Original Research Article

EFFECT OF NITROGEN FERTILIZER AND INTER ROW SPACING ON LEAVE LENGTH AND LEAVE WIDTH 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 Leave length and Leave width of Rhodes grass as indices of growth. 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 leave length and leave width was done at 3, 6, 9 and 12WAS using a meter rule. The data obtained were statistically analyzed by using analysis of variance (ANOVA), using the GenStat 64-bit Release 17.1 (software) to elucidate the valid information from the data). The result revealed that, Application of 160KgNha^{-1} generally produced plants with longer and broader ($P<0.05$) leaves compared to the rest of the treatments, however there was generally significant ($P>0.05$) effect of inter row spacing in both 2016, 2017 and the years combined, inter-row spacing of 70cm showed superiority amongst the treatments in the leaves length and leave widths parameters investigated as compared to 50 and 30cm spacings.

Keywords: Leave length, leave width, Centre for agricultural and pastoral research, nitrogen fertilizer, inter row spacing and Rhodes grass

INTRODUCTION

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. (Schaar et al., 1981). 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.

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).

According to Simbaya (2000), Malami (2005) Aregheore (2009) and Ogunbasoye and Babayemi (2010), the major limitation to ruminant animal production in the savannah zone of Nigeria are inadequate supply and low quality of the pasture feed during the long dry season. Farmers in this region usually incur huge economic losses that include poor growth of animals, reduce reproductive capacity, low resistance to disease and increase rate in mortality, especially of young animals, mainly due to inability of the pasture to meet the nutritional needs of the animals during the dry season (from October-may/June), especially in the semi- arid zone. Thus, there is need to increase availability of the forage feed through intensive production of improved pastures species which are capable of producing high quality forage for the ruminant animals in the country. 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. 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).

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°45ᴵN and longitude 5°25ᴵE 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. Leave length and leave width was measured by using a Meter rule. The data was statistically analyzed by analysis of variance (ANOVA), using the GenStat 64-bit Release 17.1

RESULTS AND DISCUSSION

Leaf Length

Results on leaf length (cm) of Rhodes grass as influenced by nitrogen fertilizer and inter row spacing during 2016 and 2017 rainy seasons and the years combined is presented in Table 1. Fertilizer application had significant (P<0.05) effect on leaf lengths at 3, 6, 9 and 12WAS in the 2016, 2017 and the years combined results. Leaf length increase linearly with the age of the plant from 6.62 cm at 3 WAS to 24.03 cm at 12 WAS. At 3WAS, application of 140 kgNha^{-1}produced longer (P<0.05) leaves in 2016, 2017 and the years combined results, which were similar (P>0.05) to the leaves of plants on application of 160kgNha^{-1} in the 2017 and the years combined results, compared to rest of the treatments. At 6WAS, longer (P<0.05) leaves were produced by plants on the application of 160 kgNha^{-1} in the 2016, 2017 and the years combined compared to rest of the treatments. At 9WAS both 140 and 160kgNha^{-1} treatments produced plants with longer (P<0.05) leaves in the 2016, 2017 and the years combined results compared to the rest of the treatments. At 12WAS also, application of 160kgNha^{-1} produced plants with longer (P<0.05) leaves in the 2016, 2017 and the yeas combined compared to the rest of the treatments. Inter row spacing had significant effect (P<0.05) on leaf length at 3, 6, 9 and 12WAS in the 2016, 2017 and the years combined. The 70cm inter row spacing generally produced plants with longer (P<0.05) leaves from 3 to 12 WAS, as compared to 50 and 30cm spacing in the 2016, 2017 and the years combined results.

The significantly (P<0.05) longer leaves of Rhodes grass produced from application of the higher dose of nitrogen fertilizer (160 kgNha^{-1}) during 2016 and 2017 trials and the years combined (Table1), is similar to the findings by Bogdan (1977) Duke (1997) and Khair (1999) on Rhodes grass, who reported longer leaves from application of higher levels of nitrogen fertilizer. The significant effect of inter row spacing observed from the wider inter row spacing of 70 cm during 3 - 12WAS in the 2016, 2017 and the years combined (Table 1) indicated that the wider inter row spacing was required to produce longer leaves of Rhodes grass in the study area. This is similar to the findings by Samson (2005) and Tanko (2013) who reported a significantly higher number of leaves per plant at wider row spacing on *Lablab purpureus* and Sesame plants, respectively, in the dry sub humid zone of Nigeria. The significantly ($P<0.05$) longer leaves of Rhodes grass produced from application of 160 $kgNha^{-1}$ and 70cm inter row spacing during 6 - 12 WAS in the 2016 and the years combined results (Table 1) may indicate the optimum fertilizer level and inter row spacing for Rhodes grass production in the study area up to 12 WAS. This is similar to the findings of Kumbhar and Sonar (1980), Alam *et al* (2014), Shukla *et al*. (2005) and Singh and Tripath (2008), who reported significantly higher productivity from high N fertilizer application and wider spacing among different rice varieties, accentuated from increase in length of leaves, elongation of stem/tillers and panicles or in general increased vegetative growth of plants. It can be said that nitrogen stimulates the biosynthesis and export of cytokinin hormone from roots to leaves that causes increasing cell division and increasing length and width of the leaves.

