ANALYTICAL PYROLYSIS OF SOIL EASILY-EXTRACTABLE GLOMALIN (EEG) FRACTION

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INTRODUCTION

Easily Extractable Glomalin (EEG) represents an organic fraction of the soil that contains mainly glomalin-related soil proteins (GRSP), a glycoprotein abundantly found in soils produced by arbuscular mycorrhizal fungi in the phylum *Glomeromycota* [1]. The EEG fraction is confirmed to have multiple ecological functions in soils, including the improvement of soil stability and resilience to degradation, facilitate aggregate formation and contribute to soil carbon storage [2] (Figure 1). In particular, this organic fraction refers to the most inmunorreactive to monoclonal antibody that targets *Glomus intraradice*s [3]. Given its potential for soil C immobilization, a detailed molecular characterization "fingerprint" of pyrolysis products of EEG fraction extracted from a Mediterranean soil under different plant covers, affected and unaffected by forest fire and at different times is conducted.

Glomalin coating a microscopic fungus on a corn root.
Credit: Photo by Sara Wright.

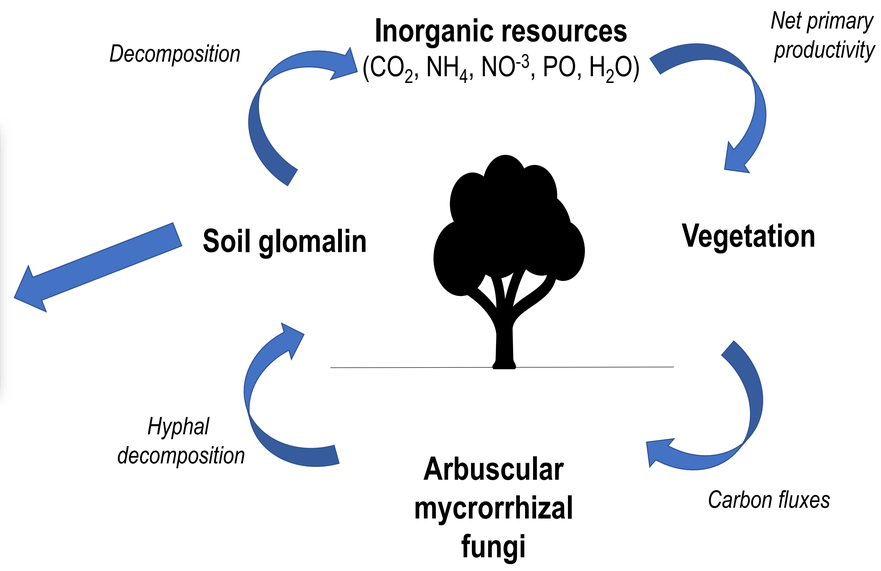

Figure 1. Glomalin cycle including processes and environmental characteristics that may influence the size of its stock in ecosystems [2].

METHODOLOGY

Pyrolysis-gas chromatography coupled to mass spectrometry (Py-GC/MS)

A total of 16 samples were extracted from soils in Gorga (NE Alicante, Spain). Further information about the sampling process and EEG extraction protocols are described elsewhere [3]. In short, samples were taken from the surface (to 2.5 cm depth; A horizon) under pine and shrub covers, immediately after a forest fire (July 2011), and at 4, 8 and 12 months after the fire. Surrounding soils with similar characteristics but unaffected by fire were taken as control.
Analytical pyrolysis (Py-GC/MS) was performed using between 1 and 2 mg sample, using a double-shot pyrolyzer (Model 2020i, Frontier Laboratories) coupled to a gas chromatograph (Agilent 6890N) and a mass selective detector (Agilent 5973N). Pyrolysis temperature was 400 ºC for 1 minute and detailed chromatographic conditions and compound assignment procedure were as described in [4].

RESULTS AND DISCUSSION

A remarkable high similarity was found between EEG samples from different plant covers, both affected and unaffected by forest fire and at different time over a year after the fire, as can be observed in the chromatograms (Figure 1).
As observed in previous studies, it has been proved that EEG contents can remain constant at higher temperatures for a long period (200ºC during 20 min) [5]. The results presented in this work lead EEG to be structurally homogeneous and likely resilient to high temperatures whilst not exceeding 200-250ºC.

A total of 139 compounds were identified and grouped according to their probable biogenic origin:

- Polysaccharides (PS)
- Lignin and polyphenols (LIG)
- Proteins and polypeptides (PRO)
- Non-specific aromatic compounds (ARO)
- Hydro-aromatics (HAR)
- Lipids (LIP)
- Polycyclic aromatic hydrocarbons (PAH)
- Terpenes (TER)

