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# *THE BENEFITS OF ACACIA BERLANDIERI BENTH* (FABACEAE) IN THE PHYSICAL AND CHIMICAL PROPERTIES OF THE SOIL IN THE NORTH OF COAHUILA

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**Abstract:** With the purpose of knowing the edaphic benefits of the guajillo (Acacia berlandieri Benth), the present investigation was carried out in the "La Esmeralda" ranch, municipality of Zaragoza, Coahuila; for which, six representative sites were chosen; eight soil samples were collected at each site, four facing north and four facing south of the canopy, in both orientations, at 0.50 m and 1.50 m, at two depths from 0 to 5 cm and from 5 cm to 10 cm. All the samples were sent to the laboratory to determine the pH, clay, sand, silt, organic matter, nitric nitrogen, total carbonates and electrical conductivity. The analyzes indicate that there are significant differences (P< 0.05) between orientation sites under aerial cover and adjacent area, for C.E, N-No3 and M.O. In relation to the C.E. and the N-No3 in the north orientation under the canopy with 0.734 mmhos/cm and 150.5 ppm, respectively, were higher by 0.23 and 0.70% than the rest of the treatments. Regarding depths, significant differences were only found for the M.O., C.E. and CaCO3 being the 0-5 cm layer with the highest concentrations. The results indicate that Acacia berlandieri plays an important role in the contribution of M.O. and N-NO3 to the soil and that the north orientation of the bush crown is a potential site for the establishment of grasses compatible with it.
**Keywords**: Bush, guajillo, semi-desert, structure, foliage.

## INTRODUCTION

The northeast of Coahuila is part of the floristic province of the Northeast Coastal Plain (Rzedowski, 2006); it is also part of the Mexican Chihuahuan Desert; which is represented by the communities of microphyllous desert scrub, desert scrub and montane chaparral (Henrickson and Johnston 1986). According to Reid et al. (1990), Estrada-Castillon et al. (2005) and Foroughbakhch et al. (2005) the thickets of northeastern Mexico are used as a source of fodder for extensive cattle grazing and serve as habitat for wildlife, as well as to obtain firewood, fence posts, wood for construction and non-timber forest products, where medicinal plants stand out (Encina et al., 2020). Acacia berlandieri Benth commonly known as "guajillo" is a shrubby legume that stands out for its protein content of 21%, slowly assimilated carbohydrates, minerals (calcium, iron and zinc), fiber and some bioactive components (Begoña et al. , 2010), the above makes it one of the most important plants in the north of Coahuila, mainly due to the forage value it represents for cattle, goats, deer and other animals during the dry periods that go from November to May. A. berlandieri is characterized by its adaptation to stony soils with high contents of calcium carbonates, poor in nitrogen (Hernández, 2007). It is noteworthy that there are few studies related to improvements in soil quality after A. berlandieri is established; therefore, the objective of the present study was to know some of the physical-chemical characteristics of the soil under the aerial canopy and adjacent areas of this shrub in two orientations and two depths in the vegetative community in which it is found.

## MATERIALS AND METHODS

The study was carried out in the "La Esmeralda" ranch in the municipality of Zaragoza, Coahuila, an area of 20 hectares was selected, a representative surface of the vegetation and soil of the ranch. This area was divided into six blocks to contemplate the difference in soils. In each block, six plants were chosen at random and sampling was carried out in each one. Eight soil samples were collected per bush, four facing north and four facing south from the canopy of the bush. The collection of soil samples in both orientations

was carried out at 0.50 m (below the aerial crown of the bush) and 1.50 m (open and/or adjacent area) from the canopy of the bush at a depth, from the soil surface, of 0 -5cm and 5-10cm. Respectively. Soil samples were dried in the sun, ground, passed through a 2-mm sieve, stored in plastic bags and sent to the laboratory. The data was analyzed through the UANL statistical program (Olivares, 2016). An analysis of variance design of split plots with complete treatments (Location of soil samples in relation to shrubs) in blocks (Shrubs) was formed. Duncan's test was used to compare means between depths, orientation and/or location and interaction, when significant differences were indicated in the ANOVA.

## RESULTS

The analysis of variance of some physical-chemical characteristics of soils below and outside the canopy (BC and FC) of the guajillo in north (N) and south (S) orientation, reported significant differences ($P<0.05$) between sites and orientations for organic matter (M.O.), nitric nitrogen (N-NO3) and electrical conductivity (C.E.), as shown in Table 1.

The OM content under the canopy in north and south orientation was statistically equal ($P < 0.05$) but higher ($P < 0.05$) than that found outside the canopy, which was the same ($p < 0.05$) in both orientations. The content of M.O. under the cup was 32% higher than outside it (6.98 vs 4.71) (Table 2). Securities classified as extremely rich.

