Management Models Evaluation of a *Castanea sativa* Coppice in the Northeast of Portugal

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Abstract

In a chestnut high forest converted into coppice, 4 permanent plots were established in 1994. These plots are being managed according to the silvicultural models proposed by Bourgeois (1992) and adapted to our conditions. The treatments are: T1 = Model 1: small dimensions; T2 = Model 2: medium dimensions; T3 = Model 3: Large dimensions; Control = coppice without intervention. In 2003, a 2nd thinning was applied in order to select the more straight and cylindrical shoots without defects. The principal dendrometrical parameters (such as: number of stumps per hectare; number of shoots per hectare; mean total height of the shoots; dominant height of the shoots; mean DBH of the shoots; dominant diameter of the shoots; basal area of the shoots per hectare and basal area of the shoots) were measured, before and after thinning. Results show that T3 presents greater vigour and the highest dominant height. Concerning dominant height, T2 was exceeded by T1, because it has a higher number of shoots and, consequently, strong competition in relation to available site resources. It was expected a T2 with dominant height superior to T1, but we believe that T2 will recover its dominant height leadership with the heavy thinning applied in the last intervention (about 75% reduction in the number of shoots). The control follows the other plots dominant height growth pattern, although presents inferior mean basal area per shoot in comparison to the other treatments.

INTRODUCTION

Coppice is a very flexible system in relation to management, producing wood material with different dimensions. Now today, logs with small dimension do not have demand as before. Thus, it is necessary to improve the management of the existent coppice stands through application of appropriate silvicultural models. With this aim, an adaptation of the models proposed by Bourgeois (1992) and Bourgeois et al. (2004) has been performed. A model to produce material of small dimensions implies a first thinning at 5-9 years old, leaving 3000 shoots per hectare and later a second thinning at 10-14 years old reducing the number of shoots to 1500. The clear cut should be realized at 25-30 years of rotation period. Another model to produce medium dimensions proposes a clear cut at 30-35 years, with two previous thinnings: the first one at 7-9 years, leaving 2000-2500 shoots per hectare, and the second at 11-13 years old, leaving 600-800 shoots per hectare, respectively. A third model to produce large dimensions determines that between the 10th and the 13th year, only 250 future shoots will be designated, the target of the silvicultural interventions being to obtain in the clear cut 150-250 shoots per hectare for quality timber. The final clear cut is foreseen at 40-50 years of rotation period.

With the application of these three treatments we intended to validate silvicultural management models for our conditions and evaluate and quantify the growth, trying to demonstrate the economical advantage of the larger dimensions model. Nevertheless, the model to select should be a compromise between the suitable silvicultural techniques (depending on variability of site conditions), and the best economical options.

MATERIALS AND METHODS

In 1994, through the project MEDCOP, financed by the European Union, 4 permanent research plots with about 1000 m^2 were established in a *Castanea sativa* coppice with two years old. This coppice results from a high forest conversion with 50 years old, where final clear cut occurred two years before. The following treatments were applied: T1 = Model 1 - small dimensions (Plot 1); T2 = Model 2 - medium dimensions (Plot 2); T3 = Model 3 - large dimensions (Plot 4); Control = without intervention (Plot 3).

The plots were submitted to a 1st thinning in 1999 (with 7 years old), and to a 2nd thinning in 2003 (with 11 years old). The shoots selection was carried out according to qualitative criteria of vitality and timber quality.

The first shoots dendrometrical measurement was carried out at 3 years old, the second at 7 years old and the third at 11 years old. The following variables were evaluated:

Number of stools per hectare (N_{St}); number of shoots per hectare (N); mean total height of the shoots (h_g); dominant height of the shoots (H_{dom}); mean diameter of the shoots (d_g); dominant diameter of the shoots (D_{dom}); basal area of the shoots per hectare (G); basal area of the shoots (g).

RESULTS AND DISCUSSION

Data collected were analyzed and the results are presented in Table 1 (year 1999 - after 1st thinning); Table 2 (year 2003 - before 2nd thinning); Table 3 (year 2003 - after 2nd thinning). Fig. 1, 2 and 3 present, respectively, the number of shoots distribution by DBH before the 2nd thinning; the number of shoots distribution by DBH after the 2nd thinning and the number of removed shoots distribution by DBH at the 2nd thinning. Basal area removed is presented in Fig. 4.

