Nutrient losses from organic and conventional crop rotations – a case study on fine sand soil

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The intensity of the cultivation is often smaller in organic than in conventional crop rotations, due to less input of nutrients into the soil. Consequently, the yields in organic farming are smaller, and the nutrient losses into the environment are also expected to be less. However, there are not many studies on the actual leaching losses of nutrients, kg ha^{-1}, from organic crop rotations, especially compared with simultaneous losses from conventional rotations. We measured N and P losses in runoff from 4-year crop rotations with four different nutrient input intensities, three of the rotations placing the demands of organic farming. The study was performed in Toholampi, Central Ostrobothnia, with four replicates, on a fine sand soil containing 5% of organic C and a moderate P status in the surface soil. The organic crop rotations from the 1st to the 4th year were: 1st year barley with undersown red clover and timothy, 2nd year grass (clover + timothy), 3rd year grass, 4th year oats + fodder vetch. In the conventional rotation, the red clover was replaced by meadow fescue, and on the 4th year, barley for fodder silage was grown.

P and N losses were highest from the conventional crop rotation (Table 1). The losses were most affected by single management practices: dissolved P losses by surface application of chemical fertiliser on the second year, a practice still commonly used in grass cultivation, and N leaching by ploughing of the grass in the third and fourth year. The four-year study is, however, too short for soil derived, long-term differences to come fully out in the leaching losses. The study continues currently on the fine sand and is supplemented with measurements on a heavy clay soil in Jokioinen, where organic and conventional crop rotations have been cultivated since 1991. With longer data sets it is possible to consider the yield level as well as the losses, when estimating the ecological sustainability of the different cropping systems.

Table 1. Runoff and losses of total N (TN), total P (TP) and dissolved molybdate reactive P (DRP) in total runoff (in parenthesis divided between surface runoff and drainage flow) and crop yield from the four crop rotations (inputs of total N, P, soluble K in parenthesis) during 4 years.

1997 - 2001 Tot. precip. 2 719 mm	A. Organic No manure (0,0,0)	B. Organic Fur manure (140,165,20)	C. Organic Cattle manure (0.9 cows ha^{-1}) (522,125,390)	D. Conventional Cattle manure (0.9 cows ha^{-1}), + NPK (808,137,508)
Runoff, mm	820 (441; 379)	790 (445; 345)	823 (456; 368)	835 (464; 371)
TN, kg ha^{-1}	31 (10; 21)	28 (9.8; 18)	29 (9.4; 19)	42 (8.6; 33)
TP, kg ha^{-1}	1.8 (1.7; 0.1)	1.8 (1.7; 0.1)	1.9 (1.7; 0.1)	2.2 (2.1; 0.1)
DRP,kg ha^{-1}	0.62 (0.58; 0.04)	0.66 (0.62; 0.04)	0.71 (0.67; 0.04)	1.4 (1.4; 0.04)
Yield,fu ha^{-1}	14 600	17 810	20 360	26 560