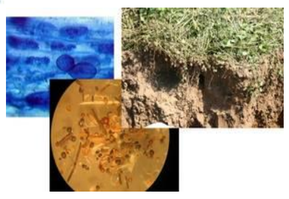
Impact of leguminous living mulch on soil microbial biomass and activity in different European climatic zones

WP 5 – Soil Ecological Impact



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Aim

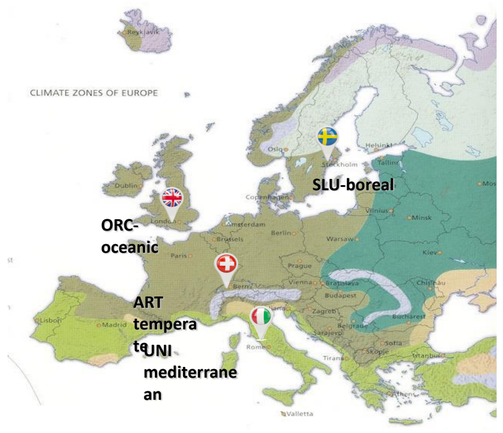
To assess the impact of leguminous living mulch on soil microbial biomass and its activity in three European climatic zones

Leguminous living mulch such as Trifolium spp. have high nitrogen content and are excellent weed suppressor maintaining also soil temperature and humidity.

Materials and Methods

The experimental field MEE1 of four European countries (UNITUS, ART, SLU, ORC) have four replications for two tillage levels. Changes of chemical and biochemical properties of soil before the main crop planting (t1) and at the main crop harvesting (t2) were assessed as percentage of variation with respect to control soil. Various leguminous LM were adopted by each MEE1 (UNITUS= subclover, SLU= white clover, ART= subclover, ORC= Yellow trefoil). All biochemical assays were made on soil left to equilibrate at room temperatu moisture at 60% of water holding capacity.

Figure 1: Location of MEE1 and climatic zones



Soil microbial biomass and enzyme activities

Soil biochemical properties: soil microbial biomass carbon was determined according to the methods of fumigation-extraction (Vance et al. 1987). Soil enzyme activities involved in C,N,S,P cycles were determined using microplate-fluorogenic assay (Marx et al. 2001; Vepsäläinen et al. 2001). Soil microbial biomass (Cmic) and synthetic enzyme index (SEI) were expressed as following:

(1)Cmic= microbial biomass carbon

I. mg Cmic g^{-1} of soil;
II. Percentage of Cmic: with respect to total organic C

(2)SEI= sum of all soil enzyme activities

I. nmol MUF g^{-1} soil h^{-1}
II. nmol MUF mg Corg h^{-1}

Results and discussion

Figure 2: Effect of LM on microbial biomass carbon expressed on soil mass base at t1 and t2

