P-ISSN: 2305-6622; E-ISSN: 2306-3599
International Journal of Agriculture and Biosciences
www.ijagbio.com; editor@ijagbio.com

Research Article

# Effect of Stage of Harvest on Dry Matter Yield and Nutritive Value of *Pennisetum pedicellatum*, *Andropogon gayanus* and *Chloris gayana* as Fodder in Adamawa State, Nigeria

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**Article History:** Received: March 22, 2016 Revised: July 28, 2016 Accepted: August 22, 2016

**ABSTRACT**

The experiment was conducted to evaluate the effect of growth, stage of harvest on dry matter yield and nutritive value of *Pennisetum pedicellatum*, *Andropogon gayanus* and *Chloris gayana* under rain fed condition in Yola, Adamawa State, Nigeria. The field experiment was laid in randomized complete block design with the plot divided into three main plots and replicated three times measuring 5x5m with inter and intra row spacings of 0.5m. The five harvesting stages are 6, 8, 10, 12 and 14 weeks respectively. Growth Was significantly different ($P<0.05$) at all stages of growth for the three grasses except weeks 6 and 7. The dry matter yield was significantly different ($P<0.05$) at weeks 10 and 12, but it was not significantly different at weeks 6, 8 and 14 respectively. Crude protein and ether extract content was highest at weeks 6 and 8, while both declined with advance stages at weeks 10, 12 and 14 respectively for all the grasses. Ash content increases with stage of growth to maximum values at week 14 for all the grasses. ADF and ADF both increases with stage of growth from week 6 to maximum values at week 14 for all the grasses.

**Key words:** *Pennisetum pedicellatum*, *Andropogon gayanus*, *Chloris gayana*, Grasses, Dry matter yield, Crude protein

## INTRODUCTION

In most tropical areas, ruminant livestock in pastoral and extensive mixed systems suffer from permanent or seasonal nutritional stress. The forages on the rangelands in these areas provide feed which are not adequate for the ruminant animals and as a result the the Fulani herdsmen migrate to other places where feed is in abundance. The movement of these Fulani herdsmen on many occasions has resulted to clashes with farmers (Nweze, 2012). In Nigeria, especially in the ruminants producing regions, efforts are not made by the Government to determine the resource available in these regions so as to increase ruminant livestock production and to avoid such clashes. Therefore, since the available feed resources such as the native pastures and crop residues are poor in quality with maturity and provide inadequate nutrients to grazing livestock. Attention by Government should be intensified to cultivate these pastures to enable the animals to have access to it when fresh as it is higher in crude protein content (Herrera, 2004). The intake of these fresh grasses under grazing conditions is a modified expression of voluntary intake and is influenced by guality, availability, harvestibility, environmental stress and management (Huston *et al*., 1991). Grasses like *andropogon gayanus*, *pennisetum pedicellatum* and *chloris gayana* are native to Africa and introduced to all Tropical and sub-tropical countries of the world (Bogdan, 1977). They are palatable and could be fed fresh, as silage or directly grazed on the field (Woodard and Prince, 1991; Woodard et al., 1991). Information on the yield and nutritive value of these grasses as influenced by stage of harvest is not available or scarce, though the species were recommended for use based on prior appraisal of quality assessment. This study was meant to evaluate the effect of stage of harvest and quality of these grasses in Adamawa State, Nigeria.

**Cite This Article as:** TF Mbahi and H Gende, 2016. Effect of stage of harvest on dry matter yield and nutritive value of *pennisetum pedicellatum*, *andropogon gayanus* and *chloris gayana* as fodder in Adamawa State, Nigeria. *Inter J Agri Biosci,* 5(6): 337-340. www.ijagbio.com (©2016 IJAB. All rights reserved)

## MATERIALS AND METHODS

### Experimental site

The experiment was carried out at the Department of Crop Production, Teaching and Research Farm, Modibbo Adama University of Technology, Yola. It is located within latitude $90^0$19'N and longitude $120^0$ 301'E, at an altitude of 185.9m above sea level and lies within Northern Guinea Savanna zone of Nigeria (Bashir, 2002). The soil is sandy loam and Yola has a tropical climate marked by rainy and dry seasons. Maximum temperature can reach 400c particularly in April, while minimum temperature can be as low as 180c with annual rainfall of less than 1000mm.

### Land Preparation and Experimental Layout.

A land of 18.5x16m was cleared, ploughed and harrowed for the ease of planting and germination. The plot was divided into three main plots and replicated three times measuring 5x5m with inter and intra row spacing of 0.5m in a randomized complete block design (RCBD).

### Measurements

The growth of the crops were measured on weekly basis using a meter rule- taking 10 samples per plot starting from week 1 after germination to week 14.

### Biomass yield (kg DM/ha)

The biomass yield was determined by cutting samples per plot starting from week 6 of growth and sub-sequently at two weeks interval up to week 14. Sub-samples were taken for oven drying at 60oc for 48 hours until constant weight for the estimation of the dry matter yield.

