International Journal of Science, Environment and Technology, Vol. 3, No 1, 2014, 224 – 232

ISSN 2278-3687 (O)

HERBAGE YIELD AND NUTRITIVE QUALITY OF *PANICUM MAXIMUM* INTERCROPPED WITH DIFFERENT LEGUMES

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Abstract: The effect of different legume intercrops on herbage yield and nutritive quality of *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 treatments consisted of sole *Panicum maximum* stand*, Panicum* interplanted with *Cajanus cajan, Canavalia ensiformis* and *Stylosanthes hamata*. The experiment was laid out in a randomized complete block design with three replications. Parameters investigated at 12weeks old on *Panicum* were biomass yield, tillers number and height, leaf length and width, chemical and mineral compositions.

Results showed that among all the legume treatments, *Stylo* significantly ($P < 0.05$) enhances biomass yield (37000kg/ha), number of tillers (27.00), tiller height (190.30cm), leaf length (86.98cm) and leaf width (2.98cm) of *Panicum.* The Crude protein (10.89%) and gross energy (3.77kca/kg) content of *Panicum* inter planted with *Stylo* were ($P<0.05$) higher than the values obtained for other treatments. P (0.31%), K (0.19 %), Ca (0.27%), Mg (0.36 mg/100g), Fe (270.30 mg/100g), Zn (35.57 mg/100g), and Cu (7.10 mg/kg), of *Panicum* inter planted with *Stylosanthes hamata* were significantly ($P < 0.05$) highest compared to its counterpart. This study revealed that *Panicum* intercropped with *Stylosanthes hamata* enhances higher herbage yield and improves its nutritive value.

*Received Dec 22, 2013 * Published February 2, 2014 * www.ijset.net*

INTRODUCTION

The major problem facing ruminant animal production in the tropics is the insufficient quality pasture for the livestock. Also, soil fertility problems are found in most tropical pasture situations (Aderinola, 2007). The forages are generally of lower nutritive value than those in the temperate regions (Akingbade *et al.*, 2004) because native grasses are grown on low fertile soil which is not well suited, for cropping (Humphreys, 1995). Herbage yield of the native *Panicum maximum* during the raining season could be somewhat high, the productivity however declines sharply during the dry season when they are dry and coarse with low feeding value (Aderinola, 2007). Sabiiti (1992) noted that during the dry season in Nigeria, forage quality especially of grass declined to 3% crude protein which is below the critical level of 7% recommended by NRC (Minson,1982). This limits feed intake and digestibility with subsequent low animal productivity.

The major challenge has been how to overcome the inadequate quality and quantity of cultivated fodders most especially during off season. 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 term of crude protein content, voluntary feed intake and digestibility (Aderinola, 2007). Legume grown with grasses offer several advantages over grasses grown alone. Alalade *et al.*, (2012) noted that inclusion of legumes in the pasture usually results in increased herbage 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 legumes 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. Apart from being relished by ruminants, farmers often use these legumes for soil reclamation (Babayemi *et al.*, 2006). Hence, in the current study, the effects of intercropping different legumes with *Panicum* on its herbage yield and nutritive value were assessed.

MATERIALS AND METHODS

EXPERIMENTAL SITE

The experiment was carried out at the Teaching and Research Farm, Ladoke Akintola University of Technology, Ogbomoso located in the derived Savanna zone of Nigeria. Ogbomoso lies at approximately 8^{0}7'North of the equator and 4^{0}15'East of Greenwich Meridian. The climate is characterized by the fairly high uniform temperature (36.20^{0}C), 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 (Adeniyi, 2005).

