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Polar Herbicides in the German Baltic Estuaries

Analysis, Occurrence and Effects

In this thesis, the two techniques: GC-MS and HPLC-MS/MS were compared for the analysis of the herbicides glyphosate, mecoprop, MCPA, isoproturon, bentazon and chloridazon and the metabolites aminomethylphosphonic acid (AMPA), chloridazon-desphenyl and chloridazon-methyl-desphenyl (CDM) in water samples. HPLC-MS/MS was preferred over GC-MS for their analysis. Two HPLC-MS/MS methods were required for obtaining good analytical results. The first method is a direct HPLC-MS/MS analysis of the compounds MCPA, mecoprop, isoproturon, bentazon, chloridazon and CDM. The second method is an HPLC-MS/MS analysis of glyphosate and AMPA after their derivatization with FMOC-Cl. The HPLC-MS/MS analytical methods were developed and validated in order to study the potential transport of the target compounds into the Baltic Sea based on their occurrence in some German Baltic estuaries. Water samples were collected from ten German Baltic estuaries in Mecklenburg-Vorpommern in 2012 and analyzed by the HPLC-MS/MS methods. Of all the target compounds, glyphosate and its metabolite AMPA were the most frequently detected compounds. All investigated estuarine sampling sites were found to be contaminated with AMPA and nine of them with glyphosate with concentrations reached up to the microgram per liter range in some samples. The effect of Roundup®, the commercial formulation of glyphosate, and AMPA on the growth of cyanobacteria *Nodularia spumigena* was also investigated in this work. *N. spumigena* showed tolerance to both toxicants when exposed to concentrations between 1-500 µg/L. *N. spumigena* was found to be unable to degrade AMPA under to the experimental conditions used.