Kmetijski inštitut Slovenije

V4-2420 Ukrepi za zmanjšanje vsebnosti kadmija v pridelkih zelenjadnic in krompirja

Javna služba v vrtnarstvu

Effects of soil amendments on Cd availability in soil

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Introduction

Cadmium (Cd) is one of the most ecotoxic metals, with harmful effects on humans, animals and plants. The presence of Cd in food is due to contamination of soil and water. Cd is transferred from soil and water to plants and aquatic organisms and accumulates in the food chain [1]. ECC Regulation 2023/915 [2] sets maximum levels for certain contaminants in food, including Cd. In Slovenia, the values for total Cd in soil are regulated - the limit is set at 1 mg/kg, the alert at 2 mg/kg and the critical at 12 mg/kg dry soil [3].

Cd content in soil in Slovenia is higher than in other European countries due to parent material. According to the Geological Survey of Slovenia the median Cd content of the surface soil layer (0-10 cm) is 0.47 mg/kg, so even a small increase of Cd (> 1 mg/kg) in soil can pose a potential risk for Cd uptake into plants [4].

AIM: Investigate the effect of repeated addition of different soil amendments (lime, lime + zeolite and lime + organic matter) on soil Cd availability in uncontaminated field where excessive content of Cd in carrot was determined in previous years.

Materials and methods

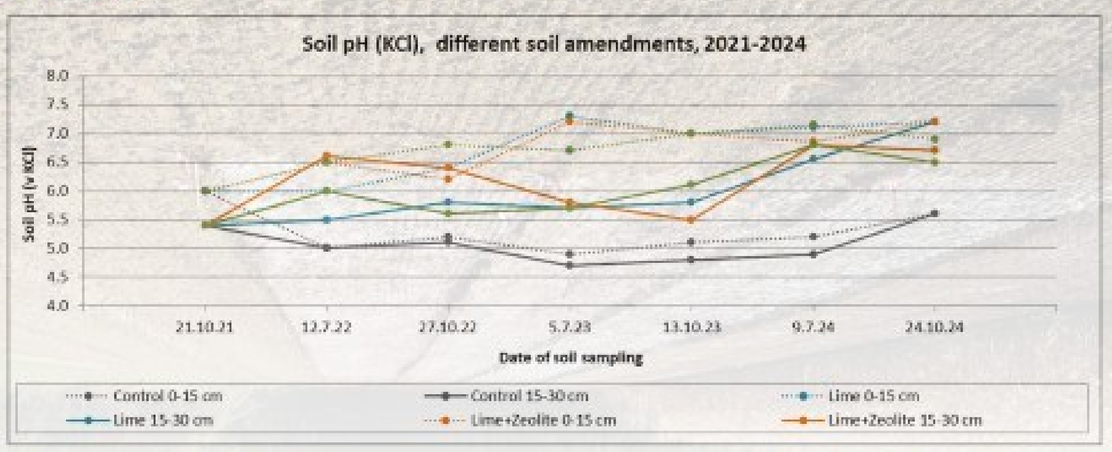
LOCATION: Field near Murska Sobota (Slovenia), moderately acidic (pH 5.4), with low organic matter (OM 1.6 %) and low cation exchange capacity (CEC 10.87 mmol/100 g), low total but high available Cd (0.294 mg/kg and 0.013 mg/kg).

EXPERIMENTAL DESIGN: Long term, split-plot: main factor control (C) and different soil amendments - liming (L), liming + zeolite flour (LZ) and lime + organic matter (LOM), subfactor 4 garlic varieties. Completely randomized, 4 replications.

