

Research Application Summary

Effect of fecal manure from cattle fed *Calliandra*, *Gliricidia* and *Luecaena* browse/maize silages on soil productivity

Kato, H.¹, Bareeba, F.B.² & Sabiiti, E.N.³

¹Department of Agriculture, Kyambogo University, P. O. Box 1, Kyambogo, Uganda

²Department of Animal Science, Makerere University, P. O. Box, 7062, Kampala, Uganda

³Department of Crop Science, Makerere University, P. O. Box, 7062, Kampala, Uganda

Corresponding author: habibkyanda@yahoo.co.uk

Abstract

Browse have tannins and lignin which bind protein N and fiber and could subsequently affect release of manure nutrients in the soil when fed to animals. In this experiment, which was a pot experiment, cattle fecal manure from browse/maize silages and maize silage alone were applied as treatments to soil with *Amaranthus cruentus* as the test crop. Four successive plantings were made without changing the soil. Soil C and N were determined at initial and after the first, second and third harvests. Five plants were harvested at collar level at flower bud stage from each pot to determine DM yield. Manure from maize silage alone had least N, a wider C:N ratio but less lignin and gave higher DM yield of the *Amaranthus*. Manure from *Calliandra*/maize silage had a higher level of N, but much of which was fiber and lignin bound, gave lower DM yields. The experiment gave indicative results that need to be tested further under farm conditions.

Key words: Browse, farm yard manure, fiber bound, lignin

Résumé

Les feuilles sont bronzées et la lignine qui lie la protéine N aux fibres pourrait ultérieurement affecter la libération d'éléments nutritifs du fumier dans le sol lors de l'alimentation de l'animale. Dans cette expérience, qui a été une expérience en pots, le fumier de bovins de fèces à partir de la navigation et l'ensilage de maïs et seul le maïs d'ensilage a été appliqués sur les traitements du sol avec *Amaranthus cruentus* comme cultures d'essai. Quatre plantations successives ont été faites sans changer le sol. Les sols C et N ont été déterminés au début et après la première, la deuxième et la troisième récoltes. Cinq plantes ont été récoltées au niveau du col au stade du bouton de fleur de chaque pot afin de déterminer le rendement de DM. Le fumier provenant d'ensilage de maïs seul avait au moins N, plus un rapport C / N, mais moins de lignine et a donné un rendement supérieur DM d'*Amaranthus*. Le fumier provenant de *Calliandra* / ensilage de maïs a un niveau plus élevé de N,

mais beaucoup étaient de fibres et de la lignine liée, et ont donné des rendements inférieurs en DM. L'expérience a donné des résultats indicatifs qui doivent être testés dans des conditions de la ferme.

Mots clés: Balayage, les fumiers, les fibres liée, de la lignine

Background

Use of farm yard manure to improve soil fertility and productivity is a key element in mixed agro-pastoral farming systems (Fernandez-Rivera *et al.*, 1993; Karl *et al.*, 1994) and it is becoming widespread in the smallholder farming systems (Ssali, 2001).

The nutrient release from farm yard manure is dependent on how uniformly it is spread, the proportion of soluble N and the C:N ratio, while at the same time these aspects are affected by storage methods (Karl *et al.*, 1994; Katurumunda *et al.*, 2010). Also, the type of feed and passage of the feed through the ruminants' digestive tract affects the availability of nutrients in the manure. The total amount and proportion of nutrients excreted in faeces and urine varies with the lignin:neutral-detergent fiber (NDF), lignin:N and polyphenol:N ratios of the diets. Feeding browses shifts N excretion from urine to faeces, and from faecal microbial to undigested feed-N (Somda *et al.*, 1993). The browses, *Calliandra calothyrsus* and *Leucaena leucocephala* have substantial levels of tannins and lignin (Bareeba and Aluma, 2000) and are known to bind protein and protect it from degradation in the rumen (Fahey *et al.*, 1980). This experiment investigated the effect of fecal manure from cattle fed *Calliandra*, *Gliricidia* and *Leucaena* browse/maize silages on soil productivity. *Calliandra*, *Gliricidia* and *Leucaena* browses are key nitrogen fixing trees in agro-forestry with potential as animal forages in mixed agro-pastoral farming systems.

