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Assessment of Water and Nitrate-N deep percolation fluxes in soil as affected by irrigation and nutrient management practices

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Many farming practices can result in contamination of groundwater, due to the downward migration of fertilizers and pesticides through the soil profile. The detrimental effects of this contamination are not limited to deterioration of chemical and physical properties of soils and waters, but also constitute a real risk to human and ecosystem health. Groundwater contamination may come from a very large array of chemicals. Nevertheless, on a global scale the main cause of pollution is a high nitrate concentration in the aquifer water. Nitrate concentrations of groundwater have constantly increased during the last decades, and the widespread use of commercial N fertilizers has been implicated as the main causative factor.

It is often claimed that nutrient management in organic farming is more environmentally sustainable than its conventional counterpart. It is commonly presumed that organic agriculture causes only minimal environmental pollution. There is scientific evidence that organic management may enhance some soil physical and biological properties. In particular, soil fertility management strategies can affect soil properties and the related hydrological processes.

It is thus crucial to quantify and predict management effects on soil properties in order to evaluate the effects of soil type, natural processes such as decomposition of organic matter, irrigation applications and preferential flow on the deep percolation fluxes of water and nitrates to the groundwater.

In this study, we measured the water fluxes and the quality of water percolating below the root zone, underlying organic agriculture systems in greenhouse. Specifically, the aim was to examine the effects of application time and type of organic matter in the soil on the nitrate-N deep percolation fluxes under the following three organic soil fertility strategies in greenhouse tomato experiment:

i. Organic input Substitution (which will be hereafter denoted SUBST) is represented as typical conventional agriculture and is a widely adopted organic production system, especially in greenhouse. So called because substituting the conventional agrochemicals with the organic allowed products;

ii. AGROMAN was characterized by a cover crop mixture and green manure, which are flattened on the ground;

iii. AGROCOM made of the mixed cover crop species and are incorporated into soil together with on-farm composting.

The SUBST was characterized by significantly lower water losses than the other two systems. In the first stage, very high nitrate fluxes were observed in all the three management systems. After, nitrate fluxes were practically null for the SUBST system, but in the second stage where some nitrate losses comes from the combination of low water fluxes and higher concentrations. Similar losses were observed for the AGROMAN system, but coming from a combination of higher fluxes and lower concentrations. Significant losses were observed in the AGROCOM system in the middle stage, coming from the combination of high fluxes and high concentrations.