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# GRASSES: PRODUCTION AND MANAGEMENT FOR SUSTAINABLE LIVESTOCK INDUSTRY

By

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All Non - Teaching Staff,
Gentlemen of the Press,
Distinguished Ladies and Gentlemen,
Great FUNAABITES !

## 1.0 INTRODUCTION

In the beginning God created the heavens and the earth (Genesis 1:1). On the third day, He gathered the waters on one side so that dry land can appear. In verse 11, on the same third day God said "Let the earth bring forth grass, the herb yielding seed...". On the sixth day, He made the earth to bring forth cattle, creeping things and beast after their kinds. Man was the last to be created that same day and was made to have dominion over all living things. How can man / mankind manage the different creatures under his control?

This lecture will focus on the aspects of production and management of grasses and animals. Grasses in this context refers to forage-based feeds (grasses, forbs, browse plants, fodders) grazed, browsed or fed to livestock in the natural and sown pastures.

Mr. Vice Chancellor Sir, the number of inaugural lectures given in this discipline in Nigeria so far are two, the first was presented in the University of Ibadan by Professor M. E Aken'Ova in 2003 and the second in Abubakar Tafawa Balewa University, Bauchi by Prof. Yahaya Shehu in 2006. Therefore, I count it a great privilege to stand here to present the third inaugural lecture in the discipline of Forage Production and Utilization in Nigeria. Coming back home, this is the ninth lecture from the College of Animal Science and Livestock

Production and the very first one to be presented from the Department of Pasture and Range Management.

### 1.1 My background

My interest in agriculture started while in the Baptist Day Primary School Offa, Kwara State, My usual practice was to go to the farm with the family of my father's aunt, the Olafimihans. My late father also loved gardening and poultry keeping usually around the homestead. He planted different vegetables and fruit trees which the children assisted in maintaining. I took interest in both crop and livestock production as co-curricular activities in the secondary school since there was no such course. On completion of the pre-degree at the School of Basic Studies, Ahmadu Bello University Zaria, I was admitted to the Faculty of Agriculture of the same University for the B. Sc. Degree. My appointment and posting to the Forage and Crop Residue Research Programme in National Animal Production and Research Institute (NAPRI) after the NYSC scheme was God ordained. I have no regrets at all. Some people thought I might not go far in academics or research work but God alone be praised for who I am today. My believe is that "With God nothing shall be impossible" (Luke 1: 37).

### 1.2 Importance of Forages

The importance of forages are seen in all aspects of life and formed a chain or link in the soil - plant - animal inter rela-

tionships:

**As soil stabilizers**:
Fodder crops are among those species cultivated to replenish soil fertility after years of continuous cultivation of food crops on the same piece of land (Tarawali and Ikwuegbu 1993; Mohammed - Saleem, 1995). The densities of earthworm were substantially higher in rotations of cereals with a volunteer pasture phase than under continuous cropping with cereals and grain legumes ( Burkerfield, 1993 ). When the vegetation, especially those of the legumes are ploughed back as green manure, it enhances the soil nutrients (Fig. 1a). In alley farming, the pruning of browse species when incorporated into the rows also increases soil nutrients.

**As Cover crop:**
Legumes are used as rotational crops to reduce soil borne diseases (Weber *et al*. 1995; Peters *et al.* 2001), or as cover crops to retain nutrients through reduced erosion and reduced weed invasions (Akobundu and Posi 1984 ; Weber *et al*. 1995; Mwangi *et al*. 2006) and as green manure to increase soil Nitrogen and improve conditions Fig. 1b).

**As Erosion control:**
Pasture species that cover the ground surface at a faster rate than others are used to prevent and control erosion in the

farmlands, on lawns and degraded areas (McCowan *et al*. 1986; Tarawali, 1991) (Fig. 1c). Some species that are commonly utilized for this purpose include the following grasses : *Cynodon spp, Brachiaria decumbens*, *Digitaria smutsii, Chloris gayana;* and legumes such as: *Calopogonium mucunoides, Peuraria phaseoloides, Chaemacrista rotundifolia*, *Mucuna pruriens* and *Arachis pintoi.*

**As feed for ruminants:**
For ruminant animals, these include: herbaceous grasses and legumes, multipurpose trees and shrubs (woody species) and other plant materials. Forage based feeds form a significant proportion of intake by domesticated and wild animals and are the cheapest source for ruminants (Fig. 1d).

**As Feed for non - ruminants:**
Some forage plants are rich in vitamins and minerals which can replace the ones from chemicals sources thus the use of forages in organic agriculture. Pasture legumes provide forage as fresh cut or for processing as dried leaf meal for livestock (Liu *et al*. 1997). The leaf meal of Stylo increased pig live weight gain by 0.5 to 0.9 kg/ day when the legume made up 10 to 20 % of the diet by weight. Chicken live weight was also significantly increased by 35 - 45 g/ day when 5 to 12 % was substituted by forage in diet for wheat and corn (Bai *et al*. 2014) (Fig 1e).

**As Medicinal purposes:**
Most of the medicinal plants utilized by human beings are part of the species that are available in the grazing land for different classes of livestock (Fig. 1f). These are grazed consciously by the animals through instinct. When some of these species are grazed above the required quantities, the animal comes down with symptoms of known or unfamiliar physiological disorders. *Cynodon dactylon* (Bermuda grass) is used as antiviral and antimicrobial ( Gyanunlimited, 2014). All parts of Mucuna are known to possess high medicinal value (Sridhar and Bhat, 2007).

**Others uses:**
Forage plants are also useful in Recreational, Turf, Ornamental (Fig. 1g), Shelter, Natural pesticide and as Traffic and warning signs on the road and as Fuel wood in many homes.

**a. Soil stabilizer**

**b. Cover crop**

**c. Erosion control**

**d. Feed for ruminants**

**e. Feed for non ruminants**

**f. Medicinal purposes**

**g. Other uses**

**Figure 1: Uses and Importance Of Forages**

### 1.3 History of Pasture Research and Development in Nigeria.

Forage evaluation has a relatively long history in Nigeria. In Northern Nigeria, forage species were first evaluated in 1935 (Agishi, 1983). This development led to the need to focus on pasture, grassland management and more cooperation between livestock and traditional crop farmers. Between 1956 and 1961, about 271 pasture species were evaluated at various centers in the sub - humid zone. At Shika Research Station, referred to as the National Animal Production Research Institute, 97 legume species were evaluated between 1956 and 1977. Fifty four species were found adaptable to the different zones of the Nigerian savanna and 18 species were recommended for large scale production and use.

### 1.4 Contributions of Livestock Industry to National Economies.

The population of ruminant livestock in Nigeria as at 2013 was estimated at 40.834,000 goats, 19,590,000 sheep and 16,286,000 cattle ( FoS, 2013 ). The contribution of agriculture to GDP of Nigeria was 22 % while livestock contributed 30 % of this total.

Agri - business accounts for 22 % of the GDP in Brazil (Apex Brazil, 2015). Livestock export made up to 30 % of this total. Brazil has the fifth largest land area and size of population

202 millions globally exported US $ 6.7 billion of beef in 2013. The beef export of the country grew by 958 % over a period of 15 years. Suffice it to note that 19.2 % of the national territory is occupied by productive pastures.

The top ten producers dominating the beef market include: USA, Brazil, European Union, China, India, Argentina, Australia, Mexico, Pakistan and Russia ( Fig. 2). These accounted for more than 80 % of the exports.

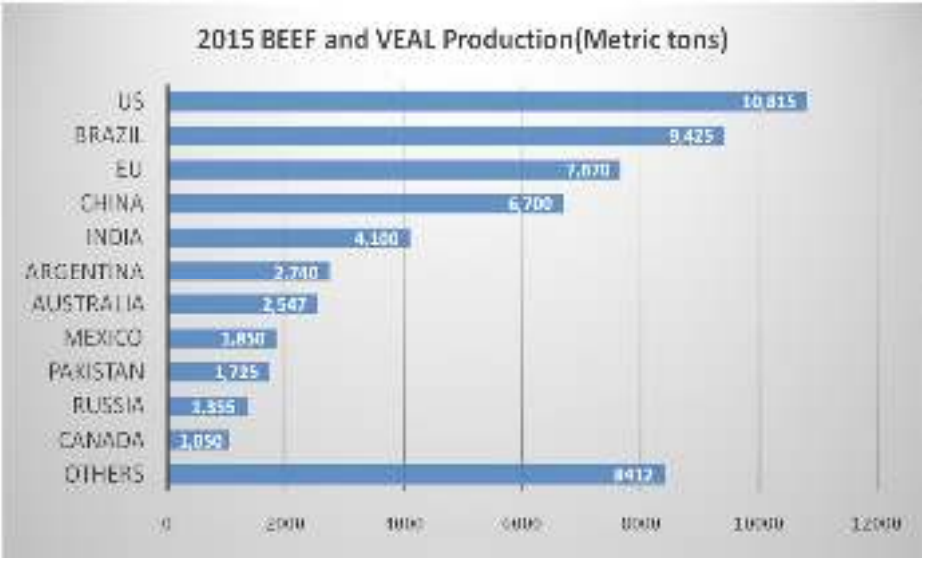


**Fig.2: Beef and veal production (metric tons) in 2015**
Source: FAS/USDA, (2015)

The total beef exports for Botswana in 2013 amounted to US $ 116.6 million (0.3 % of world's export share) and was ranked 22nd and 28th in world export of frozen and chilled beef , respectively (ITC Trade map). South Africa ranks 13th globally in beef production in 2015 (FAS / USDA 2015). No other African country was ranked in the first 50 exporting countries.