FIELD LAYOUT AND MANAGEMENT PRACTICES

The area of land used was 576m^2. The land was cleared and leveled manually to obtain a clean seed bed. Later, it was laid out in completely randomized block design. The seeds of the three selected legumes (*Cajanus cajan, Canavalia ensiformis* and *Stylosanthes hamata)* were procured from the International Institute of Tropical Agriculture, (IITA) Ibadan, Oyo State, Nigeria. *Panicum maximum* (Green Panic) tillers were sourced from within the University pasture demonstration plot. Weeding was done manually as often as required to prevent weeds from competing with the legumes and *Panicum maximum* for the nutrients. The weeds were left in the plots to decay and return the nutrients back to the soil.

There were four treatments consisting of sole *Panicum maximum*, *Panicum maximum* intercropped with *Cajanus cajan, Canavalia ensiformis* and *Stylosanthes hamata* respectively. Each treatment was replicated thrice and each experimental plot measured 5m x 5m with 1m path between plots. At the time of establishment crown splits with 2 tillers each of *Panicum* at a height of 15cm were planted per stand with a spacing of 50x50cm. At eight weeks of age, *Panicum* was cutback and intercropped with different legumes. Soil samples were collected before planting and after harvest, bulked, air dried and kept till required and subjected to chemical analysis.

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.

SOILANALYSIS

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

CHEMICAL ANALYSIS

Collected grass samples were oven dried at 60^0C 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 of A.O.A.C, (1995).

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 the same package.

RESULTS AND DISCUSSION

Table 1 shows the chemical composition of the soil before and after intercropping. The PH, nitrogen, phosphorus, potassium, calcium, magnesium and organic carbon contents of the soil increased after intercropping and decreased in the control. This shows that intercropping of legumes with *Panicum maximum* improved minerals content was achieved. Adeoye (1988) and Raynold Miller (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

Table 2 shows the effect of intercropping different legumes on herbage yield of *Panicum maximum*. There were significant ($P<0.05$) differences among the parameters measured. Biomass yield, tiller number, tiller height, leaf length and leaf width were highest in *Panicum maximum* intercropped with *Stylosanthes hamata* followed by *Panicum maximum* intercropped with *Canavalia ensiform,* and *Panicum maximum* intercropped with *Cajanus cajan* and least value was observed in control. The highest yield was observed for *Panicum maximum* intercropped with *Stylosanthes hamata*. This might be due to the growth behaviour of *Stylosanthes hamata* which would have covered the soil and cause increased availability of nutrient due to leave senescence. This is in line with report of Ajayi *et al.,* (2007) that the herbage yield mean values obtained for *Panicum maximum* intercropped with *Stylosanthes hamata* and *Aeschynomene histrix* were better than the values obtained for the sole *Panicum maximum.*

The table 3 showed the effect of intercropping different legumes on chemical composition of *Panicum maximum.* There were significant ($P<0.05$) differences in chemical composition of *Panicum maximum* intercropped with legumes. The results obtained for CP and GE were highest in *Panicum maximum* intercropped with *Stylosanthes hamata* followed by *Panicum maximum* intercropped with *Canavalia ensiform,* and *Panicum maximum* intercropped with *Cajanus cajan* and least value was observed in control. This observation might be due to growth behavior of the *Stylosanthes hamata* cover which would have shed off more leaves and decay returned the nutrient back into the soil, thus becoming more available for companion grass uptake. This agrees with the result of Fisher and Baker (1996) and Jones (1990) that legumes species consistently have higher concentration of crude protein than grasses through the senescence and decay of leaves and rooting materials of the legumes. This result was also in agreement with the observation of Turkel and Yilmaz, (1987) that intercropping forage legume with grasses improved forage quality in terms of crude protein content.

