

Dry matter production of thirteen tropical legumes in association with rhodes grass (*Chloris gayana* cv. Callide) on an acid soil in Ethiopia

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Abstract

Swards of rhodes grass (*Chloris gayana* cv. Callide) planted alone or in association with 13 forage legumes (*Aeschynomene falcata* ILCA 12144; *A. histrix* ILCA 149; *Desmodium ovalifolium* ILCA 100; *Macrotyloma axillare* cv. Archer; *Neonotonia wightii* ILCA 9784, 10254 and 10688; *Stylosanthes guianensis* cv. Cook and ILCA 11744; *S. hamata* cv. Verano and ILCA 167; and *Zornia* spp. ILCA 10901 and 11362) on a low phosphorus, acid soil in southern Ethiopia were evaluated over 2 years for dry matter yield and legume content. Average dry matter yield of 2000 kg/ha in both years and legume contents of >20% and >30% in the first and second years, respectively, after establishment were used as measures of compatibility. *Aeschynomene falcata* ILCA 12144 and *S. guianensis* ILCA 11744 were potentially better than the others as compatible companion legumes in swards of rhodes grass and further evaluation seems warranted.

Introduction

To improve forage quality on co-operative dairy farms and government cattle breeding ranches in Ethiopia, the use of grasses in association with suitable legumes has been suggested (Mengistu

and Robertson 1988; FNE 1989; Anon. 1990). Evaluation trials in the medium altitude, low phosphorus, acid soil environment of southern Ethiopia (ILCA 1987, 1989; Lazier 1988; Larbi *et al.* 1992a, 1992b; J. Ochang, unpublished data), which is representative of significant areas in western Ethiopia, Kenya, Tanzania, Uganda, Burundi and the highlands of the Cameroon, have demonstrated the potential of accessions of several species of legumes for forage production in pure stands. However, few have been evaluated in association with grasses (FNE 1987, 1989; Lazier 1988; Anon. 1990). Accordingly, we investigated dry matter (DM) production of 13 herbaceous forage legumes, selected on the basis of higher productivity, disease resistance and persistence in preliminary screening trials (ILCA 1987, 1988; Lazier 1988; Larbi *et al.* 1992a, 1992b; J. Ochang, unpublished data), in association with rhodes grass (*Chloris gayana* cv. Callide), a recommended grass for the acid soils of southern Ethiopia (Anon. 1990) and other East African countries (Bogdan 1977).

Materials and methods

The work was carried out at Soddo in the Wolayata region of southern Ethiopia (6° 50' N, 37° 45' E; altitude 1950 m) with annual rainfall of 1060 mm, falling mostly from May–October. A marked dry season occurs from mid-December to late March. Total rainfall for 1988, 1989 and 1990 was 1234, 1269 and 1045 mm, respectively. The soil is a well drained nitosol with pH 4.4 (H₂O), organic carbon 5.1%, total nitrogen 0.19% and available P 1.2 ppm (Bray II).

Rhodes grass, alone or in association with one of 13 legumes (Table 1), was sown in 4 m × 4 m plots in June 1988. Rhodes grass with *Stylosanthes guianensis* cv. Cook was the control based on performance in earlier studies (Lazier

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1988, 1989; J. Ochang, unpublished data). Legume seeds were inoculated with *Rhizobium* and sown at 4 kg/ha in rows 0.25 m apart and rhodes grass seeds sown between the rows at 5 kg/ha. The 14 treatments were arranged in 4 randomised blocks. Immediately before sowing, 10 kg/ha P as triple superphosphate was broadcast and hoed into the soil. The plots received an average of 10 t/ha farmyard manure (organic matter 12.9%, N 0.82%, P 1279 ppm), a cheaper source of plant nutrients readily available in the predominantly mixed crop-livestock farming systems in the region, and 10 kg/ha P as triple superphosphate at the beginning of the 1989 and 1990 wet seasons.

Dry matter yield was determined from five 6-weekly cuts taken from May–November 1989 and 4 cuts taken during the last weeks of April, June, August and September 1990. At each harvest, 3 random quadrats, each 1 m × 0.5 m, were sampled from each plot to a stubble height of 0.10 m. Samples were separated into grass and legume components and oven-dried at 65 °C for 48 h. After each yield cut in 1989, an equalising cut was made at the same height with hand sickles and the cut forage removed. In 1990, forage remaining after each yield cut was grazed by indigenous cattle (*Bos indicus*) for 18–36 h, using the mob-grazing technique (Mislevy *et al.* 1981). Thereafter, plots were cut to 0.10 m above ground.

Results

Productivity of the associations was generally low (Table 1). Rhodes grass in association with *Aeschynomene falcata* ILCA 12144, *Desmodium ovalifolium* ILCA 100, *Macrotyloma axillare* cv. Archer, *Stylosanthes guianensis* ILCA 11744 and cv. Cook, and *S. hamata* cv. Verano produced more than 2000 kg/ha DM during the first year after establishment. Dry matter yields for all associations except rhodes grass and *Neonotonia wightii* ILCA 10688, *S. guianensis* cv. Cook, *S. hamata* ILCA 167 and the *Zornia* spp. accessions exceeded 2000 kg/ha during the second year after establishment.

The DM yields of 7 of the 14 sward types declined from 1989 to 1990. Notable among these were the associations of rhodes grass and *M. axillare* cv. Archer, *S. guianensis* ILCA 11744 and cv. Cook and *S. hamata* cv. Verano with reductions of 23, 24, 56 and 33% respectively. In contrast, DM yields of rhodes grass and *N. wightii*, *Zornia* spp. accessions and *S. hamata* ILCA 167 associations increased by more than 19, 40 and 70%, respectively.

