

Chemistry characteristics changes of soils in bank of *leucaena leucocephala* and *brachiaria brizantha* growing alone

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Abstract

A research was done on a commercial farm located on Rosario de Perijá Municipality, Zulia state, Venezuela, with the aim of evaluating the chemical characteristics of soils in a protein bank of *Leucaena leucocephala* and a monoculture of *Brachiaria brizantha*; the area corresponds to a very tropical forest zone. Soil samples were taken in dry and rainy seasons and were determined pH, organic carbon (CO), assimilate phosphorus (P), assimilate potassium (K), calcium (Ca) and magnesium (Mg) at 0.10 and 1.5 m from the base of the leguminous stalk and in the gramineae to a depth of 20 cm. A randomized block design was used and eight blocks. The results obtained showed a significant effect ($P < 0.05$) of the season of the year on the pH and the K and Ca content, but it did not exist on CO, P and Mg. The highest values of pH (6.50) and K (0.09 me/100 g) were obtained on the dry season, while the highest content of Ca (2.95 me/100 g) was obtained on rainy seasons. On the *Leucaena* bank the highest values of P and K ($P < 0.05$) were presented compare to the monoculture. The establishment of arboreal leguminous on the production systems improves the chemical conditions of soils, constituting as an alternative in tropical soils deficient in nutrients.

Key words: leguminous, fertility, gramineae, chemistry of soils

Introduction

The double cattle proposal systems represent an important contribution in the economy of Venezuela. However, these systems have developed based in the degradation of ecosystems caused by the deforestation to establish pastures (7)

and also due to the traditional and irrational use of existent resources in the livestock exploitation systems.

The reduction of the arboreal component in cattle areas have caused a reduction in the recycle of nutrients, as well as a reduction of

the shaded area that occasion adverse environmental conditions for the animal behavior and the fertility of soils (8).

In order to reduce the negative impact of the traditional handle of cattle on the environment, the agro forest systems on the different combinations are an alternative that somehow respond to problems occasion by deforestation and degradation of ecosystems and to the sustainability of farming systems (7).

On the agro forest systems, the

use of arboreal leguminous forage have advantages that are widely known, among these are the recovery of the soil's fertility, maintenance and improvement of the physical properties of the soil, reduction of the weeds population and also that these provide additional products for the auto consumption or sell (1).

The aim of this research was to determine the influence of *Leucaena leucocephala* on the chemical characteristics of the soil compare to a monoculture of *Brachiaria*.

Materials and methods

Location of the Experimental Area

The experimental phase of the research was carried out at a commercial farm located on Rosario de Perijá municipality, Zulia state, Venezuela, geographically at 10° 15' north latitude and 72° 40' west longitude. This area is characterized as a tropical dry forest, with average precipitations of 1100 mm/yea and an average year temperature of 29°C at 100 msnm of altitude. The rainfall regimen has a bimodal distribution, with minimum in February and July and maximum in May and October (4). Soils are taxonomically classified as Typic Haplult, with a sandy loamy texture.

Description of the experiment

The protein bank of *Leucaena leucocephala* was established in 1994 in 8 has, plants were sowed at 3 m between double rows (0.5 m between rows sowed at random). In relation to the grazing handle, it was done as a

rotational way in both the leguminous as in the gramineae without any fertilization practices, with an animal load of 0.90 UA/ha. Two samplings were done, the first in February 2002, corresponding to the dry season and the second one in May, period of maximum precipitation. Samples were collected on the protein bank and on an established paddock in a *Brachiaria brizantha* monoculture, both established on the same farm.

Soil samples were taken with a borehole at a depth from 0 to 20 cm, for this, a *Leucaena* tree was chosen at random on each plot (8 in total) and the sampling points were done from 0.10 to 1.5 m from the base of the plant's stalk. Likewise, in the monoculture eight sampling points were chosen at random at a surface of 7 has for their posterior analysis.

Laboratory Analysis

Soil samples were taken to the Soil laboratory of the Agronomy Faculty, University of Zulia. The

chemical characteristics evaluated were pH, CO (Walkley – Black), P (Bray), while, K, Ca and Mg contents were extracted through the Ac NH (pH 7.0) method (6).

Statistical analysis

Results and discussion

In table 1, is observed the season effect of the year on pH and on CO, P, K, Ca and Mg contents in the soil. The highest values of pH and K were superior ($P < 0.05$) in the dry season, while in the season of higher precipitation was registered the highest Ca content.