New Zealand ranked 5th globally in beef and veal export after India, Brazil, Australia and USA ( Fig.3) while South Africa, the only nation in Africa, ranked 14th out of 32 countries enumerated.

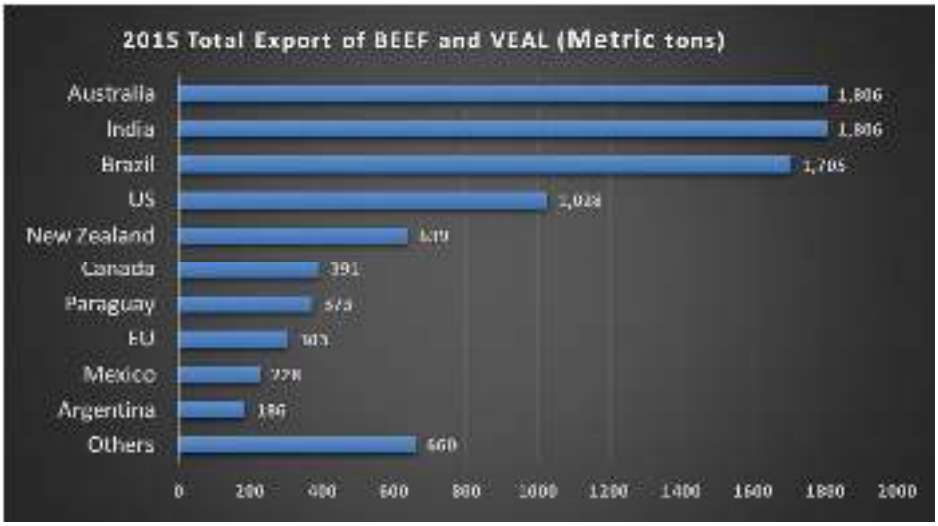


**Figure 3: Total export of beef and veal (metric tons) in 2015**

Source: FAS/USDA, (2015)

### 1.5 Guidelines for the Establishment of Pastures for Grazing Animals.

Many established pastures do not last long because certain steps were neglected. In order to avoid any loss and failure, the following guidelines are suggested:

**Plan ahead**. Adequate provision of forage feed should be made before acquiring ruminant animals. Pasture fields should be in place at least six months before animals arrive or grazing commences. Decision on the purpose of establishment (grazing, conservation *etc*) should be considered first (Fig. 4, 5 &6).

**Figure 4: Tractor Baling Hay**

**Fig 5: Baled Hay**

**Figure 6: Bunker Silo**

F**ertilizer needs.** Prior to sowing, the quantities of Nitrogen, Phosphorus and Potassium required for grass and quantities of P and K for legumes and mixed swards should be known. Other elements will be required depending on soil analysis.

**Correct variety.** The climatic condition (rainfall, temperature, humidity, day length etc) will influence the choice of species that will grow and perform well in any location.

**Use quality seed.** Obtain seed from a reputable source. An analysis of the quality of the seed is also desirable. The analysis will indicate the purity, that is, the percentages of sown variety,

other crops and weeds, of inert matter (straw, stone/ soil etc) and broken seeds. Germination details of percentage germinable and hard seeds should be known. Low viability of seeds will result in poor germination and establishment. Percentage of live seeds for grasses can also be determined from the seed analysis or from the label.

Some legumes possess hardseededness - which means they have impermeable seed coat (testa). Such seeds can be broken down with the use of sand paper (abrasives), hot water, low concentration of sulfuric acid or dry heat. Different and specific methods are, however, applicable to different species. Legume species that require other strains of the nitrogen fixing bacteria (*Rhizobium*) should be noted else the plant will not be able to fix nitrogen.

**Land preparation.** The aim should be to provide a moist condition for germination and to minimize competition for the new seedlings. The major operations involved are:
clearing of land, ploughing and harrowing.

**Sowing.** The general rule is to plant large size seeds deeper than the small sized ones which are sown close to the surface and covered lightly.

**Weed management**. Weeds compete with the sown species

and reduce productivity of the pasture. If the seed is sown into a weedy seed bed and grazing is not controlled, weeds will have adverse effects on forage production.

## 2.0 CONTRIBUTIONS TO KNOWLEDGE

My career started in the National Animal Production Research Institute (NAPRI) Shika, ABU, Zaria (established as Shika Stock Farm in 1928). I started as a novice because the number of scientists in the discipline is countable on the fingertip and activities were limited to three tertiary institutions in the country. It was rough initially but I quickly found my feet with the assistance of a Dutch, Mr. Peter de Leeuw, Prof. J.O.Akinola and late Prof. E C Agishi. I was involved in research, training and extension in forage agronomy and utilization. In July 2000, I joined the services of FUNAAB focusing more in research and training.

The Vice - Chancellor Sir, distinguished ladies and gentlemen, I want to humbly highlight my contributions to knowledge in the production and management of forage feed for livestock.

## 2.1 PASTURE SEED INDUSTRY FOR LIVESTOCK PRODUCTION

### 2.1.1 Studies On Germination Of Forage Seeds

Seeds form the foundation for good establishment of pasture species. The initial germination and subsequent growth of the plant species are determined from the quality of the seeds.

The seeds of the following species were evaluated to enhance their germination and initial growth on the field.

**a. *Centrosema pubescens* ( Common Centro )**

Omokanye and Onifade (1993) stored Centrosema seeds at room temperature in cloth bags for up to 76 months before scarification in hot water, 98$^{o}$C for 2 to 10 minutes. The germination study revealed that testa impermeability (hardseededness) persisted regardless of time of scarification in hot water (Table 1) and storage period ( Table 2 ). The proportions of hard and dead seeds decreased and increased, respectively as the time of scarification increased.

**Table 1: Effects of scarification time on germination characteristics ( % ) of Centrosema seed**

| Time (min) | Germination | Hard seed | Dead seed | Soft seed |
|---|---|---|---|---|
| **0** | 23.5 | 38.3 | 18.9 | 18.1 |
| **2** | 31.3 | 22.3 | 31.6 | 13.5 |
| **4** | 33.3 | 16.9 | 35.9 | 13.9 |
| **6** | 19.3 | 15.6 | 50.5 | 15.4 |
| **8** | 16.5 | 14.5 | 58.3 | 9.5 |
| **10** | 10.2 | 12.4 | 62.6 | 14.0 |
| **CD** | 4.7 | 9.1 | 10.9 | 3.3 |

Source: Omokanye and Onifade, (1993)

**Table 2: Effects of duration of storage on germination characteristics ( % ) of Centrosema seed**

| Storage period (Months) | **76** | **63** | **41** | **18** | **4** | **CD** |
|---|---|---|---|---|---|---|
| **Germination** | 9.8 | 15.3 | 29.4 | 30.1 | 27.2 | 9.4 |
| **Hard seed** | 8.5 | 3.6 | 9.2 | 27.0 | 57.7 | 19.5 |
| **Dead seed** | 58.9 | 62.5 | 49.6 | 31.3 | 12.5 | 9.9 |
| **Soft seed** | 22.5 | 15.9 | 10.8 | 10.0 | 9.5 | 7.2 |

Omokanye and Onifade, (1993)

On the other hand, with an increase in storage period, the percentages of hard seeds declined while that of dead seeds increased.

The maximum germination (70 %) was from seeds scarified for 4 min after 18 months of storage. While hard seeds declined, the proportion of soft seeds increased with time of scarification. The ideal storage conditions involved constant temperature and humidity which could not be guaranteed in the country. There is a need for provision of adequate storage for forage seeds to minimize wastage of resources. For short term storage seeds are dried and placed in sealed containers at 5$^{o}$C. They are stored at temperatures below freezing for long term preservation (- 20 $^{o}$C, including the use of crypreservation or freezing in or over liquid Nitrogen at - 180$^{o}$C for extremely long – term storage.

**b. *Leucaena leucocephala* L (Leucaena )**

In another study (Omokanye *et al*., 1995), the germination of *Leucaena leucocephala* seeds treated and stored for 0 to 15 months (Fig 4) increased with period of storage.

