CHAPTER 1

INTRODUCTION

Chiang Mai, located in northern Thailand, has been rapidly developed which effects on natural resources, including, environmental quality and human healthy cannot be avoided. The rapidly development in the city such as transportation; road, and building construction, had been expanded to meet the demand of residents and tourists. Air pollution becomes one of the main problems in the city. Many air pollutants, including nitrogen oxides, sulfur dioxide, particle matter etc., are released through industrial activity, consumption of fossil fuels and motor vehicle traffic. All compound dispersed to the atmosphere may cause problem to human health. Nitrogen dioxide is one of the principal nitrogen oxides which are produced by high temperatures in combustion reactions, such as the burning of coal or in the running of automobile. The main effect of breathing in raised levels of nitrogen dioxide is the increased likelihood of respiratory problems (Australian Government, 2005). So, the standard level of nitrogen dioxide was created. In Thailand air quality standard was created by Pollution Control Department (PCD). For one hour, nitrogen dioxide concentrations should not exceed 170 ppbv (PCD, 2012).

Air quality monitoring can be done in many ways such as physico-chemical methods by using equipments to measure concentration of the pollutants and biological method by using organisms as bioindicators. Physico- chemical method has an advantage that it can determine the concentration and types of pollutants but

cannot determine the effects or accumulation of pollution to the organisms and environment. Furthermore, it is rather expensive and the instrument used is often sophisticated. Biomonitoring is method to measure the response of organisms to air pollution. Application of biomonitors has several advantages. It provides integrated exposure over a certain period of time. It also can be applied in remote areas and inexpensive technical equipments are involved (Sloof *et al.*, 1988; Steinnes, 1989 cited by Sloof, 1995). Biological method using bioindicators may be done by observing changes in physiological structures, biochemistry and chemical compounds of the organisms, or by evaluating from the diversity of organisms, such as, appearing or disappearing of some certain species. This method can monitor the effects of pollutions to organisms directly without using complicated expensive equipments (Subsri, 2001). However, it cannot measure the concentration of pollutants which is the disadvantage of this method. Therefore, it is recommended that both physico-chemical and biological method should be done together, if possible, to obtain complete information. One of the inexpensive and none complicated physico-chemical monitoring methods used for air pollution monitoring is the passive sampling technique. This method is easy and the sampling tubes can be set up in all study areas without transporting of sophisticated instruments.

Several organisms such as plants and lichens are used to monitor air quality. Lichens are commonly used as bioindicators of air pollution because of their sensitivity to several kinds of air pollutants such as sulphur dioxide, copper, zinc, arsenic, and lead from air pollution (Dawson and Irving, 2008). Lichen may show the symptom such as bleached thallus or die. Beside, change in lichen communities, species composition, number or frequency, including their distribution can be used as

tools for air pollution monitoring. The main effects of nitrogen deposition on lichen can result in changes of the communities, a greater occurrence of nitrophytic species, often associated with a rise of bark pH and decrease in the biodiversity (Gombert *et al.*, 2003). In Europe lichen mapping has been applied to assess atmospheric pollutant levels in and around urban sites. The VDI method proposed by Verein Deutscher Ingenieure (1995) recommended lichen frequency as a signal to air pollution level and a map of air quality can be produced from lichen index. The method has shown good correlations between lichen and deposition of atmospheric pollutants in urban and surrounding areas (Kirschbaum and Hanewald, 1998; Larsen *et al.*, 2007 cited by Saipunkaew *et al.*, 2007). Therefore the biological monitoring method using lichen mapping in Chiang Mai city will be selected to show the quality of the ambient air in the city whereas physico-chemical method using passive sampling technique will be applied in the study as well. Nitrogen dioxide was measured because it was one of the main air pollutions in Chiang Mai city, together with increasing of vehicle registration in Chiang Mai in each year (National Information Center, 2013). This study will provide complete information on level of air pollution in the city.

Consequently, the main objectives of this study are;

(1) To produce an air quality map, in oder to define the zones of different air quality in the study areas based on lichens community.

(2) To determine the concentration of nitrogen dioxide in Chiang Mai City by using passive sampling technique.

(3) To indicate the relationships between lichen indexes and concentration of nitrogen dioxide in ambient air by using passive sampling technique.

(4) To study the distribution of some selected lichen species in urban and suburban areas of Chiang Mai.