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Potential Dermal Exposure Assessment of Farmers to Herbicide Imazapic in an Agriculture Area

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Abstract

For decades, the percentage of pesticide usage has steadily increased in order to meet the demands of food production. The aim of this study is to estimate the risk posed towards farmers through exposure to surface water containing imazapic herbicide using dermal exposure assessment (DEA). For this purpose, hazard index (HI) value was calculated to estimate the risk posed towards the farmers. Although calculated HI showed a minimum level of risk, there are concerns toward the danger of long-term exposure to the farmers of an agricultural system that could affect their quality of life.

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1. Introduction

For decades, the pattern of pesticide usage in agriculture industry has steadily increased both globally and simultaneously with the rise of population growth to meet the demands of food production (Caldas et al., 2011). Almost 30% global pesticide are from developing countries (Caldas et al., 2011) with Malaysia alone consuming

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more than 200000 tons pesticide annually comprising of more than 50000 tons of active compounds (Sabere et al., 2013). Pesticides are also classified into different classes depending on its purpose or target organism, and this includes herbicide, insecticide, fungicide, nematicide, and bactericide (Mohd Fuad et al., 2012). The type of pesticide used most in the agricultural practices are herbicides due to its efficiency in killing crop competing weeds without much effort from farm laborers as well as increasing the crop's yield (Colborn & Short, 1999). However, besides being a favored necessity in agriculture, herbicides, which are currently being distributed under various trade names are also said to post the most threat to human and environment (Ali et al., 2013).

As a developing country with a host of natural resources available, Malaysia has encouraged its agricultural industry to be one of the main sources of income to bolster the country's economic growth, where various efforts are made by both the government as well as agricultural practitioner in order to improve the quality of their livelihood (Ali et al., 2013; Yacob et al., 2012). In an agricultural area in Tanjung Karang, a new paddy strain was introduced by MARDI; the MR220 CL1 and CL2. Both these strain were introduced to prevent weedy rice problem that required farmers to apply herbicides containing the imazapic compound. Briefly, imazapic is a compound that belongs to the imidazolinone family. It is one of the well-known herbicide used by farmers to kill weedy rice in paddy fields, and it has been introduced in Malaysia for approximately three years prior to this research (Baumart and Santos, 2011; Azmi et al., 2012). However, imazapic potentially being persistent in water for up to 39 days and previous toxicological studies had shown that it can lead to several health effects such as eye irritation, anemia, liver damage, increased cholesterol and muscle degeneration. Hence, this is a major concern that may affect the quality of life of farmers (Cox, 2003). In fact, a study by Mohd Fuad et al., (2012) had recorded several cases of pesticide poisoning and death in Tanjung Karang area (Table 1).

Table 1. Farmers' reported cases and death in relation to pesticide poisoning in the study area (2005-2010)*

Year	Total case	Total death
2005	17	2
2006	19	1
2007	9	3
2008	17	3
2009	24	2
2010	8	3
Total	94	14

*Source: District Hospital Tanjung Karang (2005-2010) as cited in Mohd Fuad et al. (2012)

In relation to the direct exposure of these herbicides, the farmers may also be exposed via body absorption of the herbicide from their daily activities in the field. Eventually, this may lead to undesirable health effects to the farmers. Therefore, the aim of this study is to determine the presence of imazapic in the paddy area and to estimate the potential risk towards farmers that exposed to imazapic through surface water contact using dermal exposure assessment (DEA).

2. Method and materials

2.1. Study area

This study was carried out at Tanjung Karang Rice Irrigation area, located at 3°25' - 3°45' N latitude and 100°58' - 101°15' E longitude in the state of Selangor. Rice is grown twice a year mainly from December to April and July to November. Kampung Sawah Sempadan compartment consist of 1468 lots with the total area about 2,300

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