

MAFES Assesses metal contamination

By Charmain Tan Courcelle

A study of the practice of land application of poultry litter suggests copper and zinc may accumulate in amended soils using current nutrient management strategies.

Billy Kingery, MAFES soil scientist, has completed a study to determine the effect of long-term application of poultry litter on the amount and distribution of these metals in soil.

Metals, such as copper and zinc, and the metalloid arsenic, are added to poultry feed in trace amounts as part of a diet designed to optimize bird growth and performance. Because these compounds are excreted in poultry waste, there have been concerns that long-term land application of poultry litter could lead to metal contamination of surface and groundwater supplies through runoff and leaching, Kingery said.

“Copper and zinc can accumulate in the food chain and are potentially toxic to organisms at high levels,” Kingery said. “We began this work because the potential for copper and zinc to accumulate at high levels in soils amended with poultry litter over long periods warranted study.”

To determine the effect of litter application on the accumulation and mobility of metals in soil, Kingery and postdoctoral researcher Feng Xiang Han compared soil samples from a pasture that had been amended with poultry litter for 25 years with that from an adjacent, nonamended forest soil. They worked with the help of a poultry producer in Neshoba County, who owns the land surveyed in this study.

The team collected soil from 130 sites in the pasture and forest. Soil samples were analyzed for concentrations of copper and zinc, as well as nickel, chromium, lead and manganese — metals that also cause environmental and health problems at high levels.

“We found that metals do accumulate in waste-amended soil over time,” Kingery said. “But even with recent heavy applications of litter on this farm, the total concentration of these elements was still below limits set by the Environmental Protection Agency.”

Kingery said these results were encouraging, but total metal concentrations only provide one piece of the puzzle.



Marco Nicovich

Soil samples collected from different depths provide information about metal availability to plants.

“To fully understand metal behavior in soil, you need to know where metals partition to — are they in the organic or inorganic components? Are they available to plants? Or, are they bound strongly to soil particles?” Kingery explained.

Kingery’s team collected soil samples at different depths up to 180 centimeters (72 inches) to determine the location and levels of metals in the profiles of litter-amended soils. They also passed the soil samples through a series of chemical assays to evaluate metal mobility into the environment and availability to plants.

“Copper and zinc accumulated in fractions of amended soil that indicate they may be available for plant uptake,” Kingery said. “We also found that copper and zinc move to more strongly bound fractions in amended soils over time, so that they are less able to move into the environment.

“Our results so far suggest that current recommended nutrient management practices allow safe management of metals. No extra lengths seem to be required,” Kingery added.

But different soil characteristics and climate, can have an effect on metal accumulation. Consequently, Kingery has begun a collaboration with Agricultural Research Service scientist Karamat Sistani and the Natural Resources Conservation Service to examine metal accumulation following long-term litter application on farms located in other counties.

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Amended Soils



Marco Nicovich

Postdoctoral research assistant Feng Xiang Han performs chemical extractions on soil samples from an amended pasture.

“Soil components can affect metal availability to plants and mobility in the environment. Some components, like chelators, make metals more available to an organism; others bind metals strongly and prevent metal absorption,” Kingery said.

Kingery is also working with National Sedimentation Laboratory scientists to evaluate metal mobility in different agro-economic systems that use poultry litter.

“We’re looking at the actual runoff from plots planted with different row crops,” he said. “Management can have a strong influence on what happens to metals. These studies will give us an idea of the economics and sustainability of litter application using different management practices.”

Kingery’s research is funded by the MAFES Special Research Initiative program. In addition, this project has received backing from the Mississippi Poultry Association and the Mississippi Farm Bureau.

Nutrient Management Meetings Bring Research to Educators and Stakeholders

By Charmain Tan Courcelle

The question of what to do with the byproducts from poultry production has brought together a team of researchers, educators, producers and government and industry personnel. The group met at the Coastal Plain Branch in Newton to discuss research results and to identify future research and extension priorities.

Poultry litter — a mixture of bedding material and poultry manure — is a rich source of nutrients. In the 34 Mississippi poultry-producing counties, poultry litter is commonly used as a fertilizer for hayfields and pastures. Unfortunately, as more land in these counties has been taken out of forage production, the amount of litter resulting from poultry production has become an issue.

Scientists affiliated with MAFES and the U.S. Department of Agriculture’s Agricultural Research Service (ARS) are working together to find new uses for poultry litter; to evaluate the economics of poultry litter use; and to determine the impact of different management practices on water quality, nutrient runoff potential and fertilizer value. They presented preliminary results from these studies to district conservationists, extension specialists and county agents at an in-service session on Sept. 5 and to producers and industry stakeholders at a separate producer advisory council meeting on Sept. 6.

The Southwest Mississippi Resource Conservation and Development Council, Inc., has assisted in providing funding for the research and extension efforts at Mississippi State University. Other cooperating agencies include the MSU Extension Service, the U.S. Department of Agriculture’s Natural Resources Conservation Service (NRCS), Mississippi Farm Bureau and the Mississippi Soil and Water Conservation Commission.

Larry Oldham, MSU Extension nutrient management specialist, has led the team effort to reach a better understanding of the factors affecting litter quality and use. The team’s other main objective is to devise producer- and environment-friendly regulatory standards based on research information. Oldham and his team implemented the Newton meetings.

“These meetings represent our total program approach of research and educational outreach,” said Butch Withers, head of the Central Mississippi Research and Extension Center. “The technology transfer meeting gave us an opportunity to provide personnel at regulatory agencies and our extension staff at the state and county levels the kind of technical updates they need to help producers, and to make them aware of new management practices that can help with developing nutrient management plans.

“At our advisory council meeting, producers helped us identify what kind of topics need to still be addressed from the research, educational and regulatory standpoints.”

Representatives from NRCS, who develop nutrient management plans, were also present at the meetings.

“This research group is providing local, state-specific information about water quality and phosphorus levels that will be included in NRCS standards as part of poultry nutrient management plans,” said Kim Harris, NRCS state engineer. “NRCS wants to balance agribusiness with the environment by allowing poultry producers to continue to produce birds in an environmentally sound way.”



Jim Lytle

A group of district conservationists, extension specialists and county agents tour experimental field plots during an in-service nutrient management training session in Newton.