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Composition and dynamics of cutin and suberin biomarkers in plants and soils under agricultural use

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Cutins of plant shoots, and suberins, mostly present in roots, may act as potential biomarkers for aboveground and belowground biomass of non-woody plants. The aim of this work was to evaluate the dynamics of specific root and shoot biomarkers after land-use changes from grass to an arable land. We (i) identified and quantified specific biomarkers of cutin and suberin of three grassland species (Dactylis glomerata L., Festuca arundinacea Schreb. and Lolium perenne L.), (ii) investigated the composition of cutin and suberin in soil under different land uses (continuous and temporary grassland, arable and bare soil) of the SOERE-ACBB experimental site in Lusignan (France) and (iii) used natural 13C isotope abundances to follow the fate of cutin and suberin specific markers in soil after conversion from grassland (C3 plants) to arable land (maize, C4 plants). Our results indicated that 9-hydroxy hexadecanedioic acid and 8(9)(10),16-dihydroxy hexadecanoic acid may be used as biomarkers for aboveground biomass, whereas 1,22-docosandioic acid, 22-hydroxy docosanoic acid and 24-hydroxy tetracosanoic acid may be the most adequate belowground biomarkers for the plants investigated under the experimental conditions studied. There were marked differences in monomer composition, abundance and patterns of shoot–root allocation of these biomarkers in the plant species analysed, which demonstrates the importance to identify specific cutin and suberin biomarkers for each plant species to study the incorporation of their biomass into SOM. Cutin and suberin marker contents followed the same trends as the biomass inputs to soil: they were the highest in soils cultivated with maize and the lowest in bare soils. We found no differences in the amounts of cutin and suberin markers in soil under continuous and temporary grassland, which might indicate that the disturbance caused by conversion from grassland to cropland was transitory only. In addition, suberin marker contents decreased by 40-64 % and cutin's by 24-40 % during a 6-year bare fallow, which indicates that root markers were more sensitive than shoot markers to degradation. Changes in the 13C isotopic signatures of specific biomarkers after 6 years of maize cropping showed a higher turnover of root markers as compared to shoot biomarkers, despite the much lower root inputs from maize than from grassland plants. These findings indicate that the stabilisation of suberin in soils was more rapid but less durable than that of cutin.