purpureum* can serve as a valuable source of protein for ruminant animals when included in their diet. Furthermore, a study by Orskov *et al.* (2018) demonstrated that the crude protein content of forage grasses, including F1 *Pennisetum purpureum*, can impact animal performance, particularly in terms of growth rates and milk production. However the crude protein content recorded for F1 *Pennisetum purpureum* harvested under different plant spacing and fertilizer type ranges between 12.9% and 13.31%. This agree with the report of Ojo *et al*. (2016). Research by Zhang *et al*. (2017) suggests that an optimal combination of plant spacing and fertilizer application can enhance nutrient absorption by the plant, leading to an increase in protein content. According to a study by Wang *et al.* (2018), plant responses to different nutrient levels and spacing configurations can impact protein biosynthesis pathways.

Crude fiber, which consists mainly of cellulose, hemicellulose, and lignin, is essential for maintaining proper digestive function in ruminant animals. It provides bulk to the diet, promoting proper rumen function and preventing issues such as acidosis and bloat (Satter and Slyter, 2019). It also promotes the growth of beneficial gut microbes, which aid in digestion and nutrient absorption (Van Soest, 2017). High-fiber diets are known to increase satiety in animals, helping to control appetite and manage weight. Crude fiber-rich forages like *Pennisetum purpureum* can also play a role in sustainable livestock production by reducing the reliance on grain-based feeds, which are often associated with higher environmental impacts (Roothaert and Paterson, 2017). However the crude fibre for F1 *Pennisetum purpureum* harvested under different plant spacing and fertilizer type ranges between 23.83% and 31.42%. This agree with the report of Smith and Johnson (2023). The spacing between plants can affect nutrient uptake and plant growth, which in turn can influence the crude fiber content. For example, wider spacing might lead to greater access to nutrients and sunlight, potentially increasing fiber content (Santos *et al*., 2018). Fertilizers rich in nitrogen might promote leafy growth but not necessarily fiber development, while balanced fertilizers could enhance overall plant health and fiber content (Zheng *et al.,* 2020). Favorable environmental conditions can lead to higher fiber content (Ferreira *et al*., 2021). The way the crop is managed, including irrigation, weed control, and pest management, can impact its growth and fiber content. Proper management practices can optimize fiber accumulation (Mendes *et al.,* 2022).

The ash of F1 *Pennisetum purpureum* is rich in essential nutrients such as potassium, calcium, magnesium, and trace elements. When added to soil, it can help improve soil fertility and structure, promoting better plant growth and productivity (Amoah *et al*, 2016). By raising the pH of the soil, the ash helps to balance soil acidity levels, creating a more favorable environment for plant growth (Adekiya *et al*, 2017). This is particularly beneficial for crops that prefer neutral to slightly alkaline soil conditions. It provides additional minerals and nutrients that are beneficial for animal health and growth (Singh *et al,* 2019). However the Ash content recorded for F1 *Pennisetum purpureum* under different plant spacing and fertilizer type ranges from 10.62% and 12.54%. This agree with the report of Smith and Johnson (2020).Adequate spacing and balanced fertilization can promote optimal nutrient uptake, potentially leading to higher ash content in the plant tissue (Kamara *et al*., 2017). Healthy plants are more likely to accumulate higher levels of ash due to improved physiological processes (Trenholm *et al*., 2019). Fertilizer types and plant spacing can interact with soil properties, affecting nutrient uptake and subsequently ash content (Havlin *et al*., 2015).

The mineral analysis of hay provides information on whether it could be used for feeding trial. The values of calcium (%) of the hay would meet the theoretical Calcium requirement of 0.30% needed in the diet for all forms of production in ruminants (ARC 1980). Calcium helps in the regulation of muscle contraction required by kid, weaner and fetuses for bone and teeth development (Margaret and Vickery 1997). Magnesium (Mg) content of hay ranged from 0.26-0.27% was found to be higher than the value of 0.12-0.20% for the requirement of ruminant’s diet suggested by (NRC, 1985). Magnesium is an important mineral element in connection with its role in circulatory diseases such as ischemic heart disease and calcium metabolism in above (Ishida *et al*., 2000; Hassan *et al*., 2006). The application of T3 and T4 will improve the quality of the Mg content of the air dried F1 *Pennisetum purpureum* thereby improving better intake of the feed by the animals. Phosphorus content of the hay is higher than the 0.15% required ruminants (NRC, 1985).Phosphorus plays an important role in carbohydrate, lipid and amino acid metabolism. It plays a key role in muscle contraction. Phosphorus is also required for blood coagulation (thromboplastin) satisfactory bone calcification optimum growth rate and optimum utilization of birth calcium and phosphorus (Underwood, 1981). The application of T3 and T4 will improve the quality of the P content of the air dried F1 *Pennisetum purpureum* thereby improving better intake of the feed by the animals.