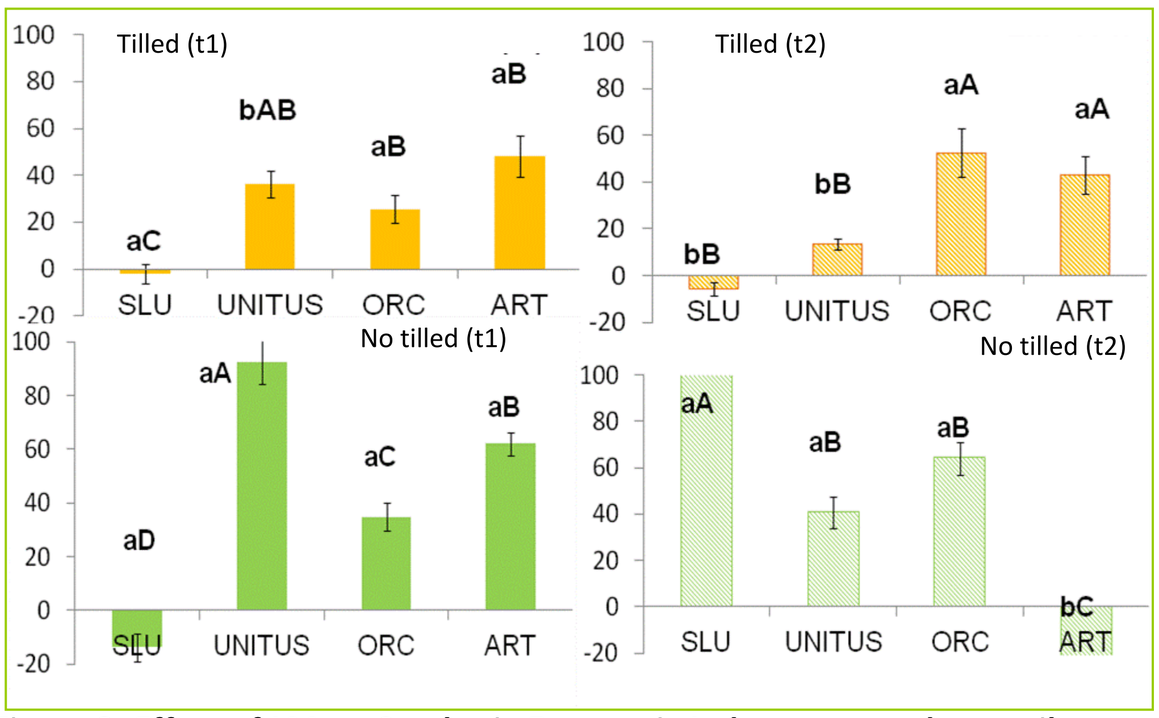


Figure 3: Effect of LM on Synthetic Enzymatic Index expressed on soil mass base at t1 -t2

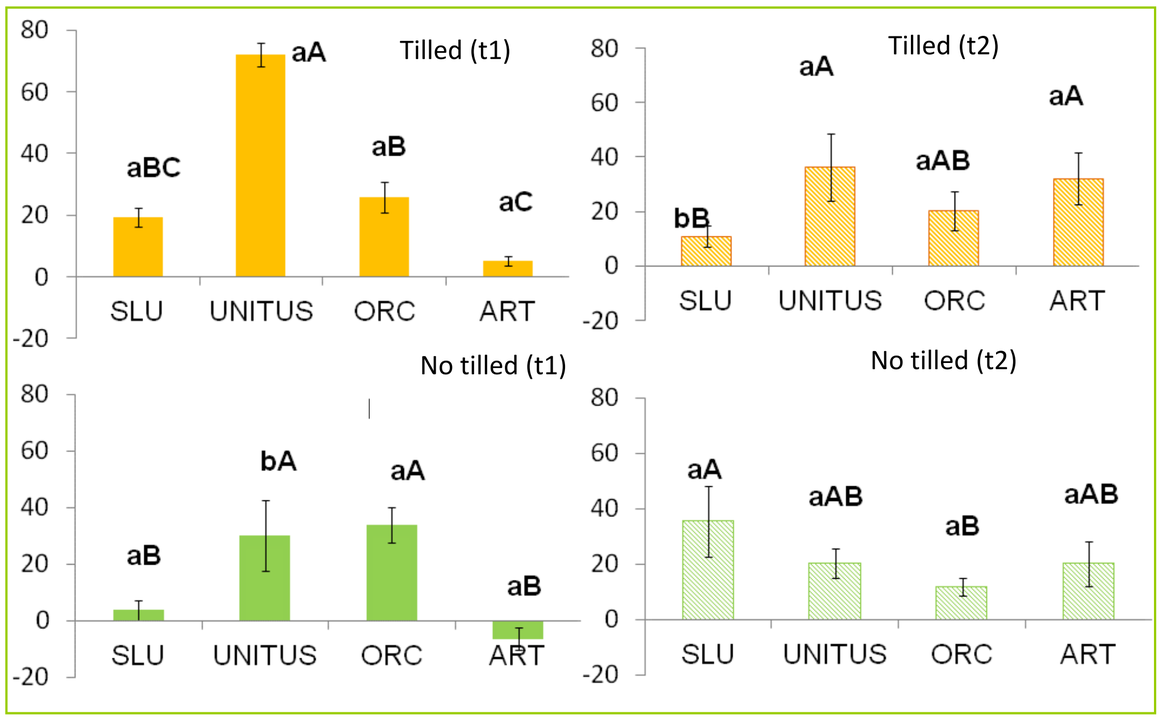


Figure 4: Effect of LM on soil microbial biomass carbon expressed per unit of organic carbon at t1 - t2

