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MODERN BIOFILM-BASED BIO-ORGANO-MINERAL FERTILIZER FACILITATES SUSTAINABLE PRODUCTION OF HIGH-QUALITY RICE

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Heavy dependency on chemical fertilizers (CF) in paddy (*Oryza sativa* L.) cultivation needs to be addressed through novel approaches such as biofilm biofertilizers (BFBF), which have shown their potential to improve grain quality and productivity. The present study was designed to investigated the potential of BFBF in organic rice cultivation by combining with modern bio-organo-mineral fertilizers (BOMF). A field experiment was conducted in Ampara, Anuradhapura, Polonnaruwa and Puttalam districts in Sri Lanka during the wet season in 2023/2024. Three previously optimized fertilizer treatments *viz*., (a) BOMF practice (500 kg NPK BOMF/ha + 2.5 L BFBF/ha), (b) hybrid practice (225 kg PK BOMF/ha + 62.5 kg CF N/ha + 2.5 L BFBF/ha), and (c) CF practice (340 kg CF NPK/ha, as recommended by the Department of Agriculture, Sri Lanka), were used along with a (d) control (no fertilizer). Treatments were applied in 10 × 10 m^2 rice plots in a block design with three replicates in each site spread over 6.4 ha. Grain yields were utilised to calculate the Sustainable Yield Index (SYI). Rice grain samples were analysed for primary metabolites using FTIR diagnostic bands, i.e. Carbohydrate: 960-1130 cm^{-1}, Protein: 1600-1700 cm^{-1}, and Lipid: 1710-1765 cm^{-1}. The results indicated that the hybrid practice produced significantly higher yields ($p < 0.05$) compared to both BOMF and CF practices, which yielded comparable results. The SYI increased with BOMF and hybrid practices (0.49 and 0.60, respectively), compared to the CF-alone practice (0.36), indicating their potential to enhance the yield in a sustainable manner. In addition, the hybrid practice exhibited a significant ($p < 0.05$) increase in carbohydrate, protein, and lipid contents by 31%, 14%, and 3%, respectively, in rice grains compared to the CF practice. In conclusion, replacing CFs with organic inputs such as BOMF and BFBF not only promotes sustainable grain production but also enhances the nutritional quality of rice, thereby opening a new avenue for eco-friendly organic rice cultivation.

Keywords: Biofilm biofertilizer, Hybrid fertilizer, Seed primary metabolites, Sustainable yield index