Environmental Science & Technology

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Viewpoint

Surface and Groundwater Contamination, Community and Ecosystem Exposures Are the Unintentional Consequences from "Recycling" Treated Seed Products

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Cite This: *Environ. Sci. Technol.* 2021, 55, 5605−5607

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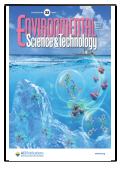
The community of Mead, Nebraska is home to 600 people and is located just a few miles north of a biofuels plant, AltEn, which in 2015 began generating ethanol from feedstock consisting almost entirely of waste seed corn treated with a number of fungicides and pesticides, including neonicotinoid insecticides. To our knowledge, this is the only facility producing ethanol by "recycling" large quantities of treated seed corn in the United States. According to information from the Center for Integrated Pest Management, expired treated seed is typically disposed of through landfills, as fuel for kilns, or as feedstock for biofuel production.[1] Treated seed can contain a wide variety of chemicals to prevent fungus and insect damage after planting. Neonicotinoid insecticides, developed to replace organophosphate and carbamate insecticides, are ubiquitously used in crop production, aquaculture, timber and forestry, and for pets and livestock.[2] Neonicotinoids are also the primary insecticide used in treated seed products, and more than 90% of all corn and 44−50% of soybeans are grown from seeds coated with these compounds.[2] AltEn's ethanol feedstock was nearly 100% treated seed corn, and marketing literature from the company indicates that they recycled 98% of North America's excess treated seed corn at the Mead facility. Because pesticides applied to the seed coating are exempt as a "treated article" under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), there are few, if any, regulatory avenues for controlling the release of these chemicals into the environment as part of biofuel production.[3] Ethanol production at the plant continued until February 8, 2021, and the majority of the solid byproduct and the wastewater that were produced daily are still stored on site.

Data obtained from sampling the solid byproduct and wastewater generated at the facility indicate alarmingly high levels of neonicotinoids. According to publicly available reports from the Nebraska Department of Environment and Energy, samples of the solid byproduct were found to contain 427 000 ppb clothianidin and 85 000 ppm thiamethoxam. To place these concentrations in context, if this byproduct were to be applied at an agronomic rate of 20 tons per acre with a clothianidin concentration of 427 000 ppb, then the active clothianidin applied per acre would be 85 times the maximum annual field load allowed by a typical registered pesticide label. Lagoon wastewater was found to contain 31 000 ppb clothianidin, 24 000 ppb thiamethoxam, and 321 ppb imidacloprid. Testing conducted in October 2020 at groundwater monitoring wells adjacent to the wastewater lagoons found 22 ppb thiamethoxam at a screened depth of 8.5 m.

Wastewater is being held in on-site lagoons, and the solid byproduct is stockpiled near the facility and was land applied in the surrounding community as recently as 2020. Stockpiles of the material have been left exposed, and wind and stormwater runoff have likely redistributed the pesticide residues throughout the area, leading to potential exposure to residents and highly sensitive insect populations. Deleterious effects on pollinators at adjacent University of Nebraska-Lincoln research sites have been observed by Dr. Judy Wu-Smart, and recent news articles describe reported human health concerns that originated around the time that land application of the solid byproduct began in 2018 (The Guardian: "'There's a red flag here': how an

Received: February 25, 2021
Published: April 15, 2021



ethanol plant is dangerously polluting a US village", January 10, 2021; Omaha World Herald: "Mead residents say plant is spreading 'poison' and making them sick", January 22, 2021). Neonicotinoids are known to persist in the environment and to bioaccumulate.[4] The potential health implications of this situation around the AltEn ethanol plant are not understood at this time, as research on neonicotinoids and human health is still in the early stages. The existing research on neonicotinoid exposure to humans and animals has found toxicity to cellular development, genetic information, and physiological function, cytotoxicity, decreased immune function, reduced growth, and lower reproductive success, along with other health outcomes.[4] Because this is an evolving situation, monitoring the environmental levels of these compounds and the populations surrounding the site is important for determining potential exposure. However, the broader concern of similar issues arising at other ethanol plants should be addressed, and the exemption of treated seed corn under FIFRA should be re-examined. The unique circumstances surrounding the situation at the AltEn plant emphasize the need for a conversation regarding the sustainability and management of treated seed. Because AltEn was receiving 98% of North America's waste and expired treated seed, there is clearly a need to discuss environmentally sustainable approaches for treated seed disposal. It is also critical to have a national conversation regarding the appropriateness of the FIFRA treated article exemption for treated seed. The concentrated production of waste material containing neonicotinoids directly adjacent to a community may serve as a tragic case study of the environmental and human health impacts of neonicotinoid exposure. Other countries have already banned the use of some neonicotinoids, and this recent environmental crisis affecting a small Nebraska community may serve as a warning for the United State to do the same.

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Notes

The authors declare no competing financial interest.

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Dr. Jesse E. Bell is the Claire M. Hubbard Professor of Water, Climate, and Health in the Department of Environmental, Agricultural, and Occupational Health at the University of Nebraska Medical Center and the School of Natural Resources within the Institute of Agriculture and Natural Resources at the University of Nebraska-Lincoln. He is also the director of the Water, Climate and Health Program at UNMC and the director of Water, Climate and Health at the University of Nebraska's Daugherty Water for Food Global Institute. His expertise and research are focused on understanding the impacts of changes in the environment and climate on natural and human processes. Before coming to UNMC, Dr. Bell developed and served as the first holder of an interagency position between the National Oceanic and Atmospheric Administration (NOAA) and the Centers for Disease Control and Prevention (CDC). He was a lead author for the U.S. Global Change Research Program report "The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment" that was released by the White House in 2016. He is also adjunct faculty for the Department of Environmental Health at Emory University. Dr. Bell received his Ph.D. from the University of Oklahoma.

https://doi.org/10.1021/acs.est.1c01305
Environ. Sci. Technol. 2021, 55, 5605−5607

REFERENCES

(1) Pesticide Environmental Stewardship. Treated Seed Disposal, 2021. https://pesticidestewardship.org/disposal/treated-seed-disposal/ (accessed 2021-01-25).
(2) Cimino, A. M.; Boyles, A. L.; Thayer, K. A.; Perry, M. J. Effects of Neonicotinoid Pesticide Exposure on Human Health: A Systematic Review. *Environ. Health Perspect.* **2017**, *125* (2), 155−162.
(3) Reynolds, D. Environmentalists Target EPA Failure To Oversee Treated Seeds Under FIFRA. *Inside EPA's Risk Policy Report* **2014**, *21* (22), 1−7.
(4) Thompson, D. A.; Lehmler, H.-J.; Kolpin, D. W.; Hladik, M. L.; Vargo, J. D.; Schilling, K. E.; LeFevre, G. H.; Peeples, T. L.; Poch, M. C.; LaDuca, L. E.; Cwiertny, D. M.; Field, R. W. A critical review on the potential impacts of neonicotinoid insecticide use: current knowledge of environmental fate, toxicity, and implications for human health. *Environmental Science: Processes & Impacts* **2020**, *22* (6), 1315−1346.

https://doi.org/10.1021/acs.est.1c01305
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