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STUDY OF NUTRIENT CHANGES AND THEIR UPTAKE BY RICE UNDER  
GREEN MANURE, CHEMICAL FERTILIZER AND TRADITIONAL  
CULTIVATION IN DRY ZONE OF SRI LANKA.

A THESIS SUBMITTED BY

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## SUMMARY

The capacity of soils to supply higher plants with certain essential nutrient elements is a fundamental problem in crop production. Deficient or toxic levels of nutrients can reduce or even entirely prevent the growth of plants. The behaviour of some of the nutrients in soil and in rice plant was investigated during a rice growing season under traditional cultivation system, which has been survived for several centuries under village-tank irrigation system with local inputs, primitive technology and cultural practices. In addition, the study was conducted under highly modernized agricultural system with recommended level of fertilizers, pesticides, mechanization etc. and applying green manure *Sesbania Sesban* instead of nitrogen fertilizer.

A rice field in a typical traditional village was selected in Anuradhapura district in the Dry Zone of Sri Lanka and soil samples and rice plants were removed along the cultivation cycle from the beginning of the season to harvest. In the same way, soil samples and rice plants were taken from the other plots which were under full recommended level of N, P, K fertilizer applications and green manure *S.Sesban* application. The soil and plant samples were subjected to analyses of phosphorus, potassium, calcium, magnesium, iron, sodium and zinc.

According to the results of the present study, phosphorus, potassium, calcium, magnesium and iron were found to be not deficient in the soil and plant available nutrients were high enough for a healthy growth of rice

plant under traditional cultivation system. No toxic level was created by increased iron or sodium contents due to flooding. With the flooding, phosphorus, potassium, calcium and magnesium also increased and maintained at high levels throughout the season. Flooding caused a decrease in the available zinc concentration in soil and was below the critical level for deficiency during the season. Rice plants contained an adequate amount of all these nutrients and at harvest, the contents of phosphorus, potassium, calcium, magnesium, iron and sodium were 4-12, 44-122, 11-21, 7-11, 5-11 and 3.2-5.7 kg/ha respectively. The grain yields were 2.4-5.4 t/ha (mean 3.5 t/ha) and the average yield for the district was 3.4 t/ha during Maha 1979/80.

Under traditional cultivation, it is evident that nutritional disorder does not occur due to phosphorus, potassium, calcium, magnesium, iron and sodium, but zinc deficiency would affect crop production. Probably insufficiency of nitrogen, especially at the latter part of the season would have affected the crop growth in this system (Palm and De Silva, 1987). Although the cultivation in this system is mainly dependant on natural supply of nutrients and local inputs, higher grain yield was obtained. The grain yield in this case was higher than the average grain yield of the district where larger irrigation schemes are available and the use of fertilizer is common, although not used at the recommended level. It shows that nutrient build-up in soil within three year long fallow period is sufficient to meet crop demand for most essential elements. Therefore the crop production in traditional system can rely

on native soil fertility for longer periods using naturally build-up nutrients in soil with the active use of fallow periods in more practical and efficient way.

The increase of fertilizer costs during last decades is a major drawback for crop production in the third world countries. It is impossible to meet crop demand with the increasing population pressure, if other cheaply available biological natural sources are not employed. The present study showed that the green manure *Sesbania Sesban* can play a vital role not only by supplying nitrogen but also by increasing other macro and micro nutrients like phosphorus, potassium, calcium, magnesium, iron and zinc in soil and rice plant.

The incorporation of *S.Sesban* and application of chemical nitrogen fertilizer increase the availability of phosphorus, potassium, calcium, magnesium, iron and sodium in soil and subsequently increase these nutrients in the rice plant over the control. Incorporation of *S.Sesban* is almost equal in efficiency to the application of fertilizer with respect to supply of all these nutrients to rice plant. As compared to control, incorporation of *S.Sesban* influenced in increasing phosphorus, potassium, calcium, magnesium, iron and sodium contents in rice plant by 19, 216, 276, 131, 257 and 245 % respectively at harvest, while application of chemical nitrogen fertiliser lead to 11, 138, 117, 59, 42 and 200 % increase of phosphorus, potassium, calcium, magnesium, iron and sodium respectively. Availability of zinc increased with incorporation of *S.Sesban* and it was at adequate level for crop growth

while zinc was at deficient level in control. Increase of iron and sodium contents in soil with the incorporation of *S.Sesban* did not exceed the toxic level and pH was around 7 during the season favouring conditions for better growth. The increase of grain yield with fertilization and incorporation of *S.Sesban* was 125% and 102% respectively compared to the grain yield in control. Therefore *S.Sesban* may be considered as an efficient source of nutrient supplier not only because of the supply of nitrogen but also its ability to increase the availability of other nutrients.

