Study of the Air Pollution Tolerance Index (APTI) of different tree species in the city of Vienna

Dina Bibi[a] , Bianka Sipos[ab], Vanda Éva Abriha-Molnár[b], Dávid Tőzsér[a], Béla Tóthmérész[c], Edina Simon[a,b]

[a]Department of Ecology, University of Debrecen, Egyetem tér 1, H-4032 Debrecen, Hungary

[b]ELKH-DE Anthropocene Ecology Research Group, University of Debrecen, Egyetem tér 1, H-4032 Debrecen, Hungary

[c]MTA-DE Biodiversity and Ecosystem Services Research Group P.O. Box 71, H-4010 Debrecen Hungary

Introduction

Plants in the vicinity of a pollution source could be screened for their sensitivity and tolerance levels for different pollutants by studying different biochemical parameters of plants, including total chlorophyll, ascorbic acid, pH of leaf extract and relative water content. These parameters are computed in a single formulation called air pollution tolerance index (APTI).

Aims

The aim of our study was to investigate air pollution tolerance index (APTI) in different plant leaves along the urbanization gradient in Wien, in Europe.

Material and Method

Samples were collected in Vienna , Austria. We analysed the APTI of three tree species *Acer platanoides* (Norway maple), *Fraxinus excelsior* (Ash), and *Querucus robur* (Oak) along the urbanization gradient representing urban, suburban and rural areas (Fig. 1). At each sampling site 5 tree individuals were chosen and from the tree 30 leaves were collected.

Acer platanoides (Norway maple)

Fraxinus excelsior (Ash)

Querucus robur (Oak)

Figure 1. Studied species along the urbanization gradient in Vienna

Air Pollution Tolerance Index

APTI values were calculated based on the ascorbic acid content in mg g^{-1}(A), total chlorophyll content in mg g^{-1}(T), pH of leaf extract (P), and relative water content (R) of the tree leaves. Using these parameters, we applied the equation proposed by (Singh et al., 1991) for APTI.

$$APTI= [A \times (T+P) +R] /10$$

Results

Based on the obtained index, individual tree species can be classified into four sensitivity categories sensitive, medium, moderately tolerant, and tolerant. The results showed that, based on the APTI, all investigated species belong to the category sensitive to air pollution (Fig. 2-4). Based on the statistical analysis, we found a significant difference between the species based on the relative moisture content, pH, ascorbic acid and chlorophyll content. We found a significant difference between the areas based on the chlorophyll content and pH. In the case of the *Q. robur* experienced a significantly lower relative moisture content, and in the case of the *F. excelsior*, a significantly lower ascorbic acid content. The highest chlorophyll content was found in *A. platanoides*.

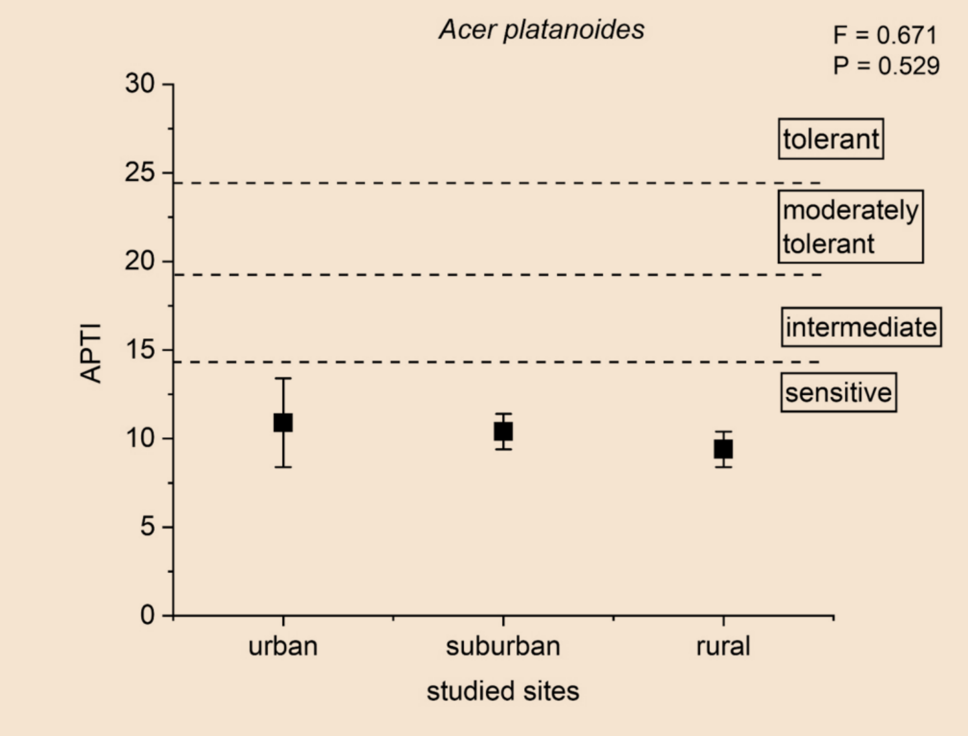

Figure 2. APTI values (mean ± SD) for *A. platanoides* along the urbanization gradient in Vienna