Table 1: Leaf length of Rhodes grass as at 3, 6, 9 and 12WAS as affected by fertilizer levels and inter row spacing, during 2016 and 2017 rainy seasons and the years combined in the dry sub humid zone of Sokoto, Nigeria

	3WAS			6WAS			9WAS			12WAS		
Treatment	**2016**	**2017**	**Combined**	**2016**	**2017**	**Combined**	**2016**	**2017**	**Combined**	**2016**	**2017**	**Combined**
Fertilizer (F) (kgNha^{-1})												
0 (F0)	3.38^{e}	3.11^{d}	3.36^{c}	6.94^{e}	6.38^{d}	6.67^{e}	9.46^{e}	8.98^{d}	9.35^{d}	10.29^{e}	10.07^{e}	8.20^{e}
100(F1)	4.68^{d}	4.25^{c}	4.84^{b}	11.03^{d}	10.01^{c}	10.52^{d}	13.05^{d}	16.53^{c}	15.03^{c}	17.20^{d}	16.36^{d}	16.80^{d}
120(F2)	5.87^{b}	5.70^{b}	5.78^{b}	13.54^{c}	15.46^{b}	14.51^{c}	14.84^{c}	17.51^{b}	16.21^{b}	18.46^{c}	19.04^{c}	18.78^{c}
140(F3)	6.53^{a}	6.71^{a}	6.62^{a}	16.72^{b}	16.93^{b}	16.83^{b}	18.17^{a}	18.74^{a}	18.50^{a}	19.68^{b}	20.33^{b}	20.02^{b}
160(F4)	5.48^{c}	6.63^{a}	6.05^{a}	17.12^{a}	17.40^{a}	17.30^{a}	18.32^{a}	18.09^{a}	18.22^{a}	23.99^{a}	24.06^{a}	24.03^{a}
LSD	0.213	0.384	0.480	1.117	3.235	0.477	0.752	1.532	0.426	1.647	2.170	1.295
Significance	*	*	*	*	*	*	*	*	*	*	*	*
Spacing (S) (cm)												
30(S1)	5.16^{ab}	5.28^{ab}	5.22^{ab}	12.18^{b}	12.61^{b}	12.40^{b}	14.21^{b}	17.01^{b}	16.14^{c}	15.23^{c}	15.78^{c}	15.13^{c}
50(S2)	4.92^{b}	5.07^{ab}	4.99^{b}	12.66^{b}	12.98^{b}	12.82^{b}	14.01^{b}	17.85^{b}	16.00^{b}	16.49^{b}	17.40^{b}	16.94^{b}
70(S3)	5.49^{a}	5.49^{a}	5.49^{a}	15.58^{a}	17.29^{a}	16.44^{a}	17.28^{a}	18.86^{a}	18.08^{a}	19.77^{a}	20.94^{a}	20.40^{a}
LSD	0.165	0.288	0.372	0.862	2.500	0.369	1.123	1.191	0.330	0.961	1.611	1.003
Significance	*	*	*	*	*	*	*	*	*	*	*	*

Means within a column followed by the same letters are statistically not significant at 5% level of probability using Least Significant Difference (LSD)at 5% probability level.*=Significant at 5% probability level, NS = not significant at 5% probability level.
F= Fertilizer, S = Spacing, F*S = Interaction between Fertilizer and Spacing
WAS = Weeks after Sowing

Leaf Width

Results on leaf width of Rhodes grass as influenced by nitrogen fertilizer application and inter row spacing during 2016, 2017 rainy seasons and the years combined is presented in Table 2. The result showed that fertilizer application had no significant effect (P>0.05) on leaf width at 3WAS in the 2016 and 2017 rainy seasons. However, in the years combined, significant effect was observed. Similarly, significant (P<0.05) effect was observed at 6, 9 and 12WAS during 2016, 2017 rainy seasons and the years combined. At 3WAS in the years combined, 160 KgNha^{-1} produced broader (P<0.05) leaves as compared to the rest of the treatments.. At 6WAS 160 kgNha^{-1} produced broader (P<0.05) leaves in 2016, 2017 rainy seasons and the years combined, compared to the rest of the combinations. At 9WAS fertilizer application of 160, 140 and 120 kgNha^{-1} produced broader (P<0.05) leaves in 2016, 2017 and years combined analysis compared to the rest of the combinations. At 12WAS fertilizer application of 160 and 140 kgNha^{-1} in 2016, 2017 and the years combined produced broader (P<0.05) leaves as compared to the rest of the combinations.