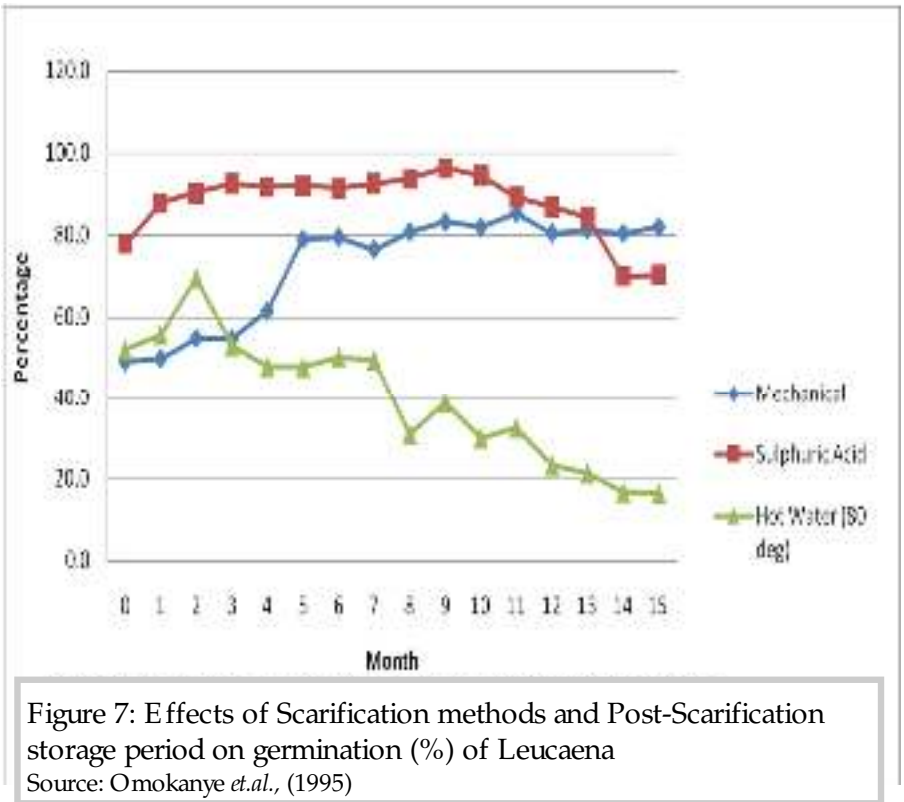


Figure 7: Effects of Scarification methods and Post-Scarification storage period on germination (%) of Leucaena
Source: Omokanye *et.al.,* (1995)

In addition, germination was better for seeds treated mechanically (with Emery paper) than those immersed in sulfuric acid for 25 min. The practical implication of this is that public and private seed companies can sell seeds / distribute the seeds to farmers a year before sowing or to sow within a year of purchase or receipt.

### c. *Albizia saman* ( Rain tree)

Rain tree (*Albizia saman*) is the first big tree on the right beside of the main gate on entering to the FUNAAB campus. The pulpy pods with 15-20 seeds are relished by pastoral animals. A trial was carried out to determine the recovery and percentage germination of rain tree seeds at different intervals after ingestion by cattle (Jolaosho *et al.,* 2006). Three breeds of cattle, namely *N'dama, Muturu* and *White Fulani* were fed with pods containing 1000 seeds. Over a 96-hour period, the total numbers of seeds recovered from *N'dama* and *Muturu* were similar but higher (P<0.05) than seeds from *White Fulani*

**Table 3: Number of Seeds Recovered from Cattle Faeces**

| Retention time (h) | Animals Breeds | | | |
|---|---|---|---|---|
| | *Muturu* | *N'dama* | *White Fulani* | Average |
| 24 | 72 | 35 | 15 | 41[b] |
| 48 | 260[b1] | 318[a] | 165[c] | 247[a] |
| 72 | 58 | 48 | 47 | 51[b] |
| 96 | 65 | 25 | 56 | 49[b] |
| Total | 455[a] | 426[a] | 283[b] | 388 |

Source: Jolaosho *et al.*, (2006)

Source: Jolaosho *et al.*, (2006)
[1] Values followed by different letters in the same row and column are significantly different at $P \leq 0.05$.

There was a distinct peak in excretion of seeds during the 30-48 hours after ingestion. The recovered seeds were subjected to germination test for 45 days. A similar pattern was observed for the percentage cumulative germination of seeds after 24, 48, 72 and 96 hours of ingestion. Germination started from Day 2, slowed down after 20 days and ceased between 35 and 40 days after sowing. Seeds recovered from faeces had higher germination percentages than the control (Table 4).

**TABLES 4: Number of Germinated Seeds from Cattle Faeces**

| Retention time (h) | Animals Breeds | | | |
|---|---|---|---|---|
| | *Muturu* | *N'dama* | *White Fulani* | Untreated |
| 24 | 43 (59.9)[1] | 10 (28.8) | 7 (48.9) | 9 (31.0) |
| 48 | 108 (41.7) | 127 (39.9) | 73 (44.1) | 20(48.8) |
| 72 | 27 (47.1) | 25 (51.0) | 23 (49.3) | 103(41.7) |
| 96 | 38 (58.5) | 14 (57.3) | 35 (61.5) | 25(49.0) |
| Total | 216 (47.5) | 176 (41.3) | 138 (48.8) | |

Source: Jolaosho *et al.*, (2006)
Values in parentheses are percentages of the number of seeds recovered

Seeds recovered from faeces of *White Fulani, Muturu* and *N'dama* were 44-62%, 41-60% and 28 - 57 %, respectively. This implies that the seeds of *A. saman* can be introduced to an area by confining the animals for 48 to 96 hours after ingestion of seeds pods. On the other hand, if the seeds are not required in an area, animals should be excluded from such areas at least 96 hours after ingestion of the pods.

## 2.2 YIELDS OF RHODES GRASS/ STYLO MIXED SWARD AS LIVESTOCK FEED

The compatibility of two perennial species: Rhodes grass (*Chloris gayana* cv. Callide) and Cook Stylo (*Stylosanthes guianensis* cv. Cook) was reported by (Onifade and Akinola, 1986 ) where the seeding ratio favoured the Stylo. The study showed that mixed grass / legume swards (6:4, 4:6 and 3:7) yielded higher total (grass + legume) herbage than the sole grass or legume swards over a 2 - year period (Table 5).

**Table 5. Effects of seeding ratio and sowing method on total DM yield (t/ ha) of Rhodes grass and Stylo over two years**

| Ratio / Method | 10: 0 | 7: 3 | 6: 4 | 5 :5 | 4 :6 | 3 : 7 | 0 :10 | Mean |
|---|---|---|---|---|---|---|---|---|
| Alternate | 5.77 | 6.24 | 6.48 | 6.43 | 6.52 | 6.52 | 3.96 | 6.01$^{ab}$ |
| Broadcast | 5.96 | 6.87 | 7.27 | 6.78 | 6.86 | 7.40 | 4.94 | 6.58$^{a}$ |
| Mixed | 5.59 | 5.49 | 6.31 | 6.00 | 6.44 | 6.65 | 3.84 | 5.76$^{b}$ |
| Mean | 5.78$^{b}$ | 6.26$^{ab}$ | 6.69$^{a}$ | 6.40$^{ab}$ | 6.60$^{a}$ | 6.86$^{a}$ | 4.24$^{c}$ | |

a, b, c.= Means in the same column or row with different letters are significant ( P< 0.05)
Source : Onifade and Akinola, ( 1986 )

Broadcasting the seeds favoured dry matter (DM) yield of sole Stylo. On the other hand, yields were similar with the three methods for the sole Rhodes grass. The period of growth was over 120 days in each of the years. With respect to crude protein (CP) content, sowing method had no significant effect on the values for both species. The values at the end of the 120 days for the grass and legume ranged from (3.4 to 3.7 %) and (9.7 to 10.7 % ), respectively.

## 2.3 TEPHROSIA AS FEED FOR SMALL RUMINANTS

One of the prominent uncultivated indigenous herbaceous legumes in the sub humid zone of Nigeria is *Tephrosia bracteolata*. Though an annual, the legume is widely fed to small ruminants in the fresh and dried forms during the wet and dry seasons, respectively (Figures 8 & 9).

A preliminary study was designed (Onifade *et al*. 2005) to provide information on the agronomic management of this forage legume with potentials for increasing feed supply for small ruminants. The observed increase in plant height (over a 12week period) and density (0 to 3 weeks after sowing) with increasing seeding rate suggests a response to increased competition for space, water and nutrients at a rate higher than 15 kg / ha (Table 6).

**Figure 8: Tephrosia**

**Figure 9: Sheep eating Tephrosia tied to a tree**

**Table 6 Effects of sowing method and seed rate on density and height of *T. bracteolata***

| Seed rate (kg/ha) | Sowing method | Density (plant/m$^2$) | Height (cm) |
|---|---|---|---|
| 5 | Broadcasting | 5.2 $^{d}$ | 20.9$^{ab}$ |
| | Drilling | 6.9$^{cd}$ | 19.4$^{bc}$ |
| 10 | Broadcasting | 8.4$^{bc}$ | 17.2$^{c}$ |
| | Drilling | 10.1$^{b}$ | 22.5$^{ab}$ |
| 15 | Broadcasting | 13.1$^{a}$ | 23.0$^{a}$ |
| | Drilling | 10.0$^{b}$ | 23.1$^{a}$ |
| SEM | | | |

a, b, c Means in the same column with different superscript are significant ( P< 0.05)

Source : Onifade *et al.*, (2005)

The differences between dry matter yields of leaf, stem and total at the least and highest seed rates were significant while yields at 10 kg / ha seed rate were intermediate (Table 7).

