Rhizosphere priming effect on soil organic carbon decomposition under plant species differing in soil acidification

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A comprehensive understanding of rhizosphere priming effects (RPE) on the decomposition of soil organic carbon (SOC) requires an integration of many factors. This study aimed to link species variation in RPE with plant traits and rhizosphere properties such as soil pH. We hypothesized that measured RPEs would correlate positively with the amounts of root exudates while negatively with rhizosphere acidification. Four C3 species (chickpea, field pea, wheat and white lupin) differing in soil acidification and root exudation, were grown in a C4 soil. A simplified, low-cost and reliable CO_2 trapping system was developed to collect total below-ground CO_2 at different plant growth stages (vegetative, flowering and maturity stages), respectively. White lupin and wheat showed greater positive RPEs, in contrast to the negative RPE produced by chickpea. The greatest RPE of white lupin was in line with its capacity to release root exudates, whereas the negative RPE of chickpea was attributed to its great ability to acidify rhizosphere soil. The enhanced RPE of field pea at maturity might result from high nitrogen deposition and release of structural root carbon components following root senescence. Root biomass and length played a minor role in the species variation in RPE. For the first time, rhizosphere acidification was shown to be an important factor affecting the magnitude and direction of RPE. Future studies on RPE modelling and mechanistic understanding of the processes that regulate RPE should consider the effect of rhizosphere pH. Under field conditions, adoption of legumes species in the cropping system also needs to consider both soil acidification and C loss or gain due to RPE.