# Effect of defoliation frequency on forage yield from intensive silvopastoral systems compared to a monoculture grassland

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## Introduction

Livestock production in the tropical regions of the world faces serious constraints as a result of climate change. Monoculture based pastures require the use of large amounts of nitrogen fertilizers to sustain production throughout the year. In general terms, tropical grasses are of low quality and when consumed by ruminant species, contribute to the emission of greenhouse gases (methane, carbon dioxide and nitrous oxide) (Herrero *et al.* 2009; Place *et al*. 2009). The establishment of intensive silvopastoral systems (iSPS) with associated shrubs legumes and grasses can increase the yield and quality of forage as well as fixation and transfer of atmospheric nitrogen (N) (Murgueitio *et al*. 2011). Therefore, the costs of nitrogen fertilizers and the emissions of greenhouse gases under practical conditions can be reduced. The intensive silvopastoral system is a kind of agroforestal practice that it is environmentally friendly and at the same time improves productivity of livestock systems. However, several aspects of its management have not been fully evaluated.

This is the case of the response to defoliation, which is an important management factor associated to the overall biomass productivity (Solorio 2005).

## Materials and Methods

The study was conducted in the State of Michoacan, Mexico (19° 05' Lat. N and 102° 21' Long. W), at an altitude of 325 m above sea level. The climate is hot and semi-arid (Garcia, 1988), with summer rains (Bs) and an average annual rainfall of 924 mm and average temperature of 28 °C. The soil type is vertisol (World Reference Base for Soil Resources, 2007). The study was conducted in an iSPS (based on *Leucaena leucocephala*, sowed at 1.6 x 0.3 m between rows and plants, respectively, associated with *Panicum maximum* (sowed between the Leucaena rows) and in a traditional, conventional system (grass monoculture). In each system, six exclusion cages, with a cutting area of 1.5 x 2.0 m, were placed randomly. The defoliation frequency was 35 and 50 days for each system. A completely randomized design was used with three replicates.Before starting the experiment, the grass and the legume were cut to a height of 15 and 50 cm, respectively, in each of the exclusion cages. Subsequently, defoliation was performed at the same height according to frequency treatment. Forage yield (kg DM/ha) and composition of forage (proportion of each species) was recorded. The data were analysed using a repeated measures model (MANOVA) with Sigmaplot version 11.0.

## Results and Discussion

The fodder yield recorded in July and September was higher with the longest defoliation frequency in both systems evaluated (Fig. 1). However, in the month of September only the iSPS defoliation at 35 days showed a low production in comparison to the other treatments. In the final period of evaluation, the total forage production was greater with the defoliation frequency of 50 days in both systems evaluated.

As there were three harvests at both frequencies, the total period of growth was different and therefore the rate of fodder production in this period was an important response variable to the defoliation treatment. In this sense, the iSPS had a fodder production of 63 kg/DM/ha/d for the 35 day harvest frequency, and 75 kg/DM/ha/d for the 50 day harvest frequency. These results imply that the interval of 50 days is better, as the daily production was still greater. It is worth noting that this average was estimated over the whole period and there would have been a difference in climatic conditions influencing these pasture growth rates, as there are two extra months in the 50-day grazing interval. However, it is also necessary to emphasize that 95% of this growth was attributed to the *P. maximum* (4545 – 8859 kg/DM/ha with the intervals of 35 and 50 days, respectively), and the increase in production of *L. leucocephala* was only 16%.

Although the defoliation frequency of 50 days resulted in an overall higher biomass production, the reduced proportion of the legume indicated a lower fodder quality. Table 1 shows that at an interval of 35 days, there was a greater production of *L. leucocephala* (31% of total biomass) compared to that of the 50 day interval (21%). No differences were found between the total monthly production of both systems, however there were marked differences between defoliation frequencies, except in the month of November, when the 50 days frequency of defoliation had a lower DM yield in both systems (Fig. 1). Bacab-Pérez *et al*. (2011) demonstrated

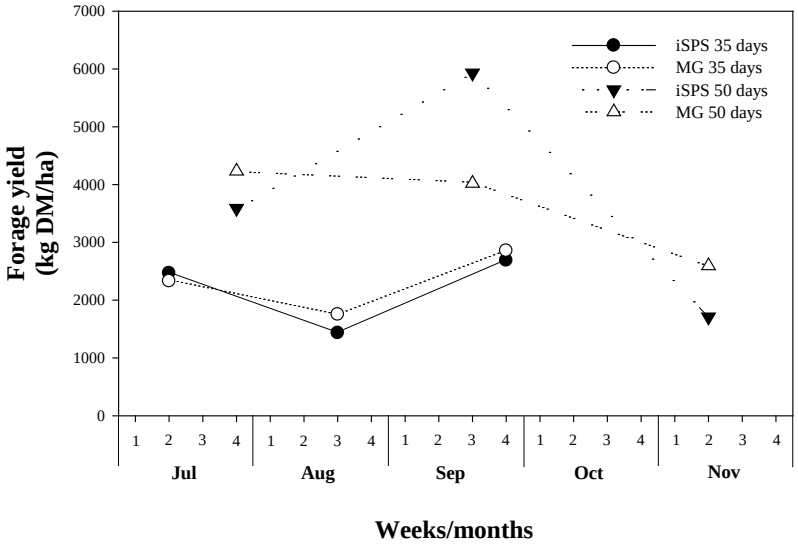


**Figure 1. Forage yield in iSPS and monoculture grassland under two defoliation frequencies (35 and 50 days).**

**Table 1. Forage yield composition of an iSPS at two defoliation frequencies.**

| Defoliation Frequency | Species (kg DM/ha) | | Total SSPi (kg DM/ha) | Total grass alone (kg DM /ha) |
|---|---|---|---|---|
| | *L. leucocephala* | *P. maximum* | | |
| 35 days | 2042 (31%) a | 4545 (69%) b | 6588 b | 6938 b |
| 50 days | 2369 (21%) b | 8859 (79%) a | 11228 a | 10843 a |
| Average | 2206 | 6702 | 8908 | 8890 |

Means in the same column followed by different letters are statistically different (Tukey, $P<0.05$).

that iSPS could yield between 2,470 and 2,693 kg DM/ha during the dry season with a defoliation frequency of 40 days. These results are similar to the data reported from this trial at 35 days defoliation. Nonetheless, when the period of defoliation is extended to 50 days, there is an increase in forage production. Thus, the differences between the positive effects of the association of trees with grasses are mainly determined by the agroecological conditions, particularly, tree density, species distribution and management of the association itself (Casanova-Lugo *et al.* 2010).

## Conclusions

The intensive silvopastoral system based on *L. leucocephala* and *P. maximum* produced similar yields of forage than the monoculture pastures, however, they can be a better alternative of farming system in the tropics by providing greater quality feed including legume species with higher nutritional value. A longer harvesting interval resulted in the greatest total biomass production obtained in both systems, but is likely to reduce forage quality of grasses. In the iSPS the increase biomass with grazing interval was also associated with a reduction in the proportion of legume fodder.

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