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Evaluation of different felling intensities in management of secondary carob forests under silvopastoral use in the Humid Chaco

Abstract

The progressive reduction of the forest surface to enable land destined for other productive activities and its subsequent abandonment, allowed the appearance of fragments of secondary forests, frequently dominated by carob trees. *Prosopis alba* that have been identified as a strategic biological resource of the Chaco Park, due to its characteristic of multipurpose tree, which gives it a high value for the management of secondary forests in areas abandoned by agriculture and livestock, offering at the same time an alternative productive. A fundamental aspect in the management of secondary forests of this species is the need to concentrate growth on the dominant trees, since the achievement of large-sized individuals is essential for supplying the wood industry. Within the framework of a project aimed at designing management tools that make it possible to make high forest production compatible with livestock. To this effect, preliminary results of the response of the forest mass as well as of the remaining individuals are presented against three intensities of selective thinning. The objective of the work is to have basic information that allows establishing sustainable management guidelines in secondary forests, in its initial stages for the provision of quality wood for forestry-industry with forestry-livestock production schemes.

Keywords: forest management, secondary forests, prosopis, silvopastoral, parque chaqueño

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Introduction

The Chaco region constitutes one of the largest extensions covered by woody vegetation in the world. In this region, the soils are naturally well supplied with nutrients, largely due to the protective effect of the forest and the abundance of legume species.[1] According to the Forest Inventory of the province of Chaco (2006), of the 10 million hectares of extension of the Province of Chaco, approximately 50% (4.9 million ha) are still covered with native forest; 3.6 million hectares are part of the semi-arid Chaco and 1.3 million of the humid Chaco. However, deforestation, irrational logging, and overgrazing that have occurred in the last century, and in particular during the last decades, have modified the physiognomy and composition of the forest and the structure and fertility of the soil.[2]

The progressive reduction of the forest surface to enable land destined for other productive activities and its subsequent abandonment, allowed the appearance of fragments of secondary forests whose surface is not known exactly because it is not discriminated as such in both national and provincial inventories, but that represent an opportunity for their knowledge and therefore propose guidelines for their best use. These colonization processes lead to the recovery of the surface of forest masses that, although they are fragmented, will be able to offer wood products to the market.[3]

Prosopis alba has been identified as a strategic biological resource of the Argentine Chaco Park for its productive and environmental development. Its multipurpose tree characteristic allows its use both for the production of quality wood in inaccessible areas for introduced forest species, as well as in silvopastoral systems associated with pastures, providing an important forage resource through its fruits rich in proteins and sugars. This characteristic gives it a high value for the reforestation of cleared areas abandoned by agriculture and livestock or in the management of secondary native forests, while offering a productive alternative.[4]

A fundamental aspect in the management of secondary forests of this species is the need to concentrate growth on the dominant trees, given that the achievement of large-sized individuals is essential for supplying the sawmill and furniture industry, which has historically been established in Chaco. Due to the economic and social importance of carob cultivation in the provincial industry and as a generator of income for the province and the region, it is necessary to know the productive potential of the different sites where populations of this species currently develop.[5]

Thinning or cutting are partial and periodic interventions that aim to produce a small number of final trees, with a larger diameter and better quality. In them, some specimens are eliminated, relieving the competition of the chosen trees that will have more lateral space to continue growing. In order to maintain acceptable growth rates, the forester, through opportune and adequate intermediate cuts, regulates density and avoids the severe effects of forest competition.[6] The level of site occupancy for a particular forest type depends primarily on the number of trees, their distribution and size category, and their spatial organization. Stand density is used as a decision or control variable in silvicultural interventions.[7]

Within the framework of PI N°111 aimed at designing management tools that make it possible to make high forest production compatible with livestock, evaluating the response in terms of growth of both the forest mass and the remaining individuals against three intensities of selective thinning, using its industrial suitability and spacing as selection criteria, preliminary results of the response in terms of growth of the treatments applied to the forest are presented.

Material and methods

The work area focuses on the establishment of the producer Raúl Gauna (27° 0'33.20"S - 60°36'20.83"W), located 10 km south of La Tigra, which is in the department of O´Higgins (Figure 1) within the Southwest Chaco Mixed Subzone, with an average annual rainfall of 1000 mm accompanied by the departments, San Lorenzo, Mayor Jorge Luís Fontana and Fray Justo Santa María de Oro. It covers an area of 962,800 ha (6 % of the total area of Chaco and Formosa). Heavy-textured soils constitute the productive base of good-yielding agriculture subject to water risk, due to waterlogging and flooding, and periods of drought that condition the sustainability of production systems. The natural vegetation is grassland-grassland-palm with low forage value and a herbaceous carpet that manifests itself with surface water coverage that increases livestock potential. The division of the land manifests itself in productive units of more than 1,000 ha dedicated mainly to cattle breeding. This subzone presents instability in the forage supply, and water limitations, either due to excesses or deficits. The positive relief areas are occasionally used in high-risk agriculture, mainly sunflower, sorghum and cotton crops.[8]

Figure 1 Location of the study area.

