CHAPTER 1

INTRODUCTION

Vegetables are one of the main exports of Thailand. Vegetables are produced mainly in the highland areas of northern Thailand, which has an important head watershed. Agrochemicals are increasingly being used, which threatens the environment and nearby communities. Recently, growing interest among consumers regarding safer and healthier vegetables has prompted an expansion of the supply of organic products. Therefore, bio-organic inputs such as organic seedling media, various types of organic fertilizers, and beneficial microorganisms play an important role in organic cultivation systems. These systems exclude the use of synthetic fertilizers, pesticides, and insecticides and usually lead to increased antioxidant components in crops (Soltof *et al*., 2010). Lysine levels in organically-grown wheat were 25 – 30% higher than conventionally-grown wheat (Wolfson and Shearer, 1981). Several studies performed on potato, tomato, celeriac, and kale showed that vitamin C levels were higher in organically-grown products compared to conventionally-grown ones (Fischer and Richter, 1986; Pither and Hall, 1990; Leclerc *et al*., 1991; Kolbe *et al*., 1995; Caris-Veyrat *et al*., 2004). A study on commercial fruit and soil quality from 13 pairs of organic and conventional strawberry agroecosystems in California indicated that the organic strawberry farms produced higher quality fruit and had

higher quality soil. The study also showed that the higher quality soil may have greater microbial functional capability and resilience to stress (Reganold *et al*., 2010).

The current concept of more nutritious food places the emphasis on foods that contain more protein, fiber, and vitamins as well as specific phytochemicals such as the polyphenolic antioxidants found in fruits and vegetables (Scallbert *et al*., 2005). Organic and bio-organic fertilizers are an alternative approach that promotes high yields and high nutritional content in crop production. The highest value of antioxidant and anticancer activities were obtained in basil plants grown in 50% and 75% compost treatments in the presence of biofertilizer (Hanan *et al*., 2010). In tomato plants the application of a mixed strain of plant growth promotion rhizobacteria (PGPR) and arbuscular mycorrhiza fungi (AMF) showed the highest values of lycopene, antioxidant activity, shoot and fruit potassium (Ordookhani *et al*., 2010). These results emphasize the importance of bio-organic fertilizers that enhance antioxidant production and activity. However, the chemical composition and nutritional values of crops can vary depending on the different types of and the quality of the organic material found in the fertilizer. A study found that various kinds of organic fertilizers showed better positive effects on total antioxidant activity than did farmyard manure. In this study organic fertilizer significantly contributed to the improvement of the nutritional value of vegetables (Bimova and Pokluda, 2008).

Chinese kale (*Brassica oleracea* var. alboglabra) is one of the most commonly grown leafy vegetables in northern Thailand. Chinese kale contains high nutritional value including protein, calcium, iron, vitamins, and fiber. These values together with

its crunchy taste have made Chinese kale a favorite among vegetables in the northern region. Studies have revealed that Chinese kale contains phytochemicals such as glucosinolates, beta-carotene, flavonoids, and vitamin C to fight against cancer (Van Poppel *et al*. 1999; Talalay *et al*., 2001; La *et al*., 2009). Improvement of the nutritional value of Chinese kale by adding bio-organic inputs in the production system is of interest and could lead to better consumer health. The humus content in organic fertilizer is a key component of its value in the agricultural system. Little consideration has previously been given to humus content in organic fertilizer, which plays an important role in crop yield and improvement in nutritional value. Therefore, in this study a high humus material (leonardite) was added to organic inputs in varying rates with and without beneficial microorganisms and their effects on nutritional values and yield of Chinese kale were evaluated. This topic is quite new and challenging to investigate; therefore, the results obtained from this study will clarify the potential and effectiveness of both leonardite and beneficial microorganisms and will also be useful as information for further research concerning the improvement of the nutritional value of crops. This positive effect could also strengthen the use of high humus materials and bio-fertilizer in both conventional and organic farming systems. Bio-organic materials have the potential to be further developed for use in both regional scale for small holder farmers and in commercial scale.

Objectives

1. To screen for effective beneficial microorganisms and evaluate their growth promoting potential on Chinese kale seedlings.

2. To determine the effectiveness of single and multiple isolates on growth and nutrient uptake in Chinese kale seedlings.
3. To determine the effectiveness of leonardite and beneficial microorganisms on growth and nutrient uptake in Chinese kale seedlings.
4. To determine the effectiveness of both components on growth, nutrient uptake, vitamin C content, and antioxidant activity in Chinese kale and identify the most effective isolates.