Forage yield and quality of *Leucaena leucocephala* and *Guazuma ulmifolia* in tropical silvopastoral systems

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Introduction

Low availability and quality of pastures during the dry season are common problems in tropical livestock production systems. However, several studies indicate that the use of trees and shrubs is a good alternative to overcome those problems (Ku-Vera et al. 1999), by producing foliage of higher nutritional value than that of forage grasses. In addition, their use could contribute to reforestation and restoration of degraded land (Casanova-Lugo et al. 2010).

While several recent reports have focused on the incorporation of *Leucaena leucocephala* in silvopastoral systems (Murgueitio et al. 2011), there is little information about other tropical tree species with high forage production potential, such as *Guazuma ulmifolia*, which is broadly used in Southeast Mexico. In addition, little is known about the effect of season on forage quality of these species under a particular management regime.

Therefore, the aim of this study was to evaluate the yield and forage quality of *L. leucocephala* and *G. ulmifolia* in the subhumid tropics during the dry and rainy seasons.

Methods

The experiment was undertaken at the Campus of Biological and Agricultural Sciences, University of Yucatán (UADY), in the Yucatán Peninsula, Mexico, from January to December 2009. Average annual rainfall is 953 mm and average annual temperature 26 °C. The area is located within a karst plateau characterized by a flat or gently rolling relief. Soils are shallow, heterogeneous, rocky (limestone) and clay-loam, with a pH of 7.5 to 7.8 (Bautista et al. 2005).

In 2004, seedlings of *L. leucocephala* and *G. ulmifolia* were planted within 5 x 10 m plots (experimental unit), in rows 2.0 m apart and with 0.5 m between plants. A complete randomized block design with 3 replicates was used. Before starting the current experiment, a standardization pruning at 1 m height was performed. During the dry season, drip irrigation was applied for 3 hours in the mornings, twice per week. Ten plants of all species, within each experimental unit, were pruned to a height of 1.0 m at 3-month intervals (2 prunings per season). Each pruning, the biomass was collected and separated into edible and non-edible material. Three samples were taken from the edible portion (leaves and tender stems) of both species, approximately 1 kg each, and were dried at 60 °C in a forced-air oven until constant weight. Dry forage subsamples (leaves and tender stems) were ground and analyzed for neutral detergent fiber (NDF) and acid detergent fiber (ADF) using an ANKOM (Macedon, NY) A200 fiber analyzer. Crude protein (CP) was estimated using a Leco CN 2000 elemental analyzer (N × 6.25). Dry matter digestibility (DMD) was estimated based on ADF concentration, according to Ayala-Burgos et al. (2006).

Forage yield data were analyzed with a one-way ANOVA to examine the effect of season. For chemical composition, a multivariate analysis of variance (MANOVA) was used, with a PROC GLM (SAS Institute). Where significant differences were found, means were compared using Tukey’s statistic (P≤0.05).

Results and Discussion

Forage yield, CP concentration and DMD of *L. leucocephala* showed no significant changes over the 2 seasons, with average values of 3.45 t DM/ha, 22.8% and 66.7%, respectively. However, the concentrations of NDF and ADF were greater during the rainy season (Table 1). In contrast, forage yield and NDF of *G. ulmifolia* were higher in the rainy season than in the dry
season, while the reverse occurred with ADF (Table 1). However, CP concentration of G. ulmifolia (14.5% on average) and DMD (65.9%) were not influenced by season.

Table 1. Edible forage yield and quality of L. leucocephala and G. ulmifolia during the dry and rainy seasons in Yucatan, Mexico.

<table>
<thead>
<tr>
<th>Season</th>
<th>Yield (t DM/ha)</th>
<th>CP (%)</th>
<th>NDF (%)</th>
<th>ADF (%)</th>
<th>DMD (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Leucaena leucocephala</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dry</td>
<td>3.5</td>
<td>22.2</td>
<td>41.3 b1</td>
<td>23.8 b</td>
<td>70.2</td>
</tr>
<tr>
<td>Rainy</td>
<td>3.4</td>
<td>23.4</td>
<td>49.0 a</td>
<td>32.8 a</td>
<td>63.2</td>
</tr>
<tr>
<td>s.e.</td>
<td>0.55</td>
<td>5.65</td>
<td>3.75</td>
<td>8.50</td>
<td>7.23</td>
</tr>
<tr>
<td></td>
<td>Guazuma ulmifolia</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dry</td>
<td>3.7 b</td>
<td>15.0</td>
<td>44.0 b</td>
<td>33.6 a</td>
<td>62.4</td>
</tr>
<tr>
<td>Rainy</td>
<td>5.3 a</td>
<td>14.0</td>
<td>47.2 a</td>
<td>24.8 b</td>
<td>69.4</td>
</tr>
<tr>
<td>s.e.</td>
<td>0.65</td>
<td>3.2</td>
<td>3.23</td>
<td>5.42</td>
<td>4.30</td>
</tr>
</tbody>
</table>

1 Means within columns and species followed by different letters are significantly different (Tukey’s statistic).

Both L. leucocephala and G. ulmifolia showed potential for production of high quality forage in Mexico. While L. leucocephala can maintain good forage yield throughout the year, growth of G. ulmifolia declines during the dry season. However, total DM production favored G. ulmifolia, although the crude protein concentration of L. leucocephala forage was higher in both seasons. Further research is needed to determine the appropriate interval between prunings for the individual species.

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