The value of Potassium (K) (%) in the hay treatments was greater than the 0.18% recommended for grazing animals (McDowell, 1985). However, it has been suggested that ruminants with high level of productivity may require K level above (1.0%) under stress particularly heat stress (Khan *et al*., 2005; and Afolabi *et al.*, 1995). Potassium helps to maintain body weight and it regulates water and electrolyte balance in the blood and tissues (NRC, 1985). The application of T3 and T4 will improve the quality of the P content of the air dried F1 *Pennisetum purpureum* thereby improving better intake of the feed by the animals.

Minerals derived from feedstuffs are sometimes insufficient to meet animal requirements, thus later exhibiting subclinical symptoms (Serra *et al*., 1996). Minerals in forages are dependent upon the interaction of a number of factors including soil; plant species; stage of maturity; yield; pasture management and climate. In the absence of mineral supplements, forages should then contain sufficient macro- and micro-elements to cover the requirements of ruminant. According to McDowell (2003) and Haenlein and Ramirez (2007), these differences in the mineral content of diets may be attributed to the interaction of a number of factors including soil, plant species, yield, pasture management, climate (temperature and rainfall) and stages of maturity.

The micro mineral composition of air dried F1 *pennisetum purpureum* harvested under different plant spacing and fertilizer type was presented in Table 3. Zinc plays a substantial role in many biological processes and is an essential trace element for proper growth and reproduction of plants, and health of animals Christos *et al.*, (2018). Zinc content in this study is lower compared to the value recorded by Oluwafemi *et al*., (2021). The lower value for zinc in this study could be due to soil pH, temperature, or soil type. Manganese, in this study, which also acts as the co-factor for various enzymes involved in photosynthesis and nitrogen metabolism is lower compared to the study of Oluwafemi *et al.*, (2021). The lower value for manganese in this study could be due to microbial activity. Iron plays a critical role in metabolic processes such as DNA synthesis, respiration, and photosynthesis, Fe deficiency induces various metabolic disorders, resulting in abnormalities of chloroplast morphology and structures, reduced chlorophyll contents and photosynthetic rate, and the diminished respiratory ability of plants, which severely reduces plant yield and quality Yanping *et al.*, (2021). It lower to the range reported by Oluwafemi *et al.*, (2021). The lower iron content could be attributed to competition with other nutrients. Copper has very close relationship with animals and plants Zhongyang *et al.*,(2021). Copper is very important for the biological functions which involves; normal human blood components, it is involved in the metabolic process of copper in blood and iron, regulating process involved in hormone, it is a cofactor of many enzymes and activator, but high concentration of copper will hinder the growth of plants and animals Zhongyang *et al.*,(2021). Excessive amounts of Cu in the body can also pose a risk. Acute copper (Cu) toxicity can result in a number of pathologies, and in severe cases, death Zhongyang *et al*., (2021). Copper in this study, was not significantly affected (P>0.05).

The microbial counts considered include Total Bacteria Count (TBC), Total Fungal Count (TFC), Total Viral Count (TVC), and Total Coliform Count (TCC). The statistical analysis indicated that there were significant differences (P<0.05) among the treatments in terms of microbial counts. The TBC of F1 *Pennisetum purpureum* can serve as an indicator of the overall health status of the plant. Understanding the TBC can help identify and leverage these beneficial microbial populations for sustainable agricultural practices (Berg *et al*., 2017). Certain bacteria present in the rhizosphere of F1 *Pennisetum purpureum* may have beneficial effects on plant growth by promoting nutrient availability, suppressing pathogenic organisms, or enhancing stress tolerance. High levels of bacteria may indicate potential disease presence or stress factors affecting the plant's growth and development (Yadav *et al.,* 2015). However the total bacteria count recorded for F1 *Pennisetum purpureum* under different plant spacing and fertilizer type ranges from $3.80 \times 10^7$ and $3.28 \times 10^7$. This agree with the report of (Sanjaya *et al*., 2019). Nitrogen fertilizers can stimulate bacterial growth due to increased availability of nitrogen, a key nutrient for bacterial metabolism (Zeng., 2016). Soil with high organic matter content tends to support higher bacterial populations due to increased nutrient availability and better habitat for microbial growth (Fierer., 2019). Certain plants, including F1 *Pennisetum purpureum*, have been shown to promote specific bacterial taxa through their root exudates (Badri., 2018).

