

FACTORS AFFECTING TREE GROWTH RESPONSES TO DROUGHT IN MEDITERRANEAN CONIFERS

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Abstract

We lack information regarding the main factors driving growth responses to drought in tree species with different vulnerability against this stressor and considering sites with contrasting climatic conditions. In this study we analyze the drivers controlling tree radial growth response to drought in two Mediterranean conifer species (*Abies alba* and *Pinus halepensis*) growing across a pronounced climatic gradient, under Mediterranean conditions, in north-eastern Spain. A drought index (Standardized Precipitation Index, SPI) characterized at several time scales (1 to 48 months) was correlated with tree-ring width chronologies to determine the significant scales at which drought mostly influenced growth and the magnitude of such influence. To summarize the patterns of growth responses to drought, we used principal component analysis (PCA). To determine the main factors affecting growth responses to drought, correlation and regression analyses were carried out using a set of abiotic (climate, topography, soil type) and biotic (Normalized Difference Vegetation Index, Enhanced Vegetation Index, tree-ring width, diameter at breast height) predictors and the PCs loadings as response variables. PCA revealed two distinct patterns of growth responses to drought corresponding to xeric and mesic sites dominated by *P. halepensis* and *A. alba*, respectively. Both species showed the strongest associations between growth and drought in summer but these responses were observed at long time scales in *P. halepensis* (9-12 months) and at short ones in *A. alba* (2-5 months). The correlation between abiotic and biotic variables and the two first principal components (PC1, PC2) summarizing the growth responses to drought indicated that tree-related (Dbh, tree-ring width), remote-sensing, climatic (water balance, precipitation) and topographic variables were significantly ($P < 0.01$) and inversely correlated with the PC1 and PC2. The growth responses to drought in xeric and mesic forests were mainly driven by the annual precipitation and annual water balance, respectively. The management of Mediterranean forests under the predicted warmer and drier conditions should focus on the main drivers modulating the negative impacts of drought on tree growth.

Keywords: *Drought, Drivers, Iberian Peninsula, Radial growth, Standardized precipitation index*