LINDEN IN WORKING UNIT CALINA, FOREST DISTRICT ORAVITA

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ABSTRACT

In the past, stands from Working Unit Calina were composed especially of European beech and sessile oak. Today, there is a large proportion of linden in these stands. The analysis of archived data from old Management Plans represented the basis of the dynamic distribution of stands with linden in composition.The importance of tending operation to regulate the stand structure and composition was put in evidence in a study case. In this respect, cleaning respacing were made in management unit 3A and stand structure changes were showed: composition (the increase of oak species and the decrease of linden and other tree species from mid-strata), dendrometric characteristics (cleaning respacing from below with the increase of dendrometric characteristic). The tending intensity has been calculated and the important role of cleaning-respacing in order to modify stand composition according to with forest natural type was highlighted.

INTRODUCTION

Three species from genus Tilia are found in Romania: small-leaved linden, large-leaved linden and silver linden. The trees can reach 20-30m height, are straight trunks and softwood (Stanescu 1979, Sofletea and Curtu, 2000). The tree species can be regenerated both generative by seeds or seedlings and vegetative by sprouts or root suckers (Sofletea and Curtu, 2000). Linden has a remarkable capacity for vegetative reproduction (Haralamb 1967, Radoglou et al. 2008, Svejgaard Jensen 2003) and this ability is very important for populations growing on the border of its natural range (De Jaegere et al. 2016). Species are important for wood production: veneer, timber, small furniture, musical instrument (Radoglou et al. 2008); flowers and honey production (Eaton et al, 2016); ecosystem services provided: fast leaves decomposition and improve nutrient cycling, reduce litter acidification and increase the topsoil fertility (Ivanescu et al 1966, De Jaegere et al. 2016), carbon storage (Moser et al, 2015) and the ornamental use of as a street trees (Tenche- Constantinescu et al. 2015).

In Romania, one of the most important tree species in the mixed stand with oaks in the composition is linden. The role of linden is to participate to canopy closer, prunning and contribute to height growth of the oaks and others tree species. This tree species are valuable if their participation in stand composition is low, the increase of this tree species participation is not desirable. Sometimes, in absence of tending operation, this thing happens.

I the near past, in Working Unit Calina, the most common trees species were sessile oak and European beech. Linden participation was about 10%. In the present, data from the Management Plan showed us a percent of 14 for linden and 55% for Quercus spp., less than 60% in the past (Anonymous, 2008).

The main aim in these stands is to favour oak species but also to maintain a good proportion of others tree species in order to perform their silvicultural role.

MATERIAL AND METHOD

Located in the hilly area, on the right slope of Dognecea Valey, Working Unit Calina has 1930.7 ha. Administrative, Working Unit Calina belongs to Forest District Oravita, Caras-Severin Romsilva Branch (Fig. 1).

Figure 1 Location of Working Unit Calina

The altitude is between 150 and 560m. The climate is submediterranean with warm and wet summer and not very cold winter. The average temperature is 9.50C and the annual precipitations are 720 mm. The most common forest types are mixed stand with sessile oak, Turkey oak and Hungarian oak (more than 80%) and also mixed stand with European beech (Anonymous, 2008). About 68% of stands are normal according to composition, productivity and regeneration methods. Stands established by artificial reproduction represent 8% from the forest area and 24% represent stand composed of tree species not so economical valuable like *Quercus* species (high percent of European hornbeam or linden).

The research consisted of the analysis of archived data from old Management Plans which represented the basis of the dynamic distribution of stands with linden in composition. In order to highlight the importance of tending operation to regulate the stand structure and composition, a cleaning-respacing operation was made in sub-compartment 3A (Fig. 2).

