

# The effect of levels of supplementation with *Sesbania sesban* foliage on intake and liveweight changes in goats

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## Abstract

Optimum levels of inclusion of leaves from *Sesbania sesban* (sesbania) in rations based on maize bran offered as a supplement to maize stover were determined in a 124-day feeding trial with individually fed goats. Twelve supplements were compared; in ten of them bran was substituted by *Sesbania* in 10% – steps up to 100%. Fresh Napier grass and bran were tested as two control treatments. Each supplement was offered to four male uncastrated goats (18 kg initial liveweight) at a level of 500 g DM/day. Daily intake and liveweight gain were measured over 56 and 124-day periods, respectively. Among the supplements, Napier grass showed highest (388 g DM/d) and pure *Sesbania* showed lowest intake (180 g DM/d); on mixtures, the 30:70 *Sesbania*/bran ratio was consumed most. Stover intakes did not differ significantly, and was lowest on pure bran. The highest gain (32 g/day) was obtained on the diet with 10% *Sesbania* and gains were also recorded with 20, 30 and 50% *Sesbania*. On all other rations goats lost weight, ranging from 5 to 15 g/d.

The results suggest that small amounts of *Sesbania* can be included with maize bran as a supplement for growing goats fed on maize stover, but there appeared to be no benefit of including more than 30% *Sesbania*.

## Introduction

Although there is adequate information on the use of *Leucaena leucocephala* (leucaena) as a protein supplement for ruminants in Malawi (Thomas and Addy 1977; Banda et al 1985), the threat to its survival from termites and attacks by psyllids (Bray and Sands 1987; Kanyama Phiri et al 1993) calls for alternative sources of tree fodder (Reed et al 1990). *Sesbania sesban* (sesbania) appears a suitable alternative as it is indigenous to sub-Saharan Africa and less prone to damage from termites. Its crude protein and digestibility are comparable to leucaena and *Gliricidia sepium* (Brewbaker 1987; Kanyama Phiri 1993). It grows faster than leucaena, and can provide fodder in the establishment year. With a protein content in excess of 25%, sesbania increases the intake of low-quality feedstuffs (Minson and Milford 1967; Gutteridge and Topark-Ngram 1990); it is multi-purpose and can be used as a shade-tree and in alley-cropping systems (Mengistu 1988).

The feeding value of sesbania is well documented for cattle (Gutteridge and Shelton 1993), sheep (van Eys et al 1985; Reed et al 1990) and goats (van Eys et al 1986; Ash 1990; Ash et al 1992). As was shown with *Leucaena* and *Gliricidia* (Jones 1979; Chadhokar and Lecamwasan 1982; Karachi 1993), it is expected that feed intake and animal performance peak at a specific level of sesbania supplementation (Ash et al 1992), because polyphenolic compounds in the leaves can negatively affect growth, intake and digestibility when fed in excess (Reed et al 1990). It is against this background that a study was carried out to determine the effect of different supplemental levels of sesbania leaves on feed intake and liveweight change of goats.

## Materials and methods

The trial was conducted at Bunda College of Agriculture near Lilongwe, Malawi from 15 October 1992 to 15 February 1993.

Climatic data for this period are given in Table 1. Forty-eight uncastrated local male goats were purchased from a local market. Animals were drenched with Thiabendazole, and sprayed with Chorofenvinphos, at three- and four-weekly intervals to treat internal and external parasites, respectively. The goats were divided into 12 groups of four animals each with an initial average weight of 17.8±2.5 kg. Each group was randomly assigned to one of the 12 supplemental treatments.

The 12 supplements were: Pure maize bran, pure dwarf *Pennisetum purpureum* (Napier grass), and 10 mixtures of bran and *Sesbania* foliage formulated to provide 10-100% legume. The experiment was laid out as a one-factor, randomised complete block with four animals per treatment. Animals were housed, fed and watered individually. At 0900 h each goat was fed 0.5 kg DM/d of supplement followed by 1 kg DM/d of maize stover, fed at mid-day. One per cent salt (sodium chloride), dissolved in water was sprinkled on daily stover ration.

The first period covered 56 days with a 14-day adjustment phase prior to a 42-day period to measure intake. Animals were weighed every two weeks prior to the morning feeding. Feed and stover offered and refused were sampled weekly to determine intake. The

Table 1. Weather data (September 1992–February 1993).

