Urea-doped hydroxyapatite nanoparticles and effects on crops: from lab to field scale

Youri PII - *Free University of Bozen-Bolzano*

At present, the quest for innovative and sustainable fertilization approaches aiming to improve agricultural productivity represents one of the major challenges for research. In this context, nanoparticle-based fertilizers can indeed offer an interesting alternative with respect to traditional bulk fertilizers. Several pieces of evidence have already addressed the effectiveness of amorphous calcium phosphate-based nanoparticles as carriers for macronutrients, such as nitrogen (N), demonstrating increase in crop productivity. Nevertheless, despite N being a fundamental nutrient, very little research has been carried out to understand the physiological and molecular mechanisms underpinning the uptake/use of N-based fertilizers supplied to plants via nanocarriers. To this regard, also the effectiveness of these innovative fertilizers in guaranteeing the same or higher quality in economically important food crops has been little investigated.
For these reasons, a study on two different levels of complexity has been undertaken. The response of hydroponically grown *Cucumis sativus* L. to amorphous calcium phosphate nanoparticles doped with urea (U-ACP) has been investigated by assessing the urea uptake dynamics at both biochemical and molecular levels. In addition, the accumulation of N in both root and shoots, and the general ionomic profile of both tissues have been determined to assess the potentiality of U-ACP as innovative fertilizers. At field scale, U-ACP have been tested as nanofertilizers for viticulture, thereby supplying potted adult Pinot gris cv. vines plants via either fertigation or foliar spray for two productive seasons (2019-2020). Vine plants have been assessed for qualitative and quantitative parameters, and the results clearly show the efficacy of U-ACP nanoparticles as a N source.