Figure 2 Sub-compartment 3A

The actual composition in this sub-compartment is European hornbeam (EH) – 50%, linden (LI) – 30%, sessile oak (SO) – 10% and different other broadleaves tree species (Dif) – 10% and the age is 20 years old. The elevation is between 180-240m, with a south-west orientation and 20-degree slope

A 150 square meters plot was established in 2016 (Fig. 3). A number of 47 trees from different species, diameters and total height were measured and 26 trees were removed. The data were extrapolated to the hectare.

Figure 3 Experimental plot

RESULTS AND DISCUSSIONS

Linden is very common in mixed stands with oaks in their composition (Fig. 4). In most sub-compartments, the percent of linden in stand composition is between 10 and 30 percent, which is usual for the types of forest in this area.

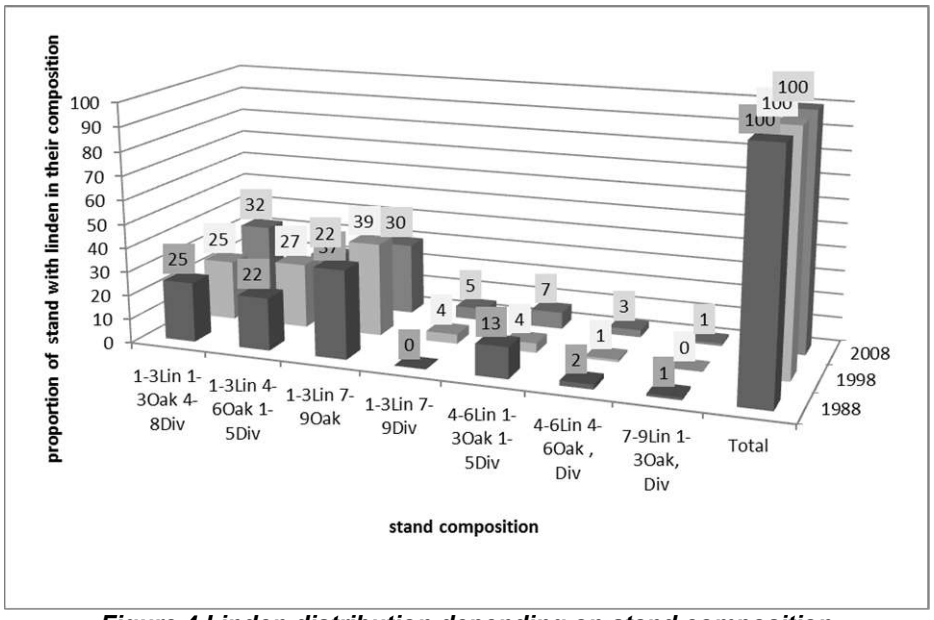

Figure 4 Linden distribution depending on stand composition

There are stands with a higher percent of linden in composition, between 40 to 60 % or even 70 to 90%. In all these cases linden substitutes the oaks, which are much more economical valuable species. These happened because a bad or no application of tending

operation happened. It is also important to consider the high capacity of linden to regenerate vegetatively by root-suckers and sprouts.

An interesting analysis is about the linden distribution on age classes (Fig. 5). It can be seen a high percent of linden in the old stands as a result of the silvicultural treatments applied in the past. The same hight percent of linden is also found in young stands. In this case, the stand composition can and should be improved, a solution being well-applied tending operations.

