Sources of nitrogen in a Napier grass/legume mixture on smallholder dairy farms in central Kenya

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Introduction In Kenya , dairy production is a major source of smallholder farm income , especially in recent years after the collapse of coffee prices . The smallholder dairy systems are characterised by low weight gains in young stock and low milk production (5-6 kg cow^{-1} day^{-1}) . The low yields are attributed to inadequate year-round feed supply , protein and energy intake . The main source of forage is Napier grass (*Pennisetum purpureum*) grown in monoculture . A Napier grass/forage legume mixture can address the constraints to forage yield as the legumes have the ability to fix atmospheric nitrogen (N) through their symbiotic association with rhizobia (Giller , 2001) .

Materials and methods The site was in central Kenya (36 .3°E , 0 .30°S) . The soils are humic Nitosols with relatively high inherent fertility . The area receives 1 ,000 mm of rainfall in 2 seasons . The experiment was laid out in a randomised complete block design replicated 5 times with plots measuring 8 x 8 m . Napier grass (*Pennisetum purpureum*) cv . Bana was intercropped with one of the following legumes : *Desmodium intortum* cv . Greenleaf (ILRI 104) , *Macrotyloma axillare* cv . Axillare (ILRI 6756) and *Neonotonia wightii* cv . Tinaroo (ILRI 9794) . All the legumes were inoculated with appropriate *Bradyrhiziobium* spp . After the first three months establishment period the forage was harvested every 8 weeks and the yield separated into grass and legume components . Biological nitrogen fixation (BNF) was determined using the ^{15}N natural abundance method .

Results The Napier grass/*Desmodium* mixture had the highest legume and total dry matter (DM) yield ($P>0.05$) in the three years of the trial , although the grass component yield was slightly lower than that from the mixture with *Macrotyloma* . The mixture with *Neonotonia* had the lowest legume and total DM yield in the same period . Over a period of three years the Napier/*Desmodium* mixture had the highest total nitrogen yield followed by the mixture with *Macrotyloma* (Table 1) . The mixture with *Desmodium* derived the highest amount from biological nitrogen fixation (BNF) while the Napier/*Neonotonia* mixture had the least N from BNF (Table 1) . The proportion of nitrogen derived from BNF was relatively low , the highest being 22% . Even with *Desmodium* which had the highest proportion of N from BNF the mixture still extracted 412 Kg/N ha from the soil (Table 1) .

Table 1 *Nitrogen yield and sources in a Napier grass legume mixture in central Kenya .*

Mixture of Napier grass with :	Grass N yield (Kg/ha)	Total N yield (grass+legume) (Kg/ha)	N from BNF (Kg/ha)	Proportion of N from BNF (%)	N from soil (Kg/ha)
Desmodium	265	530	118	22	412
Macrotyloma	353	487	66	14	421
Neonotonia	267	326	32	10	294

Conclusions The low proportion of N derived from BNF could be attributed to the high inherent soil fertility at the site . The legume mixtures still extracted a large amount of N from the soil which would have to be replenished but still contributed a large amount of N from BNF .

Reference

Giller , K .E . (2001) *Nitrogen Fixation in Tropical Cropping Systems* . 2nd Edn (CAB International : Wallingford) .