CHAPTER 3

MATERIALS AND METHODS

This study consisted of a farmer field survey, an on-farm research and an on-station study, and a laboratory study.

3.1. Farmer field survey

The farmer field survey were subsequently conducted in 1999 and 2000 rice-growing season in Pa Pai village, Pa Pai sub-district, San Sai district, Chiang Mai province by using both the observation and formal interview. The purposes of these field studies were to understand farmers' rice-based production systems and their fertilizer management in rice.

3.2. On-farm research

The on-farm research on the effect of *S. rostrata* on rice yields was conducted at Pa Pai village, Pa Pai subdistrict in San Sai district, Chiang Mai province from April to December 1999 aimed to assess the effect of *S. rostrata* on rice yield and its economic return.

Soil samples from the farmers' rice fields were taken before *Sesbania* planting for nutrient content analysis. *S. rostrata* seeds were supplied to each farmer at 20 kg ha^{-1} for broadcasting in June. The legumes were grown for 50-60 days before being incorporated into the soil. Rice seedlings were transplanted at 4-7 days after *S. roasrata* incorporation.

Dry biomass of *S. rostrata* in the farmers' fields was determined before incorporating. Rice yields from *S. rostrata* and non-*S. rostrata* fields were recorded at harvest.

The participating farmers were interviewed for their responses to the performance of *S. rostrata* in their rice fields. Information related to production cost of *S. rostrata*-rice system was also gathered for use in the analysis of economic benefit, in which partial budgeting was used.

3.3. On-station study

Part I: Agronomic effect

The on-station experiment was conducted on sandy loam soil (San Sai series) at the Irrigated Research Station of the Multiple Cropping Center, Chiang Mai University (19°N, 99°E) from May to December 1999 to measure the agronomic effects of four nutrient management practices on three group of rice and study nitrogen dynamics in the *sesbania* system.

3.3.1. Experimental design

The experiments consisted of 2 factors (nutrient managements and rice varieties) arranged in split-plots design with 2 replications. Experiment I, main plots were assigned to 4 types of nutrient management (Control (plot no. 1), *S. rostrata* (plot no. 2), (16-20-0) at 156.2 kg ha^{-1} + (46-0-0) at 62.5 kg ha^{-1} (plot no. 3), Integrated *S. rostrata* with (46-0-0) at 62.5 kg ha^{-1}) (plot no. 4). Sub plots were assigned to 6 varieties of selected glutinous rice and non–glutinous rice (RD.6, Dangkornkaen, RD.23, Sanpathong, Chinat, and Niew-Ubol). Experiment II, main plots were assigned to 4 types of nutrient management (Control (plot no. 1), *S. rostrata* (plot no. 2), (16-20-0) at 156.2 kg ha^{-1} + (46-0-0) at 62.5 kg ha^{-1} (plot no. 3), Integrated *S. rostrata* with (46-0-0) at 62.5 kg ha^{-1}) (plot no. 4). Sub plots were assigned to 6 varieties of the selected quality rice (Chinat, KDML 105, Pitsanuloke 60-2, Dangmali, Pitsanuloke 60-1). Experiment III, main plots were assigned to 4 types of nutrient management (Control (plot no. 1), *S. rostrata* (plot no. 2), (16-20-0) at 156.2 kg ha^{-1} + (46-0-0) at 62.5 kg ha^{-1} (plot no. 3), Integrated *S. rostrata* with (46-0-0) at 62.5 kg ha^{-1}) (plot no. 4). Sub plots were assigned to 6 varieties of HYV rice

(Supanburi 90, Supanburi 60, RD.7, Supanburi 2, Chinat, Supanburi 1). The size of each experiment unit was 4 m x 6 m.

3.3.2. Cultural practices

S. rostrata seeds were broadcasted at 18.75 kg ha^{-1} on 11th May 1999 and allowed to grow for 56 days. On 6th July 1999, *S. rostrata* was plowed into the soil. Above ground dry biomass was measured before incorporation.

The seeds of three groups of rice: selected glutinous rice and non-glutinous rice varieties, selected quality rice varieties, and selected of HYV rice were broadcasted on 16th to 24th June 1999. On 16th to 22nd July 1999 the 30-days-old seedlings of rice were transplanted at 25 x 25 cm. spacing with 1 seedling per hill. Chemical fertilizer (16-20-0) was applied at 156 kg ha^{-1} to plot No. 3 at 7 days after transplanting. Urea fertilizer (46-0-0) was applied as top dressing at 62.5 kg ha^{-1} to plot No. 3 and plot No. 4 at 45 days after transplanting. The rice yields were harvested at early November 2000.

3.3.3. Data collection

Sesbania:

At 56 days after broadcasting, *S. rostrata* heights were measured from 10 plants randomly chosen from one square meter sampling area per plot. Above ground biomass of *S. rostrata* and N content of dry biomass of *S. rostrata* was measured before rice transplanting.

Rice:

At harvest, 10 hills of rice were randomly chosen for the measurement of plant height. Plant height of rice was measured from ground level to the top of the highest

panicle. Two square meter sampling area of rice per plot was used for yield characteristics.

Data analysis:

The analysis of variance (ANOVA) was used to analyze the treatment effects and their interactions on lowland rice yield.

