# Effect of Number of *Stylosanthes Hamata* Rows on Herbage Yield, Nutritive Quality and Performance of Wad Sheep Fed Native *Panicum Maximum*

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**Abstract**
The effect of number of *Stylosanthes hamata* rows on herbage yield and nutritive quality of native *Panicum maximum* was assessed at Teaching and Research Farm of Ladoke Akintola University of Technology Ogbomoso, Oyo State in the derived Savannah Zone of Nigeria. The experiment was laid out in a randomized complete block design with each plot replicated thrice. *Stylosanthes hamata* seeds were interplanted with native *Panicum* at 8weeks cut back of establishment using different inter-sown spacing of 25cm, 16.7cm and 12.5cm with 1row, 2rows and 3rows of legume respectively. Parameters investigated at 12weeks old on native *Panicum* were biomass yield, tillers number and height, leaf length and width, chemical and mineral compositions. The grass herbage harvested from experimental plot were fed as sole diets to West African dwarf ram to determine feed intake (g/d/kg $^{0.75}$), nutrient digestibility (g/kg) and weight gain (g/h/d). Results showed that herbage yield, chemical and mineral composition of *Panicum* at 12weeks old improved. Biomass yield (383000kg/ha), number of tillers (33.00), tiller height (140.14cm), leaf length (51.37cm) and leaf width (2.38cm) were significantly higher for native *Panicum* inter planted with 2 and 3rows of *Stylosanthes hamata*. Crude protein (9.85%) and gross energy (3.13kca/kg) content of *Panicum* inter planted with 2 and 3rows of legume spacing were ($P<0.05$) higher than 1 row. P (0.20%), K (0.36 %), Ca (0.32%), Mg (0.25 mg/100g), Fe ( 270.30 mg/100g), Zn (10.00 mg/100g), and Cu ( 2.00 mg/kg ), of *Panicum* inter planted at 2 and 3rows of *Stylosanthes hamata* spacing were ($P<0.05$) better than other. The feed intake (43.70 g/d/kg $^{0.75}$), nutrient digestibility (79.67 g/kg) and weight gain (53.6 g/h/d) of animals fed *Panicum* interplanted with 3rows of *Stylosanthes hamata* was significantly ($P<0.05$) highest compared to its counterpart. This study revealed that intercropping of *Stylosanthes hamata* with native *Panicum* at 2 and 3 inter rows spacing promoted higher herbage yield and nutritive value for the *Panicum maximum*. Animals fed with this as sole diet experienced higher weight gain.
**Keywords:** Stylosanthes hamata, Panicum maximum, number of row, feed intakes, herbage yield, Nutritive value, Wad Sheep

## 1. Introduction
Ruminant animals are important sources of animal protein throughout the world, including the developing economies (Timon and Hamahan, 1986). It was estimated in 1992 that meat from sheep and goats came second only to beef in importance for meat supply in Nigeria (Osinowo, 1994). Rapid and!increasing demand for products of animal origin exists in tropical countries. Ruminant animals can play an important role in meeting this demand and for income generation and poverty alleviation in rural and peri-uban areas (Osinowo, 1994)
Nutrition is one of the most important factors that determine the profitability of any livestock venture (Adu, 1982). Akinlade *et al.,* (2005) reported that a major problem facing small ruminant animal producer is how to feed the animals adequately in all year round. Consequently, the issue of palatability and nutritive quality changes has become of interest and great concern to researchers (Huston *et al.*, 1993).
Pasture production is a major agricultural resource supporting both intensive and extensive systems of ruminant production. Ruminant animals rely on pasture for their nutrition than on any other feed resource (Aderinola *et al*., 2008). *Panicum maximum* species are notable forages for animal production in south west Nigeria. Use of fertilizers to improve forage yield and usage of commercial concentrates as livestock supplements are limited due to inability of farmers to purchase them (Sodeinde *et al*.,2006). The importance of forage legumes in increasing herbage production from grasses and enhance the quality of feed produced has been recognized (Muinga *et al*., 2007). Legumes benefit grasses by contributing nitrogen to the soil through atmospheric fixation, decay of dead root nodules or mineralization of shed leaves (Aderinola, 2007).

