

#### **FACTOR SCIENCE AND INNOVATION** FORUM

## Innovations in Soil and Plant Nutrient Management

Why can't quality assessment be postponed any longer? Etore Capri, Ncoleta Alina Suciu







## 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.







Why Cadmium is a problem?

Cadmium

 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;



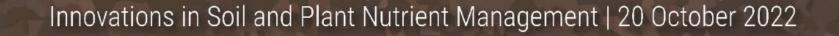
✓ Phosphate from igneous deposits contain low Cd concentrations (range < 1-4 mg Cd kg<sup>-1</sup>), and such deposits are in South Africa and Russia. Higher Cd concentrations (range < 1–150 mg Cd kg<sup>-1</sup>) are reported in phosphate rock from sedimentary deposits derived from Morocco, Togo, Senegal 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 mg kg<sup>-1</sup> P<sub>2</sub>O<sub>5</sub>.
- ✓ 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 mg kg<sup>-1</sup> P<sub>2</sub>O<sub>5</sub>, 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).
- $\checkmark$  The cross compliance under the CAP provisions.







✓ 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!