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Effect of Anaerobic Soil Disinfestation System on Soil Carbon and Nitrogen Mineralization of Tea Nursery Soils in Up Country Wet Zone

Gamage, K.C.[1], Amarasinghe, S.R.[1]*, Liyanage, L.R.M.C.[2]

[1]*Department of Soil Science, University of Ruhuna, Matara, Sri Lanka*
[2]*Soils and Plant Nutrition Division, Tea Research Institute of Sri Lanka, Talawakelle, Sri Lanka*
*rajika@soil.ruh.ac.lk

Abstract

Anaerobic Soil Disinfestation (ASD), is a promising pre-treatment method that can alter the chemical methods by disinfecting the soil, creating an anaerobic condition. This method is implemented by incorporating soil with easily decomposable organic amendments and covering it with air-impermeable polythene. However, the dynamics of Carbon and Nitrogen contents in the ASD system has not been clearly defined yet. Therefore, this study was conducted to determine the dynamics of Carbon and Nitrogen using different organic amendments in this system. Easily decomposable organic matters were selected such as *Tithonia diversifolia*, *Gliricidia sepium*, cabbage crop residues, poultry litter and cattle manure and their combinations. Treatments were applied at a 5 t/ha rate to both aerobic and anaerobic systems and analysed for soil organic carbon, NO_3^--N, NH_4^+-N, pH and redox potential on day-35 and a comparison was done between aerobic and anaerobic systems. Further, an incubation study was conducted for 35 days to determine C and N mineralisation by each treatment under the aerobic condition. After 35 days, redox potential has been noticeably reduced until -50 mV in some anaerobic-treated soils confirming the anaerobic condition. The organic carbon content in treated soil under anaerobic conditions was higher than the aerobic conditions. Higher carbon content in anaerobic condition was observed in soil incorporated with cabbage crop residue (16.551%±2.93) and the poultry litter 40%+*Gliricidia* 60% combination (18.85%±6.25). The highest carbon content (14.73%±6.26) was observed in the soil treated with cabbage residue in aerobic conditions. There were no considerable changes shown in anaerobic NO_3^--N mineralization compared to aerobic treatments. However, in aerobic condition, poultry litter 40%+*Gliricidia* 60% combination and cabbage crop residue treatments showed significantly higher NO_3^--N production. The highest NH_4^+-N production was observed in *Tithonia* (41.15±1.63 ppm), cabbage crop residue (42.89±1.30 ppm), and the combination of cattle manure 40%+G*liricidia* 60% (43.69±0.158 ppm) treatments in anaerobic conditions. Poultry litter 40%+*Gliricidia* 60%, poultry litter 40%+cabbage 60% and cattle manure 40%+*Gliricidia* 60% which showed a higher NH_4^+-N yield content in aerobic conditions. The highest CO_2-C was obtained in Cabbage crop residue at day-35 of aerobic incubation (1423 mg/kg). There was a positive and significant increase in carbon ($p<0.05$) and NH_4^+-N ($p<0.05$) in the ASD system compared to aerobic conditions by nourishing and reconditioning the soil using incorporated organic amendments under an anaerobic environment.

Keywords: Aerobic, Anaerobic soil conditions, *Gliricidia*, Organic matter, Poultry litter