Role of some legumes in the restoration of burned forest areas

Lombardi P., Staglianò N., Talamucci P.

in

Sulas L. (ed.).
Legumes for Mediterranean forage crops, pastures and alternative uses

Zaragoza : CIHEAM
Cahiers Options Méditerranéennes; n. 45

2000
pages 423-426

Role of some legumes in the restoration of burned forest areas

P. Lombardi, N. Staglianò, P. Talamucci
DiSAT – Università di Firenze, P.le delle Cascine, 18 – 50144 Firenze (Italia)

Summary - In order to obtain a preliminary evaluation of the possibility and the modality of restoration of burned forest areas in Mediterranean environments of Tuscany, a trial was carried out in a hilly area near Lucca (Northern Tuscany), just after a wild fire. The trial consisted, after a preliminary evaluation of spontaneous woody and herbaceous vegetation, in the sowing, on a slope, of two forage crops: a mixture of *Trifolium subterraneum* (cv "Seaton Park") and *T. brachycalycinum* (cv "Clare") and sulla in pure stand (*Hedysarum coronarium*, ecotype "Nugola"); the sown cover crops were compared also to development of spontaneous canopy. On studied swards were collected data regarding establishment, soil coverage, canopy structure, litter and recolonization of woody and herbaceous species. The mixture of subclover was more successfull than sulla.

Key-words: forest fire, *Trifolium subterraneum*, *Hedysarum coronarium*, bulk volume

Résumé - *Pour évaluer la possibilité et les modalités d'intervention dans les milieux méditerranéens concernées par les incendies, une expériméntation a été conduite sur un site de colline chez Lucca après le passage du feu. Après une caractérisation de la végétation ligneuse et herbacée spontanée, on a mise en place des enherbements en utilisant* Hedysarum coronarium, *ecotype "Nugola", un mélange de* Trifolium subterraneum *(cv "Seaton Park") et* T. brachycalycinum *(cv "Clare") qui ont été comparés avec la végétation spontanée. Les observations conduites ont concerné l'installation, le recouvrement, la densité, la structure de la végétation, la couverture morte et la stratégie d'occupations de l'espace par les espèces herbacées (spontanées et semées) et par les ligneuses. Le mélange de trèfle souterrain s'est montré plus intéressant que* Hedysarum coronarium.

Mots-clés: *incendie de forêt,* Trifolium subterraneum, Hedysarum coronarium, *phytovolume*

Introduction

Fire is a major hazard especially when the forest comprises only softwood, rich in resins and highly flammable. The burning causes changes in micro-climate, in soil and vegetation.

Negative effects caused by fires can be limited by grazing (Talamucci, 1991; Legrand *et al.*, 1994), or sowing and grazing firebreaks (Pardini *et al.*, 1993; Etienne and Valeix, 1995), or removing mechanically the understorey. Herbaceous species sown after the fire must have small amount of dry biomass, short height, and high hard seed stock in the soil. This research evaluates the effect of the subterranean clovers in burned forests. In addition sulla has been studied because of the increasing interest on its extra-productive uses (Talamucci, 1998).

Materials and methods

The trial was carried out in Monte Serra (LU) at about 500 m a.s.l. with NE aspect, annual rainfall 665 mm and annual mean temperature 12.5 °C. Soil pH was 5.3. The tree stand was a pine forest (*Pinus pinaster*) whose crowns and trunks had been mostly burned.

The following 5 treatments were compared: a) burned forest sown with a mixture of subterranean clovers (50% *Trifolium subterraneum* cv "Seaton Park" and 50% *T. brachycalycinum* cv "Clare"), b) burned forest sown with sulla (*Hedysarum coronarium*

ecotype "Nugola") inoculated with *Rhizobium hedysarii*, c) burned forest with sulla not inoculated, d) burned forest not sown, e) unburned forest. The clovers were not inoculated because naturally spread in the area. Seeds were broadcast in September 1998. The following measurements were taken: specific contribution of the herbaceous vegetation after Daget and Poissonet; number of plants, taken each week for the first month (inside metallic frames of 0,04 m^2); evolution of the soil covering by herbaceous species (by sight evaluation); sward height and height of the maximum biomass allocation (Inclined Point Quadrates); annual soil erosion (Gerlach equipment). The self-reseeding rate were measured only for subterranean clovers.

