Original Research Article

EFFECT OF NITROGEN FERTILIZER AND INTER ROW SPACING ON HERBAGE YIELD OF RHODES GRASS (*Chloris gayana* Tan) IN THE DRY SUB HUMID ZONE OF SOKOTO NIGERIA

ABSTRACT

A field experiment was conducted during the 2016 and 2017 rainy seasons at Centre for Agriculture and Pastoral Research (CAPAR) of the Usmanu Danfodiyo University Sokoto, Nigeria to study the effect of nitrogen fertilizer and inter-row spacing on herbage yield of Rhodes grass. A factorial combination of five fertilizer levels (0, 100, 120, 140 and 160 kgNha^{-1}) and three inter row spacing *(30, 50 and 70cm) were used, making fifteen treatments combinations, which were laid out in a RCBD replicated four times. Determination of herbage yield at the end of 12 weeks post planting was carried out using a 0.25m^2 (0.5m x 0.5m) area metallic frame (Quadrat). The herbage was harvested at 5cm above ground level using hand Sickle from the four plots for each treatment. The samples collected ware oven dried for the estimation of dry matter yield. The result revealed that, Application of 160KgNha^{-1} generally produced higher ($P < 0.05$) dry matter yields compared to the rest of the treatmen, however there was generally no significant ($P > 0.05$) effect of inter row spacing in both 2016, 2017 and years combined inter-row spacing of 70cm showed superiority among the treatments in the herbage yield compositions investigated compared to 50 and 30cm spacing.*

Keywords: Centre of agricultural and pastoral research, herbage yield, nitrogen fertilizer, inter row spacing and Rhodes gras

INTRODUCTION

Ruminant livestock in Nigeria which includes 52.5 million Cattle, 33 million Sheep and 16.2 million Goat, in Nigeria account for about 85% of the domestically produced meat in the country (FAO 2009). These animals form an important part of the nation's agricultural production system there by providing income to the farmer and foreign exchange to the nation. In addition to providing manure for arable farming, hides and skins, for leather and tanning industries social security and as insurance for food security, to mention but just a few (Tarowili *et al.*, 2004; Olson *et al.*, 2004, Peden *et al.*, 2005).

Land which was previously used for grazing is gradually brought into cultivation to satisfy the food needs of the increasing human population. Livestock are forced to graze on marginal land and use crop residues which are often low in both quantity and quality, which results in poor livestock performance. (Isa et al., 2019; Schaar et al., 1981).

The major problem facing the livestock producers in the savanna zones of Nigeria is provision of adequate feeding to the animals during the dry season. This challenge is most severe in the dry sub humid zone of the Savanna, where the dry season is longer (from October-may/June) and crops and pasture productivity are also low due to lower annual rainfall and poorer soils (Umunna and Iji, 1993; Adegbola 2004; Babayemi and Bamikole, 2006, Ogunbosoye and Babayemi, 2010). During dry season the decreased quantity and quality of the natural pasture and crop residue makes it impossible for the animal to meet their nutritional requirements. Supplementary feed stuffs such, as Cotton Seed Cake, Groundnut Cake etc are also very expensive during this period. This problem results to loss of body, high rate of reproductive failures, incidences of diseases and mortality of young animals amongst other things (FAO, 1988). Therefore there is need to increase the forage production to meet the feed requirements of livestock in the Savanna region of the country.

However about 90% of Cattle and 70% of the Sheep and Goat in Nigeria are under extensive system of production. Over 80% of these animals are found in the savannah zones of the country where extensive area for growing and or forage feed availability are the severe limiting factors of production (FDLPCS, 1992; Aregheore 2009).

