Plants more vulnerable to nanoparticles when parents grown in contaminated soil

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Plants are more vulnerable to toxic nanoparticles if their parents were grown in contaminated soil, according to the first multi-generational study on the safety of cerium oxide nanoparticles in agriculture, published in NanoImpact. The results highlight the importance of improving and increasing research on the impact of nanomaterials on plants.

In another NanoImpact paper, scientists warn that our knowledge of the risks to agriculture associated with using nanotechnology is not sufficient. They say it's time to rethink the way we investigate the risks posed by nanomaterials to plants, specifically to food crops.

Already a trillion dollar industry, nanotechnology is still growing rapidly. It is based on the engineering of tiny particles, at a scale of one-billionth the size of a meter, for use in a wide variety of technological applications, from sunscreen to batteries.

Nanoparticles are used in thousands of commercial products, and it is therefore impossible to stop them from accumulating in the environment. However, unlike many other materials, they may be very reactive and are thought to have unique health and safety impacts on people and the environment.

One important final destination for engineered nanoparticles is agricultural soil. Nanoparticles are carried to the soil through irrigation and by applying fertilisers from wastewater treatment plants. Because of

this, crops can be exposed to heightened levels of nanoparticles in the environment in which they grow.

What's more, nanotechnology could potentially revolutionize agriculture in the same way it has changed medicine and communications, so researchers need to understand the impact it has - not just on the plants that are growing, but also on future generations of crops.

"We need to explore the impact of nanoparticles on plant growth now, so we can expand our agricultural toolbox and meet the demands of a growing global population in a changing climate," said Dr. Jason C. White of the Connecticut Agricultural Experiment Station in the US, who is one of the scientists calling for more research. "Any technology has both risks and benefits and even in instances where the benefits could be tremendous, the risks must be thoroughly understood prior to deployment."

More research looking at the effect of nanoparticles on several generations of plants is needed, says Dr. White. This was the focus for Dr. Samuel Ma and his colleagues at Texas A&M University, Southern Illinois University Carbondale and the Connecticut Agricultural Experiment Station in the US.

Dr. Ma and the team studied the effect of cerium oxide nanoparticles on plant health and yield on three generations of plants - the first time such a comprehensive study had been done. They grew three generations of the plant Brassica rapa, a plant related to turnips, canola and bok choy, in soil contaminated with cerium oxide. They studied the effect of the nanoparticles on the growth and reproduction of the plants.

Their results showed that exposure lowered the quality of the seeds and affected subsequent generations of the plants, reducing yield. The offspring generations also displayed more signs of stress than their

parent plants in the same growing conditions.

"Our study is pioneering in that it significantly extended the horizon for the study of plant nanoparticle interactions and provided an important new perspective in the study of nanoparticle effects on agricultural crops than most short term studies in the literature," said Dr. Ma.

More information: Xingmao Ma et al. Multigenerational exposure to cerium oxide nanoparticles: Physiological and biochemical analysis reveals transmissible changes in rapid cycling Brassica rapa, *NanoImpact* (2016). DOI: 10.1016/j.impact.2016.04.001

Alia D. Servin et al. Nanotechnology in agriculture: Next steps for understanding engineered nanoparticle exposure and risk, *NanoImpact* (2016). DOI: 10.1016/j.impact.2015.12.002

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