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Decomposition of cattle dung on mixed grass-legume pastures

JOSÉ C.B. DUBEUX JR.[1], CAROLINA C. LIRA[2], ERINALDO V. DE FREITAS[3], MÉRCIA V.F. DOS SANTOS[2,5], MÁRIO A. LIRA[3,5], CAROLINE DYKSTRA[4], ERICK R.S. SANTOS[2] AND FERNANDO TENÓRIO FILHO[3]

[1]*University of Florida, North Florida Research and Education Center, Marianna, FL, USA.* http://nfrec.ifas.ufl.edu
[2]*Universidade Federal de Pernambuco, Recife, PE, Brazil.* www.ufpe.br
[3]*Instituto Agronômico de Pernambuco, Recife, PE, Brazil.* www.ipa.br
[4]*University of Guelph, Guelph, Canada.* www.uoguelph.ca
[5]*CNPq fellow.* www.cnpq.br

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Introduction

Animal excreta contribute positively to nutrient cycling and can improve the quality of soil (Dubeux Jr. et al. 2009; Carvalho et al. 2010). Cattle excrement, when evenly distributed over a pasture, can help to maintain plant nutrition without the application of fertilizers. The introduction of legumes intercropped with grasses benefits the soil by means of nitrogen fixation. When ruminant animals eat legumes, the feces produced may have lower C:N, C:P, lignin:N and lignin:P ratios, promoting better nutrient return to the soil than when cattle eat only grass. Given the importance of nutrient return from and decomposition time of cattle feces on pastures, the objective of this study was to quantify the decomposition of feces of heifers managed in mixed grass-shrubby legume pastures and grass-only pastures.

Materials and Methods

The research was performed at the experimental research station of Itambé, run by the Instituto Agronômico de Pernambuco (IPA). Average precipitation during the experiment was 727 mm. The experiment examined the decomposition of feces of heifers grazing signal grass (*Brachiaria decumbens*) pastures or signal grass plus shrubby legumes. Treatments were: Signal grass in pure stand and not fertilized; signal grass in pure stand + 60 kg N/ha/yr; signal grass intercropped with *Mimosa caesalpiniifolia*; signal grass intercropped with *Leucaena leucocephala*; signal grass intercropped with *Bauhinia cheilantha*; and signal grass intercropped with *Gliricidia sepium*. The pastures were planted in July 2008; legumes were planted in double rows spaced 10 m x 1.0 m x 0.5 m. Paddocks (plots) measured 660 m^2 and were individually fenced. Fecal samples were collected from cattle grazing/browsing the different pasture combinations, and dried at 65 ºC for 72 hours. Samples were then exposed in nylon bags under field conditions (Dubeux Jr. et al. 2006) for 7 time periods (4, 8, 16, 32, 64, 128 and 256 days) with 3 replicates per exposure time, from 23 June 2010 to 26 February 2011. Losses of organic matter, nitrogen (N), phosphorus (P) and potassium (K) were assessed at each stage. The means were analyzed using the PROC MIXED procedure of SAS (SAS Institute 1996). A single exponential model (Wagner and Wolf 1999) was used for percentage loss of organic matter.

Correspondence: José C.B. Dubeux Jr., University of Florida, North Florida Research and Education Center, 3925 HWY 71, Marianna, FL 32446, USA.
Email: dubeux@ufl.edu

Results and Discussion

The *Brachiaria decumbens* + 60 kg N treatment had the highest rate of fecal biomass loss (k=0.0031 g/g/d), with 55% loss of organic matter over the 256-day exposure period. The lowest rate of loss was seen for the grass-*Mimosa caesalpiniifolia* treatment (k=0.0018 g/g/d), with 37% of the material decomposing over the same period. Loss rates for the grass-*Gliricidia sepium* and *B. decumbens* treatments were 0.0025 and 0.0027 g/g/d, respectively, while the grass-*Leucaena leucocephala* decomposition rate was close to that of the *B. decumbens* + 60 kg N treatment (Table 1). Losses of N, P and K were similar on the various treatments with marked losses over time (Figure 1). Loss of N over 256 days (16%) was much lower than that of phosphorus (60%) and potassium (99.6%).

