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Review

Review of the doctoral (PhD) dissertation 'Phytotoxicity of Atmospheric Particulate Matter' by **Selenge Tumurbaatar**.

The dissertation focuses on an important and timely topic: the effect of atmospheric particulate matter on plants. A wide range of anthropogenic sources contribute to the emission of these pollutants. In this work, two major sources, traffic-related emissions and open burning of domestic waste, have been examined. The candidate examined the potential toxic effects of PAHs on various target species, using standardized methods under controlled conditions. The dissertation presents an interesting approach to this problem: the impact of atmospheric PM from two different sources was tested under controlled conditions, and the pollutants were generated artificially, which makes the results comparable and repeatable. The significance of the work is evident, as the growing effects of urbanization - such as the increasing number of vehicles on roads and the burning of household waste, a longstanding but still urgent problem - are not studied often enough.

The thesis consists of 112 numbered pages; according to the lists of tables and figures, it contains 12 tables and 31 figures. Its structure generally follows the typical format: it includes the Abstract in three languages (including Hungarian and English), followed by the Introduction, Materials and Methods, and a Results and Discussion sections. The findings of the work are summarized in a Conclusion chapter, and in five thesis points of the work at the end of the dissertation. The dissertation is well-written and contains very few typographical errors. Its language is easy to read while remaining scientific. The document is well-edited, with minimal mistakes. Although the number of figures and tables is relatively high, they are mostly informative and help clarify the results.

The doctoral dissertation is based on four accepted and two submitted scientific articles (with a summarized IF: 10.2)

The introduction chapter provides the reader a good insight into the topic, introduces the sources of the pollutant, and reveals the potential dangers of these. The author found a good balance to provide important information, but the chapter is still not too long. The mechanism of phytotoxicity is also presented in this section, along with potential testing methods. It has some very short paragraphs, which slightly makes the impression of an incoherent text.

The Materials and Methods section offers a comprehensive overview of the sources of the treatment agents and a detailed description of the test plants used. Some pictures of the plants could have improved the description section, but the plant descriptions are very thorough. The cultivation and treatments are also well described. I found the explanation of how PAHs were measured with GC-MS to be somewhat brief. Although the chapter cites MSZ protocols, a PhD dissertation has enough room for a more detailed description (e.g., the type of column used, the GC settings, and the standards applied).

The structure of the presentation of the Results and Discussion (R&D) is sometimes a little bit incoherent (in some cases, there is a discussion subchapter in the R&D, while in others, there is not), but the general structure of the presentation of the materials and methods and R&D is easy to follow/understand.

The tables are well edited, using the same formatting, and help to understand the results of the thesis. The figures are also well edited, contain helpful information, and help better understand the results. However, in some cases the citations of the tables/figures in the text are incorrect (e.g. on page 76 the author citing Table 11, but the cited results can be found in Table 12, or on page 41 citing Table 4), and some figures are not described/discussed in detailed, just cited as 'Figure 26 illustrates the distribution of 2- to 6-ring PAHs across different compartments along the soil–root–aerial parts pathway.'.

The presentation of the results of the statistical analyses consistently has at least six digits (e.g., on page 40: ($Df = 1$, $F = 16.43$, $p = 0.000385$)). It is unnecessary to present that many digits; instead of $p = 0.000358$, it is recommended to present $p < 0.001$. Based on an ANOVA test, you can not make a statement 'Statistically significant decreases in chlorophyll b…', because ANOVA reveals only if there is a significant difference, but never the direction (increase or decrease).

The citation formats differ slightly across chapters, and some unnecessary abbreviations appear in the text.

All five of the 'New scientific points' (Chapter 8) present some new results and (partly) can be accepted, but some of them (e.g., 1-2) are too long and contain too much methodology description.

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Questions:

Why are oxidative stress–related enzymes and photosynthetic pigment parameters considered effective indicators of air pollution–induced phytotoxicity?

What environmental and human health implications arise from the accumulation of PAHs in edible plant parts, particularly in areas affected by traffic emissions and illegal waste burning?

Why were the filters only stirred several times during the 24h extracting period, instead of continuous stirring (Chapter 3.1.1)?

Why were the plants cultivated in a wide range of temperatures (22±10°C)?

How can foliar and root uptake pathways be (quantitatively) compared when exposure concentrations are expressed in different units (µg kg^{-1} vs µg L^{-1})?

Considering the scientific novelty of the dissertation, I recommend the dissertation for acceptance.

Mezőkomárom, Hungary, 2025.12.22. .....

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