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BIO-ORGANO-MINERAL FERTILISER APPLICATION PROMOTES CARBON SEQUESTRATION AND STABILISATION IN RICE ROOT-ZONE SOILS

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Limited land availability restricts soil carbon sequestration (SCS), highlighting the need for improved, climate-beneficial techniques for farmers. This study explores the potential for SCS and stabilisation through the use of biofilm biofertiliser (BFBF) in combination with modern bio-organo-mineral fertilisers (BOMF). Field experiments were conducted in Ampara, Anuradhapura, Polonnaruwa, and Puttalam in Sri Lanka, during the wet season in 2023/2024. Three previously optimised fertiliser treatments; (a) BOMF practice (500 kg NPK BOMF ha^{-1} + 2.5 L BFBF ha^{-1}), (b) hybrid practice (225 kg PK BOMF ha^{-1} + 62.5 kg CF N ha^{-1} + 2.5 L BFBF ha^{-1}), and (c) chemical fertiliser (CF) practice (340 kg CF NPK ha^{-1}), and a (d) control (no fertiliser) were applied in 10 × 10 m^2 rice plots in a randomised complete block design with three replicates in each site. Root-zone soil samples were collected at a depth of 0.25 m and air-dried for measuring soil organic C (SOC) and labile C (SLC) (mg kg^{-1}), which were used to calculate SCS. Fourier transform infrared spectroscopic diagnostic bands; water-soluble C (~3400 cm^{-1}), aliphatic B-humin (~2920 and 2850 cm^{-1}), ketones in humin residues (~1730 cm^{-1}), and humified-aromatic stable C (~1620 – 1650 cm^{-1}) were used to measure C mineralisation and stabilisation. The results indicated that the hybrid practice sequestered significantly ($p < 0.05$) higher quantities of C (41.75 Mg ha^{-1}) than the CF practice (24.91 Mg ha^{-1}). In addition, the hybrid practice also exhibited significant ($p < 0.05$) increases in water-soluble C, aliphatic B-humin, ketones in humin residues, and humified-aromatic stable C contents by 66%, 10%, 66%, and 59%, respectively, compared to the CF practice. In conclusion, both labile and stable carbon fractions increase with the application of BOMF-based hybrid practices, suggesting a promising and climate-smart approach to enhancing SCS in rice cultivation.

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Keywords: Biofilm biofertiliser, Carbon sequestration, Climate-smart agriculture, Root-zone soil