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From Forest Nursery Notes, Winter 2011

164. © Afforestation improves soil fertility in south-eastern Spain. Fernandez-Ondono, E., Serrano, L. R., Jimenez, M. N., and Navarro, F. B. European Journal of Forest Research 129:707-717. 2010.

Afforestation improves soil fertility in south-eastern Spain

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Received: 20 June 2009 / Revised: 19 January 2010 / Accepted: 5 March 2010 / Published online: 25 March 2010
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Abstract In the 20th century, in the Mediterranean area, many extensive afforestation efforts were made with the primary objective of protecting soils from erosion and improving their fertility. This study evaluates the effects of the afforestation undertaken in the Guadalentín basin (SE Spain) with respect to the organic and inorganic soil constituents and physico-chemical soil properties. Given the phytoclimatic environments in the basin (sclerophyllous and hyperxerophyllous), paired samples were taken beneath the tree canopy of the pine plantations and in nearby open zones. With the same methodology, samples were taken from areas considered to be native forest. The data were submitted to different multivariate analyses of variance (two-way MANOVAs) in order to compare the effects and interactions of the factors CANOPY (with and without trees), PHYTOCLIMATE (sclerophyllous and hyperxerophyllous), and TYPE OF FOREST (afforested or native) on the dependent variables measured (soil variables). Significant differences were found at 0–10 cm in

soil depth under pine afforestations in relation to adjacent open areas. Below this depth, differences were found only between phytoclimatic environments. No significant interactions were found between the variables analysed at any of the depths, indicating that the effects of the afforestations on the soil characteristics were independent of the phytoclimatic environment. The afforestation in the Guadalentín basin, in the two phytoclimatic environments considered increased the soil fertility. Nevertheless, the native forests presented the highest soil organic-carbon contents, mainly in the sclerophyllous phytoclimate type (*Quercus ilex* subsp. *ballota* forests). Therefore, although the afforestations improved the soil fertility in relation to the open areas, the maximum potential has probably not been reached in relation to that observed in the native forests. The effects that forest development (age, basal area) over time exerts on soil properties remain to be verified by further research.

Keywords Afforestation · Differential pedological characteristics · Organic carbon · Guadalentín basin

Communicated by A. Merino.

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Introduction

The severe processes of erosion and desertification of large zones of the Mediterranean region have for decades worried governments and researchers (Albadalejo et al. 1988; United Nations 1992); and therefore, the protection of the soil currently constitutes a priority environmental policy in many countries and international organizations (Commission European Communities 2006). Erosion, the most important soil-degradation process, is related to human demographic pressure, the reduction in the plant cover, the special characteristics of the Mediterranean climate,