CHAPTER I

INTRODUCTION

1.1 Problem Definition

Nowadays, glyphosate is one of the most popularly used herbicides globally and also in Thailand. The Thai Department of Agriculture reported that Thailand had been importing glyphosate more than any other herbicide. In 1999, 6,766,000 kg was imported and the amount drastically increased to 24,882,000 kg in 2003.

The use of glyphosate as a herbicide is widespread because glyphosate can effectively control many species of annual and perennial grasses. It is therefore used in both agriculture and landscaping. As Thailand is primarily an agricultural country, the high use of glyphosate herbicide in the country is of particular concern.

Glyphosate herbicide was classified by the EPA as a group "E" substance, which means it is non-carcinogenic for humans. However, this decision is not as convincing because there is a lack of long-term data to support it. Therefore, despite its classification in group E, the use of glyphosate herbicide in large amounts over a long period of time may result in glyphosate contamination in the environment.

Glyphosate herbicide is commonly used together with other fertilizers, especially formula N-P-K (in the ratio of 16:16:16), in agricultural practices. The applications of these chemical fertilizers in the areas that have been treated with glyphosate have the possibility of becoming a larger environmental problem due to glyphosate leaching into groundwater. Almost all of the previous studies on the behavior of glyphosate in the environment have dealt with the adsorption of glyphosate on soil; few studies have looked into the leaching behavior of glyphosate. Moreover, the studies on glyphosate leaching have been done in the laboratory;

therefore, the behavior of glyphosate in the environment under natural conditions has not been properly evaluation.

The leaching of glyphosate into groundwater, which is influenced by both natural factors and chemical fertilizers, could become a serious problem for our country since the large agriculture areas of Thailand are comprised of many natural water resources, especially the central part of Thailand. There is a high potential risk of people becoming exposed to glyphosate contaminated water, especially since the regulatory controls and monitoring plan on glyphosate contamination in environment have not been set up in Thailand.

Since glyphosate is among the most commonly used herbicides in Thailand, safer application methods would help to support the Thai government's goal of sustainable development.

1.2 Objectives

This study has 3 main objectives:

1.2.1 To study glyphosate leaching behavior without the influence of a chemical fertilizer.

1.2.1.1 To determine the leaching of glyphosate and its metabolite aminomethyphosphonic acid (AMPA) that may occur under natural conditions.

1.2.1.2 To compare the influence of the amounts of rainfall during two seasons (the rainy season and summer) on the leaching of glyphosate and its metabolite AMPA.

1.2.2 To study the influence of a commonly used multi-chemical fertilizer on glyphosate leaching.

1.2.2.1 To study the influence of a chemical fertilizer that contains total N 16%, $P_2O_5$16%, K_2O16%, MgO 0.6%, and CaO 4.8% on the leaching of glyphosate and its metabolite AMPA.

1.2.2.2 To compare the leaching of glyphosate influenced by the chemical fertilizer and amount of rainfall during two seasons (the rainy season and summer).

1.2.3 To study the effects of a chemical fertilizer on the accumulation of glyphosate in soil.

1.2.3.1 To compare the residual glyphosate in soil influenced by the amount of rainfall during two seasons (the rainy season and summer)

1.2.3.2 To compare the effects of the chemical fertilizer and the rainfall during two seasons on the quantity of residual glyphosate in the soil.

1.3 Hypotheses

1.3.1 Glyphosate strongly adsorbs onto soil, but it is also highly water soluble. Its high water solubility plays a significant role under natural conditions; therefore, glyphosate leaching is greater during the rainy season than in the summer.

1.3.2 The agricultural application of a phosphorus-containing chemical fertilizer on soil that has been treated with glyphosate can cause the glyphosate to leach into the groundwater. This occurs because the fertilizers competes with and replaces the glyphosate in the soil by adsorbing onto the specific phosphorus sorption sites.

1.3.3 The other chemicals contained in the fertilizer can effect the accumulation of glyphosate in soil by forming complexes with the glyphosate.

1.4 Scope of the Study

This study focuses on determining the influences of a chemical fertilizer (composed of 16% as N, P, K, MgO 0.6%, and CaO 4.8%) and the amount of rainfall, on glyphosate leaching. The other chemicals contained in the fertilizer will be studied

as the minor effect on glyphosate leaching and accumulation in soil also. The monitoring period lasted 60 days. After the monitoring period, the residual glyphosate in the soil was evaluated to understand its sorption characteristics.

1.5 Expected Outcomes

The overall outcome from this research was the formation of a suitable schedule for fertilizer applications in agricultural fields that utilize glyphosate herbicides. Since unsuitable fertilizer applications can lead to glyphosate leaching into groundwater, the proper management of fertilizer applications will help to save the environment and protect humans from exposure to contaminated water.

The specific outcomes of this study are:

1.5.1 Data on glyphosate leaching during two different seasons.

1.5.2 Data on the influences of a chemical fertilizer and the rainfall during two seasons on glyphosate leaching.

1.5.3 The effects of the chemical fertilizer and glyphosate herbicide usage on the environment in terms of their leaching and accumulation in soil.