The lowest base contents in the rainy season may happen due to the lixiviation of minerals, especially of K, and in a lower proportion of Mg and Ca (3). In relation to P, this is one of the steadiest elements inside the soil, since its losses are not caused by washing or volatilization, nevertheless, its high stability implies low solubility, so many tropical soils have a high capacity of fixing it causing deficiencies for plants (2). Similar conceptions were done by Velasco *et al.* (15).

In relation to contents of P and K in the soil of the *Leucaena* bank, it was observed that at the time that the stalk gets farther P values reduced

The information was analyzed using the statistical analysis SAS (13). Means were obtained through the minimal squares procedure, using the Tukey test for comparing these.

significantly ($P < 0.05$), meanwhile, the opposite happened with K. However, the values produced are superior to those obtained in the monoculture of *Brachiaria* (table 2). It has been established that the presence of trees on paddocks increase the presence of organic matter and improve the micro weather, which favors the biological activity of the micro and macro fauna, and specially of bacteria, fungi and mycorrhizal fungus, which results in a higher mineralization, mobilization and availability of some nutrients of N, P and K in the soil (10, 12). Also, the extended and deep radicle system of trees increases the available area to catch water and nutrients of depths that are out of the reach of roots of the forage gramineae. Similar conceptions were done by Cresco *et al.* (5) evaluating two systems with and without *Leucaena leucocephala* in 100% of the native pasture area. They mentioned that on the 100% *Leucaena*

Table 1. Season's effect on the characteristics of the soil.

Época	pH	CO(%)	P(ppm)	K (me/100 g)	Ca (me/100g)	Mg (me/100g)
Dry	6.50 ^a	0.75	4.00	0.09 ^a	1.56 ^b	1.57
Rainy	5.81 ^b	0.91	2.10	0.03 ^b	2.95 ^a	1.40

Means with different letters in the same column differ statistically ($P < 0.05$)

Table 2. Chemical characteristics of the soil in a *Leucaena leucocephala* and *Brachiaria brizantha* bank as monoculture.

System	pH	CO(%)	P (ppm)	K (me/100 g)	Ca (me/100g)	Mg (me/100g)
Bank (0.10 m)*	5.99	0.83	4.68 ^a	0.05 ^b	2.26	1.62
bank (1.50 m)*	6.09	0.87	1.91 ^b	0.09 ^a	2.49	1.69
Monoculture	6.38	0.78	2.57 ^b	0.05 ^b	2.01	1.15

Means with different letters in the same column differ significantly (P<0.05)

*Bank (0.10 and 1.50 m) = Sampling distance from the *Leucaena* stalk

Extraction methods of nutrients: CO (Walkley – Black), P (Bray) y K, Ca y Mg (Ac NH (pH 7.0)).

system incremented the fallen leaves production, the recycle nutrients (N, P and K) and the diversity of individuals and biomass of the edaphic macro fauna in comparison to the native pasture paddock.

In researches done by Mahecha *et al.* (9) in associations of star pasture (*Cynodon plectostachyus*) with *Leucaena* and *Prosopis juliflora*, they found higher contents of P in the associations in relation to values in the gramineae growing alone, and they mentioned that this may be a consequence of the highest contents of organic matter (product of pruning, excreted and fallen leaves), on the soil's profile, that at the same time increases the tampon power of the soil solution, making it easier P to tie as a humane and might be available. They also mentioned that Ca, Mg and Na presented the same tendency of P. Likewise, Primavesi (11) mentioned that some plants move P towards the excreted amino acids through roots, and act as chelate, by mycorrhiza or bacteria of the rhizosphere, situation that occurs when arboreal leguminous are established.

In recent researches, Tien Dung *et al.* (14) comparing monoculture systems of cassava (*Manihot esculenta*) and *Flemingia* (*Flemingia macrophylla*) to the association among both species, observed that the soil fertility is superior and keeps in the alternate crops system with an additional benefit in the reduction of the soil's erosion. The beneficial effects of the leguminous on the soil's fertility are also due to the recycle of nutrients, since this specie covers the soil's surface with a huge quantity of dead leaves.

However, Bolivar *et al.* (3) reported contradictory results evaluating *Acacia mangium* and *Brachiaria humidicola* in monoculture. They observed that P, K, Ca and Mg contents did not vary at different distances of the leguminous row, mentioning that the results on this research do not show significant effects of *Acacia* in the improvements of bases, though Ca and K concentrations tended to be higher in the agroforestry system.

Conclusions

The establishment of *Leucaena leucocephala* in the tropical farming production systems improves the

chemical conditions of the soils, constituting an alternative in tropical soils deficient in nutrients.

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