CHAPTER 1

INTRODUCTION

1.1 The need and safe use of pesticides

Pesticides are chemicals that mostly used in agriculture for the control of pests, weeds or plants diseases. Without pest control, food and fiber productions may not be enough for the demanding of mankind. Worldwide research data estimated that agricultural production might be reduced for about 40% if pesticides are not applied (Kennedy, 1998). Moreover, human population reportedly increased from 2 billion in 1930 to about 6 billion at present time, more food production for about 2 times are needed for feeding world population in the 21st century (Perry *et al*, 1998). Consequently, the need of more food production lead us to maintain mass agricultural production field. Besides of adding nutrient with using fertilizer, pesticides are used to eliminate all crops' pests although they are known dangerous to health of users, consumers and the environment if they are carelessly used.

Currently, world consumption of pesticides is herbicides (43%), insecticides (32%), fungicides (19%), with the remaining of 6% divides between growth regulator and miscellaneous chemicals (Perry *et al*, 1998). In Thailand, pesticides consumption was herbicides (55%), insecticides (26%), fungicides (17%) and others (2%) which was estimated from importation weight. Fruits and vegetables are reportedly required more pesticides than other agricultural productions, and residues that contaminated most in the environment were insecticides, fungicides and herbicides (Tayaputch, 1998).

There are basically 3 common concerns causing from pesticides used. Firstly, the concern of hygiene of pesticide sprayer who has the greatest chance to both careless and accidentally expose to pesticides. Secondly, the concern of consumer health that they have chanced to absorb and accumulate pesticides from contaminated foods in their bodies. Many vegetables had residue of pesticides, for example, 91 in 171 samples of milled rice were found residue of pesticides (Tejada *et al*, 1998; Tayaputch, 1998). Thirdly, the impact of environmental pollution on non-target organisms such as birds, useful insects, fish and aquatic organisms. They are easily exposed to drift of aerial spraying pesticides in agricultural field, through watershed drainage or accidental spillage, and even though intentional application (Ibrahim *et al*, 1998). Non-target organisms living in terrestrial and aquatic habitats might die when they exposed to pesticides. Bird and fish were common organisms used in the experiments on acute poisoning caused by pesticides and other organisms such as mollusk accumulated pesticide residues in their bodies (Stansley, 1993; Tejada *et al*, 1998).

Nowadays there are actions to protect human health and other living-things from pesticides' exposure. World Health Organization (WHO) cooperation with Food and Agricultural Organization (FAO) proposed clearly actions concern with human health. They set Maximum Residue Limit (MRL) to limit the maximum concentration of pesticides' dose in various kinds of foods (Tejada *et al*, 1998). For examples, in apple, oranges, and sweet potato have MRL of parathion for 0.05 mg/kg, which meant that these foods should not contain parathion more than 0.05 mg/kg (FAO/WHO, 2000).

For the environment, currently there are a lot of researches are interested in pesticide contaminated or affected in the nature. These research works are divided into 3 categories. Firstly, is the work connecting with the residue detection in abiotic or biotic component such as the work done by Varca and Tejeda (1998) studied residue of pesticides in soil and water in rice paddy in the Philippines, and Tabucanon and Boonyatumanond (1998) detected pesticides' residue in Chao Phraya river, Thailand. Secondly, is the work done on pesticides' type and dose responses in organism, for example these reportedly by Kunh and Streit (1994), Ibrahim *et al* (1998), Scaps *et al* (1997) and Lari *et al* (1994) who studied types and dose responses in gammarus, midge, rag worm and birds, respectively. Thirdly the work that related with population or community changing affected by pesticides used such as the work done by Kence and Jdeidi, (1997) studied changing of house fly population in malathion treated condition, Josefo, (1994) and Rojee, (1995) studied impact of highland agriculture to community of macroinvertebrate. Consequently of this works, development of methodology with sensitivity and precision for detection of pesticides and bioindicator field which monitor of physiological, population and community of living-things for indication the impact of pesticides in the environment are developing until now.

1.2 Study site of interest

The present work was proposed to study an impact of pesticides used in Ban Mae Sa Mai, a highland agricultural area in Mae Sa Noi watershed, Mae Rim district, Chiang Mai, Thailand where the area is about 5 km^2. About half of watershed area has been

changed to agricultural area. Lychee, rice, cabbage, lettuce, and maize, for examples have been regularly grown in this area. Organophosphate and carbamate pesticides (OPs and CAs, respectively) have been reportedly used (Stuetz, 1998). Many crops have been usually grown in cold season and harvest in early dry season. In dry season, when water was not enough and dramatically changing climate in rainy season then there were not much agricultural activities. Therefore, the present study was interested in an environmental impact of pesticides used in Mae Sa Noi watershed. Mae Sa Noi stream where originated and flows across the middle of this watershed was seasonally monitored on physico-chemical parameters, macroinvertebrate communities and on the activity of cholinesterase (ChE) of chironomids.

The effect of OPs and CAs is to block the nervous system. Their molecular targets are cholinesterase enzymes, particularly acetylcholinesterase, an enzyme that controls the transmission of nerve impulses at synapses (U.S. Department of Health & Human Services, 1993). Hence, other names of these pesticides are known as **cholinesterase-inhibiting pesticides**. Most of them are not so persistent but their toxicities are mostly very high. After several sprayings, non-target organisms especially aquatic macroinvertebrate, water bugs and some dragonfly nymph were suddenly dead (Rojee, 1995). This impact directly disturbs the equilibrium of food web in aquatic ecosystem. Consequently the changing of communities and population densities of living-things were taken place. Theoretically, therefore, preventing continuous exposure of OPs and CAs will enable the enzyme system to recover (Ibrahim *et al*, 1998). However, in the environment where pesticides are heavily used, most non-target organisms are likely to

be continuously exposed to these pesticides. Then enzyme activities were unable to recover and organisms finally died (lethal).

The present study intended to focus on macroinvertebrate community changed causing from pesticides. The reports on the use of pesticides and community study are inadequate to conclude by deduction that the changes of populations and communities occurred caused by pesticides used. Laboratory bioassay would provide evidences confirming the conclusion. Therefore, the seasonal monitoring of activities of chironomid ChE activity was also carried out.

1.3 Objectives of the present study

Objectives of the present study were to assess the impact of pesticides used to the communities of benthic macroinvertebrate and to measure cholinesterase activity in chironomids from study site in order to imply the impact of pesticides used on macroinvertebrate community change in Ban Mae Sa Mai, Chiang Mai province.