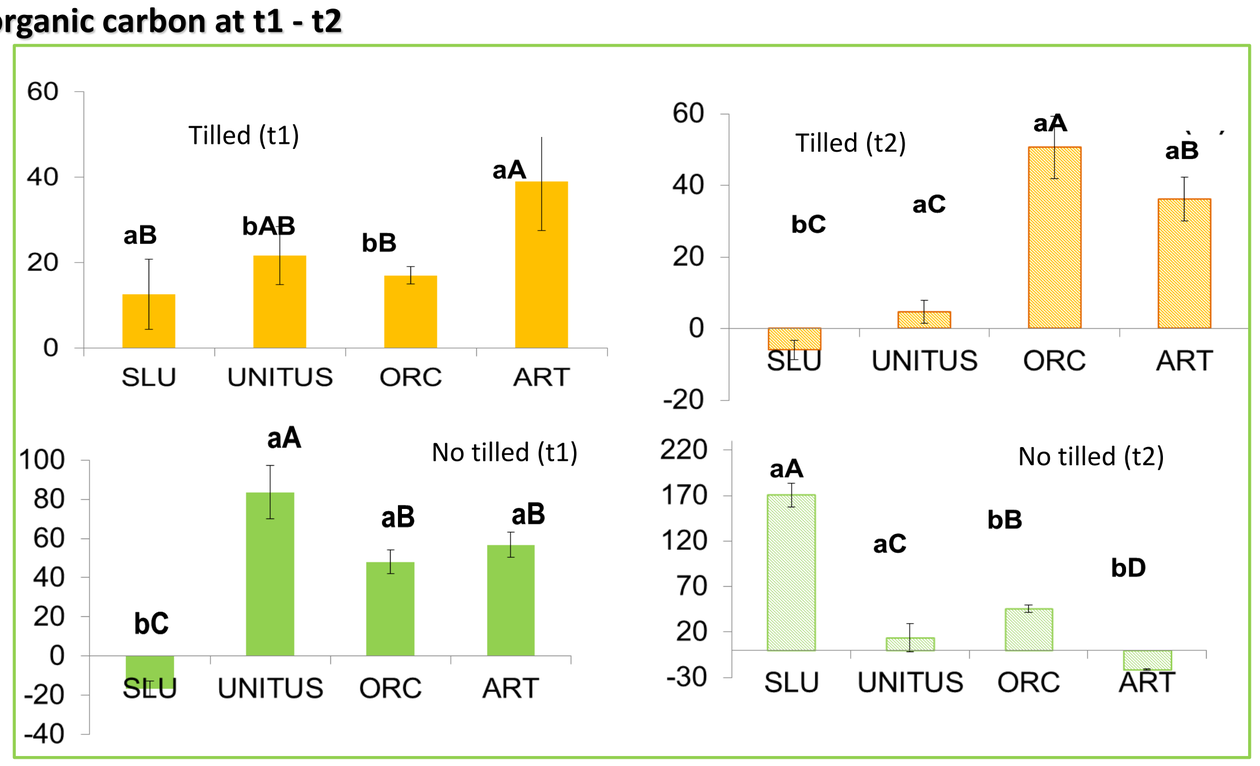
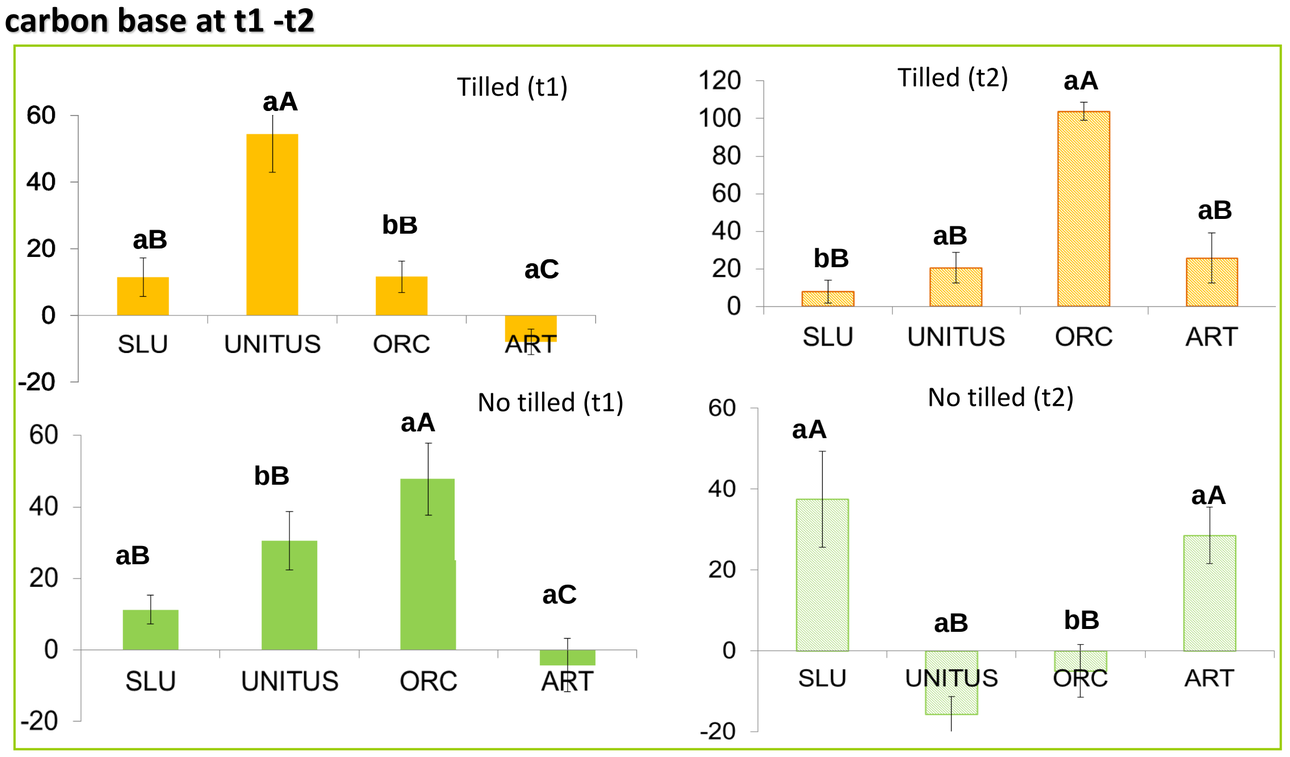