**Table 7: Leaf, stem and total DM yields (kg/ ha) of *Tephrosia bracteolata* at different seed rates and sowing methods between 4 and 12 weeks after planting**

| | WAP | | | |
|---|---|---|---|---|
| Seed rate (kg/ha) | 4 | 8 | 12 | Mean |
| Leaf | | | | |
| 5 | 221.5 | 357.9 | 454.3 | 344.6$^{b}$ |
| 10 | 252.6 | 400.0 | 543.3 | 398.6$^{ab}$ |
| 15 | 305.1 | 539.6 | 616.2 | 487.3$^{a}$ |
| Mean | 260.1$^{c}$ | 432.5$^{b}$ | 537.9$^{a}$ | |
| Stem | | | | |
| 5 | 130.6 | 249.8 | 598.1 | 326.2$^{b}$ |
| 10 | 137.6 | 314.9 | 722.3 | 391.6$^{ab}$ |
| 15 | 189.7 | 301.0 | 816.3 | 435.7$^{a}$ |
| Mean | 152.6$^{c}$ | 288.6$^{b}$ | 712.1$^{a}$ | |
| Total | | | | |
| 5 | 352.0 | 606.0 | 1052.4 | 670.8$^{b}$ |
| 10 | 390.2 | 714.1 | 1265.6 | 790.2$^{ab}$ |
| 15 | 495.8 | 840.5 | 1432.5 | 922.9$^{a}$ |
| Mean | 412.7$^{c}$ | 720.2$^{b}$ | 1250.1$^{a}$ | |

Means with different superscripts in the same row or column for each component differ significantly ($P<0.05$). WAP = Weeks after planting
Source: Onifade *et al.,* (2005)

Broadcasting seeds resulted in higher leaf and total DM yields than drilling in rows. The corresponding DM yields were 853 and 740 kg/ ha. Total DM yield of the legume increased from 413 to 1250 kg / ha at 3 and 12 weeks after sowing, respectively.

Sowing methods did not have any influence on the CP and Ash contents in the plant. Crude protein contents in the leaf ranged from 14 to 18.4 % while the range for Ash was from 5 to 12.4 %. The crude protein and ash contents of stem and leaf of *T. bracteolate* were not affected by sowing methods and seeding rate (Onifade *et al.,* 2005). The contents of CP in leaf ranged from 9.6 to 19.3% in the broadcasted plots and from 12.7 to 17.5% in the drilled plots. The corresponding CP values for stem were (2.6 to 7.0%) and (2.6 to 6.2%) over the 12 week period. The contents of CP and Ash in the forage declined with age of plant.

For fodder production, broadcasting the seeds of *T. bracteolata* at 15 kg / ha will give greater total DM yield than drilling the seeds.

## 2.4 USE OF ORGANIC MANURE ON GRASS SPECIES

The use of organic to complement expensive inorganic manure is accepted and widely practiced in crop-livestock sys-

tems in Nigeria. However, for the natural pastures, there is little or no deliberate effort to enhance their production. Guinea grass (*Panicum maximum*) is one of the dominant grass species in the rangeland of the sub - humid, thus the need to evaluate the responses of two varieties ( local and Ntchisi ) of the grass to cowdung (Onifade *et al*., 2005) and to poultry and sheep and goat manures (Onifade *et al*., 2011).

The manures were applied at rates equivalent to 0 and 30 kg N/ha. The crown splits of both varieties were planted in May, 2002 and manured one week after planting (WAP).

Plant heights reached a maximum at 16 WAP with poultry manure. The reduction in height beyond 16$^{th}$ week was due to the effect of lodging and as the plant reached the reproductive stage. Over the 20- week period, plant heights were highest (150 cm) with the local variety which received poultry manure and least (88 cm) for the Ntchisi without manure. The faster mineralization and hence earlier uptake of nutrients by the plants from poultry manure than the other manure was exhibited by the local variety at early growth stage.

**Table 8 : Yields ( t DM/ ha) and crude protein contents (%) of the grasses during the growing season**

| WAP | Ntchisi 4 | Local 4 | Ntchisi 8 | Local 8 | Ntchisi 12 | Local 12 | Ntchisi 16 | Local 16 |
|---|---|---|---|---|---|---|---|---|
| Control | 0.22$^{b}$ | 0.18$^{b}$ | 1.26$^{c}$ | 1.17$^{b}$ | 1.82$^{b}$ | 1.47$^{c}$ | 1.58$^{c}$ | 1.48$^{c}$ |
| Poultry | 0.40$^{a}$ | 0.46$^{a}$ | 1.59$^{bc}$ | 1.35$^{b}$ | 3.01$^{a}$ | 3.07$^{a}$ | 2.29$^{b}$ | 2.92$^{b}$ |
| Sheep+ Goats | 0.37$^{a}$ | 0.42$^{a}$ | 3.60$^{a}$ | 3.30$^{a}$ | 3.49$^{a}$ | 1.97$^{b}$ | 5.65$^{a}$ | 4.61$^{a}$ |

Leaf Crude protein (%)

| WAP | Ntchisi 4 | Local 4 | Ntchisi 8 | Local 8 | Ntchisi 12 | Local 12 |
|---|---|---|---|---|---|---|
| Control | 11.2 | 11.5 | 10.1 | 9.6 | 9.2 | 8.9 |
| Poultry | 15.9 | 14.6 | 14.1 | 13.4 | 12.7 | 11.9 |
| Sheep+ Goats | 15.2 | 14.8 | 13.7 | 12.8 | 12.3 | 11.4 |

Means with different superscripts in the same column for each component differ significantly ($P<0.05$).
Source: Onifade *et al.,* (2005)
WAP: weeks after planting

Yields of grasses with manures were higher than the control (Table 8). Yields at 4 WAP were mainly of leaf. Total herbage production for Ntchisi was better than the local variety. The higher quality of poultry manure did not significantly enhance forage yields due to rapid rate of mineralization and loss through volatilization and grazing by stray animals during the trial period.

## 2.5 PRODUCTIVITY OF GRAZED PASTURE USING SHEEP

### 2.5.1 FORAGE YIELD COMPONENTS

One of the ways of managing livestock on pasture for optimum production without adverse effect is through the grazing system adopted. The animals could be managed on the natural or sown pastures covering different hectarages. Borders are necessary to keep livestock within the property and to ensure efficient utilization of the pasture by the animals.

With information from grazing trials, the number of animals a given pasture will support for a period of time could be estimated. This type of trial is rare and limited to research institutes/stations in Nigeria because of the facility and time (years) required and for good prediction of pasture productivity.

Grazing trials by Adegbola and Onayinka (1968) at Fashola, de

Leeuw and Brinkman (1974) Agishi (1979) and Okeagu (1981 and 1990) at Shika were with cattle on sown or natural pastures. The animals were supplemented with concentrate especially during the dry season. A summary of results from grazing trials during the rainy season in Shika at various stocking rates (1.0 to 6.8 head/ha) showed that average daily gain varied from 0.15 to 0.76 kg/head on rangeland and on *Digitaria smutsii*, respectively. The response of small ruminants in grazing trials in Nigeria was not available.

A trial was therefore conducted over a - 5 year period aimed at providing basic information for small and large scale farmers regarding the productivity of Rhodes grass-stylo pasture at different stocking rates (Onifade *et al.*, 1993 and 2002). Yankasa sheep were set stocked (continuous grazing) on the pasture at the rate of 12, 18, 24, 30 and 36 animals/ha for 154 to 210 days in each of the grazing period. The grazing period commenced from late rainy into the dry season (August to April) in the dry sub - humid zone of Nigeria. The herbage mass of stem, leaf and leaf + stem of Rhodes grass, green material and total herbage were highest in the ungrazed plot (control) and declined as stocking rate and grazing days increased (Fig 10).

Stocking rate had no significant effect on dead material in the first grazing period (GP 1) because the trial was conducted in

the dry season ( Table 9 ). At other periods, production of dead material was least in the control and highest at the 12 sheep/ha. The weight of dead material increased with days spent on pasture. On the other hand, leaf mass of *C. gayana* on offer declined ($P<0.05$) as stocking rate (SR) and duration of grazing increased. The proportion of stylo declined and was virtually eliminated due to high competitive ability of *C. gayana*, the grazing of the stylo on a continuous basis and late stocking of pasture in each period (Fig 11).


**Fig 10: Sheep grazing**

**Fig. 11: *Chloris gayana***

### 2.5.2 Live - weight Gain per Head (g/ head/ day)

Daily live - weight gain (LWG/hd) showed a negative linear relationship with stocking rate (Onifade *et al.,* 2002). Differences in LWG among stocking rates in the first grazing period were not significant ( Table 10 ). The LWG at 24 and 30 animal/ha were similar in all the grazing periods. Sheep at the lowest SR had better (P< 0.05) LWG than those at the highest SR.

