

# Structural and functional leaf diversity lead to variability in photosynthetic capacity across a range of *Juglans regia* genotypes

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## Abstract

Similar to other cropping systems, few walnut cultivars are used as scion in commercial production. Germplasm collections can be used to diversify cultivar options and hold potential for improving crop productivity, disease resistance and stress tolerance. In this study we explored the anatomical and biochemical bases of photosynthetic capacity in 11 *J. regia* accessions in the USDA-ARS National Clonal Germplasm Repository. Net assimilation rate ( $A_n$ ) differed significantly among accessions and was greater in those from lower latitudes coincident with increases in stomatal and mesophyll conductance, leaf thickness, mesophyll porosity and gas-phase diffusion, and leaf nitrogen, and lower leaf mass and stomatal density. High CO<sub>2</sub>-saturated assimilation rates led to increases in  $A_n$  under limiting conditions. Greater  $A_n$  was found in lower latitude accessions native to climates with more frost-free days, greater precipitation seasonality, and lower temperature seasonality. As expected, water stress consistently impaired photosynthesis with the highest % reductions in three lower latitude accessions (A3, A5, and A9), which had the highest  $A_n$  under well-watered conditions. However,  $A_n$  for A3 and A5 remained amongst the highest under dehydration. *J. regia* accessions, which have leaf structural traits and biochemistry that enhance photosynthesis, could be used as commercial scions or breeding parents to enhance productivity.