# EFFECTS OF AIR-DRYING AND REWETTING ON MICROBIAL BIOMASS, BASAL RESPIRATION AND β -GLUCOSIDASE AND β-GALACTOSIDASE ACTIVITIES OF MINIMALLY DISTURBED SOILS UNDER MEDITERRANEAN CONDITIONS

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**INTRODUCTION:** Soil biochemical assays offer potential as indicators of biological functioning of soil. In Mediterranean regions, for much of the year field moist surface soil can have water similar to that of air-dry samples (Hinojosa et al., 2004). Drying and remoistening can influence on microbial biomass and biochemical activity of soils.

The objectives of this study were (i) to evaluate the effect of air-drying or air-drying and rewetting on microbial biomass carbon (MBC), extractable carbon (EC), basal soil respiration (BSR), β-glucosidase and β-galactosidase activities in soils with minimal anthropogenic disturbance, (ii) to assess if rewetting air-dried soil samples is an accurate sample pre-treatment procedure when using these properties to evaluate the quality of the studied soils.

**MATERIAL AND METHODS:** Superficial layer samples of ten soils were collected in spring 2006 from different zones including a wide range of plant cover, climatic conditions and lithologic characteristics. Site and soils characteristics are given in Table1. The β-glucosidase activity and β-galactosidase activity of field-moist soil samples stored at 4ºC was determined within the first 2 weeks following sampling and was compared with that of the same soil samples once they had been air-dried during one week at room temperature. To assess the effect of rewetting on microbial biomass carbon (MBC), basal soil respiration (BSR), β-glucosidase activity and β-galactosidase activity air dried soil samples were rewetted to 60% of their water holding capacity (WHC) and kept in the dark at 28 ºC for 7 days before the mentioned parameters were assayed. Extracted C (EC) was obtained by extraction with 0,5 M K2SO4 in the proportion of ¼ (w/v) and determined by dichromate digestion by the Walkley-Black procedure (Nelson and Sommers, 1982).. MBC was determined using the fumigation extraction procedure (Vance et al., 1987). BSR was determined as the CO2 produced after 7 days of incubation at 28º C, as reported by Hernández and García (García et al., 2003) with all samples adjusted at 60% WHC. The β-glucosidase and β-galactosidase activities were determined as reported by Tabatabai (1982) with calibration plots of p-nitrophenol prepared by using each soil, so as to take into account the relative adsorption of p-nitrophenol by each soil (Vuorinen, 1993). All determinations were performed in triplicate and all values reported are averages of the three determinations expressed on a dry weight bases.

**Table 1 Sites and soils characteristics**

| Soil | Location | Parent Rock | Soil type‡ | Habitat type | Soil use type | Texture | pH (1:2.5) | E.C (1:5) | $CaCO_3$ % |
|---|---|---|---|---|---|---|---|---|---|
| LT | Litoral | Granodiorite | Cambisol | MF Qi | f | LSa | 6.95 | 0.064 | - |
| CR | Corredor | Limestone | Ranker | MF Qs | f | L | 6.45 | 0.129 | - |
| MN | Montnegre | Granodiorite | Ranker | MF Qs | f | SaL | 6.45 | 0.092 | - |
| VC | Vic | Marls | Cambisol | AG | dg | L | 8.50 | 0.163 | 37 |
| OR | Ordal | Limestone | Luvisol | MF Pf | f | C | 8.00 | 0.191 | - |
| IG | Igualada | Marls | Cambisol | DG | ab | CL | 8.50 | 0.159 | 64 |
| PN | Panadella | Limestone | Xerosol | MF Qi | f | SaCL | 7.80 | 0.243 | - |
| BL | Balaguer | Gypseous marls | Xerosol | RGa | dg | SaL | 8.15 | 2.000 | 12 |
| LG | La Granja | Marls | Cambisol | SS | s | CL | 8.40 | 1.377 | 35 |
| SG | Segre | Alluvial deposits | Fluvisol | RP | f | SaL | 8.65 | 0.121 | 33 |

2006 average air temperature; **2006 average precipitation; ‡FAO – Unesco, 1974. MF: Mediterranean forests; Qi: Catalo-provençal lowland holm-oak woodlands; Qs: Catalan cork-oak woodlands; AG: Aphyllanthes grasslands; Pf: Iberian aleppo pine forests; SS: Sparto steppes; RP: Riparian poplar galleries; DG: Dry calcareous grasslands; RGa: Rosemary garrigues. f: Forests; dg : dry grasslands; ab: abandoned lands; s: steppe.
Sa: Sand; L: Loam; C: Clay; EC: Electrical conductivity at 25ºC in $dS.m^{-1}$

Table 2 ANOVA table showing F value of extractable organic carbon (EC), microbial biomass carbon (MBC), basal respiration (BR), β-glucosidase activity and β-galactosidase activity in soils of Catalonia

| | EC | MBC | SBR | β-glucosidase | β-galactosidase |
|---|---|---|---|---|---|
| Pre-treatment (PT) | 774.77*** | 24.07** | 982.10*** | 169.60 *** | 281.47*** |
| Soils (S) | 603.66*** | 160.52*** | 135.33*** | 859.37*** | 1560.28*** |
| PT x S | 44.46*** | 1.46 ns | 57.55*** | 24.42*** | 84.50*** |

*,** and *** indicate significance at P < 0.05, P < 0.01 and P < 0.001, respectively. ns, non-significant; ; EC, extractable carbon; MBC, microbial biomass carbon; BSR, basal soil respiration.

