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SPACE DISTRIBUTION OF GUAJILLO (*Acacia berlandieri* Benth), STRUCTURE AND ASSOCIATED ARBUSTIVES IN TWO AGOSTADERO RANCHES IN NORTHERN COAHUILA

Pedro Hernández Rojas
National Institute of Forestry, Agriculture and Livestock Research
Zaragoza, Coahuila, Mexico
https://orcid.org/0009-0008-8086-9131

Mauricio Velázquez Martínez
National Institute of Forestry, Agriculture and Livestock Research
San Luis Potosi, Mexico
https://orcid.org/0000-0002-5767-364x

Victor Hugo Gonzalez Torres
Centro de Bachillerato Tecnológico Agropecuario, Zaragoza, Coahuila, Mexico

Carlos Alberto Ponce Ontiveros
Centro de Bachillerato Tecnológico Agropecuario, Zaragoza, Coahuila, Mexico.

Carlos Ríos Quiroz
National Institute of Forestry, Agriculture and Livestock Research
Saltillo, Coahuila, Mexico

Macotulio Soto Hernández
National Institute of Forestry, Agriculture and Livestock Research
Zaragoza, Coahuila, Mexico
https//orcid.org/0000-0002-9042-9710

Abstract: In order to determine the spatial distribution pattern of guajillo, its structure and relationship by age and height, and to define its association with other shrubs, the present study was carried out in two pasture ranches in northern Coahuila. Based on the results, guajillo in the two ranches is distributed in an aggregated form, being higher in Rancho "Coahuila" with block size 64 (block size 1 = 3 m^2) and 32 (block size 1 = 4 m^2) in Rancho "La Salada", under plot size of 192 m^2 and 128 m^2, respectively. Density was higher at the first ranch than at the second (3.49 m^2 plants vs. 1.56 m^2 plants), respectively. In both, the large (76 - 100 cm) and medium (51 - 75 cm) plant classes dominated (33.9, 24.7% and 27.11, 26.22%). There is a positive and significant relationship ($P < 0.05$, 0.17) of small plants (26 - 50 cm in height) with very large plants (> 100 cm) and medium plants (51 - 75 cm) in Rancho "Coahuila" and likewise in Rancho "La Salada" with levels ($P < 0.03$ and 0.20). Guajillo in Rancho Coahuila does not depend (X^2t 0.05) on cenizo, quebradora, guayacán and cabellito for its distribution, but not in Rancho "La Salada", with which it is positively associated, except with cabellito. It is concluded that guajillo presents a pattern of spatial distribution aggregated to a greater and lesser degree, possibly due to differences in density, soil conditions and grazing. The sampling unit at Rancho "Coahuila" and "La Salada" is 3m x 4m and 4m x 4m, respectively. Very large and medium sized plants are the target in cases of guajillo control.
Keywords: Guajillo, spatial distribution, structure and association.

INTRODUCTION

Guajillo (*Acacia berlandieri* Benth) is a shrub species of the Fabaceae family, native to the southeastern United States and northeastern Mexico (CONABIO. 2016). It is widely distributed in the *Acacia - Leucophyllum* ecosystem, typical of the northeastern state of Coahuila (González.1972), in which it plays an important role in complementing the livelihood of livestock in the region during critical periods of low forage availability (November to April) from pastures, to the extent that its use by livestock in adverse weather conditions is possibly being affected, since ranchers have commented that the ash (*Leucophyllum frutescens (*Berl.) I.M.Johnston) is dominating it.

This is possible, since Ellison in 1960 and Mairomi and Tume in 2021, reported that grasslands and communities of arid and semi-arid vegetation are being abruptly altered by severe grazing, fire suppression, dissemination of shrub seeds by cattle, among others. Tuller (1973) indicates that desert shrub communities are portions of fragile ecosystems and, generally, their structure is the result of the action of large herbivores, imposed on vegetation patterns associated with abiotic, biotic and anthropogenic factors, which strongly influence them through the differential availability of resources (Cingonali *et al.*, 2003; Díaz *et al.*, 2012 and Maciel-Mata *et al.*, 2015), causing species in their communities to be distributed in a random, uniform and aggregated manner; the first occurs when there are continuous conditions in a habitable space and any point in it has the same probability of being occupied without affecting the presence of another individual. In the case of the latter, species show a negative interaction by competing for some resource, and the latter shows positive effects of attraction to form dense groups of individuals (Pielou, 1960 and Franco-López *et al.,* 1989).

