

Shallow groundwater nitrogen and denitrification in a newly afforested, subirrigated riparian buffer

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Summary

1. The EU ‘Nitrates Directive’ (Directive 91/676/EEC) and the WFD (Water Framework Directive 2000/60/EEC) introduced a series of measures designed to reduce and prevent water pollution caused or induced by nitrates from agricultural sources. Therefore, there is an urgent requirement to control the nitrate concentration in freshwater. The objective of this paper was to verify the potential capacity of a specifically designed afforested riparian zone in removing the excess of nitrogen from river water.

2. A buffer zone was set with irrigation ditches, to produce a subsurface water flow carrying water from the study river through the buffer strip to drainage ditches. This experimental system enables the co-occurrence of two main processes: vegetation/microbial nitrogen uptake and denitrification. Both *in situ* denitrification and denitrification potential were measured at different soil depths, and nitrogen removal of water passing through the buffer system was measured.

3. After the first year, high removal rates (63–64%) of total nitrogen in water were recorded. The lowest rate of denitrification took place in the upper soil layer, while maximum denitrification occurred in the medium layer (40–55 cm). Denitrification occurred mainly in the first few metres of the irrigation ditches leading away from the river. The denitrification rates clearly increased from the second to the third year, with highest rates in summer and autumn. Denitrification potential indicated that carbon availability was the most limiting factor.

4. *Synthesis and applications.* This study has demonstrated that nitrogen levels can be reduced in rivers by forcing water to circulate through afforested buffers. Nitrogen was removed both by plants and by microbial denitrification. Such activity can be supported by promoting anoxic conditions through appropriate water flow management. This could be achieved by creating semi-natural floodplains where water flows can be efficiently managed as in a drained wetland.