

Chapter 1

Introduction

1.1 *Bradyrhizobium japonicum*

B. japonicum are a collection of nitrogen-fixing bacteria in root nodules of soybeans (*Glycine max*). Elkan & Bunn (1992) reported that, in free-living state, Gram-negative *B. japonicum* grow slowly. The generation time is more than 6 hours. The type of flagellation is one subpolar flagellum. Glycolysis is mainly via the Entner-Doudoroff pathway where glucose is converted to ethanol and CO₂ as shown in Figure 1.1. *nifHDK* which code for nitrogenase are on separate operons as shown in Figure 1.2.

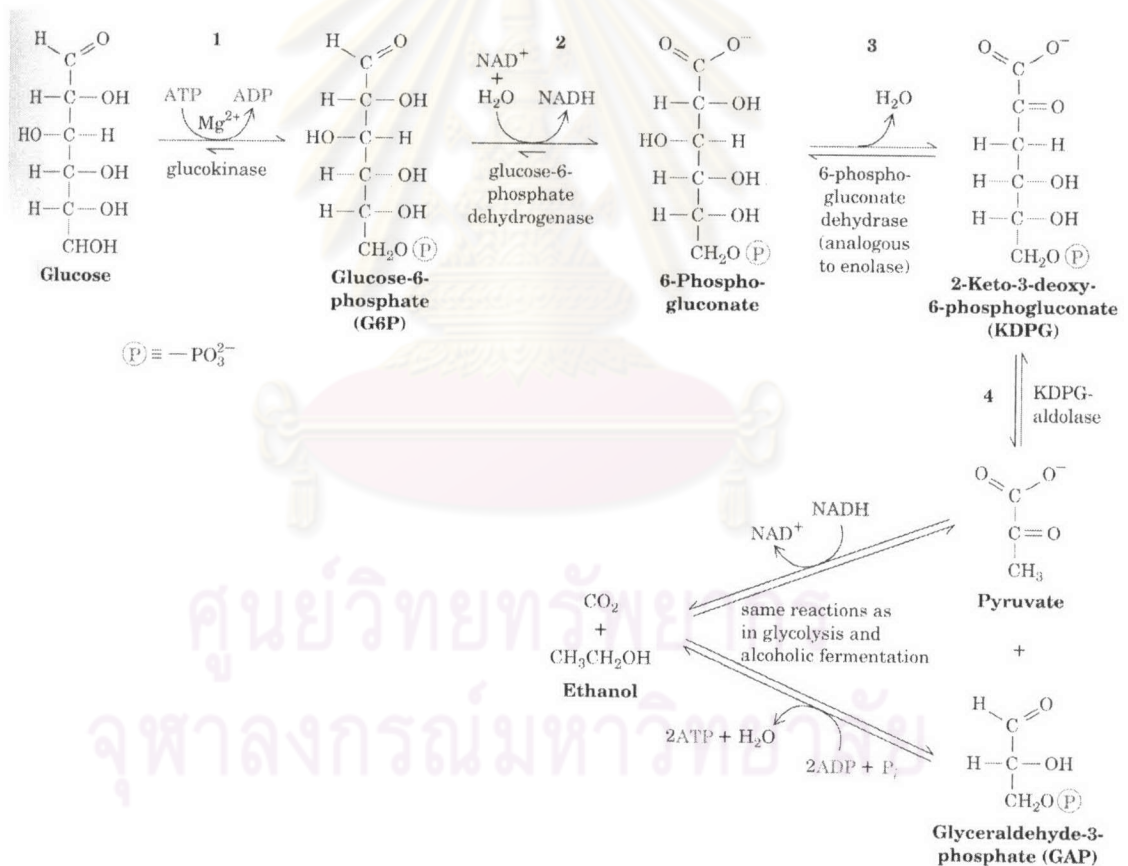


Figure 1.1 The Entner-Doudoroff pathway for glucose breakdown (Voet & Voet, 1995).

