The effects of mowing frequency, proximity to the road, and season on the physicochemical properties of urban roadside lawn soils

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Background

Roadside lawns are an important component of urban greenery because of the ecosystem services they provide. They often function as buffers between vehicle and pedestrian zones, helping to mitigate the negative impacts of road traffic on people. To enhance this function, less frequent mowing is recommended, as it promotes greater plant biomass and diversity, thereby increasing the capacity to capture traffic-related pollutants. However, reduced mowing is also likely to alter the soil environment, which remains poorly understood.

Research questions:

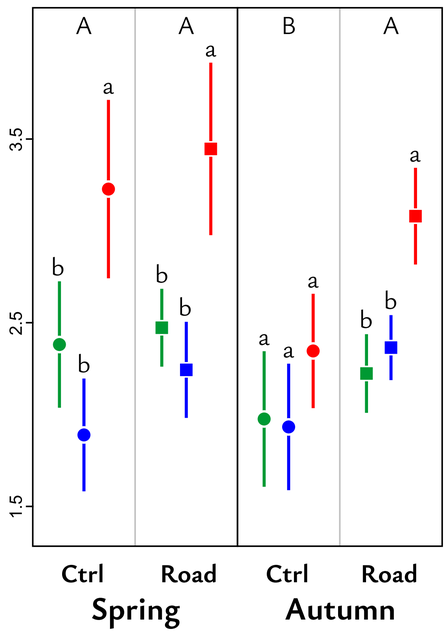
Does the mowing frequency affect the physicochemical properties of roadside lawns? Does the effect of mowing frequency depend on proximity to the road and the season?

Methods

Sites: N=14 sites (4×12 m) in two cities (Kraków and Katowice) in S Poland.
Mowing frequency: **low (1× per year)**, **medium (3× per year)**, and **high (6× per year)**.
Proximity to the road: near-road (0.5–1 m) and control (3–3.5 m) samples.
Seasons: spring and autumn sampling.
Soil analyses: pH, electrical conductivity (EC), Cl^-, organic C, and total Ca, Cr, K, Mg, N, Na, Ni, Pb, and Zn.
Statistical analysis: Linear mixed effects models.

Results

Cr (log-transformed mg/kg, mean ± SE)



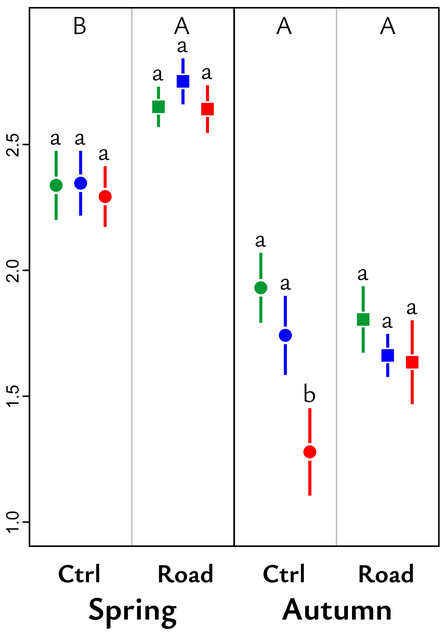
Mowing frequency ***
Road proximity *
Season *

The total content of trace metals (particularly Cr and Ni) in the soil was higher in plots with a high mowing frequency than in other plots. This difference was more pronounced in spring.

Explanation:

Frequent mowing, particularly in spring when vegetation is developing, reduces the filtering properties of the plant cover. This allows particulate matter to penetrate the soil more easily.