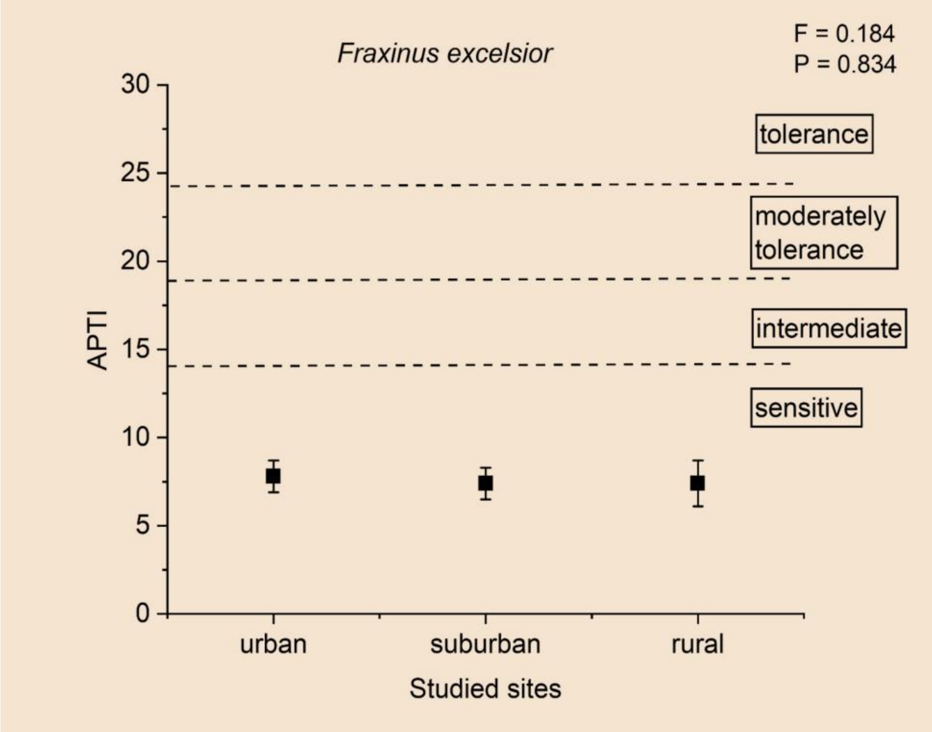

Figure 3. APTI values (mean ± SD) for *F. excelsior* along the urbanization gradient in Vienna

Discussion

We demonstrated that the three tree species can be considered bioindicators species suitable for air pollution monitoring. There were significant differences between the species based on the relative moisture content, pH, ascorbic acid, and chlorophyll content. We found a significant differences between the areas based on the chlorophyll content and pH. We determined that all three species are sensitive to air pollution.

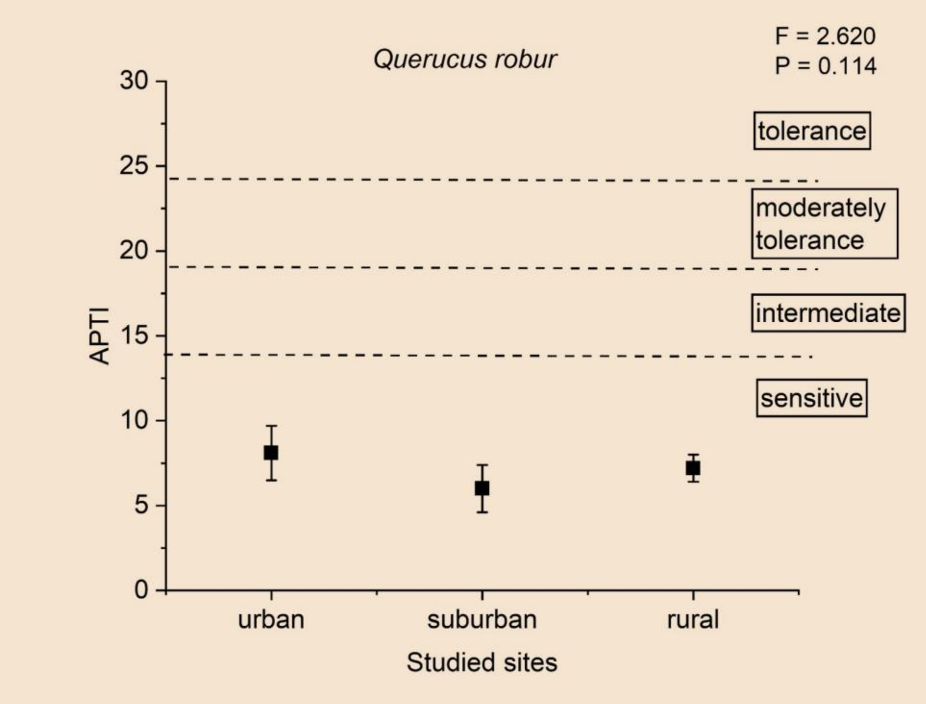

Figure 4. APTI values (mean ± SD) for *Q. robur* along the urbanization gradient in Vienna

Conclusion

We found that tree leaves are reliable bioindicators of urban air pollution. APTI is useful in selecting pollution-tolerant species and can be used for urban green infrastructure planning in the phase of species selection.

References

Singh, S.; Rao, D.; Agrawal, M.; Pandey, J.; Naryan, D. Air pollution tolerance index of plants. J. Environ. Manag. 1991, 32, 45–55.

Acknowledgment: Research was funded by the Scholarship Program for Christain Young People (Application ID 2360)