The recolonization of the woody species was evaluated measuring the canopy cover and the bulk volume after the method proposed in France by Etienne and Legrand (1994) and inside three permanent transects put down the slope in each plot, each transect was 5 m^2 (0.5m x 10m). The canopy cover $R=\Sigma S_i$ (S in dm^2, R in %) and the total bulk volume $VT=\Sigma(S_i x H_i)$ (H in dm e VT in m^3 ha^{-1}) were calculated for each shrub.

Results and discussion

The forest under-store comprises the following woody species: *Arbutus unedo, Calicotome spinosa, Cistus salvifolius, Cytisus scoparius, Erica arborea, Rubus ulmifolius, Fraxinus ornus, Castanea sativa, Pinus pinaster* (seedlings). The burning has favored the growth and diffusion of those species that were already present before the fire, especially the germination of *Pinus pinaster* and *Cistus salvifolius*. *Fraxinus ornus* was planted after the fire.

The average canopy cover obtained by the woody species (table 1) resulted not sufficient in the burned areas and particularly were the annual clovers were introduced.

Table 1. Canopy cover, average height and bulk volume of the shrubby species.

	Avg. Canopy Cover %	Mean height dm	Bulk volume m^3 ha^{-1}
Burned forest sown with clovers	3.5 d	4.3 b	148.0 d
Burned forest sown with inoculated sulla	4.7 c	4.5 b	221.5 c
Burned forest sown with non inoculated sulla	5.9 b	4.7 b	274.9 b
Burned forest not sown	6.4 b	4.9 b	310.4 b
Unburned forest	79.2 a	7.6 a	6040.0 a

Values in the columns with different letters are significantly different for $p<0.05$
Percentage values transformed according to Bliss before the statistical analysis

The sward has probably reduced the growth of the shrubs, especially young seedlings as those of *Cistus salvifolius*. The higher canopy cover and bulk volume has been recorded in the forest that was not burned and where the shrubs were grown without disturbing factors, consequently in these areas the fuel amount was higher.

Botanic composition was very poor of native herbaceous species, which is quite common in pine forests. The most abundant species were *Brachypodium rupestre* and *Lolium rigidum* whose diffusion was probably favored from the above chestnut forest (*Castanea sativa*), and *Pteridium aquilinum* quite spread from the spring after the fire.

The germination of the sown species started about 10 days after the sowing. The higher number of plants was obtained with the mixture and was 397 per m^2 (figure 1) one month after the sowing.

Inoculation of the sulla sorted a great difference compared to the non inoculated plots. This confirms the necessity of the inoculation.

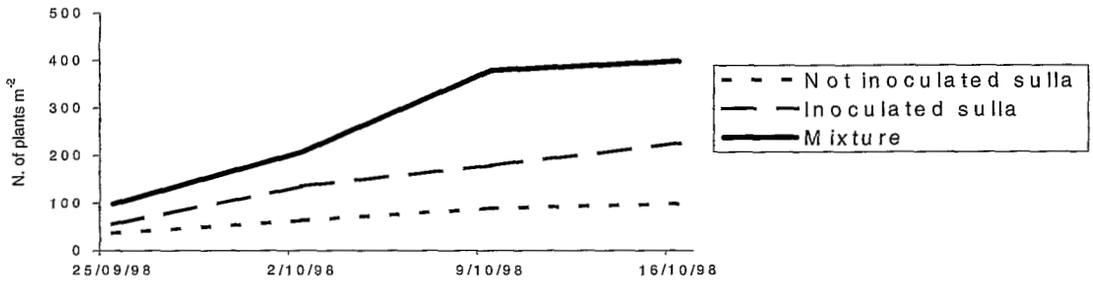

Fig. 1. Evolution of the number of plants of the sown species.

The mixture of subterranean clovers confirmed its superiority (table 2). The seedlings of sulla without inoculation were not able to grow more than the cotyledons. *Trifolium subterraneum* in the mixture covered the soil more than *T. brachycalycinum* probably thanks to its higher adaptability to the acidic soils. The sown species gave a mediocre cover, however higher than that originated from the native herbaceous species whose seed stock in the soil was probably poor.
Sward height in the mixture of clovers was not significantly different from that in the inoculated sulla or the native species. The non inoculated sulla gave the shorter sward.

