Effect of Tillage and Slurry Application on Soil Quality and CO_2 Emissions

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Key words : cow slurry , tillage , microbial activity , CO_2 emissions

Introduction Agricultural ecosystems generally contain less soil organic carbon (SOC) pool than their potential capacity because of the low return and high rate of mineralization of biosolids , and severe losses due to accelerated erosion and leaching . The depletion of SOC pool leads to decline in soil biological quality and resilience with attendant reduction in biomass productivity , decreased capacity to degrade and filter pollutants , increased risks of soil degradation by erosion and other processes , and increase in emission of greenhouse gases (GHGs) . Some farming practices , such as organic fertilization , no-tillage and legume-based rotations can mitigate these problems . The main objective of the current work was to study the effects of the utilization of cow slurry and no-tillage on soil quality and CO_2 emission . We also intend to study the potential of soil microbial activity to assess the effect of these agricultural practices .

Materials and methods In Spring 2005 , a 2-year field assay was established in Basque Country (northern Spain) , in an acid (pH =5 .1) silty clay loam soil . The field assay consisted of an intensive crop rotation (cereal-legume mixture in winter /forage corn in summer) . The following treatments were applied in a randomized complete block design with 3 replicates : (i) convencional tillage + mineral fertilization , (ii) convencional tillage + cow slurry , (iii) no-tillage + mineral fertilization , and (iv) no-tillage + cow slurry . An absolute control (v) , consisting of a contiguous native meadow , was also studied . Mineral fertilization consisted of 150 kg N ha^{-1} , 100 kg P ha^{-1} , and 150 kg K^+ ha^{-1} and similar doses were used for the organic fertilization treatment with fresh cow slurry . For the conventional tillage , soil was ploughed to 25 cm with a mouldboard plough and then rotavated . Direct sowing for the no-tillage treatment was carried out with a Semeato machine . Soil OM content (MAPA , 1994) , dehydrogenase activity (Dick *et al* . , 1996) and CO_2 emission (PP-Systems EGM-4/SRC-1) were measured . Data were analysed using ANOVA and Fisher test .

Results and discussion The highest value of soil OM content was found in no-tilled and organically (cow slurry) fertilized plots , although the differences were statistically significant only when compared to those conventionally tilled plots treated with mineral fertilizer . Soil dehydrogenase activity , which apparently plays a role in oxidation of organic matter , also showed the highest value in no-tilled and organically fertilized plots , but in this case it was significantly higher than all the rest of the treatments . Dehydrogenase activity can be more sensitive to treatments most likely due to its being associated with viable microbial populations (Dick *et al* . , 1996) . Within each tillage system , plots amended with cow slurry showed higher values of dehydrogenase activity . Regarding CO_2 emission , conventional tillage seemed to increase CO_2 flux to atmosphere .

Table 1 *Effect of treatments in summer 2007 .Different letters within each line indicate significant differences ($p \leq 0.1$).*

	Till+Mineral	Till+Slurry	No-till+Mineral	No-till+slurry
OM content (%)	2 .71±0 .05^{a}	2 .92±0 .07^{ab}	2 .88±0 .09^{ab}	2 .99±0 .09^{b}
Dehydrogenase (mg INTF kg^{-1} dry soil h^{-1})	0 .33±0 .09^{a}	1 .23±0 .18^{a}	0 .37±0 .13^{a}	3 .77±1 .35^{b}
CO_2 emission (g CO_2 m^{-2} h^{-1})	0 .46±0 .16^{a}	0 .50±0 .02^{a}	0 .23±0 .03^{a}	0 .39±0 .02^{a}

Conclusions Cow slurry application increases soil OM content and dehydrogenase activity , particularly when is combined with no-tillage . Dehydrogenase activity has a great value as early and sensitive indicator of changes in soil properties induced by different systems of tillage and fertilization . No-tillage can contribute to reduce CO_2 emission form soil .

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References

MAPA , 1994 . M todos Oficiales de An lisis III . Madrid , España : M° de Agricultura , *Pesca y Alimentación* , p . 662 .
Dick , R .P . , Breackwell , D .P . , Turco , R .F . , 1996 . Soil Enzyme Activities and Biodiversity Measurements as Integrative Microbiological Indicators . In : Doran , JW , Jones A J . Methods for Assessing Soil Quality . Madison : *Soil Science* Society of America , 247-271 .