

# Adaptive mechanisms and genomic plasticity in drought tolerance identified in a European population of black poplar (*Populus nigra* L.)

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## Abstract

Predictions indicate that summer droughts will increase in frequency and intensity over Europe. Therefore the study of adaptation to drought for the ecologically and economically important genus *Populus* is essential. Wild trees of *Populus nigra* were collected in five European countries, reflecting a wide range of rainfall and temperatures. Small leaf sizes were observed in genotypes from Spain and Southern France, possibly indicating an adaptation to drought tolerance. Six genotypes from different latitudes of origin and displaying contrasting leaf phenologies and carbon isotope discrimination values ( $\Delta^{13}\text{C}$ ) were selected for a drought experiment in controlled conditions.

Biomass was affected by drought stress for all genotypes with different degrees of reaction. Spanish and French genotypes rapidly responded to drought stress with stomatal closure and decreased in  $\Delta^{13}\text{C}$  which is negatively associated with water use efficiency. Gene expression using microarrays and real-time PCR were then studied and revealed differences in response to drought between genotypes: 3167 transcripts were differentially expressed in response to drought in the Italian genotype while only 649 transcripts were differentially expressed in response to drought in the Spanish trees. Stomatal formation and patterning genes differed in response to water deficit such as *ERECTA*, *TOO MANY MOUTHS*, *MUTE* and *SPEECHLESS*.

These results provide important insights into morphological, physiological and genetic variation underpinning adaptation to drought across Europe that may be valuable in future conservation and management of trees facing climate change.