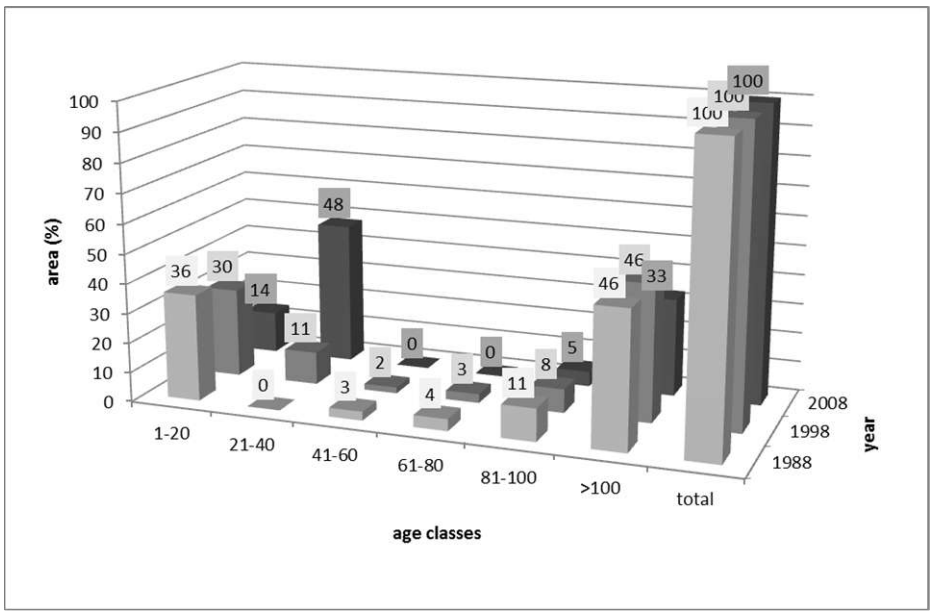

Figure 5 Linden distribution depending on age classes

The importance of these operations is illustrated in a case study. Sessile oak, Turkey oak, linden, European hornbeam, Manna ash (MA) and black locust (BL) were tree species identifies and inventoried in the experimental plot. The stocking in number and basal area before and after removal of the trees is presented in table 1.

Table 1

Stand stocking and basal area per hectare

No of trees	total	Tree species					
		SO	TO	LI	EH	MA	BL
Stand stocking							
initial	3134	400	133	1267	800	67	467
removed	1735			934	667	67	67
remaining	1399	400	133	333	133		400
Intensity %	55,4			73,6	83,4	100	14,4
Basal area							
initial	21,52	5,88	2,72	4,76	3,97	0,53	3,66
removed	6,98			3,38	2,89	0,53	0,1867
remaining	14,54	5,88	2,72	1,38	1,09		3,47
Intensity %	32,40			71,00	72,70	100,0	5,10

The stand showed a high initial stocking, of 3,134 trees ha-1in with a basal area of 21.52 sq.m ha-1. This made possible a very heavy intervention, with a removal of over 55% of trees, reducing the stocking to 1,399 trees ha-1 and the basal area to 14,54 sq.m ha-1 (Table 1).

The intervention was from below, the thinnest trees were removed. This was confirmed by the intensity of intervention, 55.4 the intensity by a number of trees and 32.4 by basal area.

The removed trees were linden, black locust, European hornbeam and Manna ash so, after the intervention the stand composition changed from 13% SO 2%TO 40% LI 15%BL 26%EH 2% MA to: 29%SO 10%TO 24%LI 29%BL 10%EH.

Table 2

Biometrical characteristic of trees species

No of trees	total	Tree species					
		SO	TO	LI	EH	MA	BL
Mean DBH							
initial	9,0	13,0	16,0	7,0	8,0	10,0	9,0
removed	7,0			6,0	7,0	10,0	6,0
remaining	11,0	13,0	16,0	8,0	10,0		10,0
Mean Height							
initial	11,3	13,6	15,7	10,0	11,0	7,5	13,4
removed	9,7			9,0	10,5	7,5	10,5
remaining	13,3	13,6	15,7	11,5	12,3	-	13,9

The smallest trees were removed so the mean diameter and mean height increased for most of the species (table 2).

CONCLUSIONS

The research highlight the dynamic of linden trees in working unit Calina. In the absence of responsible cleaning respacing activities correlated with the great capacity of vegetative regeneration of linden trees (sprouts and root suckers) the area occupied by linden increased in the last 30 years. The tree species is much common in the young stands (less than 40 years old) but also in old stands (more than 100 years old) and show a lack o interest in tending operations. The changes of structure and composition of the stand after cleaning respacing was highlight.

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