



Fluorescent tracers to evaluate pesticide dissipation and transformation in agricultural soils

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This study evaluates the mobility and dissipation of two organic fluorescent tracers (uranine, UR and sulforhodamine-B, SRB) in soil from an agricultural field. Two plot experiments were conducted for 2.5 months in 2012 and 2016 to compare the behavior of reactive fluorescent tracers (UR and SRB) to the chloroacetanilide herbicide S-metolachlor (S-MET) and bromide (BR), used as a traditional conservative tracer. SRB in top soil closely mimicked the gradual recession of S-MET, while BR overrated both top soil mobility and slow leaching of S-MET in the soil column. In contrast, UR quickly receded in the soil and was entirely dissipated at the end of the study periods. Instead, a strong fluorescent signal that was stable against acidification, and non-traceable in background samples, gradually developed at an excitation wavelength of 510 nm in samples from the uppermost soil layer starting 40 (2012) and 22 (2016) days after tracer application. We hypothesize that (bio-)chemical transformation of UR accelerated tracer loss with concomitant formation of the specific transformation product TP510. By LC-MS/MS analysis we propose a probable molecular structure of TP510 and sulfonation as one likely transformation process. Overall, we anticipate our results to be a starting point to use fluorescent tracers in longer term (>2 months) agricultural soil studies as a proxy for S-MET and possibly also other organic pesticides, as they are non-conservative in unsaturated soil and may follow similar dissipation and transformation patterns. At the same time their analysis is less costly and they pose smaller environmental risks. Further research on the SRB/UR-TP510-system is necessary, but given its ability to mimic S-MET dissipation processes, we anticipate its use as a complementary tool to study pesticide fate in unsaturated soils where transformation products are extensive, yet unknown or challenging to measure.