INTERSPECIFIC AND INTERANNUAL VARIABILITY OF STOMATAL AND LEAF TRAITS IN POPLAR CLONES

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INTRODUCTION

Stomata play a crucial role in plant functioning by regulating the exchange of water vapor and carbon dioxide between the plant and its environment [1]. Balancing water loss with CO_2 uptake has been a key factor throughout plant evolution, and in today's hotter and drier climate it has become even more critical. Studying stomata is therefore essential for understanding plant growth and resilience under changing climate [2,3].

In the study, we analyzed morphological differences in stomata among 10 clones of poplar (*Populus* sp.). Leaves and stomatal imprints were collected during three climatically contrasting years. The aim was to determine whether the observed differences were primarily caused by environmental conditions or by intraspecific (genetic) variability.

METHODS

Clone No.	Clone Name	Clone Characteristics
P739	NL-B-132m	*Populus × euroamericana* (Dode) Guinier
P741	Virginiana de Frignicourt	*Populus × euroamericana* (Dode) Guinier
P462	Androscoggin	*Populus maximowiczii × trichocarpa* (Stout et Schreiner)
P284	Robusta	*Populus × euroamericana* (Dode) Guinier
P239	I-476	*Populus × euroamericana* (Dode) Guinier
P467	NE-42	*Populus maximowiczii × trichocarpa* (Stout et Schreiner)
P494	Oxford	*Populus maximowiczii × P. × berolinensis* (Stout et Schreiner)
P716	Panonnia	*Populus × euroamericana* (Dode) Guinier
P114	Fritzi Pauley	*Populus trichocarpa* (Torr. et Gray f)
P463	MAX1	*Populus maximowiczii × nigra*

Fig. 1: Poplar Clones Evaluated

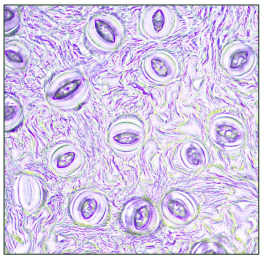

Fig. 2: Stomatal imprint (40×10 magnification)

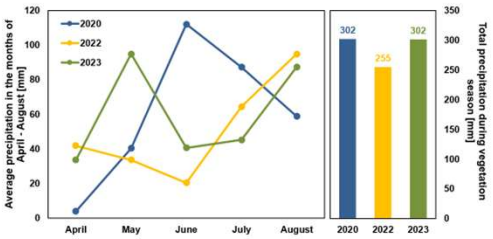

Fig. 3: Precipitation in the months April - August

- Ten poplar clones (Fig. 1) growing in the clonal plantation of fast-growing trees in Budča, Slovakia were evaluated over three climatically contrasting years (Fig. 3, 4).
- Leaves were collected at the turn of August and September from the upper crown on the southeastern side, in order to minimize the effects of orientation, crown position, and sunlight on stomatal traits.
- A transparent varnish was applied to one leaf per individual, and after drying, the imprint was transferred to a microscope slide using adhesive tape.
- Stomata were counted on 10×10 magnification images within a 0.5 × 0.5 mm frame and converted to density per mm², while stomatal size (4–5 stomata per imprint) was measured on 40×10 images by determining guard cell length. All assessments were performed in ImageJ.
- Leaves (≈5 per individual) were scanned to determine area in ImageJ, dried at 75 °C for 72 h, weighed for dry mass, and LMA was calculated as dry mass per leaf area.
- Data were analyzed in RStudio; means and standard deviations were calculated, and differences among clones and years were tested using ANOVA with Tukey's post-hoc test after verifying normality.

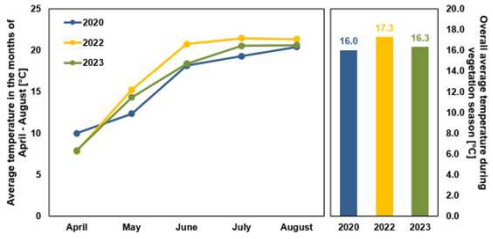

Fig. 4: Average temperature in the months April - August

RESULTS

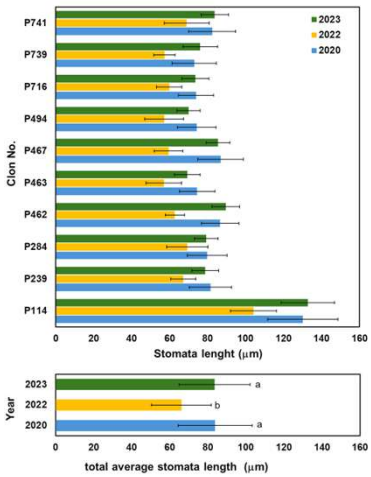

Fig. 5: Evaluation of average stomatal length among clones and overall across the study years.

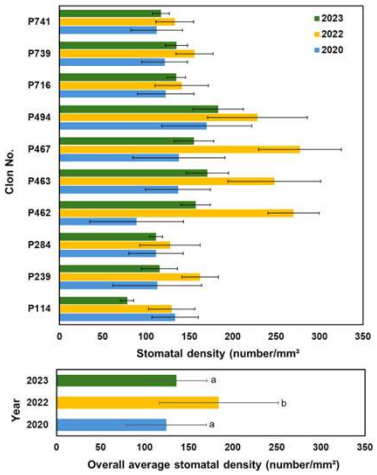

Fig. 6: Evaluation of the average stomatal density among clones and overall across the study years.

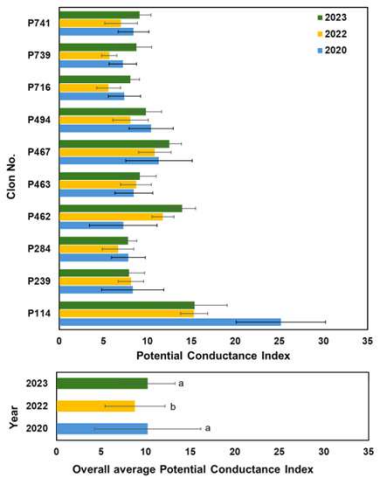

Fig. 7: Evaluation of the average value of Potential Conductance Index among clones and overall across the study years.

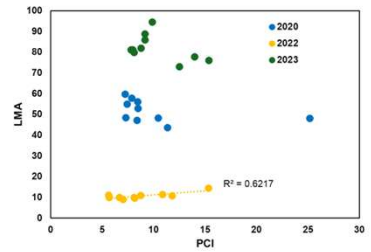

Fig. 8 Graph showing the relationship between leaf mass per area and the Potential Conductance Index

CONCLUSIONS

- Genetic predisposition appears to influence stomatal traits, as certain poplar clones consistently exhibited larger stomata and higher Potential Conductance Index (PCI) across all years (Fig. 5, Fig. 7). Among them, the *Populus* Fritzi Pauley (P114) clone showed the best values in most parameters, suggesting superior CO_2 assimilation capacity and growth potential. However, its larger stomata may compromise drought tolerance due to slower stomatal closure.
- Year-to-year comparisons showed the smallest stomata and highest stomatal density in the driest year (2022), indicating adaptation to minimize water loss while maintaining gas exchange. PCI values varied little among years, although 2022 was statistically lowest.
- Leaf mass per area (LMA) was unexpectedly lowest in 2022, contrary to expectations of thicker leaves under drought. In 2023, LMA tripled, possibly reflecting an adaptive response to prior stress, suggesting plants exhibit a form of stress memory.

ACKNOWLEDGEMENT

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