With the evidence of the loss of species diversity, vegetation cover and productivity in ecosystems and/or vegetation communities and in the face of more intense and recurrent climate change, there has been a growing concern for studies with an ecological approach, such as the distribution patterns of species, their structure and processes under the local micro-environmental conditions required by each of the species that make up their ecosystem; to explain their capacity for growth, development, establishment, renewal, the probability of mortality and competition (Anand, 1994 and Linares-Palomino, 2005). With the support of methodological and statistical tools, generated with ecological approaches, where the use of some of them implies considering special requirements regarding the spatial distribution of individuals, shape and size of sampling units, adjustment tests, correction and indexes (Clark and Evans, 1954; Cook and Hurst, 1962; Pielou, 1960; Kershaw, 1963, 1973; Piñeiro, 1976; Harper, 1977; Orloci, 1978 and Greig Smith, 1979).

Given the lack of studies of this nature in the *Acacia - Leucophyllum* ecosystem in northern Coahuila, and the importance of these studies in the contribution of knowledge in order to generate sustainable and productive management strategies in ecosystems where agricultural and forestry activities are developed, this study was conducted with the following objectives:

OBJECTIVES

1) Determine the spatial distribution pattern of guajillo.

2) To know the structure by age and plant height.

3) Determine the relationship between plant height class densities.

4) To define the association of guajillo with other shrub species.

MATERIALS AND METHODS

STUDY AREA

The study was carried out in two pasture ranches: "Coahuila" and "La Salada" in the municipality of Zaragoza, Coahuila, whose climate and soil physical-chemical characteristics of the study sites in the ranches (SPP, 1987) are presented in Table 1.

The dominant vegetation is of the medium thorny scrub type with the *Acacia-Leucophyllum* association, characterized by the presence of shrubs such as guajillo (*Acacia berlandieri* Benth), cenizo *(Leucophyllum frutescens* Berl. J.M. Johansthon), chaparro prieto (*Acacia rigídula* Benth), quebradora *(Brickellia veronicifolia* (H.B.K.) Gray, vara dulce (Eysenhardtia polystachya (Ort.) Gray), sweet cane *(Eysenhardtia polystachya* (Ort). Sarg), cabellito (*Calliandra eriophyla* Benth), *corona de cristo (Koeberlinia spinosa* ZUCC*)*, guayacán (*Porlieria augustifolia* Engelm) and grasses such as navajita roja (*Bouteloua trífida* Thurb), zacate rizado (*Panicum hallí* Vasey), zacate tres barbas (*Aristida spp*), zacate banderilla (*Bouteloua curtipendula* (Michx). Torr), love grass (*Erogrostis intermedio* Hitchc), among others (COTECOCA, 1972).

SAMPLING AND ANALYSIS

The procedure under which the objectives were achieved is shown below.

SPATIAL DISTRIBUTION PATTERN

For this, a plot was delimited perpendicular to the slope, 3 m wide by 256 m long at the "Coahuila" ranch and at the "La Salada" ranch a plot 4 m wide by 256 m long, which were divided into units of 3 x 1 m and 4 x 1 m, respectively. The width of each plot was determined based on previous observations, considering the criteria suggested by Cook and Hurst (1962), who state that the size of the

Features	Ranchos	
	Coahuila	**La Salada**
Latitude	28° 36' 28.4"	28° 50' 07.7"
Length	101° 12'03.5"	100° 55' 11.3"
Type of climate	Dry semidry: BSo hw(x^1)	Dry semidry: BSo hw(x^1)
Isotherms (°C)	20-22	20-22
Isojets (mm)	400-500	400-500
Physiography	Lomerío	Lomerío
Soil slope (%)	**7 (Inclined)**	**5 (Gently inclined)**
Type of soil	***Rendzine with lytic phase***	***Xerosol with petrocalcic phase***
Floor depth (cm)	0 -10 (Somero)	0 -12 (Somero)
pH	7.7 (Alkaline)	7.8 (Alkaline)
MO (%)	4.7 (Very High)	4.5 (Very high)
P (%)	***1.1 (Low)***	***6.6 (Very high)***
Na (meq/100 g)	0.1 (Low)	0.2 (Low)
K (meq/100 g)	0.6 (Medium)	0.4 (Medium)
Ca (meq/100 g)	**28.1 (High)**	**15.0 (High)**
Mg (ppm)	**3.2 (Low)**	**1.6 (Low)**
EC (meq/100 g)	>2 (High)	>2 (High)
CEC (meq/100 g)	***26.6 (Medium)***	***15.0 (Low)***
Soil texture	Franca	Migajón-clay-sandy
Sources of information and interpretation: SPP, 1982. Climate charts, isohyets, isotherms and soil types: Scale 1:1000,000. Color. SPP, 1982: Edaphological chart on physical and chemical analysis of soil. Scale 1:250,000. Color: Agrolab, 2005. Fertilab. 2024 Interpretation of soil analysis on physical and chemical soil characteristics.		