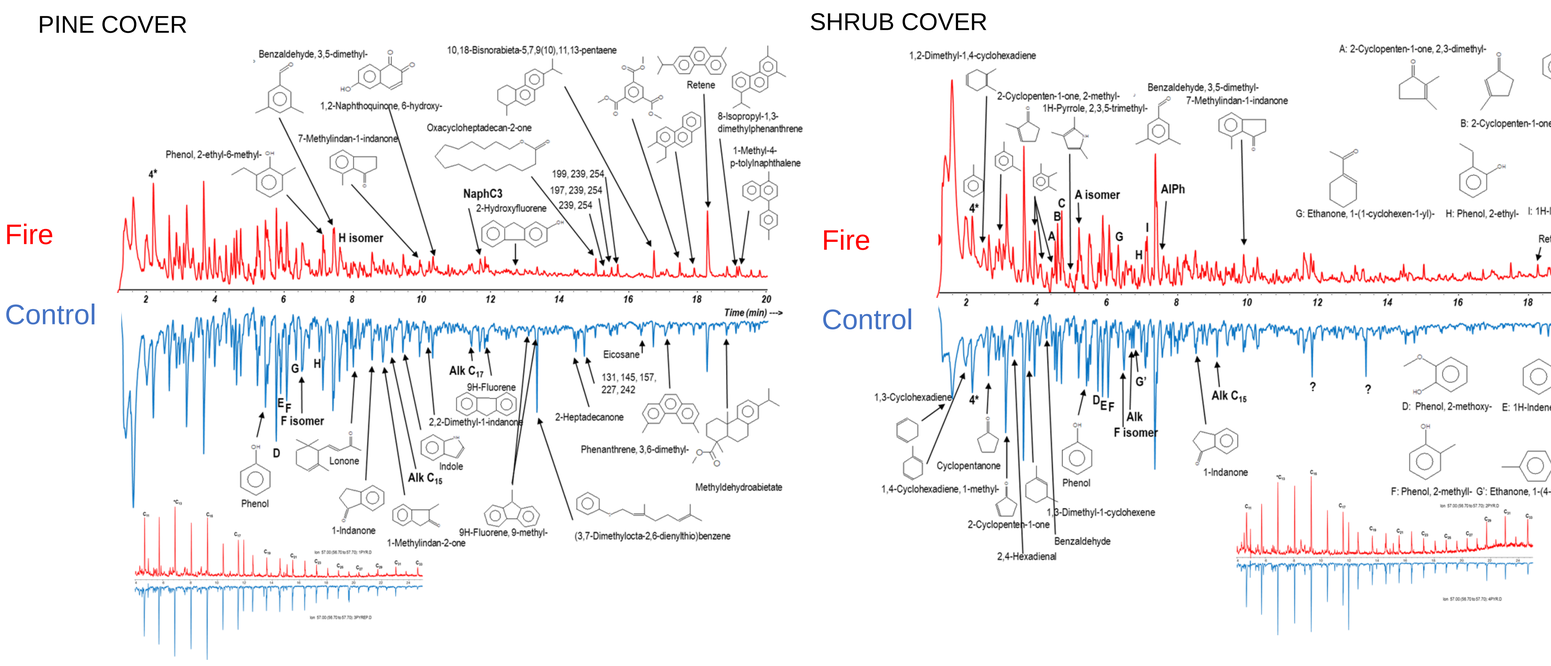

Figure 2. EEG "Fingerprint". Pyrograms obtained from analytical pyrolysis (Py-GC/MS), corresponding to glomain extracts from soil under pine and shrub covers, affected and unaffected by forest fire. The slight trace under main chromatograms match with an alkali chain (m/z 57)

The chemical structure accounted for PS (42 ± 5 %), mainly cyclopentanodione, cyclopentanones and alkyl-derivatives; ARO (24 ± 3%), mainly benzene, phenol and alkyl-derivatives; and HAR (12 ± 3%), mainly indano and alkyl-derivatives (Figure 3a and 3b). The remaining 20% included PAH (8 %), LIP (7 %), LIG (5 %) and PR (2 %). Finally, TER included typical compounds from essential oils such as damascones and thymol.

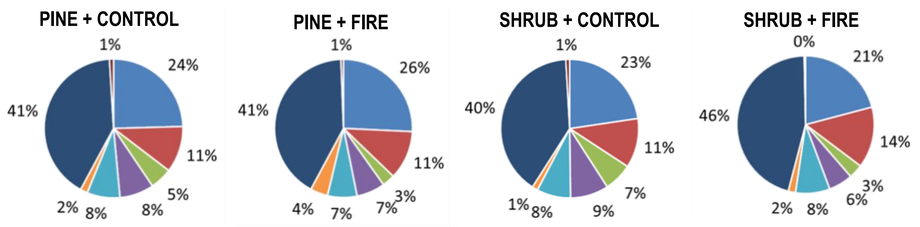

Figure 3. Relative abundance of EEG fractions extracted from soils under different vegetation covers, both affected and unaffected by forest fire.

High contents in carbohydrate-derivate products combined with the presence of nitrogenous compounds correspond to a glyco-protein structure. Also, high proportions of aromatic compounds lead to previous results in which EEG is proved to be rich in aromatic carbon and carboxilic [6, 7]. This work proves that EEG, according to its different chemical C composition, presents a very similar structure to humic acids. Comparison with previous results reinforces the idea of Easily Extractable Glomalin having a role in **carbon sequestration.**

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