Research Approach

The study investigated *Amaranthus cruentus* growth response to application of cattle manure obtained from dairy cattle fed *Calliandra*, *Gliricidia* and *Leucaena* browse/maize silages (20% browse DM basis). The study was carried out using pots in a screen house at Kyambogo University in central Uganda. The manure was obtained from a feeding trial for over four feeding periods of 28 days each. The manure samples were air dried, aggregated and ground in a laboratory mill to pass through a 2 mm sieve. The fecal manure was analyzed for organic matter (OM), total N, nonprotein nitrogen (NPN), acid detergent fiber (ADF), acid detergent fiber nitrogen (ADFN) and acid detergent

lignin (ADL). The top soil used in the pots was collected from a field with low fertility as shown by poor growth of crops growing on it. The soil samples were analyzed for OM, organic carbon (C) and total nitrogen (N). Treatments were made in quadruplets in a completely randomized experimental design. The manure was applied at the rate of 5 g of ground manure/kg of soil as an equivalent rate of 10t/ha for 3 years for Uganda, each hectare being equivalent to a plough share of 2,000,000 kg of soil (Anderson and Ingram, 1993). Four successive plantings were made without changing the soil or treatments. Adequate moisture for crop growth was maintained by regular watering with tap water. Soils were sampled from each pot at the beginning and after the first, second and third harvests and analyzed for OM, C and N. Five plants were harvested at flower bud from each pot at collar level, weighed and fresh weights recorded. Whole plant materials of the five plants from each pot were packed in paper bags and dried in the oven at 60°C for 72 hours to determine dry matter (DM) % and DM yield (kg). The soil and DM yield data obtained were subjected to statistical analysis by Genstat Release 12.2 (VSN International, 2010) and significant differences were obtained LSD at probability level of 5%.

Research Application

Fecal manure from feeding maize silage alone had lower levels of N and ADL, but a wider C:N ratio, lowest levels of soluble N and fiber bound N (ADFN) compared to manure from browse/maize silages (Table 1). Treated soils attained and maintained higher levels of C and N particularly with manure from maize silage alone (Table 2). Application of manure to the soil caused higher DM yields compared to the control. Manure from maize silage alone in spite of having least N, a wider C:N ratio had less lignin and therefore, readily released more N in the soil which supported higher DM yields of *Amaranthus cruentus*. Calliandra silage mixture had a higher level of N, but most of

Table 1. Chemical composition (%DM) of the faeces from feeding cattle browse/maize silages (20% browse DM basis).

Composition	Calliandra	Gliricidia	Leuceana	Maize
Carbon	41.99	40.10	40.84	41.09
Nitrogen	2.27	2.05	2.28	1.80
C:N Ratio	18.50	19.56	17.91	22.83
NPN (% total N)	19.13	18.43	14.58	12.84
ADF	46.96	46.13	46.50	46.22
ADFN (% total N)	25.42	19.97	26.11	15.64
ADL	12.32	6.22	6.73	2.13

Table 2. Mean levels (%) of carbon, nitrogen and C:N ratio of soils fertilized with fecal manure from feeding browse/maize silages (20% browse DM basis) and the DM yield of *Amaranthus*.

Composition	Soil treatments					SE
	Control	CF	GF	LF	MF	
Initial						
Carbon	0.97 ^c	1.31 ^b	1.22 ^b	1.31 ^b	1.52 ^a	0.06
Nitrogen	0.118 ^c	0.130 ^b	0.120 ^c	0.130 ^b	0.150 ^a	0.002
C:N	8.31 ^b	10.08 ^a	10.17 ^a	10.08 ^a	10.13 ^a	0.44
Mean values from three planting cycles						
Carbon	1.17 ^c	1.25 ^{bc}	1.38 ^a	1.35 ^{ab}	1.27 ^{abc}	0.06
Nitrogen	0.123 ^d	0.137 ^b	0.141 ^a	0.135 ^{bc}	0.133 ^c	0.002
C:N Ratio	9.41 ^{ab}	9.09 ^b	9.81 ^{ab}	10.02 ^a	9.63 ^{ab}	0.44
DM Yield (kg)	0.23 ^c	0.36 ^b	0.40 ^{ab}	0.43 ^{ab}	0.46 ^a	0.04

^{abcd}Value followed by different super scripts in the same row and significantly different (P<0.05). CF – fecal manure from Calliandra/maize silage, GF- fecal manure from Gliricidia/maize silage, LF- fecal manure from Leucaena/maize silage, MF - fecal manure from maize silage.

which was fiber and lignin bound which limited N release that resulted in lower DM yields of *Amaranthus cruentus*.

The results suggest that cattle fecal manure from browse/maize silage mixtures has a potential for improving soil fertility and productivity. However, cattle fecal manure from non browse forages (maize silage alone) had a higher soil fertilizing ability because of lower levels of fiber and lignin bound N and ADL.

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