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Importance of poplar plantations in the groundwater mass balance and stream base flow of a Mediterranean basin

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Poplar plantations are used for biomass production in many countries.Poplar (Populus spp.) is well known for its large biomass production, its ability to adapt to different environments, its ability to synergise with agriculture and its high energy potential. These plantations areoften located in areas where the tree roots can reach the water table of shallow aquifers to reduce irrigation costs but increasing evapotranspiration, mainly during the summer. This study aims to assess the effects of these plantations on an aquifer water budget and on the stream base flow of a Mediterranean basin, the Santa Coloma river (321.3 km2) located in the NE Spain. A numerical flow model was constructed using Visual Modflow 4.5 Software to simulate groundwater flow in the shallow aquifers and the stream-aquifer interaction for a period of 9 years. Once the model was calibrated, different land use scenarios, such as deciduous forests, dry farming and irrigated farming, were simulated for comparison. The mass balance shows that poplar extracts an average of 2.40 hm3 from the aquifer. This amount of water represents the 30% of the aquifer withdrawal, approximately 18% of the average recharge of the aquifer and 12 % of the total outputs of the system. This effect reduces the groundwater flow to the main stream and increases the infiltration from the stream to the aquifer. Compared with deciduous forest as a soil use , there is an average reduction in the main stream flow by 46% during the summer months, when the lowest flow occurs and when the river is most sensitive. These results indicate that this impact should be considered in basin management plans and in evaluating the benefits of this type of biomass production.Additional research is needed to conceptualise the costs and benefits of this type of non-natural plantations for biomass production, specifically, the associated economic benefits and the effects on the water budget (i.e. stream flow) at various scales (local, basin or national level).

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