Defining Research Needs & Crop Protection Products

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Bridging Nano EHS Research Efforts: A Joint US-EU Workshop
March 10, 2011
Overview of Presentation

• Overview of nanotechnology

• How is nanotechnology being used by the crop protection industry?

• What are the research needs for nanotechnology relating to EHS?

• What are the key issues with the technology for the crop protection industry?
Why discuss nanotechnology?

• Nanomaterials have the same chemical composition as their larger (non-nano) counterparts
  ß exhibit a larger surface area for any given mass

• Nanomaterials
  ß May be more chemically reactive
  ß May have different biological reactivity

• Materials may be inert in larger form but may be reactive at the nanoscale

• Thus, nanomaterials may have the ability to affect the target organism and the non-target organism (and ecosystems) differently than do products made up of larger particles of the same material

• Not necessarily a safety or health issue
Nanotechnology is Global

• Nanotechnology products are currently on the market in 24 different countries.

• Currently, the US, East Asia and Europe have the most products.

• Increase from less than $12 billion in 2006 to $18 billion in 2008.

• Predicted impact of $2.5 trillion by 2015

(Lux Research, 2009)
Where is nanotechnology today?

• After more than twenty years of basic and applied research, nanotechnologies are increasing in commercial use.

• The rapidly growing field of nanotechnology and its products pose interesting challenges to policy-makers and regulators.
  
  § limitations in data and uncertainty about health and environmental effects

• Current status with nanotechnology policy and research is not surprising as it reflects the same questions posed with earlier generations of chemical/technology management.
Nanomaterials

The most common materials are:

- Silver
- Carbon (including fullerenes)
- Zinc (including zinc oxide)
- Silica
- Titanium (including titanium dioxide)
- Gold
Crop protection product pipelines

Using nanotechnology

• Pesticides
• Fungicides
• Herbicides
Nanotechnology uses by the crop protection industry

• Greater precision in pesticide usage
  • Reduced spray drift and surface runoff
  • Controlled release
  • Reduced amounts

• Efficient emulsification and encapsulation of active ingredients
  • Greater stability
  • Precision in release

• Modern Agricultural Revolution
  • Promising uses of nanotechnology
Research needs – Characteristics

Size distribution

Aerodynamic diameter

Impact of ‘size characteristics’ versus ‘chemical composition’

Commonality versus Differences

• Resources considerations
• Experimental animal use
One early application of nanotechnology across industries is to tackle the problem of poor water solubility of hydrophobic chemicals.

- Bioavailability of chemicals are altered by changes in solubility.

Testing the active ingredient versus testing the final product formulation?
Research needs - Toxicity

Nanomaterials may behave differently and these unique properties may influence toxicity

- Inhalation (do nanomaterials go to the deep lung?)
- Blood brain barrier (do nanomaterials translocate to the brain?)

Definition of dose

- Traditional mass-based dose metrics may need to evolve for nanotoxicity studies

What about aggregation so that nanoproperties are lost?
Research needs - Exposure

• Inhalation?
• Blood brain barrier?

As biological toxicity needs to be examined, exposure should inform the evaluation.

Prior exposure to non-intentionally produced nanomaterials?
Research answers

Are these new questions?

Collaboration between industry & government & academia

Methods development

- Delivery of nanomaterials
- Detection of nanomaterials

• Scientific discussions about environmental health and safety questions for nanomaterials should bridge geographies and governments
  
- Programs of work that leverage resources and establish communities of research practice
- Both near-term and future collaborations
What are the concerns with the technology?

Regulatory uncertainty
- Adequacy of FIFRA
- Proposed ‘adverse event’ approach

Learning from biotechnology
- Do the existing laws provide for protection of human health and the environment?
Science-centric future!

- Science-based policy supported by research solutions is an essential foundation to our future
- Drives policy and legislation
- Get involved in advocating for research priorities and funding
- Research funding is essential to policy and regulatory decision making
  - Scientific information
  - Training future scientists
  - Public – private partnerships
- Science can and should be the regulatory “check-and-balance”
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