Table 1. Agroecological characteristics of the ranch sampling sites. Zaragoza-C.E. Saltillo Experimental Site. CIRNE-INIFAP.

sampling unit to be used is that in which the species under study has a frequency greater than or equal to 30%. Subsequently, in each of the divisions of each plot, the number of guajillo plants and other shrubs present was counted. The height was recorded according to five categories (Table 2), assuming that they are directly related to the age of the plant (López *et al.*, 1989).

Category	Height (cm)	Ranking
1	0 a 25	Very small plants
2	26 a 50	Small plants
3	51 a 75	Medium plants
4	76 a 100	Large plants
5	>100	Very large plants

Table 2. Plant height categories contemplated in the study sites in northern Coahuila. Zaragoza-C.E. Saltillo Experimental Site. CIRNE-INIFAP.

Once the information on the number of guajillo plants was integrated, the spatial distribution pattern was determined using the method of variance of contiguous quadrats, proposed by Greig-Smith (1979) and with the support of the SPASSOC program of statistical ecology (Ludwing and Reynolds, 1988).

Then, the relationship between different height classes of the plants present was analyzed by simple linear regression (Steel and Torrie, 1960), the population density and the percentage of plants for each height category were obtained.

INTERSPECIFIC ASSOCIATION

To define this, the presence and absence of all shrubs contained in 60 sample units (SU) of 12 m^2 (3 m x 4 m) and 16 m^2 (4 m x 4 m) randomly distributed in the "Coahuila" ranch and 60 MU in the "La Salada" ranch, respectively, were recorded. The criteria used to define the size of the MU was that of Cook and Hurst (1962) and, according to Pileou (1977) and Greig-Smith (1983), who indicate that any association index used depends on the size, shape and distribution of the MU, which are in accordance with the size and spatial distribution of the species under study. Once the information was concentrated, it was analyzed by means of the SPASSOC statistical ecology program (Ludwing and Reynolds, 1988), using the Dice Index (DI) (1954), which is based on the harmonic mean of a/m and a/r, which is:

$$DI = \frac{2a}{2a + b + c}$$

Where: a,b,c, are the presence and absence values in a 2 x 2 species pair contingency table.

RESULTS AND DISCUSSION

SPATIAL DISTRIBUTION

The effect of block size on variance, in relation to the guajillo distribution pattern in the "Coahuila" and "La Salada" ranches, is shown in Figure 1.

In this figure it can be observed that guajillo is distributed in an aggregated form with block sizes of 8 and 64 in the first ranch and with block sizes of 2 and 32 in the second ranch. This indicates that guajillo manifests strong positive aggregation effects to form dense clusters (Franco-López *et al*., 1989). The aggregation block at "La Salada" ranch, of 32, is similar to that reported in hojasén by López (1989).

The greater intensity of aggregation in the first ranch, with respect to the second, could be explained by the better soil conditions (Table 1) and the benefit provided by the higher CEC content (26.6 meq/100 g vs. 15.0 meq/100 g) to the plants, by providing a nutrient reserve to replenish the nutrients that were absorbed by the plants or washed from the root zone (Fertilab, 2024). (Fertilab, 2024) and, as well as quite possibly, to better grazing management, since an inadequate management plan under adverse climatic conditions becomes a disturbance factor that affects and/or determines the structure of a plant community (Emmel, 1957; Ellison, 1960 and Yinebeb *et al*., 2023). In Michoacán, Díaz *et al.* (1986) found a positive relationship of *Acacia berlandierei* Benth with higher E.C. (mmhos/cm), calcium (Ca), magnesium (Mg), sodium (Na) and bicarbonates (HCO3).

