# COMPARISON OF PLANT AND SOIL NUTRITIONAL STATUS BETWEEN ORGANICALLY AND CONVENTIONALLY CULTIVATED TWO COCONUT LANDS IN THE INTERMEDIATE ZONE OF SRI LANKA

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**Introduction**

**Management of soil fertility and replenishment of soil nutrients through external application of fertilizers or manures is a promising practice of sustainable agriculture systems. However, with the prolonged conventional farming practices with inorganic fertilizers, soils have lost its original capacity of sustaining soil fertility. Along with this, the trend for organic agriculture is also gaining the attention due to attractive prices paid for organic products and concerns to safeguard the environment. In this context, organically cultivated coconuts have captured the attention. According to the 2009 statistics report by IFOAM on world organic agriculture, coconut has been listed among the key crops organically cultivated worldwide and suggests that the importance of understanding the prospects of organic coconut cultivation.**

**Thus, the growing trend of organic coconut farming and organic coconut products pose a need on identifying the plant and soil fertility status of organically managed coconut lands in comparison with conventionally cultivated lands of similar field conditions. This is important to justify the stakeholders and policy makers to promote organic coconut cultivation in Sri Lanka, in order to maintain sustainable productivity of coconut lands over the years. Therefore, this preliminary research was conducted with the main objective of comparing the plant and soil nutritional status of organically managed and conventionally managed coconut lands.**

**Methodology**

**Soil and leaf samples were collected from an organically managed and a conventionally managed coconut lands in the Low Country-Intermediate zone of Sri Lanka. The two coconut lands were selected in close vicinity and they were in similar field conditions, but differ in management practices. Both coconut lands were on Sandy Loam to Sandy Clay Loam textured, Borallu Series, which belongs to the Great Soil Group Red Yellow Podzolic (Typic Hapludults) soils. The organic coconut land is a certified organic field applying poultry manure and compost annually since 2011, while conventional land is applied with the recommended coconut inorganic fertilizer annually.**

**Top soil samples (0-22 cm) from manure circle (MC) and Leaf samples (14$^{th}$ leaf which is the indicative leaf of nutritional status of the palm) from Individual 10 palms were collected and considered as replicates for each coconut land. In adiition, three top soil samples from the center squares (CS) of coconut were also collected. Samples were collected during the latter part of the fertilizer cycle before fertilizer was applied for the year 2015. Nitrogen (N), Phosphorus (P), Potassium (K) and Magnesium (Mg) contents of**

**leaf samples were measured following digestion and detection technique. Soil pH (1:5 water), and Organic Carbon (OC) content were analyzed as basic properties of soil and total soil N, available soil N and P, exchangeable K and Mg were measured to assess the nutritional status of soils.**

**A statistical comparison using the two sample t-test at a significant level of $p < 0.05$ using SAS 9.1 statistical software was conducted in order to compare the difference in measured properties between two coconut lands and to compare the difference in soil properties between MC and CS of each coconut land separately.**

**Results and Discussion**

**The plant nutritional status of matured coconut palms was evaluated by the leaf nutrient content of 14$^{th}$ leaf of coconut palm and comparing it to the reference sufficiency ranges of each nutrient (Table 1). According to the results, the plant nutritional status of organically managed coconut land is in sufficiency levels with respect to N and P. However, the results indicate a slight risk of falling into K deficiency and a clear deficiency of Mg as shown in the Table 1, whereas the conventionally cultivated land shows deficiency in Mg content even falling below the Mg level of organically managed land.**

**Potassium is the most critical nutrient with respect to bearing coconut palms and the nutrient of highest removal through abstraction of nuts from coconut lands. Leaf K levels at the lower limit (1.2%) of the sufficiency range in the organically cultivated land suggests that the importance of applying a supplementary source of potassium along with organic manures as recommended by the Coconut Research Institute, (CRI) Sri Lanka. According to the organic manures have the ability to meet the N requirements of coconut lands where they only have the ability to partially meet the K, P, and Mg requirements of the palms. As the soils have a lesser capacity (Table 2) to supply K to plants and the only source to meet the demand of K in coconut is by the means of external inputs.**

**Though Somasiri *et al.* (2003) have indicated that the recommended inorganic fertilizer for coconut shows a deficit between losses of N from coconut lands, the studied conventional land with the recommended fertilizer application and higher capacity of soil with a mean total N of 792 mg kg$^{-1}$ in the CS (Table 2) maintains the plant nutritional status of N within the sufficiency range. Yet, organic coconut land with a soil N supplying capacity far less than the other field with a total soil N level of 168 mg kg$^{-1}$ in CS, maintains the plant N status within the sufficiency level. This is therefore clearly explaining that the applied organic manures significantly enrich the MC of coconut palm with a sufficient pool of Total N to supply N continuously (Table 2).**

**According to the Phosphorus levels of the 14$^{th}$ leaf of coconut (Table 1), both field shows a higher P levels that are above the sufficiency range. The organically managed coconut land shows a significantly higher P nutrient level than the conventional coconut land; this could be clearly correlated with the soil P level as there is a clear observation of enrichment of soil with P levels in organic coconut land with the application of poultry**

