European Commission

Science for Environment Policy

# Potentially harmful effects of nanomaterials on soybean crops

**A new study has examined contamination** of fully grown soybean plants by two nanomaterials – nano-cerium oxide and nano-zinc oxide. The results could be concerning, as they indicate that the nanomaterials are absorbed by plants, possibly affecting growth, yield, and the fixation of nitrogen in soil, an important ecosytem service.

**20 November 2012**
**Issue 306**
**Subscribe to free weekly News Alert**

**Source:** Priester, J.H., Ge, Y., Mielke, R.E. *et al.* (2012) Soybean susceptibility to manufactured nanomaterials with evidence for food quality and soil fertility interruption. *Proceedings of the National Academy of Sciences*. DOI: 10.1073/pnas.1205431109

**Contact:** holden@bren.ucsb.edu

**Theme(s):** Agriculture, Chemicals, Soil



**With the rapid expansion of nanotechnology**, there is concern about the build-up of manufactured nanomaterials and their possible entry into the food chain. Absorption of nanomaterials from soil is a route of exposure for plants. The nano form of cerium oxide is found in fuel additives and could be deposited on soil and plants from the exhaust fumes of agricultural vehicles. Nano forms of zinc oxide, which is used in cosmetics and sunscreen, could be washed into the wastewater system and be present in 'biosolids', a solid product from the final stage of wastewater treatment. Biosolids are used as fertilisers and could potentially expose some crops to manufactured nanomaterials.

Previously published research on microscopic communities living in soil, and plants grown hydroponically (in mineral nutrient solutions without soil), has indicated that the build-up of manufactured nanomaterials could alter food crop quality and yield. However, no single study has grown plants to full maturity in field soil contaminated with manufactured nanomaterials.

The study examined the impact of two nano metal oxides – cerium oxide and zinc oxide – on soybean plants grown fully in farm soil and under realistic conditions. Soybean is a food crop that is particularly vulnerable to manufactured nanomaterial exposure and is the fifth largest crop in global agricultural production. It also performs an important ecosystem service by fixing nitrogen in the soil, which means there is less need for synthetic fertiliser to produce adequate yields.

The nanomaterials were added in varying concentrations to the soil before planting the soybean seedlings. During plant growth and upon harvesting mature plants, a number of measurements were taken, including plant growth rate, plant yield, accumulation of nanomaterial metals in plant tissue, and the plant's ability to fix nitrogen in the soil.

Results indicated that, although the nano-zinc oxide slightly encouraged plant growth, zinc had accumulated in significant amounts in the plant, especially in the leaves. This suggests that although the soybean plants were growing better, the crop could contain a high level of zinc if exposed to large amounts of the nanomaterial in biosolids.

The impacts of nano-cerium oxide were different: even at low levels of exposure to this material, plant growth and the size of soybean pods were reduced. This indicates that nano-cerium oxide could have a substantial effect on the quantity and quality of the crop. Furthermore, it appeared that the nano-cerium oxide entered the roots and root nodules, the latter of which are important to the nitrogen fixing process that soybean crops perform. With higher amounts of nano-cerium oxide in the soil, soybeans were nearly incapable of fixing nitrogen.

The results of this study suggest that the two manufactured nanomaterials produced at high levels could affect soybean agriculture and accumulate in the crop so humans and wildlife could potentially be exposed to these materials. This highlights the importance of managing waste streams and exhaust fumes containing the nanomaterials to control potential exposures.