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Factors affecting the fate and transport of glyphosate and AMPA into surface waters of agricultural watersheds in the United States and Europe

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Abstract:

Glyphosate [N-(phosphonomethyl)glycine] is a herbicide used extensively in almost all agricultural and urban areas of the United States and Europe. Although, glyphosate is used widely throughout the world in the production of many crops, it is predominately used in the United States on soybeans, corn, potatoes, and cotton that have been genetically modified to be tolerant to glyphosate. From 1992 to 2007, the agricultural use of glyphosate has increased from less than 10,000 Mg to more than 80,000 Mg, respectively. The greatest areal use is in the midwestern United States where glyphosate is applied on transgenic corn and soybeans. Because of the difficulty and expense in analyzing for glyphosate and AMPA (aminomethylphosphonic acid, a primary glyphosate degradate) in water, there have been only small scale studies on the fate and transport of glyphosate. The characterization of the transport of glyphosate and AMPA on a watershed scale is lacking. Glyphosate and AMPA were frequently detected in the surface waters of 4 agricultural watersheds in studies conducted by the U.S. Geological Survey in the United States and at the Laboratory of Hydrology and Geochemistry of Strasbourg. Two of these basins were located in the midwestern United States where the major crops are corn and soybean, the third is located the lower Mississippi River Basin where the major crops are soybean, corn, rice, and cotton, and the fourth was located near Strasbourg, France where the use of glyphosate was on a vineyard. The load as a percent of use ranged from 0.009 to 0.86 percent and could be related to 3 factors: source strength, hydrology, and flowpath. Glyphosate use in a watershed results in some occurrence in surface water at the part per billion level; however, those watersheds most at risk for the offsite transport of glyphosate are those with high application rates, rainfall that results in overland runoff, and a flowpath that does not include transport through the soil.