CHAPTER 1 INTRODUCTION

1.1 Rationale

Thailand's prawns harvest yields 500,000-550,000 tons annually, accounting for 28 % of the world's prawn production. Over 90 % of Thailand's shrimp product is for exporting in the form of refrigerated, frozen and processed prawns. 99% of shrimp farming in the country is for white leg shrimps, while the other 1% is for black tiger prawns. Approximately 70 % of the total shrimp landing becomes organic waste such as heads, shells and meat portions of shrimp from the processing of shrimp. The major components (dry weight basis) of shrimp waste are protein (35– 50%), chitin (15–25%), minerals (10–15%) and carotenoids (Sachindra, 2003; Rødde et al., 2008). Concerning for environmental, health, and safety, researchers or/and seafood processors have studied to enhance value of seafood processing wastes. They can use to produce the several biomaterials or nutrients such as chitin, chitosan, pigments, seafood, peptones, and mineral. Therefore, shrimp waste is the most important resource for using in chitin, chitosan and carotenoid production (Kim and Rajapakse, 2005; Tharanathan and Kittur, 2003; Khanafari et al, 2008; Sachindra et al., 2005). Shrimp shell can use as the organic fertilizer for promoting microorganism and plant. The chitinolytic bacteria could produce hydrolytic enzyme, chitinases for carbon and nitrogen assimilation (Chang et al., 2007).

Fungal disease is a serious problem in the important crop plant cultivation which caused by pathogenic fungi (Gohel et al., 2006; Brimner and Boland, 2003) such as *Fusarium oxysporum* (Getha and Vikineswary, 2002), *F. solani* (Prapagdee et al, 2007), *Phytophthora capsici*. (Joo, 2005), *Pythium aphanidermatum* (Yan et al., 2008). Chemical fungicides are extensively used in current agriculture and also caused environmental pollution, human health, and increased fungal pathogen resistance to fungicide. Therefore, biological control of plant pathogens provides an attractive alternative means for management of plant disease without the negative impact of chemical fungicides. This method is more environmentally friendly than chemical fungicides. Microbial antagonists are widely found and used for controlling pathogenic fungi. The fungal cell wall is mainly consisted of glucan and chitin. Therefore, the b-1, 3-glucanase, cellulase, and chitinase could response for fungal cell wall degradation (Gupta et al., 1995; Inglis and Kawchuk, 2002).

The genus *Streptomyces* is well known as antifungal biocontrol agent that can inhibit several plant pathogenic fungi (El-Tarabily et al., 2000; Joo, 2005; Xiao et al., 2002). The antagonistic activity of *Streptomyces* to fungal pathogens is usually related to the production of antifungal compounds (Fguira et al., 2005; Taechowisan et al., 2005) and extracellular hydrolytic enzymes such as cellulases, hemicellulases, amylases, glucanases, chitinases (Beyer and Diekmann. 1985). The extracellular chitinase enzyme is considered to be important hydrolytic enzymes (El-Katatny et al., 2009; Gupta et al., 1995; Gomes et al., 2000; Taechowisan et al., 2003). Moreover, spores or mycelia of *Streptomyces* can apply into the field and greenhouse as biological control agents (BCAs). BCAs have been formulated into various types such as liquid, solid, and powder. However, the feasibility of using BCAs in greenhouses or the field is depended on its formulation types, mode of actions, and delivery methods (Saenz-de-Cabezon et al., 2010; Melin et al., 2011). The biological control agents from *Streptomyces* has never produced as the commercially products in Thailand. In this study, the soil antagonitic *Streptomyces* sp. isolate S4 was isolated and proved to be novel specie of antagonistic *Streptomyces* against various plant pathogenic fungi. The agro-industry, shrimp shells and rice bran was used as a major component in media. The response surface methodology (RSM) is an efficient experimental strategic tool to obtain the optimum conditions for producing the biological control agent (BCA). The shelf life and affectivity of biological control agent was also tested.

1.2 Objectives

This study aims at producing biological control product of antagonistic *Streptomyces* isolated from termite mound in Thailand. The specific objectives include:

1.2.1 To isolate of plant pathogenic fungi causing seedling damping off diseases in economic plant nursery.

1.2.2 To isolate and screen for antagonistic actinomycetes against fungal seedling damping off and root rot diseases.

1.2.3 To identify the selected antagonistic actinomycetes.

1.2.4 To study antagonistic mechanism.

1.2.5 To produce bioproduct of the antagonistic actinomycetes.

1.3 Hypotheses

The hypotheses of this research were:

1.3.1 The antagonistic actinomycetes could be isolated.

1.3.2 The selected actinomycetes could be inhibited the plant pathogenic fungi causing seedling damping off diseases.

1.3.3 The shrimp shell and rice bran could be used for cell mass production.

1.3.4 The selected actinomycetes could be produced as biocontrol product.

1.4 Scopes

1.4.1 Soil samples and the infected seedlings were collected for isolation the soil actinomycetes and pathogenic fungi.

1.4.2 The soil actinomycetes were tested for inhibiting the isolated pathogenic fungi and identified.

1.4.3 The antagonistic mechanism of selected actinomycetes; antibiosis, hydrolytic enzymes (chitinase and cellulose), and mycoparasitism was studied in liquid and solid medium.

1.4.4 The solid state fermentation medium was optimized for selected actinomycetes production.

1.4.5 The biocontrol product of selected actinomycetes was produced and monitored the shelf life while storing at 4°C and room temperature for 6 months.

1.5 Expected Benefits

The antagonistic actinomycetes could be inhibited the various pathogenic fungi and could be grown in agro-industry waste (shrimp shell and rice bran). The biocontrol product of antagonistic actinomycetes could be developed as commercial product.