**Table 9 : Effects of stocking rate (SR) and grazing duration on mean dry matter yields of green material and leaf of *C. gayana***

| SR (sheep/ha) | Green material (t/ha) | | | | | Leaf (t/ha) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Grazing period | | | | | Grazing period | | | | |
| | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| Control | ND | 8.7$^{a}$ | 8.8$^{a}$ | 8.9$^{a}$ | 8.5$^{a}$ | ND | 1.8$^{a}$ | 1.6$^{a}$ | 1.6$^{a}$ | 2.1$^{a}$ |
| 12 | 9.4$^{a}$ | 7.0$^{b}$ | 7.6$^{a}$ | 7.3$^{b}$ | 7.1$^{b}$ | 1.2$^{a}$ | 1.0$^{b}$ | 1.2$^{a}$ | 0.9$^{b}$ | 1.4$^{b}$ |
| 18 | 8.8$^{ab}$ | 7.0$^{b}$ | 7.2$^{ac}$ | 7.0$^{bc}$ | 6.8$^{c}$ | 1.1$^{ab}$ | 1.0$^{b}$ | 1.1$^{bc}$ | 0.7$^{bc}$ | 1.2$^{c}$ |
| 24 | 8.6$^{ab}$ | 6.5$^{bc}$ | 7.3$^{bc}$ | 6.8$^{c}$ | 6.6$^{cd}$ | 0.9$^{ab}$ | 0.9$^{b}$ | 1.0$^{bc}$ | 0.7$^{bc}$ | 1.1$^{cd}$ |
| 30 | 8.5$^{ab}$ | 6.3$^{cd}$ | 6.8$^{c}$ | 6.6$^{c}$ | 6.3$^{de}$ | 0.9$^{ab}$ | 0.9$^{b}$ | 0.9$^{c}$ | 0.6$^{c}$ | 1.0$^{d}$ |
| 36 | 8.3$^{b}$ | 5.9$^{b}$ | 6.8$^{c}$ | 6.3$^{d}$ | 6.1$^{e}$ | 0.8$^{b}$ | 0.7$^{c}$ | 0.9$^{c}$ | 0.5$^{c}$ | 1.0$^{d}$ |
| SEM | 0.33 | 0.12 | 0.14 | 0.10 | 0.47 | 0.09 | 0.06 | 0.05 | 0.04 | 0.03 |
| Grazing Duration | | | | | | | | | | |
| 0 | 12.8$^{a}$ | 10.3$^{a}$ | 9.5$^{a}$ | 8.8$^{a}$ | 9.2$^{a}$ | 2.7$^{a}$ | 2.4$^{a}$ | 2.2$^{a}$ | 1.5a | 2.4$^{a}$ |
| 42 | 10.1$^{b}$ | 9.6$^{b}$ | 9.4$^{a}$ | 7.8$^{b}$ | 8.4$^{b}$ | 1.2$^{b}$ | 1.9$^{b}$ | 1.8$^{b}$ | 1.0b | 1.8$^{b}$ |
| 84 | 8.1$^{c}$ | 8.0$^{c}$ | 7.5$^{b}$ | 6.7$^{c}$ | 7.1$^{c}$ | 0.6$^{c}$ | 1.4$^{c}$ | 1.0$^{c}$ | 0.6c | 1.4$^{c}$ |
| 126 | 6.7$^{b}$ | 5.4$^{d}$ | 5.9$^{c}$ | 5.3$^{d}$ | 5.3$^{d}$ | 0.3$^{c}$ | 0.3$^{d}$ | 0.4$^{d}$ | 0.3d | 0.7$^{d}$ |
| 168 | 5.8$^{d}$ | 4.4$^{e}$ | 4.8$^{d}$ | - | 4.4$^{e}$ | 0.1$^{c}$ | 0.2$^{d}$ | 0.2$^{d}$ | - | 0.3$^{d}$ |
| 210 | - | 3.7$^{e}$ | - | - | - | - | 0.1$^{d}$ | - | - | - |
| SEM | 0.03 | 0.12 | 0.12 | 0.08 | 0.43 | 0.08 | 0.06 | 0.05 | 0.03 | 0.03 |

$^{+}$ GPI = 23/10/85 - 8/4/86; GP2 = 21/8/86 - 20/3/87; GP3 = 25/8/87 - 8/3/88; GP4 = 12/9/88 - 14/2/89; GP5 = 5/9/89 - 6/3/90

a….e: Means in the column followed by similar letter do not differ significantly (P=0.05) ND = Not determined

Source: Onifade *et al.,* (1993)

**Table 10: Effects of stocking rate on daily live weight gain (g/ head) of sheep during the five grazing periods**

| Stocking Rate (sheep/ha) | Grazing period 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| 12 | 26.7$^{a*}$ | 52.4$^{a}$ | 60.6$^{a}$ | 60.1$^{a}$ | 61.8$^{a}$ |
| 18 | 20.0$^{a}$ | 38.7$^{ab}$ | 47.2$^{ab}$ | 47.1$^{ab}$ | 58.9$^{a}$ |
| 24 | 14.8$^{a}$ | 32.7$^{ab}$ | 35.7$^{ab}$ | 26.0$^{bc}$ | 44.7$^{ab}$ |
| 30 | 5.9$^{a}$ | 14.3$^{ab}$ | 30.6$^{ab}$ | 22.7$^{bc}$ | 37.1$^{ab}$ |
| 36 | -0.7$^{a}$ | 11.3$^{b}$ | 23.0$^{b}$ | 16.2$^{c}$ | 24.0$^{b}$ |
| SED | 9.0 | 9.6 | 6.5 | 6.0 | 8.4 |

* Means in the same column with different superscripts differ at $P<0.05$
Source: Onifade *et al.,* (2002)

The negative linear relationships between LWG /head and SR were expressed with the following equations for each of the grazing period:

| | | | | | | |
|---|---|---|---|---|---|---|
| GP | 1 | Ya = | 40.9 | - | 1.15x | ($R^2$ = 0.99) |
| | 2 | Ya = | 72.5 | - | 1.78x | ($R^2$ = 0.96) |
| | 3 | Ya = | 76.1 | - | 1.53x | ($R^2$ = 0.97) |
| | 4 | Ya = | 79.3 | - | 1.57x | ($R^2$ = 0.93) |
| | 5 | Ya = | 84.3 | - | 1.62x | ($R^2$ = 0.97) |

Where Ya is daily LWG /animal and x is the stocking rate

Similar relationships were reported by Jones and Sandland (1974). A curvilinear relationship was established between LWG /ha and stocking rate as shown below for the 5 periods:

$Yh = 6.44x \quad -0.17x^2 \quad (R^2 = 0.99)$
$Yh = 14.65x \quad -0.35x^2 \quad (R^2 = 0.98)$
$Yh = 14.02x \quad -0.27x^2 \quad (R^2 = 0.97)$
$Yh = 10.63x \quad -0.23x^2 \quad (R^2 = 0.98)$
$Yh = 15.95x \quad -0.32x^2 \quad (R^2 = 0.99)$

Where Yh = LWG /ha and x is the stocking rate

Both the daily LWG /hd and LWG /ha became poorer with an increase in grazing days. The optimum stocking rates (OSR) in the first, second, third, fourth and fifth grazing periods were 17.8, 20.4, 24.9, 21.2 and 26.0 animals/ha, respectively.

**2.5.3 Daily Cumulative LWG (kg/ hd)**

At all stocking rates, the general pattern of animal growth in each grazing period was initiated by a period of weight gain, followed by no net gain and finally losses in weight (Table 11). There was no difference in cumulative LWG between animals at 18 and 24/sheep/ha during the first three grazing periods. The study indicated that after 100 and 120 days of grazing at the highest and lowest SR, respectively, grazing animals should be given supplementary feed.

**Table 11: Cumulative live weight gain (kg/ head) of sheep during the five grazing periods**

| Grazing days | Grazing periods | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| 14 | 1.8$^{i}$ | 1.65$^{i}$ | 1.6$^{h}$ | 2.1$^{g}$ | 2.2$^{h}$ |
| 28 | 2.8$^{h}$ | 3.13$^{h}$ | 3.0$^{g}$ | 3.3$^{f}$ | 4.0$^{g}$ |
| 42 | 3.5$^{ef}$ | 4.28$^{g}$ | 4.3$^{fg}$ | 4.4$^{c}$ | 5.5$^{f}$ |
| 56 | 4.0$^{cde}$ | 5.20$^{f}$ | 5.5$^{ef}$ | 5.5$^{d}$ | 6.6$^{e}$ |
| 70 | 4.6$^{abc}$ | 6.08$^{ef}$ | 6.4$^{de}$ | 6.2$^{cd}$ | 7.6$^{d}$ |
| 84 | 4.9$^{a}$ | 6.80$^{de}$ | 7.3$^{cd}$ | 6.9$^{abc}$ | 8.4$^{bcd}$ |
| 98 | 5.0$^{a}$ | 7.38$^{cd}$ | 8.1$^{abc}$ | 7.3$^{ab}$ | 9.1$^{ab}$ |
| 112 | 4.7$^{ab}$ | 7.90$^{abc}$ | 8.7$^{ab}$ | 7.5$^{a}$ | 9.6$^{a}$ |
| 126 | 4.2$^{bcd}$ | 8.33$^{ab}$ | 9.1$^{a}$ | 7.2$^{ab}$ | 9.8$^{a}$ |
| 140 | 3.7$^{def}$ | 8.50$^{a}$ | 9.4$^{c}$ | 6.5$^{bc}$ | 9.7$^{a}$ |
| 154 | 3.1$^{fg}$ | 8.45$^{a}$ | 9.2$^{a}$ | 5.5$^{d}$ | 9.8$^{ab}$ |
| 168 | 2.3$^{hi}$ | 8.03$^{abc}$ | 8.8$^{ab}$ | | 8.8$^{abc}$ |
| 182 | | 7.43$^{bcd}$ | 8.3$^{abc}$ | | 8.1$^{cd}$ |
| 196 | | 6.78$^{de}$ | 7.7$^{bcd}$ | | |
| 210 | | 6.08$^{ef}$ | | | |
| SED | 0.09 | 0.25 | 0.2 | 0.15 | 0.14 |

* Means in the same column with different superscripts differ at P<0.05
Source: Onifade, ( 1993)

**2.5.4 Chemical Composition of the Rhodes Grass Pasture.**

The chemical composition of pasture species is an important factor to consider in the utilization of forage by animals. In the grazing study conducted with sheep, (Onifade, 1993), findings showed that though the leaf had a higher Crude Protein (CP) content than the stem, the values in both decreased ($P<0.05$) with increase in days of grazing but were unaffected by SR over grazing periods 2, 3 and 4 when the pasture received only P fertilizer ( Table 12 ).

