# INTERCROPPING MULTIPURPOSE TREES (MORINGA, ALBIZIA AND LEUCAENA) WITH MAIZE AND ITS UTILIZATION AS DRY SEASON FEEDS FOR RUMINANTS IN SOUTHERN GUINEA SAVANNAH, NIGERIA

**D.O Ogunbosoye[1,*] & Afe A.I[2]**

*[1]Department of Animal Production, Fisheries and Aquaculture, Kwara State University, Malate Nigeria: [2]Department of Crop Production, Kwara State University, Malete, Nigeria; *Corresponding author (olufunflory@gmail.com); Phone No. +2348038262722*

**ABSTRACT**

A field trial was carried out to investigate the suitable cropping pattern in browse trees (Moringa, Albizia, and Leucanea)/maize system and their utilization as dry season fodders. Full population of browse trees were intercropped with full population and fifty percent population of maize in a 2x3 factorial in split plot arrangement and replicated four times. Cropping pattern involving combinations of full population of browse trees and maize recorded higher plant height than those involving intercropping combination of 50% full population. Sole maize significantly had longer cobs than those at the intercrops. There was no significant difference in maize cob length between the three cropping patterns. Number of seed/cob of maize at combination of 50% full maize with browse trees were higher than when full population of maize was intercropped. Intercropping involving maize at full population produced higher grain yield than 50% full population. The highest grain yield (2.33t/ha) at the intercrop was obtained at combination of full population of maize with Albizia. Sole maize significantly performed better than the intercrop in grain yield. All the browse species evaluated at the intercrops were high in crude protein concentration with moderate value of Neutral Detergent Fiber (NDF), Acid Detergent Fibre (ADF) and Acid Detergent Lignin (ADL). The three browse plant species were accepted by the goats toward the end of the experiment indicating the browse species intercropped with maize to be a suitable feed for ruminants to ameliorate dry season feed deficit and enhances food security through the production of maize.

**Key words**: browse trees, cropping pattern, dry season, feed scarcity, goats

## INTRODUCTION

Ruminants play a significant role in the lives of rural farmers, providing milk, meat, animal traction, manure for crop production, cash from sales of animal products and a safety net of capital assets against misfortune in harsh weather. However, poor nutrition has been the main factor limiting ruminant production in the tropic due to unavailability of feed all year round.

The use of multipurpose trees such as Moringa, Albizia and Leucaena in livestock production in Nigeria cannot be over emphasized in solving feed shortage. Composition of feed given to animals has a very significant influence on animal performance such as reproduction, milk production, quality and growth performance. Adegbola (2002) observed that poor performance of ruminants during dry season was as a result of poor quality roughages fed to these animals without supplementation with concentrates or quality forages. The conventional feed resources (grains) available during the lean period are very expensive to feed ruminants because of the competition with man for sustainability (Akinmuti 2004). This situation has indeed necessitated the search for cheap, readily available feed materials that can meet the nutritional requirements of farm animals and less competitive. Most of the multipurpose trees (MPTS) have hitherto not been systematically exploited for strategic year round livestock production; especially during dry season to boast an improved productivity. The MPTS are considered to be repository of quality nutrients under good management and both palatability and digestibility will be enhanced.

Voluntary intake of tropical grasses can be a major constraint to ruminant performance in the tropics. The solution to this problem may be through the incorporation of tree fodders as feed supplements to improve the rumen environment, which can lead to increased forage intake. A lot of studies have been carried out on few of the browse trees, and the most prominent ones are *Leucaena leucocephala. Gliricidia sepium, Albizia odoratissima* (Ogunbosoye and Babayemi 2010). However, in ruminant

production practices, a common practice is to offer a variety of tree fodders as supplements, either separately or with grasses (Sandoval-Castro *et al.*2005). Therefore, to obtain sufficient and good quality feed for the ruminant, a strategy has to be developed to assess the value of these parameters as predictors of forage preference, and their values in designing feed for effective management of the available browse plants. Preference assessment or otherwise called acceptability is a fast and cheaper means of assessing fodder plants in a short period of time (Sandoval-Castro *et al*. 2005). Therefore, this research was focused on the establishment and utilization of browse trees intercropped with maize by ruminants.