The average content (150.5 ppm) of N-NO3 in soil under the canopy and in north orientation was higher than the content in south orientation, and soil outside the canopy in both orientations, which were statistically equal (Table 1). Table 2 shows that the N-NO3 of the soil under the canopy (120.4) was 50% higher than the nitrogen found outside the canopy (59.46), which are classified as very high.

The E.C. reported for the soil under the canopy in north orientation (0.734 mmhos/cm) was higher than that found in south orientation (0.595) and this in turn was higher than the soil content outside the canopy in its two orientations, which were the same. According to the classification scale, the soils are not saline. Likewise, it is observed that the C.E. of the soil under the canopy (0.837) was 54 % higher than that found in the soil outside the canopy (0.457).

Potential hydrogen (pH), carbonates (CO3), clay, sand, and silt were not significant ($P<0.05$) between sites and orientations according to analysis of variance. However, the pH (slightly alkaline) tends to be higher in the soil outside the canopy and facing south, than under the canopy and facing north. A similar aspect occurred with CO3, only that it tends to increase more in the north orientation than in the south of both sites. The CO3 values for the site under the canopy (42.82%) and outside it (46.26) are classified as very high; In addition, the texture of both sites is clayey, with sand and silt being similar, and the soil under the crown slightly less clayy.

Besides, the analysis of variance reported differences ($P<0.05$) between depth levels (0 to 4.9 and 5 to 10 cm) for M.O, C.E. and CaCO3 (Table 3), which were higher than the depth from 0 to 4.9 cm with mean values of 6.82 %, 0.606 mmhos/cm and 45.2%, respectively.

In the case of site interaction by orientation and depth, the analysis of variance showed a significant difference ($P<0.05$) only for M.O. (Table. 4). According to Duncan ($P<0.05$) the organic matter with average values of 7.81% for the soil under the cup to the north at a depth of 0 to 5 and 7.89% in soil under the cup to the south of 0 to 5 cm, were the same between yes and higher than 6.29 and 5.494% under the canopy to the north and south from 6 to 10 cm, respectively (Table 3). These, in

| Yards | pH | M.O. (%) | $N\text{-}NO_3$ (ppm) | C.E.x$10^3$ (mmhos/cm) | $CO_3$ (%) | Clay (%) | Sand (%) | Silt (%) |
|---|---|---|---|---|---|---|---|---|
| BCN | 7.64x | 7.05x | 150.5x | 0.734x | 43.3x | 40.0x | 25.9x | 34.0x |
| BCS | 7.67x | 6.91x | 90.3y | 0.595x | 41.6x | 43.4x | 26.5x | 30.2x |
| FCN | 7.61x | 4.73y | 58.0y | 0.426x | 46.6x | 39.4x | 27.6x | 32.9x |
| FCS | 7.70x | 4.69y | 60.9y | 0.489x | 45.9x | 42.2x | 24.9x | 32.9x |

BCN: under the cup to the north, BCS: under the cup to the south, FCN: outside the cup to the north, FCS: outside the cup to the south.

Table 1. Differences in soil properties under and outside the guajillo canopy in two orientations in northern Coahuila.

| Properties | Under the glass | Out of the cup | Classification |
|---|---|---|---|
| Hydrogen potential (pH). | $7.66^1$ x | $7.65^2$ x | $^{1,2}$ Slightly alkaline |
| Organic material (%) | $6.98^1$ x | $4.71^2$ y | $^{1,2}$ Extremely rich |
| Nitric Nitrogen ($N\text{-}NO_3$ %) | $120.40^1$ x | $9.46^2$ y | $^{1,2}$ Very high |
| Electric conductivity (mmhos/cm) | $0.837^1$x | $0.457^2$ y | $^{1,2}$ Not saline |
| Total Carbonates ($Co_3$ %) | 42.48 $^1$ x I | $46.26^2$ x II | $^{1,2}$ Very high |
| Clay %) | 41.68 $^1$ x I | $40.84^2$ x II | I, II Texture |
| Sand (%) | 26.22 $^1$ x I | $26.21^2$ x II | |
| Silt (%) | 32.08 $^1$ x I | $32.94^2$ x II | |

Table 2. Average classification of some physical-chemical characteristics of the soil under the guajillo canopy and outside it.

| Depth (cm) | pH | M.O. (%) | $N\text{-}NO_3$ (ppm) | C.E.x$10^3$ (mmhos/cm) | $CaCO_3$ (%) | Clay (%) | Sand (%) | Silt (%) |
|---|---|---|---|---|---|---|---|---|
| 0 a 5 | $5.7^x$ | $6.3^x$ | $94.5^x$ | $0.606^x$ | $45.2^x$ | $40.5^x$ | $27.4^x$ | $32.1^x$ |
| 5 to 10 | $7.6^x$ | $5.4^y$ | $85.4^x$ | $0.516^y$ | $43.5^y$ | $42.0^x$ | $25.0^x$ | $32.9^x$ |

