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Sensitivity of selected tropical microalgae isolated from a farmland and a eutrophic lake to atrazine and endosulfan

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Abstract

There has been concern over the adverse ecotoxicological effects of atrazine and endosulfan on microalgae. This study aimed to assess the effects of these two widely used pesticides on growth, pigmentation, and oxidative response of microalgal isolates from a farmland and a eutrophic lake in Malaysia, in comparison with the model species *Pseudokirchneriella subcapitata*. Results showed that the microalgae originated from the eutrophic lake were generally more sensitive to the pesticides than those from the farmland. The microalgae were more sensitive to atrazine (EC_{50} = 43.07–> 5000 μg L^{-1}) than endosulfan (EC_{50} = 1.51–> 50 mg L^{-1}). Amongst the microalgae, *Scenedesmus arcuatus* was most sensitive to atrazine (EC_{50} = 43.07 μg L^{-1}) while *Chlorella* sp. 1 was most sensitive to endosulfan (EC_{50} = 1.51 mg L^{-1}). Microalgae from the farmland were generally very tolerant to endosulfan (EC_{50} > 50 mg L^{-1}). Photosynthetic pigment content (pg $cell^{-1}$) increased in *S. arcuatus* after exposure to atrazine while the content decreased in most of the microalgae after exposure to endosulfan. Oxidative response to the pesticides varied amongst the tested microalgae and time point measured. Both ROS levels and lipid peroxidation decreased in *Chlorella* sp. 5 after exposure to atrazine at 96 h compared to 48 h. In *S. arcuatus*, there was no pronounced increase in SOD and catalase activities despite the increase in ROS and lipid peroxidation after exposure to atrazine. Indigenous microalgae such as *S. arcuatus* could be a useful bioassay organism for toxicity testing of the pesticides while tolerant species from the farmland could be useful for bioremediation of endosulfan contamination.

Keywords Atrazine · Endosulfan · Microalgae · Oxidative stress · *Chlorella* · *Scenedesmus*

Introduction

Pesticides are one of the major chemicals used in agriculture to increase crop productivity and food supply, and in the prevention of vector-borne disease. The increased use of pesticides has resulted in the release of large amounts of the toxic contaminants into the environment. It has been estimated that on a global scale, 4.6 million tonnes of chemical pesticides are sprayed into the environment annually. However, only 1% of the sprayed pesticides are effective, as 99% of the chemicals are released into non-target environments, including soils, water bodies, and atmosphere (Zhang et al. 2011). Contamination of the environment by pesticides is of concern as most pesticides are known to be highly toxic to many target and non-target organisms including microalgae.

Atrazine is a herbicide of the triazine family that inhibits photosynthesis, mainly photosystem II (PSII) by binding to plastoquinone-binding protein. The agrochemical is one of the most effective and inexpensive herbicides in the world, with an annual application between 70,000 and 90,000 tonnes

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