## MATERIALS AND METHODS

### Establishment at the permanent site

The experiment was laid out in a 2x3 factorial in split plot arrangement and replicated four times. The treatment consisted of Moringa, Abizia and Leuceana as the main block while various population of maize constituted the sub-plot. Poultry manure was applied at the rate of 7.5t/ha at 2weeks before transplanting. Seedlings were transplanted at four weeks old to the main field at a spacing of 4.0m x 4.0m. Maize was introduced to the browse trees at one week after transplanting.

### Chemical composition of browse trees

Crude protein, crude fibre, ether extract and ash contents of the browse plants were determined (AOAC 2000), acid detergent fibre (ADF), neutral detergent fibre (NDF), and acid detergent lignin (ADL)were assessed using the method proposed by Van Soest et al. (1991)

### Acceptability study

The study was carried out at the sheep and goat unit of Teaching and Research farm, College of Agriculture, Kwara State University. Nine adult female red Sokoto goats were used in a cafetarian feed preference study which lasted for 14 days with 7 days of adaptation. The initial weight of the animals were between 15-17 kg at10-12 months old. They were housed in groups in well ventilated open pens capable of accommodating animals with the feeders and drinkers. The forages were harvested fresh and 3 kg of each was introduced to the animals in different containers. Each plant replicated thrice in order to have access to the plants. The positioning of the plants in the pens were changed daily to avoid conditioning and learning effects by the animals sticking to the same feed in the particular position. The feeding of the animals was monitored for 2 hours (0800-1000) daily. Average daily intake was calculated. Coefficient of preference (COP) was determined as the ratio of individual intake of the forage and the average intake. Forage with COP less than unity is considered not accepted, while COP greater than unity is well accepted (Babayemi 2007; Ogunbosoye and Otukoya, 2014)

### Data collection and statistical analysis

**T**he following data were collected for analysis; plant height of browse trees were taken at 6 and 8 weeks after transplanting (WAT), stem girth at 8 WAT. Maize data collected were plant height and stem girth at 6WAT, number of cobs per plant, cob length, number of grains per cob weight of 1000 grains and grain yield. On acceptability study, intake and COP of browse plants records were taken. Data were subjected to analysis of variance using SAS (2010) package and treatment means compared using Duncan's Multiple Range Test of the same statistical package. This was done where results were significant at 5% level of probability.

## RESULTS

The significant interaction effect of cropping pattern and population density on plant height, stem girth and days to 50% flowering of maize intercropping is presented in Table 1. Generally, cropping pattern involving combinations of full population of browse trees and maize recorded higher plant height than those involving intercropping combination of 50% full population. The significant interaction effect of cropping pattern and population density on cob length, cob circumference, number of seeds per cob weight of 1000 grains and grain yield in moringa, albizia and leucaena maize intercropping is presented in Table 2. Sole maize had longer cobs than those at the intercrops. Irrespective of the population density, there was no significant difference in maize cob length between