The contents of P in leaf and stem of Rhodes grass were not affected by SR and grazing days during the three grazing periods. A similar trend was recorded for contents of K in leaf and stem of *C. gayana* except where the content declined with GP in the 3rd grazing period. Stocking rate had no influence on the contents of Calcium and Magnesium in the leaf and stem of *C. gayana* during the three grazing periods. On the other hand, the trends of changes in contents were not conclusive with respect to the values of Ca and Mg as grazing period increased.

**Table 12: Effects of stocking rate and grazing period on crude protein (%) of the species contents in second, third and fourth grazing periods.**

| SR | GP (2) | | | (3) | | (4) | |
|---|---|---|---|---|---|---|---|
| | Stem | Leaf | Stylo | Stem | Leaf | Stem | Leaf |
| 12 | 5.0 | 8.3 | 11.2[a] | 4.6 | 8.4 | 4.8 | 8.3 |
| 18 | 4.8 | 8.5 | 9.3[b] | 4.5 | 7.9 | 5.0 | 8.2 |
| 24 | 5.1 | 8.8 | 9.1[b] | 5.1 | 8.8 | 4.9 | 8.3 |
| 30 | 4.8 | 8.2 | 9.6[b] | 5.6 | 8.1 | 5.1 | 8.6 |
| 36 | 4.8 | 8.7 | 8.7[b] | 4.9 | 8.8 | 5.1 | 8.5 |
| Control | 4.6 | 8.9 | 9.0[b] | 4.5 | 8.9 | 4.6 | 8.0 |
| SED | NS | NS | 0.44 | NS | NS | NS | NS |
| Days | | | | | | | |
| 0 | 6.8[a] | 9.5[a] | 12.3[a] | 6.8[a] | 10.5[a] | 6.9 | 9.7 |
| 84 | 4.8[a] | 8.6[ab] | 8.8[b] | 5.8[ab] | 8.3[b] | 4.7 | 9.0 |
| 126 | 4.3[b] | 7.6[b] | 7.5[c] | 4.4[b] | 6.7[c] | 3.3 | __ |
| 210 | 3.5[b] | __ | __ | 2.5[c] | __ | __ | __ |
| SED | 3.4 | 0.13 | 0.31 | 0.30 | 0.17 | 0.34 | 0.21 |

Means with different superscripts in the same column for each component differ significantly ($P<0.05$).
Source: Onifade, (1993)

## 2.6 USE OF DUAL PURPOSE LEGUMES AS LIVE-STOCK FEEDS

### 2.6.1 Cowpea ( *Vigna unguiculata* )

In the integration of crop and livestock activities, dependence on crop residues as fodder resources is on the increase. Two of these residues are groundnut and cowpea haulms which are used as supplementary feed during the dry season. A three -year study (Omokanye *et al.,* 2003) was undertaken as part of the Nigeria Cowpea Varietal trials to evaluate grain and fodder yields of the dual purpose varieties developed by IITA and IAR, Zaria (Fig 12). In terms of fodder dry matter yield, 3 varieties (TVU 12349, IAR - 72 and IAR 2/180/4-12) produced more than 3,000kg/ha ( Table 13 ).

**Table 13: Mean crude protein content and residual fodder yield and yield components**

| Cowpea varieties | Fodder yield (kg/ha) | CP (%) | Leaf content (%) |
|---|---|---|---|
| IT89 KD-288 | 2150 | 19.9 | 42 |
| IAR 2/180/4-9 | 2488 | 19.5 | 27 |
| IAR 2/180/4-12 | 3025 | 17.8 | 41 |
| IAR 7/180-4-5 | 2813 | 15.2 | 45 |
| IAR 4/48/15-1 | 2113 | 15.8 | 57 |
| IAR 72 | 3475 | 21.6 | 56 |
| TVU 12349 | 4238 | 19.8 | 57 |
| Kananado (Check) | 1638 | 18.2 | 15 |
| Mean | 2743 | 18.5 | 43 |
| LSD (P<0.05) | 487 | 3.1 | 5.4 |

Source: Omokanye *et al.,* (2003)

All the varieties except two had less than 40% leaf after pod harvest. Apart from the control, other varieties maintained green leaves till 3 weeks post pod harvest. Based on NRC (1976), all the varieties met the critical CP requirements (10. 88%) for cattle production.

Seed yield varied from 563 kg/ha (control) to 1099 kg/ha (IAR 4/48/15-1). The variety TVU 12349 appeared most suitable for combined use (Table 14).

**Table 14: Seed yield and yield components of Cowpea**

| Cowpea varieties | Pod Number (plant$^{-1}$) | Seed number (pod$^{-1}$) | 100 seed wt (g) | Seed Yield (kg/ha) |
|---|---|---|---|---|
| IT89 KD-288 | 26.8 | 11.50 | 21.69 | 963 |
| IAR 2/180/4-9 | 20.0 | 12.44 | 12.15 | 738 |
| IAR 2/180/4-12 | 28.3 | 11.36 | 14.15 | 850 |
| IAR 7/180-4-5 | 31.6 | 12.16 | 13.78 | 686 |
| IAR 4/48/15-1 | 32.2 | 11.33 | 13.29 | 1000 |
| IAR 72 | 23.2 | 12.50 | 19.04 | 763 |
| TVU 12349 | 30.3 | 13.88 | 9.43 | 886 |
| Kananado (Check) | 11.3 | 9.80 | 19.39 | 563 |
| Mean | 25.5 | 11.87 | 15.36 | 806 |
| LSD (P<0.05) | 3.6 | 2.40 | 4.39 | 238 |

Source: Omokanye *et al.*, (2003)

Figure 12. Cowpea

### 2.6.2 Groundnut (*Arachis hypogea* )

Groundnut (*Arachis hypogea* ) is widely cultivated for seed and forage and it is a major source of household income (Williams *et al.,* 1996). Ten groundnut varieties were evaluated for both seed and fodder production in a study conducted over 3 years under the Nationally Coordinated Research Project on groundnut in the sub humid zone (Omokanye *et al.,* 2001). Variety ICGV/87123 gave the least forage yield while M 517-801 the highest (Table 15). Seven varieties including the control RMP 12 recorded yields above 5 t/ha.

**Table 15: Average leaf: stem ratio, forage yield and crude protein content and leaf spot for groundnut varieties examined at Shika, Nigeria 1995 to 1997**

| Varieties | Leaf: stem ratio (%) | Forage yield (t/ha) | Crude protein (%) | Late leaf spot (%) |
|---|---|---|---|---|
| MDR 8-15 | 31 | 5.66 | 19.9 | 26.4 |
| 88.801 | 48 | 5.09 | 20.8 | 12.0 |
| M517-801 | 49 | 6.58 | 18.2 | 14.6 |
| M343-81A | 52 | 6.13 | 19.5 | 14.9 |
| ICGV-SM 86021 | 24 | 4.56 | 17.9 | 17.3 |
| ICGMS 42 | 29 | 5.76 | 15.2 | 21.7 |
| RMP 12 | 57 | 5.78 | 15.8 | 16.7 |
| M554-76 | 43 | 4.44 | 21.6 | 18.9 |
| M516-791 | 47 | 5.46 | 19.8 | 16.6 |
| M576-801 | 41 | 4.98 | 14.8 | 22.6 |
| ICGV 87123 | 21 | 2.66 | 18.2 | 10.9 |
| S.E.M | 5.7 | 0.78 | 0.78 | 2.12 |

Source: Omokanye *et al.,* (2001)

The CP contents in haulms of all the varieties were above the level (10.88%) recommended for ruminants. Seed yield and yield components were different ($P<0.05$) for the varieties while difference between year x varieties interaction was not significant ($P>0.05$). The practical application is that producing and conserving groundnut as haulms will meet feed demand of ruminant livestock in the dry season and generate income for farmers.

## 2.7 FORAGE FOR MICRO - LIVESTOCK

### 2.7.1 Effects of Seed Rate and Fertilizer Type on Growth of *Tridax procumbens*

*Tridax procumbens* is relished by rabbits (Aduku *et al.*, 1989) and preferred out of 16 other species (Figures 13 & 14). It was referred to as Public Work Department (PWD) weeds in South Western Nigeria. Its wide distribution and importance as a weed are due to its spreading stem and abundant seed production. *Tridax procumbens* is used as green feed for poultry and to stop bleeding in certain parts of India (FAO, 1998). There is paucity of research data on its potential as a forage plant, thus the study on the agronomy, evaluation and quality of the forage (Onifade *et al.,* 2001). Mean total (leaf + stem) yield (DM) increased with increase in seed rate with only seeds sown at 60kg/ha recording more than 2,000/kg/ha ( Table 16 ).

