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Influence of sylvopastoral management on the functioning of the cork-oak forest

MASSON Philippe

ENSAT, Laboratoire d'Ingénierie Agronomique, 145 avenue de Muret
31076 TOULOUSE (FRANCE)

Résumé : L'objectif de la communication est de présenter l'effet de traitements sylvo pastoraux (débranchement et pâturage) sur le fonctionnement et la prévention des incendies de forêts de chêne-liège dégradées du nord ouest de la méditerranée. Il apparaît que beaucoup de paramètres de production sont améliorés par la gestion sylvopastorale : la croissance apicale du chêne-liège est augmentée de 14 à 28 %, l'alimentation minérale en azote et surtout en phosphore est améliorée. Le contrôle des arbustes par les animaux est facilité par une bonne qualité de la strate herbacée, établie après débranchement avec du trèfle souterrain et des graminées pérennes. La productivité d'une telle amélioration pastorale varie de 1 T MS/ha dans un peuplement dense de chêne-liège à 3 T MS/ha en zones ouvertes. La dynamique de la végétation après débranchement est généralement forte surtout dans une suberaie de faible densité. Le contrôle des plantes ligneuses par le pâturage est satisfaisant dans les essais utilisant des chèvres et des bovins avec un système de clôture et de pâturage tournant avec chargement instantané élevé. La situation avec un recouvrement des arbres de 20 à 30 % semble la plus appropriée à la gestion sylvopastorale avec des avantages équilibrés pour le forestier et l'éleveur.

Mots-clés : chêne-liège, sylvopastoralisme, prévention des incendies, rénovation des forêts.

OBJECTIVES

This paper gives the main results of two european research programs¹ conducted in the cork oak forest of the north-west of the mediteranean region.

The aim of those program is to study the effect of sylvopastoral treatments on cork-oak forests in 10 European sites located in South of France, North of Spain and Sardinia, which have been cleared of scrub and grazed with or without sowing, concerning the growth and production parameters as well as shrub control (Masson, 1994).

On 8 experimental sites situated in representative areas, 3 plots were established for the 3 following treatments :

- A) non treated plot (control)
- B) shrub cleared plot without grazing
- C) shrub cleared plot with grazing

On four sites the C plots were sown with a forage mixture of subterranean clover and perennial grasses, cocksfoot and tall fescue.

The C plots were grazed by various animals ; goats (2 trials), sheep (3 trials), cattle (2 trials), horses (1 trial).

¹ FOREST MA 2B-CT-91-0019 and CAMMAR 8001-CT 90-002

PARAMETERS OF GROWTH AND PRODUCTION

The measurement of growth segments in 1992 and 1993 on 10 trees representative of each experimental plot (Caritat *et al.*, 1988) in 7 sites showed a statistically significant improvement for the longitudinal growth on 5 sites in the B and C treatments compared with the control plot.

The global effect on the average apical growth on all the sites is important (table 1). The increase of the growth in the C plots is 28 % in 1991-1992 and 14 % in 1993 of the growth measured on the control plots, this effect is much lower for the B plots (scrub clearing without grazing).

So the sylvopastoral treatment of the cork-oak forest has a strong influence on the longitudinal growth of the tree ; this effect seems to decrease after a few years. It should be linked to the control of the scrub regrowth by animals.

Table 1 : Effect of scrub clearing and grazing on apical growth of cork-oak

TREATMENT	INCREASE OF APICAL GROWTH	
	begining experimentation 1991, 1992 (*)	end experimentation 1993
scrub clearing and grazing (C-A) / A (%)	+ 28 %	+ 14 %
scrub clearing only (B-A) / A (%)	+09 %	+ 06 %

(*) 1991 for France and Spain, 1992 for Italy

In half of the studied sites, the foliar area was also improved in the scrub cleared and grazed plots ; we notice no differencies for the others.

Foliar analysis was made after having developed the method of foliar analysis for the cork oak (Bertoni and Robert, 1992). Branches are cut around the crown of each 10 trees chosen, in four opposite directions. Leaves are sorted according to their age. The analysis was made on leaves of the previous year which were 6 to 10 months old in February and 10 to 14 months old in June.

We notice an interesting effect of scrub clearing and grazing on P and N content of the leaves. Those effects are not always significant but we observe a more important and significant effect on P in the sown plots. Concerning the micronutrients, we observe an increase of the Mg content and a decrease of the Mn content, element generally absorbed in quite high quantity by the cork-oak with may be a risk of toxicity (table 2).

Table 2 : Foliar mineral content : average of all sites, 1992 and 1993

Element	A	B	C
N % DM	1,51	1,61	1,63
P % DM	0,105	0,116	0,127
Mn > ppm DM	1114	1017	956

Consequently it seems that in most of the cases, plots cleared of scrub (B) and those cleared sown and grazed (C), show a significant increase in the growth rate of trees with a better mineral nutrition. The reasons for this effect are probably numerous : almost always when it is controlled by grazing, scrub clearing reduces the competition of lignous species, notably *Erica arborea*, for water and mineral nutrients. The sown or spontaneous legumes fix atmospheric nitrogen, the animals recycle through their faeces nitrogen and potash, which consequently leads to an improvement in the fertility level for the treated plots.

