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^{13}C NMR and isotopic (δ^{13}C) investigations on modern vegetation samples: a tool to understand the soil organic matter degradation dynamics and preferences

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Soil organic carbon, one of the largest reservoirs of carbon, is a heterogeneous mixture of organic compounds with dominant contribution derived from decomposition of plants in various stages. Although general ideas about the processes and mechanisms of soil organic matter (SOM) degradation have been developed, a very few study has linked the SOM with its parent material. In this study we aim to generate reference data set of functional groups from modern vegetation samples (C_3 and C_4plants) to better understand the degradation dynamics and preferences. The carbon functional groups from modern vegetation samples (eight C_3 and nine C_4 plants collected from Mohanpur, Nadia, West Bengal, India) were examined by solid state ^{13}C CPMAS NMR spectroscopy. Additionally, isotopic investigations (δ^{13}C) has also been carried out on the modern vegetation samples to understand the relationship of bulk isotopic values to the concentration of functional groups. The major functional groups (alkyl C, O-alkyl C, aromatic C, carbonyl C and aldehyde/ketone) of modern vegetation samples form 16%, 65%, 5%, 14% and 1% respectively in C_3 plants. Considerable differences has been observed for C_4 plants with average values of alkyl C, O-alkyl C, aromatic C, carbonyl C and aldehyde/ketone are 8%, 83%, 3%, 5% and 1% respectively. The concentration of functional groups from the modern vegetational samples can be considered as reference scale to compare with the ^{13}C NMR data derived from the different soil horizons to understand the SOM degradation dynamics. The $\delta^{13}C_{VPDB}$ values of modern vegetation samples plotted against the individual concentration of functional groups shows significant correlation in C_4 plants, whereas a lack in correlation has been observed for C_3 plants. We assume this difference in relationship of $\delta^{13}C_{VPDB}$ values with functional groups of C_3 and C_4plants can be due to the differences in photosynthesis pathways, the fractionation of CO_2 and accumulation of the products during various stages of photosynthesis. A more detailed investigation is warranted to understand the governing mechanism behind this observation.