The lower aggregation in block size on both ranches could be due to increased competition for nutrients in the soil (Franco-López *et al*., 1989) and low rainfall within and between years under inadequate grazing, as reported by Emmel (1975).

The largest block size of 64, found at the "Coahuila" ranch and 32 for the "La Salada" ranch, establishes that the sampling plots for future guajillo density studies at the sampled sites are 192 m^2 and 128 m^2, respectively.

DENSITY STRUCTURE BY HEIGHT CATEGORY

The density structure by height classes of *Acacia berlandieri* Benth on the "Coahuila" and "La Salada" ranches is shown in Figure 2, respectively.

It can be seen that both ranches are dominated by individuals of large class with 33.92% and 27.11% and medium class with 24.73% and 26.22%, respectively. The first ranch had a lower percentage of very small (11.35%), small (11.35%) and medium (24.73%) individuals than the second ranch, which had 16.01%, 20.44% and 26.22% of very small, small and medium plants, respectively. Similar behavior was found by López (1989) when working with *Flourencia cernua* DC, in Saltillo, Coahuila. This could be explained by the effect of grazing, as reported by Yinebeb *et al.* (2023), who found that grazing is an environmental disturbance factor that affects the structure of plant communities.

The density of *Acacia berlandieri* Benth per unit area and total, was higher in the "Coahuila" ranch with respect to the "La Salada" ranch by 44.67% (3.49 vs. 1.56) and 78.95% (285 vs. 225), respectively (Figure 3). As well as in the medium, large and very large categories by 79.73, 63.54 and 44.23; not so, in the small and very small categories where the ranch "La Salada" with 12.50 and 48.38% surpassed the ranch "Coahuila". In addition, it can be seen that the behavior of the density (very small plants to very large plants) in each ranch is bell-shaped, but the density in the stratum of very large plants of "La Salada" ranch, is a little more out of phase, which possibly indicates that this type of plant class, is giving rise to plants of small and very small category or is being affected by a strong grazing pressure.

In addition, the higher density per square meter found in the "Coahuila" ranch (3.49 plants) (Figure 3), the higher percentage of large (33.92%) and very large (18.73%) plants, compared to the density of 1.56 plants (Figure 3) and large (27.11%) and very large plants found in the "La Salada" ranch, may be due to a better grazing management with cattle in the period from November to May in the first ranch.11%) and very large plants found in the ranch "La Salada", may be due to better grazing management with cattle in the period from November to May in the first ranch; although it is also not ruled out that, while this benefits plants of this size, it harms very small and small plants, which may be suppressed by plants of larger size (Arthur, 1973 and Hernández *et al.*, 2018).

RELATIONSHIP BETWEEN PLANT HEIGHT CATEGORIES

The positive and significant relationship ($P< 0.05$; 017 and 0.03) of the class of small plants (26 - 50 cm in height) with the class of very large plants (> 100 cm in height) and medium plants (51 - 75 cm) in the "Coahuila" ranch (Table 3) and "La Salada" ranch (Table 4), respectively; together with the prediction equations found in Tables 3 and 4, for these relationships, establish, for the case of the "Coahuila" ranch, that for each very large plant, there are 5.0 small plants and, per medium plant, 0.42 small plants.

In the case of "La Salada" ranch, there are 1.49 and 0.44 small plants for each very large and medium plant, respectively, which means that these kinds of plants are giving rise to new plants and/or renewal of *Acacia berlandieri* Benth in the plant community and/or ecosystem. Therefore, they become nurseries and/or safe sites in terms of soil nutrients for the reforestation of that shrub (Hernández *et al.*, 2023 and Hernández *et al.*, 2018), using the small category plants (25 - 50 cm in height).

It can also be seen in Tables 3 and 4 that the small class plants went through a critical stage which was the very small plant class (1 - 25 cm in height), due to a negative, although not significant relationship ($P < 0.76$ and 0.83) with the very large class plants, respectively; perhaps due to the scarcity of precipitation in certain periods of the year (Eddy and Judd, 2003) which has a positive and significant relationship with *Acacia berlandieri* shoot elongation, with limited soil nutrients (Hernández *et al...*, 2023).

