Environmental risks of new pesticides with nanoparticles insufficiently examined, say researchers

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The environmental risks of new pesticides containing nanoparticles are inadequately researched, according to four Leiden University scientists, who have published an article in the journal *Environmental Science &*

Technology. They call for an examination of the long-term and environmental effects of pesticides containing nanoparticles.

Pesticides with nanomaterials seem to offer a promising solution. They are expected to protect agricultural crops without harming the environment and our health. These nanoparticles sometimes are the active ingredient, while at other times, they enhance the effectiveness of the actual pesticide as an additive.

But does it really work as ideally as it sounds? Metal particles or organic compounds in nanoproducts may be released slowly or only under optimal (weather) conditions. This allows them to work for a longer period in the field and reduce leaching and runoff into surface water.

The nanostructure can also facilitate better binding to crops or enhance the penetration of substances into the pest organism they are meant to control. Due to this efficiency, farmers may require less of nanoproducts compared to traditional pesticides.

This sounds promising, but ecotoxicologist Tom Nederstigt is less enthusiastic. He conducted research on the environmental effects of manufactured nanoparticles in surface water, and investigated how the effects of exposure to these nanoparticles could be measured. He observed that these effects are currently not realistically examined.

"In the case of nanopesticides, evaluations often do not consider that they generally work for a longer time and can be more toxic than traditional products. In practice, this could mean that use and emissions are smaller, but the downsides for nature are greater," Nederstigt notes.

In their article, Nederstigt and colleagues explain how adverse effects of nanoproducts can occur and what researchers should focus on when assessing safety. For example, moles or crows may consume beetles

killed by a nanoproduct. This product could accumulate in them, raising concerns.

If beetles are exposed to the product for a longer time due to delayed release, the same may apply to non-target organisms such as worms and dragonflies, which may experience harm even though they are not the targets. Risk assessors of nanoproducts also rarely consider the effects on microbes, despite their significant role in soil and all organisms on Earth, an aspect studied by co-author Bregje Brinkmann.

"Assessments generally focus only on direct exposure and its effects," the researchers write. They only consider the impact on those beetles, for example, the direct target of a product. "To truly understand the impact of nanoproducts, ecotoxicological research must also focus on indirect exposure and indirect effects." This includes non-target organisms such as worms, bees, dragonflies, and predators that may ingest the product directly or through their food. Assessors should also examine whether the product ends up in groundwater and neighboring areas.

Co-author Willie Peijnenburg is a professor of Ecotoxicology and Biodiversity and works part-time at RIVM (National Institute for Public Health and the Environment). Their website includes a page on the risk assessment of nanopesticides for humans, showing the same caution as the article.

However, it also mentions that the European Food Safety Authority (EFSA) and the Dutch Board for the Authorization of Plant Protection Products and Biocides (Ctgb) assess the safety of products. In the case of the controversial pesticide glyphosate—which kills all plants except those made resistant to it—they concluded that the product is safe.

According to co-author Martina Vijver and many other scientists, these agencies are biased in selection of studies they include in their

assessments.

"EFSA hardly considers publications by university-affiliated scientists," they wrote to the Dutch agriculture minister in a letter on the topic of glyphosate—another synthetic pesticide. Independent studies on this product now raise suspicions that it has many undesired effects on water quality, biodiversity, and health.

Improving the authorization process

Guidelines for market authorization of pesticides are developed, validated, and established internationally. This is done by organizations such as the OECD (Organization for Economic Cooperation and Development) and ISO (International Organization for Standardization). Implementation of these guidelines in regulations also occurs internationally. EFSA handles this for pesticides, and ECHA (European Chemicals Agency) does so for chemicals in general.

For nanoproducts, the guidelines allowing them to enter the market are just being established and are still largely in development. Adjustment of the guidelines is still possible. Therefore, the authors argue for a focus on the effects on non-target organisms, taking into account the often longer exposure duration of these products.

More information: Tom A. P. Nederstigt et al, Sustainability Claims of Nanoenabled Pesticides Require a More Thorough Evaluation, *Environmental Science & Technology* (2024). DOI: 10.1021/acs.est.3c10207

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