## RESULTS

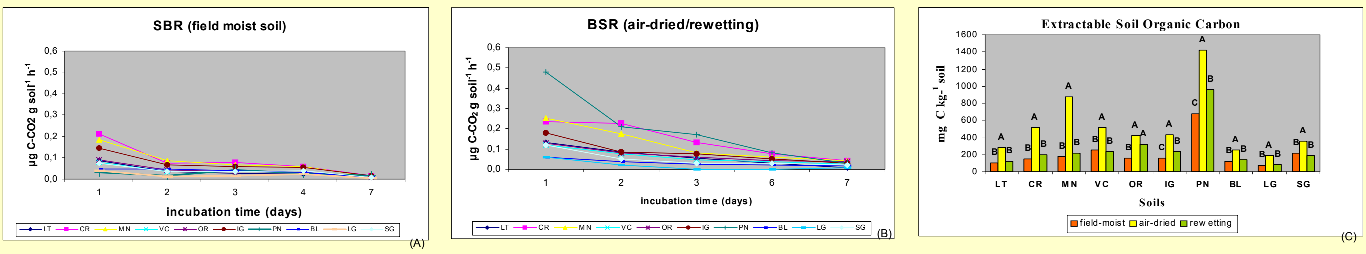


Fig.1. Soil basal respiration (A) air-dried soil, (B) air-dried/rewetted soil, (C) EC in field-moist, air-dried and air-dried/rewetted soils.

- ➢ The results obtained from repeated measures ANOVA (Table 2) showed significant interaction between type of soils and pre-treatment applied, except for MBC which was significantly higher in field-moist soils.
- ➢ The EC after 7 days de incubation following than rewetting in the soil was not significantly different from that measured before air-drying except in the soils OR, IG and PN in which was significantly higher in rewetted air-dried soils.
- ➢ The enhanced values of EC in rewetted OR and IG soils could be explained by the important reduction of their microbial biomass content when compared with that of the correspondent field-moist soils: the water potential increase when rewetting air dried soils would have released a high proportion of their MBC
- ➢ The rapid rewetting of the dry soil yielded a pulse in soil $CO_2$ production that persisted for 2 to 6 d.
- ➢ The effects of rewetting in soil β-glucosidase and β-galactosidase activities were different depending both on soil and type enzyme activity. Generally, β-glucosidase and β-galactosidase activities had higher values in rewetted air dried than in field moist soils.

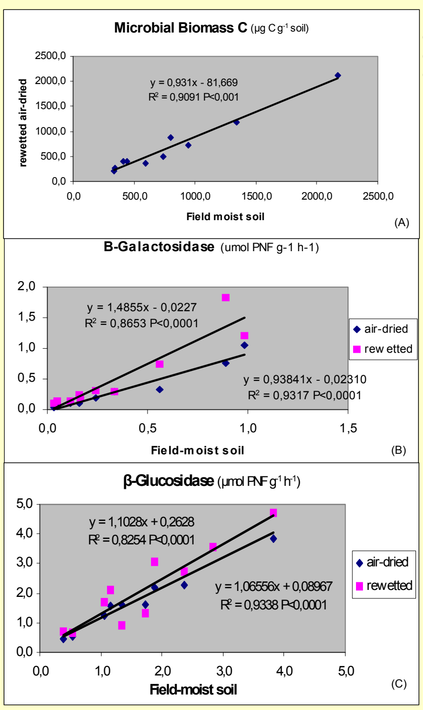


Fig. 2 Relationship between (A) MBC, (B) β-galactosidase and (C) β-glucosidase activities determinate under field-moist conditions and air dried (♦) and air-dried/rewetted (■ ).

- ➢ β-glucosidase and β-galactosidase activities of air dried and field moist samples were positively correlated
- ➢ Linear regressions between field-moist and rewetting air-dried soil sample showed that MBC and β-glucosidase activity of rewetted air dried samples provided the same trend among soils than that of field-moist.
- ➢ The greatest deviation was observed with β-galactosidase activity, with overestimations of the field values when rewetting air dried soil were use.

## CONCLUSIONS

- ➢ Rewetting air dried soils caused a decrease of microbial biomass and an increase of basal respiration with respect of field-moist soils.
- ➢ In the majority of the studied soils it was found that β-glucosidase and β-galactosidase activities were higher in rewetted air dried than in field-moist soils.
- ➢ Even if air-dried and rewetting air drying significantly altered some field-moist, the values obtained in air-dried and rewetted samples provided the same ranking of differences among soils as did those present in the field-moist ones.

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