LES LEGUMINEUSES A GRAINES

Actes du Séminaire organisé par la FIS
Madagascar, 22-27 février 1988

Edités par

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Cofinancé par

Le Ministère de la Coopération, France
Le Ministère des Affaires Etrangères, France

avec l'aide du

Centre Technique de Coopération Agricole et Rurale (CTA)
De l'UNESCO

Publié par

Fondation Internationale pour la Science (FIS)
Grev Turegatan 19, 114 38 Stockholm, Suède

Composé et mis en page par

BIEM, 68 Bd. de Port-Royal, 75005 Paris, France

Imprimé par

Imprimerie JOUVE, 18 rue Saint-denis, 75001 Paris, France

1989

MILLET BASED CROPPING SYSTEMS WITH FORAGE LEGUMES FOR IMPROVING NUTRITIVE VALUES OF CROP RESIDUES IN THE SAHELIAN ZONE

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INTRODUCTION

The crop residues from sorghum and pearl millet represent an important potential feed resource. In 1981, 55.2 and 51.4 million tons of crop residues were produced from sorghum and pearl millet respectively (Kossila, 1985). Pearl millet is the most prevalent cereal in the Sahel and farmers usually leave millet stover in the field after grain harvest. Grazing livestock then walk through the fields and eat first the leaves and later the stalks. Farmers also use millet stalks as fuel, and for construction. During the long Sahelian dry season, cattle rely mostly on crop residues for their subsistence and in dry years the amount of crop residues left for grazing animals is very low. In this study, we examined the quality of pearl millet stover and the feed value of leguminous hay supplements intercropped with pearl millet.

METHODS

Experiments were conducted at Sadoré (ICRISAT Sahelian Center) located at 13° N, 2° E, 45 km south of Niamey, Niger. Soils are very sandy (> 90 % sand), with low cation exchange capacity (0.6 to 3.2 meq 100 g^{-1}), low pH (4.4 to 4.7), and very low native fertility. Rainfall in 1987 was 470 mm, which was 20 % below the long term average of 560 mm. The growing season was about 90 days between mid July and early October.

Table 1. Hay production (t ha^{-1}) of different legumes at ICRISAT Sahelian Center Sadoré, Niger, 1987 rainy season. 13 kg ha^{-1} P applied before sowing.

Legume	Association with millet	Pure
Vigna unguiculata	0.16 (0.05)*	-
Stylosanthes hamata		
sown 1986	0.46 (0.21)	2.51 (0.09)
sown 1987	2.06 (0.64)	-
Sesbania pachycarpa	0.88 (0.39)	-

* SE in brackets.

A randomized block design with four replications in 116 m^2 plots was used. Cowpea (*Vigna unguiculata* local cultivar) was sown on 15 July in association with pearl millet. Pure pearl millet was sown also on 15 July. Stylo (*Stylosanthes hamata*) and *Sesbania pachycarpa* were sown on 17 July in association with the cereal or in sole stands. In the case of the perennial stylo, plots sown in 1986 were also used and pearl millet was sown between the rows 1 m spaced. Pearl millet was harvested in early October. Hay of the legumes was harvested at the end of October. Samples of the legumes and the various fractions (leaves, stems and heads) of pear millet were dried at 60°C for 48 h, finely ground and analyzed for ash, N, and P content and *in vitro* digestibility at the nutrition laboratory of ILCA (International Livestock Centre for Africa) in Addis Ababa.

RESULTS

Forage production by legumes grown in sole crop or in assocation with pearl millet was quite variable (Tabl. 1). Cowpea gave lower yields than the two other legumes. Stylo production was higher for plots sown in 1986 than for those sown in 1987. In pearl millet proportions of crop residues ranged from 45 to 65 % ot the total above ground dry matter production (1.35 t ha^{-1}). Stems accounted for 44 % and leaves for 21 % of the biomass.

Nitrogen content was not significantly different amoung the legumes (2.33-3.48 % DM) and P content was lower in *S. hamata* (0.22 %) than in cowpea and *Sesbania* (0.35 %). Digestibility was similar for the three legumes (68 %) (Tabl. 2). Nutritive value of the different pearl millet fractions is given in table 2 ; among those heads are removed from the fields and not available to grazing cattle. Leaves are much more nutritious and digestible than the stalks which constitute the main part.

DISCUSSION

The N or crude protein (CP) content (% N x 6.25) of forage can have a significant effect on digestibility. If CP content is below 7 % (1.1 % N), microbial activity in the rumen of the cattle is depressed by lack of nitrogen (Humphreys, 1978 ; Crowder and Chheda, 1982). Nutritive value of pearl millet parts (Table 2) was similar to data reported from Nigeria by Powell (1985a, 1985b). Leaves which are the most nutritious and have highest digestibility among the millet fractions are consumed entirely at the beginning of the dry season. This leaves only the stalks, which constitute the main fraction of the total above ground biomass, as the main crop residue on which animals must rely for the rest of the dry season.

Table 2. Ash, N, and P content and digestibility (% dry matter) of the different legumes and millet fractions.

	% of D.M.			
Plant	Ash	N	P	Digestibility
Vigna unguiculata	14.80 (1.89)*	3.40 (.13)	.35 (.02)	68.85 (1.11)
Sesbania pachycarpa	1.93 (.93)	3.48 (.35)	.37 (.03)	68.18 (.93)
Stylosanthes hamata	6.51 (4.07)	2.33 (.78)	.22 (.07)	68.33 (1.70)
Millet (108 days)				
- leaf	17.62 (1.87)	1.54 (.19)	.12 (.02)	66.73 (1.46)
- stem	4.60 (.30)	.49 (.10)	.08 (.01)	38.76 (.96)
- head	5.80 (.79)	1.92 (.14)	.36 (.03)	62.39 (.65)

* SE in brackets

To increase the nitrogen content and digestibility of stalks to the minimum level (7 % CP), quite large quantities of leguminous hay should be added to the diet of grazing animals. Using the formula of Nnadi and Haque (1986), 250 kg of cowpea or sesbania hay with a N content of 3.5 % must be added to 1 t of pearl millet stalk with a N content of 0.5 %. For stylo (N content of 2.5 %), 428 kg would be needed. Forage legume production could be increased by growing sole crops of leguminous plants. However it is unlikely that farmers could fit a sole crop of forage legume into their present cropping systems.

The advantage of the cereal-legume association is that it yields leguminous hay with a high N content and increases the N content of the soil. In the Sahel, farmers intercrop pearl millet and cowpea to a large extent. *S. hamata*, a perennial legume can give more yield than cowpea (ICRISAT, 1988), providing an acceptable cropping system can be devised. In the Sahel, stylo would be completely grazed back during the dry season. Thus it would be necessary to fit the stylo into the cereal system in order to protect it against grazing during the rainy season and to allow it to set seed before grain harvest. In the following year, germination would occur as soon as the rains start and the stylo would establish again in the pearl millet fields.

The indigenous *S. frucicosa* is an ideal ideotype. It starts flowering 3 weeks after establishment, sets pods in 6 weeks and disseminates seed 2 weeks later. But *S. fruticosa* is less productive than *S. hamata* (ICRISAT, 1988). We have noted that two *S. hamata* varieties (Verano and CIAT 147) have similar phenological behavior. We believe that *S. hamata* can fit into the cereal based system and have undertaken experiments to test different intercropping methods like alternate rows or strips of stylo and pearl millet.

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