### Chemical analysis

Forage were collected, processed and analysed for dry matter by oven drying at 60oc for 48hours. Crude protein (CP) was determined by Kjeldahl method, ash by burning in a furnace at 550oC for 3 hours and crude fat by soxhlet extraction according to A.O.A.C. (2004) method. Acid detergent fiber (ADF) and neutral detergent fiber (NDF) were determined according to Van Soest and Robertson (1985) method.

### Statistical analysis

The results obtained were subjected to analysis of variance of a randomized block design (Steel and Torrie, 1980). The treatment means were separated using least significant difference (LSD).

## RESULTS

### Growth pattern of the three grass species

The growth pattern of three grass species (*Pennisetum pedicellatum*, *Andropogo gayanus* and *Chloris gayana*) is presented in figure 1. The growth in height ranged from 4.37 to170.00cm (*pennisetum pedicellatum*), 3.27 to 209.63cm (*Andropogo gayanus*) and 3.27 to 181.53cm (*chloris gayana*) respectively. The growth was slow but steady from weeks 1 to 7 and thereafter increases with stage of growth to maximum values at week 14 and declines with drop in rainfall and tussling. There was no significant difference (P>0.05) in growth across the treatment groups in weeks 6, 8 and 14, while significant difference in growth (P<0.05) was observed in weeks 10 and 12 respectively.

### Dry matter yield

The data on dry matter yield is summarized in Table 1. Dry matter yield ranged from 2900.00 to 4060.00 (T1), 3500.00 to 6700.00 (T2) and 2500.00 to 5300.00 Kg DM/ha. The growth in all the treatments increases with stage of growth to a maximum values at week 14 and declined . There was no significant difference (P>0.05) in growth across the treatment groups in weeks 6, 8 and 14, while significant difference (P<0.05) was observed in treatments 10 and 12 respectively.

### Chemical composition of the three grass species

### Dry matter

The result of the chemical composition of the grass species is presented in Table 2. Dry matter increased from 20.63 to 58.83, 23.63 to 60.00 and 25.43 to 61.27 from week 6 to maximum values at week14 for all the grasses. Crude protein content ranged from 3.97 to 7.81%, 2.55 to 5.92% and 5.43 to 9.70%. The crude protein content of the grasses decreases with stage of maturity. Ash content ranged from 4.39 to 8.40%, 4.81 to 8.88% and 5.26 to 10.65%. The ash content increases with stage of maturity. Ether extract ranged from 4.87 to 8.21%, 4.99 to 9.17% and 7.60 to 10.49% and decreases with stage of maturity also. ADF content ranged from 12.63 to 36.14%, 16.57 to 40.85% and 14.60 to 35.9% and increases with stage of maturity and NDF content ranged from 32.45 to 54.96%, 13.12 to 35.89% and 15.60 to 45.27% respectively and also increases with stage of maturity.

**Table 1:** Mean Annual Rainfall and Temperature of the Study Area During 2015 Season.

| Month | Rainfall (mm) | Temperature (oc) | |
|---|---|---|---|
| | | Max | Min |
| January | 0.00 | 25.0 | 21.0 |
| February | 0.00 | 29.5 | 23.4 |
| March | 0.00 | 37.2 | 25.0 |
| April | 9.25 | 34.7 | 28.3 |
| May | 25.40 | 37.0 | 26.5 |
| June | 80.15 | 31.6 | 25.0 |
| July | 130.04 | 28.0 | 23.0 |
| August | 150.85 | 30.0 | 24.0 |
| September | 130.28 | 31.0 | 25.5 |
| October | 21.15 | 34.0 | 26.1 |
| November | 0.00 | 35.2 | 22.0 |
| December | 0.00 | 30.0 | 20.5 |

Source: Meteorological Station, Modibbo Adama University of Technology, Yola, Nigeria.

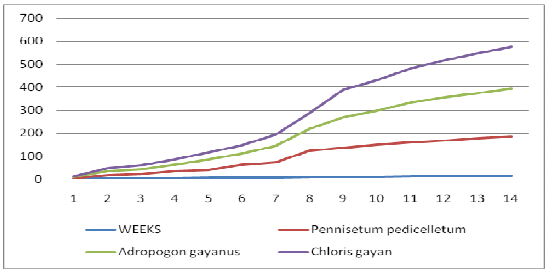


**Fig. 1:** Growth pattern of *Pennisetum purpureum*, *Andropogon gayanus* and *Chloris gayana* (cm).

**Table 2:** Biomass Yield of Three Grass Species (Kg/DM/ha)

| Weeks | *Pennisetum pedicellatum* | *Andropogon gayanus* | *Chloris gayana* | LSD |
|---|---|---|---|---|
| 6 | 2900.00 | 3500.00 | 2500.00 | 1460.11ns |
| 8 | 3010.00 | 4700.00 | 3100.00 | 1798.47ns |
| 10 | 3560.00 | 5410.00 | 3980.00 | 852.00* |
| 12 | 3630.00 | 5690.00 | 4420.00 | 811.39* |
| 14 | 4060.00 | 6700.00 | 5300.00 | 550.92ns |

