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# Arbuscular mycorrhizal fungi can improve the growth of aromatic plants and prevent soil erosion after forest fires

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## INTRODUCTION:

Forest fires are regarded as one of the major environmental problems in Portugal. Among their negative impacts is loss of green area and soil structure damage, which increase soil erodibility. Adequate soil structure is essential to support plant and animal life and to moderate environmental quality with particular emphasis on soil carbon sequestration and water quality (Certini, 2005). After a forest fire the ecosystem has the capacity to recover through ecological succession. This is, however, a slow process and there is the need for human intervention in order to mitigate the negative impacts of forest fires. Aromatic plants, such as rosemary, are among the first to grow in post-fire Mediterranean forest ecosystems (Luis et al., 2006). This together with their commercial value makes these plants attractive candidates to be used in the first stages of restoration of burned forest soils. Arbuscular mycorrhizal fungi (AMF) are a group of soil microorganisms that forms mutualistic symbioses that can benefit plants by improving the uptake of mineral nutrients, mineralising organic nutrients and conferring drought resistance (Oliveira et al., 2005). AMF have also the capacity to promote soil aggregation by several mechanisms including the release of soil binding agents.

## OBJECTIVES:

The aim of this study was to assess the effect of inoculation with an arbuscular mycorrhizal fungus, *Glomus claroideum*, on the growth of rosemary (*Rosmarinus officinalis* L.), an aromatic plant species native to Mediterranean ecosystems, and on soil aggregation after forest fires.

## MATERIALS AND METHODS:

Rosemary plants were propagated through cuttings in trays with 70 cm<sup>3</sup> cells. Half the cells received 5 g of inoculum of *G. claroideum* consisting of spores, mycelia and colonised root fragments. After rooting the plants were transplanted to 1 L pots containing either burned or unburned forest soil. The burned soil was prepared by heating samples in a muffle furnace for 20 min at 500 °C. The experiment comprised four treatments: (i) non-inoculated control plants in burned soil, (ii) non-inoculated control plants in unburned soil, (iii) plants inoculated with *G. claroideum* in burned soil and (iv) plants inoculated with *G. claroideum* in unburned soil. After a growth period of 4 months, plant height was measured in order to compare the growth of the rosemary plants within the different treatments. Leaf chlorophyll a+b concentration was determined by spectrophotometry. The number of trichomes per mm<sup>2</sup> of leaf was determined by microscopy and was used as an indication of the potential of the rosemary plants to produce essential oils. The soil aggregation was assessed in soil samples collected from the pots by determining the mean weight diameter (MWD) according to the dry method of Kemper and Rosenau (1986). Fresh root samples were collected and stained as described in Oliveira et al. (2005). Root colonisation by mycorrhizal fungi was then assessed by microscopy.

## RESULTS AND DISCUSSION:

A significant increase in plant height was obtained in plants inoculated with *G. claroideum* and grown in burned soil (Table 1). This may have been due to the increased soil nutrient availability that is usually associated with forest fires and their subsequent uptake by the inoculated AMF. The leaf chlorophyll a+b concentration was also significantly higher in plants inoculated with *G. claroideum*, suggesting improved

nutrition of these plants. The number of trichomes in the leaves of rosemary was found to be significantly higher in plants inoculated with *G. claroideum* and grown in burned soil, indicating that these plants can potentially produce larger quantities of essential oils.

**Table 1** - Effect of inoculation of *Rosmarinus officinalis* with *Glomus claroideum* in burned and unburned forest soil

AMF	Soil	Plant height (cm)	Number of trichomes / mm <sup>2</sup> of leaf	Concentration of chlorophyll a+b (mg/g)	MWD (mm/g)	AMF colonisation
Control	Burned	16.83 ± 2.33b	12.74 ± 3.80b	0.53 ± 0.10a	2.94 ± 0.23a	Negative
Control	Unburned	13.80 ± 1.69a	7.92 ± 2.00a	0.48 ± 0.18a	3.32 ± 0.03b	Negative
<i>Glomus claroideum</i>	Burned	19.24 ± 2.25c	26.52 ± 7.34d	0.74 ± 0.10b	3.17 ± 0.07b	Positive
<i>Glomus claroideum</i>	Unburned	13.30 ± 1.29a	16.50 ± 4.99c	0.65 ± 0.07b	3.54 ± 0.12c	Positive

Values are means ± SD. Means followed by the same letters within each column are not significantly different according to Duncan's multiple range test at the level of P < 0.05; AMF, arbuscular mycorrhizal fungi; MWD, Mean weight diameter.

The burned soil had lower values of soil aggregation (determined by MWD) when compared with unburned soil. This may be explained by the negative impact on the soil structure caused by forest fires. However, soils inoculated with *G. claroideum* had significantly greater values of aggregation than their respective non-inoculated controls (burned and unburned). These results show that the soils inoculated with *G. claroideum* were less prone to erosion. Typical structures of arbuscular mycorrhizas here observed in the roots of inoculated plants grown in both burned and unburned soils, while no colonisation was observed in non-inoculated control plants. This indicates that the inoculated *G. claroideum* was capable of colonising the roots of rosemary in both burned and unburned soils and may have contributed to the observed improved plant growth and soil aggregation.

## CONCLUSION:

This study demonstrates that the relationship between rosemary plants and AMF is an asset for future restoration of burned soil, contributing to the improvement of soil aggregation and plant growth, thereby reducing the effects of forest fires, and possibly enhancing the production of compounds of interest with economic benefits.

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