the trees cropping patterns. Number of seed/cob at combination of 50% full maize with browse trees were higher than when full population of maize was intercropped. Intercropping involving maize at full population produced higher grain yield than 50% full population. The highest grain yield (2.33t/ha) at the intercrop was obtained at combination of full population of maize with Albizia.
The chemical composition of the browse foliage is shown in Table 3. The dry matter content of the browse plants ranged between 29.8% in*Moringa oleifera* and 44.00% in *Leucaena leucocephala.* The value obtained in these plants was lower in moringa when compared with others. The crude protein (CP) contents of *Albizia odoratissima, Leucaena leucocephala* and *Moringa oleifera* are 16.3%, 21.03%, and 28.75%, respectively. The highest CP value was obtained from moringa, a non-leguminous plant while the other two are legumes. The crude fibre values were from 10.16% in moringa to 15.87% in albizia and leucaena had 14.34%. Plant materials contain a group of substances, insoluble in water and organic compounds like ether. These are referred to as lipids and act as stores of energy. The highest value of ether extract was obtained in moringa (8.20%) which is an indication of high energy feed. Ether extract is the lipid component and the energy derived from it is utilized by the animal for body maintenance and production and the least value was obtained in *Leucaena leucacephala* (3.44%). The ash contents of browse plants range from (6.50% to 16.55%). The ash content of any feed is a measure of mineral level. The values of ash content was lowest in *leucaena leucocephala*, a legume but higher value was obtained in moringa, a non-leguminous plant.

The fibre fraction of the foliage of browse species shows that *Moringa oleifera* leaves had the highest neutral detergent fibre (NDF) value of 28.85% while the least (25.3%) was recorded for Albizia odoratissima. Acid detergent fibre (ADF) ranged from (13.34% to 22.0%) *M. olivera* and *A. odoratissima* respectively. Acid detergent lignin ranged between 7.55 to 11.0% with the *Albizia odoratissima* having the highest value and leucaena the least value.

The daily free choice intake of browse plants is presented in Table 4. The animals consumed more moringa from the inception of the study far above other fodders. As the day progressed, intake of other browse trees was improving. Similar trend was observed in the coefficient of preference (COP) values. In this study, *Albizia odoratissima* and *Leucaena leucocephala* were not initially consumed as expected. But looking at the coefficient of preference (COP) which is the ratio of individual intake and the average intake of individual forages, the COP was getting better till the end of the study.

**DISCUSSION**

The complementary effects as observed in this study were an indication of high potential of low-cost approach to sustain agricultural production and reduce environmental degradation. The intercropping advantage as observed in this study is consistent with the works of earlier researchers on intercropping involving maize and arable crops such as: cowpea/ maize (Afe, and Olofintoye, 2013), maize/sesame (Mkamilo, 2004). According to Nair (2007), the system is based on the premise that land use systems that are structurally and functionally more complex than either crop or tree monocultures result in greater efficiency of resource capture and utilization (nutrients, light, and water), and greater structural diversity that entails a tighter coupling of nutrient cycles. The significant difference observed among the browse trees in this study could be attributed to differences in their growth habits. Naturally, moringa is a fast growing plant compared to albizia and leucaenea and was able to compete for natural resources particularly light interception better than the other browse trees. This is evident in the taller maize height in maize/moringa intercrop.

The CP levels of the browse species agreed with the report of Ogunbosoye and Babayemi (2012). This result, however, falls within the minimum and maximum protein requirement for ruminants in the tropics (Minson 1990). The ash values were high, suggesting substantial mineral deposited in the browse plants. In earlier studies, Ogunbosoye and Babayemi (2012) obtained similar enhanced ash contents in browse plants. Values obtained for NDF, ADF and ADL corroborate those reported for some browse species in Nigeria (Larbi *et al*. 1996).

The observed marked preference towards *Moringa oleifera* during the two hours preference study may be due to its high crude protein with low crude fibre. Moreover, Bamikole *et al*. (2004) observed

that when five species of ficus were introduced to goats in a cafeteria feed preference study; the animals were able to make their choice among the ficus trees as a result of preferential taste by the goats. It is therefore concluded that the three browse plant species can be successfully established and intercropped with arable crops like maize to alleviate dry season feed scarcity being encountered by ruminant animal farmers and the arable crop (maize) could serve as additional food to the farmers.

**REFERENCES**

Adegbola, A.A. (2002). Nutrient intake, digestibility and rumen metabolites in bulls fed straw with or without supplements. *Nigerian Journal of Animal Production*. 29: 40-46.

