

THE EFFECT OF SEASON ON THE YIELD AND NUTRITIVE VALUE OF *Gliricidia sepium* AND *Leucaena leucocephala*

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ABSTRACT

Four plots of *Gliricidia* and two plots of *Leucaena* were harvested at three monthly-intervals to monitor dry matter yield, chemical composition and *in vitro* organic matter digestibility. The plants had been established (*Gliricidia* from stakes, *Leucaena* from seeds) and were spaced 1m apart on rows and 1m between rows. Each plot size was 6m x 6m.

There was no significant difference ($P > 0.05$) in the dry matter yield of the two browse species. Season did not have significant ($P > 0.05$) effect on the dry matter yield of *Leucaena* but had on that of *Gliricidia* ($P < 0.01$). The early dry harvest produced the lowest yield for both *Gliricidia* and *Leucaena* and these were significantly lower than the yield from other harvests.

Season had significant effect ($P < 0.01$) on the chemical composition of *Leucaena* except on the percent Acid Detergent Fibre (ADF) and lignin but season had no effect on the organic matter digestibilities of the two browse species: *Leucaena* was higher in nutritive value than *Gliricidia*.

Key words: *Gliricidia*, *Leucaena*, dry matter yield nutritive value.

INTRODUCTION

Gliricidia sepium and *Leucaena leucocephala* are trees or shrubs that originated from central America and South America. They have been introduced to Africa and Asia and have become naturalised in the Phillipines (NAS, 1977, 1980). The two browse species

have been the subject of many studies in the recent past and their use as animal feed is well recognised and reviewed (Gray, 1968; Hill, 1971; NAS, 1977 and 1980; Jones, 1979; Bloom, 1981; Chadhokar, 1982 and Smith and Van Houtert, 1988).

Feeds are not of equal value in supporting the animal for maintenance and production. Feed supply nutrients, that is, protein, carbohydrates, fats, water, vitamins and minerals. The nutritive value of a feed is essentially a function of the availability of its energy and nutrient contents. According to Van Soest (1983) nutritive value is multifaceted, but useful attributes of a feed are feed consumption, digestibility and energetic efficiency.

Poor quality tropical grasses and herbaceous forage legumes scarcely provide adequate levels of nutrients for maintenance and production during the dry season. During the rainy season the forages grow very rapidly and as such may support moderate animal growth rate at this period. The situation becomes critical during the dry season when the growth rate of these forages declines. Animals grazing such pastures do not obtain sufficient nutrients even for maintenance and they often lose weight. In the following rainy season, when feed from forage improves, the animals regain weight to compensate for the loss during the dry season.

Gliricidia and *Leucaena* contain higher levels of nutrients than grasses during the dry season and thus, they become particularly valuable sources of feed especially for goats (Rose-Innes and Mabey, 1964; Kapu 1975; Reynolds and Adcoy, 1986). *Leucaena* and *Gliricidia*

have great potential as sources of high quality nutrients for ruminants and are suitable as year round feed because of their draught resistance, persistence, vigorous growth and regrowth and palatability (Reynolds and Atta-Krah, 1986). They have high crude protein of high digestibility and are also high in minerals and vitamins (Jones, 1979 and Smith and Van Houtert, 1988).

The integration of herbage from *Gliricidia* and *Leucaena* into livestock production systems demands a proper evaluation of their year round dry matter yields and nutritive value potential. This study was therefore conducted to investigate the effect of season on the yield and nutritive value of the forage produced.

MATERIALS AND METHODS

The experiment was conducted at the Obafemi Awolowo University Teaching and Research Farm situated in South Western Nigeria coordinates ($7^{\circ} 28^1$ N and $4^{\circ} 33^1$ E) at an altitude of 240m above sea level. The average annual rainfall is about 1290 mm. The rainy season stretches from April to October while the dry season is from November to March. The two seasons have mean monthly rainfall of 161 mm and 32 mm respectively.

On 14th of August 1987, six plots planted around the same time - two for *Leucaena* and four for *Gliricidia* were cut back to the height of 1m above the ground. The plants were spaced 1m apart on rows and 1m between rows. The plot size was 6m x 6m. The shrubs were cut back close to the point where the branches took off from the main stem, such that the stem remaining was about 1m above ground. The browse species were harvested at three monthly intervals thereafter and the yield of each plot was determined. Five harvests were made, the first harvest was made on 13th November, 1987 while the 2nd, 3rd, 4th and 5th harvest were made on 15th February, 18th May, 16th August and 14th

November 1988. The harvests were divided into dry and rainy seasons respectively.