Table 1. Percentage of organic biomass of heifer feces from grass-legume pastures and grass-only pastures remaining after different exposure times in the field.

Treatment	Days of exposure (%)								Exponential model
	0	4	8	16	32	64	128	256	
Brachiaria decumbens	90.2	89.2	88.3	86.4	82.7	75.9	63.8	45.2	$Y = 90.2^{-0.0027t}$
B. decumbens + 60 kg N/ha	87.3	86.2	85.2	83.0	78.9	71.4	58.4	39.1	$Y = 87.3^{-0.0031t}$
B. dec. + *Gliricidia sepium*	88.9	87.9	87.0	85.3	81.9	75.5	64.2	46.4	$Y = 88.8^{-0.0025t}$
B. dec. + *Leucaena leucocephala*	90.2	89.2	88.1	86.1	82.1	74.7	61.8	42.3	$Y = 90.2^{-0.0029t}$
B. dec. + *Bauhinia cheilantha*	88.6	87.8	87.0	85.58	82.4	76.7	66.3	49.7	$Y = 86.6^{-0.0023t}$
B. dec. + *Mimosa caesalpiniifolia*	90.5	89.6	89.2	87.9	85.4	80.6	71.8	57.9	$Y = 90.5^{-0.0018t}$

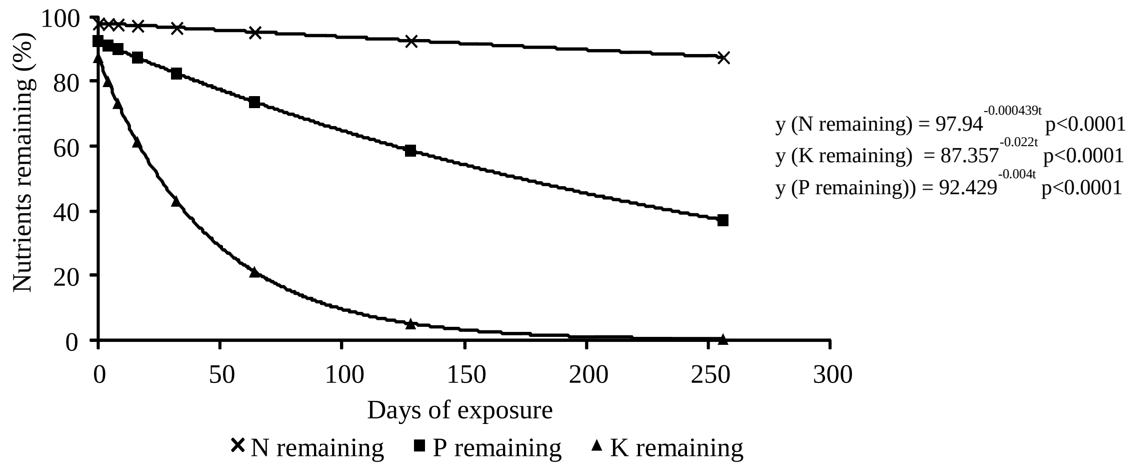

Figure 1. Percentage of nitrogen, phosphorus and potassium in heifer feces from grass-legume and grass-only pastures remaining after different exposure times in the field.

Conclusions

Dung decomposition from cattle grazing on the *B. decumbens* - *M. caesalpiniifolia* system was lower than for dung in other grass-legume combinations. Secondary compounds in *Mimosa* may partially explain this pattern. While organic biomass loss from feces in nylon bags in mixed grass-legume and grass-only pastures was quite significant during the season, after 256 days, 45−73% of the organic matter remained on the various treatments. How these figures relate to natural conditions is open to debate, e.g. dung beetles etc. were excluded. It was significant that only a small proportion of N was lost from the dung during this period but most P and virtually all of the K had disappeared. These findings are significant for nutrient cycling and nutrient use efficiency.

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