ESTABLISHMENT AND PRODUCTIVITY OF AN HERBACEOUS LAYER UNDER CORK-OAK FORESTS

Changes in the vegetation were measured during the 3 years by permanent lines on 8 sites and by cover estimates on 4 sites.

Concerning the herbaceous layer which is important for the nutrition of animals in the case of sylvopastoralism, we can observe, after scrub clearing, the slow but continuous establishment of a spontaneous sward of low quality which is mostly made up of annual grasses of low productivity and of various species (*Anthoxanthum odoratum*, *Briza media*, *Vulpia myuros*...).

The quality of the herbaceous layer has been highly improved after sowing adapted forage species, such as *Trifolium subterraneum*, *Dactylis glomerata* or *Festuca arundinacea*. We know the influence of forage resources with high nitrogen and energy content on facilitating the consumption of ligneous species by animals.

The herbaceous production under cork-oak forest varied with the tree cover from 1,000 - 1,500 kg of dry matter per hectare under cork-oak forest of 35-40 % cover, up to 2,000 or even 3,000 kg under very clear cork-oak forest as in firebreaks with few trees. But the main competition for the herbaceous layer come from the scrub layer when it is badly controlled.

Moreover a thriving herbaceous layer contributes to the soil protection and to its biological functioning. A combination of legumes with grasses seems advisable for sustainable productivity.

SHRUB CONTROL BY GRAZING ANIMALS

Undergrowth control in forest is the main incentive for forest grazing, with the aim of fire prevention. We notice a progression of the undergrowth layer under cork oak forest in the scrub cleared plots without grazing (B) and an unequal control of this layer under cork-oak forest in the plots with grazing (C), phenomenon which is variable according either to the animal type or to the farmer management. Vegetation dynamic under forest after scrub clearance is generally strong : we notice, for instance, regrowth of *Erica arborea*, *Calycotome spinosa*, *Arbutus unedo*, *Cytisus villosus* (in Sardinia) and the reseedling of *Cistus* (*C. salvifolius*, *C. monspeliensis*) and of *Ulex parviflorus*. The dynamic of scrub regrowth is directly proportioned to the degree of openness of the environment. We can estimate that the effect of scrub clearance has almost disappeared after five to seven years.

The control of the ligneous plants by grazing is satisfactory in the trials using goats or large animals such as cattle or horses with a system of fences managed in a rotational grazing with an average stocking rate of 0,2 to 0,4 livestock units per hectare and an instant high stocking rate (2 to 5 livestock units per hectare). However, except in the case of goats grazing in a thick cork-oak-forest, the undergrowth layer of the forest is not stabilized but continues to grow and we will have to need to be cleared again.

The voluntary intake of the different species varies according either to the animal as to the species. *Erica arborea* is consumed by all animals. On the contrary, *Cistus monspeliensis* is hardly ever consumed except by goats and mainly during the winter season. The control of this species which is vigorously established in the open environment is therefore problematical.

On 4 sites an evaluation of the cover and phytovolume of the shrub layer has been made on the total area of the 4 farms i.e. of 200 ha after 4-5 years of grazing. Table 3 shows the interest of scrub clearing and pastoral improvement on the shrub control by animals (Masson et al 1994).

Table 3 : Cover and phytovolume of the scrub layer on 4 farms (200 ha) after 4 years of grazing

Treatment of the forest	% cover of shrubs	Phytovolume of shrubs (m ³ /ha)
scrub cleared, sown, grazed	24 %	1490
scrub cleared and grazed	46 %	4290
grazed without scrub clearing	47 %	8230

CONCLUSION

These programs show clearly the interest of agrosylvopastoral treatments on the fertility of the cork-oak forests with interesting consequences on cork-oak growth and nutrition.

The limits are linked to the efficiency of the animal to control shrub regrowth.

Scrub clearance of very degraded cork-oak forest for fire prevention is justified and creates areas with a certain possibility for forage production, but their maintenance is difficult. On the contrary, scrub cleared plots in thick cork-oak forests will be easier for the animals to maintain despite low productivity in herbaceous species.

The intermediate situations (cover of cork-oak being about 20 to 30 %) give an interesting herbaceous production of 1 to 2 tons in dry matter per hectare. With good management of grazing, the scrub stratum can be controlled in a satisfying way and consequently this situation becomes a good field for pastoralism with linked and balanced management of the forest and pastoral functions in the same area. This reclamation management links an environmental interest to an economic one, and, if properly located, it should ensure the protection of larger areas of cork-oak forest.

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