Samples were taken and separated into leaves, stems and bark. Sub-samples of the browse at each harvest were taken and even dried at 70°C for 24 hours to determine the dry matter content. The dried samples were ground and stored in air tight plastic bottles until they were analysed. The dry matter, ash and crude protein contents were determined using standard methods of analysis (AOAC, 1975). For the protein, the digest was analysed using Kjeltec auto 1030 analyser. The auto analyser consists of a Distilling unit, a Titration unit together with the digestion system. The samples were also analysed for neutral detergent fibre (NDF), acid detergent fibre (ADF), acid detergent lignin (ADL) using the method of Van Soest (1967) and *in vitro* organic matter digestibility (OMD) as described by Tilley and Terry (1963). Total Apparent Digestibility (TAD) was estimated using the method described by Georing and Van Soest (1970) and the estimate was compared with *in vitro* OMD.

Data from the experiment were analysed using the analysis of variance. All significant mean differences were compared by Duncan's Multiple Range Test (Steel and Torrie, 1960).

RESULTS AND DISCUSSION

Dry matter yield

The mean dry matter yield of *Leucaena* was 2.29 ton/ha while that *Gliricidia* was 2.16 ton/ha. There was no significant difference in the dry matter yields of the two browse species ($P > 0.05$). Season had no significant effect on the yield of *Gliricidia* and *Leucaena*. The mean dry matter yields were 1.26 ton/ha and 2.98 ton/ha for dry and rainy seasons respectively for *Leucaena* and there was no significant difference between yields. The dry and rainy season yields of *Gliricidia* were 1.91 ton/ha and 2.32 ton/ha and the difference between the yields was not significant.

Browse harvested in February produced the

lowest dry matter yield of .65 ton/ha and .13 ton/ha for *Leucaena* and *Gliricidia* respectively. These were statistically lower than the dry matter (DM) yields of 3.68 ton/ha and 2.52 ton/ha respectively for *Gliricidia* and *Leucaena* harvested in May (P0.01) (Table 2).

The dry matter yields of *Gliricidia* and *Leucaena* reduced as the effect of the dry season became more severe (Table 2) harvest 1 and 2. Yields are reduced because the plants are stressed during the dry season (NAS 1977). The stress condition led to increase in the number of fallen leaves as the dry season became more and more severe. Also, legumes tend to flower around the middle of the dry season (January to February) with subsequent reduction in vegetative growth (NAS, 1977).

The second harvest produced the lowest yield because it was made in February which happened to be in the peak of the dry season and the flowering period. The third harvest was made in May which marked the onset of the rainy season. The significantly higher yield of that harvest was because February to May coincided with the period that the browse had broken dormancy (towards the end of February) and began to produce the new flush of leaves and also because of the onset of the rainy season in April.

The annual yield of *Leucaena* in this study was in the range of 2 to 20 tons per ha reported on good sites by NAS (1977). The low yield was possibly due to the erratic pattern of rainfall that characterised 1987 and 1988. The low yield of *Gliricidia* in the dry season was because of its establishment from stakes while *Leucaena* was established from seeds and therefore had better established root system which could penetrate the water table and thus able to draw on deep water resources as well as tap nutrients, thus increasing its production in the dry season. According to Sumberg (1984), sown *Gliricidia* plants have a deeper, more extensive root system that improves dry season growths and foliage retention. Also, the low yield was aggravated by the fact that *Gliricidia* shed so much leaves

during the dry season and this is in agreement with the observation of Chadhokar (1982). According to Chadhokar (1982), *Gliricidia* remains green all year round, particularly when harvested regularly but foliage growth and retention are low during the dry season. The yield of *Gliricidia* in this study (1.90 ton/ha) was higher than the one recorded by Oakes and Skov (1962) who obtained 0.99 ton per ha.

The lack of significant difference between the dry and rainy seasons yields of *Gliricidia* and *Leucaena* shows the advantage of leguminous legumes over grasses that produce significantly lower yields in the dry season than the rainy season and thus are not able to sustain livestock growth in the dry season (Kapu, 1985; Reynolds and Adeoye 1986). The yields of the two browses in the two seasons show that they can successfully be used all the year round and most especially during the dry season when the yield of other forages declines.