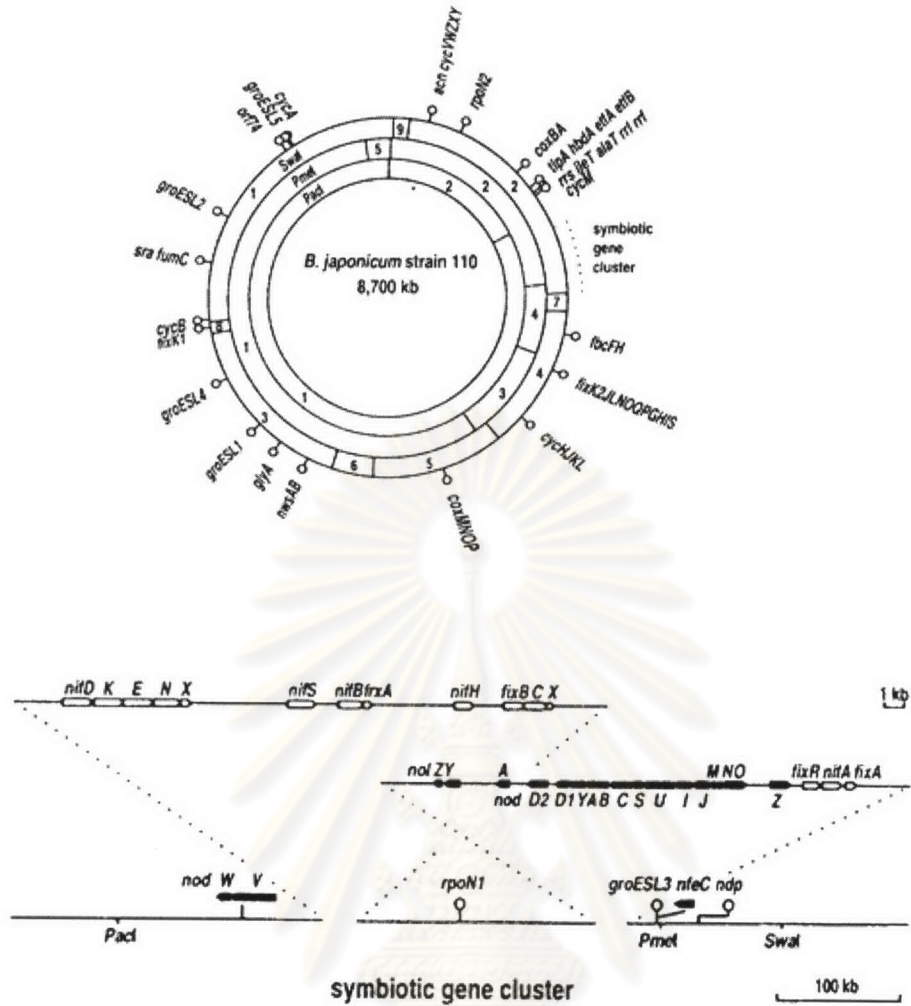


Figure 1.2 Physical and genetic maps of *B. japonicum* USDA 110 (Kundig et al, 1993) showing *nifH* and *nifDK* are on separate operons.

1.2 Some factors affecting soybean productivity

Apart from different degrees of nitrogen fixing ability of different *B. japonicum* strains, other factors affecting soybean productivity are as follows :

1.2.1 Soybean cultivars

Figure 1.3 shows soybean cultivation areas in Thailand. The Department of Agricultural Extension, Ministry of Agriculture and Cooperatives, has distributed seeds of various soybean cultivars to soybean growers as indicated in Table 1.1



Figure 1.3 Soybean cultivation areas in Thailand (Department of Agricultural Extension, 2003)

Table 1.1 Cultivars of soybeans distributed to soybean growers in various parts of Thailand by the Department of Agricultural Extension in 2004.

Northern part (Chiangmai, Phitsanulok)	<i>Glycine max</i> cv. CM 60, SJ 4, SJ 5
Northeastern part (Petchaboon)	<i>Glycine max</i> cv. CM 60, SJ 4, SJ 5
Central part (Sukhothai, Lop Buri)	<i>Glycine max</i> cv. CM 60, SJ 4, SJ 5

(Sources :Personal Communications with officers of Chiangmai, Phitsanulok, Petchaboon, Sukhothai and Lop Buri Field Crops Research Stations.)

1.2.2 Effect of liming on soil surface Al contents and nodulation

It has been documented that as soil acidity increases, soluble aluminium increases to toxic levels. Aluminium toxicity restricts root growth and phosphorus uptake (<http://www.agric.ab.ca>).

In 1996 Unkovich et al studied the effect of liming on clover (*Trifolium subterraneum* L.) nodule number and soil Al contents on an unproductive pasture on acid soil (pH 4.2) near Albany, Western Australia. Three rates of lime application (0, 1.25 and 5.0 ton.ha⁻¹) were made on 6 replicate 4 m² plots. Three plots of each treatment were tilled to incorporate lime into the surface and sub-soil layers, the other three plots were left undisturbed. All plots were sown with uninoculated clover seeds 18 days after lime application. After a further 53 days representative soil samples from all plots were cored to 10 cm depth for pH and Al content determinations. Roots were washed and nodules counted. The results indicated that pH of the soil surface rose to 4.8 and 6.8 in 1.25 and 5.0 ton.ha⁻¹ lime application plots. Soil surface concentrations of Al were reduced significantly and nodulation was found to improve significantly in all treatments.

1.3 Scope and aims of the experiments

Although several factors including *B. japonicum* strains, soybean cultivars, soil minerals and soil temperatures have effects on the bacterial nitrogen fixing potential, the scope of the experiments reported in this thesis is to find out the effects of changing medium pH on the intracellular protein profiles of three strains of *B. japonicum* and to find out the effect of pH in the acid range on nitrogen fixing potential of the three *B. japonicum* strains.

The aims of the following experiments are to detect changes of protein profiles in *B. japonicum* S76, S78 and S162 in response to changes medium pH and to assess the nitrogen fixing potential of these three *B. japonicum* strains when inoculated onto soybean cultivars (*Glycine max* cv. Chiangmai 2 (CM 2), Chiangmai 60 (CM 60), and Sukhothai 2 (ST 2)).