Intercropping forage legume with grasses has been reported to increase forage dry matter yield, forage quality in terms of crude protein content, voluntary feed intake and digestibility (Aderinola, 2007). Legume grown with grasses offer several advantages over grasses grown alone. Baylor (1994) noted that inclusion of legumes in the pasture usually results in increased yield, higher quality and improved seasonal distribution of forage. Legume-grass mixtures have reduced weed encroachment and erosion and have led to greater stand longevity than legume or grass monoculture (Akinlade *et al*., 2003).
Some creeping legume such as *Canavalia ensiformis, Stylosanthes hamata, Pueraria Phaseliodes* and *Centrosema pubescences* are high in crude protein and are well adapted to varying weather and ecological soil conditions. Farmers often use these legumes for soil improvement (Babayemi and Bamikole, 2006). The objective of this study was to investigate the effect of number of *Stylosanthes hamata* rows on herbage yield, nutritive quality and performance of WAD sheep fed native *Panicum maximum.*

## 2. MATERIALS AND METHODS

### *2.1 Experimental Site*

The experiment was carried out at the Teaching and Research Farm, Ladoke Akintola University of Technology, Ogbomoso located in the derived Savannah zone of Nigeria. Ogbomoso lies at approximately $8^0$7'North of the equator and $4^0$15'East of Greenwich Meridian. The location has the lowest temperature of about $18^0$C during the peak of harmattan and the highest of about $37^0$C recorded during the peak of dry season with moderate to heavy seasonal rainfall (1247mm annually) and high relative humidity. The natural vegetation is considered to be low land rainforest but under the influence of high agricultural activities comprising of a bush fallow system of farming, little high forest remains. Therefore, it is regarded as a derived savanna vegetation zone because grassy vegetation has followed the clearing of land and cultivation with soil elevation of 1150ft (Adeniyi, 2005).

### *2.2 Field layout and management practices*

The area of land used was 1504m$^2$. The land was cleared, stumped and leveled manually to obtain a clean seed bed. Seeds of the legume (*Stylosanthes hamata)* were procured from the International Institute of Tropical Agriculture, (IITA) Ibadan Oyo State, Nigeria. Native *Panicum maximum* (Green Panic) were sourced from within the University pasture demonstration plot. Treated seeds of *Stylosanthes hamata* planted into the soil by drilling along the rows at the rate of 7.5 kg/ha. Each treatment was replicated thrice and each experimental plot measured 10m x 15m with 1m path between plots. At the time of establishment crown splits with 2 tillers, 15cm height of *Panicum maximum* were planted per stand with a spacing of 50x50cm. At eight weeks of age, the *Panicum* was cutback and intercropped with *Stylosanthes hamata* in three different inter-row spacing of 1row, 2rows and 3rows of legume at different interrow spacing of 25.0cm, 16.7cm and 12.5cm, respectively. Soil samples were collected before and after 12weeks of planting, bulked, air dried and kept till required and subjected to chemical analysis. Weeding was done manually as often as required to prevent weeds from competing with the legume and *Panicum maximum* for the nutrients.

### *2.3 Data collection*

Twelve (12) weeks after legume-inter sown with *Panicum maximum* data were collected on nine *Panicum maximum* stand per plot on tiller number, tiller height, leaf width and leaf length. Tiller number and height, leaf length and leaf width measured randomly within each plot with the aid of the measuring tape, while the tillers were visually counted. Biomass yield was determined by manual harvesting of the grasses within each replicate in a 1m$^2$ quadrat thrown once and weighed.

### *2.4 Soil Analysis*

Before imposing treatments soil samples were randomly taken with the aid of soil auger at twenty (20) different locations within each replicate at 0-15cm depth and the analysis was done. At 12 weeks after establishment, soil samples for each treatment were also randomly taken with the aid of soil auger and analysed as described by (A.E.S 1998).

### *2.5 Animals and their management*

Nine (9) West African dwarf sheep, about one year old weighing 12-15kg purchased from local markets were used in the study. These were randomly divided into 3 animals per treatment with each animal constituting a replicate. The animals on arrival were confined in the quarantine pen which had been previously washed and distinfected using lodophor solution. The animals were treated against internal and external parasite using Ivomec at 1ml to 10kg of body weight. They were also given long acting anti-biotic at 1ml to10kg of body weight. The animal was transferred into individual pens having the floor covered with wood shaving for the growth trial study.

