CTA-203-Plastic Plants and Mercury

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For a Diver Every day is Ocean Day

Plastic in plants and mercury down deep

More bad news about our impact on the environment.

The growth of *Arabidopsis thaliana* was affected by nanoplastics. Credit: Salicyna / Wikimedia Commons

Studies highlighting our trashing of the environment are depressingly common, and four new papers only serve to highlight the depth (quite literally) and breadth of the real and potential impact.

Three report new findings about the spread of plastics and mercury at sea, while the fourth provides evidence, the researchers say, that now ubiquitous nanoplastics can accumulate in terrestrial plants and stunt their growth.

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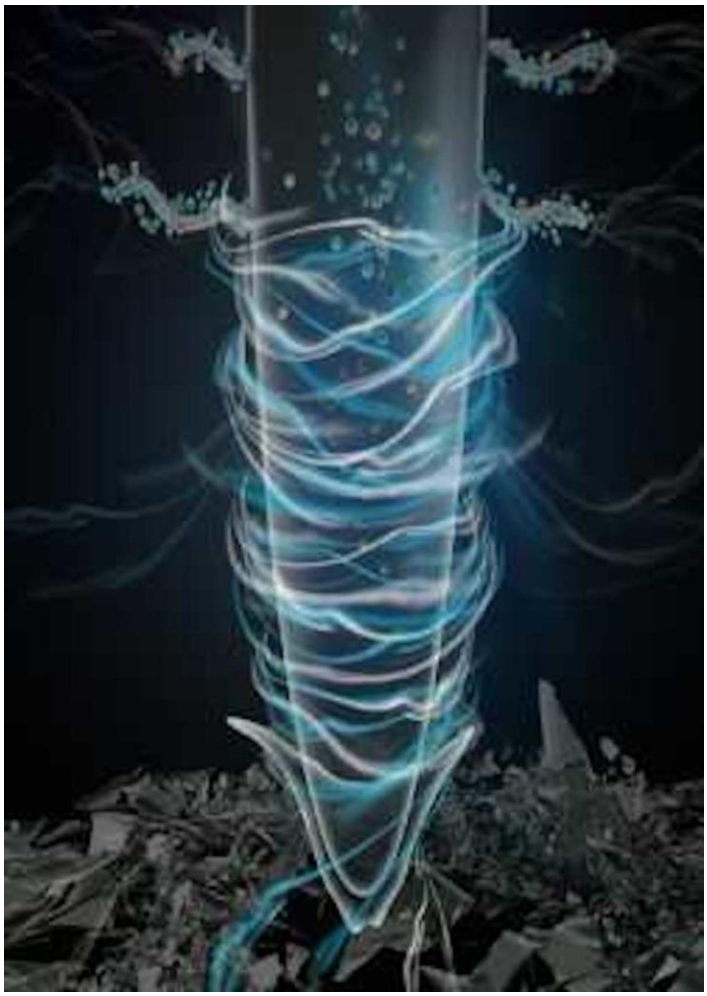
In the journal *Nature Nanotechnology*, a team from the University of Massachusetts (UM) in the US and China's Shandong University reports on studies growing the commonly-used model plant *Arabidopsis thaliana* in soil mixed with fluorescently labelled nanoplastics to assess plant weight, height, chlorophyll content and root growth.



A graphic showing roots and root hairs absorbing nanoplastics. Credit: UMass Amherst / Shandong University

After seven weeks, they observed that plant biomass and height were lower in plants exposed to nanoplastics than in controls. Similarly, the growth of seedlings exposed to nanoplastics for 10 days was found to be inhibited.

"[The plants] were smaller, and the roots were much shorter," says UM's Baoshan Xing. "If you reduce the biomass, it's not good for the plant; yield is down, and the nutritional value of crops may be compromised."

The researchers synthesised polystyrene nanoplastics with both negative and positive surface charges and found that while the latter were not taken up as much, they were more harmful when they were. The reasons are not yet clear.

Regardless of the surface charge, the researchers say, Arabidopsis can take up and transport nanoplastics with sizes of less than 200 nanometres.

So too, unfortunately, can marine animals. In the second paper, published in *Biology Letters,* Italian and Irish researchers report what they say is the first field-based evidence that plastics are entering food webs in Antarctica.

The team, which was led by Elisa Bergami from the University of Siena, found a tiny, insect-like animal called a collembolans floating on a piece of polystyrene foam along the shores of the Fildes Peninsula on King George Island, and using a specialized microscope detected traces of polystyrene in the gut.

"The fact that one of the most abundant collembolans in remote Antarctic soils is ingesting microplastics implies that these anthropogenic materials have deeply entered the soil food web, will be redistributed through the soil profile and may have already become an integral part of the biogeochemical cycles in soils," the authors write.

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In a similar vein, scientists say they have found that both man-made and natural methylmercury, a toxic form of mercury easily accumulated by animals, has reached the deepest depths of the ocean, with implications for how it affects the marine environment, and how it may be concentrated in the food chain.

The findings were presented independently by two research groups to the online Goldschmidt geochemistry conference, though neither paper has yet been peer reviewed.

The Chinese submersible Deep Sea Warrior used to explore the Mariana Trench. Credit: Ruoyu Sun and IDSSE-CAS

"This is a surprise. Previous research had concluded that methylmercury was mostly produced in the top few hundred meters of the ocean," says Ruoyu Sun, who leads a research group from China's Tianjin University.

"This would have limited mercury bioaccumulation by ensuring that fish which forage deeper than this would have had limited opportunity to ingest the methylmercury. With this work, we now believe that isn't true".

Sun and colleagues collected endemic fauna and sediments in the 11,000-metre Mariana Trench and the Yap Trench, both in the Pacific Ocean, and found "unequivocal mercury isotope evidence" that the mercury in the fauna originates exclusively from methylmercury from the upper ocean.

In the second study, a team led by Joel Blum from the University of Michigan, US, reports that mercury in fish and crustaceans from the Mariana Trench and the Kermadec Trench, near New Zealand, is largely derived from the atmosphere and enters the ocean in rainfall.

"Some of this mercury is naturally-produced, but it is likely that much of it comes from human activity," says Blum.

Key facts

- Mercury is a naturally occurring element that is found in air, water and soil.
- Exposure to mercury – even small amounts – may cause serious health problems, and is a threat to the development of the child in utero and early in life.
- Mercury may have toxic effects on the nervous, digestive and immune systems, and on lungs, kidneys, skin and eyes.

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- Mercury is considered by WHO as one of the top ten chemicals or groups of chemicals of major public health concern.
- People are mainly exposed to methylmercury, an organic compound, when they eat fish and shellfish that contain the compound.
- Methylmercury is very different to ethylmercury. Ethylmercury is used as a preservative in some vaccines and does not pose a health risk.

Mercury exists in various forms: elemental (or metallic) and inorganic (to which people may be exposed through their occupation); and organic (e.g., methylmercury, to which people may be exposed through their diet). These forms of mercury differ in their degree of toxicity and in their effects on the nervous, digestive and immune systems, and on lungs, kidneys, skin and eyes.

Mercury occurs naturally in the earth's crust. It is released into the environment from volcanic activity, weathering of rocks and as a result of human activity. Human activity is the main cause of mercury releases, particularly coal-fired power stations, and residential coal burning for heating and cooking, industrial processes, waste incinerators and as a result of mining for mercury, gold and other metals.

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The only thing necessary for the triumph of evil is that good men do nothing"....*Edmund Burke*

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