Table 4, shows the effect of legume on mineral composition of *Panicum maximum* intercropped with different legumes. Generally, for all the minerals composition of *Panicum maximum* planted with *Stylo* had the highest values for , K, Ca, Mg, P, Fe, Zn and Cu followed by *Panicum maximum* in *Canavalia* and in *Cajanus* while the least values was observed on sole *Panicum maximum* stand. The mineral composition of a *Panicum maximum* intercropped with different legume was generally higher in values. Legumes are known to contain more minerals than grasses and the root and leaves of these leguminous plants also under go **senescene** and they decay thus returning the mineral back to the soil for utilization by their companion grasses. Mile and Manson, (2000) also reported that the level of P, K, Ca and Mg in the plant is dependent upon the availability of these minerals in the soil, thus with a number of leguminous species containing a higher concentration of important minerals than perennial grasses (Jones, 1990; Fisher and Baker, 1996) their leaves senescence and decay return these mineral back into the soil, thus becoming more available for companion grass uptake. Renard and Garba, (1987) observed that forage legumes improved the nutritive value of harvested companion product.

CONCLUSIONS

Herbage yield and nutritional composition of *Panicum maximum* interplanted with *Stylosanthes hamata,* performed better than the others. *Panicum maximum* intercropped with *Stylosanthes hamata* in derived savannah zone of Nigeria will ensure good quality and quantity forage.

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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
Control	6.08	0.07	13.54	0.88	2.62	2.07	1.51
P. max in C. cajan	6.73	0.34	15.60	1.78	3.62	2.55	1.67
P. max in Canavalia	6.94	0.40	16.16	1.79	3.90	2.83	2.36
P. max in Stylo	6.74	1.40	16.29	1.87	3.68	2.97	2.96

Table 2: Effect of intercropping different legumes on herbage yield of native *Panicum maximum*

Treatment	Biomass yield(kg/ha)	tiller no	tiller ht(cm)	leaf length(cm)	leaf width(cm)
P. max in Cajanus	19000^c	20.00^c	152.20^c	74.97^c	2.94^c
P. max in Canavalia	29000^b	21.00^b	163.63^b	84.79^b	2.96^b
P. max in Stylo	37000^a	27.00^a	190.30^a	86.98^a	2.98^a

P. max (sole)	9800^{d}	13.00^{d}	142.03^{d}	50.10^{d}	2.00^{d}
SEM	89.67	4.92	18.99	6.78	0.01

^{abcd}Means along the same column with different superscripts were significantly (P<0.05)different.

Table 3: Effect of intercropping different legumes on chemical composition of *Panicum maximum*

Treatment	CP%	NDF%	ADF%	ADL%	G.E(kca/kg)
P. max in *Cajanus*	8.22^{c}	71.32^{b}	51.52^{b}	15.36^{b}	3.22^{c}
P. max in Canavalia	9.27^{b}	69 .96^{c}	50.00^{c}	14.85^{c}	3.64^{b}
P. max in Stylo	10.89^{a}	68.54^{d}	49.97^{d}	13.15^{d}	3.77^{a}
P.max(sole)	7.11^{d}	73.98^{a}	52.81^{a}	16.18^{a}	3.00^{d}
SEM	1.61	9.28	6.10	1.89	0.01

^{abcd}Means along the same column with different superscripts were significantly (P<0.05)different.

Table 4. Effect of intercropping different legumes on mineral composition of *Panicum maximum*

Treatments	K%	Ca%	P%	Mg (mg/100g)	Fe (mg/100g)	Zn (mg/100g)	Cu(mg/kg)
P. max in *Cajanus*	0.16^{c}	0.21^{b}	0.24^{c}	0.27^{c}	26.50^{c}	31.90^{c}	6.80^{c}
P. max in *Canavalia*	0.17^{b}	0.21^{b}	0.25^{b}	0.33^{b}	28.87^{b}	32.90^{b}	6.93^{b}
P. max in *Stylo*	0.19^{a}	0.27^{a}	0.31^{a}	0.36^{a}	29.73^{a}	35.57^{a}	7.10^{a}
P. max (Sole)	0.14^{d}	0.14^{c}	0.21^{d}	0.26^{d}	24.23^{d}	28.40^{d}	6.71^{d}
SEM	0.01	0.01	0.01	0.01	5.18	7.01	1.01

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