Table 2. Canopy cover, avg. height of the sward and height of the maximum biomass density.

	Canopy cover %	Sward height cm	Height of maximum density of biomass cm
Burned forest sown with clovers	40 a	12.6 a	6.1 b
Burned forest sown with inoculated sulla	31 b	10.0 a	8.2 a
Burned forest sown with non inoculated sulla	9 d	3.4 c	2.5 c
Burned forest not sown (herbaceous native species)	5 d	7.5 b	4.5 c
Unburned forest (herbaceous native sp.)	22 c	11.8 a	8.0 a

Values in the columns with different letters are significantly different for $p<0.05$
Percentage values were transformed according to Bliss before the statistical analysis

The biomass was concentrated close to the maximum height, exception in the mixture were the maximum concentration was at about half height. This has improved the control of the soil erosion, and was more enhanced in *Trifolium subterraneum* than in *T. brachycalycinum*.

The reseeding rate of the clover has been 0.17, which is too poor to guarantee a good persistence of the sown sward. The reduced number of seedlings was probably due to the competition of the ferns during the flowering and the ripening of the seeds of the clover.

Soil erosion (table 3) has been consistent and inversely proportional to the canopy cover. The sown clovers have maintained the erosion similar to that of the unburned forest.

The dead biomass (mainly pine needles) in the unburned forest was the highest because of the abundant litter accumulated, the burned areas shown a smaller amount because the production of the sown species was not sufficient to balance the destruction of the litter caused by the fire. The latter condition is preferable in terms of reduced intensity of the fires.

Table 3. Annual soil erosion and litter.

	Soil erosion (kg Gerlach^{-1})	Litter t ha-1
Burned forest sown with clovers	6.2 c	0.53 b
Burned forest sown with inoculated sulla	8.7 b	0.47 b
Burned forest sown with non inoculated sulla	10.8 a	0.49 b
Burned forest not sown (herbaceous native species)	11.1 a	0.49 b
Unburned forest not sown (herbaceous native species)	6.6 c	0.95 a

Values in the columns with different letters are significantly different for $p<0.05$.

Conclusions

Even if limited only at the first year, this trial has indicated that a sown sward can reduce the soil erosion that follows the fires. Subterranean clover mixture has shown a good adaptation to the difficult area tested. It has given the best avoidance of shrub and ferns encroachment and soil erosion. However it did not give guarantee of good reseeding and this problem should be studied further. The establishment of the non inoculated sulla was really difficult, while the inoculated one shown a better behaviour. However its use could be limited to the initial colonization of the soil when the ashes deriving from the fire allow conditions of the soil more suitable for this species.

The use of the methodology of the bulk volume proved to be highly useful to follow the evolution of the fuel biomass through the years, and consequently to point out the level of risk of fire and to plan the more suitable prevention means.

References

Etienne, M., Legrand, C. (1994). A non destructive method to estimate shrubland biomass and combustibility. In: *2nd Int. Conf. on Forest Fire Research,* 21/24 Nov.1994, Coimbra Portugal, Vol. I, 425-434.

Etienne, M., Valeix, J. (1995). Installation d'élevages ovins sur grandes coupures. *XVI Int. Grassl. Congr. Nice (F)*, 1587-1588.

Legrand, C., Etienne, M., Rigolot, E. (1994). Une méthode d'aide au choix des combinaisons techniques pour l'entretien des coupures de combustible. *Forêt méditerranéenne*, XV, 4, 397-408.

Pardini, A., Piemontese, S., Argenti, G. (1993). Limitazione del rischio di incendi boschivi per mezzo di bande parafuoco inerbite con trifoglio sotterraneo (*Trifolium brachycalycinum* Katzn & Morley e *T. subterraneum* L.) e pascolate con ovini nella Toscana meridionale. *L'Italia Forestale e Montana*, 48, 341-352.

Talamucci, P. (1991). Pascolo e bosco. *L'Italia Forestale e Montana*, 46, 88-117.

Talamucci, P. (1998). Il ruolo della sulla nell'attuale contesto della foraggicoltura italiana. In: *"La sulla: possibili ruoli nella foraggicoltura mediterranea", I Georgofili, Quad. 98-I*, 7-27.