Part II: Nitrogen-dynamics

3.3.4. Nitrogen-dynamic experimental treatments

Nitrogen-dynamics in the paddy field were studied by inserting the metal frames (25 cm. in diameter and 20 cm. in hight) into the soils in the plots planted with Chinat rice variety. The metal frames were inserted into the soils to protect the soil inside the frame from invasion of rice roots. This treatment was designated as A treatment and the soil inside the frame was abbreviated as soil sample A. Another metal frames of the same size were inserted into the soils, and the upper rim of the frames were covered with the sheets of black color plastic. This treatment was designated as B treatment and the soil inside the frame was abbreviated as B sample. Those the soils from B treatment were kept free of photoautotropic microbial activities. The plastic bottles containing the soils of each experimental plots were buried in the soil. This treatment was designated as C treatment and the soil inside the bottle was abbreviated as C soils sample, for studying the changes of N without the loss from leaching and runoff and crop removal. The soil samples, which were taken among the four rice hills outside the metal frames which were influenced by rice root and all N loss from the soil were considered as D soil samples. A detailed procedure for the study of N-dynamics in the field was presented in Figure 2.

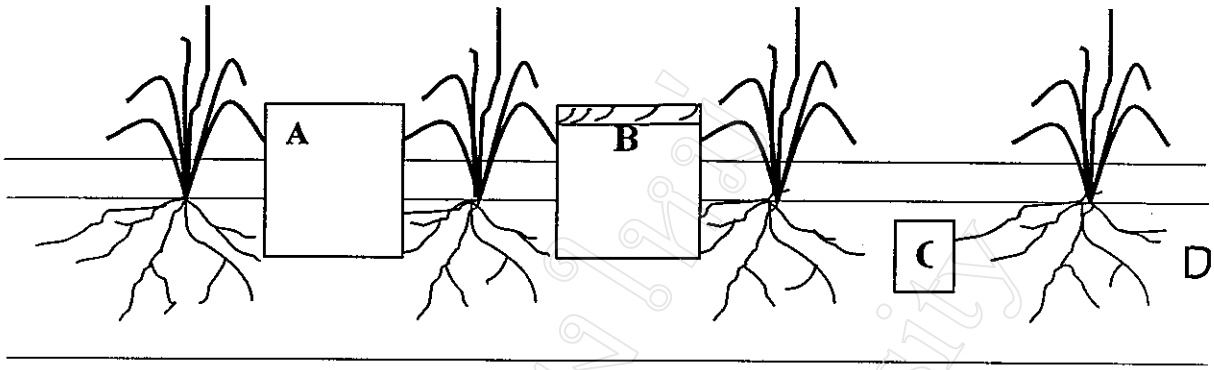

Figure 2. Diagram showing procedures for study nitrogen dynamics in the field

A, B,C and D soils samples from each plot were collected at each stage of rice growth according to the time table inTable 1.

All distillation soil samples were analyzed for inorganic N by using 2 M KCL soil extracting solution and MgO-devada alloy method. Ten grams of each soil sample in each plot was extracted with 100 ml of 2 M KCL in plastic bottle by using 30 minutes shaking. After shaking they were filtered with no.1 filter paper. The filtrates were kept under – 4 °C until analysis.

The plant samples from each growth stage were measured for dry weight and analyzed for % N by using Micro Kjeldahl method. Total N uptake was calculated from the formula:

N uptake = Dry weight x %N / 100

Table 1. Timetables for soils and rice plants samplings.

Time of collection	Date	Stage of Rice Growth
1st	August 19, 1999	Maximum tilling
2nd	September 10, 1999	Panicle initiation
3rd	September 27, 1999	Flowering
4th	October 11, 1999	15 days after flowering
5th	October 20, 1999	Harvesting

3.4. Laboratory experiment

3.4.1. Nitrogen mineralization experiment

In order to study the N-mineralization of *S. rostrata* in different 4 soil types (Table 2) in 2000 the incubation study was used. Two treatments, with and without addition of *S. rostrata* were used for each representative rice soil in Chiang Mai lowlands by using 10 grams of soil sample per treatment. In the *S. rostrata* added treatment, 10 gram of each soil types were thoroughly mixed with ground S. rostrata at the rate of 200 μgNg^{-1} soil. The soil from each treatment were placed in 250 ml closed plastic bottles. 50 ml of distilled water was added to each bottle to bring the soil to submerged condition. The soils were incubated at room temperature for 0, 1, 2, 3, 4, 5, 6, 7, 14, 28, 45, 60, 90, 120 days. Three replications were used for each soil type. At the end of each incubation period, 50 ml of 4 M KCL was added to the soil in each bottle, shaking for 30 minutes and then filtering before determination of NH^{+}_{4} and NO^{-}_{3} by using MgO-devada alloy and distillation method.

Table 2. Four sampling soils and it properties

Representative rice soil in Chiang Mai lowlands	pH	Organic matter (%)	Available P (ppm)	Exchangeable K (ppm)
Multiple cropping center	5.72	1.68	282	144
Sankampang	5.27	3.15	10	153
San Sai	5.55	1.61	47	84
Mae Taeng	5.20	3.64	5	261

PH: soil: water 1:1

Organic matter: by Walkly Black method

Available P: by Bray No. 2

Exchangeable K: by NH_4OAC 1 M pH 7 extracting solution