According to the respective prediction equations, on the "Coahuila" ranch (Table 3), out of a total of 38 very small plants per very large plant, 2.5 plants die. On the other hand, in the "La Salada" ranch, Table 4 shows that, out of a total of 4.23 very small plants per very large plant, 0.44 plants die.

The positive and significant relationship ($P<0.17$) found (Table 3), of the medium plant

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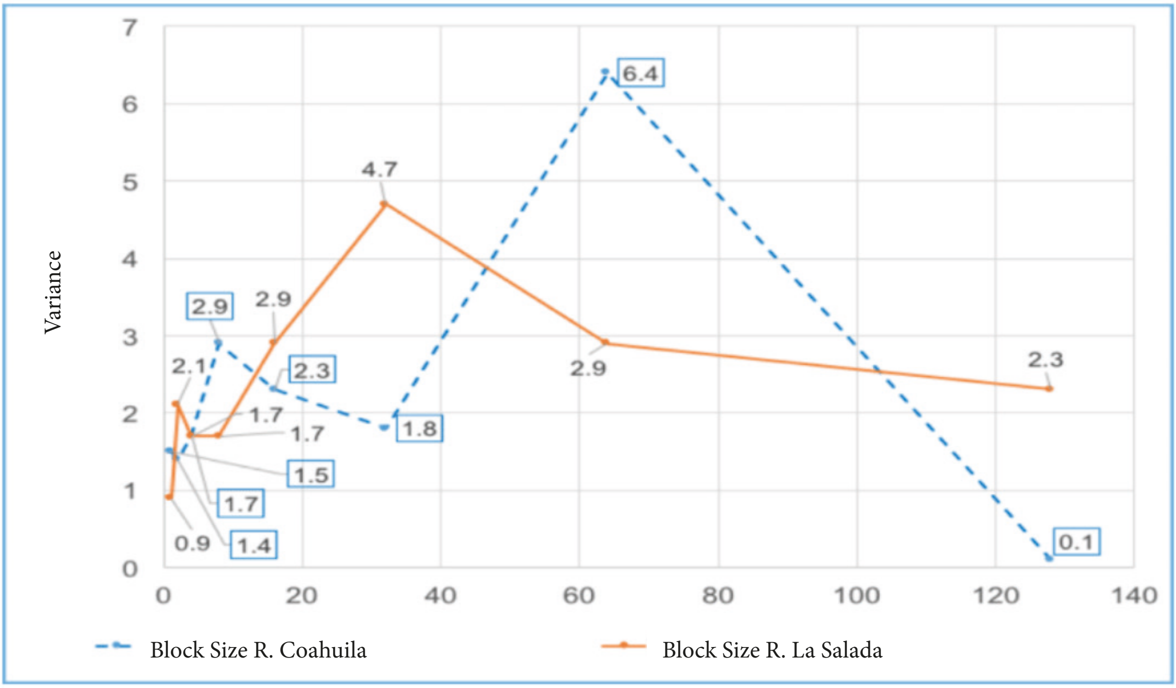
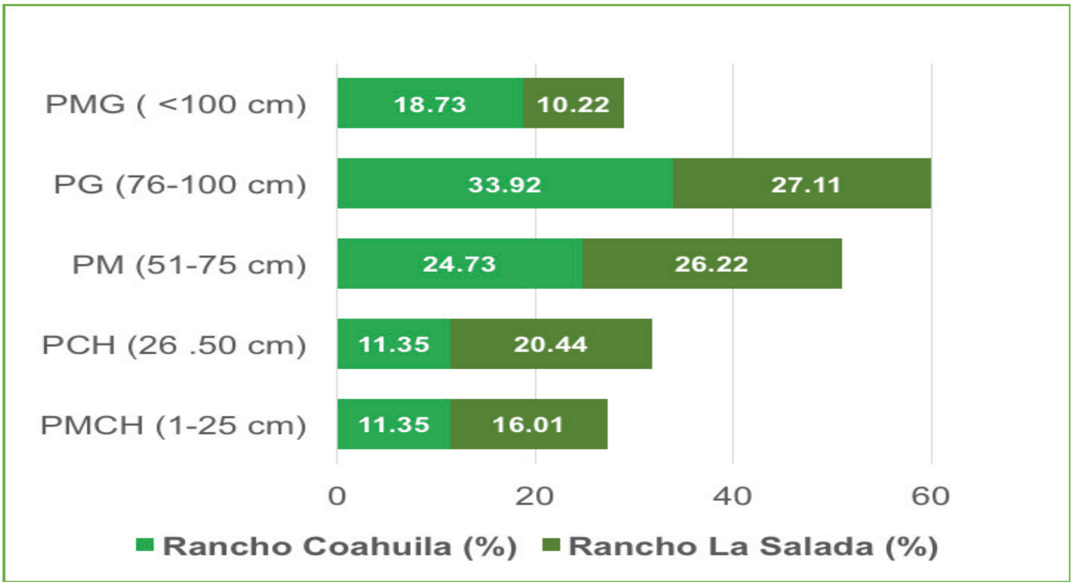
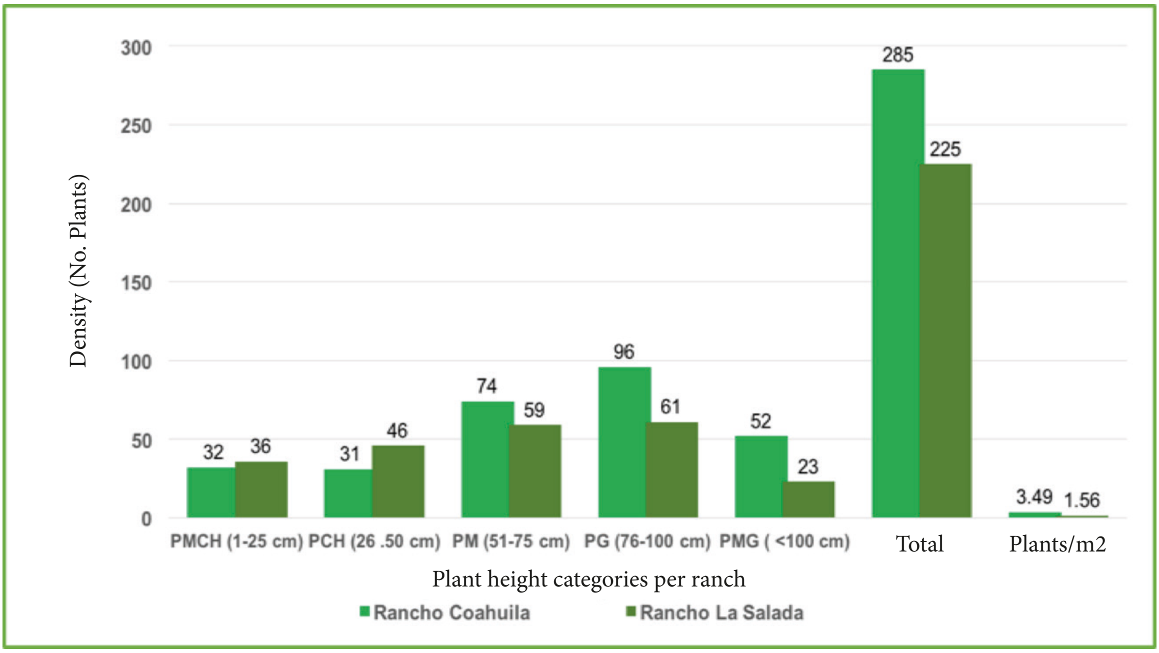


