Reduction of Poverty through Improved Animal Nutrition via Low Input Agricultural Production of Panicum Maximum

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Running title: Rumen degradability of *P. maximum*

Key words: Rumen – Grass – Fertilizer – Degradability – Ruminants – Crude protein – Poverty reduction.

INTRODUCTION

Livestock among the rural poor is presently known to sustain an estimated 675 million people (14). The rate of growth of livestock will make it to be half of the total world agricultural output by the year 2020 (7). Unfortunately developing countries where majority of the world poorest people are living, growth in the livestock sub sector is being hindered by financial and asset, technical, socio-cultural, religious bias, lack of competitiveness, pests and diseases and reduction in available land for grazing. Intensive grass production is yet to attract attention of farmers in the sub-Saharan Africa. Hence, animals are poorly nourished via nutrient deficient forage since many tropical soils are low in nutrient content. The problem is further compounded through non-availability of chemical fertilizers coupled with poor logistics when available. Therefore, there is an urgent need to search for alternatives if animals will not be under-nourished, so as to improve their productivity. Productions of certain arable crops have been enhanced through the use of organic manure (2, 13). Murillo *et al*. (17) reported that yield of Rye grass increased significantly when compost was applied.

Although, organic manure can be easily sourced and therefore more easily available and affordable compared to inorganic fertilizer, it has the problem of slow release of its nutrients (10). Therefore, to enhance the ability of plants for efficient uptake, symbiotic fungi, arbuscular mycorrhiza may be integrated. *Andropogon gerardii* had its biomass yield increased from 7 – 70 fold by inoculation with AM fungi (11). AM fungi inoculation is known to enhance field grown leguminous trees and cassava under tropical conditions (8,9). Therefore, the present study is evaluating the roles of organomineral fertilizers and mycorrhizal fungi on the productivity and rumen degradability of *Panicum maximum.*

MATERIALS AND METHODS

The research was carried out at the Teaching and Research Farm of the University of Ibadan (7°20' N, 3°54'E). Grass pasture, comprising sole Guinea grass (*Panicum maximum* Var. Ntchisi), established in May 1996 was used for the study. It was a split plot design having 3 replicates with mycorrhizal inoculation having two levels serving as the main plot factor while the subplot factor was the organomineral fertilizer application (two grades of organomineral fertilizers – A, B, mixtures of A and B in 1:1 (w/w) ratio and no application). The three cutting regimes of 4, 6, and 8 weeks was the sub-sub plot factor. The OM was applied at the rate of 2 tons/ha after cutting back the grass at 10 cm above the ground. AM fungus (50 g) inoculum consisting of root-soil-spore mixture was applied approximately 5 cm sub surface around the plant. The inoculum used was *Glomus clarum*. Harvesting at designated periods of 4, 6, and 8 weeks include root samples for mycorrhizal infection analysis and dry matter yield.

Rumen organic matter degradability was determined using cannulal sheep and methods of Qrskov and McDonald (18) while the effective degradability (ED) was determined using the method of McDonald (14). Nitrogen was determined by the standard micro-Kjeldahl method (4). Neutral detergent fibre (NDF) and acid detergent fibre (ADF) were determined as reported (19). Analysis of variance was carried out as appropriate while the means were separated using Duncan's multiple range test.

RESULTS

Mycorrhizal infection and yield

All treatments were infected by mycorrhizal fungi irrespective of application of mycorrhizal inoculum (data not shown). There was no significant difference in the percentage colonization between the inoculated and non-inoculated plots. The values of mycorrhizal colonization ranged from 40 – 45 % within various treatments. Dry matter yields were not significantly different with respect to frequency of cutting either with or without mycorrhizal inoculation under respective organomineral fertilizer application (Table I). Yields of grass under different organomineral fertilizers were not significantly different at respective cutting frequency. Mycorrhizal inoculation however contributed significantly to the yield of grass. With or without organomineral fertilizer application, the yield of inoculated grass was consistently higher compared to the non-inoculated grass. All the fertilizers applied (A, B, A+B) increased the yield of grass significantly at all the ages of cutting with or without mycorrhizal inoculation compared to the control without fertilizer application. Interestingly, the yield of grass at 6 and 8 weeks cutting age when under fertilizer application but not inoculated with mycorrhizal was not significantly different from no fertilizer but mycorrhizal inoculated control.

