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Soil carbon storage under elevated atmospheric CO_2

M. Cristina Moscatelli (1), A. Lagomarsino (2), P. De Angelis (2), S. Grego (1)

(1) Dept. of Agrobiology and Agrochemistry, University of Tuscia, Via S. Camillo De Lellis, Viterbo 01100, Italy. (2) Dept. of Forest Environment and Resources, University of Tuscia, Via S. Camillo De Lellis, Viterbo 01100, Italy. (e-mail: mcm@unitus.it/fax +39 0761 357242)

Soil carbon (C) long term storage is influenced by the balance among ecosystems net primary productivity (NPP), the rate of delivery of new organic matter to soil pools and the decomposition of soil organic matter (SOM). Plant inputs to soil (as litterfall, roots and root exudates) may be affected in quantity and quality by the increase in plant biomass and by the biochemical modifications of plant tissues, both occurring in elevated CO_2 environments. This work was carried out in the frame of the EURO-FACE project. Within a *Populus x euramericana* plantation six plots were planted with three different genotypes (*P. alba*, *P. nigra*, *P. x euramericana*). Three of these plots were treated with 550 ppm of atmospheric CO_2 with FACE technology, the other three were kept as controls. Each plot (Control and FACE) was divided in two halves, one of which was treated with nitrogen fertilization. The following results are referred to soils sampled within the period 2001-2004.

The aim of this research was to separate soil C fractions (LC, WSC, TEC) relevant for microbial metabolism characterised by a different degree of degradability and to estimate changes due to elevated CO_2 and N fertilization treatments. The overall labile C (LC), representing the sum of microbial biomass C (MBC) and the C extracted in 0.5M K_2SO_4 (ExC), was considered as an *active* organic fraction playing an important role in the substrate availability for microbes. Inside LC, the Water Soluble C (WSC) plays an important role as the most immediate and easily degradable C source for microorganisms. Total Extractable C (TEC) and Total Organic C (TOC) were analysed as index of C storage. We also calculated the C/N ratio of microbial biomass and of extractable SOM (0.5M K_2SO_4 extr. C and N). Finally microbial basal respiration of bulk soil was determined as an index of mineralization activity. The effect of elevated CO_2 was a significant increase of labile C and WSC fractions (+23 and +13%

respectively) accounting as a whole for an average 3% of TOC while the N fertilization decreased significantly these pools. The elevated CO_2 treatment increased the C/N ratio of microbial biomass and of the extractable SOM (+22 and +39% respectively). On the other hand the two treatments didn't induce any significant change on the two "slow" fractions TEC and TOC. Microbial basal respiration was significantly decreased by N fertilization (-32%) but was not influenced by CO_2 enrichment.

These results suggest that the increase of labile C could be a consequence of enhanced fine root production or increased root exudation occurred under elevated CO_2. Nevertheless the potential respiration of soil microorganisms was unaffected by CO_2 enrichment suggesting that the low quality of labile C fractions (high C/N ratio) could limit their utilization in FACE soils favouring a microbial immobilization process. Owing to the difficulty of measuring changes in C against the background C-content of the soil, soil C storage was unaffected by CO_2 treatment, although a possible positive trend of C storage in the long period could be hypothesized.