Figure 1. Spatial distribution of guajillo (*Acacia berlandieri* Benth) in the ranch "Coahuila (---) and ranch "La Salada" (---) in northern Coahuila. Block size 1 is = 3 m² (----). Block size 1 is equal to 4 m² (---). Zaragoza-C.E. Saltillo Experimental Site. CIRNE-INIFAP.



Height structure of *Acacia berlandieri* Benth. individuals at "Coahuila" and "La Salada" ranches. Zaragoza-C.E. Saltillo Experimental Site. CIRNE-INIFAP. Total density of 285± 40 with 3.49 plants/m² and 225± 30 with 1.56 plants/m² per ranch, respectively. PMG=Very large plants. PG=Plantas Grandes. PM=Medium Plants. PCH=Plantas Chicas. PMCH=Very Small Plants.



Density by plant height category of *Acacia berlandieri* Benth. at the "Coahuila" and "La Salada" ranches. Zaragoza-C.E. Saltillo Experimental Site. CIRNE-INIFAP.

Relationship between Plants	Equation of Prediction	R	R^2	Level of Significance
Very small - Girl	Y= 9.71 - 0.29(X)	-0.14	0.02	0.85
Very small - Medium	Y= 2.59 + 0.34(X)	0.33	0.11	0.66
Very small - Large	Y= 25.06 - 0.82(X)	-0.52	0.27	0.47
Very small - Very large	Y= 38.00 - 2.50(X)	-0.24	0.06	0.76
Girl - Medium	Y= -0.66 + 0.42(X)	0.82	0.68	0.17*
Girl - Large	Y= 3.66 + 0.11(X)	0.14	0.02	0.86
Girl - Very large	Y= -0.54 + 5.00(X	0.94	0.89	0.05**
Medium - Large	Y= 28.43 - 0.61(X)	-0.39	0.16	0.60
Medium - Very large	Y= -62.25 + 6.50(X)	0.63	0.40	0.37
Large - Very large	Y= -15.25 + 3.00(X)	0.45	0.20	0.55
Very small (1-25 cm); Small (26-50 cm); Medium (51-75 cm); Large (76-100 cm); Very large (> 100 cm). *, ** : Significance level.				

Table 3. Relationship between plant class densities of *Acacia berlandieri* Benth on the "Coahuila" ranch in 192 m^2 plots. Zaragoza-C.E. Saltillo Experimental Site. CIRNE-INIFAP.

Relationship between Plants	Equation of Prediction	R	R^2	Level of Significance
Very small - Girl	Y = 2.42 + 0.25(X)	0.19	0.03	0.60
Very small - Medium	Y = 7.09 - 0.53(X)	-0.43	0.18	0.25
Very small - Large	Y = 1.28 + 0.38(X)	0.29	0.08	0.44
Very small - Very large	Y = 4.23 - 0.22(X)	-0.08	0.006	0.83
Girl - Medium	Y = 2.13 + 0.44(X)	0.47	0.22	0.20
Girl - Large	Y = 3.56 + 0.23(X)	0.23	0.06	0.54
Girl - Very large	Y = 1.20 + 1.49(X)	0.73	0.54	0.02**
Medium - Large	Y = 4.33 + 0.34(X)	0.32	0.11	0.39
Medium - Very large	Y = 3.72 + 1.06(X)	0.49	0.24	0.17*
Large - Very large	Y = 5.28 + 0.37(X)	0.18	0.03	0.65
Very small (1-25 cm); Small (26-50 cm); Medium (51-75 cm); Large (76-100 cm); Very large (> 100 cm). *, ** : Significance level.				

Table 4. Relationship between plant density classes of *Acacia berlandieri* Benth at "La Salada" ranch in 128 m^2 plots. Zaragoza-C.E. Saltillo Experimental Site. CIRNE-INIFAP.

(51 - 75 cm) with the very large plant (> 100 cm) indicates that the latter promotes the development of the former, which is partly explained by the higher percentage of medium plants (26.22 vs. 10.22%), respectively (Figure 2).

As well as the trend in the positive relationship between medium and large plants (Tables 3 and 4), it is established that these are objectives in case any control plan is intended to be exercised on the density of guajillo.

INTERSPECIFIC ASSOCIATION

The lowest values of X^2c found for the relationship of the guajillo *Acacia berlandieri* Benth with *Brickellia veronicaefolia* Kunth (DC), *Calliandra eriophylla* Benth, *Leucophyllum frutescens* I.M. Jonhst, corona de cristo *Koeberlinia spinosa* ZUCC and *Porlieria augustifolia* Engelm at "Coahuila" ranch (Table 5) and "La Salada" ranch (Table 6) and, in relation to the value of 3.84 of X^2 tables at 0.95%, they report that guajillo is distributed independently of the presence of these shrub species. Although there is a tendency to be distributed in negative and positive association, as reported by the DICE association index (Table 5), which indicates the probability that at least one of the 2 species is found in the different sampling units.