Nutrient composition

With the application of different OMFs, the crude protein (CP) content of the grass were not significantly different but were significantly higher compared to the unfertilized grass (Table I). The CP at the 8th week regrowth was least compared to those of 4 and 6 weeks in all treatments whether inoculated or not inoculated with mycorrhizal fungi. Mycorrhizal inoculation significantly increased the CP of the grass with or without OMF application. Mycorrhizal inoculation and OMF application did not affect neutral detergent fibre (NDF), acid detergent fibre (ADF), ether extract (EE) and ash of the grass (Table II). Hence, the data were pooled. Subsequent analysis revealed that the age at cutting had significant effect on the NDF, ADF, EE, and ash, such that the values increased with the age at cutting.

Organic matter degradability

There was no significant effect of OMF application and mycorrhizal inoculation on the degradation characteristics of Guinea grass, which decreased with increase in cutting age (Table III). Similar patterns were maintained by the soluble fraction, degradation fraction and effective degradability.

Discussion

Soil fertility amendment can be better achieved through the application of organic materials compared to the application of chemical fertilizers (7). Where the soil is extremely poor, mixture of organic materials and inorganic fertilizer can be applied, the effectiveness of which can be improved through the combination of symbiotic microbes such as arbuscular mycorrhizal fungi (8). In the present investigation, the effect of mycorrhizal inoculation on the yield was minimal with particular reference to the cutting frequency when fertilizer was applied. The compatibility of the introduced mycorrhizal can be seen in the yield of grass when inoculated but not amended with fertilizer being not significantly different from those with fertilizer but not inoculated with mycorrhizal. When under OMF application, the yield of grass with and without mycorrhizal inoculation was 23.8 and 13.9 % higher compared to those without OMF application. Increase in yield with cutting frequencies had been reported by Mokunye (16). The treatments in this investigation further confirmed his result. The enhancement of nutrient uptake by mycorrhizal fungi is in accordance to other reports (8, 11). The dry matter degradation of the present work was not affected by inoculation and fertilizer application.

Conclusion

There is a very high potential in the application of OMF and arbuscular mycorrhizal fungi in the improvement of guinea grass or forage production. These can reduce the search for fodder in the dry season and enhance production of animals by resource poor farmers and invariably enhanced their income.

Acknowledgements

The research was partly funded by the Senate Research Grant given to the first author by the University of Ibadan, Ibadan. We are also grateful to Mrs Giwa for technical support.

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Table I. Dry matter yield (tha^{-1}) and crude protein of guinea grass as affected by mycorrhizal inoculation and organomineral fertilizer application

Fertilizer	Mycorrhizal inoculation	Age at cutting					
		4		6		8	
		Yield	Crude	Yield	Crude	Yield	Crude

			proten		protein		protein
A	Without	7.39b	10.30b	6.40b	9.60b	7.05b	8.92b
"	With	10.43a	13.20a	9.00a	12.41a	9.15a	10.29a
B	Without	7.95b	10.90b	6.47b	9.55b	6.22b	9.15b
"	With	10.47a	12.44a	9.07a	12.11a	9.21a	10.14a
AB	Without	7.39b	10.86b	6.78b	9.01b	7.81b	8.97b
"	With	11.04a	13.13a	9.39a	11.96a	9.74a	10.20a
0	Without	4.33d	7.22d	4.11c	7.00c	4.26c	6.91c
"	With	5.85c	9.04c	5.98b	9.01b	5.35b	8.24c

* -- Means on the same column followed by different letters are significantly different according to Duncan's Multiple Range Test. (P<0.05)

Table II. Nutrient composition of guinea grass as affected by age at cutting

Age at cutting	Nutrient Composition			
(Weeks)	NDF	ADF	EE	Ash
4	58.4c*	47.1a	2.7a	12.7b
6	65.9b	47.3a	1.8b	14.1a
8	77.2a	46.0b	1.2b	14.8a

Table IV. Rumen organic matter degradation characteristics (g/kg DM) of guinea grass cultivated with organomineral fertilizer and mycorrhizal fungi at different cutting age.

Fertilizer	Mycorrhizal inoculation	Degradation characteristics								
		Soluble fraction			Degradation fraction			Effective degradability		
		4	6	8	4	6	8	4	6	8
A	Without	282a*	267b	248c	431a	406b	364c	471a	400b	384c
"	With	285a	251b	243c	437a	402b	376c	468a	410b	390c
B	Without	297a	279b	239c	435a	410b	368c	470a	406b	388c
"	With	294a	262b	246c	432a	403b	360c	472a	400b	390c
AB	Without	286a	254b	241c	439a	405b	363c	469a	413b	386c
"	With	289a	261b	247c	436a	402b	361c	471a	410b	378c
0	Without	293a	277b	252c	428a	411b	373c	470a	409b	384c
"	With	298a	278b	257c	430a	404b	372c	474a	411b	377c

Footnote as in Table I