

## **Impact of farming practices on phosphorus transport in an irrigated watershed in the middle Ebro Basin (Spain)**

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Phosphorus (P) losses caused by intensive agriculture have negative effects on water quality of surface aquatic systems. To better understand the impact of farming practices on P transport in irrigated agricultural systems, temporal patterns of P concentrations (total P (TP), total dissolved P (TDP) and particulate P (PP)) were analyzed over two hydrologic years (October 2007-September 2009) in the El Reguero Basin (Huesca, Spain). Water and P mass balances were also calculated in order to identify the main source and transport factors of the transfer of P. Farming practices (mainly irrigation and fertilization) carried out in spring and summer seasons increased TP concentrations reaching a maximum of 1.01 mg P L<sup>-1</sup>. Results of P mass balance revealed that the main source was fertilization responsible for more than 98 % of total P inputs in the watershed. In the case of crop P requirements, results indicated that 60 % of applied P (fertilizer) exceeds crops needs and leads to an excess of 53.7 kg P ha<sup>-1</sup> year<sup>-1</sup>. This excess contributes to the P build-up on the soil surface, making it susceptible to further transfer to streams and subsequent deterioration of water quality. According to the soil survey performed in the study area, soils showed a P enrichment ratio of 31% (P-Olsen from 29.30 ppm at the beginning of the agricultural season to 38.45 ppm at the end). Therefore, P fertilization should be calculated according crop needs and the available phosphorus in the soil. 94 % of TP concentrations were recorded in the dissolved form indicating that the dominant pathway for P transfer was subsurface flow, mainly by leaching process of excess irrigation water. All the water samples analyzed during the study period presented TP concentrations superior to the threshold of eutrophication (0.02 mg L<sup>-1</sup>) indicated by Sharpley et al. (2001). The El Reguero stream drainage water was classified as hypertrophic during the 1<sup>st</sup> study year (mean annual TP = 0.179 mg L<sup>-1</sup>, > 0.100 mg L<sup>-1</sup>) and eutrophic during the 2<sup>nd</sup> study year (mean annual TP = 0.061 mg L<sup>-1</sup>, > 0.035 mg L<sup>-1</sup> and < 0.100 mg L<sup>-1</sup>) (Olmos Gracia, 2000). The exported masses of P were 240 kg in 2008 and 229 kg in 2009 and the TP losses of 0.204 and 0.194 kg P ha<sup>-1</sup> for 2008 and 2009, respectively. The amount of TP load in El Reguero stream is very small with regard to total phosphorus input (0.2%). Based on P mass balance, mitigation of P in El Reguero stream watershed should focus on reducing the amount of the applied phosphate fertilizers through accurate nutrient budgeting and fractionating over the vegetative crop cycle. Farmers should also take into account P content in crop residues which is approximately 40- 60% of harvested P, most of which is plowed under (principally corn residues).

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