Association	Samples	X^2_C	Association Index DICE
Acbe - Brve	60	0.012*	-0.634
Acbe - Falling	60	0.070*	-0.472
Acbe - Lefr	60	0.540*	-0.758
Acbe - Kosp	60	0.021*	+0.145
Acbe - Poan	60	1.912*	-0.169

Ac be: *Acacia berlandieri* Benth; Br ve: *Brickellia veronicifolia* Kunth (DC); Ca er: *Calliandra eriophylla* Benth; Le fr: *Leucophyllum frutescens* I.M. Johnst; Co sp: *Koeberlinia spinosa* ZUCC; Po an: *Porlieria augustifolia* Engelm. *Nonsignificant values with respect to $\mathbf{X^2_t}$ at 5%= 3.84. This indicates that there is no association.

Table 5. Statistical test and interspecific association of guajillo (*Acacia berlandieri* Benth) with five shrubs at the "Coahuila" ranch. U.M = 12 m² (3m x 4m). Zaragoza-CE Experimental Site. Saltillo, CIRNE-INIFAP.

The trend in the negative association of guajillo (*Acacia berlandieri* Benth with *Brickellia veronicaefolia* Kunth (DC), *Calliandra Eriophylla* Benth and *Porlieria angustifolia* Engelm in the "Coahuila" ranch (Table 5) indicates that the elimination of any of them does not affect the distribution of guajillo, but not *Koerberlinia spinosa*, whose eradication automatically eliminates guajillo. According to Franco-López *et al.* (1989), the aforementioned tendency expresses that guajillo is competing with both species, except with the latter, for some resource (Franco--López et al., 1989).

Association	Samples	X^2_C	Association Index DICE
Acbe - Brve	60	0.107*	+0.774
Acbe - Falling	60	0.001*	+0.753
Acbe - Lefr	60	0.001*	+0.756
Acbe - Kosp	60	0.348*	c+0.764
Acbe - Poan	60	0.183*	-0.369

Ac be: *Acacia berlandieri* Benth; Br ve: *Brickellia veronicifolia* Kunth (DC); Ca er: *Calliandra eriophylla* Benth; Le fr: *Leucophyllum frutescens* I.M. Johnst; Co sp: *Koeberlinia spinosa* ZUCC; Po an: *Porlieria augustifolia* Engelm. *: *Non-significant values at 5%.*Non-significant values with respect to $\mathbf{X^2_t}$ at 5%= 3.84. Which indicates that there is no association.

Table 6. Statistical test and interspecific association of guajillo (*Acacia berlandieri* Benth) with five shrubs at "La Salada" ranch. U.M = 16 m² (4m x 4m). Experimental Site Zaragoza-C.E. Saltillo. CIRNE-INIFAP.

Contrary to what would happen in the ranch "La Salada" (Table 6), if any of the mentioned shrubs are removed in this ranch, by reporting a tendency of positive association with the guajillo, the natural distribution of the latter would be affected by its positive relationship (Hernández *et al.* 2018) due to the sharing of biotic and abiotic factors.

The findings at the "La Salada" ranch, in relation to the "Coahuila" ranch, may be due to a lower density of shrubs with respect to the first ranch (3.49 plants m²), as well as to the plot size (4 m x 4 m = 16 m²) used for sampling, which was higher than that used at the "Coahuila" ranch, which was 3 x 4 m = 12 m².

CONCLUSIONS

- Guajillo has an aggregated spatial distribution pattern to a greater and lesser degree due to soil conditions, precipitation and grazing management plan.

- The plot size and sampling unit in the "Coahuila" and "La Salada" ranches for subsequent studies is 192 m^2 and 128 m^2; 3 m x 4 m and 4 m x 4 m, respectively. Very large class plants (> 100 cm in height) and medium class plants (51-75 cm) promote new populations.

- Large class (75-100 cm) and medium class (51-75 cm) plants are dominant. On the "Coahuila" ranch, the density of guajillo is higher (3.49 plants/m^2) than on the "La Salada" ranch (1.56 plants/m^2).

- Medium plants become the target in case of guajillo density control. Eradication of *Leucophyllum frutescens*, *Brickellia veroniaeifolia*, *Porlieria angustifolia*, *Calliandra eriophylla*, *Koeberlina spinosa*, does not significantly interfere with guajillo propagation.

- The results of the present study suggest continuing with the development of research in different precipitation gradients, where the spatial distribution, the relationship of the structure and association of the vegetation with the abiotic and biotic environment are contemplated, with the purpose of identifying the current status of the present and emerging species of relevance, in order to contribute to productive and sustainable management plans of the beef cattle and goat production system under pasture conditions.

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