**manure (Table 2). According to previous investigation on different sources of organic manures for coconut cultivation higher P levels have been reported in poultry manures.**

| Leaf Nutrient (Nutrient level of 14th Frond ) | Organically Managed Coconut Land | Conventionally Managed Coconut Land | Nutrient Sufficiency Range for Coconut |
|---|---|---|---|
| Nitrogen % | 2.07 | 1.97 | 1.7 % - 2.1 % |
| Phosphorus % | 0.15* | 0.14 | 0.11 % - 0.13 % |
| Potassium % | 1.19 | 1.36* | 1.2 % - 1.5 % |
| Magnesium % | 0.22* | 0.17 | 0.25 % - 0.35 % |

**Table 1. Leaf nutrient levels of the 14th frond of coconut lands and the reference Nutrient Sufficiency Range for each nutrient for coconut palm**
***Data are represented as means (n=10). Within a row, mean values with the asterisk (*) mark are the highest means significantly different at p < 0.05.***

**Table 2. Soil nutrient levels of top soil (0-22 cm) in Manure Circle (MC) and Center Square (CS) of coconut lands**

| Soil Nutrient | Organically Managed Coconut Land | | Conventionally Managed Coconut Land | |
|---|---|---|---|---|
| | MC | CS | MC | CS |
| Total N (mg $kg^{-1}$) | 699.43 (7)\|* | 168.00 (3) | 987.43 (7)*\| | 792.00 (3)*\| |
| Available N(mg $kg^{-1}$) | 38.63 (10) | - | 39.18 (10) | - |
| Olson P (mg $kg^{-1}$) | 447.25 (10)*\|* | 9.70 (3) | 15.06 (10) | 13.27 (3) |
| K ($cmol_c$ $kg^{-1}$) | 0.18 (10)\|* | 0.07 (3) | 0.73 (10)*\|* | 0.11 (3) |
| Mg ($cmol_c$ $kg^{-1}$) | 2.95 (10)*\|* | 0.11 (3) | 0.64 (10)\|* | 0.21 (3)*\| |

***Data represented as mean and sample sizes are in parenthesis. Highest mean values significantly different at p < 0.05 between two coconut lands of MC and CS indicated by (*|), where (|*) indicates the highest mean values significantly different at p < 0.05 between MC and CS of each coconut land.***

**As the observation made that both the coconut lands have shown a deficiency condition with respect to Mg nutrition (Table 1), According to Somasiri et al (2003) the dolomite supplied via fertilizer recommendation does not meet the Mg lost from a coconut land. According to Tennakoon and Bandara (2003), organic manures have only the ability to partially supply the requirement of Mg demand of coconut and this finding is justified here in both management systems. However, with the observation of the significant increase of soil Mg level in MC of coconut (Table 2) and leaf Mg level (Table 1) in organic coconut land suggests that organic manures have a higher capacity than dolomite to enrich and maintain Mg nutrition both in soils and plants with the continues application over the time.**

**Even though from this investigation it cannot be clearly concluded whether conventional or organic coconut land is better in maintaining coconut plant and soil nutritional status at desired levels, the organic coconut land has shown a significant improvement in fertility status in MC (where the organic manure is added in coconut plantations) with**

**respect to pH (by two units) and soil organic carbon (by 1%) (Figure 1 A and B) and all soil nutrient levels (Table 2) compared to its own CS. However, such overall improvement cannot be observed in conventional coconut land.**

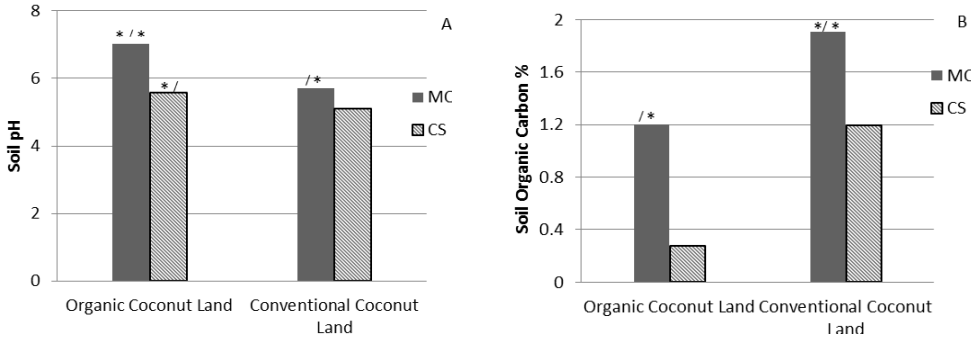


**Figure 1. The effect of different management practices of organically and conventionally managed coconut lands on Soil pH (A) and Soil Organic Carbon % (B) of top soil (0-22 cm) in Manure Circle (MC) and Centre Square (CS) of coconut lands. (*/) denotes the highest significant mean at $p < 0.05$ between two coconut lands of MC and CS separately, where (/*) denote the highest significant mean at $p < 0.05$ between MC and CS of each coconut lands.**

## Conclusions and Recommendations

**The results on plant nutritional status of two management systems suggest that more emphasis on K nutrition is needed in the organic management system while Mg nutrition needed attention in both systems. According to the results of the comparison between organically and conventionally managed coconut lands, with the clear observation of improvement in MC of organic coconut than its CS and by comparing such an improvement in conventional coconut land, organic coconut land shows a prominent role in improving soil nutritional status and by has the potential to improve the plant nutritional status over the time. To further ensure the results of this investigation continuous monitoring of these two fields over the time is recommended.**

## References

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