Afe, A.I, Olofintoye J.A. (2013). Response of cowpea cultivars of contrasting maturity dates to varying component population ratios of maturity maize. *Journal of Agriculture and Biodiversity Research.* Vol. 27) pp 137-143.

Akinmutimi, A.H. (2004). Evaluation of sword bean (*Canavaliagladiata*) as an alternative feed resource for broiler chickens. Ph.D thesis Michael Okpara University of Agriculture, Umudike.

Association of Official Analytical Chemist (AOAC, 2000). Official Methods of Analysis 17th ed. Association of Analytical Chemists. *Washing*, DC

Babayemi, O.J. (2007). In vitro fermentation characteristics and acceptability by West African Dwarf goats of some dry season forages. *African Journal of Biotechnology* Vol. 6 (10), pp. 1260-1265

Bamikole, M.A, Ikhatua, U.J, Arigbede, O.M, Babayemi, O.J, Etela, I. **(**2004). An Evaluation of the Acceptability as forage of some Nutritive and Anti-nutritive Components and of the Dry Matter Degradation Profiles of Five Species of Ficus. *Tropical Animal Health and Production*, 36; 157-167.

Larbi A, Smith JW, Adekunle IO, Kurdi, I.O (1996) Studies on the multipurpose fodder trees and shrubs in West Africa: variation in the determination of forages quality in Albizia and Paraserianthes. *Agroforestry Systems*.33.29-39.

Minson, D.J. (1990). Forage in Ruminant Nutrition. Academic Press London, N.Y

Mkamilo, G.S. (2004) .Maize-sesame intercropping in Southeast Tanzania: Farmers' Practices and Perceptions, and Intercrop Performance. PhD Thesis, Wageningen University, Netherlands.

Nair PKR. (2007).The coming of age of agroforestry. *Journal of the Science of Food and Agriculture 87*(9) 1613-1619.

Ogunbosoye, D.O and Babayemi O.J (2010). Potential values of some non-leguminous browse plants as dry season feed for ruminants in Nigeria. *African Journal of Biotechnology* vol. 9 (18), pp 2720-2726.

Ogunbosoye, D.O and Babayemi, O.J. (2012). The utilization of some tropical browse plants by pregnant West African dwarf goats in southern Nigeria. *International journal of Environmental Sciences,* vol 1 No.4 224-229.

Ogunbosoye, D.O and Otukoya, K.O. (2014).Evaluation of Preference and Intake of Browse Species by West African dwarf goats in Nigeria. *International journal of innovative research and development*. Vol 3 168-175.

Sandoval-Castro, C.A, Henry, L,Lizarraga-Sanchez, Francisco J. Solorio- Sanchez. (2005).Assessment of tree fodder preference by cattle using chemical composition, *in vitro* gas production and *in situ* degradability. *Animal Feed Science and Technology.* 123-124, 277-289.

SAS. 2010. Statistical Analysis System. SAS/STAT users' guide. Version 8. SAS Institute Inc. Cary, NC

Van Soest, P.J, Robertson, J.B and Lewis, B. (1991). Methods for dietary fiber, and non-starch polysaccharides in relation to animal nutrition, *Journal of Dairy Sci*ence 74, 3587-3597.

**Table 1: Interactive effects of cropping pattern and population density on plant height, stem girth, of moringa, albizia, and leucaena and days to 50% flowering of maize in a moringa, albizia, leucaena/maize intercropping.**

| Cropping pattern | Plant Height (cm) | | Population density Stem Girth (cm) | | Days to 50% Flowering | |
|---|---|---|---|---|---|---|
| | 100 | 50 | 100 | 50 | 100 | 50 |
| MA/MO | 168.35a | 166.95a | 1.54b | 1.58d | 57.03 | 57.47 |
| MA/AA | 159.14b | 157.18b | 1.75b | 1.78c | 56.90 | 56.10 |
| MA/L | 152.70b | 148.83b | 1.35c | 1.53d | 57.93 | 57.3 |
| SMO | 149.12c | 149.12b | 7.52a | 7.52a | - | - |
| SAA | 49.00d | 49.00c | 1.33c | 1.33c | - | - |
| SL | 46.21d | 46.21c | 1.35c | 1.33c | - | - |
| SM | 158.56b | 158.56b | 1.72b | 1.72b | 57.03 | 57.03 |
| CV (%) | 7.8 | 6.5 | 12.2 | 9.3 | 8.2 | 7.249 |