The experimental design consisted of completely randomized plots with three thinning intensities and three replications. In each plot of 2000 m^2 (50x40 m), plots were installed where the response in terms of growth and production of the forest mass will be evaluated against three felling intensities (T0 = control - T1 = extraction of 40% of the basal area - T2 = extraction of 60% of the basal area). The thinnings were selective, using their industrial aptitude and spacing as selection criteria. It was sought that the spacing of the remaining specimens be as homogeneous as possible in each lot to be intervened. Regarding the pruning treatment, it was carried out on the remaining specimens in all the intervened plots except for the control.[9]

Measurements to evaluate the effect of different felling intensities on the growth and production of secondary *Prosopis* forests were made in sampling cores on the intervention plots (40 m x 50 m). The sampling cores are circular and have an area of 1000 m^2 each. They were installed starting from the center of the intervention plot and marking a circumference with a radius of 17.86 m (Figure 2). When installing the test in each sampling nucleus, all the trees were numbered and marked with paint, once the treatments were finished (cutting), the remaining trees were verified.

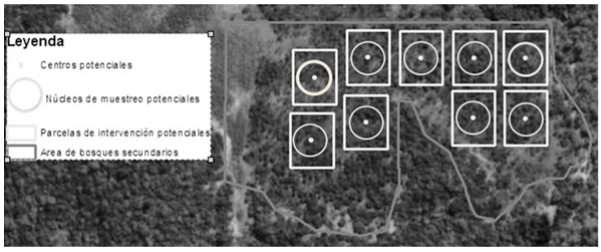


Figure 2 Sketch of intervention plots and sampling nuclei.

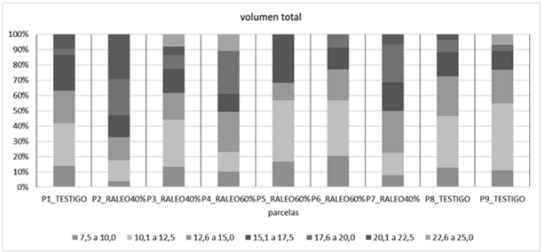
A first measurement was made of all the specimens present in the sampling nucleus of all the dasometric variables (Diameter at breast height (DBH); Commercial height (Hcom); Total height (Ht); Crown diameter and, in addition, species, health status and straightness were observed). Specimens with a DBH less than 7.5 cm were discarded, which were considered as regeneration.[7] Forms were used to record the dasometric measurements. The recorded information was analyzed with the free version INFOSTAT software.

Results

The first results constitute the baseline for the temporary evaluation of the response in terms of growth of the treatments applied to the forest, in general terms they are representative of this type of formations in the study area. Table 1 shows that, in general terms, the variability observed for DBH and Ht is relatively low and similar between the applied treatments, while for commercial height one of the values is relatively high, an expected behavior based on the pruning carried out and of the great genetic variability that forests of natural origin have without genetic improvement. If we take into account the values of the average annual increase of these variables, understood as the quotient of the value of the variable and age, it can be noted that they are similar to those cited[5] for forests cultivated with carob trees of that age for good to fair quality sites (Graph 1).

Table 1 Statistical summary of the main dendrometric variables revealed

Treatment	n	DAP (cm)			Hcom (m)			Ht (m)		
		media	D.E.	CV	media	D.E.	CV	media	D.E.	CV
40%	136	13,2	3,8	28,9	2,1	0,6	29,1	7,9	0,8	10,6
60%	91	12,4	3,2	25,4	2,2	1,5	67,0	7,4	0,9	11,9
Testigo	221	12,4	3,2	25,7	1,8	0,5	31,3	7,4	0,7	9,0



Graph 1 Relative distribution of the total volume according to each felling treatment.

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Next, the relative distribution of the total volume and density by diameter class according to each felling treatment is presented.

Discussion

It can be seen that in the case of interventions of 40% intensity, the distribution of total volume and density are more balanced in the different diameter classes, while in the case of plots without intervention or with a cutting intensity of 60% the highest relative values of these variables are found in the diameter classes between 10 and 15 cm. In this sense, the distribution of the felling throughout the entire diameter range of these young forests makes it possible to evaluate the response to the intervention covering said amplitude, either in terms of diameter growth, volumetric growth, regrowth, etc., while strong interventions decrease this possibility, focusing the evaluation of that response on only a few individuals of lower and intermediate classes. Taking into account the growth dynamics, it is foreseeable that the recovery times of the extracted basal area will be different for the cutting intensities tested, constituting one more variable to be evaluated.

Conclusion

It is concluded that applying the selection criteria of the specimens, the cuts of intermediate severity not only allow a better distribution of the specimens in space but also in the different size classes, while the most severe cuts concentrate the specimens in few classes. diametric. At the end of the 5th year of interventions, it is expected to have more basic information, which will allow establishing preliminary guidelines for sustainable management of this type of forest.

Recommendations

Follow-up and monitoring of the response of the forest to logging is recommended during the next 5 to 7 years to generate information that allows the formulation of sustainable management guidelines for the production of quality wood, for young secondary forests of these characteristics in systems silvopastoral within the study area.

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Conflicts of interest

They do not exist.

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