Geophysical Research Abstracts
Vol. 12, EGU2010-8921, 2010
EGU General Assembly 2010

Fertilization effects on soil organic matter turnover in a long term experiment

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Agricultural management practices such as residues application, level and kind of fertilization and amendment, tillage intensity can affect the capacity of soil to sequester and incorporate carbon (C). These practices also influence both above-ground and below-ground plant production and, as a consequence, the amount of C that enters the soil. However, studing the dyamics of C inputs in soils and the effects of the agricultural management practices on C incorporation in soil organic matter (SOM) requires long-term field experiments.
The long-term field experiment in Cadriano, at the University of Bologna, Italy, started in 1966 and still in progress, compares two continuous rotations of corn and wheat, interacting with two cattle manure supplies (M0: no manure – M1: 20 t ha-1 year-1 of fresh material) and two mineral NP rates (N0P0: no NP fertilizers – N1P1: 100 kg P2O5 ha-1 plus 200 and 300 kg N ha-1 for wheat and maize, respectively). The experimental design is a split-plot replicated twice, with fertilizer sub-plots of 56 m2 of area each. The field is annually ploughed to 40 cm depth. Crop residues are always removed, with the exception of roots and stubbles. By using the delta 13C technique we measured the amount of corn-derived C retained over a 36-years period in total soil organic C (SOC) and in the humic fraction that is referred as the most stable pool of SOC. These amounts were compared with the total inputs of belowground C (roots and rhizodepositions) in order to highlight if the capacity of soil to stabilize the new C inputs can be affected by the different fertilization practices.
The results showed that the amount of corn-derived C in SOC increased in the following order: control (20.5%), Mineral (25%) Manure (29.4%), the same trend was observed for the humic fraction. On the contrary the cumulative C input over the same period followed a different order, the highest was obtained for the mineral treatment, than for the manure and the control treatment. The higher C input measured with the mineral fertilization did not imply also a greater C stabilization, probably because the greater availability of nutrients could have stimulated greater mineralization processes. The manure seems to be able to stabilize more C possibly through a greater level of microbial biomass and activity, that in this situation was not probably limited by either nutrients or energy source. In the control (C0) the deficiency of both nutrients and energy source could have slowed down the C mineralization, thus leading more corn-derived C in the soil. Therefore the fertilization management not only affects the plant production and the C input to soil, but also the C mineralization and the capacity of soil to stabilize C, and this must be carefully considered and taken into account since it deeply influences the potentaility of soil for C sequestration.

The research was carried out with funds provided by MIUR (PRIN prot. 2007J5Z9LK_003)