Understanding and Mitigating the Impacts of Agrochemicals

Pesticides, herbicides, fertilizers, and other agrochemicals are used on farms and in urban and residential settings to control pests and diseases and protect crop yield and quality. Chemicals are also present in pharmaceuticals and microplastics used in agriculture. Despite important uses, agrochemicals can adversely affect human, animal, and environmental health when they leach or run off into soil and water or accumulate in edible organisms.

Researchers from 20+ Agricultural Experiment Stations are:

- Monitoring and characterizing the fate of agrochemicals in agricultural, urban, and natural areas.
- Determining adverse impacts from agrochemical exposure to cells, organisms, and ecosystems.
- Developing tools to mitigate the adverse impacts of agrochemicals.

This team has provided information and technology to farmers, government agencies, manufacturers, and others, helping them make prudent decisions that minimize the adverse impacts of agrochemicals, while maximizing crop production.

The multistate approach has many benefits.

Long-term, interdisciplinary, multistate research makes it possible to understand agrochemical impacts across multiple scales from the molecular to systems level in a way that no single institution or state can. Working together, researchers can share knowledge, tools, and other resources to facilitate efficient, innovative research. Working on a large, diverse team also helps early career scientists create long-lasting connections and develop skills. Through regular meetings this project fosters creative brainstorming and productive collaborations. With members across the nation, findings can be shared widely.

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Learn more: mrfimpacts.org

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IMPACTS

Research Highlights

Researchers developed tools to detect agrochemical contamination and measure toxicity, including:

- A low-cost, minimally invasive sensor that can rapidly quantify multiple biomarkers associated with even very low pesticide exposures (Washington State University).
- A simplified way to measure the toxicity of compost samples (Ohio State University).

By studying the impacts of agrochemicals on surface waters, researchers showed how:

- Seasonality and weather affect the occurrence, distribution, and loading rates of pesticides in four Kentucky watersheds (University of Kentucky).
- Events and field conditions contribute to glyphosate runoff from croplands (Cornell University).
- Shallow water and salinity affect agrochemical fate and toxicity (Louisiana State University).
- Urban use of pyrethroids can contaminate streams with hormone-disrupting chemicals (University of California).

Research helped understand the impacts of agrochemicals on food safety. Scientists:

- Shed light on how heavy metals make their way from soil and irrigation water into edible plants and animals (University of Nebraska).
- Identified which contaminants are most likely to accumulate in vegetables (University of California).

Project members shed light on how pesticides affect pollinator health. Scientists:

- Found pesticide levels in tested agricultural landscapes have low potential for adverse effects on bees (Montana State University, Washington State University).
- Developed a sensitive fiber that can detect neonicotinoids in the nectar and sap of live, flowering plants (University of California).

Studying the impacts of agrochemicals on fish and wildlife, researchers found that:

- Even low doses of PFAS could adversely affect eastern tiger salamanders (Purdue University).
- Adverse effects of agrochemicals on fish in early life stages can persist through multiple generations (Oregon State University).
- The toxicity of agrochemicals and microplastics can differ depending on environmental conditions like salinity and temperature (Oregon State University).

To reduce chemical use, researchers showed that:

- Applying less dairy slurry fertilizer to corn fields in the summer can reduce nitrate loss without impacting yield (USDA-ARS, South Dakota).
- Essential oils can be biopesticides (University of Hawaii).
- Smooth brome--a perennial grass--can be planted to trap wheat stem sawfly, a pest that causes $350 million in damage to fields each year (Montana State University).

Scientists discovered new ways to remediate agrochemical contamination, including:

- Low-cost amendments that can remediate herbicide-contaminated compost (Ohio State University).
- Glycerol, which can enhance the ability of the bacteria to biodegrade carcinogenic PAHs (University of Hawaii).
- Research that NOAA is using to support emergency response decision making after non-petroleum oil spills (Louisiana State University).
- Vegetative buffers to reduce pesticide concentrations in runoff (University of Florida and the Center of Excellence in Regulatory Science in Agriculture).
- A cost-effective soil amendment to control concentrations of contaminants in crops (University of Nebraska).

Scientists shared outreach, education, and advice about agrochemicals to industry groups, policymakers, regulators, non-profits, and others. For example:

- The U.S. Environmental Protection Agency used findings to create pesticide labels and set restrictions.
- Project members helped produce a statewide plan for monitoring microplastics in California drinking water (Oregon State University).
- A project member led an expert panel to refine California's Pesticide Evaluation Protocol.
- Project members created the Center of Excellence in Regulatory Science in Agriculture, which collaborated with international colleagues on pesticide regulatory processes for the European Union and Latin America (North Carolina State University, Louisiana State University, Bayer)
- Researchers contributed to free resources like the National Pesticide Information Center and TOXicology NETwork (housed by Oregon State University).
- Researchers produced widely-cited publications.