Nanotechnology in Agriculture and Food Systems Estimating Exposure & Risk

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Key Challenges in Agriculture & Food Systems

- Poor crop resilience
 - Vulnerable to collapse
- Water availability
- Poor nutrient utilization efficiency
- Soil degradation
- Food safety
- Food waste/loss



Key opportunities for nanotechnology in crop agriculture

Sensors and sensing

Disease, weather, nutrients, pH,...
 Connectedness (IoT)

- Nutrient & disease/stress management
 - Increase utilization efficiency
 - Improve micronutrient deficient soils
 Eurous virus salt drought heat
 - Fungus, virus, salt, drought, heat
- Nutrient recovery
 - o Water treatment
- Biostimulation and biofortification











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Rodrigues et al. ES Nano 2017 DOI: 10.1039/C6EN00573J

Nanomaterial product registrations in France



ecologique-solidaire.gouv.fr/sites/default/files/Rapport_R-nano_2017.pdf

How and where will nanomaterials be applied?

- Water treatment/reuse
- Soil applied





Foliar applied

- Food/Food packaging
- Self-cleaning surfaces







Potential Exposure Points



- During application
- In foods





- Runoff from use
- Combustion of biofuels



What are the Risks?

- Experience with common nanomaterials suggests that overall risks may be low^{1,2}
 - Toxicity of ENMs is generally low
 - Predicted Exposure Concentrations (PECs) are low



Dose

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¹Arvidsson, Environ. Sci. Technol. 2018, 52, 2436–2437 ²Musee, Environ. Sci. Technol. 2018, 52, 6723–6724

Gaps in Predicting Exposures

 Modeling exposures to nanomaterials used in agrochemicals is difficult

	Good	OK	Bad
Exposure Routes			
Food		_	\checkmark
Runoff			
Application		\checkmark	
Factors Influencing Exposure			
Transformations			
Transport		\checkmark	

Key Points

- Nanoenabled agrochemicals have great potential and are already being used
- Exposures need to be better understood because their application creates a region where ENMs are in relatively high concentrations relative to other types of releases
- Exposures after application are poorly characterized