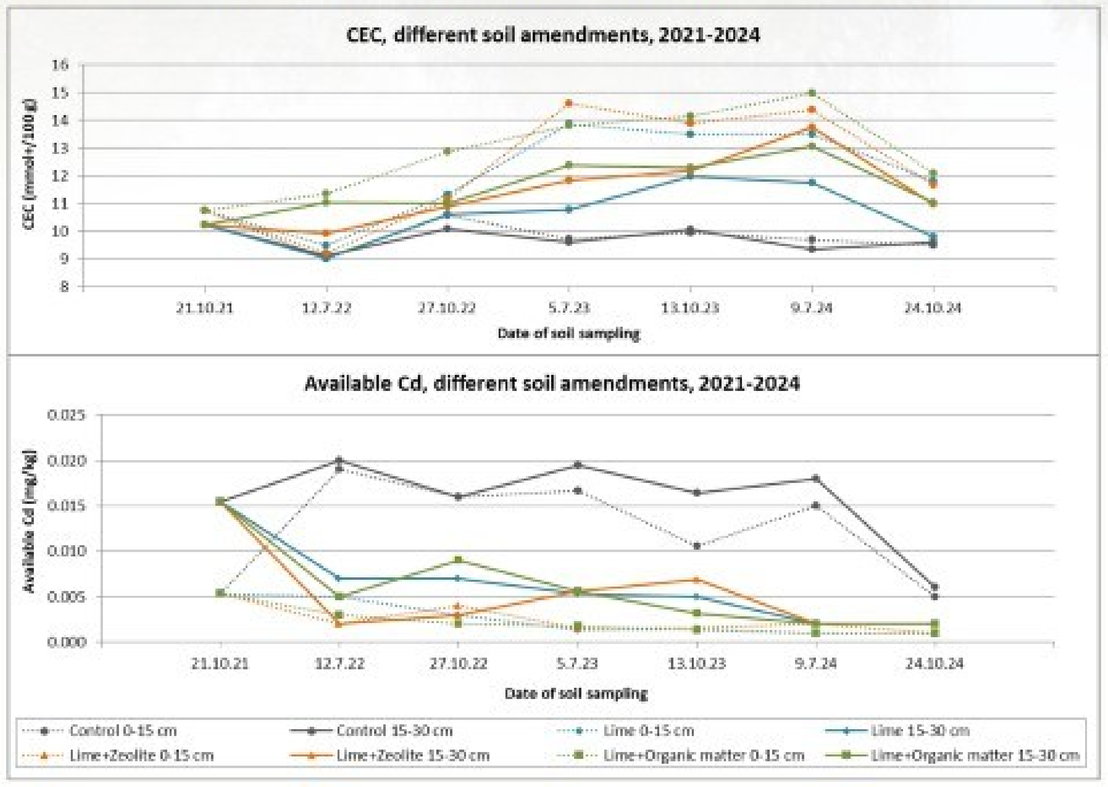
CONDUCTING OF EXPERIMENT: Amendments applied each autumn and mechanically worked into the soil. For LOM, green rye straw incorporated in 2022, wheat straw in 2023 and green mass of white mustard in 2024. Soil from the main plots sampled before adding of amendments (autumn) and after the harvest of garlic (summer) at 0-15 and 15-30 cm .

CHEMICAL ANALYSIS: soil pH ISO 10390, CEC NFX 31-108 and Melich-Peech method, soil OM SIST ISO 14235, total soil Cd SIST-TS ISO/TS 16965 and available soil Cd ISO 19730.

Results



The highest soil OM was measured on LOM plots. OM first increased at the upper layer and with time also at 15 to 30 cm.



Conclusions

Repeated addition of all studied soil amendments (lime, lime + zeolite, lime + organic matter) in uncontaminated soil with elevated level of plant available Cd resulted in:

- an increase in soil pH with time on all plots with amendments, the effect in the first two years was more pronounced in the upper layer while over time also lower layer was affected;
- an increase in soil OM on plots with incorporated OM, predominantly at the upper layer;
- an increase in CEC with time on all plots with amendments at both soil depths, the changes at upper layer were quicker, combination of lime with OM or zeolite increased CEC in lower layer more then lime alone;
- a decrease in bioavailable Cd with time on all plots with amendments at both soil depths, the changes at upper layer were quicker.

References

[1] NIJZ. (2023). Kadmij v živilih. Available from: https://nijz.si/moje-okolje/varnost-zivil/kadmij-v-zivilih/

[2] EC (2023). Commission Regulation (EU) 2023/915 of 25 April 2023 on maximum levels for certain contaminants in food and repealing Regulation (EC) No 1881/2006. OJ EU L 119/103, 2023.

[3] Uredba o mejnih, opozorilnih in kritičnih imisijskih vrednostih nevarnih snovi v tleh (Uradni list RS, št. 68/96, 41/04 – ZVO-1 in 44/22 – ZVO-2). Priloga 1: Mejne in kritične imisijske vrednosti snovi v tleh. (1996). Št. 68 – 29. XI: 5774.

[4] Gosar M., Šajn R., Bavec Š., Gaberšek M., Pezdir V., Miler M. (2019). Geochemical background and threshold for 47 chemical elements in Slovenian topsoil. Geologija, 62(1), 7–59. Available from: https://doi.org/10.5474/geologija.2019.001