DISCUSSION

Burning rice straw

One of the reasons for limited use of crop residues in rice-soybean cropping system was the burning of rice straw. About 79% of rice straw (Table 7) in this system was burnt before growing soybean. However, Pintongkum et al. (1991) observed that yields of soybean grow in burnt and unburnt rice straw were not significantly different. Oferi (1980) reported that there were arguments for and against the practice of burning crop residues in the farm. Among the advantages of burning were the cost effective control of pest and weed. In contrast, some nutrients such as nitrogen and potassium as well as the beneficial physical and physio-chemical effects were lost. Amarasiri et al. (1980) found that burning rice straw in the field encouraged the lost of nitrogen and potassium nutrients of about 93% and 20%, respectively. Hence, burning rice straw in the field in the long term may have negative effects to soil quality.

Effects of organic matter on rice crop

In this study, *Sesbania rostrata* presented a very effective source of nitrogen for paddy rice crop in rice-soybean cropping system. Incorporation of this green manure showed a significant increase in rice yield and yield components particularly in the number of panicles per square-meter.

The increase in rice yield was related to an increase in dry matter (straw and grain) and the N-uptake of rice at the panicle initiation stage and in the grains.

Sesbania rostrata illustrated a high biomass of about 15 t/ha on fresh weight basis or 2.9 t/ha of dry matter and high nitrogen accumulation of about 88.3 kgN/ha with low C/N ratio(12.0). It produced nodules on the stem as well as on roots which are able to fix N at a high rate. Morris et al.(1986) suggested that slow decomposition of green manure may match soil solution N concentration to N-uptake rates by rice. Azam (1990) also suggested that nitrogen might not be the only factor causing enhancement of rice yield. The organic matter in the soil in the form of green manure is highly labile and will affect the soil reaction, microbial process, oxidation-reduction and the mineralization of nutrients.

However, no difference on rice yield was detected when comparing *Sesbania rostrata* to urea as sources of N for rice in this experiment. In this respect, *Sesbania rostrata* appeared to be a potential alternative to chemical fertilizer.

Soybean residues alone did not affect rice crop because low amount of 1.25 t/ha with the C/N ratio around 28-30 was used in this study. The N accumulation was 15 kgN/ha which was not enough to supply to the rice crop. Morris et al. (1986) and

Frankenberger et al.,(1985) observed that the amount of N supply by crop residues depended on the amount applied, the quality of the residues particularly its N concentration and the condition for mineralization. In wetland rice, Kai et al. (1973) observed that the C/N ratio of crop residues added to the soil had marked effect on the rate and the pattern of net immobilization. The wider the C/N ratio, the larger amount of N immobilized. The C/N ratio of soybean residue was about 28-30 which was higher than that in *Sesbania rostrata*. Therefore, soybean residues with low amount may not only be unable to supply adequate N to rice but will be also immobilized and subsequently will be not available to rice.

Application of soybean residues with urea was less effective on rice crop than incorporating *Sesbania rostrata* or urea alone. The reason was that the presence of some soybean residues in flooded soil that may promote immobization of NH^{+}_{4} and thereby retard nitrification of added NH^{+}_{4} (Broadbent, 1979b).

In the case of two rice varieties, RD7 and KDML 105, although grain yield of these two varieties did not showed significant difference, KDML105 showed higher response to organic materials in terms of N-uptake in grain than RD7 (Table 14). The N concentration in grain of KDML105 was significantly higher than that of RD7. The factor which is responsible for this difference is not clearly identified from this experiment. However, Ladha

et al. (1986) reported that distinct genotypic differences existed in rice plant-associated with N_2 fixation.

Effect of organic matter on soil

No significant differences in soil properties were detected both before and after harvesting or among the treatments since this experiment lasted for only one year, Such changes in soil chemistry could be observed in the long term experiment.

Economic consideration

The result of economic analysis from different treatments indicated that *Sesbania rostrata* treatment gained the highest return over total variable cost with MRR of 196%. Comparing to urea treatment, the later gave the higher MRR with about 221% and lower return over total variable cost than the former. The sensitivity analysis revealed that the changes in the price of urea and the cost of land preparation for *Sesbania rostrata* will affect the MRRs of urea and the *Sesbania rostrata* treatments. The maximum MRR (Table 23) indicated that if the price of urea increases to 6 baht/kg as the cost of land preparation for *Sesbania rostrata* is 625 baht/ha and if the price of the urea increases to 8 baht/kg when the cost of land preparation for *Sesbania rostrata* is 937.5 baht/ha, the MRR of the *Sesbania rostrata* treatment will be higher than that of the urea treatment. At these prices of urea and the cost of land preparation for *Sesbania rostrata*, serious consideration should be

taken for *Sesbania rostrata* as an alternative source of N in rice-soybean cropping system. However, the feasibility of green manuring in this system will be dictated by other factors before farmers can grow green manure crops as described by Garrity and Flinn (1988). This could be summarized as a decision tree in Appendix Figure 2. On farm trial with farmers' participatation should be encouraged to evaluate the feasibility of *Sesbania rostrata* incorporation under farmers' circumstances in rice-soybean cropping systems.