With the first intervention in year 1999, the number of shoots left was superior to that proposed by Bourgeois (1992) because the coefficient of stability (h/DBH) didn't allow a more intense thinning, especially in the treatments T2 and T4 (Monteiro and Patrício, 1999). However, in the 2nd intervention (year 2003), it was possible to reduce the number of shoots to the densities proposed in the original models. Treatment T4 still presents greater vigor than the others, showing higher dominant height (H_{dom}).

In this stage of model application T2 was exceeded by T1 in relation to H_{dom}, probably because T2 has a higher number of shoots and, consequently, strong competition in relation to available site resources. It was expected a T2 with dominant height superior to T1, but we believe that T2 will recover its dominant height leadership with the heavy thinning applied in the last intervention, reducing the number of shoots from 3685 to 761. The control, at this moment, follows the other plots dominant height growth pattern, although presents inferior mean basal area per shoot in comparison to the other treatments.

Note that values for dominant height and also for the quadratic mean and dominant diameter can decrease after a thinning due to the applied qualitative selection. With this selection some of the thickest and higher shoots can be removed if they don't have a straight and cylindrical form or show other defects. With this procedure we are, on the one hand, selecting for the final clear cut, shoots that present well formed stems and on the other hand, making available logs with commercial dimensions easily saleable.

With the monitoring of the trial and successive data analysis there is opportunity to select shoots with quality and dimensions that give an answer to market demand, conducing to greater revenues for forest producers.

ACKNOWLEDGMENTS

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Tables

Table 1. Results of the second dendrometrical measurement after thinning.

1999 after 1st thinning									
	N_{St}	N at start	N	h_g (m)	H_{dom} (m)	G (m^2 ha^{-1})	g (m^2)	d_g (cm)	D_{dom} (cm)
T**1**	636	8868	3473	7	7.9	11.6	0.0033	6.5	11.3
T**2**	654	8491	3778	7.5	9.1	13.65	0.0036	6.8	11.9
Control	617	8613	6305 *	6.8	8.1	14.58	0.0023	5.4	11.6
T**3**	574	8745	2523	8.4	10.7	10,1	0.004	7.1	12.5

Table 2. Results of the third dendrometrical measurement before thinning.

2003 before 2nd thinning							
	N	h_g (m)	H_{dom} (m)	G (m^2 ha^{-1})	g (m^2)	d_g (cm)	D_{dom} (cm)
T**1**	3422	8.9	11.6	22.7	0.0066	9.2	15.5
T**2**	3685	9.9	10.2	24.5	0.0066	9.2	15.9
Control	5788 *	8.9	11.4	24.7	0.0043	7.4	15.6
T**3**	2510	9.8	12.8	17.4	0.0069	9.4	15.9

Table 3. Results of the third dendrometrical measurement after thinning.

2003 after 2nd thinning							
	N	h_g (m)	H_{dom} (m)	G (m^2 ha^{-1})	g (m^2)	d_g (cm)	D_{dom} (cm)
T**1**	1501	9.6	11.2	12.6	0.0084	10.3	14.9
T**2**	761	10.3	11.1	6.2	0.0082	10.2	13.8
Control	5788	8.9	11.4	24.7	0.0043	7.4	15.6
T**3**	534	10.3	11.7	4.3	0.0081	10.1	13.3

N_{St}: number of stools per hectare, N: number of shoots per hectare, hg: mean total height of the shoots, H_{dom}: dominant height of the shoots, G: basal area of the shoots per hectare, g: basal area of the shoots, d_g: mean diameter of the shoots, D_{dom}: dominant diameter of the shoots.

* Reduction in the number of shoots per hectare (N) in control is only due to natural mortality.

Figures

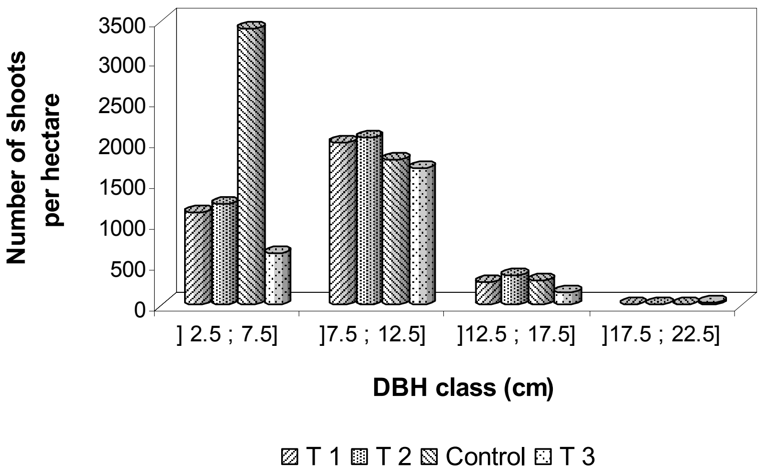

Fig. 1. DBH distribution of the number of shoots in 2003 before 2nd thinning.

