Abstract

In Sri Lanka, coconut is cultivated under diverse soil conditions of varying fertility status occured in different agro-climatic zones. Although chemical and physical characteristics in some of these soils are known, their biological properties are yet to be studied. Hence the aim of this study was to determine the microbiological parameters and other related properties of different coconut soils and assess their changes after amendment with cattle manure.

First part of this study, 20 different soil series in coconut growing areas were analysed for number of total bacterial and fungal colonies; identification of bacteria and fungi; biomass carbon and nitrogen; CO_2 evolution; nitrogen mineralization, available nitrogen; available phosphorus; organic carbon; total nitrogen; pH; exchangeable potassium and magnesium; C/N ratio, available water and moisture content. The above parameters were determined in the soils of manure circles and center of square of coconut palms separately.

Microbiological, physical and chemical parameters of the soils of the manure circles were significantly ($p \leq 0.001$) higher than those of the center of squares of the coconut palms. The microbiological parameters varied with the soil series. The bacterial population densities were significantly ($p \leq 0.001$) high in Ambakelle, Kalpitiya, Rathupasa and Madampe soil series while the fungal colonies were significantly ($p \leq 0.001$) high in Thambarawa, Pallama, Wilattawa and Ambakelle soil series.

Only Kalpitiya, Kuliyapitiya, Gambura soil series contained biomass C more than 200 mg/100 g of soils. Biomass N was the highest in Boralu soil series followed by Kalpitiya, Rathupasa and Gambura. CO_2 evolution was high in Kalpitiya, Katunayaka and Wariyapola soil series while N mineralization rate was high in Ambakelle, Weliketiya and Rathupasa soil series.

Bacilli spp were the dominant bacteria in all studied soil series. In addition *Micrococcus, Staphylococcus, Enterobacter, Serratia, Corynebacterium, Pseudomonas* and *Actinomycetes* were also identified. Fungi such as *Penicillium, Aspergillus* and *Curvularia* were common in most of the soil series than other species.

The plant available water in soils of Ambakelle, Rathupasa and Madampe series were greater than other soils and it was low in Sudu and Boralu soil series.

For all soil series NO_3^--N concentrations were lower than the NH_4^+-N. NH_4^+-N concentrations were significantly high in Gambura, Andigama, Pallama compared to other soils. NO_3^--N concentration was the highest in Kurunegala series. Organic C and total N were significantly high in Boralu and Warakapola series compared to

other soils. Madampe soil series showed significantly ($p \leq 0.001$) highest available P content than others. Melsiripura and Warakapola soil series showed significantly ($p \leq 0.001$) higher exchangeable K contents while Madampe and Wariyapola soil series showed high Mg concentrations. Most of the chemical properties were low in Sudu soil series. The pH of the soils of the manure circles and center of the squares were not much different, but pH was significantly different among the soil series.

Few parameters showed fairly responsive ($r > 0.5$) relationships each other i.e. organic C vs CO_2 evolution and moisture, available P vs biomass N while others showed minor relationships ($r = 0.2$-0.5).

To assess the changes of the above soil parameters after amendment with organic manure, six different soil series viz. Andigama, Kuliyapitiya, Boralu, Ambakelle, Weliketiya and Pallama were selected. Eight coconut palms were selected in each soil series and four of them were manured at the rate of 35 kg of Cattle manure and 1.2 kg of muriate of potash per palm while the other 4 palms were kept as controls. Soil sampling was carried out at two months interval from August, 1996 to June 1997 after manure application. Soil samples were taken 3.5 feet away from the base of the palm with 0-15 cm depth.

Most of the soil series showed highest values in most of the microbiological, physical and chemical properties during the 2-4 months after manure application and thereafter a decreasing trend occured. Twelve month after establishment of the experiment Weliketiya soil series showed the highest increase in number of total bacterial colonies, biomass N and N mineralization as 117%, 285% and 498% respectively over the control. The number of total fungal colonies showed highest increase (96%) in Pallama soil series. Ambakelle soil series showed the highest increase (454%) in CO_2 evolution over the control and biomass N was the highest (153%) in Boralu soil series. Bacteria species *Bacillus,* fungi species *Penicillium* and *Aspergillus* were predominant during the decomposition process.

Twelve months after establishment of the experiment Ambakelle soil series showed the highest increase of available P and exchangeable Mg while Boralu soil series showed the highest available N and organic C concentrations. Highest increase in exchangeable K was observed in Andigama soil series.

Leaf nutrients i.e. N, P, K and Mg has significantly ($p \leq 0.01$) increased in the manured palms than the control palms. Most of the microbiological properties i.e. fungal and bacterial count, biomass C , biomass N showed positive correlations with soil moisture content. Positive relationships were also found between most of the microbiological parameters vs plant available nutrients such as available N, available P and exchangeable bases.

According to these results the cattle manure treated soil have shown an improvement of soil quality, increasing some valuable biological, chemical and physical parameters of the soils. The microbiological mediated processes and nutrients retention varied among the studied soil series according to their texture and climatic conditions.