Analysis of soil environmental factors in relation to land Management practices regarding soil biotic aspects as the Matrices: an example in Sakaerat, Thailand

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ABSTRACT

Thechange in soil qaulity has many aspects. This makes changes in sol qaulity be multidimensional. The land degradation and various gradients have such multidimensionalty. Multivariate profiling of soils on a gradient of interest often provides integrative measurs that explain the gradient in association with soil enviornmental changes. For this purpose, we can explore relationships between multivariate profiles of soil bacterial communities and various soil enviornmental factors. The Sakaerat Environmental Research Station, Thailand has a land degradation gradient represented by its above ground vegetative types: dry evergreen forest (the original vegetative type), dry deciduous forest (moderately disturbed status) and bare ground (the most degraded status). Soil were sampled under these vegetative types in February (dry season), March (just after temporal rain) and Juan (rainy season) 2001. Then, multivariate profiles of the soils were obtained with soil physico – chemical measurements, the antibiotic resistance most probable number (MPN) method (method 1), the antibiotic disk diffusion method (method 2), and the sole carbon source MPN method (method 3). Determination of the land degradation was attempted by depicting a principal component score plot for each data set. Throughout the dry to wet seasonal transition, the physico – chemical profiles consistently provided the most significant PC that explained the degradation. The degradation was explained by high values of bulk density, sand content and acidity, and low values of moisture and clay contents, pH, electrical conductivity, cation exchange capacity, total carbon and nitrogen contents and available phosphorus and cations . By comparing the soil bacterial profiles, it was shown that the satisfactory determination of the degradation gradient in PC score plot depends on the sampling times and the methods. Sampling

time as a source of variation of soil, and bacterial profileswas more significant than vegetative type. Based on the sole carbon source MPNs, the Shannon index, the Shannon evenness index and the Simpson diversity index were determined for the soils, and regression analyses were performed regarding the soil physico-chemical variables as the independents. The analyses also specified sampling time as a primary source of variations of these indexes. For the March sample set, the degradation was primarily explained by dryness, which was concomitant with lower diversity of soil bacterial community. Redundancy analysis (RDA) unveiled reationships between the soil physico-chemical and the bacterial community profiles in the ordination plane. Method 1 consistently explained the degradation by dryness, while methods 2 and 3 low available K and/or P. The February RDA diagrams provided by methods 2 and 3 indicated that the first axes were similar integrative measures of the degradation gradient. These first RDA axes showed that the bacteria that utilize fructose as the sole carbon are frequently seen in K rich soils. On the other hand, the RDA axis provided by method 1 did not explain the occurrence of the bacterial biotype, though the three diagrams determined the degradation gradient comparably well. This discrepancy indicates multidimensionality of the degradation gradient. and implies the difference in the suitability for explaining a particular gradient of interest in association with the environmental factors. The specified environmental extermities in the BG soil may be the causes and/or the effects of the poor productivity. Using maize and mung bean, experiments were made to ameliorate the dryness, K depletion, high values of bulk density in the BG soil. The dryness, high bulk density and K depletion was shown to stress plants. But the significance of the high acidity was not pronounced due to a limitation of the experiment. Comparing multivariate response of soil bacterial community and the plant, the bacterial community showed little restoration of its physiological functions, while the plants resulted in improved growth more significantly. Thus, the importance of wholistic restoration/rehabilitation strategy of soil ecosystem was stressed. This case study showed the applicability of the scheme integrating the soil physico-chemical and the bacterial aspects to find the integrative measure of any gragients of our interest and investigating the cause effect relationships.