An algal toxicokinetic model for population level ecological risk assessment

Takashi Nagai, Satoru Ishihara, Atsushi Yokoyama, Takashi Iwafune

Various herbicides are used for weed prevention in paddy fields. These herbicides flow directly out from paddy fields to rivers through drainage channels, and are detected from April to August in river waters in Japan. Moreover. these herbicides are highly toxic to algae, and therefore there is a higher concern for the aquatic risk caused by paddy herbicides. Population viability is a main endpoint of ecosystem protection, and therefore it is needed to assess timed effect and subsequent population recovery considering these time-varying exposure. The aim of this study is the development of an algal toxicokinetic model to predict algal population dynamics under time-varying herbicide exposure for population level ecological risk assessment.

We investigated the effect of herbicide pretilachlor, which is widely used in paddy fields in Japan, on the growth and mortality of the green algae Pseudokirchneriella subcapitata. According to the standardized test guideline, a 72 h algal growth inhibition test was conducted. Dead cells in subsamples were stained with the green nucleic acid dye SYTOX-Green, and live and dead cells were counted separately using flow cytometry. Moreover, cells in the algal growth inhibition test that were exposed for 72 h were inoculated with herbicide-free fresh medium, and their growth was monitored to investigate population recovery after timed exposure. Algal population dynamics are described based on the logistic model and toxicity are described by growth inhibition and mortality. Model parameters were deterimned from these test results, and model prediction of algal population dynamics was consistent with the measured values.

Key Words: Herbicide, Green algae, Flow cytometry, Population recovery