Processes involving phosphorus accumulation and losses in undisturbed soil columns

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Nutrient losses to ground and surface waters following soil fertilisation largely contribute to the deterioration of water quality, and may lead to eutrophication of adjacent water bodies. Inappropriate fertiliser management may result in a supply of P that exceeds crop needs, and in the long term, may also affect soil P buffer capacity. These processes may lead to P losses via runoff, mainly in the particulate form, and leaching. Based on these considerations the effect of agronomic practices on P losses was evaluated in two temperate overfertilised cropping systems (NW Italy) managed since 1996 with (traditional; TRAD) and without (agro-environmental; PSR) mineral P fertilisation. Over 14 years, the absence of P fertilisation in the PSR system led to a reduction in Olsen P levels from 45 to 20 mg/kg, whereas Olsen P levels in the TRAD plots remained almost constant (35 mg/kg).

To evaluate the effect of fertilisation and organic amendment on the risk of P losses from TRAD and PSR maize plots, in 2010three subplots were established in each system and treated with (i) mineral P, (ii) municipal solid waste compost, and (iii) a no P control. A compost application dose was chosen to deliver the same amount of total P as for the mineral P subplots. Intact undisturbed soil columns (0-15 cm) were installed in each subplot immediately after fertilisation, by means of PVC tubing each having an anion exchangeable resin bag at the bottom to trap the leached soluble phosphate. Soil columns and bulk soil samples were destructively sampled in triplicate at four different times during the growing season to evaluate P losses after fertilisation, before and after irrigation/rain events and at harvest.

P leaching was evaluated by analysing the anion exchangeable resins while P susceptibility to runoff was evaluated by applying a soil dispersion test which simulates surface runoff, in order to quantify the amount of total dispersed solids and the main forms of soluble and colloidal P. In addition, the main processes involved in soil P cycling, including crop P uptake, microbial activity and P deriving from free and stabilized organic matter have been studied.