Month	Total rainfall (mm)	Temperature (°C)		Relative Humidity (%)
		Max.	Min.	
September	–	30	14	57.4
October	–	29	21	49.4
November	1	28	18	61.0
December	131	28	22	88.8
January	166	26	18	92.1
February	376	26	17	113.5

experiment lasted 124 days; during the final 68 days only weights were recorded.

Crude protein content of the feed was determined by the micro-Kjeldahl procedure (AOAC 1975). Analyses for neutral and acid detergent fibre content followed the procedure described by Goering and Van Soest (1970). The protein precipitation activity (PPA) of tannins extractable in 70% aqueous acetone was determined by the radial diffusion method of Hagerman (1987) as modified by Wood et al (1993). Mineral content of the feeds was determined by atomic absorption.

The significance of the effects of levels of inclusion of sesbania leaves on goat liveweight changes was determined by analysis of covariance, using initial weight as a covariate. Feed and stover intakes were subjected to analysis of variance.

When the F-value was significant, means were separated by Tukey's multiple comparison procedure (Ott 1984), in order to establish significant differences.

## Results and discussion

The chemical composition of the supplements is presented in Tables 2 and 3. As the content of sesbania in the sesbania/bran mix increased from 10 to 100%, there was a corresponding increase in the percentage crude protein of the supplement from 17 to 32%. The percentage of crude protein in the pure (100%) sesbania leaves compares favourably with those of leucaena and

gliricidia (Jones 1979; Chadhokar and Lecamwasan 1982).

Table 2. Crude protein, neutral detergent fibre (NDF) and acid detergent fibre (ADF) contents (% DM) of supplementary feed.

Diet	% DM		
	CP	NDF	ADF
Stover	3.3	73.6	51.6
Napier	13.8	60.7	31.6
Bran, 100%	15.6	31.4	6.4
% <i>Sesbania</i>			
10 <sup>a</sup>	16.9	33.9	6.6
20	17.5	29.8	7.1
30	19.4	26.8	8.1
40	20.6	26.3	8.4
50	22.5	28.2	8.5
60	23.8	25.5	9.8
70	27.5	26.8	10.2
80	28.1	21.0	9.5
90	29.4	24.9	10.3
100	31.9	22.9	12.3

a Supplement of 90% bran and 10% *Sesbania* (etc).

Liveweight gain did not respond to increasing protein content of the diet (Table 4) being highest on 10% sesbania after 56 days, with the goats losing weight on supplements containing more than 30% sesbania.

Table 3. Mineral content of the goat diets.

Diet	% DM			PPM		
	Ca	Fe	P	Cu	Zn	Na
Dwarf Napier	2.90	0.59	0.60	5.00	65.0	140
Maize bran	4.00	0.66	0.15	5.00	15.0	270
% <i>Sesbania</i>						
10%	3.45	0.43	0.45	2.00	65.0	120
20%	3.05	0.95	0.28	5.00	55.0	220
30%	3.85	0.65	0.34	6.00	55.0	300
40%	3.65	0.43	0.10	5.00	50.0	230
50%	3.05	0.44	0.38	6.00	50.0	340
60%	3.30	0.68	0.30	5.00	50.0	220
70%	3.55	0.65	0.41	5.00	45.0	240
80%	2.80	0.74	0.12	3.00	40.0	200
90%	3.45	0.78	0.47	3.50	50.0	370
100%	2.95	1.01	0.25	6.00	35.0	280

On supplements containing 10–30% sesbania and 70–90% bran goats gained 20–30 g/d over 56 days, which declined to 13–16 g/d when measured over a 124-d period. On the 30:70 sesbania–bran supplement the highest stover intake was reached (Table 4) and the entire diet provided 80 g CP/d and 230 g ADF/d converting to a content of 11% and 31%, respectively.

The loss of weight may be related to protein binding effects of tannins in the sesbania, which had a moderately high protein precipitation activity (sesbania showed a PPA = 384 cm<sup>2</sup>/g DM) compared to PPAs of low tannin leaves of leucaena of 100 to 150 cm<sup>2</sup>/g (C.D. Wood, personal communication). Tannins – naturally occurring anti-nutritional polyphenolic compounds in leaves of most tree fodders, including sesbania–have been widely reported to form complexes with dietary proteins, thereby decreasing the digestibility of the protein by the microbes in the gastro-intestinal tract (Waterman et al 1980; Mueller-Harvey et al 1987). Research elsewhere (Reed et al 1990) has demonstrated high levels of condensed tannins in *Acacia cyanophylla* protein. However, the observation that two goats died on the 100% sesbania diet suggests that toxins were present in the sesbania.