Chemical Composition

The dry season harvests produced the higher percentages of ash, crude protein *in vitro* organic matter digestibility, lower neutral detergent fibre and lignin than the rainy season in the two browse species (Table 3). This was due to the fact that the plants were stressed by the dry season and as such remained vegetative during the period. The leaf was therefore succulent and immature (young) since the period coincided with the time the plants break dormancy to start the production of new flush of leaves. This is in agreement with the work of Hierreral *et al* (1966), who obtained a higher crude protein content when plants were harvested in the vegetative or early flowering stage than at advanced pudding stage. As such, cell wall component decreased while crude protein and digestibility increased in February following production of new leaves. It is known that the percentage of crude protein in young leaves is usually higher than that of older ones, the

TABLE 1. EFFECT OF HARVESTS ON THE DRY MATTER (DM) YIELD OF *GLIRICIDIA* AND *LEUCAENA**

Harvest	<i>Gliricidia</i> DM yield (ton/ha)	<i>Leucaena</i> DM yield (ton/ha)
1.	1.560 ^B	2.451 ^b
2.	.134 ^A	.650 ^a
3.	3.680 ^C	2.522 ^b
4.	3.300 ^C	2.567 ^b
5.	2.122 ^B	3.390 ^c
Mean	2.159	2.294
s.e. mean	.482	.373

* Means within the same column with different superscripts are significantly different. Small and capital superscripts denote significant difference at (P 0.05) and (P 0.01) respectively.

TABLE 2. EFFECT OF SEASON ON THE CHEMICAL COMPOSITION OF THE LEAVES OF *GLIRICIDIA* AND *LEUCAENA* *(DM BASIS)

Browse	Season	Ash %	CP %	NDF %	ADF %	Lignin %	<i>in vitro</i> OMD %
<i>Gliricidia</i>	Dry	7.17 ^A	21.77 ^a	39.85 ^a	22.08 ^A	9.11 ^a	57.22 ^a
	Rainy	5.41 ^B	18.93 ^b	40.40 ^a	24.79 ^B	10.44 ^b	54.64 ^a
	Mean	6.29	20.35	40.12	23.39	9.77	55.93
	S.e. mean	0.37	0.67	0.39	0.41	0.36	1.32
<i>Leucaena</i>	Dry	7.10 ^a	25.19 ^a	39.54 ^a	20.37 ^a	7.85 ^a	47.59 ^a
	Rainy	6.40 ^a	22.89 ^a	39.52 ^a	22.58 ^b	8.58 ^b	45.57 ^a
	Mean	6.75	24.04	39.53	21.47	8.21	46.58
	S.e. mean	0.30	0.91	0.74	0.49	0.35	1.33

* Means within the same column within each browse species are significantly different from one another. Small and capital superscripts denote significant differences at P 0.05 and P 0.01 respectively.

TABLE 3. THE CHEMICAL COMPOSITION AND *IN VITRO* OMD OF THE LEAVES OF *GLIRICIDIA* AND *LEUCAENA*.*

Browse	Ash %	CP %	NDF %	ADF %	Lignin %	<i>in vitro</i> OMD %
<i>Gliricidia</i>	6.06 ^a	19.98 ^A	40.20 ^a	23.79 ^A	9.95 ^A	55.59 ^A
S.e. mean	0.31	0.67	0.39	0.41	0.28	1.73
<i>Leucaena</i>	6.68 ^a	23.81 ^B	39.53 ^a	21.70 ^B	8.26 ^B	46.36 ^B
S.e. mean	0.30	0.91	0.74	0.49	0.43	1.45

ab AB* Means within the same column with different superscripts are significantly different from one another. Small and capital superscripts denote significant differences at P 0.05 and P 0.01 respectively.

increase in the proportion of young to old leaves will consequently increase the total protein content of the browse plants and decrease in cell wall constituent and hence increase digestibility.

The significant difference in the organic matter digestibility of *Gliricidia* and *Leucaena* and the low value of *Leucaena* and the low value of *Leucaena* digestibility (table 4) may be due to the reduction of the activity of cellulolytic bacteria by mimosine *in vitro* and as such, *in vitro* digestibility of *Leucaena* is often underestimated by 2 to 7% (NAS, 1977). This is supported by the higher total apparent digestibility of *Leucaena* (76.30%) as against 53.80% for *Gliricidia*. Mimosine is deleterious depending on feeding level.

The composition of *Leucaena* and *Gliricidia* in the dry and rainy seasons (Table 3) confirm the advantage of leguminous browse over tropical forage legumes and grasses with drastically reduced nutritive value in the dry season (Ademosun et al, 1984) (Reynolds and Adeoye, 1986). For *Leucaena* there was no seasonal significant difference in the chemical composition except in percent acid detergent fibre and lignin and it can therefore be safely used as protein supplement all the year round especially in the dry season. There was also no significant difference in the organic matter digestibility of *Gliricidia* in both the dry and rainy seasons. The significantly higher crude protein and lower fibre content of *Leucaena* than *Gliricidia* (Table 3) might explain why the *Leucaena* leaf is usually selected before *Gliricidia* leaf by WAD goats (Mani 1984, Teniola, 1990).

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