1.0. INTRODUCTION

Biological control is the activity of predators, parasites, or pathogens in maintaining another organism's population density. The increase tempo of development in biopesticides is closely related to the growing awareness and emphasis on integrated pest management (CPM) and sustainable agriculture (Menn, 1996). However, world biopesticide sales in 1990 were estimated to be $120 million, representing less than 0.5%, of the world agrochemical market. Over 90% of biopesticides sales are represented by a single product type, containing *Bacillus thuringiensis* Bol., for control of insect pests. Nevertheless, biopesticide sales are estimated to be increasing at 10.25% per annum whilst the world agrochemical market is static or even shrinking (Rodgers, 1993). Although it has been carried out successfully in many countries around the world, its application is still limited in Malaysia. Currently bacterial insecticides are being manufactured and marketed by industries. A bacterial insecticide consists of a bacterial culture or product, that results in the death of an insect (Bulla *et al.*, 1979).

There are a number of bacteria which are used in the control of insect pests. They belong to the Pseudomonadaceae, Enterobacteriaceae, Lactobacillaceae, Micrococcaceae and Bacilliaceae (Bulla *et al.*, 1979). They are generally target specific and resistance develops slowly. However, only a few have been successfully used in biological control. Of these *Bacillus thuringiensis, B. popilliae, B. lentimorbus* and *B. sphaericus* which belong to the family Bacilliaceae form spores while some form a crystalline inclusion as well.

Bacillus thuringiensis occurs in the natural habitat. It is a rod-shaped, aerobic, Gram-positive bacterium which is subdivided into more than 20 varieties based on H-serotype and by biochemical means (Dulmage, 1981). New strains have been characterised by unusual crystal morphology or protein profile, DNA probes, reactivity with crystal antisera and insecticidal activity (Chilcott and Widley, 1994). Certain enzymes have been known to be secreted during the various stages of the growth of the culture (Warren, 1968; Hanson *et al.*, 1970; Yousten and Rogoff, 1969). The crystals form a number of protein subunits which have been identified by electrophoresis (Huber *et al.*, 1981; Haider *et al.*, 1986; Insell and Fitz-James, 1985). Studies have been conducted on the application of *B. thuringiensis* for mosquitoes control (Lee and Seleena, 1990; Balaraman *et al.*, 1986). An attempt was made to obtain a better insight into the mechanism of production of the spore and crystal synthesized by the organism. Thus, a study was conducted with the following objectives :

(i) to determine the trends in exo and endoenzyme synthesis with respect to sporulation and crystal formation during the growth of selected strains of *B. thuringiensis*

(ii) to isolate and purify the crystals from the spores and to determine the subunits of the crystals by electrophoresis

(iii) to scale-up the production of potential strains of *B. thuringiensis* in a pilot plant fermenter

(iv) to conduct an integrated study using *B. thuringiensis* and chemical insecticides on cabbage for biological control of the Diamondback moth.