Values with the same letter on the row are not significantly different at 5% level of probability by Duncan Multiple Range Test. MA=maize, MO=moringa, AA=albizia, L=leucaena, SMO=sole moringa, SAA=sole albizia, SL=sole leucaena, SM=sole maize

**Table 3: Interactive effects of cropping pattern and population density on cob length, cob circumference, numbers of seeds per cob, weight of 1000 grains and grain yield in a moringa, albizia, leucaena/maize intercropping**

| Cropping pattern | Cob length | Cob circumference | Numbers of seed per cob | Population density Numbers of seed per cob | Weight of 1000 grains | Weight of 1000 grains | Yield | Yield |
|---|---|---|---|---|---|---|---|---|
| | 100 | 50 | 100 | 50 | 100 | 50 | 100 | 50 |
| MA/MO | 17.42a | 16.23a | 488.53c | 488.43c | 231.00b | 233.90b | 2.10c | 1.96c |
| MA/AA | 17.30a | 17.17a | 509.97b | 511.33b | 256.37b | 257.50b | 2.33b | 2.34b |
| MA/L | 17.30a | 17.22a | 503.3b | 506.20b | 234.23b | 232.80b | 2.22c | 2.10c |
| SM | 18.57a | 18.57a | 567.57a | 567.57a | 273.03a | 270.03a | 2.53a | 2.53a |
| CV (%) | 6.8 | 8.9 | 9.2 | 7.249 | 8.3 | 12.0 | 3.6 | 13.0 |

**Table 4: Chemical composition of the tree forages**

| Parameters (%) | Albizia | Leucaena | Moringa |
|---|---|---|---|
| DM | 43.6 | 44.0 | 29.8 |
| CP | 16.3 | 21.03 | 28.75 |
| CF | 15.95 | 14.34 | 10.16 |
| Ash | 6.71 | 6.50 | 16.65 |
| EE | 5.90 | 3.44 | 8.20 |
| NDF | 25.90 | 26.2 | 28.85 |
| ADF | 22.0 | 18.5 | 13.34 |
| ADL | 11.0 | 08.44 | 7.55 |

**Table 5: Preference study of goats fed fresh Albizia, Leucaena and Moring plants**

| | Daily forage intake (kg) and coefficient of preference (COP) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Day 1 | | Day 2 | | Day 3 | | Day 4 | | Day 5 | | Day 6 | | Day 7 | |
| Forage | Intake | COP | Intake | COP | Intake | COP | Intake | COP | Intake | COP | Intake | COP | Intake | COP |
| AO | 0.37b | 0.38 | 0.63b | 0.3b | 0.82b | 0.33b | 1.24b | 0.71b | 1.36b | 0.69 | 2.66b | 0.98b | 2.97 | 1.0 |
| LL | 0.3b | 0.31 | 0.88b | 0.42b | 1.16b | 0.46b | 1.3b | 0.74b | 1.5b | 0.76 | 2.97a | 1.03ab | 2.93 | 1.0 |
| MO | 2.2a | 2.3 | 2.67a | 1.28a | 3.0a | 1.2a | 3.0a | 1.72a | 3.0a | 1.5 | 3.0a | 1.04a | 3.0 | 1.0 |
| SEM | O.19 | 0.2 | 0.09 | 0.04 | 0.11 | 0.04 | 0.08 | 0.04 | 0.03 | 0.02 | 0.05 | 0.01 | 0.03 | 0.00 |

**a,b = means on the same row with the same letter are not significantly different ( P>0.05)**