Transformation Kinetics and Mechanism of the Sulfonylurea Herbicides Pyrazosulfuron Ethyl and Halosulfuron Methyl in Aqueous Solutions

Little is known about how popular herbicides react and degrade in soil or aquatic environments. Two of these herbicides include Pyrazosulfuron Ethyl (PE) and Halosulfuron Methyl (HM), which are part of the sulfonylurea herbicide category. Both are post-emergence herbicides and are so highly effective that they need to be applied only at rates of grams per hector. Because these herbicides inhibit the key enzyme that participates in protein synthesis in plants, they can have a major effect on sensitive agricultural areas such as legumes or pastures for grazing.

Typically these types of herbicides only degrade because of microbial influences or chemical hydrolysis. To understand the pathway and conditions for chemical hydrolysis degradation, ISTC's Wei Zheng collaborated with researchers at the U.S. Department of Agriculture to conduct several laboratory experiments. They tested PE and HM in acidic, neutral, and basic conditions (pH 3, 7, 9 in pure water). The results showed that both PE and HM degraded more slowly in neutral pH conditions, and therefore are more stable in neutral pH media. PE and HM had similar hydrolysis degradation results, but the degradation rate in basic conditions was 30 times higher for HM than for PE events, even though they have nearly identical chemical structures.

Because soil and aquatic environments contain many additional natural chemicals than pure water, cyclodextrins were added to the three different pH water solutions to simulate potential soil conditions. As it turned out, the addition of cyclodextrins did not change the results of the experiment. From these findings, the researchers noted that cyclodextrins have the ability to take up foreign molecules, meaning that cylodextrins could be sorbed to zeolite or silica and added to a sand filter at a drinking water treatment plant to remove herbicide or pesticide residues from contaminated drinking water sources.

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Publications

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