LINKAGES IN SOIL ECOLOGY

Argonne National Laboratory
Argonne, Illinois
22-25 May 2005
KUPERSMAN, R.G., CHECKAI, R.T., SIMIM, M., PHILLIPS, C.T., KOLAKOWSKI, J.E., and KURNAS, C.W. Soil characteristics and weathering-and-aging of TNT in soil affect toxicity to soil invertebrates. Edgewood Chemical/Biological Center, Aberdeen Proving Ground MD.

We investigated the toxicity of 2,4,6-trinitrotoluene (TNT) to soil invertebrates in five natural soils that vary in organic matter, clay content, and pH. Sanafras sandy loam (SSA), Tellier sandy loam (TSL), Puchfeld clay loam (KCL), Kirkland clay loam (KCL), and Webster clay loam (WCL). The qualitative "relative bioavailability scores" for organic chemicals in natural soils were considered "high" for SSL and TSL; "medium" for KCL and SSL; and relatively "low" for WCL, soil, according to Eco-SSL criteria (USEPA 2003). We adapted standardized toxicity tests for the soil invertebrates Eisenia fetida (ISO 11268-2:1998), Enchytraeus crypticus (ISO 16378:2003), and Folsomia candida (ISO 11268:1998) to conduct TNT exposures in soils (after a 24-h moisture equilibration period) that were either freshly amended, or after amendment subjected to wetting-drying cycles (10-14 weeks) in the greenhouse. This was done to investigate the effect of weathering-and-aging of TNT in soil on the resulting toxicity. Reproduction data were analyzed using nonlinear regression models to determine TNT concentrations causing a 20% (EC20) or 50% (EC50) reduction in the measurement endpoints. Preliminary results showed that toxicity of TNT was both species and soil type specific. Weathering-and-aging TNT is soil significantly altered the toxicity to all species tested based on EC50 values at 95% confidence intervals, compared with results of freshly amended treatments. This was true for all species and soil types except for E. fetida in TSL and E. crypticus in KCL. Toxicity to both E. fetida and E. crypticus as measured by juvenile production in freshly amended soils closely paralleled relative bioavailability scores, and for E. crypticus in weathered-and-aged treatments. Soil organic matter and clay contents had strong correlation (r > 0.8) with effects on E. crypticus, based on increasing EC50 values for juvenile production. Toxicity for juvenile production by F. candida in both freshly amended and weathered-and-aged treatments, and for E. fetida in weathered-and-aged treatments, varied among soil types. Differential toxicity to the three soil invertebrate species in the five soils will be discussed in relation to soil physiochemical properties and weathering-and-aging effects. Toxicity benchmarks derived in these studies will be submitted to the Eco-SSL Task Group for use in developing an Eco-SSL for TNT in soil invertebrates, results of these studies will undergo quality assurance before inclusion in the Eco-SSL database.

LACHNITZ, H.L., ARCHER, D.A., JOHNSON, J., WILTS, E., BARBOUR, N., and EKLUND, J. Use of FAME to distinguish management effects in conventional and organic farming systems. USDA ARS North Central Soil Conservation Research Laboratory, Morris MN.

A large-scale study on conventional and organic management systems was established. Two vs. four year crop rotations (corn-soybean, corn-soybean-wheat-alfalfa), organic vs. organic fertilizer source, and conventional vs. strip tillage management practices were compared. Fatty acid methyl esters (FAME) were extracted from the top 10 cm of soil in spring samples collected over three years from initial plot establishment. FAME profiles were compared by principle component analysis to determine if management practices affected the microbial community.

LAUWORN, C.N. and NEHES, D.A. Impact of Coleoptera-active Bt corn on extracellular enzyme activities of montarget microbial communities that inhabit soil and litter. University of Toledo, Toledo, OH.

Soil microbial communities are potentially exposed to Cry1Ab toxins emitted from living or decaying roots of Bt corn (Event MON863, Ventus® Rootworm) targeted for corn rootworms. Our objective was to determine whether coleopteran-active Bt corn affected the colonization rate and patterns of succession of microbial communities that mediate decomposition over time. Extracellular enzyme activity (EAA) was quantified in decomposing root tissue of a Bt hybrid compared to a non-Bt, isogenic hybrid treated with a soil insecticide, and 2 a non-Bt, isogenic hybrid without insecticide. Treatment plots (0.2 ha) were established in a non-till field and replicated three times in a Latin square design. Soil core (26 x 10 cm; 1 mm by 1.5 mm; mesh size) with roots from Bt-corn were buried in soil (15-cm depth) at the initiation of root senescence (just after anthesis). Subsamples of decomposing roots were collected and analyzed for EEA at 1, 3, and 6 weeks thereafter and three times in spring months, before plowing the next crop. Assays for the activities of 16 hydrolytic and oxidase enzymes involved in the acquisition of carbon, nitrogen, and phosphorus from detrital organic matter was performed. The assays covered the major groups of detrital macromolecules and the major categories of extracellular enzymes (glycosidases, peptidases, esterases, oxidases, and peroxidases). Results from the assays showed no significant differences in enzyme activity between the three crop treatments over the various collection times. However, major differences were found between seasons. Significantly different activity levels over sampling times were expected because it is understood that there are different rates for enzyme activity levels throughout the process of decomposition. There does not appear to be any evidence that coleopteran-active Bt corn affects detrital resources used to support microbial metabolism, relative bioavailability of