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Management practices to mitigate long-term soil organic carbon losses in arable soils of Bavaria

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Over the past decades, soil organic carbon (SOC) in agricultural soils has shown a decreasing trend across Europe, reflecting the combined effects of management practices and climate change. Long-term field experiments offer a unique opportunity to study these effects and identify management strategies that can mitigate SOC losses under changing climatic conditions.

This contribution combines results from two long-term experiments located at the same site in Puch/Fürstenfeldbruck, Southern Germany: a compost amendment experiment (1994–2023) and a management comparison experiment (IOSDV, 1983–2021) with varying organic matter inputs and mineral nitrogen fertilization rates. Both experiments revealed a distinct SOC content decline, coinciding with a marked regional temperature rise and increased frequency of drought–rewetting cycles. Despite continuous or even increasing organic inputs, SOC contents declined in most cases, indicating climate-driven acceleration of SOC mineralization.

Across treatments, only management strategies combining multiple organic amendments (e.g., slurry, straw incorporation, and cover crops) or the application of compost can mitigate SOC loss to a certain extent. The results emphasize that improved management can buffer SOC losses and compensate enhanced decomposition processes under a warming climate.

The analysis of both long-term experiments highlights the necessity for improved agricultural management to mitigate SOC losses and maintain soil functionality in a rapidly changing climate.