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Influence of plant community structure on vulnerability to drought of semiarid pine woodlands.

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The growth, water status and water use efficiency of trees are sensitive to drought. The severity of drought experienced by trees can be magnified or diminished depending on plant community structure and density. This is especially important in semiarid environments. In dense afforested plantations, high inter-tree competition for soil water could increase the water stress of trees in comparison to plants in an open woodland. On the other hand, the shading effect of the tree canopy and the increased soil infiltration capacity in semiarid afforested stands could prevail over competition and buffer the drought effect. Thus, in dense afforested plantations, greater inter-tree competition but more favourable microclimatic conditions may have opposite effects, and the prevalence of one of them could depend on annual meteorological conditions.

To test these hypotheses, we made a long term assessment (50 years) of tree ring growth and isotopic composition of *Pinus halepensis* in two nearby communities: an afforested pine stand and an open pine woodland with under storey (shrub land), both located in semiarid SE Spain (Murcia). We sampled 10 trees per site and we measured tree ring width. The individual time series were detrended and the mean chronology was calculated for each series. On selected five trees per location, the annual δ^{13}C and δ^{18}O were measured on cellulose extracted from latewood. The relationships between measured variables and meteorological (temperature and precipitation) data, provided by the Spanish Agency of Meteorology, were statistically assessed with linear regression analyses.

We found a strong significant correlation between the standardized mean chronologies of pines in both communities. In both sites, the mean sensitivity of the mean chronologies was high: 0.37 in the open pine woodland (*ow*) and 0.54 in the afforested stand (*as*), suggesting that the individual growth series have a clear common signal. Our results show significant positive correlations between mean chronologies and total annual precipitation (Pearson's r = 0.52 in *ow*; r = 0.51 in *as*), total monthly precipitation in March (r = 0.40 in *ow*; r= 0.40 in *as*) and in May (r = 0.39 in *ow*; r= 0.31 in *as*), precipitation in the current summer (r= 0.30 in *ow*; r = 0.36 in *as*) and the total amount of precipitation from October of the previous year to April of current year (r= 0.61 in *ow*; r= 0.63 in *as*). Precipitation seems to be the driving factor influencing growth of pines in this semiarid environment.

When comparing the standardized mean chronologies of both communities we observe greater growth of pines in the open pine woodland than in the afforestated stand. However, in rainy years, pines in the afforested stand experienced relatively greater increment in growth. Inter-tree competition for soil water seems to limit tree radial growth in semiarid pine plantations, but the beneficial effect of more mesic microclimatic conditions appear to prevail in more favourable years. Defoliating insect outbreaks in the dense pine plantation could also be partly responsible for reduced radial growth of trees.

Measurement of carbon and oxygen stable isotope composition of latewood cellulose could provide insight into the physiological responses of trees to changes in water stress.