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The Potential of Silver Thicket (*Euphorbia stenoclada* Baill.) as Dry Season Supplement Feed for Pastoral Herds in Southwestern Madagascar

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Key words: Coastal shrubland, resource degradation, ruminants, succulent tree, transhumance.

Introduction

Livestock rearing is very important in the semi-arid southwest of Madagascar, where cattle and small ruminants fulfill multiple economic and socio-cultural functions. Animals are herded on sparsely vegetated sandy soils of the coastal zone and, during rainy season transhumance, on more densely vegetated calcareous plains of the adjacent Mahafaly plateau. *Euphorbia stenoclada* Baill., locally called "samata", is a succulent evergreen spiny tree reaching up to 10 m height. It is endemic to the coastal region and not directly browsed by ruminants. To bridge the often severe dry season forage scarcity, herders cut and chop *Euphorbia* branches, thus providing >80% of the animals' daily feed (Feldt, 2015). This practice threatens growth and regeneration of natural *Euphorbia* stands, from which also seedlings are transferred to plantations near settlements. The present study, conducted near Tsimanampesotsa National Park (24.099°S, 43.832°E), therefore determined natural and planted *Euphorbia* stand density, biomass yield and fodder use as well as the plant's nutritional value.

Materials and Methods

The study covered six villages spreading 50 km from north to south along the coastal strip. The point-centered quarter method (Cottam and Curtis, 1956) served to investigate the distribution of *Euphorbia* along four 1 km transects from each village center. At each sampling point, the following parameters were measured for the four nearest *Euphorbia* trees (>2 m): distance to sampling point, height (total, stem and crown) and crown width. Utilization intensity was scored from 1 to 5 (unused to heavily damaged). Plants <2 m height were not considered as these were not used for fodder. If a 30 m radius around the measurement point contained <4 plants, the spot was considered treeless. The surface of village plantations was mapped with a GPS, and number and average height of trees determined. To quantify fodder biomass, 30 trees of different utilization intensity were selected, 25-50% of their branches cut and dry mass (DM) of the latter determined after chopping and sun drying.

The fodder value of *Euphorbia* was determined in a difference trial with 8 healthy male sheep of 24-32 kg live weight that were kept outdoors in a spacious and shaded enclosure. During the initial 3 weeks they individually received 600 g DM d^{-1} of mature *Heteropogon contortus* (L.) P.Beauv. ex Roem. & Schult. grass. In weeks 4 and 5, animals received 300 g DM d^{-1} each of *Heteropogon* and locally bought freshly chopped *Euphorbia*. In weeks 3 and 5, feed offered and refused as well as faeces excreted were quantified for each animal, the latter by using faecal collection bags. *Euphorbia* refusals and faeces were weighed fresh and air-dried in the shade. Samples of feed offered, refused and of faeces were analyzed for concentrations of DM, crude protein (CP), phosphorus (P), neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL) applying standard protocols.

Results and Discussion

Plants in natural stands were 3-4 m high with a crown cover of 3-6 m^2 (Table 1). Stands were very heterogeneous with older and therefore bigger trees, smaller and more intensively used trees, as well as undisturbed individuals, pointing to a healthy population. Goetter et al. (2015) also found a high number of seedlings and plants <2 m in wild stands in the same region, but at the same time reported a high mortality of lopped trees. Small plantations showed the highest *Euphorbia* density, but even in larger plantations tree density was >4 times higher than in the densest natural stands. Low average tree height in plantations pointed to their recent establishment through transplanting of wild seedlings.

Table 1. Characteristics of wild and planted *Euphorbia stenoclada* stands (Mean ±SD).

Village	Efoetse	Ankilibory	Maromitilike	Marofijery	Manasy	Beroka
Wild stands						
Points with trees [a] (%)	32.5	50.0	37.5	57.5	30.0	47.5
Tree density [b] (n ha^{-1})	32	99	40	128	108	177
Tree height [c] (m)	3.7±1.3	3.9±1.3	3.8±1.3	3.9±1.2	4.0±1.3	3.4±1.2
Crown cover (m^2 $tree^{-1}$)	5.5±4.9	3.4±2.6	4.0±3.0	5.8±6.3	6.1±3.4	3.0±2.5
Use intensity (score)	2.1±0.5	3.1±0.9	2.8±1.0	3.0±1.2	2.9±1.1	2.8±0.9
Biomass (kg DM $tree^{-1}$)	27±33	13±24	16±20	31±48	14±19	11±18
Plantations (n)	2	5	4	4	6	2
Area (m^2)	412±163	1283±1607	180±73	2177±3057	636±764	57±6
Tree density (n ha^{-1})	324±352	744±354	2734±1294	935±401	2020±1416	5550±292
Tree height [d] (m)	1.6±0.1	2.6±0.5	2.0±0.5	2.1±0.5	2.1±0.4	1.5±0.2

[a] Total=40 points per village. [b] Across whole village, no SD. [c] Only trees >2 m accounted for. [d] All trees accounted for.

The quality of mature *Heteropogon* was very low (Table 2), and its DM digestibility therefore improved from 36% to 52% when consumed together with fresh *Euphorbia*. The DM digestibility of *Euphorbia* was determined at 61%, whereas its NDF and ADF digestibility averaged both 58% as compared to 48% and 35% in *Heteropogon*.

Table 2. Average* proximate composition of mature *Heteropogon* and *Euphorbia.*

Component	(unit)	*Heteropogon contortus*	*Euphorbia stenoclada*
DM	(g kg^{-1} fresh matter)	936	234
CP	(g kg^{-1} DM)	11	39
NDF	- " -	781	557
ADF	- " -	596	565
ADL	- " -	476	301
P	(mg kg^{-1} DM)	438	900

* No SD given due to low sample number, i.e., two 1-week pool samples for *Euphorbia, and* two 2-week pool samples for *Heteropogon.*

Conclusions and Implications

Euphorbia stenoclada is a quantitatively and qualitatively important dry season ruminant fodder for the livestock-dependent inhabitants of Madagascar's southwestern coastal zone. Offered along with poor quality grasses, it supplies energy, phosphorus and some protein when nearly no other feed is available outside the national park where grazing is prohibited. The plant additionally supplies animals with water in a region where many wells hold brackish water. But intense lopping and transfer of wild seedlings to (private) plantations threaten its future communal usage. Vegetative propagation of *Euphorbia* through cuttings (Goetter et al., 2015) therefore seems to be a promising countermeasure.

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