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Rhizosphere priming on soil organic carbon decomposition: the role of root traits

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The influence of living roots on soil organic matter decomposition is termed the rhizosphere priming effect (RPE). Although root traits are critical for understanding the RPE, it is unclear how the trade-offs among root traits, exudation and mycorrhizal symbioses mediate the RPE. The RPEs of 12 grassland species were quantified using a natural ^{13}C tracer method in a mesocosm experiment. Ten root functional traits were measured to examine the trade-offs among root traits, and their linkage with the RPEs. All species produced positive RPEs, with legumes and forbs showing larger RPEs than grasses. The magnitude varied from 32% to 350% compared to the unplanted soil. After accounting for root biomass effect, specific RPEs were positively correlated with specific root length, specific root surface area, root exudation rate, and specific rhizosphere respiration, while negatively correlated with root diameter and arbuscular mycorrhizal fungi colonization. These results demonstrate that plants with thinner roots show efficient root morphology and/or more exudation by inducing larger specific RPEs, while plants with thicker roots associate more with mycorrhizal symbioses and induce smaller specific RPEs. Overall, root functional traits play key roles in mediating the species-specific RPEs and have implications for predicting soil organic matter dynamics.