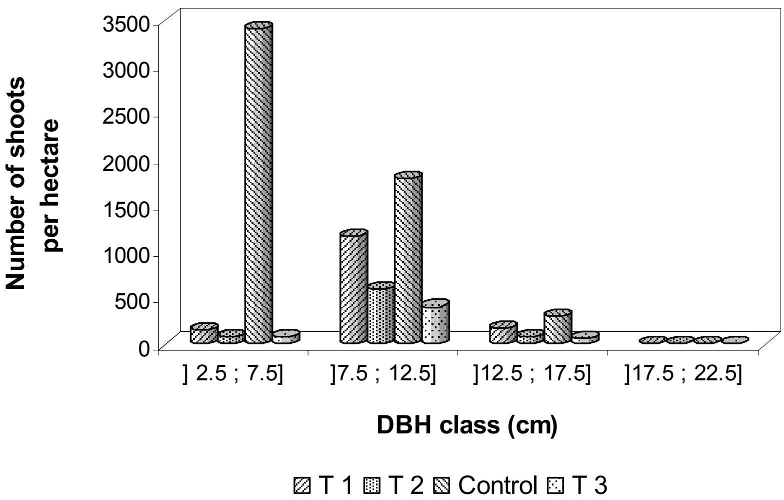

Fig. 2. DBH distribution of the number of shoots in 2003 after 2nd thinning.

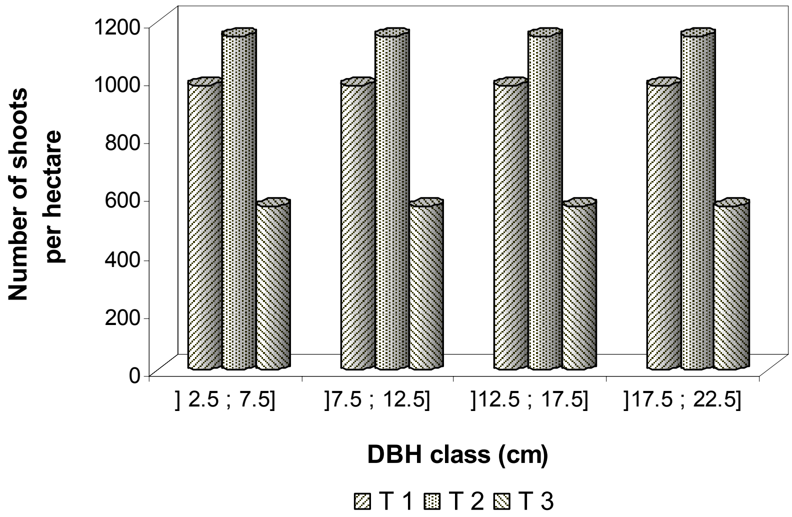

Fig. 3. DBH distribution of the number of shoots removed in 2003 after 2nd thinning.

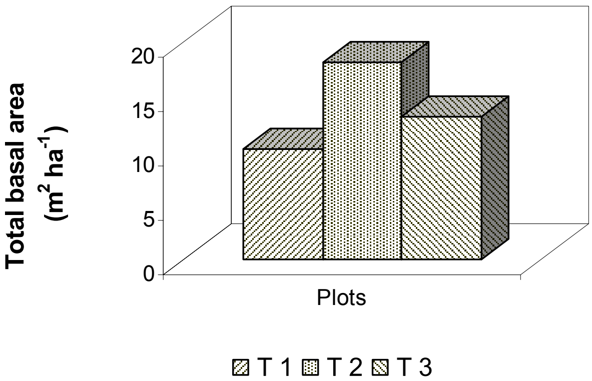

Fig. 4. Basal area removed in 2003 thinning.