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Carbon and Phosphorus in soil particulate fraction: effect of continuous agriculture, tillage and fertilization

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In Argentinean Pampas region, the practice of intensive agriculture has diminished total organic carbon (TOC) content in soil. This degradation process can impact over phosphorus (P) organic fractions associated to it, and therefore limit soil capacity to provide P through mineralization. Along this line, P content in soil particulate fraction (PF) has been proposed as an index to estimate this capacity. The aims of this work were to evaluate (1) the effect of continuous agriculture, tillage and P fertilization over TOC and P fractions content in soil and PF, and (2) the stability of P-PF as a mineralization index. To this end, a long term experiment initiated in 2001 in Balcarce, Argentina, under continuous agriculture, was analyzed. There, two tillage systems – conventional till (CT) and no till (NT) – and two fertilization treatments – nitrogen (N) and N + P (NP) – were evaluated. Phosphorus rate was 30 kg ha-1 year-1. In each plot, the following parameters were determined in 2002, 2005, 2008 and 2011: TOC, P Bray, total P (Pt), inorganic P (Pi), and organic P (Po) content in the whole soil and in the PF. Also, C supply by residues and P soil balance during the experiment were calculated, and the P sorption capacity was determined in samples from 2011. C supply was greater in CT (7% relative to NT) and in NP (14% relative to N). However, TOC in soil was not modified neither by tillage or fertilization. Even though, C in the PF decreased (3% annually) by the use of continuous agriculture. This reduction was positively associated to the one observed in other soil properties as Pt, Pi and Po in the PF. P fertilization lessened this reduction in Pt (18,9 mg kg-1 in N and 23,1 mg kg-1 in NP in 2011) and Pi (4,2 mg kg-1 in N and 6,2 mg kg-1 in NP in 2011), but not in Po. This indicates that, Po is affected by management practices and, contrary to Pt, is stable to fertilization. Therefore Po can be studied as a potential P mineralization index. The difference among P fertilization treatments in Pt and Pi was caused by the sorption of Pi in the FP (111 μg g-1 maximum sorption capacity in N and 56 μg g-1 in NP). Also, Pi content in the PF was related to P Bray, proving that the PF is a source of P available to crops.