Botanical Composition and Nutritive Value of Grazing Lands from Organic and Conventional Agrosilvopastoral Production Systems of Tropical Southeastern Mexico

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Botanical composition and nutritive value of grazing lands from organic and conventional agrosilvopastoral production systems of tropical south-eastern Mexico

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Introduction

In the current situation of agriculture, organic livestock farming has been not only adapted to ameliorate undesirable impacts on environment but also it is challenged to hold or improve agricultural yields obtained by conventional agriculture. In the Mesoamerican biological corridor, a region recognized with an abundant diversity, almost all animal husbandry is based on extensive grazing and traditional agrosilvopastoral systems (Nahed-Toral *et al.* 2009; Nahed *et al.* 2010). Furthermore, the conversion of natural jungle areas to new farmland through deforestation is a prevalent problem for biological conservation. Therefore, precise knowledge for suitable agriculture and livestock production are needed to stop the ecological damage while the economic and social aspects are attended. The present study aims to investigate the relative frequency of botanical species for ruminant production in organic and conventional systems in south-eastern Mexico. The study would help to describe forage availabilities and nutritive potential of species that can be use as basis to plan more efficient agrosilvopastoral systems while preserving ecological and sustainable farming practices.

Methods

Experimental set up

The experiment was carried out in south-eastern México, within the Mesoamerican biological corridor, in the vale of Tecpatán, in the mountains of the north-eastern part of the state of Chiapas. The area is located between 93°15´ and 93°52´ West longitude and between 16°59´ and 17°23´ North latitude. The region is situated in the mid-watershed of the Grijalva River. Climate is warming humid with abundant summer rains. Total annual precipitation is 1932 mm, average altitude is 320 masl, and topography is rough. Two production systems were included in the study with 4 organic and 4 conventional farms each. Organic farms were considered only if they were in compliance with the multi-criteria of the organic livestock proximity index recommended by Mena *et al.* (2012). The organic livestock production units are characterized by not using external inputs but with the employment of agricultural residues and grazing areas ranging from free tree areas to complete forested grazing pastures and zero grain supplementation. In contrast, farms in conventional systems utilize external inputs, e.g. grain supplements.

Relative frequency determination, forage sampling and chemical composition

A survey to the owners was carried out in September and December 2010 to identify the most frequent species found in the farms. Later, an on-field examination was performed for botanical classification. Those forages, which were not identified, were submitted to ECOSUR herbarium for further taxonomic evaluation. To calculate the relative frequency of forages, the recommendations of Lamprecht (1990) were followed, using the equation: $f_i = n_i/N$; where f_i = relative frequency, n_i = absolute frequency and N= size of the sample. To calculate the percentage of single forage the following formula was employed: $p_i = f_i*100\%$; where p_i = percentage of single forage and f_i = relative frequency. For chemical analyses, sampling was done by collecting 500 g of single species in triplicate simulating the cattles' bites including leaves, stems or a combination of them, in line with the individual bites of cattle. Vegetation samples were identified, collected and dried. The samples were ground to a particle size of 1 mm and analysed. Moisture, fat, crude fiber and ash content were determined using standard methods (AOAC 2003). Nitrogen was measured using the Micro-Kjeldahl technique (AOAC 2003). N-free extract was calculated as the difference between 100% and the summed moisture, protein (nitrogen factor: 6.25), fat, crude fibre and ash percentages. NDF and ADF were analysed according with Goering and Van Soest (1970). All samples were analysed three times.

Results and Discussion

Thirty-four species were identified in the grazable land. The total frequency for organic production systems were

22 species whereas for conventional 18 species. The lower species richness of conventional in comparison to organic system is related to the use of herbicides that may decrease the abundance of some susceptible species (Mena *et al.* 2012). Legumes (38.2%) and forbs (38.2%) were the most frequent forages in both organic and conventional farms. Conversely, we found a lower frequency of grasses (20.6%) and woody species (2.9%). The most frequent legumes included: *Desmodium intortum, D. aparines, Acacia macracantha, Centrosema plumieri, Erythrina chiapasana, Leucaena leucocephala* and *Guazuma ulmifolia.* Among the forbs, the species: *Sida rhombifolia, Asclepias curassavica, Hyptis verticillata, Clidemia dentate* and *Adelia barbinervis* were the most frequent. For grasses species: *Cynodon plestostachius, Brachiaria brizantha, P. maximum cv. Mombasa, B. decumbens* and *Pennisetum purpureum* were the most abundant.

Though the low frequency of forages (including improved grasses), their presence on the assessed grazable lands is significant, because some of them provided larger biomass for ruminant consumption than indigenous vegetation as reported by Nahed-Toral *et al.* (2009). Woody vegetation was distributed within the grazing areas as scattered tress or as live fence-posts (*e.g. Guazuma ulmifolia*), mostly associated with climbing species (*e.g. Centrosema*). A key function of such trees whether within or among grazable lands is to provide shelter against direct sunlight, to be a source of complementary fodder, to support water retention and to facilitate nutrient recycling (Nahed *et al.* 2010; Nahed-Toral *et al.* 2012). *L. leucocephala*, *Albizia guachapele* and *Gliricida sepium* had the highest protein content (24.3, 23.1 and 18.6% of CP, respectively).

Other species as *A. caudate, B. brizantha, B. brizantha cv. Toledo* (19.9, 9.2 and 8.9% of PC, respectively) and forbs as *Adelia barbinervis, Byttneria aculeate* and *Arthotrafilus frantzii* (23.1, 22.2 and 18.9% of PC, respectively) were found with high protein values. NDF was found to be higher in *P. purpureum* (75g/100g), *C. plectostachyus* (72g/100g), *B. decumbens* (70g/100g) and *A. caudatus* (46g/100g). For ADF values, the species *D. aparines, H. verticillata* and *A. caudatus* got 43.3, 42.1 and 40.2 g/100 g, respectively.

Conclusion

Larger number of plant species in organic than in conventional were found. The species frequency of both systems is able to maintain livestock production. However, organic farming is a better option to provide and further ecological sustainability of the grassland areas, since most of current conventional farming is ecologically unsustainable. The implementation of organic standards may help to promote farming practices to maintain the vulnerable ecological areas of great biological diversity.

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