Project Title: Impact of Municipal Sewage Sludge and Chicken Manure on Metribuzin and Chlorpyrifos Mobility from Soil into Runoff and Seepage Water

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Contaminated surface water has become a critical environmental problem. Environmentally and economically viable agriculture requires the use of cultivation practices that maximize agrochemical efficacy while minimizing their off-site movement. Soil erosion, nutrient runoff, loss of soil organic matter, and the impairment of environmental quality from sedimentation and pollution of natural waters by agrochemicals have stimulated interest in proper management of natural resources.

Agricultural activities are frequently conducted in close proximity to lakes, reservoirs, and streams. Over 500 million kg of pesticides are used each year in the United States in both agricultural and urban settings. Contaminated runoff from farmland contributes a significant proportion of the pesticide load released to surface waters. There is a concern over the risks of contamination of food and drinking water by residues of synthetic agrochemicals, and the negative impact of agrochemicals on the countryside. A central hope in these concerns is the safe use of agrochemicals, development of new soil management practices, and use of mitigation techniques. Accordingly, new technological and infrastructural solutions are needed to reduce pesticide releases into our natural water resources.

The sharply escalating production costs associated with the increasing costs of energy and fertilizers to U.S. farmers and the problems of soil deterioration and erosion associated with intensive farming systems have generated considerable interest in less expensive and more environmentally compatible production alternatives such as recycling wastes (chicken manure and sewage sludge) from several processing operations for use as soil conditioner to provide high quality organic amendments for soil improvement and crop production. Identifying management strategies that meet crop nutrition needs, support crop production, and protect surface and subsurface water quality is the focus of this project.

Three soil management practices were used: i) soil mixed with sewage sludge obtained from Louisville, KY at 15 t acre^{-1} on dry weight basis (treatment-1); ii) soil mixed with chicken manure obtained from the University of Kentucky Poultry Research Facility, Lexington, KY at 15 t acre^{-1} on dry weight basis (treatment-2); and iii) no mulch rototilled bare soil (treatment-3) was used for comarison purposes. Erosion plots (n=18) were rototilled and planted with kale (*Brassica oleracea* cv. Winterbar) and collards (*Brassica oleracea* cv. Top Bunch) seedlings of 46 days old in summer 2012. The soil was sprayed with the herbicide Sencor (Metribuzin) at the rate of 0.5 lb of the formulated product (metribuzin 75% active ingredient and 25% inert ingredients) $acre^{-1}$. Kale and Collards foliage were sprayed with chlorpyrifos (an insecticide). Soil, runoff, and seepage (infiltration) water were collected following natural rainfall and/or irrigation events during the growing season to monitor the impact of soil amendments on persistence of pesticides in soil and their mobility into runoff and seepage water. Soil and runoff water samples were collected from each of the three soil treatments following natural rainfall events for pesticide analyses. Total runoff water lost per rainfall event and per each 0.02-acre plot was used to monitor pesticides in soil under the three soil management practices and their mobility into runoff water arising from agricultural fields. Our hypothesis: organic matter in soil amendments mixed with native soil might decrease the mobility of pesticides active ingredients, preventing the contamination of aquatic environments.

Preliminary Results

Half-life ($T_{1/2}$) values of metribuzin in soil were 24.32, 17.74, and 11.84 days in CM, SS, and No-Mulch treatments, respectively. The concentrations of nitrogen as nitrate (NO_3 -N) and ammonia (NH_4-N) in runoff and infiltration water collected from three soil management practices varied among treatments, but were all much lower than the limit of 10 mg L^{-1} allowed in drinking water. Addition of chicken manure and sewage sludge to native soil increased water infiltration, lowering runoff water volume and metribuzin residues in runoff following natural rainfall events.

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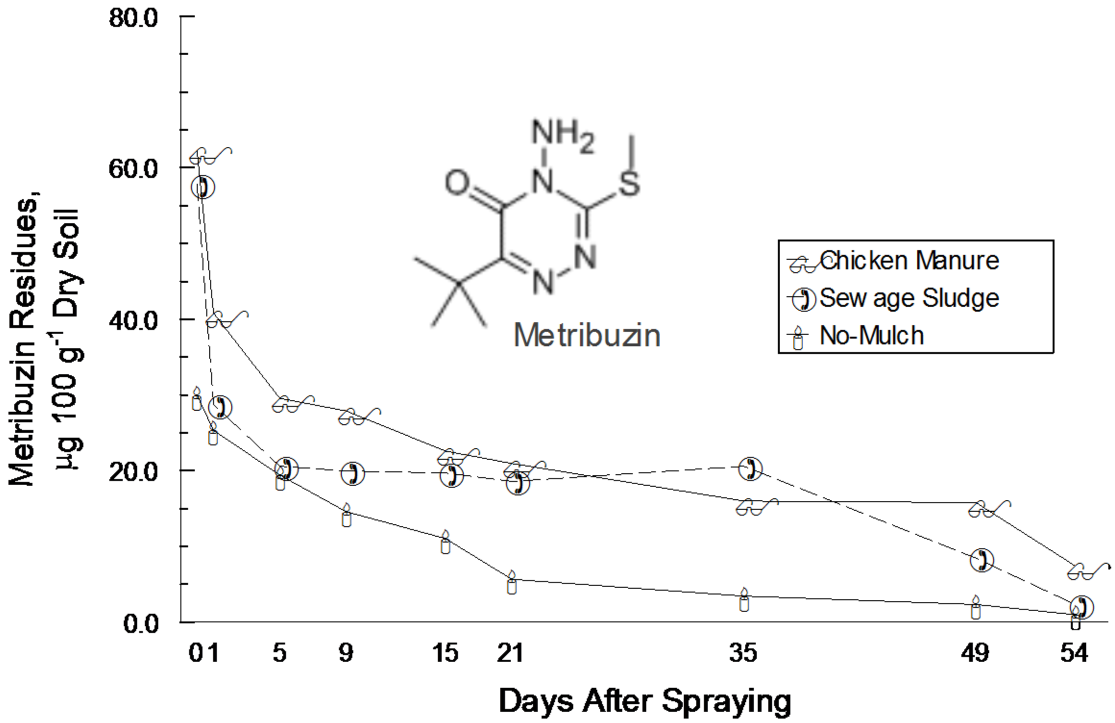

Figure 1 Metribuzin residues expressed as µg g^{-1} dry soil collected following a single field spray under three soil management practices (Kentucky State University Research Farm, Franklin County, KY).

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Table 1. Average initial residues extracted from soil one hr following spraying, dissipation constants, and half-life ($T_{1/2}$) values of metribuzin in native soil and soil incorporated with amendments in the rhizosphere of collard plants grown at Kentucky State University Research Farm, Franklin County, Kentucky, USA.

Soil treatment	Sewage Sludge Incorporated with Native Soil	Chicken Manure Incorporated with Native Soil	No Mulch Native Soil
Initial Residues (μg g^{-1} dry soil)	57.83	62.33	30.00
Dissipation Constant (K)	0.039065	0.02849	0.058519
$T_{1/2}$ Values (days)	17.74 b	24.32 a	11.84 c

† Each value in the table is an average of 3 replicates. $T_{1/2}$ values in a row accompanied by different letter are significantly different ($P < 0.05$) using ANOVA procedure.


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