Cl^- (log-transformed mg/l, mean ± SE)



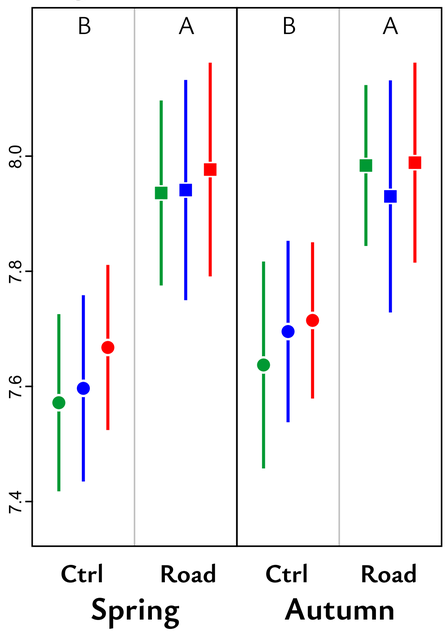
Mowing frequency *
Road proximity **
Season ***
Mowing frequency × Season *
Road proximity × Season **

The soil content of Cl^- was lower at the high mowing frequency, but only in autumn.

Explanation:

Cl^- is highly mobile and can be leached from the soil if the root system is damaged by frequent mowing.

Mg (log-transformed mg/kg, mean ± SE)



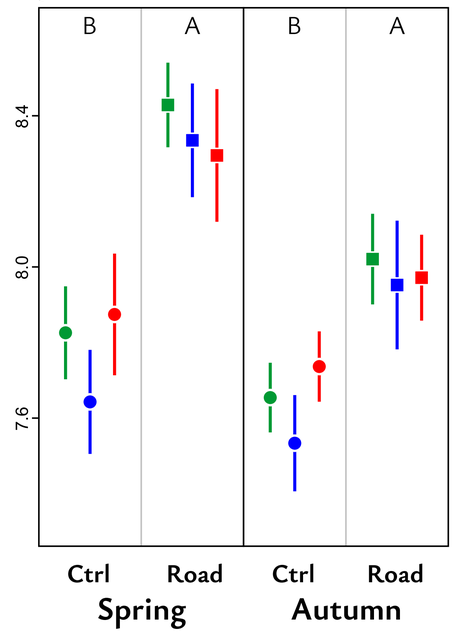
Road proximity ***

The soil near the road contained more total Ca, Mg, and Cr than the control soil.

Explanation:

Vehicle traffic and erosion of concrete road elements produce metal pollution.

pH (mean ± SE)



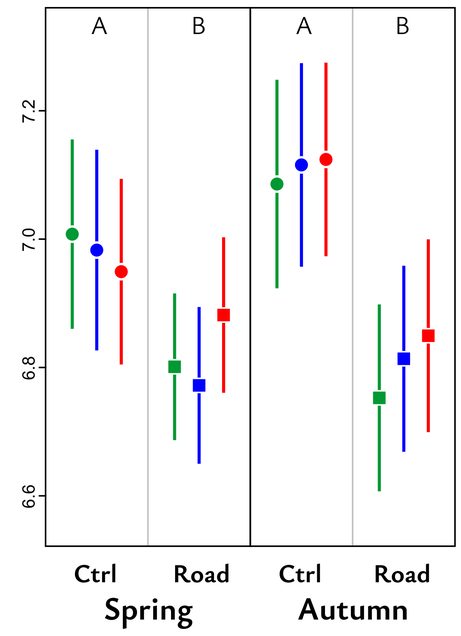
Road proximity ***
Season ***
Season × Road proximity **

The soil near the road had higher levels of pH, EC, Cl^-, and total Na than the control soil. The differences were evident in spring but weak in summer.

Explanation:

Winter de-icing agents cause periodic salinization of the soil.

K (log-transformed mg/kg, mean ± SE)



Road proximity ***
Season **
Season × Road proximity ***

The total content of K in the control soil was higher than in the near-road soil, particularly in summer.

Explanation:

Healthy vegetation releases more K, which is retained in the soil more effectively by the soil adsorption complex due to weaker competition from other base cations.

Conclusions

Better-developed vegetation provides more effective protection against road pollution and prevents mobile nutrients from being lost from the soil.

The road produces a steep gradient in soil properties (nutrients, xenobiotics), which can negatively affect soil microbiome functioning and plant nutrition.