### *2.6 Experimental diets*

*Panicum maximum* forages were harvested manually at 12 weeks of regrowth at about 10cm above the ground level and chopped between 5 to 10cm lengths with the aid of cutlass and separately fed *ad libitum* to each experimental animal. *Panicum maximum* intercropped with 1row, 2rows and 3rows of *Stylosanthes hamata* were fed to the animals at 3% of the body weight without legume supplement daily and water was given *ad libitum*.

*2.7 Digestibility study*

Nine (9) West Africa Dwarf sheep were used for a digestibility study. Three rams were selected per treatment. The animals were transferred into individual metabolic cages that allowed for separate collection of feaces and urine. They were in the cages for 21 days during which daily feed and fecal production were evaluated. They were given *Panicum maximum* alone. The animals were allowed to acclimatize for 14 days after which data on feed offered and faecal output were collected and weighed daily for 7 days. Sub samples of feed and faeces were taken and oven dried at $60^0$C for 24 hours to determine dry matter content. Samples of the feed and feaces were kept till required for chemical analysis.

*2.8 Chemical Analysis*

Collected grass samples were oven dried at $60^0$C for 48 hrs and ground. The finely ground samples were analysed for Crude protein (CP) according to A.O.A.C (1995). Neutral detergent fiber (NDF), acid detergent fiber (ADF), acid detergent lignin (ADL) and gross energy (GE) were determined by the method of Van Soest *et al*., (1991). The mineral contents for K, Ca, Mg, Fe, Zn and Cu in digest were determined using atomic absorption spectrophotometer and Phosphorus was determined by Vonadomolybdate calorimetry method A.O.A.C, (1995).

*2.9 Statistical Analysis*

Data obtained were subjected to analysis of variance using General linear model of SAS, 2000. The significant means were separated using Duncan multiple range test.

**3 RESULTS AND DISCUSSION**

Table 1 shows the chemical composition of the soil before and after intercropping. The $P^H$, nitrogen, phosphorus, potassium, calcium, magnesium and organic carbon contents of the soil increased after intercropping and decreased in the control. This shows that after intercropping of legumes at different rows with *Panicum maximum* improved minerals content was achieved. Adeoye (1988) and Raynold (1994) reported that as the level of nitrogen in the soil increases the amount of available minerals in the soil increases. This might be due to residual effect of decayed leaves and nitrogen fixed by legume which contributed to soil improvement. Miles and Manson, (2000) also reported that the level of P, K, Ca and Mg in the plant depends upon the availability of these minerals in the soil.

Significant ($P<0.05$) differences were observed on the effect of *Stylosanthes hamata* row on herbage yield of *Panicum maximum* as shown in Table 2. *Panicum maximum* intercropped with 2 and 3 rows of *Stylosanthes hamata* had higher significant ($P<0.05$) value for biomass yield, tillers number, tillers heights, leaf length and leaf width. This result might be due to the residual effect of decay leaves and reduced direct sunlight and erosion. Legumes are known to fix nitrogen directly which aid the growth of companion grasses. More nitrogen could have been fixed by closer spacing of the leguminous crop. This observation agrees with the result of Tripathi and Psychas (1992), who observed that improved soil nitrogen increased leaf elongation rate and size in plants. The herbage yield increased in 2 and 3 rows of *Stylosanthes hamata* intercropped with *Panicum maximum*, might be due to growth behavior and plant density of the legumes to the grass. This agrees with the findings of Fujital *et al.,* (1992) that closer legumes transfer more nitrogen in legume grass mixture than distant legume. The increase biomass yield was due to increase in leaf production, increased number of tillers, and increased rate of leaves extension which stimulated the greater light capture and hence photosynthesis and thus increases yield. This was in harmony with the report of Reynolds, (1992) that inter planting of grass with legume at a closer spacing transferred more nitrogen in legume grass mixture than the distant legumes.