Figure 5: Effect of LM on Synthetic Enzymatic Index of soil expressed on organic carbon base at t1 -t2



The effect of LM on soil biochemical properties such as Cmic and enzyme activity (SEI), expressed as percentage with respect to the control, are showed on soil mass base (Figures 2 and 3) and per unit of organic carbon (Figures 4 and 5). A general positive effects of LM was observed at both tillage levels in all MEE1 sites. The effect of tillage was significant at t1 only at MEE1 of UNITUS (Mediterranean climate). Conversely, in the Northern European MEE1 (SLU), the positive effect of LM on soil biochemical properties was significant at t2 in not tilled soil. When Cmic and SEI were expressed per unit of organic carbon the effect of LM were similar to those showed by the same properties expressed on soil mass base. Those results suggest that the effect of LM on soil biochemical properties were not due to soil organic carbon content change. Further interpretation and discussion of the obtained results will be done with the weather data set of various MEE sites and once the second set of MEE data is available. Seasonal climatic data such as temperature and rainfall will be necessary at each site in order to thoroughly interpret the biogeochemical cycle soil organic matter.

Conclusions

The positive effect of LM on soil microbial biomass and its activity was more evident in the Mediterranean environment starting from the main crop planting (t1) . Conversely, in the Northern site the effect of LM was significant in not tilled soil at the main crop harvesting (t2). These preliminary results establish the bases for the final evaluation at end of the project, on the importance of pedoclimatic conditions to prove the effect of LM at different tillage levels.

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Vepsalainen, M., Kukkonen, S., Vestberg, M., Sirvio, H., Niemi, R.M., 2001. Application of soil enzyme activity test kit in a field experiment. Soil Biology and Biochemistry 33, 1665–1672.

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