**Table 3:** Chemical Composition of Grass Species (%DM).

| WK | Treatment | DM | CP | ASH | EE | ADF | NDF |
|---|---|---|---|---|---|---|---|
| 6 | T1 | 20.63 | 7.81 | 4.39 | 8.21 | 12.63 | 32.45 |
| | T2 | 23.63 | 5.92 | 4.81 | 9.17 | 16.57 | 13.12 |
| | T3 | 25.43 | 9.70 | 5.26 | 10.49 | 14.60 | 15.60 |
| 8 | T1 | 26.77 | 7.01 | 4.96 | 8.52 | 14.46 | 39.30 |
| | T2 | 28.10 | 5.15 | 5.34 | 7.60 | 18.15 | 15.56 |
| | T3 | 31.17 | 8.88 | 6.25 | 9.67 | 16.72 | 21.56 |
| 10 | T1 | 40.00 | 5.83 | 5.46 | 6.49 | 21.14 | 41.00 |
| | T2 | 42.23 | 4.30 | 6.23 | 6.93 | 23.15 | 17.18 |
| | T3 | 43.33 | 7.50 | 8.03 | 9.59 | 21.19 | 31.26 |
| 12 | T1 | 47.07 | 4.89 | 7.12 | 5.69 | 28.26 | 52.93 |
| | T2 | 50.45 | 3.46 | 8.00 | 5.10 | 32.00 | 23.56 |
| | T3 | 56.30 | 6.34 | 9.17 | 8.59 | 28.54 | 33.57 |
| 14 | T1 | 58.83 | 3.97 | 8.40 | 4.87 | 36.14 | 54.96 |
| | T2 | 60.00 | 2.55 | 8.88 | 4.99 | 40.85 | 35.89 |
| | T3 | 61.27 | 5.43 | 10.65 | 7.60 | 35.90 | 45.27 |

## DISCUSSION

The growth pattern for the three grass species (*Pennisetum pedicellatum* , *Andropogon gayanus* and *Chloris gayana*) in this study were consistent and slow at the early stages from weeks 1 to 7 and thereafter increases gradually to the peak at weeks 12 and 13, then declines at week 14 as a result of tassling, seed production and drop in rainfall. *Chloris gayana* exhibits better growth, followed by *Andropogon gayanus* and least with *Pennisetum pedicellatum* but the growth was steady. Growth pattern of the grasses in this study is in agreement with the earlier reports by Hong et al. (1987), Ibrahim et al. (2006) and Tessema (2008) who reported that the significant growth observed was because the grasses were planted sole and was not in mixtures which reduces competition for nutrients and sun light. The dry matter yield among the three grass species increases with stage of growth and significant differences ($P<0.05$) were observed in treatments 10 and 12, while treatments 6, 8 and 14 showed no significant differences ($P>0.05$). The differences in dry matter yield among three grass species also could be associated to the plant height or size at maturity. Similar findings was reported by Tewedoros and Messert, 2010, but disagree with Mero and Uden (1998) who recorded lower values as reported by this authors.

Tessema (2008), Murphy (2010) and Ecocrop (2014) reported similar findings and concluded that any differences observed among such plants could be associated with location, soil fertility, season, climatic and environmental factors. Crude protein content of the grasses decreases with cutting days or stage of growth to the lowest values at week 14, and the drop is sharp when the grasses are not in association with leguminous crops. The result in this study agrees with the earlier reports by Kidunda *et al*. (1990) ; Van Soest (1994); Seyoum *et al*. (1998); Tessema *et al*. (2002) and all attributed to the dilution of the crude protein contents of the forage crops to the rapid accumulation of cell wall carbohydrates at the latter stages of growth. The ash content of the grasses increases to a maximum values at week 14 for all the grasses. The effect of leaf shattering also increased the proportion of leaves to stem ratio in the samples and hence the ash. The values obtained are comparable to the reports by Aye and Adeyeye, 2002; Aye, 2002; Arigbede *et al.,* 2002 with *panicum maximum*. Ether extract content of the grasses reduces with stage of growth to lowest values at week 14. The values obtained in this study agrees with the earlier reports by Aye and Adeyeye, 2002; Aye, 2002; Arigbede *et al*., 2002 with *panicum maximum.* Acid Detergent Fibre (ADF) and Neutral Detergent Fibre (NDF) in this study increases with stage of maturity and similar to the reports by Seyoum *et al*. (1998); Tessema *et al.* (2002) and Adane (2003) with *pennisetum pedicellatum* and stated that grasses sown alone have higher ADF and NDF than those sown in association with legumes. The increased in nutritive value of the grasses in association also increase intake and digestibility when fed to animals (Van Soest, 1994 and McDonald et al., 2002).

## Conclusion

The study carried out to evaluate the growth, dry matter yield and nutritive value Pennisetum pedicellatum, *Andropogon gayanus* and *Chloris gayana*. Growth was higher with *chloris gayana* followed by *Andropogon gayanus* and least with *Pennisetum pedicellatum,* while *Andropogon gayanus* produced highest dry matter and least with *Pennisetum pedicellatum*. Crude protein and ether extract reduces while ADF and NDF increase with stage maturity. The grasses could best be harvested between weeks 10 and 12 respectively when dry matter and nutritive values are moderate before leaf shattering and drop in quality.

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