

AUTECOLOGY OF *PROSOPIS CALDENIA* (BURK.) IN THE REGION OF “CALDEN” OF THE PROVINCE OF SAN LUIS, ARGENTINA

G.E. Gabutti¹ and M.J.L. Privitello¹

¹F.I.C.E.S. - U.N.S.L. Av. 25 de Mayo 384, 5730. Villa Mercedes, San Luis, Argentina

ABSTRACT

Different estimates of the growth of *Prosopis caldenia* (Burk.) were related in the area of the “caldén” forest, Province of San Luis: trunk diameter, treetop coverage and total tree height to infer the annual growth percentage. The number of trees per hectare and their distribution was calculated based on size. Pod production per hectare was evaluated to determine forage potential.

KEY WORDS

Prosopis caldenia (Burk.), growth, density, production

INTRODUCTION

“Caldén” is an arboreal species from the leguminous family, a subfamily of the “mimosoideas”, abundant in the “Caldén” District, in the “Espinal Province”. It forms xerophytic open forests of about 8 to 10 metres high (Cabrera, 1976). The “caldén” forest area covers approximately 10% of the surface of the province of San Luis and it is characterized by sandy to loamy sand soils (Anderson, 1970). Its climatic regime permits its classification as a semi-arid area. The annual average precipitation is 545 mm, 27% in spring, 42% in summer, 28% in autumn and 3% in winter. The average July temperature is 9.3°C and the average January temperature is 24.4°C; the extreme temperatures are -14.2°C and 43°C, the frost period is approximately 177,83 days (Orquín, 1983).

Phytosociologic, edaphic and microclimatic studies of the area (Orquín, 1983, 1987; Losada, 1983) show the ecologic importance of the “Caldén” forest, in addition to the importance of wood as a source for different uses and as a forage in winter, especially during prolonged drought (Alfonso, 1951), since pods have an appropriate protein level: 15% and a good energetic value (Privitello, 1988; Menvielle, 1985). There are no previous studies about “caldén” growth except for those of “caldén” forestry mass increase in the forests of La Pampa, Argentina (Lasalle, 1962).

The autecology study of the species included three objectives:

1. Relate different estimates of tree growth: trunk diameter, total height and treetop coverage.
2. Estimate the number of trees per hectare and their distribution as related to the trunk diameter.
3. Determine the production of “caldén” pods.

MATERIALS AND METHODS

The studies were conducted at “Rancho Grande” Establishment, 15 km SW of Villa Mercedes, Province of San Luis, in a “caldén” forest community stand. Eighty three “caldenes” were identified and labelled at 1.20 m height to measure the tree trunk perimeter every year in the same place. According to the trunk perimeter, they were grouped in 10 width class intervals of 0.20 m being the Ist= 0 - 0.20 m, the IInd= 0.21 - 0.40 m and the same successively to the interval IXth; in the Xth interval trees with widths over 1,80 m were situated. The measurements that were carried out once a year, in July-August, in the latent season of the “caldén” during four years (1981/1984) were:

- Trunk perimeter (P) with a tape measure, from where the diameter was calculated ($D=P/\pi$).
- The height of the tree with clinometer.
- Two diameters of the treetop projection (direction E-W= and direction N-S = d2) to calculate their coverage where $C=\pi(d1 +$

d2)²/16

- The percentage of annual trunk diameter growth (PATDG), for the considered period is:

$$\text{PATDG} = \frac{\text{actual diameter} - \text{previous year diameter}}{\text{previous year diameter}} \times 100$$

The estimated values for each year were averaged for each class interval and the annual averages of the four years of information were analyzed by means of regression models. To calculate the number of trees per hectare and the relative density per width class interval, the Cottam and Curtis method (1956) was applied on 280 trees. “Caldén” pods were collected from four one m² ground samples of under treetop coverage, situating them: North, South, East and West, in the center of the treetop projection of each labelled tree for four years (1982, 88/89/90). The collection was carried out when 100% of the pods had fallen (mid June). They were dried in oven at 65°C for 48 hours and the average weight of dry matter was determined from these samples. The average production per tree for each class interval was calculated, based on the average sample value and its treetop coverage. The total pod production per hectare was obtained from the sum of the products between the annual average production value per tree and the number of trees per hectare for each class interval.

