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ORIGINAL PAPER

Do the Rootstocks can be a Barrier to Contamination Risk of Sour Cherry Trees with Toxic Metals?

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Abstract

This study aimed to evaluate the influence of eight *Prunus* rootstocks on trace elements (TE) and heavy metals (HMs) concentrations in leaves of grafted 'Šumadinka' sour cherry in Čačak region (Serbia). Element amounts in soil and leaves were analyzed using standard procedures (Kjeldahl, colorimetric, flame photometry and atomic absorption methods) and the transfer factor (TF) was calculated to assess soil to plant metal transfer. The results revealed that rootstock significantly influenced TE and HMs accumulation in leaves. The invigorating Adara rootstock induced the highest leaf concentrations of Fe, Mn, Cu, B, Cd, Ni and Cr whereas Krymsk 6 promoted the highest leaf Zn, Na and Pb levels. MaxMa 14 together with Krymsk 6 and Adara rootstocks induced the highest and similar leaf Zn and B concentrations, respectively. A weak accumulation response for leaf Fe, Cu, Ni and Cr was recorded on Krymsk 6, and for leaf Zn, B, Na and Cd on Myrobalan rootstock. The lowest leaf Fe was found in scion grafted on Colt and Krymsk 6 rootstocks, while Colt alone induced the lowest leaf Mn concentration. Adara showed the lowest leaf Pb amount which was not detected in leaves of trees grafted onto the remaining rootstocks. The TF values were below 1 for all elements, indicating a limited soil-to-leaf transfer of TE and HMs in various rootstocks. In conclusion, the concentrations of all elements were within the permissible limits, demonstrating that sour cherry production in this environment is safe and not in risk of toxic metal contamination.

Keywords Contamination · Excessive concentrations · *Prunus cerasus* L. · Toxic metals · Transfer factor · 'Šumadinka' cultivar

1 Introduction

According to data from relevant literature sources, more than half of the elements in the periodic table (between 60 and 92) are known to occur in plant tissues, and it is likely that, with further improvements in procedures for plant chemical analysis, most remaining elements will eventually be detected as well (Asher 1991). Numerous studies have confirmed that 17 mineral elements are currently recognized as essential for the growth, development and productivity of higher plants (Kirkby 2023), including fruit species (Aras and Karakurt 2019; Aras et al. 2019). These elements originally defined according to criteria originally proposed by Arnon and Stout (1939) continued to represent the foundation of modern plant nutrition. The remaining elements present in plant tissue are generally absorbed in small quantities incidentally, as plants acquire the nutrients required for growth and reproduction. Other authors report that between 17 and 22 elements may be essential or functionally important for the normal growth and development of different plants (Pilon-Smits et al. 2009; Brown et al. 2022; Kirkby 2023), including fruit species (Milošević and Milošević 2023). However, the distinction between "essential nutrients" and "functional nutrients" (Subbarao et al. 2003), has created some conceptual ambiguity in plant mineral nutrition (Brown et al. 2022).

The group of functional elements includes 17 essential and five beneficial elements (Al, Co, Na, Se and Si) which

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