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# Carbon gain optimization in five broadleaf deciduous trees in response to light variation within the crown: correlations among morphological, anatomical and physiological leaf traits

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**Abstract –** Leaf trait variations in five deciduous species (*Quercus robur, Corylus avellana*, *Populus alba, Acer campestre*, *Robinia pseudoacacia*) growing in an old broadleaf deciduous forest in response to light variation within the tree crown was analyzed. Net photosynthetic rate ($P_N$), leaf respiration rate (R) and the photosynthetic nitrogen use efficiency were, on average, more than 100% higher in sun than in shade leaves. *A. campestre* and *C. avellana* sun leaves had the highest specific leaf area (SLA, 156.0 ± 17.9 $cm^2$ $g^{-1}$) and the lowest total leaf thickness (L, 101.9 ± 8.8 μm) underlining their shade-tolerance. Among the shade-intolerant species (*Q. robur*, *P. alba* and *R. pseudoacacia*), *Q. robur* had the lowest SLA and the highest L in sun leaves (130.6 ± 10.0 $cm^2$ $g^{-1}$ and 160.8 ± 9.6 μm, respectively) since shade-intolerant species typically have thicker leaves. The higher $P_N$ decrease in respect to R decrease from sun to shade leaves attested the higher sensitivity of $P_N$ than R to light variations within the crown. This determined a 69% lower $R/P_N$ in sun than in shade leaves. This result is further attested by the significant correlation between $P_N$ and the relative photosynthetic photon flux density. The shade-tolerant species have a 76% higher $R/P_N$ ratio than the shade-intolerant ones. The measured leaf phenotypic plasticity (PI = 0.35) was in the range of broadleaf deciduous species. Plasticity is a key trait useful to quantify plant response to environmental stimuli. It is defined as the ability of a genotype to produce different phenotypes depending on the environment. Among the considered species, *Q. robur* showed the highest PI (0.39) and *P. alba* the lowest (0.29). Knowledge on phenotypic plasticity is important in making hypotheses about the dynamics of the studied forest in consideration of environmental stress factors, including invasive species competition and global climate change.

**Keywords:** deciduous trees, forest, gas exchange, light gradient, shade tolerance, specific leaf area

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