Aeschynomene falcata ILCA 12144, *A. histrix* ILCA 149, *M. axillare* cv. Archer, *S. guianensis* ILCA 11744 and cv. Cook, *S. hamata* ILCA 167 and the *Zornia* spp. accessions appeared persistent in the mixed swards, contributing more than 25% of the total DM in both years. The

Table 1. Total dry matter yields of rhodes grass (*Chloris gayana* cv. Callide) alone and in association with 13 legumes, and legume contents of the mixed swards over the period May 1989–September 1990 on low phosphorus, acid soil at Soddo, southern Ethiopia.

Sward type	Accession	Yield		Legume content	
		1989	1990	1989	1990
		(kg/ha)		(%)	
<i>Chloris gayana</i> (RG)	cv. Callide	3290 (1) ¹	2927 (1)	—	—
RG + <i>Aeschynomene falcata</i>	ILCA 12144	2299 (7)	2232 (7)	25 (8)	37 (5)
RG + <i>A. histrix</i>	ILCA 149	1949 (8)	2441 (4)	29 (7)	24 (9)
RG + <i>Desmodium ovalifolium</i>	ILCA 100	2977 (6)	2652 (2)	3 (11)	18 (12)
RG + <i>Macrotyloma axillare</i>	cv. Archer	3164 (3)	2410 (5)	31 (6)	27 (8)
RG + <i>Neonotonia wightii</i>	ILCA 9784	1787 (9)	2475 (3)	4 (10)	20 (10)
RG + <i>N. wightii</i>	ILCA 10254	1759 (10)	2091 (9)	3 (11)	18 (12)
RG + <i>N. wightii</i>	ILCA 10688	1554 (11)	1927 (10)	2 (13)	20 (10)
RG + <i>Stylosanthes guianensis</i>	ILCA 11744	2988 (5)	2256 (6)	64 (1)	44 (2)
RG + <i>S. guianensis</i>	cv. Cook	3270 (2)	1450 (14)	58 (2)	56 (1)
RG + <i>S. hamata</i>	cv. Verano	3123 (4)	2100 (8)	5 (9)	31 (6)
RG + <i>S. hamata</i>	ILCA 167	1014 (13)	1731 (12)	33 (5)	31 (6)
RG + <i>Zornia</i> sp.	ILCA 10901	1363 (12)	1904 (11)	36 (4)	38 (4)
RG + <i>Zornia</i> sp.	CIAT 11362	953 (14)	1655 (13)	46 (3)	44 (2)
LSD (P = 0.05)		1575	1397	21	12

¹Values in parentheses are rankings of entries.

proportions of *S. hamata* cv. Verano, *D. ovalifolium* ILCA 100 and *N. wightii* accessions in the mixed swards increased by more than 15 percentage units, while *M. axillare* cv. Archer, *S. guianensis* cv. Cook and *S. hamata* ILCA 167 decreased by 2–4 percentage units from 1989 to 1990.

Discussion

An important prerequisite to a successful tropical grass-legume association is that the legume component must be maintained at reasonably high level in the pasture to ensure an adequate supply of nitrogen to the system. This requires the search for legumes which are vigorous, persistent and compatible with the associate grass. Assuming a minimum DM yield of 2000 kg/ha in both years, and legume contents of 20% and 30% in first and second years, respectively, after establishment as a measure of compatibility in the present study, *A. falcata* ILCA 12144 and *S. guianensis* ILCA 11744 appeared to offer considerable prospects as compatible companion legumes in swards of rhodes grass. The relatively high performance of *S. guianensis* ILCA 11744 in association with rhodes grass confirmed earlier reports from Ethiopia (FNE 1987; Anon. 1990; Lazier 1989), Malawi (Thomas 1976a) and other East African countries (Bogdan 1977) on the compatibility of rhodes grass with *S. guianensis*.

Outbreak of anthracnose (*Colletotrichum gloeosporioides*) is seen as a major disadvantage for using *S. guianensis* accessions in southern Ethiopia (Lazier 1989). However, in the present and earlier trials (ILCA 1987, 1988; Lazier 1988; Larbi *et al.* 1992a; J. Ochang, unpublished data), *S. guianensis* ILCA 11744 was relatively tolerant of anthracnose attack compared with cv. Cook. Accession *S. guianensis* ILCA 11744 therefore merits further evaluation.

The productivity of the different associations varied, and appeared to be related to the growth habits, competitive abilities and regrowth potentials of the component legumes (Harper 1977). The decline in DM yield of some sward types from 1989 to 1990 could be a function of lower rainfall in the 1990 growing season. This combined with an outbreak of anthracnose to produce drastic reductions in DM yields of 56 and 33%, respectively, for the rhodes grass and *S. guianensis* cv. Cook and *S. hamata* cv. Verano

associations from the first to the second year after establishment. Differences in legume contents between years may be partly due to the use of different methods of removing residual herbage after sampling cuts.

It is recognised that aspects of compatibility are better served by grazing than clipping studies, since cutting trials do not always simulate grazing (Thomas 1976b). With this in mind, our results showed that *A. falcata* ILCA 12144 and *S. guianensis* ILCA 11744 appeared to offer considerable prospects as companion legumes in swards of rhodes grass for the medium altitude, low phosphorus, acid soil environment of southern Ethiopia. These associations may also be suitable for significant areas in western Ethiopia, Kenya, Tanzania, Uganda, Burundi and the highlands of Cameroon with similar climatic and edaphic conditions to the site of the present study (ILCA 1987). Further evaluation is warranted with possible inclusion in the list of recommended forages for the subhumid, medium altitude environments in Ethiopia (Anon. 1990).

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