Manipulating soil microbial carbon pump towards belowground carbon sequestration

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The Paris Agreement aims to limit the increase in global average temperature to 1.5℃. To reach this ambitious goal, the 4 per 1,000 Initiative, calling for an annual increase in soil carbon stock of 0.4% on agricultural lands globally, is serving as a promising urgent practice for climate change remediation. Accordingly, investigations about the stabilization of soil organic carbon (SOC) in agricultural systems have increased considerably in recent years. The recent concept - soil microbial carbon pump (MCP) – emphasizes the active role of microbes in SOC sequestration by the incorporation of microbial-derived carbon through long-term incessant microbial assimilation. Therefore, understanding and optimizing the transfer of carbon to belowground through soil MCP are essential. Here, we synthesize independent data from two long-term agricultural field studies from the two largest United States bioenergy research programs. We interrogate the soil MCP concept by investigating the spatial and temporary dynamics of microbial necromass, as evaluated by its amino sugar biomarker and SOC. Microbial necromass was the dominant contributor to SOC that had been enhanced by diversifying to perennial grassland cropping systems. We delineate and suggest two parameters – soil MCP capacity and efficacy – that should be useful proxies for future studies evaluating soil carbon storage in changing climates.