The NIEHS Superfund Research Program: Research Highlights on Drought-Associated Environmental Exposures

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NIEHS Superfund Research Program (SRP)

- **Mission**: Provide practical science to solutions to protect human health
- NIH peer-reviewed, competitively awarded grants to universities and small businesses
- **Unique team-science approach**
  - Brings together diverse disciplines: health researchers, engineers, biologists, ecologists, earth scientists, and social scientists
  - Aims to understand & reduce exposure to potentially harmful contaminants and improve health
- Works closely with industry, government, tribal, and business partners to deliver practical solutions
SRP is Part of the National Institutes of Health

• The NIH Research Mission is to seek fundamental knowledge about living systems to enhance health, lengthen life, and reduce illness and disability.

• NIEHS focuses on understanding how the environment affects people in order to promote healthier lives.

• SRP grantees use unique solution-oriented approaches to address complex environmental health problems. They study environmental contaminants to lower cleanup costs, reduce exposures, and improve health.

• SRP's central goal is to understand and break the link between chemical exposure and disease.
SRP Grantee Research is Relevant to Droughts

- **University of Arizona**: Addressing contamination concerns in the arid U.S. Southwest
- **University of New Mexico**: Toxic effects of mixed metals and uranium exposure on tribal communities in the Southwest
- **UC Berkeley**: Developing new technologies for water-stressed regions
- **UC San Diego and Dartmouth**: Identifying plant genes and proteins linked to drought resistance
- **UC Davis**: Assessing health effects of wildfires
- **Texas A&M**: Tools and models for addressing exposures to mixtures during extreme events
The University of Arizona – Health & Environmental Impacts of Metal Mining

Project: Revegetation of Mining Wastes in Arid and Semiarid Environments: Plant-Microbe-Metal Interactions and Fertility Island Effects
Project Leader: Raina M. Maier

Project: Toxicological Impact of Mine Tailings Dust on Lung Epithelial Barrier Function
Project Leader: Robert Clark Lantz

Project: Prediction and Properties of Airborne Dust Arising from Mining Sites
Project Leader: A. Eduardo Saez

Project: Role of NRF2 in the Pulmonary Response to Inhaled Mine Tailing Dust
Project Leader: Donna D. Zhang

Community Engagement Core
Project Leader: Karletta Chief
Location: Arizona and Northern New Mexico
Communities: Native American
Selected Findings – Fate & Cleanup of Metal Mining

University of Arizona

- **Health Effects**: Early life inhalation exposure to mine waste dust affects lung development in mice. Early life exposure leads to adult disease.

- **Bioaccessibility**: Geochemical weathering increases lead bioaccessibility in semi-arid mine waste. Identified types of lead present in weathered mine waste that correspond to increased risk of human exposure.

- **Phytostabilization**: Reducing wind-blown dust using drought-resistant plants.
Sustainable Solutions – Phytostabilization of Mine Waste

University of Arizona

- **Innovation:** Revegetation strategy “compost-assisted phytostabilization” to stabilize arsenic and lead in soils and prevent dispersion via wind in semi-arid and arid regions.

- **Status:** Field study at Iron King Superfund site in Dewey-Humboldt, AZ. Currently working with major mining companies to improve mine waste remediation practices.

The University of New Mexico: Abandoned Uranium Mines & Indigenous Peoples

Project: Immobilization of U, As, and Co-occurring Metals in Mine Wastes
Project Leader: Jose Manuel Cerrato

Project: Mechanisms of Immune Dysregulation Produced by Uranium, Arsenic and Metal Mixtures
Project Leader: Scott W. Burchiel

Project: Modulation of Uranium and Arsenic Immune Dysregulation by Zinc
Project Leader: Debra MacKenzie

Project: Toxic Metals in Airborne Particulate Matter Originating from Abandoned Uranium Mine Sites
Project Leader: Melissa Gonzales

Community Engagement Core

Project Leader: David Begay
Locations: Arizona, New Mexico, Mexico
Communities: Laguna Pueblo tribe and two Navajo communities
Selected Finding – Toxicity of Mine Dust

University of New Mexico

• Found that particulate matter near uranium mine sites was enriched with uranium and vanadium.

• **Results:** Revealed that the dust from the mine led to increased pulmonary and cardiac toxicity in mice, and higher levels of inflammation and oxidative stress in human cells.

• **Status:** Researchers now analyzing how much dust is traveling to community members in the region and looking at health effects from inhalation exposure.

Water Scarcity & Chemical Contaminants

UC Berkeley

- **New Technology**: Method to clean up stormwater, underused potential drinking water source. Coated sand with two type of manganese → binds to herbicides, pesticides, and BPA, removing them from water

- **Alternative Methods**: Identifying barrier approaches for removing chemical contaminants for potable water reuse. Nanofiltration, ozonation/biological filtration, and activated carbon filtration might be alternatives for inland communities.

SRP Collaboration: Drought-Tolerant Plants

Dartmouth College, UC San Diego

**Project:** Arsenic Uptake, Transport and Storage in Plants  
**Project Leader:** Mary Lou Guerinot, Dartmouth

**Project:** Molecular Mechanisms of Metal Detoxification and Engineering Accumulation in Plants  
**Project Leader:** Julian Schroeder, UCSD

- Both projects are exploring the uptake and transport of toxic metals in plants, such as rice.
- Identifying transporters that can resist toxic metals but also how these transporters can increase salt and drought tolerance, control water loss, and expand energy storage.
Collaboration: Understanding How Plants Grow and Upload Nutrients

Dartmouth and UC San Diego SRP Centers

- Identified specific protein transporters that can improve the uptake of water and nutrients in acidic soil.
- Using these protein transporters in breeding research could lead to improved salt and drought tolerance of crops.
- Implications for increasing food production with limited land and water resources.

Infrastructure to Respond to Disasters: Assessing Wildfire Risks

University of California, Davis

• SRP Center researchers conducted non-targeted analysis on ash samples after 2017 Northern California wildfires.

• Over 2,300 nontarget compounds were detected in samples from neighborhoods destroyed by the fires that were not present upwind of the fires.

• A majority of compounds require further identification and are being analyzed.
Texas A&M: Redistribution of Contaminants during Natural & Manmade Environmental Disasters

Project: Dynamic Exposure Pathways Under Conditions of Environmental Emergencies
Project Leader: Anthony Knap

Project: Mitigation of Chemical and Mixture Effects Through Broad-Acting Sorbents
Project Leader: Timothy D. Phillips

Project: Inter-Tissue and –Individual Variability in Response to Mixtures
Project Leader: Ivan Rusyn

Project: Single Cell, Multi-Parametric High Throughput Platform to Classify Endocrine Disruptor Potential of Chemicals
Project Leader: Michael A. Mancini (Baylor)
Thank You!

Acknowledgements:

NIEHS Hazardous Substance Research Branch
Michelle Heacock        David Balshaw
Heather Henry          Bill Suk
Brittany Trottier

MDB Inc.
Abigail Brewer
Sara Amolegbe

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