CHAPTER 3

MATERIALS AND METHODS

To understand farmers' practices in mungbean production and soil conditions in farmers' fields in the study area, and explore possibility to improve productivity of mungbean, this research involves two parts of studies. These are field survey and field experiment.

3.1 Field survey

The survey was carried out during March to May, 1997 in which it was aimed to understand the current farmers' practices in mungbean production in the region, cropping systems and characterizing properties of soil in mungbean fields.

The informal and formal survey were carried out in two villages, namely Binh Dien and Huong Ho. The two villages represent variation in topography, climate and soil type in the hilly zone in Thua Thien Hue.

Descriptive survey, key informant, and questionnaires were conducted as three steps to gain primary information on mungbean production, cropping systems, agricultural land, mungbean growing area, fertilizer management, crop yields, and climatic data. Twenty farmers who grow mungbean in each village were randomly chosen for formal survey with questionnaires. Secondary data related to the study sites such as climatic data (rainfall, temperature, air humidity and evaporation), soil, input and yield of some main crops were collected from farmers and related authorities.

In order to characterize some properties of soils (pH, available P, Al^{3+}), a total of twenty soil samples were taken from 20 farmers' fields grown mungbean in the two

villages. Five sub-samples of soil were collected at 0-20 cm depth in each farmer's field for each composite sample.

Survey data have been analyzed by descriptive statistical method. Results from survey were used to adjust plan execution of the field experiment.

3.2 Field experiment

3.2.1 Material and experimental site

Field experiment was undertaken to examine responses of mungbean varieties to various amount of phosphorous fertilizer application levels at the farm in Huong Ho commune, Huong Tra District, Thua Thien Hue province, Vietnam.

Four different phosphorous application rates suggested by Linear Regression and Plateau (LRP) model (Waugh *et al.*, 1973) were 0, 56, 75 and 112 kg P_2O_5 per hectare. Four mungbean varieties namely Lang (local cultivar), VC 2768A, V 87-13 and V 41-52 were sown in 29 March 1997 in Red-Yellow Ferralitic on Clay Shale Soils (Acrisols) with 5% slope in Huong Ho.

Nitrogen and potassium fertilizers were applied as a basal dosages of 69 kg N /ha and 32 kg K_2O/ha to provide sufficiency of these elements for mungbean growth (Tiaranan *et al.*, 1985). Lime [$Ca(OH)_2$] was applied at the amount of 1,300 kg/ha (Cu, 1996). The experiment consisted of two factors i.e. phosphorous fertilizer application levels and mungbean varieties arranged in a randomized complete block design with three replications. Lime were broadcast before sowing 15 days over the whole plot area of 2×6 square meter, and incorporated to the soil depth of 20 cm. Seven days before sowing of mungbean, different phosphorous fertilizer rates were applied in each plot selected randomly of each replication. Seeds of four different varieties were sown in each plot at spacing of 40×20 cm with 3 seeds per hill.

3.2.2 Sampling procedures and data collection

3.2.2.1. Soil samples

A composite soil sample at 0-20 cm depth were collected before treatment imposing for analyzing initial soil available phosphorous, mineral N, exchangeable K^+, Ca^{2+}, Mg^{2+}, Al^{3+}, H^+, $pH_{(KCl)}$, CEC and organic matter.

Two weeks after phosphorous applications, the soil sample from each plot was again taken and analyzed for available phosphorous, exchangeable Al^{3+}, and $pH_{(KCl)}$.

3.2.2.2. Plant samples

Bio-mass

On three occasions during growing season which are V4, R4 and R6 stages one square meter of mungbean plants in each plot were harvested for measurements of bio-mass (under part and above part). In which V4 is defined when plant has 4 and 5 nodes with fully developed leaf respectively; R4: full pod, R6: full seed and beginning maturity (Steven *et al.*, 1982).

Dry weight of roots, weight of nodules, number of nodule per plant, and plant height

Ten plants were randomly selected from each sampling area to measure root dry weight, number of nodule per plant and weight of nodules. They were carefully dug and then rinsed in the water tank. Firstly, root dry weight was weighed after total roots were dried at 70^0C until stable weight was reached (the field was irrigated a day before digging). Then, number of nodule was counted and then all nodules of total dry roots were deducted before total dry roots were weighed again. Weight of nodules was counted from comparison between root dry weight with nodules and root dry weight without nodules. Number of nodule per plant was counted during they were

deducted from roots. Plant height was also estimated from above parts of the ten-plant sample.

Yields and yield components

At final harvest, seed yield were obtained from an sampling area of one square meter of each plot. Number of pod/plant, 100-seed weight, number seed per pod were measured on a randomly selected and fixed sub-sample of ten plants.

N,P,K concentrations in the youngest fully expanded leaves

At the V4 stage, 30 youngest fully expanded leaves (YFEL) were sampled from each plot and analyzed for N,P,K concentrations (Ulrich and Hills, 1967: Bell *et al.*, 1986 cited by Craswell *et al.*, 1987). The mungbean leaves were analyzed for N,P,K concentrations by following chemical methods:

Total nitrogen content (%) was determined by Kjeldahl method. Total phosphorous content (%) was determined cabonmetric method based on acid ascorbic reduction of amonium phosphomolybdate complex (Olsen and Dean, 1974 cited by page *et al.*, 1982). Total potassium content (%) was determined by flame photometry (Knudsen *et al.*, 1980 cited by Page *et al.*, 1982).

3.2.3 Chemical analysis

Soil samples were analyzed for various chemical properties. Exchangeable Aluminum (Al^{3+}) and H^{+} was extracted with KCl 1N and titration with NaOH (Richard and Paul, 1974 cited by Page *et al.*,1982). Aluminum saturation was calculated by dividing the Al^{3+}(including H^{+}) by CEC (Sanchez,1976). Exchangeable cations were extracted by CH_3COONH_4: Calcium, and Magnesium were determined by titration with EDTA (Lanyon and Walter, 1968 cited by Page *et al.*, 1982). Potassium concentration was analyzed by flame photometry (Knudsen, 1968 cited by

Page *et al.*, 1982). Mineral N was extracted by KCl 2M and determined by steam distillation methods (Keeney and Nelso, 1980 cited by Page *et al.*,1982). Available phosphorous was determined by Bray II's method (Sanchez, 1976, Olsen and Sommers, 1974 cited by Page *et al.*, 1982). Organic carbon content was estimated according to the Walkley-Black procedure (Alison, 1960 cited by Page *et al.*, 1982).

3.2.4 Economical analysis

Cost and benefit were analyzed in order to understand the profitability of mungbean production. Partial budgeting analysis will be used and variable costs of labours, seeds and fertilizers for mungbean production and the return on capital, and return to labor were estimated for each treatment. The variable costs for calculation was based on the average data from two surveyed villages and estimation in field experiment.