Inter row spacing had no significant (P>0.05) effect on leaf width at 3WAS in 2016, 2017 and the years combined, at 6WAS there was no significant (P<0.05) effect of inter row spacing on leaf width in 2017, however significant (P<0.05) effect was observed in 2016 and the years combined analysis. At 9WAS significant (P<0.05) effect of inter row spacing on leaf width was observed in 2016, 2017 and the years combined analysis and at 12 WAS in 2017.

The significantly (P<0.05) broader leaves recorded from Rhodes grass plants on 160 kgNha^{-1} during 3 - 12 WAS in the 2016, 2017 and the years combined results (Table2) indicated higher growth potential by the Rhodes grass at higher nitrogen fertilizer dose of

160 kgNha^{-1}. The mean leaf width recorded for the Rhodes grass plant at 12 WAS in this study (2.46 - 2.59 cm) was higher than the 0.3 – 0.9 cm reported by Duke (1997).This may be due to differences in the cultivars used, higher nitrogen levels, better soil conditions and most likely better agronomic practices or may indicate a better adaptation by the Rhodes plant to the Sokoto Semi-arid environment.

The significant effect of inter row spacing observed from the wider row spacing (70 cm) during 3 - 12WAS in the 2016, 2017 and the years combined results (Table 2) indicated that the wider inter row spacing was required to produce broader leaves of Rhodes grass in the study area. This is similar to the findings by Mannetja and Kersten (1992) on Rhodes grass plants in East Asia, where broader leaves were recorded from wider inter row spacing. Kutu andAsiwe (2009) explained that plant spacing is an important agronomic attribute which affects light interception by plant during which photosynthesis takes place. It also enables the plants to utilize more effectively the soil moisture and nutrient and avoid excessive completion among the plants (Obi, 1991).

Table 2: Leaf width of Rhodes grass at 3, 6, 9 And 12WAS as affected by nitrogen fertilizer levels and inter row spacing during 2016 and 2017 rainy seasons and the years combined in the dry sub humid zone of Sokoto, Nigeria

	3WAS			6WAS			9WAS			12WAS		
Treatment	**2016**	**2017**	**Combined**	**2016**	**2017**	**Combined**	**2016**	**2017**	**Combined**	**2016**	**2017**	**Combined**
Fertilizer (F) (kgNha^{-1})												
0(F0)	0.32	0.46	0.39^{b}	0.83^{c}	0.76^{d}	0.76^{d}	1.02^{b}	1.17^{c}	1.097^{c}	1.57^{c}	1.57c	1.57^{c}
100(F1)	0.39	0.60	0.49^{ab}	1.58^{a}	1.25^{c}	1.25^{c}	1.75^{a}	1.49^{b}	1.62^{b}	2.00^{b}	1.89^{b}	1.94^{b}
120(F2)	0.49	0.66	0.58^{ab}	1.64^{a}	1.36^{bc}	1.36^{bc}	1.79^{a}	1.69^{a}	1.75^{a}	2.00^{b}	1.98^{b}	1.97^{b}
140(F3)	0.48	0.64	0.39^{b}	1.34^{b}	1.45^{b}	1.45^{b}	1.74^{a}	1.82^{a}	1.86^{a}	2.39^{a}	2.49^{a}	2.48^{a}
160(F4)	0.79	0.66	0.73^{a}	1.79^{a}	1.61^{a}	1.61^{a}	1.86^{a}	1.86^{a}	1.78^{a}	2.46^{a}	2.59^{a}	2.49^{a}
LSD	0.419	75.651	0.213	0.202	0.186	0.136	0.189	0.165	0.126	0.257	0.147	0.145
Significance	NS	NS	*	*	*	*	*	*	*	*	*	*
Spacing (S) (cm)												
30(S1)	0.42	0.57	0.49	1.29^{b}	1.11	1.20^{b}	1.56^{b}	1.60^{ab}	1.58^{b}	2.10	1.93^{b}	2.11
50(S2)	0.47	0.65	0.53	1.40^{ab}	1.15	1.27^{ab}	1.61^{ab}	1.53^{b}	1.57^{b}	2.04	1.99^{b}	2.02
70(F3)	0.59	0.59	0.63	1.50^{a}	1.26	1.38^{a}	1.73^{a}	1.69^{a}	1.72^{a}	2.09	2.18^{a}	2.14
SE	0.114	20.53	0.059	0.055	0.050	0.037	0.051	0.050	0.035	0.069	0.040	0.039
LSD	0.325	58.59	0.165	0.156	0.144	0.105	0.146	0.144	0.097	0.199	0.114	0.112
Significance	NS	NS	NS	*	NS	*	*	*	*	NS	*	NS

Means within a column for factor followed by the same letters are not statistically different at 5% level of probability using Least Significant Difference (LSD)at 5% probability level.*=Significant at 5% probability level,   NS = not significant at 5%probability level.
F= Fertilizer,S = Spacing, F* S = Interaction between fertilizer and spacing
WAS = Weeks after Sowing

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