



Water use and water use efficiency after thinning in Aleppo pine plantation in Southwest of Valencia, Spain

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Mediterranean forests need a proactive adaptive silviculture in the face of global change, being their water-use (WU) and water use efficiency (WUE) the key factors to forest managers. Thinning, as a silvicultural practice, has the potential to alter the water potential gradients that exist between soil and canopy. As a result, a change in the amount of water used by trees is produced.

The aim of this study is to analyse the effects of the adaptive silviculture on the water-use and water-use efficiency. To that end, both WU and WUE, are measured in an Aleppo pine plantation, where different thinning intensities were applied. The experimental set-up consisted of four plots, three of them corresponding to thinning treatments in 2008 at different intensities High, Middle and Low plus an unthinned plot – control. Additionally, a plot next to the treatment, thinned with High intensity in 1998 was sampled to assess the longer-term effects of thinning. The plots are located at Southwest of Valencia-Spain.

WU was measured in four trees per plot on the period April 2009 to May 2011 using HRM sapflow-sensors. WUE was described following the Carbon stable isotope theory by a dendrochronological approach. A stable isotope analysis was performed in the same trees used to measure sapflow. The analysed rings were those correspondent to the 3 previous years to the thinning, and the following after the treatment.

The results from this study indicate that stand WU is significantly different ($p < 0.05$) in each tested treatment, being higher in control plot, followed by Low, Medium and Heavy treatments. However, considering only the tree, the average WU was higher in the Heavy treatment. No significantly differences were found between low and control trees.

The dendrochronological analyses showed a general variability in ring width during the initial growth (first 15 years). In the following years, the ring widths were very small, probably conditioned by climate conditions. However, immediately after thinning, all trees showed a significant increase when compared with control.

The WUE show different patterns in dry and wet years, and between thinned and control plots. The correlation between WU and WUE was higher in the thinned plots than in control plot. Different patterns of the relationship between WUE and WU were found during years 2009 and 2010. A positive slope was found in thinned plots during 2008 (Low, Medium and Heavy), while negative slope was described in Heavy thinning 1998 and Control plots.

In conclusion the reactions after thinning equally promote an increase in WU (tree transpiration), growth and WUE. However in the control plot the increase of WU produces a decrease of WUE. This probably responds to the lower rate of growth found in this plot.

This study shows clearly the impacts of thinning in forest growth, water use and water use efficiency. Some of the effects of thinning have been pointed out in other studies. However, this study introduce a novel contribution relating WU to WUE in a Mediterranean Aleppo pine plantation.