Thesis Title Nutrient Cycling in Ecosystem of Coffee-Based Agroforestry Systems in the Highland

Author Mr. Dusit Seramethakun

M.S. (Agriculture) Soil Science

Examining Committee:

Assist. Prof. Dr. Soontorn Khamyong	Chairman
Assist. Prof. Chavalit Chalothorn	Member
Assist. Prof. Dr. Manas Sanmaneechai	Member
Assist. Prof. Dr. Suchart Jiraporncharoen	Member

Abstract

The study on nutrient cycling in coffee-based agroforestry systems in the highland had been carried out at two locations, during January 1989 and June 1991. The locations were Doi Sam Mun Highland Agroforestry Researh Station, nearby Hau Mae Mung village, Pai district, Mae Hong Son province and Khun Chang Kian Agricultural Research and Training Center of Chiang Mai University in Doi Suthep-Pui national park, Chiang Mai province. The size of study plots was 10 X 10 m. There were four plots at Doi Sam Mun; pure-stand coffee, coffee-Calliandra calothyrsus, coffee-Pinus kesiya and coffee-Docynia indica. Two plots were used at Khun Chang Kian; coffee-Cajanus cajan and coffee-Calliandra calothyrsus. The study included four ecological aspects; the nature of ecosystem structure, growth and production, changes in physical environment and nutrient cycling. The 4 years old coffee-Pinus sp. system gave higher coffee

yield, 176 g/tree, than other systems. At the 6th year, the growth of Pinus sp. was better than other trees. Since this tree has the regular shape and appropriate size of crown, the shade in this system was reiative good. The change of air temperature near the soil surface was not severe. The maximum temperature was 8 °C lower than the pure-stand plot. The coffee- Docynia sp. system gave the lower coffee yield and the slower growth of Docynia sp. as compared with the coffee-Pinus sp. system. However, the air temperature in both systems were similar. The coffee tree in coffee-Calliandra sp. system produced lower coffee yield per tree, although Calliandra sp. was capable to fix N from the atmosphere. Since all leaves of this tree are fallen during the dry season for a few months, the light intensity was therefore not suitable and might cause in poor growth of coffee. Although, the pure-stand coffee system gave the higher total coffee yield per unit area, the lowest yield per tree was obtained. The maintenance cost may be higher in this system. The change of temperature in the pure-stand coffee system was more severe than that in agroforestry systems. The maximum temperature was as high as 41 °C.

There are many factors which influence on coffee yield including light, temperature. soil moisture and plant nutrients. Though the coffee-Pinus sp. system had the poorer nutrient balance as compared with those of coffee-Docynia sp. and coffee-Calliandra sp.. the coffee yield per tree was higher. Since the differences in soil properties and moisture among those systems were not marked, the light is thought to be the limiting factor in coffee production. It was noted that the nutrient balance in coffee-Pinus sp. system was not the good one. However, it was not the limiting factor for coffee production. At the 4th year, the nutrient recycling in coffee-Docynia sp. system through above-ground litter of both coffee and Docynia sp.

was the highest. The recycling of various nutrients, except P, in coffee-Calliandra sp. system was higher than the coffee-Pinus sp. system. The amounts of N, P, K, Ca and Mg in those litterfall in the system of coffee-Docynia sp. were 6.96, 0.21, 3.27, 1.84 and 0.42 kg/rai/year, respectively. The coffee-Calliandra sp. system gave the amounts of those nutrients of 6.71, 0.11, 1.81, 1.02 and 0.39 kg/rai/year.respectively. The coffee-Pinus sp. system had the amounts of 4.67, 0.14, 0.97, 0.79 and 0.35 kg/rai/year, respectively.

Among these agroforestry systems, the coffee-Docynia sp. system had the highest accumulation of nutrients in term of total living biomass of tree, coffee and ground cover. The intermediate and lowest accumulations were observed in the systems of coffee-Calliandra sp. and coffee-Pinus sp., respectively. The amounts of accumulated N, P, K, Ca and Mg in coffee-Docynia sp. system were 71.85, 18.94, 39.90, 95.87 and 17.76 kg/rai, respectively. In the coffee-Calliandra sp. system, the amounts of these nutrients were 61.56, 12.31, 32.36, 33.94, and 9.11 kg/rai, respectively. The amounts in the coffee-Pinus sp. system were 50.15, 11.88, 27.49, 30.19, and 7.22 kg/rai, respectively.

At Doi Khun Chang Kian location, the coffee-Cajanus sp. and coffee-Calliandra sp. systems did not have great difference in yields of 3 years old coffee. There were 70 and 90 g/tree, respectively. Since these trees were still small, their effects on physical environments and nutrient balance were thought to be small.