# LEAF AREA INDEX AND DRY MATTER YIELD OF *MEGATHYRSUS MAXIMUMS* AS AFFECTED BY RATES OF GOAT MANURE APPLICATION AND HARVEST STAGE IN THE SUDAN SAVANNAH ZONE OF NIGERIA

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**ABSTRACT**
*The study investigated the effect of varying rates of goat manure and cutting stages on Leaf Area Index-LAI and Dry Matter Yield-DMY of Megathyrsus maximums in the Sudan Savannah region of Nigeria. The experiment was laid in RCBD with three main plots; 3, 6 and and 9t/ha goat manure application rates and three subplots (6, 8, and 10 weeks after planting-WAP). The result showed that the varying rates of goat manure had a significant effect on the LAI but not on the DMY. The cutting stages had significant effect on the LAI and DMY. It was concluded that Megathyrsus maximums cultivated with 9t/ha goat manure and harvested at 10WAP produced the closest canopy and optimum dry matter yield. It was therefore recommended that farmers in this part of Nigeria should cultivate Megathyrsus maximums using goat manure at 9t/ha for higher LAI and DMY which is an indication of forage productivity.*
**Key words: Goat manure, harvest stage, panicum, dry matter**

## INTRODUCTION

Paucity of feed is a major challenge facing livestock productivity in Nigeria (Babayemi and Bamikole, 2006) as feed accounts for 70-75% of the total cost of production. The Sudan Savannah region of Nigeria is known for high livestock population in Nigeria (FMARD, 2017). This higher livestock population is threatened by several factors such as low pasture productivity as a result aftermath effect of climate change, farmers/herders clash, armed banditry amongst other menace (Aruwayo *et al*., 2021). Tropical soils are characterized by poor nutrient quality which results in production of forage with poor nutrient value (Aregheore, 2002). Goat manure is an organic soil amendment that has been shown to improve soil fertility and crop productivity (Andre *et al.,* 2020). Though there is paucity of information on the use of goat manure on forage productivity in the region, previous studies have shown that application of inorganic fertilizer significantly affected phenological variables and agronomical parameters (Buli *et al.,* 2022). Additionally, the effect of goat manure on soil with varying doses of nitrogen fertilizer has been studied in several climes, and different nitrogen fertilizer application rates have been found to affect agro-physiological performance and productivity of maize (Gudade *et al*., 2022). A review on the effects of goat manure on soil fertility and crop productivity suggests that it has the potential to improve the productivity of arid regions' soil by increasing the water holding capacity and reducing infiltration rate (Andre *et al*., 2020). Furthermore, goat manure treatments have been shown to significantly increase the yield of grasses, the rate of application and type of manure have also been found to affect the forage dry matter yield of *Megathyrsus maximums* (Dele *et al*., 2017). The results of this study will provide valuable information on the potential of goat manure application and harvest stages on the LAI and DMY of *Megathyrsus maximums* in the Sudan Savannah region of Nigeria.

## MATERIALS AND METHODS

### Experimental site

The experiment was conducted at the experimental field of Prof Lawal Abdu Saulawa Livestock Teaching and Research Farm, Federal University Dutsin-Ma, Katsina State, Nigeria. Located on Latitude $11^0$9'N, and Longitude $07^0$38' E, at an Altitude of 610m above the sea level, along Kankara road with defined wet and dry season. The wet season starts from early June to late September while the dry season is from September to June. The total annual rainfall ranges from 1110-1580mm with a long term average of 1058.60mm. Maximum air temperature of $28.25^0$C were recorded in September

and minimum air temperature of $23.35^0$ C in September with relative humidity of approximately 68% during the rainy season (MSGRPF, 2023).

**Soil Samples of Experimental Site**

Soil samples were collected for nutrient analysis from the experimental site with the aid of Soil auger at four corners and center of the plots at 0-30cm depth to make a composite for soil analysis at the beginning of experiment so as to ascertain the level of nutrient in the soil as well as determining the nutrient requirement. The soil sample was analyzed for physical and chemical properties as described by ASAE (1998). The analysis was carried out at the chemical laboratory of the Department of Soil Science, Faculty of Agriculture, Ahmadu Bello University, Zaria. The soil, at 0-15cm consist of 28% clay, 26% silt and 46% sand which is classified as being loamy soil. The soil is slightly acidic with pH (6.36) and of moderate Organic carbon (0.58%). The total nitrogen (0.18%) and available phosphorus (4.53ppm) were low. The exchangeable cations, $Ca^{2+}$, $Mg^{2+}$, $K^{+}$ were low to moderate in the soil while $Na^{+}$ was of moderate status.

**Land Preparation and Experimental Design**

A gross land area measuring 9m×9m was used for the trial. The land was cleared and seed beds were prepared to meet a better condition for early establishment of seedlings. The experiment was laid out in a randomized complete block design with 3x3 factorial arrangements, replicated three times. 3 levels of goat manure (3, 6 and 9 t/ha) were the main plot factors and 3 cutting stages (6, 8 and 10 weeks after planting-WAP) were the sub-plot factors. Forage samples cut at each stage of harvest was bulked, and sub-samples analyzed for proximate composition. The analysis was carried out at the Chemical Laboratory, Department of Animal Science, Ahmadu Bello University Zaria.

