BIOLOGICAL EFFECT OF THE ADDITION OF THERMALLY DRIED AND COMPOSTED SEWAGE SLUGES TO RESIDUAL SOILS FROM A LIMESTONE QUARRY

Gracielo Morera1, Patricia Jiménez1, Manuel Bonmatí2, Marta Ginocchio2

1 Department of Agro-Food Engineering and Biotechnology. Technical University of Catalonia. Barcelona. Spain.  
2 Department of Applied Mathematics II. Technical University of Catalonia. Barcelona. Spain.  

manuel.bonmati@upc.edu

INTRODUCTION

Residual materials coming from limestone quarries extraction are often used in the working reclamation process. Application of sewage sludge to residual materials facilitates the establishment of a vegetation cover. Besides protecting the soil from erosion, this can stimulate C and N cycling, thereby reducing pollution by run off and leaching (Aldabejo et al., 2000). Studies of enzyme activities provide information on the biochemical processes occurring in soil. There is growing evidence that soil biological parameters may be valuable and sensitive indicators of soil ecological stress or restoration.

The aim of this work was to assess the effects of six different sewage sludge treatments applied in 2012, on β-glucosidase and β-galactosidase activity, soluble organic matter, total and extractable carbohydrates, soil respiration and soil microbial biomass of residual soils from a limestone quarry.

MATERIAL AND METHODS

Residual soils: Both residual soils contained in waste material generated from the working of a limestone quarry situated in Begues (Central Catalonia). The Mining Soil (MNS) was a mixture generated during the extraction process of the working, containing a 38% of fine earth; pH 8.5; lime 39.3%; C 0.47%; N 0.06%; sand 42.5%; silt 37%; clay 20.4%. The Milling Soil (MLS) was generated during the milling process of the stony material and contained 14% of fine earth; pH 8.9; lime 63.6%; C 0.27%; N 0.05%; sand 54.8%; silt 22.6%; clay 22.4%.

Analytical measurements: Extracted C (EC) was obtained by extraction with 0.5 M K2SO4, in the proportion of 1/4 (w/v) and quantified (TOC SHIMADZU V-CSN); total carbohydrates (TCH) as reported by Cheshire and Mundie (1966); extractable (soluble in 0.5 M K2SO4) carbohydrates (ECH) by Badalucco et al. (1992); microbial biomass (MB) by the fumigation-extraction method (Vance et al, 1991); thermal respiration (TTR) and cumulative CO2 as measured by Frank and Tabatabai (1989). β-glucosidase and β-galactosidase activities were measured according to Albenzio (1992) using the hydrolysis of p-nitrophenol (PNP) as substrate. The enzyme activity was assayed by the spectrophotometric method at 405 nm. Cumulated CO2 was measured as the difference of the g CO2 released by the microbial biomass after fumigation and unfumigated soil, TTR was calculated as the difference of the g CO2 released by the soil and fumigated soil. Enzyme activities and CO2 assimilation were measured on a dry weight bases. To find out which of the assayed parameters were more sensitive to the action of the six sewage sludge types on the two soils, the calculated means of each parameter were normalized by using mean values. Values not followed by the same letter show significant differences (p<0.05).

RESULTS

Statistical results

Parameters with no interaction sludge-soil

β-Glucosidase activity. * Besós treated soils: 1.04 µmol PNP g-1 h-1 = 2 x T. (rest of mixtures)

TCH: X MNS-sludge mixtures= 1,51 mg g-1 = 1,5 x X MLS-sludge mixtures

EC: X MNS-sludge mixtures= 188 mg kg-1 = 1,2 x MLS-sludge mixtures

*, β: Besós sludge was the one with the lowest stable organic matter content

PART 3

CONCLUSIONS

Differences in the sludges origin did not allow to find absolute parameters distinguishing differences among the two post treatments (thermally drying or composting) of the sludges. The only exception was Cumulated CO2

MB/C and Cumulated CO2 were higher in thermally dried sludge treated soils than in composted sludge treated soils; they were the most sensitive parameters in the detection of the effect of organic matter stabilization by composting post treatment over the sludges added to soils

β-glucosidase was the most sensitive parameter in the detection of the decomposable organic matter content of the sludges present in the mixtures

MNS residual soil was able to retain more organic matter (TCH and EC) than MLS residual soil

The normalized values of the assayed parameters showed that ECH was the index better detecting differences among the six sludges in their effects over the soils.