

Impact of plant age on dehydrogenase activity of soil in Oil Palm (*Elaeisguineensis* Jacq.) plantation sites of Buhchangphai, Mizoram, India

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ABSTRACT

The activity of dehydrogenases is one of the most frequently used biological parameters for the evaluation of soil quality. They are a potent factor in shaping the diversity of soil microorganism. Among all enzymes in the soil environment, dehydrogenases are one of the most important, and are used as an indicator of overall soil microbial activity (Quilchano and Marañon, 2002; Gu *et al.*, 2009; Salazar *et al.*, 2011). Establishment of Oil Palm Plantation provoke many statement which poses immense challenge, that mono cropping practice of Oil Palm (*Elaeisguineensis* Jacq.) Plantation could have an impact on the soil enzymatic activity and the research aim to study the status of soil Dehydrogenase Activity (DHA) in soil of different ages of plantation. The data were collected during late monsoon and study site was located at Buhchangphai. In the study site, weeding was done periodically near the main trunk. Soil from plantation managed with fertilizer and plantation free from fertilizer were analyzed separately. Soil samples were collected from palm avenue which represent plant age of 3, 5, 10 and 15 years old. Soil was sampled 0-15 cm depth from two plots P (1) 2m, P (2) 5m away from the main trunk. V method sampled soil was then brought to laboratory in insulated ice box for analysis. Soil type is mainly sandy loam to sandy clay loam. Dehydrogenase activity was determined using TTC reduction method (Casida, 1977). The result showed a significant decline in DHA as the Palm age increase, and P(1) having decrease DHA in comparison to P(2) in all the study sites. The reduction of enzyme activity in any agriculture land over time is a concern. The DHA were significantly reduced in soil of older plantation elsewhere and therefore further research in determining the reason of disruption in soil enzymatic activity is yet a big challenge.

Key words: Oil palm plantation, Plant age, Dehydrogenase activity, soil, Buhchangphai.

Introduction

The livelihood of small scale to marginal farmers depend on the production from their land. Sustained soil fertility and economic is always a key future determinant for most farmers. The biological activity and its characteristics in soil is a vital for maintaining the quality of soil. Oil palms (*Elaeisguineensis* Jacq.), have been widely cultivated

in Kolasib district of Mizoram for over nearly two decade and occupied lands with varied topography, from steep to gentle slope to flat field. The soil is a complex system, rich in microbial diversity which forms an important ecosystem for nutrient and biogeochemical cycles. Fertilizers application may hamper the biological community and its activity as well. Biological characteristics of soil in many ways contribute to the physicochemical changes in soil.

The Oil Palm Plantation is expanding, yet any assessment on soil quality impact has not been done in the state to identify the potential threats of the cultivation to the soil biological community, hence the proposal. The research is designed to study the change in soil dehydrogenase activity with different age of the oil palm cultivation. Southern part of Kolasib provide an ideal climate, topography, elevation for the cultivation of oil palm in Mizoram.

Soil dehydrogenases are the major representatives of the Oxidoreductase enzymes class (Gu *et al.*, 2009). According to Quichano (2002), among all enzymes in the soil environment, dehydrogenases are one of the most important, and are used as an indicator of overall soil microbial activity. Establishment of Oil Palm Plantation provoke many statement which possess immense challenge, that mono cropping practice of Oil Palm (*Elaeis guineensis* Jacq.) Plantation could have an impact on the soil enzymatic activity and the research aims to study the status of soil Dehydrogenase Activity (DHA) in soil of 3,5,10 and 15yrs plantations respectively.

Methodology

Studied sample was located at Buhchangphai (24°19'45.1"N 92°38'57.2"E), Kolasib district, Mizoram. Elevation 47m. Identification of plantation – 3y, 5y, 10y, 15y. (- fert.) and 3y, 5y, 10y, 15y. (+ fert.) was done. Soil collection was done during late monsoon and soil of 0-15 cm depth was taken as sample. Sample was taken from Plot 1 – weeded zone and Plot 2 – 5m from main trunk. Sample was transported in a sterile plastic bag, which is transported to laboratory in an Insulated ice box to maintain the temperature. Soil Dehydrogenase activity estimation was done by TTC reduction method (Casida, 1977).

Table 1. Soil dehydrogenase activity under different age of plantation

| Plant Age (-fert.) | PLOT | Dehydrogenase (mg TPF g ⁻¹ 24h ⁻¹) | |
|--------------------|------|---|---------------|
| | | -fert. | +fert. |
| 3 | 1 | 0.219 ± 0.006 | 0.106 ± 0.005 |
| | 2 | 0.217 ± 0.016 | 0.224 ± 0.018 |
| 5 | 1 | 0.163 ± 0.008 | 0.102 ± 0.014 |
| | 2 | 0.187 ± 0.012 | 0.256 ± 0.004 |
| 10 | 1 | 0.059 ± 0.004 | 0.108 ± 0.018 |
| | 2 | 0.069 ± 0.071 | 0.148 ± 0.012 |
| 15 | 1 | 0.055 ± 0.003 | 0.079 ± 0.014 |
| | 2 | 0.061 ± 0.021 | 0.41 ± 0.012 |
| Control | | 0.222 ± 0.008 | |

Result



Fig. 1. Sample area site map of Buhchangphai.

Discussion

The result show that DHA level in 15 years plantation (0.055 ug TPF mg⁻¹ 24 hrs⁻¹) was quiet low in comparison with soil under 3 years plantation (0.219 ug TPF mg⁻¹ 24 hrs⁻¹) and in control (0.222 ug TPF mg⁻¹ 24 hrs⁻¹). On comparing the soil free from fertilizer(-fert) with soil irregularly treated inorganic fertilizer(+fert), Soil receiving fertilizer show higher DHA in older plant age and in all P2 stand. Farmer frequently introduce Glycel herbicide in the weeded circle of their plantation. However, fertilizer application was done in a long interval and infrequent. The DHA level in the soils of P2 soil were all higher and the organic matter and vegetation cover present in the unweeded circle P2 may contribute to the increase in soil DHA activity.

The reduction of enzyme activity in any agriculture land over time is a concern and from the field observation it is clear that proper land management system has to be introduce in the study area. The DHA were significantly reduced in soil of older

plantation elsewhere and therefore further research in determining the reason of disruption in soil enzymatic activity is yet a big challenged. Proper management system has to be introduced in the study area, the investigation prescribes proper agriculture land management.

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