**Goat manure preparation and application**

Goat manure was sourced from the goat unit of Professor Lawal Abdu Saulawa Livestock Teaching and Research Farm, Federal University Dutsin-Ma. The goat manure was applied at the rate of 3, 6 and 9t/ha in treatments 1, 2 and 3 respectively. Each treatment was replicated three times making a total of nine (9) sub-plots. Goat manure was reduced into powdered form for easy mineralization and broadcasted on the experimental plots, incorporated into the soil using hoes three (3) weeks before transplanting for proper mineralization.

**Seed sourcing, treatment and seedling production**

Seed of *Megathyrsus maximums* was sourced from the Seed Store of the National Animal Production Research Institute (NAPRI), Shika, Zaria. The seed was treated against insect attack using insecticide (Apron plus) at 5g/kg before planted in the nursery, where they were raised to seedling before being transplanted to the experimental field three weeks after nursery establishment at a spacing of 50 x 20cm inter-row and intra- row space respectively, Weeds were controlled at 3 and 6 weeks after transplanting in order to prevent weed infestation.

**Chemical Composition of goat manure**

Goat manure was analyzed for its chemical composition in order to determine the nutrient content. The result showed that the manure contained 3.95% total nitrogen (N), 0.85% phosphorus (P). 24045.73mg/kg potassium (K) and 4900.10mg/kg micro minerals with 2892.5mg/kg iron (Fe), 217.5mg/kg manganese (Mn), 63.00% copper (Cu), and 350.00% zinc (Zn). This result indicates that goat manure is relatively nutrient loaded and is one of the organic manure of animal origin that can be used for soil amendment

**Data Collection**

Samples of *Megathyrsus maximums* harvested at 6, 8 and 10WAP were weighed, sub-sample taken, oven dried to a constant weight at 105°C for the estimate of Dry Matter Yield, while the LAI was estimated using the formula, LAI=Plant Area/Land Area, where Plant Area=PH×LL×LW×0.75 and the Land Area= Inter row space ×intra-row space. Where LAI= leaf area index, PH= plant height, LL= leaf lengthand LW= leaf width.

**Statistical analysis**

All data collected were subjected to two-way analysis of variance (ANOVA) using generalized linear model (GLM) procedure of SAS (2000). Significant ($p<0.05$) difference between treatment means were separated using Duncan Multiple Range Test, (Duncan, 1955) of SAS package.

**Table 1. Effect of Goat manure and stages of cutting on the Leaf Area Index and Dry Matter Yield of *Megathyrsus maximums***

| | Yield parameters | |
|---|---|---|
| | **LAI** | **DMY** |
| Goat Manure (t/ha) | | |
| 9 | 3.85[a] | 8.78 |
| 6 | 2.84[b] | 8.51 |
| 3 | 2.96[b] | 7.61 |
| SEM | 0.46 | 1.62 |
| | | |
| Stages of cutting (Weeks after transplanting) | | |
| 10 | 5.34[a] | 16.27[a] |
| 8 | 2.71[b] | 6.40[b] |
| 6 | 1.59[c] | 2.23[c] |
| SEM | 0.46 | 1.62 |

[abc]Means with different superscripts along the columns differ significantly (P<0.05). SEM= Standard Error of the Mean

Leaf Area Index (LAI) is an important factor in the dry matter accumulation and yield of *Megathyrsus m*maximums, it is the ratio of the total leaf area to the ground area covered (Jonathan *et al*., 2017). In this study, the LAI was higher (p<0.05) in grass fertilized with 9t/ha of goat manure and harvested at 10WAP this implies that the LAI increased as the rate of manure application increased and the harvest stage advanced. This could be as a result of essential nutrient present in the combination with adequate moisture, thereby increasing the root absorption, net assimilation rate (NAR), relative growth rate (RGR), maximum light interception, increased LAI, high rate of photosynthesis and dry matter accumulation as the plant pass through the growth stages (Gomez *et al*., 2012). The DMY observed in this study as affected by manure rate is lower than what was reported by (Dele, 2018). This variation could be as a result of different ecological zone or the inherent soil fertility of the experimental areas. The result of the DMY as affected by the rate of goat manure application was not (P>0.05) significant but the DMY at 9t/ha was 15% higher when compared with the 3t/ha application rate. However, the stage of harvest had a significant (P<0.05) effect on the DMY with the 10WAP producing the highest (16t/ha) DMY. This could be as a result of higher LAI index at this stage, as it has been established that the relationship between the LAI and DMY is directly proportional (Shuaibu *et al.,* 2018). This is within the range of DMY/ha reported by (Akinola, 2018, Jimoh *et al*., 2019 and Idowu, 2021) during separate studies on the DMY of *Megathyrsus maximums*.

## CONCLUSION

It was concluded that application of goat manure at 9t/ha and harvested at 10WAP produced forage with high productivity in terms of LAI and DMY. It was therefore recommended that livestock farmers in the Sudan Savannah region of Nigeria cultivate *Megathyrsus maximums* using goat manure at the rate of 9t/ha and harvest at 10 WAT for a higher LAI and DMY for enhanced livestock productivity.

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