An alternative explanation for decreasing liveweight gains when the proportion of sesbania in the supplement increased above 30%, may be that energy intake became limiting, since energy content of sesbania leaves is low as shown by a low NDF% of pure leaf. Similar observations have been made for other legume species (Thomas and Addy 1977).

It was observed that goats maintained on pure bran and pure Napier grass supplement also lost weight. The high fibre content (40% ADF) of the Napier grass and stover resulted in low digestibility and contributed to the heavy loss of weight (Table 4). The loss in weight (16

g/d) by goats maintained on the pure bran which had a similar protein and fibre content as the diet with 10% sesbania (Table 2) may be due to scouring associated and low intake (Table 4). Chronic scouring was observed in all goats on pure bran, suggesting that it should not be fed at a level of 500 g/d together with high fibre diet of maize stover.

Intake of supplement did not differ significantly with level of sesbania fed, but the goats ate more Napier grass and less bran ( $P < 0.05$ ); the latter also significantly lowered the intake of stover relative to the other treatments while the level of sesbania had no effect.

A similar trend was also observed when the experimental period was extended to 124 days (Table 4). The trend in liveweight gain results appear to suggest that the content of sesbania in the diet should not exceed 30% (Ash et al 1992).

## Conclusions

This experiment has demonstrated that small amounts of sesbania leaf can be included in a maize bran supplement to provide protein for growth and for meat production. It has been further demonstrated that high levels of sesbania will depress intake and weight gain of goats.

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Table 4. Mean intake daily and weight change of goats over 56 days.

Type of supplement	Intake (kg DM/d)			Weight change (g/d)	
	Supplement	Stover	Total	56 days	124 days
100% Bran	0.18c	0.20b	0.38	-32	-16
100% Napier	0.39a	0.29a	0.68	-35	-23
% <i>Sesbania</i>					
10%	0.26abc	0.26ab	0.52	+32	+15
20%	0.31ab	0.28ab	0.59	+28	+16
30%	0.35ab	0.39a	0.74	+19	+30
40%	0.24bc	0.25ab	0.49	-38	-7
50%	0.31ab	0.28ab	0.59	+10	+0
60%	0.26abc	0.26ab	0.52	-38	-16
70%	0.33ab	0.28ab	0.61	-27	-6
80%	0.28ab	0.26ab	0.54	-27	-6
90%	0.29abc	0.27ab	0.56	-40	-16
100%	0.24bc	0.25ab	0.49	-59	-5

Means followed by different letters in a column are significantly different at the 5% level.

## Effet de différents niveaux de complémentation avec des feuilles de *Sesbania sesban* sur l'ingestion et l'évolution du poids chez les caprins

### Résumé

Un essai d'alimentation de 124 jours a été effectué pour déterminer les niveaux optimum d'incorporation de feuilles de *Sesbania sesban* à des rations à base de son de maïs offertes comme complément de tiges de maïs à des caprins nourris individuellement. 12 compléments ont été comparés dont 10 pour lesquels le son de maïs a été progressivement remplacé par *Sesbania* de 10 en 10% jusqu'à 100%. Deux compléments, à savoir l'herbe à éléphant fraîchement coupée et le son de maïs ont été utilisés. Chaque complément a été donné à 4 boucs entiers (18 kg de poids initial) à raison de 500 g de MS/j. L'ingestion journalière et le gain de poids vif ont été mesurés respectivement pendant 56 et 124 jours. Le niveau de consommation des compléments était maximum pour l'herbe à éléphant (388 g de MS/j) et

minimum pour *Sesbania* (180 g de MS/j); quant aux mélanges, c'est la ration contenant 30% de *Sesbania* et 70% de son de maïs qui a été la plus consommée. L'ingestion de tiges de maïs n'était pas significativement différente et était minimum avec le son de maïs pur. Le gain moyen quotidien (GMQ) était maximum avec la ration à 10% de *Sesbania* (32 g/j); des gains moins importants avaient été enregistrés avec les rations contenant 20, 30 et 50% de *Sesbania*. Toutes les autres rations avaient occasionné des pertes de poids allant de 5 à 15 g/j.

Ces résultats montrent que l'alimentation de caprins en croissance recevant du son de maïs peut être complétement avec de faibles quantités de *Sesbania* mais qu'il n'y a aucun avantage à dépasser le taux de 30%.