Application of SSP, NPK and CAN yielded more total DM than the control respectively by about 59%, 75% and 75%. Total DM yield was highest (above 2000/kg/ha) when harvested 12 weeks after sowing over the 2-year period. The crude protein content of whole plant was not affected by seed rate. The application of NPK gave higher CP content than other sources. As expected, CP content decreased with increase in growth. The CP content recorded 12 weeks after sowing was above 7% and considered suitable for maintenance of ruminants (Minson, 1971). This compliments the DM yield obtained same period as optimum time to harvest

**Figure 13: Rabbits feeding on forages**

**Figure 14:** ***Tridax procumbens***

**Table16: Means of forage dry matter (DM) yields and crude protein contents of *Tridax procumbens* over the two years as influenced by seed rate, fertilizer type and growth stage at Shika, Nigeria**

| | Forage DM yields (kg/ha) | | | Crude protein contents (%) | | |
|---|---|---|---|---|---|---|
| Treatment | Leaf | Stem | Total | Leaf | Stem | Whole plant |
| Seed rate (kg/ha) | | | | | | |
| 20 | 584$^{c}$ | 629$^{c}$ | 1213$^{c}$ | 21.8$^{a}$ | 12.3 | 14.6 |
| 40 | 802$^{b}$ | 929$^{b}$ | 1731$^{b}$ | 17.6$^{b}$ | 12.8 | 14.0 |
| 60 | 1034$^{a}$ | 1205$^{a}$ | 2239$^{a}$ | 15.6$^{c}$ | 11.2 | 12.0 |
| Fertilizer type | | | | | | |
| Control (no fertilizer) | 401$^{c}$ | 351$^{c}$ | 752$^{c}$ | 6.7$^{d}$ | 4.3$^{c}$ | 5.1$^{d}$ |
| SSP (20kg P/ha) | 742$^{b}$ | 917$^{b}$ | 1659$^{b}$ | 12.3$^{c}$ | 9.6$^{b}$ | 10.5$^{c}$ |
| NPK (50kg N/ha) | 1088$^{a}$ | 1233$^{a}$ | 2312$^{a}$ | 20.6$^{a}$ | 11.6$^{a}$ | 14.0$^{a}$ |
| CAN (50kg N/ha) | 1022$^{a}$ | 1182$^{a}$ | 2204$^{a}$ | 15.4$^{b}$ | 10.8$^{ab}$ | 11.1$^{b}$ |
| Growth stage | | | | | | |
| (Weeks post sowing) | | | | | | |
| 6 | 540$^{c}$ | 484$^{c}$ | 1024$^{c}$ | 18.5$^{a}$ | 11.8$^{a}$ | 14.3$^{a}$ |
| 9 | 986$^{a}$ | 883$^{b}$ | 1889$^{b}$ | 17.9$^{a}$ | 9.4$^{b}$ | 12.3$^{b}$ |
| 12 | 1010$^{a}$ | 1120$^{a}$ | 2130$^{a}$ | 13.0$^{b}$ | 8.1$^{b}$ | 10.0$^{c}$ |
| 15 | 740$^{b}$ | 1200$^{a}$ | 1940$^{b}$ | 5.6$^{c}$ | 7.1$^{c}$ | 4.0$^{d}$ |

Means in a column for a particular treatment with different superscripts differ significantly ($P<0.05$). SSP: Single superphoshate; NPK: compound fertilizer; CAN: Calcium ammonium nitrate.
Source: Onifade *et al.,* (2001)

### 2.7.2 Lablab ( *Lablab purpureus* )

This dual purpose legume has also shown good potential in increasing LWG and milk production when the forage is fed to ruminant livestock during the dry season (Figures 15 & 16). The seeds on the other hand, are used by human beings and in feeds for monogastric animals.

**Figure 15: *Lablab purpuerus***

**Figure 16: Cattle being fed with lablab during the dry season**

The three prominent cultivars of *L. purpureus* were examined (Amodu *et al.,* 2003) to determine the influence of sowing date and spacing on the fodder and seed yields. Sowing in July produced higher forage and seed yields than other dates for the 3 cultivars ( Table 17 ).

Sowing at a close spacing of 30 x 30cm gave higher fodder yield while seed yield was favoured at 90 x 30cm spacing in the 2-year study. The widest spacing produced the highest and least seed yields in the white (Rongai) and black (High Worth) varieties, respectively. With the prevailing weather condition, July appeared best to sow *L. purpureus* for both fodder and seed production in the Northern Guinea Savannah of Nigeria.

**Table 17: Effects of sowing date and spacing on fodder yield (t/ ha)**

| Spacing/ Sowing date | 1996 | | | 1997 | | |
|---|---|---|---|---|---|---|
| | S1 | S2 | S3 | S1 | S2 | S3 |
| D1 | 2.53[b] | 2.46[b] | 2.53[b] | 2.80[b] | 1.93[b] | 2.77[b] |
| D2 | 3.48[a] | 2.73[a] | 3.16[a] | 3.30[a] | 3.02[a] | 3.50[a] |
| D3 | 2.06[c] | 1.49[c] | 1.80[c] | 2.13[c] | 1.66[c] | 1.57[c] |
| D4 | 0.57[d] | 0.53[d] | 0.47[d] | 0.58[d] | 0.49[d] | 0.51[d] |
| Mean | 2.16 | 1.8 | 1.99 | 2.2 | 1.77 | 1.96 |

Means within a column with the same letter(s) do not differ significantly (P>0.05)

SED for spacing = 0.089 SED for spacing = 0.076
D1 = June, D2 = July, D3 = August, D4 = September
S1 =30cmx30cm, S2 = 60cmx30cm, S3 = 90cmx30cm
Source: Amodu *et al.,* (2003)

## 2.8 ON - FARM TRIALS

Groundnut is grown for both seed and fodder by farmers in crop-livestock systems (Olorunju *et al.,* 1996; Williams *et al.*, 1996) (Table 17). Late maturing cultivars were preferred compared to the early maturing types in the sub humid zone of Nigeria. The result of an on-farm evaluation of selected dual purpose groundnut cultivars (Omokanye *et al.*, 2002) showed that the improved cultivars recorded fodder yields above 5000/kg/ha ( Table 18).

**Figure 17a: Groundnut plant**

**Figure 17b: Groundnut field**

**Table 18: Mean forage and seed yields of groundnut (*Arachis hypogaea*) cultivars tested on-farm in a part of sub humid Nigeria**

| Varieties | Field Emergence (%) | Forage yield (kg/ha) | Leaf:Stem (%) | Pod yield (kg/ha) | Shelling (%) | Seed Yield (kg/ha) |
|---|---|---|---|---|---|---|
| 88.80l | 85 | 5958 | 46 | 2295 | 64 | 1469 |
| M343-80l | 88 | 6231 | 48 | 2367 | 65 | 1539 |
| M516-79l | 90 | 5257 | 45 | 2092 | 60 | 1255 |
| Check | 89 | 3346 | 42 | 1640 | 62 | 1017 |
| LSD (P=0.05) | 8 | 441 | 8 | 258 | 7 | 184 |

Source: Omokanye *et al.*, (2002)

Ten farmers from five villages in the sub humid environment were involved in the 2-year study. Pod yield was greater than 2,000kg/ha in all the varieties except for the control. When pooled over cultivars, seed yields varied from 1161kg for farm 8 to 1337kg/ha for farm 10.

The concentrations of all minerals except P in the fodder were influenced ($P < 0.05$) by cultivars ( Table 19). All the groundnut cultivars however, had less than the critical level of 3.5 % for Ca suggested for young beef cattle (Minson, 1976). The need to supplement the matured haulms with sources of Calcium becomes imperative during the dry season.

**Table 19: Forage nutritive value (%) of groundnut (*Arachis hypogaea*) cultivars tested on-farm in a part of sub humid Nigeria**

| Varieties | N | P | K | Ca | Ca:P | NDF | ADF |
|---|---|---|---|---|---|---|---|
| 88-80l | 3.01 | 0.69 | 4.94 | 3.39 | 4.91 | 51.3 | 47.3 |
| M343-80lA | 2.97 | 0.73 | 4.73 | 2.81 | 3.85 | 50.3 | 49.5 |
| M516-79l | 2.31 | 0.47 | 4.66 | 2.64 | 5.62 | 48.2 | 53.0 |
| Check | 2.42 | 0.56 | 3.68 | 1.32 | 2.36 | 42.7 | 52.1 |
| LSD (P=0.05) | 0.51 | 0.17 | 1.03 | 0.68 | 0.89 | 4.0 | 5.3 |

Source: Omokanye *et al.*, (2002)

There were positive and significant relationships between seed and forage yields (r = 0.604) and between seed and pod yields (r = 0.688). On the other hand, the relationships between forage yield and nutritive value were not very impressive. Farmers preferred cultivars M343-801A and 88-801 for higher forage and pod yields, large seed and oil content of nut following local extraction.

## 3.0 TOWARDS RESOLVING CONFLICTS BETWEEN HERDSMEN AND CROP FARMERS

As one of the stakeholders in resolving the conflicts between herdsmen and crop farmers which has become a national issue, the need to work together cannot be overemphasized. The provision of feed is uppermost to the livestock producer since it constitutes over 70% of the production cost in the industry. The livestock must be fed or grazed daily including all public holidays and weekends.

The natural pasture has been the main source of forage for the ruminant livestock in Nigeria. The variation in availability of pasture year-round depend more on the climatic / vegetation zone among other factors. Sufficed to say that the duration of rainy days vary from less than 90 in the extreme North to 360 days in the swampy / mangrove area (Figure 18).