Table 3 shows the effect of number of *Stylosanthes hamata* rows on chemical composition of *Panicum maximum*. There were significant ($P<0.05$) differences among the parameters considered. *Panicum maximum* intercropped with 2 and 3rows of *Stylosanthes hamata* had the highest crude protein and gross energy content. It was also observed that ability of legumes to fixed nutrient to the soil and utilized by companion grass which will reflected on the grass quality. The crude protein contents of *Panicum maximum* was still within the acceptable range for ruminant performance (NRC 1981), also more than the critical CP level of 7 % recommended by ARC (1980) and 8 % suggested by Norton (1994) for ruminal function. This agrees with the observation of Reynolds (1992) who observed that closed legume transfer more nitrogen in legume-grass mixture than amount fixed by other distant legume. The NDF, ADF and ADL contents decreased with increased in level of CP% and GE in the grass. This is in line with the findings of Adepoju, (2005) who observed a decrease in CF percentage as the CP percentage increases this might due to general believed that the more the CP content of forage the lesser the fibre fraction.

The significant effect was observed for *Stylosanthes hamata* rows on mineral composition of *Panicum maximum* in Tables 4. Two and Three rows had higher values of K, Ca, Mg, P, Fe, Zn and Cu than 1 row. The minerals (K,

Ca, Mg, P, Fe, Zn and Cu) contents of *Panicum maximum* intercropped with different inter row of *Stylosanthes hamata* were increased with increasing inter row spacing of the different legumes. It was observed that closer planting geometry of legume with grass resulted into higher contents of these mineral in the *Panicum maximum.* This observation agree with the result of Fisher and Baker (1996) that herb and leguminous specie consistently have higher concentration of some important minerals than perennial grasses which when planted together are made available for the grasses uptake through the senesces and decay of leaf and rooting materials of the legumes. Higher values were obtained in closer legume spacing.
The significant ($P<0.05$) differences were observed for feed intake (g/d/kg $^{0.75}$) of WAD sheep fed *Panicum maximum* intercropped with *Stylosanthes hamata* at different planting rows in Table 5. Three rows produced higher values for DM (517.33 g/d/kg $^{0.75}$) and CP (43.70 g/d/kg $^{0.75}$) also the dry matter intake was highest for the *Panicum maximum* intercropped with 3 rows of *Stylosanthes hamata* than the *Panicum maximum* intercropped with 1 row. Higher dry matter intake was observed for close grass-legume row spacing and the dry matter intakes decreased with decreased legume-grass inter row spacing. The observed variation in dry matter intake could be as a result of increased bacteria production in the rumen (Singh *et al.*, 1981).
The nutrient digestibility by WAD sheep fed *Panicum maximum* intercropped with *Stylosanthes hamata* at different inter row spacing was shown in Table 6. There were significant ($P<0.05$) differences among inter row spacing for nutrient digestibility. The digestibility of dry matter (DM) and crude protein (CP) were highest for animal fed *Panicum maximum* intercropped with 3 rows of legumes. The least value was obtained in the animals fed sole *Panicum maximum* stand. Increased crude protein content of forages could have induced higher crude protein nutrient digestibility, though increase in bacteria production in the rumen content at the expense of protozoa development (Tarakony and Sommer, 1983) and an increased escape of dietary protein to intestine due to ruminal retention time associated with high levels of feed intake (Firkin *et al.,* 1986) could have occurred. Tukel and Yilmaz (1987) observed that intercropping forage legume with grass increase crude protein digestibility of the grass. The result obtained for nutrient digestibility by WAD sheep fed *Panicum maximum* inter row with 3rows of stylo were higher for CP digestibility (61.97-79.67 g/kg) without supplementation with concentrate compared to the report of Murphy *et al*, (1994) that (57-76.21 g/kg) CP digestibility when complete diets were given to lambs. HadjiPanayioton (1990) reported digestible CP of (73-76 g/kg) for lambs and (74-75%) for kids fed concentrate supplemented with hay. Abazinge *et al.*, (1994) however obtained (64.8-74.4 g/kg) digestible CP for sheep fed grass with concentrate and silage.
The weight gain of WAD sheep fed *Panicum maximum* intercropped with *Stylosanthes hamata* at different inter row spacing was presented in Table 7. The highest average final weight (kg) was highest in treatment 3 with (16kg). The average weight gains also highest in 3 rows (53,6kg) followed with 2 rows (35.79g/h/d) and (10.79/h/d) least value was observed on 1 row. An improvement in voluntary feed intake is often attributed to increased rate of forage digestion which may permit improved body condition in ruminants (Weder *et al.*, 1999). The increase in weight gain (g/h/d) recorded may be attributed to improved forage composition and feed intake brought about by legume-grass spacing effect. The legume at different inter row spacing fed to WAD sheep had positive impact on weight gain of the animals. This might be due to residual effect of legume on grass