According to FDLPSCS (1992), Umunna and Iji (1993), Adebowale and Taiwo (1996), Mortmoore (2000) and Aregheore (2009), the bulk of the feed resources used for the ruminant livestock production in Nigeria include; natural pasture in the native range lands, crop residue and agricultural by-products. The increasing demand for animal and animal related products can be met through the use of improved pasture species supplementation to satisfy animal's dietary requirements (Yakubu et al., 2019). It is therefore more economical to use grassland as a source of meat and milk because grass herbage cannot be used directly by man but can be used indirectly through animals that convert it to edible products. In Nigeria, pasture production and utilization has not been developed except on government farms, university experimental, teaching and demonstration farms. Ruminant livestock in Nigeria depends largely on natural grasslands that are nutritionally poor. The savanna zone characterised by low annual rainfall of shorter duration, lighter sandy soils and longer dry season, has low potential for natural forage production (Umunna and Iji, 1993; Adamu and Odioun, 2002).

Therefore, in order to meet the feed requirements of the ruminants animals in Nigeria; there is need to increase the forage production in the savanna region of the country. This requires production of improved pasture species with potential to high herbage production and nutritive value in the different sub regions of the savanna. Thus dependence on natural pasture that provides the cheapest source of nutrients for ruminants has resulted in failure to meet the nutritional demands of livestock throughout the year. Native pasture are mostly composed of law quality grasses which the nutrient content of the herbage is only sufficient during the developmental period of the herbage fallowing rainfall in Nigeria (Amodu 2004).

Nuru (1996) reported that with the current increase in crop production through massive land clearing, coupled with population growth and hence the development of more and larger towns and cities, the land use patterns is changing and less land is available for extensive livestock production. These has led to the introduction of improve pasture production which yields more dry matter of high nutritive value, leading to greater animal productivity than do native pastures as part of the technologies to improve animal husbandry/production (Nuru, 1996).

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Excess fertilizer application, on the other hand, can be detrimental as ‘fertilizer burn’ may occur when too much fertilizer is applied resulting to drying out of leaves and damage or even death of the plant (FAO 2006). Therefore determination of Optimum fertilization level is important for better crop production. (Peacock *et al.* 1991) reported that Rhodes grass responds well to nitrogen and phosphorus fertilizer application and higher yields are obtained when N is given after a basic application of Phosphorus. Fertilizer also increases the proportion of leave in the herbage, but when applied after flowering it can increase the proportion of stem (Bogdan 1977). Khair (1999) noted that Rhodes grass responded well to nitrogen fertilizer when applied in separate doses.

Inter-raw spacing is also an important cultural practice that affects crop productivity. The close spacing produces thin, slow growing and weaker plants. The wide spacing, on the other hand produces crop with lose canopy resulting to poor absorption of solar radiation, leading to low photosynthesis rate resulting to poor productivity of the crop. Wide spacing also expose crop to high weed infestation and production of low quality herbage. Optimum spacing is therefore necessary for effective growth, yield and quality of crops. If seedlings are widely scattered (spaced) Rhodes grass can quickly produce a dense stands that means that close spacing produces thin, slow growth and weaker sword (Mannetja and Kersten, 1992).

Materials and Methods

Experimental Site

This study was conducted at the Center for Agriculture and Pastoral Research (CAPAR), formally Dabagi Farm, of Usmanu Danfodiyo University Sokoto, during the 2016 and 2017 raining season. The farm is geographically located on latitude12°45′N and longitude 5°25′E and on 350m altitude. The farm is situated at 33 kilometers away from Sokoto metropolis, along the Sokoto-Gusau road, in Dange shuni local government area of Sokoto State, Nigeria. The farm has a total land area of about 512 ha, (CAPAR 2010). Dabagi farm falls within the Sudan-Savanna vegetation zone. Isah and Shinkafi (2000), the climate is characterized by alternating wet and dry seasons. The rainy season starts normally in June/July and ends in September with approximate annual rainfall of 500 - 900 mm with wide inter annual variations. (SERC, 2017). The total annual rainfall during the 2016 and 2017 were 663.42 mm and 606.18 mm respectively. The soil texture was sandy loam; with sand, silt and clay represented at 92.7%, 5.9% and 1.4% respectively.

