EFFECT OF COVER CROPS ON SOIL QUALITY OF COCONUT (*Cocos nucifera* L.) CULTIVATION IN THE INTERMEDIATE ZONE OF SRI LANKA

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Introduction

In Sri Lanka, coconut yield shows considerable fluctuation between years with a general trend of decline over generations mainly due to variation in the major climatic parameters and properties of soils. The nutritional status of soil is deteriorating due to continuous cultivation, poor management practices and improper soil and nutrient management. Degradation of soil quality as a result of the long-term coconut cultivation has been recognized as a challenge for sustainable coconut production. Cover cropping is considered as a management practice that conserves soil moisture, reduce soil degradation and improve productivity. However, quantification of soil quality improvements in different cover-crops needs investigation. Therefore, this study was conducted to assess the improvement of soil quality in coconut cultivation in the intermediate zone with two widely grown cover crops of *Puereria phasioloides* and *Brachiaria brizantha* compared to coconut mono crop system with no cover cropping.

Methodology

The experiment was conducted in a coconut plantation in the low country intermediate zone of Sri Lanka (Andigama soil series- Typic Troporthents, shallow, fine loamy, non-calcareous, isohyperthemic).

The considered coconut-cover crop systems in this experiment were *Puereria phasioloides (CPCS)* and *Brachiaria brizantha (CBCS)* and coconut mono-crop system (CMCS) without cover crops as a control. Coconut plantation was under age of 15-20. The soil samples were collected from three randomly selected locations in each site to represent each cultivation system. Samples were obtained from centre of the square between coconut palms from two depths (0-11 cm and 11-42 cm). Bulk density and dry aggregate stability was determined using undisturbed samples obtained from the top soil. Electrical Conductivity (Conductivity meter Conductance- Bridge – Griffin), total Oxidizable Organic Carbon was determined using Walkley-Black method and Sodium Acetate method was used to determination of Cation Exchange Capacity. All data of soil physical and chemical properties were analyzed by one-way ANOVA with Turkey test using SAS software.

Results and Discussion

Bulk Density and Aggregate stability: Bulk density values of different treatments in different depths are shown in the Table 1. Even though CMCS showed the highest bulk density and CPCS showed the lowest bulk density, the difference was not significant among different systems. There was no significant difference in bulk density of top soil and sub soil.

Mean weight diameter (MWD) which indicates the size of soil aggregates was varied across different management systems. The MWD of coconut with *P. phaseolodes* (1.74 mm), *and B. brizantha* (1.78 mm) was significantly higher (P<0.05) than that of coconut land without any cover crop (1.52 mm). This shows facilitation of large aggregate formation in soils with cover crop. It could be due to addition of organic matter and root exudates from the cover crop facilitating aggregate formation.

Table 1. Soil Bulk density of different cropping systems at two depths

Treatment	Bulk Density ± SE (g/cm3)	
	Top soil	Sub soil
Coconut+*Pueraria phaseolodes (CPCS)*	1.55±0.06	1.52±0.04
Coconut+*Brachiaria brizantha(CBCS)*	1.57±0.04	1.53±0.05
Coconut with No cover crop (CMCS)	1.58±0.03	1.55±0.06

