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# Innovations in Soil and Plant Nutrient Management

Why can't quality assessment be  
postponed any longer?

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# Use of phosphate fertilizers in Europe

- ✓ Europe has a **very high consumption of P**, with only 16% of the P present in fertilizer reaching human food, while the **main fraction is lost** through net accumulation in agricultural soils, soil erosion or crop residues.
- ✓ **New Circular Economy Action Plan**, the EU revised the previous 2003/2003 fertilizer regulation to encourage the supply of **safe and high-quality fertilizer products coming from domestic organic sources**.
- ✓ It is expected that the European Commission develop shortly the **Integrated Nutrient Management Action Plan (INMAP)**, to ensure more sustainable application of nutrients and boost the markets for **recovered nutrients**.



**Cd**  
Cadmium



## Why Cadmium is a problem?

- ✓ **Cd** in mineral phosphate fertilizers depends on phosphate rocks - **apatite and phosphorite** - by far the most important phosphorus-bearing raw material used in the fertilizer industry;
- ✓ Different types of phosphate rocks have different levels of Cd, based on the type of ore (igneous or sedimentary) and geographic provenance;
- ✓ **Phosphate from igneous deposits contain low Cd concentrations** (range  $< 1-4 \text{ mg Cd kg}^{-1}$ ), and such deposits are in **South Africa and Russia**. **Higher Cd concentrations** (range  $< 1-150 \text{ mg Cd kg}^{-1}$ ) are reported in phosphate rock from **sedimentary deposits** derived from **Morocco, Togo, Senegal and Idaho, USA**.

# Cadmium transfer to soil

- ✓ **Annual net accumulation** of Cd in the soil is about **1%** of the amount already present in agricultural soils;
- ✓ In soils fertilized with products containing **1–20 mg kg<sup>-1</sup> P<sub>2</sub>O<sub>5</sub>**, Cd tends to **accumulate very slowly**, whereas at a concentration of more than **60 mg kg<sup>-1</sup> P<sub>2</sub>O<sub>5</sub>**, soil accumulation is much **higher**;
- ✓ **Strategies to reduce Cd in soil**, other than stopping P fertilizer, would be required to prevent production losses. Such strategies could include substantially **lowering the Cd concentration in P fertilizers**, **lowering soil pH**, or using **plants that hyperaccumulate Cd**.



**+ 1 %**



# Cadmium accumulation in crops



- ✓ **Significant percentage of Cd present in the soil** would theoretically have a **limited bioavailability**, **plants** can increase Cd solubility by **releasing root exudates** that change the pH of the rhizosphere, therefore **increasing Cd accumulation**;
- ✓ Even if the **plants do not exhibit symptoms of toxicity**, the **edible parts** of plants may exhibit **Cd accumulations higher than those allowed for human consumption**.
- ✓ Over the **two last decades**, numerous publications have addressed the biomolecular processes of Cd accumulation in plants with the scope of **creating cultivars that accumulate less Cd in their consumed parts**.

# The impact of Cd on human health



- ✓ Most of the **Cd** absorbed by the human body is excreted, but between **5% and 10% is retained, mostly (> 50%) in the kidneys;**
- ✓ The biological half-life of Cd is within 6 to **38 years** in the kidneys and 4 to 19 years in the liver;
- ✓ **Damage to the kidneys** occurs when the **Cd** concentration in the renal cortex exceeds approximately **200 mg kg<sup>-1</sup>** (wet weight), as evidenced by excretion of proteins (proteinuria) and calcium (Ca);
- ✓ Recent **European and French** studies have shown that the **risk related to Cd dietary exposure cannot be ruled out for a part of the population.**

# EU and MSs position on Cd limits



- ✓ The European Union adopted **Regulation (EU) 2019/1009**, limiting Cd content in **organo-mineral phosphate fertilizers at  $60 \text{ mg kg}^{-1} \text{ P}_2\text{O}_5$** .
- ✓ This threshold seems **inadequate** compared to the threshold values for **Cd currently in place in some EU countries**: 12 member states have a **Cd threshold between 20 and 50  $\text{mg kg}^{-1} \text{ P}_2\text{O}_5$** , 8 have the same threshold as that proposed in the regulation, and 2 have a higher threshold.
- ✓ The interaction of different contextual legislative frameworks (Water Directives, Nitrogen Directive).
- ✓ The cross compliance under the CAP provisions.



## Remarks

- ✓ **Strategies able to reduce soil Cd concentrations**, by considering the local production system, the climate, and the soil type, **should be adopted.**
- ✓ Such strategies could include
  - ✓ the use of **P fertilizers with low Cd content**,
  - ✓ the use of **cultivars that accumulate less Cd in their consumed parts**,
  - ✓ **soil phytoremediation** before crops cultivation,
  - ✓ the production of **mineral P fertilizers with higher nutrient use efficiency** than those produced,
  - ✓ **the decadmiation of P rocks** from the raw materials,
  - ✓ an **increased use of recovered nutrients**.
- ✓ **Additional research** is needed for a better **understanding** and **optimization** of the **processes** and an **evaluation** of the **economic benefits** and **impacts**.

Suciu N, De Vivo R, Rizzati N, Capri E (2022) Cd content in phosphate fertilizer: Which potential risk for the environment and human health? Current Opinion in Environmental Science & Health, 30, 100392.





Thank you!