

Ecological Risks from Agricultural Land Treated with Biosolids

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The annual application of five million tons of waste materials such as biosolids (*i.e.*, sewage sludge, animal manure, and industrial by products such as coal fly ash) to agricultural land in the United States provides economic benefits to producers. Such applications provide societal benefits as well, stemming from the safe disposal of these otherwise undesirable waste products.

At the same time, routine management practices, such as the application of fertilizer, use of copper- or arsenic-based pesticides, and land application of biosolids, introduce small amounts of metals into agricultural land. The risk posed to ecological receptors from additions of these small amounts of metals is unclear. Therefore, it is critical to determine the risk posed from low to intermediate levels of metals to allow benefits to be realized without damaging soil or ecosystem resources.

In the absence of scientific risk-based guidelines, some states have adopted overly conservative and unrealistic guidelines. U.S. EPA Ecological Soil Screening Levels (EcoSSLs) (U.S. EPA 2005) are broad, conservative screening values. The actual risk posed by agricultural practices to soil ecosystems may be minimal even when metal levels exceed screening levels, necessitating a site-specific evaluation of risk.



For example, concern over arsenic contamination of soil and water has led to adopting a soil screening level of 2.1 mg/kg arsenic in soil in the state of Florida. Soils exceeding 2.1 mg/kg arsenic must be further investigated to determine if there is an environmental risk. However, arsenic has a natural abundance in soil of 6 mg/kg, making this soil screening level overly conservative. Guidelines such as these may decrease the value of “suspect” land that requires “further investigation.” Land devaluation results in economic hardship for agricultural producers, homeowners, and public lands in Ohio and elsewhere.

This research addressed an important agricultural and environmental issue—the risk posed to soil ecosystems from the introduction of metals associated with land application of biosolids. Ohio Agricultural Research and Development Center (OARDC) scientists studied the impact of biosolids applied to agricultural soils at the Waterman Farm on The Ohio State University campus in Columbus, Ohio. Of special interest was the impact on plants (*i.e.*, ryegrass) and soil invertebrates (*i.e.*, earthworms). The major objective of this research was to evaluate science-relevant, laboratory-derived techniques for assessing the bioavailability of metals and ecotoxicity in agricultural land treated with biosolids.

The metal levels of the biosolids-treated plots at Waterman Farm were well below U.S. EPA Part 503 regulatory limits. However, cadmium (Cd), chromium (Cr), and lead (Pb) levels were found to exceed U.S. EPA EcoSSLs for avian and mammalian ecological receptors, but not EcoSSLs for soil invertebrates and plants. This data suggests that although metal levels due to biosolids application to these soils are in compliance with Part 503 regulations, they exceed screening levels for avian and mammalian ecological receptors, suggesting that further assessment of the impacts of metals on ecological receptors in agroecosystems receiving biosolids is warranted.

To this end, future research will focus on the quantification of ecological risk from agricultural land treated with biosolids for soils near or at the U.S. EPA regulatory limits for metals. Biosolids-amended agricultural land that meets this criterion has been identified and will be the focus of a future extramural grant from our research group. Although various measures of metal bioavailability were employed in our study, in order to make meaningful comparisons of these different methods, they must be tested in soils of differing physical and chemical characteristics.



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