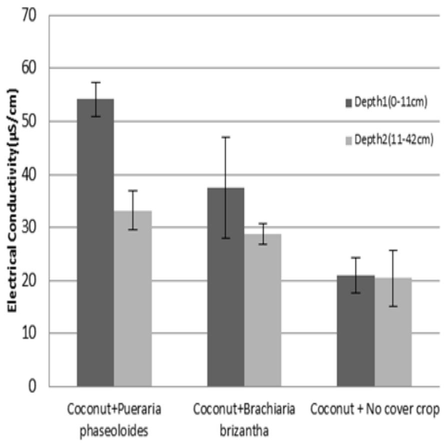

Figure 1. Electrical conductivity of soils in different cropping systems

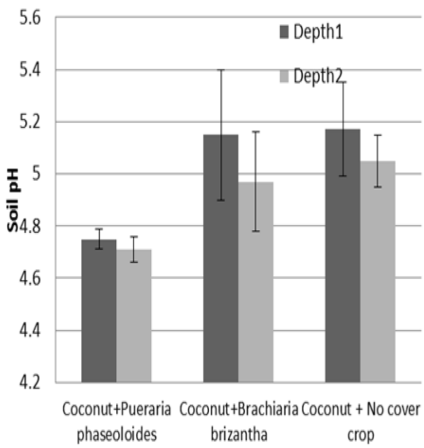

Figure 2. Soil pH in different cropping systems

Soil pH and Electrical conductivity (EC)

Electrical conductivity of CPCS and CBCS was significantly (P<0.05) higher than CMCS system (Figure 2). The EC of depth1 was higher than that of depth2 in all cropping systems. This may be due to salt from various sources including fertilizer which accumulates in top soil when water evaporates from soil surface. Less rainfall in the intermediate zone may have further enhanced this situation. The soils of CPCS showed significantly lower pH compared to other systems. This pH level was lower than the general pH range of coconut growing soil which is 5.5-7.5. However, top soil pH of other two systems has shown the pH within the favorable range.

Organic carbon (OC) and cation exchange capacity (CEC): Soil organic carbon content was significantly different among cropping systems (Figure 3). The CPCS has shown the highest OC content about 0.66% because its high biomass production added to the soil.

The CBCS has a mean value of 0.63% and these cover crops have improved OC content in soil compared to the CMCS which was 0.40%.

When considering the depths, it shows that top soil has a significantly higher OC level compared to the sub soil. This is due to the crop residue accumulation and mineralizing on the soil surface compared to the deeper layers of profile. This is a common phenomenon found in many agricultural soils.

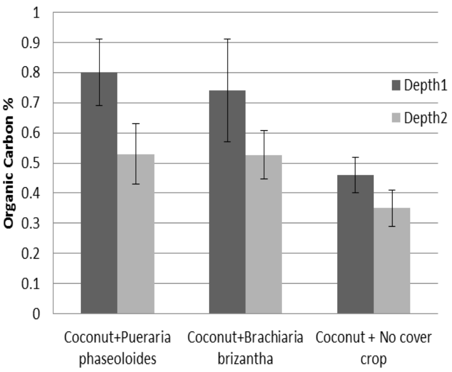

Figure 3. Organic carbon of soils in different cropping systems

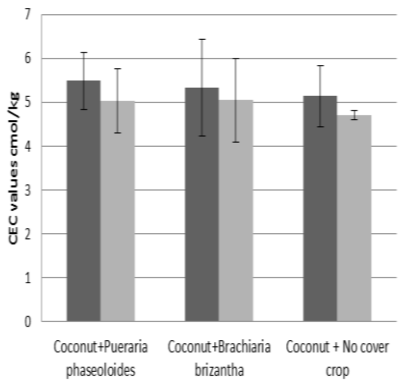

Figure 4. Cation exchange capacity of soils in different cropping systems

The CEC has also shown similar trend to OC among cropping systems (Figure 4). Even though the CEC was higher in both cover cropping systems compared to the CMCS, there was no significant difference in CEC values of different cropping systems. Higher CEC of soils are beneficial because it enhances the retention of nutrients in soil for plant uptake while reducing losses of nutrients by leaching.

Conclusions

The overall results show that coconut land with cover crops improved soil properties compared to the coconut land without cover crop in the same soil type. Therefore, growing cover crop has numerous benefits in terms of soil quality improvements.

Among the cover crops of *Pueraria phaseolodes* and *Brachiari brizantha, the Pueraria phaseolodes* showed significant improvement in organic carbon which is considered as key for improving overall soil quality. Furthermore, the ability of *Pueraria* species to fix atmospheric nitrogen is an added advantage in improving soil fertility. However, lowering of soil pH and its effect on other nutrient availability under *Pueraria phaseolodes* needs further investigations.

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