EGU21-3999, updated on 06 Jul 2022
https://doi.org/10.5194/egusphere-egu21-3999
EGU General Assembly 2021

Allometric models for the estimation of leaf area and dry weight from sapwood and heartwood area in black locust (*R. pseudacacia*)

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Allometric equations relating a tree's vascular system with its leaf area and dry weight are developed for numerous forest species, in order to link their hydraulic architecture to carbon and biomass allocation. In 1964, Shinozaki *et al.* published the Pipe Model Theory (PMT) according to which, a given amount of leaves is supported by and is directly proportional to the area of the conductive tissue of the trunk. The present study aimed at testing whether PMT applies for *R. pseudacacia* plantations established for restoration and carbon sequestration purposes. A total of 25 trees of black locust grown at the restored former open-cast mining areas of the lignite center of the Hellenic Public Power Corporation (HPPC) in Ptolemaida and Aminteo, NW Greece, were destructively sampled. For each tree we determined its leaf area, foliage dry weight, diameter at breast height, as well as the cross-sectional areas of the trunk, the sapwood and the current sapwood at the stump height (0.30m), the breast height (1.3m), in the middle of the stem, at the base of live crown, at 1/3 and 2/3 of the length of the crown. The relationships of leaf area and foliage dry weight with the different cross-sectional areas at the selected stem heights were tested with simple and multiple linear regression models at $p<0.001$.

Among all tested relationships, PMT was more strongly verified by the linear relationship estimating both leaf area and foliage dry weight by the total cross-sectional area at the middle of the stem (R^2=0.81). Sapwood area was found to be a less strong estimator of leaf area and foliage dry weight. The best relationships between sapwood area and leaf area / foliage were established when measured at the 1/3 of the length of the crown (R^2=0.70 and 0.77, for leaf area and dry weight, respectively). The widely used relationship of sapwood at breast height to both leaf area and weight was less strong in our study (R^2=0.66 and 0.68, for leaf area and dry weight, respectively). Furthermore, our results were not consistent with the theory of Shinozaki et al. (1964) that the ratio of leaf area to sapwood area increases from the top of the tree to the base of crown, where it is stabilized until breast height. These deviations may be due to the age of the studied plantations which does not exceed 30 years and the properties of the growth substrate consisting mainly of depositions from the extraction of lignite. The strongest allometric models for the estimation of leaf area and weight by tree diameter were built at breast height (R^2=0.72) and at the base of live crown (R^2=0.73), respectively. In addition, the trees' diameter at the base of live

crown could be reliably estimated by their diameter at breast height (R^2=0.78). Our results were only partly consistent with the PMT. However, the established relationships may be useful for modelling and assessment of carbon allocation, water balance and growth of black locust plantations in restoration sites.