## 4.0 Conclusions

Herbage yield and nutritional composition of *Panicum maximum* interplanted at 3 rows of *Stylosanthes hamata,* improved. Animals fed with *Panicum maximum* without legume supplement had higher nutrient digestibility and weight gain. *Panicum maximum* can be intercropped with legume at 3rows of *Stylosanthes hamata*, in derived savanna zone of Nigeria will ensure good quality forage, better feed intake and enhanced weight gain.
Finally, legume can be a good alternative to the use of the unaffordable inorganic nitrogen fertilizer that has been recently discovered to pose threat to the environment.

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**Table 1: Chemical composition of experimental site soil before and after legume intercropping**

| Legumes treatment | Chemical composition of soil | | | | | | |
|---|---|---|---|---|---|---|---|
| | $P^H$ | N(mg/g) | P(mg/g) | K(cmol/kg) | Ca(cmol/kg) | Mg(cmol/kg) | O.C |
| Initial | 6.47 | 0.09 | 14.76 | 1.41 | 3.58 | 1.87 | 1.28 |
| *P. max* in Stylo 1row | 6.67 | 1.10 | 16.02 | 1.77 | 3.92 | 2.51 | 2.30 |
| *P. max* in Stylo 2rows | 6.69 | 1.20 | 16.06 | 1.83 | 3.87 | 2.64 | 2.64 |
| *P. max* in Stylo 3rows | 6.74 | 1.40 | 16.29 | 1.87 | 3.68 | 2.97 | 2.96 |

**Table 2. Effect of *Stylosanthes hamata* rows on herbage yield of native *Panicum maximum***

| Stylo rows | Biomass yield (kg/ha) | Tiller no | Tiller height (cm) | Leaf length (cm) | Leaf width (cm) |
|---|---|---|---|---|---|
| 1row | 286000$^{b}$ | 20.00$^{b}$ | 124.12$^{b}$ | 40.30$^{b}$ | 2.36$^{a}$ |
| 2rows | 382000$^{a}$ | 32.00$^{a}$ | 136.11$^{a}$ | 51.31$^{a}$ | 2.38$^{a}$ |
| 3rows | 383000$^{a}$ | 33.00$^{a}$ | 140.14$^{a}$ | 51.31$^{a}$ | 2.38$^{a}$ |
| SEM | 101.10 | 7.12 | 21.04 | 9.08 | 0.10 |

$^{ab}$Means along the same column with different superscripts differs significantly (P<0.05) different.

**Table 3. Effect of *Stylosanthes hamata* rows on Chemical composition of *Panicum maximum***

| Stylo rows | CP% | NDF% | ADF% | ADL% | G.E(Kcal/kg) |
|---|---|---|---|---|---|
| 1row | 8.72$^{b}$ | 39.74$^{a}$ | 30.15$^{a}$ | 20.20$^{a}$ | 3.12$^{b}$ |
| 2rows | 9.81$^{a}$ | 38.47$^{b}$ | 29.07$^{b}$ | 19.09$^{b}$ | 3.13$^{a}$ |
| 3rows | 9.85$^{a}$ | 38.47$^{b}$ | 29.05$^{c}$ | 19.10$^{b}$ | 3.13$^{a}$ |
| SEM | 2.05 | 7.10 | 5.14 | 4.44 | 0.20 |

$^{abc}$Means along the same column with different superscripts differ significantly (P<0.05) different