The treatments for this research consisted of five Nitrogen fertilizer levels (0, 100, 120, 140, and 160Kg/ha) and three inter row spacings (30, 50, and 70cm), which were combined factorially and laid out in a randomized complete block design (RCBD) replicated four times. The forage was sown on 15th and 8th of July 2016 and 2017 respectively. The fertilizer treatments were applied at three (3) weeks after sowing. Dry weight was completely determined by Oven drying. The herbage sample from each plot was bulked for each treatment to form a representative sample.

The data were statistically analyzed by analysis of variance (ANOVA), using the GenStat 64-bit Release 17.1

RESULTS AND DISCUSSION

Herbage dry matter yield (DMY)

Results on herbage dry matter yield as influenced by nitrogen fertilizer application and inter row spacing during 2016, 2017 and the years combined is presented in table 1. Significant ($P < 0.05$) effect of nitrogen fertilizer application on the dry matter yield of Rhodes grass was observed in 2016, 2017 and the years combined. Application of 160KgNha^{-1} generally produced higher ($P < 0.05$) dry matter yields compared to the rest of the treatments. Inter row spacing had not significant ($P > 0.05$) on the herbage DMY ha^{-1} of Rhodes grass in both 2016, 2017 and the years combined however there was generally no significant ($P > 0.05$) interaction between nitrogen fertilizer application and inter row spacing. The significantly ($P < 0.05$) higher DMY of Rhodes grass recorded from application of 160 kgNha^{-1} at 12 WAS in the 2016, 2017 and the years combined results (table 1) indicated that Rhodes grass requires at least 160 kg ha^{-1} of nitrogen fertilizer to produce high herbage dry matter yield in the study area. This result is similar to the findings by Rains (1963), Frankow-Lindberg, (1987), Akinola and Olarunju (1990), Rasmussen *et al*., (1996), Burhan and Hago (2000), Muhammad and Abubakar (2004) Yakubu and Magaji (2004) Muhammad *et al*., (2005), Abdelrahman (2007), Aderinola et al., (2009) and Na-Allah (2015), who also reported significant increase in herbage dry matter yield of Rhodes grass with increase in nitrogen fertilizer levels. The non-significant ($P > 0.05$) effect of inter row spacing recorded from the varying inter row spacing (30, 50 and 70 cm) during 3 – 12 WAS in the 2016, 2017 and the years combined results (table 1) may be explained by the Rhodes grass ability to withstand competition and suppress weeds under both close and wide row spacings (Duke, 1978).

Growth and development of crops is determined by row spacing and nitrogen levels (DAOFW, 1999).

Table 1: Herbage dry matter yield of Rhodes grass as influenced by nitrogen fertilizer and inter row spacing, during the 2016/2017 rainy season and the years combined in Sokoto Nigeria.

Treatment	**2016**	**2017**	**Combined**
Fertilizer (Kg/ha^{-})			
0 (F0)	5500^{d}	4877^{e}	5189^{e}
100 (F1)	9060^{c}	7173^{d}	8123^{d}
120 (F2)	9683^{c}	8333^{c}	9018^{c}
140 (F3)	10660^{b}	9780^{b}	10221^{b}
160 (F4)	11322^{a}	11100^{a}	11215^{a}
LSD	866.4.	957.67	422.91
Significance	*	*	*
Spacing (cm)			
30 (S1)	9703	8836	48948
50 (S2)	9600	8090	50603
70 (S3)	9600	770.50	51779
LSD	583.59	788.90	4670.53
Significance	NS	NS	NS
Interaction			
F * S	NS	NS	NS

Means within a column for a factor followed by the same letters are statistically not significant at 5% level probability,
LSD $_{(t < 0.05)}$ Least Significant Difference at 5% probability level.
*=Significant at 5%, NS = not significant at 5%, of probability level
F*S= Interaction, F= Fertilizer
S = Spacing, WAS = Weeks after Sowing.

Conclusion

The study concluded that application of $160KgNha^{-1}$ generally produced higher (P < 0.05) dry matter yields compared to the rest of the treatmen, however there was generally no significant (P > 0.05) effect of inter row spacing in both 2016, 2017 and years combined inter-row spacing of 70cm showed superiority among the treatments in the herbage yield compositions investigated compared to 50 and 30cm spacings.

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