Table 3. Behavior of physical-chemical characteristics of the soil in two soil depths under the guajillo canopy.

| Yard | Profile cm | pH | M.O (%) | $N\text{-}NO_3$ (ppm) | C.E. x $10_3$ (mmhos/cm) | CaCO3 (%) | Clay (%) | Sand (%) | Silt (%) |
|---|---|---|---|---|---|---|---|---|---|
| North* | 0 a 5 | $7.65^x$ | $7.8^x$ | $160.2^x$ | $0.780^x$ | $43.9^x$ | $41.7^x$ | $23.2^x$ | $35.0^x$ |
| | 5 a 10 | $7.63^x$ | $6.3^y$ | $140.8^x$ | $0.689^x$ | $42.7^x$ | $38.3^x$ | $28.7^x$ | $33.0^x$ |
| South* | 0 a 5 | $7.71^x$ | $7.9^x$ | $114.2^x$ | $0.698^x$ | $41.4^x$ | $41.9^x$ | $30.1^x$ | $28.0^x$ |
| | 5 a 10 | $7.60^x$ | $5.9^y$ | $66.3^x$ | $0.491^x$ | $41.9^x$ | $44.9^z$ | $22.8^x$ | $32.3^x$ |
| North** | 0 a 5 | $7.63^x$ | $4.7^z$ | $47.5^x$ | $0.423^x$ | $48.4^x$ | $36.9^x$ | $30.1^x$ | $32.9^x$ |
| | 5 a 10 | $7.58^x$ | $4.8^z$ | $68.5^x$ | $0.428^x$ | $44.9^x$ | $41.9^x$ | $25.0^x$ | $33.0^x$ |
| South** | 0 a 5 | $7.75^x$ | $4.8^z$ | $56.0^x$ | $0.521^x$ | $47.1^x$ | $41.5^x$ | $26.1^x$ | $32.4^x$ |
| | 5 a 10 | $7.65^x$ | $4.6^z$ | $65.8^x$ | $0.456^x$ | $36.3^x$ | $43.0^y$ | $23.6^x$ | $33.4^x$ |

* Under the cup, **Out of the cup. Different literals within columns indicate a significant difference at 5%.

Table 4. Behavior of the physical-chemical characteristics of the soil under the crown and adjacent areas in two orientations and two depths.

turn, were superior to the interactions of the soil under the crown, which were similar to each other with a mean value of 4.71% of M.O.

## DISCUSSION

The presence of a higher content of OM and N-NO3 in the soil under the guajillo canopy compared to the soil in the adjacent area, corroborates the hypothesis of the nutritional benefits of Acacia berlandieri, since it offers a better substrate to the soil and these are smaller as it moves away from the plant canopy. Similar attributes were found by Tiedemann and Klenmedson (1973) in Tucson, Arizona and García et al (1989) in Mesquite in Múzquiz, Coahuila. The higher content of N-NO3 under the canopy to the north is possibly due to the fact that the humidity conditions are more favorable for the decomposition of organic matter. According to this, it can be said that the north side is more fertile, an aspect that can be used for replanting with species that require the OM and N-NO3 content reported here. It is expected that the grasses found under the guajillo canopy are of higher nutritional quality than those present in areas outside it.

The increase in the C.E. in the soil under the canopy and facing north, it may be due to the trend towards a greater increase in total CO3, which in a certain way affects the drainage of precipitation, raising the dissolved salts by capillarity towards the upper part (Ortíz and Ortíz,1980).

The pH of 7.66 found in the present study and compared to that reported by García et al (1989) in Isla de Fertilidad and adjacent mesquite areas (9.03 vs 8.91), respectively, may be due to the higher content of M.O found under the canopy. of the guajillo (6.98%) and outside it (4.71%) compared to that reported under and outside the mesquite canopy (4.03 and 2.76%) respectively, as indicated by Tiedemann and Klemmedson (1973).

The highest concentration of the M.O. EC. and total CO3 in the Superficial stratum of 0-5 cm of the soil, it could be said that it is a reflection of the climatic conditions of the arid zones that are characterized by high temperatures, and scarce and erratic precipitation that in general make the soil a development slow compared to that of rainy areas where soils develop faster.

From the point of view of M.O, it can be said that the soil under the canopy of the guajillo in north and south orientation in the 0-5 cm soil layer is considered richer, because it is the area of greatest exposure to the fall of the material.

## CONCLUSIONS

Based on the results obtained, it is concluded that the soil under the aerial crown of the guajillo has a higher M.O. N-NO3 and C.E. that the area adjacent to said bush; the north orientation under the aerial canopy of the guajillo is the one that contains the highest N-NO3 and C.E; as well as M.O that is also high in the South orientation. The pH, total carbonates and contents of clay, sand and silt did not register significant differences between sites, orientations and depths, except for total carbonates that showed it in depth, the stratum being 0-5 cm higher than the 5-10 cm.

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