



## FRACTAL CHARACTERIZATION OF LEAF GEOMETRY IN *Populus alba* L.

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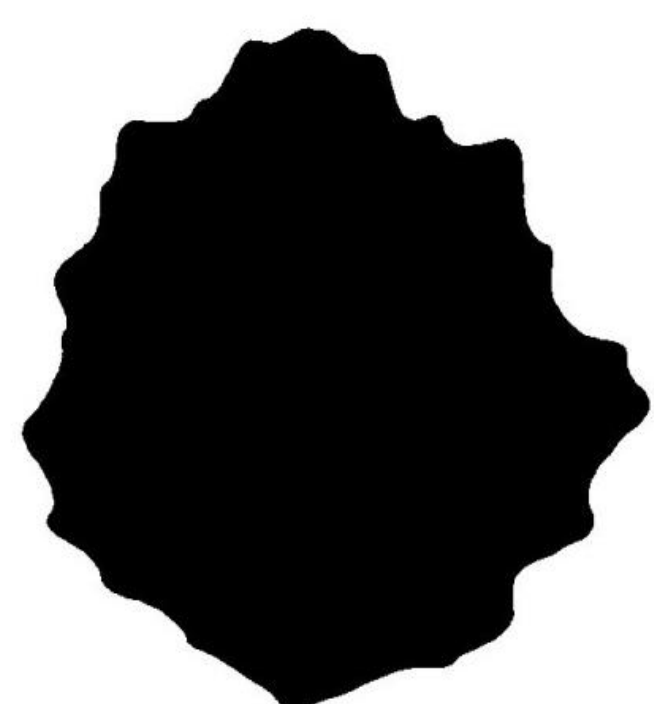
**Abstract:** The study used fractal analysis to evaluate and describe the geometry of the leaves at the *Populus alba* L. specie. The leaf samples were taken randomly, from mature trees, from the Cenad Forest Protected Area, Timis County, Romania. The leaves were scanned in a 1:1 ratio, and binarized images of the leaves were used for fractal analysis of leaf geometry. The box-counting method was used for the fractal analysis in order to obtain the values of the fractal dimensions (D).

### • Introduction

In the plant field, fractal analysis has found applicability in the study, characterization and identification of different plant species based on leaf geometry (BRUNO et al., 2008; BACKES et al., 2009; DU et al., 2013, MUSARELLA et al., 2018), leaf midrib cross-sections (DA SILVA et al., 2015), in plant taxonomy studies etc. (BAYIRLI et al., 2014).

### • Material and method

The leaves of *Populus alba* L. specie were scanned in a 1:1 size ratio. The images were analyzed to evaluate the fractal geometry of the leaves. Binarized images were used.



The box-counting analysis method (Voss, 1985) was used to obtain the fractal dimensions D.

In addition to the fractal analysis, the values of the leaf parameters were recorded (RASBAND, 1997), such as, L (leaf length), w (leaf width), SLA (scanned leaf area), Per (leaf perimeter). The values of foreground pixels (FP), fractal dimensions (D), correlation coefficient for D ( $R^2$ ), and standard error (SE) were recorded from the fractal analysis.

### • Results and discussions

From the analysis of CV values, it was found that the smallest variation was recorded in the case of fractal dimensions (D), and the largest in the case of SLA. This suggests that the fractal dimensions (D) is the most stable parameter in the characterization of leaf geometry in the species *Populus alba* L.

It was found that the values of the fractal dimensions D had a closer correlation with the leaf perimeter (Per), followed by the SLA and FP. This shows that the perimeter (Per), as an element of leaf geometry, had a much higher importance in defining the values of fractal dimensions (D) compared to the other parameters studied (FP and SLA).

The parameter L (leaf length) and the parameter w (leaf width) had a moderate importance in defining the fractal dimension (D), according to  $R^2 = 0.799$  in the case of L and respectively  $R^2 = 0.698$  in the case of w.

### • Conclusions

Between the fractal dimensions (D) and the dimensional parameters of the leaves, interdependence relations were identified, described by polynomial equations of degree 2 in static safety conditions,  $p < 0.001$ .

Compared with foliar parameters L, w, Per, SLA, the fractal dimensions D showed high stability in characterizing the geometry of the analyzed leaves at the species *Populus alba* L.