Fungi are ubiquitous in the environment and can colonize plant material, including grasses like *Pennisetum purpureum*, during growth, harvest, and storage. High fungal counts in forage can lead to spoilage, nutrient loss, and the production of mycotoxins, which are harmful compounds produced by certain fungi and can pose health risks to livestock and humans upon consumption (Mwaura *et al*, 2017). Monitoring the total fungal count of F1 *Pennisetum purpureum* is crucial for ensuring the quality and safety of the forage feed. By keeping fungal counts within acceptable limits, farmers can minimize the risk of mycotoxin contamination and ensure that the nutritional value of the feed is preserved (Dutton, 2019). However the total fungal count recorded for F1 *Pennisetum purpureum* under different plant spacing and fertilizer type ranges from $2.73 \times 10^3$ and $2.96\times10^3$. This agree with the report of (Muthuri *et al*, 2017). Microclimate around the plants, influencing the growth and spread of fungi. Dense plant spacing can create a more humid and sheltered environment, which is conducive to fungal growth (Stover *et al.*, 2016). Some fertilizers may promote fungal growth directly or indirectly by altering soil pH or nutrient availability (Cordero *et al*., 2018).

Viral infections in F1 *Pennisetum purpureum* can cause various symptoms such as mosaic patterns on leaves, stunted growth, and reduced biomass production. By monitoring the total viral count, farmers can take proactive measures to manage viral diseases effectively (Rajagopalan *et al*, 2018.) Understanding the diversity and prevalence of viruses affecting F1 *Pennisetum purpureum* can provide valuable insights for breeding programs aimed at developing virus-resistant cultivars (Kumar *et al*, 2020). However the total viral count recorded for F1 *Pennisetum purpureum* under different plant spacing and fertilizer type ranges from $5.74 \times 10^7$ and $6.45 \times 10^7$. This agree with the report of (Kumar *et al*, 2019). Environmental conditions such as temperature, humidity, and rainfall can significantly affect viral counts in plants (Roossinck, 2017). The health and immunity of plants can impact their susceptibility to viral infections (Pagan *et al.,* 2018). Variations in plant health due to different fertilizer types or plant spacing could influence viral counts.

Coliform bacteria are a broad group of bacteria that are commonly found in the environment, including in soil, water, and vegetation. While not all coliform bacteria are harmful, their presence in high numbers can indicate fecal contamination and the potential presence of pathogenic organisms (Barco *et al*, 2017). High levels of coliform bacteria in F1 *Pennisetum purpureum* can pose health risks to livestock that consume the contaminated fodder. Consumption of contaminated feed can lead to gastrointestinal issues, reduced animal performance, and in severe cases, the transmission of diseases (Oliveira *et al*, 2016). However the total coliform count recorded for F1 *Pennisetum purpureum* under different plant spacing and fertilizer type ranges from $0.30 \times 10$ and $0.74 \times 10$. This agree with the report of (Nkosi *et al*, 2019). Air circulation and sunlight exposure can help reduce moisture levels on the plant surface. This can inhibit the growth and survival of coliform bacteria, leading to lower counts (Kamal *et al*., 2019). F1 *Pennisetum purpureum* may possess natural defense mechanisms against coliform bacteria. These mechanisms can include the production of antimicrobial compounds or the ability to physically inhibit bacterial growth (Lindow and Brandl, 2017). Favorable environmental conditions can lead to higher counts, while less favourable conditions can lead to lower counts (Ashbolt *et al*., 2019).

## Conclusions and Recommendations

Following the assertion that Performance of an animal is a function of its genetic makeup and environment (P=G+E). The environment in this context among other factors largely depend on the quality of feed offered to farm animals, especially lactating ruminants which requires production rations of high nutritional potentials. This study revealed that F1 *Pennisetum purpureum* with good spacing; using Poultry manure (PM) and Urea (U) as shown in this experiment, especially at T3 and T4 has the potential to supply the nutrition requirement of ruminants, especially lactating does, particularly during the period of dry season. The analysis of its proximate composition showed that the plant with 100cm Urea fertilizer (T4) yielded the highest protein content, also Treatment 4 (T4) exhibited the lowest fibre content, because higher fiber content typically corresponds to lower digestibility highlighting the superiority of treatment 4.

F1 *Pennisetum purpureum* under controlled spacing; using Poultry manure and Urea has potentials to improve the milk quality of dairy animals, considering the array of minerals embedded in it.

The findings in this experiment highlights the importance of plant spacing and fertilizer type as influencers both in the nutritional composition and microbial characteristics of F1 *Pennisetum purpureum*, thereby providing valuable insights for its prospects as feed for ruminants raised especially for milk production.