**Table 4: Effect of number of rows of *Stylosanthes hamata* on minerals composition of native *Panicum maximum***

| Stylo rows | K% | Ca% | P% | Mg (mg/100g) | Fe (mg/100g) | Zn (mg/100g) | Cu (mg/kg) |
|---|---|---|---|---|---|---|---|
| 1row | 0.23$^{b}$ | 0.20$^{b}$ | 0.18$^{b}$ | 0.10$^{b}$ | 260.27$^{b}$ | 07.26$^{b}$ | 1.05$^{b}$ |
| 2rows | 0.30$^{a}$ | 0.35$^{a}$ | 0.20$^{a}$ | 0.25$^{a}$ | 270.27$^{a}$ | 10.00$^{a}$ | 2.00$^{a}$ |
| 3rows | 0.36$^{a}$ | 0.35$^{a}$ | 0.20$^{a}$ | 0.25$^{a}$ | 270.30$^{a}$ | 10.00$^{a}$ | 2.00$^{a}$ |
| SEM | 0.03 | 0.02 | 0.01 | 0.01 | 68.11 | 2.01 | 0.01 |

$^{abc}$Means along the same column with different superscripts differ significantly (P<0.05) different.

**Table 5: Feed intake (g/d/kg $^{0.75}$) of WAD sheep fed *Panicum maximum* intercropped with *Stylosanthes hamata* at different planting rows**

| Rows | Chemical composition (g/d/kg $^{0.75}$) | | | |
|---|---|---|---|---|
| | DM (g/d/kg $^{0.75}$) | CP(g/d/kg $^{0.75}$) | NDF (g/d/kg $^{0.75}$) | ADL (g/d/kg $^{0.75}$) |
| 1 row | 493.57$^{c}$ | 41.23$^{c}$ | 371.96$^{b}$ | 80.70$^{b}$ |
| 2 rows | 498.74$^{b}$ | 42.00$^{b}$ | 342.44$^{c}$ | 74.25$^{c}$ |
| 3 rows | 517.33$^{a}$ | 43.70$^{a}$ | 341.83$^{d}$ | 63.34$^{d}$ |
| SEM | 48.09 | 8.03 | 44.73 | 12.03 |

$^{abcd}$Means along the same column with different superscripts were significantly (P<0.05)different.
1= *Panicum maximum* intercropped with 1row of *Stylosanthes hamata*
2= *Panicum maximum* intercropped with 2rows of *Stylosanthes hamata*
3= *Panicum maximum* intercropped with 3rows of *Stylosanthes hamata*

**Table 6: Nutrient digestibility** (g/kg) **of WAD sheep fed *Panicum maximum* intercropped with *Stylosanthes hamata* at different planting rows**

| Rows | Chemical composition (g/kg) | | | |
|---|---|---|---|---|
| | DM(g/kg) | CP(g/kg) | NDF(g/kg) | ADL(g/kg) |
| 1 row | 34.15$^{c}$ | 61.97$^{c}$ | 82.76$^{b}$ | 84.80$^{b}$ |
| 2 rows | 46.17$^{b}$ | 72.49$^{b}$ | 76.38$^{c}$ | 77.04$^{c}$ |
| 3 rows | 52.24$^{a}$ | 79.67$^{a}$ | 75.75$^{d}$ | 76.53$^{d}$ |
| SEM | 8.11 | 9.34 | 9.12 | 9.67 |

$^{abcd}$Means along the same column with different superscripts were significantly (P<0.05)different
1= *Panicum maximum* intercropped with 1row of *Stylosanthes hamata*
2= *Panicum maximum* intercropped with 2rows of *Stylosanthes hamata*
3= *Panicum maximum* intercropped with 3rows of *Stylosanthes hamata*

**Table 7: Average daily change in weight of WAD sheep fed with *Panicum maximum* Intercropped with *Stylosanthes hamata* at different inter row spacing**

| Parameter | Rows | | |
|---|---|---|---|
| Legume at different inter row | 1 | 2 | 3 |
| Number of animals | 3 | 3 | 3 |
| Duration of feeding(in days) | 28 | 28 | 28 |
| Average Initial weight | 15 | 15 | 15 |
| Average final weight | 15.5 | 16 | 16.5 |
| Average weight gain(g/h/d) | 17.9 | 35.7 | 53.6 |

1= *Panicum maximum* intercropped with 1row of *Stylosanthes hamata*
2= *Panicum maximum* intercropped with 2rows of *Stylosanthes hamata*
3= *Panicum maximum* intercropped with 3rows of *Stylosanthes hamata*