Chapter 1

INTRODUCTION

The increase in the cost of fossil energy, the worldwide demands for nitrogen fertilizer in food production and the by-effects of chemical fertilizers on sustaining soil fertility as well are the major reasons for interests in biological nitrogen fixation as an alternative or at least a supplement to the use of chemical nitrogen fertilizers. Soybean is the one of the most important legume crops which has been drawing a great deal of attention on the researches of how to improve its ability of nitrogen fixation through agronomic innovation.

In some lowland and delta areas of river mouth, because of waterlogging problems or temporary flooding, soybean has been considered as unsuitable due to low yield and rice has become the monoculture crop. Soybean saturated soil culture (SSC) is an innovation of water management by which soybean can adapt to waterlogging conditions so that diverse cropping systems can be arranged.

Saturated soil culture of soybean was developed in Australia. It describes a method of irrigation in which the water table is maintained continuously between 3 and 15 cm below the surface of the soil throughout the growing season (Hunter et al, 1980 and Troedson et al, 1986 and 1989). The high water table is normally imposed during the second or third weeks after plant

emergence. A shallow zone of aerobic soil remains and the plants grow in this altered micro-environment.

Comparisons of saturated soil culture with conventional irrigation procedures have recorded grain yield increases of up to 68 percent in both field and greenhouse studies (Nathanson et al, 1984) with an average yield improvement of 22 percent (Garside et al, 1980 and 1987).

The adaptation of soybean to SSC has recently been studied in clay soils in Australia and Thailand (Troedson et al, 1980; Nathanson et al, 1984; Chinchat et al, 1987; Pookpakdi et al, 1987 and Hartley, 1988). Positive yield responses have generally been reported; however, SSC may also increase soybean nitrogen fixation. Troedson et al (1986) contributed the higher yield of SSC soybean to more prolific nodulation and greater rates and more prolonged nitrogen fixation than that in conventional irrigation methods (CI). But neither large nor consistent difference between soil water regimes in specific acetylene reduction activity (ARA) of nodules have been detected (Nathanson et al, 1984). Furthermore, neither of these studies differentiated between the amount of nitrogen fixed under SSC and CI. To determine the response of soybean nitrogen fixation in SSC may help to evaluate the potential contribution of the SSC technique in the maintenance of soil nitrogen fertility for sustaining cropping systems.

Commonly it has been found that SSC soybean plant shows

transient signs of nitrogen deficiency after the water level was raised. This problem could be resolved by an application of nitrogen fertilizer (Troedson et al, 1980). However, nitrogen fertilizer may suppress subsequent nodulation and nitrogen fixation. It may be necessary to determine the effect of fertilizer nitrogen on soybean's symbiotic capacity before the contribution of nitrogen fixation to grain yield under SSC can be understood. However, large genotypic variability exists in both soybean's ability to fix nitrogen in presence of high soil nitrogen (Hardersen et al, 1984) and in its yield response to SSC (Hartley, 1988 and Garside et al, 1987). Therefore, the effects of SSC on growth and nitrogen fixation in the present study has been determined for two recommended soybean varieties in the present and absence of combined nitrogen.