CHAPTER I

INTRODUCTION

Soybean *Glycine max* (L.) Merrill is a good meat and fish substitute because of its comparatively high protein content (40%). Furthermore, soybean seeds are also high in oil content, about 19-21 % by weight. Since soybeans have a high percentage of oil and protein, it is sometimes called the "miracle bean." The importance of soybean as the most important oil and protein crop has been recognized globally and at the regional level as well (Baldwin and Fulmer, 1984). Soy protein is particularly useful to people allergic to animal or dairy protein, to those on low cholesterol diets and lastly to religious and philosophical vegetarians. In addition, institutional use of soy protein in the form of artificial meat is increasing (Christiansen, 1970). The use of soybean as the source of vegetable oil has been estimated about 20-24% of all fat and oil in the world (Walter and Samuel, 1983).

For nearly 500 years, the soybean has been cultivated for human consumption. Even today, 95% of soybean oil produced is consumed as food. It is only within the last 40 to 50 years that the effectiveness of feeding soy proteins to animals was demonstrated, and the confinement feeding of large numbers of animals in one location was adopted. Today, 97% of the soybean meal produced is consumed in commercial animal feeds (Baldwin and Fulmer, 1984).

Apart from this, as a legume soybean is capable of utilizing atmospheric nitrogen through biological nitrogen fixation and is therefore more dependent on symbiotic nitrogen than most crops.

With the alarming increases in soybean consumption in the world, there is a greater need to increase the crop productivity to feed. In order to increase the yield, the main causes of variability that makes the yield difference need to be identified. There are factors which may contribute the yield difference: such as the abilities in nodulation, nitrogen fixation and also variety.

In Myanmar, soybean is one of the important cash crops and this crop is the second largest position of crop cultivated after rice due to the increasing demand for domestic consumption and export (CSO, 2006). The annual area under soybean in Myanmar is about 146,000 ha and production is about 165, 000 metric tons in 2004-2005. The majority of the soybean area, about 50%, is in Shan State, and the remaining cultivated areas are in Ayeyarwaddy, Bago, Magway and Mandalay Divisions, and Chin, Kachin, Kayah, Kayin and Mon States (CSO, 2006). The average yield of soybean in Myanmar is 1275 kg per hectare (CSO, 2007).

Urea is the main source of nitrogen applied to all crops grown in Myanmar but it is very expensive and not readily available (Hla Than and Thein Han, 1988). Rhizobial inoculant can be used to substitute the nitrogenous fertilizers in food legume crops. Root nodule bacterial research and inoculant production was initiated at the Plant Pathology Section of Department of Agricultural Research (DAR), Yezin in 1978 to supply nitrogen for leguminous crops through Biological Nitrogen Fixation (BNF) system. At present, 250,000 packages of peat based root nodule bacterial inoculants for 7 legumes crops (groundnut, chickpea, blackgram, greengram, pigeonpea, soybean and cowpea) are annually produced and distributed through Extension Division of Myanma Agrculture Service (MAS) (Maw Maw Than *et al*., 2006). Nowadays, exotic bradyrhizobial strains of TAL 379, TAL 377 and TAL 102

from NifTAL (Nitrogen fixation for Tropical Agricultural Legumes) are used in Root nodule bacterial inoculant production for soybean (DAR, 2004).

Bradyrhizobium was the first rhizobial genus to be created in addition to Rhizobium. It was created to accommodate so-called "slow-growing strains" of rhizobia and for 10 years contained only one named species: the soybean-nodulating *B. japonicum* (Jordan, 1982). The existence of at least two genetically divergent types of *B. japonicum* was recognized and the group was subsequently split into two species with the creation of *B. elkanii* (Kuykendall *et al*., 1992). A third genus of soybean-nodulating Bradyrhizobia, *B. liaoningense*, was created in 1995 to accommodate exceptionally slow-growing strains (Xu *et al*., 1995).

The major problem of soybean inoculation is that existing indigenous strains in the field may often suppress the introduced inoculant strain applied to soybean subsequently. Therefore, it is necessary that the highly effective introduced strain has also the capacity to compete with the resident ineffective root nodule bacteria in the soil (Dowling and Broughton, 1986).

Matsukuma *et al*., (1994) and Okazaki *et al.,* (1995) reported that a variety of actinomycetes inhabit a wide range of plants as either symbionts or parasites. They also reported that several new or rare species of actinomycetes were discovered from plants and suggested that their secondary metabolites might be promising sources of novel antibiotics and growth regulators of other organisms. Actinomycetes, especially *Streptomycetes spp.,* isolated from the rhizosphere of the plants cultivated in the soils have proven to be excellent biocontrol agents of soil borne plant pathogens (Yuan and Crawford, 1995). Control of soil-borne diseases with endophytic actinomycetes biocontrol agents has elicited considerable interest. Increased concern about the

environmental impacts agrochemicals in soil and ground water and the lack of effective chemical controls for many soil-borne diseases has stimulated this trend (Paulitz and Linderman, 1991).

In modern agriculture, application of agrochemicals is still an effective method to control plant disease. However, since the use of agrochemical has been fallen into disapproval because of environment pollution, harmful effects on a variety of non-target organisms and the harmful effect of their residues on the health of field workers and consumers. In addition, their use is, in certain cases, efficiently unviable. Control of pests and disease by means of biological processes for example the use of entomopathogenic microorganisms or those that reduce/ provoke other microorganisms pathogenic to plants are the alternative methods to reduce or eliminate the use of chemical products in agriculture. Preferably, an agent of biological control of fungal root pathogens should provide a sufficient amount of aggressive activity in the rhizosphere in order to reduce root disease symptoms (Chet *et al*., 1990 and Crawford *et al*., 1993).

There was an interesting report on the effect of endophytic actinomycetes and root nodule bacteria on nitrogen uptake and growth of various leguminous crops including soybean under experiment in the controlled room (Thapanapongworakul, 2003). In case of soybean, inoculation of selected endophytic actinomycetes isolated from sweet pea which showed antagonistic ability against fungal plant diseases could improve nitrogen uptake of the soybean plant grown under controlled condition about 83% compared to uninoculation control treatment and such endophyte could compatible well with Bradyrhizobium. Thapanapongworakul's research result with soybean is attractive for further investigation in pot or field trials.

Not so much research on native root nodule bacteria and soybean has been conducted in Myanmar. Recently, Thi Thi Aung (2007) studied the effectiveness of 38 Bradyrhizobium strains, collected from Upper Myanmar soybean growing areas, in symbiosis association with soybean variety; Yezin-3 was determined by using modified Leonard's bottle jar method with N free nutrient solution in screenhouse. The data were recorded at 45 days after sowing (DAS).When the nodule pattern, nodule dry weight and shoot dry weight of the plants inoculated with the tested Bradyrhizobium strains were compared, five Bradyrhizobium strains designated as YAU 5, YAU 6, YAU 15, YAU 17 and YAU 29 were found to be more effective than other strains. Anyhow, the effectiveness of Myanmar isolates should be studied further by pot or field experiment.

This research was therefore conducted to investigate further whether the selected endophytic actinomycetes which has been tested previously with soybean and Bradyrhizobial isolates particularly those from Myanmar will affect nodulation and nitrogen fixation of different soybean varieties under pot trails using soil as the growth medium. The results from this research will be used as the guide line to improve the growth and yield of soybean from different sources by biological means.

The objective of this research is to evaluate the responses of soybean varieties from different origins to selected endophytic actinomycetes and Bradyrhizobia in term of plant growth, nodulation, nitrogen fixation and seed yield.