Spatial distribution of carbon and nitrogen stable isotope in soil of an oil palm plantation

ABSTRACT

The conversion of lowland tropical forests to oil palm plantations is known to reduce the amount of soil carbon and nitrogen. However, this has been criticised as the plantations also contribute to a net gain of the soil carbon (C) stock. In this study, carbon and nitrogen stable isotopes techniques was used to confirm the source of carbon stored in plantation soils and to prove the effects of plantation activities on soil organic carbon. The objective of this study was to investigated the total organic carbon (TOC) and nitrogen (TON) content, and δ 13C and δ 15N values of soil in an oil palm plantation at different soil depths: 0-30, 30-60 and 60-90 cm and at different distances ((1.5 m: weeded circle), 3.5 (inter-rows) and 4.5 m (frond heap)) away from the tree base. The results showed that the ratio of soil δ13C and δ15N increased with depth and unusual δ15N value was reported on topsoil 0-30cm, a non-uniform distribution of soil OM (%), TOC (%), TON (%) and C/N ratio in the surface soil among the distances were observed. Negative correlation between δ13C and δ15N and bulk density (Bd) in respect of TOC and TON content were found. Value of δ13C at 0-30, 30-60 and 60-90 cm depths was -26.50, -26.36 and -26.23% respectively. This study conclude that, a low proportion of C was lost from the plantation soil , a long phase of C3 species dominated the soil before the establishment of the oil palm plantation and that frond heaps and large concentration of roots had a significant influence on OM (%), TOC (%), TON (%) and C/N ratio in the surface soil among the distances. The δ15N value in the top soil might be a useful indicator of the source and limited level of nitrogen in the area of study, however, further research is needed to confirm our observations.

Keyword: δ12N and δ15N stable isotopes; Carbon cycle; Oil palm plantation