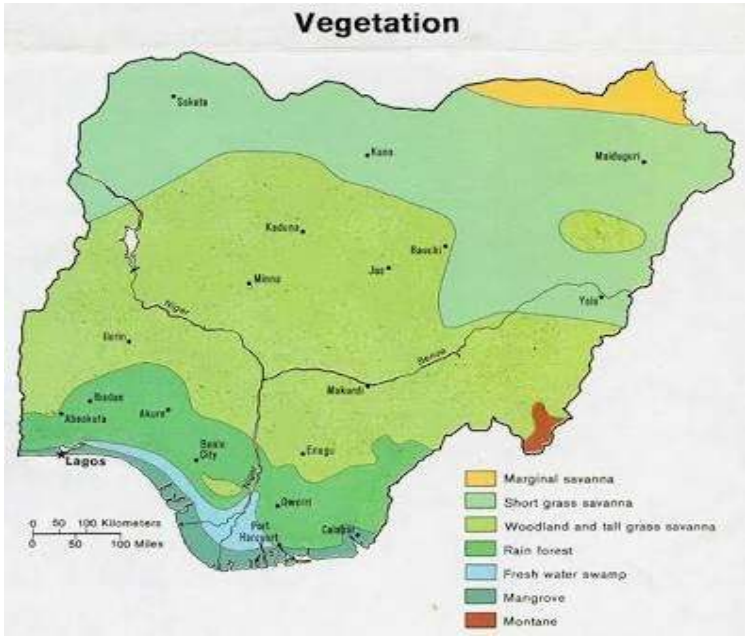


**Figure 17: Map of Nigeria Vegetation zone**

As the growing season comes to an end in the semi arid zone, south ward movement of livestock in search of green pasture begins.

The 112 grazing reserves gazetted by some state governments (Table 20) out of 415 earmarked to cater for the settling of pastoralists and for livestock production have been encroached upon and degraded (Kallah, 1999). These reserves were established based on the Grazing Reserve Law of 1965.

The vegetation in the reserves has further deteriorated with the presence of unpalatable plants, bare ground and less tree canopy. In addition, facilities such as water dams, clinics, schools in most of the reserves are no longer functional (NAPRI, 2008).

Concerted efforts by State governments on the renovation of this feed resource base to "carry" more livestock will, to a greater extent, reduce unwarranted movement and number of animals seeking for greener pastures led by pastoralists, an action which usually results in conflicts. The renovation will include :

a. Provision of infrastructure and facility. The provision of infrastructure and facilities for water, health and education in these reserves using sustainable participatory approach to the management of the resources will result in enhanced livestock production. The formation of pastoral associations / cooperatives is encouraged for good governance in each Local government area. The role of civil societies such as Miyetti Allah, and Pastoral Resolve among others in facilitating the community -based discuss to address issues related to pastoralists is acknowledged. These societies to a large extent should continue to work at delivering sustainable development for pastoral communities in the country.
b. Reseeding the natural pastures. The gradual reseeding of

the grazing reserves and control of weeds and erosion / bare ground in affected areas will increase the provision of forage feed for the ruminant animals. Pasture species adapted to various ecological zones had been recommended (Agishi, 1983; Kallah, 1999b). These high yielding species are easy to establish, managed and conserve for times of feed shortage. Though the quantity of seeds to cover the affected area of reserve may not be readily available, training the crop farmers and pastoralists in the simple techniques of pasture production, management and conservation will be a solution.

The rehabilitation of grazing reserves will necessitate the reduction in number of animals or sales of bulls for fattening. Secondly, the need to take another count of the national herd is urgent to enable proper planning of resources for the development of the livestock industry. Lastly, to effectively monitor the status and development of fodder resources in the reserves and across the country, an Institute for Grassland and Pasture Research should be established. Suffice to mention that this is within the mandate of the Nigerian Institute of Animal Science, (NIAS).

**Table 20: The Gazetted Grazing Reserves Nationwide**

| S/NO | No of Grazing Reserves | State | Range of area (ha) | Remarks |
|---|---|---|---|---|
| 1 | 30 | Adamawa | 297 - 20,163 | 1 Developed |
| 2 | 8 | Taraba | 1,400 - 13,400 | None Developed |
| 3 | 2 | Kwara | 20,232 - 21,156 | Both Developed |
| 4 | 1 | Niger | 30,200 | Partially Developed |
| 5 | 1 | Katsina | 123,000 | Partially Developed |
| 6 | 1 | Kaduna | 33,419 | Partially Developed |
| 7 | 16 | Borno | 350 - 28,000 | 4 Partially Developed, 11 not Developed, 1 Developed |
| 8 | 9 | Sokoto | 285.6 - 21,128 | 8 Not Developed, 1 Partially Developed |
| 9 | 6 | Zamfara | 1,198 - 250,000 | 2 developed, 4 undeveloped |
| 10 | 16 | Yobe | 100 - 4,976 | None Developed |
| 11 | 10 | Bauchi | 1040 - 42,065 | 4 partially developed |
| 12 | 5 | Gombe | 1330 - 138,777 | None developed |
| 13 | 1 | Plateau | 120,437 | Not developed |
| 14 | 3 | Nasarawa | 17,000 - 50,000 | 1 partially developed |
| 15 | 1 | Kogi | 7,205 | Not developed |
| 16 | 1 | Enugu | 800 | Partially developed |
| 17 | 1 | Ogun | 52,012 | Not developed |

Source: Kallah, 1999 ( Adapted )

Other avenues for increasing production in the Livestock Industry are :
a. Establishment of ranches.

Efforts by both federal and state government and some individuals in the past in establishing ranches failed due to lack of maintenance of infrastructure and facility for the animals and poor management of feed resources and animals.

The different enterprises /specialization in ranching are as follows :
Cow -calf, feeder calves, finishing / feedlot / fattening and dairy beef. In this proposal, I suggest the public - private partnership (PPP) approach. Other logistics will involve location of project, provision of feed, health facility, availability of labour and efficiency of animal reproduction. Different locations : along the Rivers Niger and Benue valleys, in the savanna, derived savanna and in the highlands can be used to finish bulls before they are slaughtered and processed as frozen beef.

b. Peri- urban dairy programme
This type of project, common in India and Kenya, involves small holders keeping 4 to 6 lactating cows (crossbreds) around cities / towns. Each farmer will have access to 2 to 4 hectares of land for mixed farming and will be trained to feed, produce and preserve fodder to maintain the cows. Through

the cooperatives to be formed, daily production of milk will be sold to processing companies for pasteurization etc. An enabling environment is, however needed to make this type of programme succeed and cost effective.

c. Commercial feed production
Both crop and livestock farmers can be trained to grow and preserve pasture species / fodder which they can use or sell to ranches / feedlot enterprises. The production of legume haulms, harawa, is a lucrative business for feeding animals year round. With the availability of such supplementary feed, there will be less competition between farmers and herdsmen.

## 4.0 RECOMMENDATIONS AND CONCLUSIONS

### 4.1 Training of Manpower in Pasture and Range Management.

Due to the restructuring of school curriculum in the 1980s, emphasis on the training of technical officers in the Colleges of Agriculture to manage the rangelands was left out. Presently, the number of staff in the Ministry of Agriculture with sound knowledge in this area is very scanty as many have retired. The Federal University of Agriculture, Abeokuta is presently the only tertiary institution in the Nigerian University system with a Department of Pasture and Range Management. The number of graduates with B. Agric., M. Agric. and Ph. D is increasing nationwide but still falls below the demand required for training and managing the feed resources for

grazing animals. I seize this occasion to call on the NUC to facilitate the creation of at least one Department of Pasture and Range Management in each geo - political zone of this country. In the same vein, the training at the Diploma level for technical officers in Range Management should be reinstated. With the renewed interest in the development of pastures by the present administration, the need for adequate manpower to be trained to produce and manage the feed resources is paramount. This calls for provision of fenced paddocks, tractor mounted equipment such as mowers, choppers, blowers, hay balers, hay rakes etc.

**4.2 Pasture Seed Production.**

Seed forms the bedrock for food and feed security both for humans and livestock. The seed industry for food crops is already established in the country. On the other hand, the pasture seed industry is yet to be adequately developed. At present, NAPRI and some private farms produce small quantities of pasture seed that cannot meet the demand of the nation. There is urgent need for both private and public sectors to invest in pasture seed production. My opinion is that instead of importing large quantities of pasture seeds that may lose viability within a short period, the Federal Government should encourage domestic production of seeds of adapted species that will provide avenues for employment for our teeming youths. In addition, while foreign exchange will be saved for the country, it will encourage the provision of needed infra-

structure and facilities for pasture seed production. Finally, it will be a training avenue for both undergraduate and post graduate students.

### 4.3 Society for Grassland Research and Development in Nigeria

I want to appreciate the renewed effort of Prof. Alaba O. Jolaosho and others in the Department of Pasture and Range Management and COLANIM which culminated in the first stakeholders meeting of personnel in grassland research and development in November 2008 held in Federal University of Agriculture, Abeokuta (FUNAAB). Earlier attempts to form a society since 1980s by older colleagues were not successful. The Society for Grassland Research and Development in Nigeria (SOGREDEN) was incorporated in November 2011. The first National workshop and conference was held in November 2013 and December 2015 at NAPRI, Zaria and FUNAAB, respectively. As the foundation President of the Society, I want to urge all members and prospective members to collaborate and network with each other so as to move the society from childhood to maturity.

### 4.4 Livestock Population

For good planning, the population of livestock in the country needs to be updated. The last estimate was done almost 25 years ago (RIM, 1992). In addition, movement of animals across borders-national, state and local government should be

closely monitored.

Finally, an integrated effort that would place equal emphasis on livestock and grassland components is required for further development of the livestock sector in the country.

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