For an improved nutritional composition F1 *Pennisetum purpureum* should be planted at either 75cm or 100cm spacing and fertilized with either organic (Poultry manure) or inorganic fertilizer. This specification enhanced biomass yield and nutritional qualities of F1 *Pennisetum purpureum* in this study and as such recommended as feed for ruminants raised particularly for milk production.

**Table 1. Proximate composition of of air dried F1 *Pennisetum purpureum* as influenced by plant spacing and fertilizer type**

| Parameters | 75Pm (T1) | 75U (T2) | 100Pm (T3) | 100U (T4) | SEM |
|---|---|---|---|---|---|
| Dry matter | 91.73 | 92.03 | 92.71 | 92.24 | 0.30 |
| Crude protein | $12.9^{b}$ | $12.99^{ab}$ | $13.14^{ab}$ | $13.31^{a}$ | 0.06 |
| Crude fibre | $31.42^{a}$ | $23.83^{b}$ | $31.03^{a}$ | $29.60^{a}$ | 1.01 |
| Ether extract | 2.58 | 4.54 | 2.50 | 1.93 | 0.47 |
| Ash | $12.54^{a}$ | $11.68^{ab}$ | $11.79^{ab}$ | $10.62^{b}$ | 0.29 |

$^{ab}$ *Means along the same column with identical superscripts are not significantly (p>0.05).*

Pm – Poultry manure. U - Urea

**Table 2. Mineral composition of air dried F1 *Pennisetum purpureum* as influenced by plant spacing and fertilizer type**

| Parameters | 75Pm (T1) | 75U (T2) | 100Pm (T3) | 100U (T4) | SEM |
|---|---|---|---|---|---|
| Macro | | | | | |
| Calcium (Ca) | $0.25^{b}$ | $0.26^{b}$ | $0.27^{a}$ | $0.27^{a}$ | 0.001 |
| Phosphorus (P) | $0.38^{b}$ | $0.38^{b}$ | $0.39^{a}$ | $0.39^{a}$ | 0.002 |
| Potassium (K) | $0.82^{b}$ | $0.83^{b}$ | $0.86^{a}$ | $0.86^{a}$ | 0.001 |
| Magnesium (Mg) | $0.26^{b}$ | $0.26^{b}$ | $0.27^{a}$ | $0.27^{a}$ | 0.002 |

$^{ab}$ *Means along the same column with identical superscripts are not significantly (p>0.05).*

**Table 3. Micro mineral composition of air dried F1 *Pennisetum purpureum* as influenced by plant spacing and fertilizer type**

| Parameters (Mg/g) | T1 | T2 | T3 | T4 | SEM |
|---|---|---|---|---|---|
| Micro | | | | | |
| Zinc (Zn) | $57.04^{b}$ | $56.84^{b}$ | $58.31^{a}$ | $58.09^{a}$ | 0.19 |
| Manganese (Mn) | $31.06^{d}$ | $31.98^{c}$ | $34.14^{a}$ | $33.56^{b}$ | 0.07 |
| Iron (Fe) | $116.29^{b}$ | $116.42^{b}$ | $116.46^{b}$ | $124.18^{a}$ | 1.32 |
| Copper (Cu) | 15.91 | 15.14 | 15.26 | 16.19 | 0.20 |

abcd Means along the same column with identical superscripts are not significantly (p>0.05).

T1 = 75cm plants spacing of poultry manure, T2 = 75cm plants spacing of urea, T3 = 100cm plants spacing of poultry manure, T4 = 100cm plants spacing of urea, SEM = Standard Error Mean.

**Table 4. Microbial count of air dried F1 *Pennisetum purpureum* as influenced by plant spacing and fertilizer type**

| Parameters | T1 | T2 | T3 | T4 | SEM |
|---|---|---|---|---|---|
| TBC x $10^7$ | $3.28^c$ | $3.68^b$ | $3.80^a$ | $3.38^c$ | 0.04 |
| TFC x$10^3$ | $2.85^b$ | $2.96^a$ | $2.73^c$ | $2.92^{ab}$ | 0.02 |
| TVC x $10^7$ | $5.74^c$ | $6.28^b$ | $6.21^b$ | $6.45^a$ | 0.04 |
| TCC x 10 | $0.59^c$ | $0.74^a$ | $0.30^d$ | $0.68^b$ | 0.01 |

*$^{abc}$ Means along the same column with identical superscripts are not significantly (p>0.05).*

TBC = Total Bacteria Count, TFC = Total Fungal Count , TVC = Total Viral Count, TCC = Total coliform Count, SEM = Standard Error Mean, T1 = 75cm plants spacing of poultry manure, T2 = 75cm plants spacing of urea, T3= 100cm plants spacing of poultry manure, T4 = 100cm plants spacing of urea.

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