RESULTS AND DISCUSSIONS

The trunk diameter annual averages (m), treetop coverage (m²), tree height (m) and PATDG (%) for each width class interval are shown in table 1. The treetop coverage and the trunk diameter relation is lineal and correspond to the following equation:

$$y = -10.095 + 219.745x$$

$$R = 0.993$$

The relation of the tree height (y) and the trunk diameter (x) is adjusted to the following exponential function (Mitscherlich):

$$y = 10.5198 - 8.5969 e^{-3.2768x}$$

$$R = 0.984$$

The inflexion point of the curve corresponds to trees of 0.20 m in diameter (0.62 m perimeter), corresponding to width class IV interval and the height of six meters, being the percentage of annual height growth of 40% with respect to the previous. In trees of 0.30 m in diameter (0.94 m perimeter) corresponding to class V interval the growth percentage falls to 21% with respect to the previous.

The percentage of tree trunk diameter annual growth based on the trunk diameter (x) corresponds to the following equation:

$$y = 1.3965 + 22.6191 e^{-14.2647x}$$

$$R = 0.902$$

The PATDG is independent to tree diameter from 0.40 m onwards being constant in approximately 1.4% annually. A 0.40 m tree diameter annual growth is 6 mm approximately for diameters less than 0.40 m, the PATDG is incremented at the time that plants of lesser diameter are considered, being the average annual growth of 6 mm.

The number of trees resulting from the application of the Cottam

and Curtis method is 306 trees per hectare. The number of trees distribution for each class interval (relative density) indicates that the studied population is stationary (Odum, 1986). The relative density and the production of pods for each width class interval is represented in Figure 1. The tree average pod production of each width class interval, along four years, is shown in Table 1. The sum of the total pods production each width class interval determines the production per hectare of the forest, which is equal to 622 kg of pod dry matter (similar to the natural grassland production of the area), in years when the tree reproductive phase is not affected. Analysing these results it is deduced that trees in width class intervals 1 and 2 present a greater number of individuals (48%) and the very low pod production (0.66% of the total production per hectare).

The production tends to increase from width class III interval onward and two groups are differentiated: the trees from class III to VII intervals with 42% of the individuals that contribute the 60.48% of the total production, and the trees above the class VII interval represented only by 10% of the individuals that contribute the 38.86% of the total production.

In conclusion, "caldén" is a slow growth species and there is a relation with the PAGDT up to 0.40 m. For the trees to reach this value 60 to 70 years must elapse. For this reason it is not convenient to cut them down if their maximum growth potential is expected. The 50% of the "caldenes" of this forest with 20 to 25 years old, a diameter greater than 12.7 cm (width class interval III) and an annual growth average of 6 mm contribute the total production of pods. Forests with trees older than 25 years can be considered a valuable forage resource during winter in the "Caldenal" region, in years when tree reproductive phase is not affected.

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Table 1

Behaviour of the annual average of the treetop coverage values, trunk diameter, tree height and production per tree, of each width class interval, along four years. "Rancho Grande", San Luis, ARGENTINA

	YEAR	WIDTH CLASS INTERVALS									
		I	II	III	IV	V	VI	VII	VIII	IX	X
Treetop coverage (m*)	1981	5.0	9.1	23.2	36.2	47.5	71.3	90.1	96.3	97.3	176.4
	1982	5.5	8.3	21.2	37.8	43.6	72.7	90.1	96.3	96.5	171.7
	1883	6.7	11.2	24.5	42.7	57.0	76.0	90.6	93.8	106.1	190.8
	1984	7.7	12.3	27.7	42.2	55.1	80.4	86.3	93.3	113.9	186.1
Trunk diameter (m)	1981	0.044	0.092	0.160	0.225	0.282	0.347	-	-	0.552	0.863
	1982	0.050	0.096	0.161	0.228	0.288	0.354	0.424	0.474	0.552	0.853
	1983	0.054	0.103	0.170	0.234	0.298	0.361	0.430	0.479	0.559	0.865
	1984	0.062	0.110	0.176	0.240	0.303	0.374	0.435	0.483	0.564	0.841
Tree height (m)	1982	3.2	4.5	5.2	6.1	7.2	8.2	8.5	9.5	8.4	10.2
	1983	3.3	4.7	5.4	6.5	7.23	8.5	9.5	8.4	10.2	
	1984	3.4	4.6	5.5	6.5	7.1	7.7	8.8	8.4	8.3	10.1
	1982	0.00	0.00	0.83	2.65	3.83	7.25	-	-	6.07	29.14
Production per tree (kg)	1988	0.00	0.05	0.81	1.59	2.77	1.84	4.17	2.85	2.95	0.00
	1989	0.04	0.11	1.99	4.23	3.74	4.08	6.33	6.36	4.86	8.30
	1990	0.02	0.03	0.82	3.20	2.51	3.36	4.72	4.14	4.12	5.10

Figure 1

Relative density distribution and pod production per hectare for each width class interval, Rancho Grande, San Luis, ARGENTINA.

