



United States Department of Agriculture  
Research, Education and Economics



Agricultural Research Service  
Date: 4/8/2009

# Natural Resources Research Update

ARS would like your feedback as to the value of this technical update. You can provide feedback about this specific update by responding to this email or send your comments to [NRRU.update@ars.usda.gov](mailto:NRRU.update@ars.usda.gov) and refer to technical update number: 238745

Title: Phosphorus loss prediction on cropland areas

Contributing Scientists: John E. Gilley

Location: Agroecosystem Management Research Unit, Lincoln, NE

Text: The application of beef cattle or swine manure to cropland areas at rates in excess of crop nutrient requirements can result in the accumulation of soil P and an increased potential for P transport by overland flow. The P content of runoff is influenced by manure application rate, residual soil P content, length of time since the previous manure application, soil characteristics, and runoff conditions. If the effects of these variables on P concentration of runoff can be quantified, nutrient management practices can be implemented to protect surface water quality. The objectives of this project were to: 1) determine the relationship between P in soil and the movement of dissolved P (DP) to surface water, 2) develop procedures to identify areas susceptible to P losses in a landscape, and 3) identify comprehensive nutrient management practices to protect surface water quality. Field rainfall simulation tests were conducted on paired 0.75 m wide by 2 m long plots. Rainfall was applied for 30 min at an intensity of 70 mm hr<sup>-1</sup> using a portable rainfall simulator. Following the initial rainfall event, two additional tests were conducted at approximately 24-hr intervals. Field experimental tests were conducted using beef cattle and swine manure applied under both no-till and tilled conditions at rates required to meet crop nutrient requirements. Tests were conducted on sites containing corn, soybean and wheat residues. Nutrient transport was measured soon after manure application, throughout the year, and after long-term manure application. On a Sharpsburg silty clay loam soil located near Lincoln, Nebraska, DP concentrations of runoff were found to increase in an exponential fashion from 0.18 to 3.37 mg L<sup>-1</sup> as soil Bray P content varied from 50 to 300 mg L<sup>-1</sup>. As the length of time since manure application increased from 2 to 350 days, the mean concentration of DP declined from 2.16 to 0.51 mg L<sup>-1</sup> on beef cattle manure treatments and from 0.77 to 0.28 mg L<sup>-1</sup> on swine manure treatments. Manure application rate, residual soil nutrient content, length of time since the previous manure application, soil characteristics, and runoff conditions were all found to influence the DP concentration of runoff. Phosphorus-based manure and compost application was found to be an environmentally sound management system. The DP concentration of runoff following N-based manure application can be an environmental concern when applied under no-till

conditions without incorporation. With proper application and management, manure can serve as a valuable nutrient source and soil amendment without causing adverse environmental impacts.

Gilley, J.E, B. Eghball, B.J. Wienhold, and P.S Miller. 2001. Nutrients in runoff following the application of swine manure to interrill areas. *Trans. of the ASAE*. 44(6):1651-1659.

Gilley, J.E, B. Eghball, and D.B. Marx. 2007. Nutrient concentrations of runoff during the year following manure application. *Trans. of the ASABE*. 50(6):1987-1999.

Gilley, J.E., W.F. Sabatka, B. Eghball, and D.B. Marx. 2008. Nutrient transport as affected by rate of overland flow. *Trans. of the ASABE*. 51(4): In press.

As the principal in-house research arm of the U.S. Department of Agriculture, the Agricultural Research Service has a mission to: Conduct research to develop and transfer solutions to agricultural problems of high national priority and provide information access and dissemination to ensure high-quality, safe food, and other agricultural products, assess the nutritional needs of Americans, sustain a competitive agricultural economy, enhance the natural resource base and the environment, and provide economic opportunities for rural citizens, communities, and society as a whole.

The U. S. Department Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or part of an individual's income is derived from any public assistance. (Not all prohibited bases apply to all programs) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410, or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.