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Litter decomposition patterns in a semiarid Mediterranean ecosystem

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Accumulation of soil carbon is mainly controlled by the balance between litter production and litter decomposition. While aboveground litter decomposition in mesic systems is thought to be controlled by climate, litter quality, and soil faunal interactions (Aerts, 1997), it is becoming increasingly evident that factors other than water availability, including photodegradation, physical fragmentation of litter, and soil movement may play central roles in determining rates of carbon and nutrient turnover in arid and semiarid ecosystems (Whitford et al., 2002; Austin and Vivanco, 2006; Throop and Archer, 2007).
Decomposition and its controls were studied using the litter-bag method by exposing two different litter types (Pinus halepensis Mill. and Rosmarinus officinalis Linn.) for a 20 month period in two Mediterranean ecosystems of the eastern Iberian Peninsula: 1) a $\sim$ 150-yr-old forest stand, and 2) an abandoned agricultural field. Both sites are covered by a typical Mediterranean shrubland (Rosmarinus officinalis, Quercus coccifera, and Juniperus oxycedrus) with scattered Aleppo pines (Pinus halepensis).
A single exponential decay model (Olson, 1963) fit the data well (R2 values ranging from 0.46 to 0.82). Litter types differed in their decomposition dynamics despite of similar initial content of C and N, and C:N ratios. Rosemary litter decomposed more rapidly than Aleppo pine litter across sites (R2 = 0.742; F= 132.18; P<0.0001). After 20 months, rosemary litterbags had significantly less mass than did Aleppo pine litterbags regardless of site (pooled across sites: rosemary = 44.77% $\pm$ 2.21% (mean $\pm$ SE), Aleppo pine = 70.25 % $\pm$ 2.21% (mean $\pm$ SE); F= 132.18; P<0.0001). There was also a significant site effect on decomposition rates. While P. halepensis litter decomposed 1.5 fold-more rapidly (R2= 0.68; F= 45.93; P<0.0001), R. officinalis litter decay rates were 1.2 fold-higher in forest than in abandoned field site.
Soil temperature or water availability could not explain the differences in decomposition rates between sites throughout the study period. Instead, there was a strong relationship across collection dates between decay rates and litterbag ash content, a conservative indicator of soil accumulation (Throop and Archer, 2007). Moreover, ash content was strongly correlated with the total duration of rainfall events across collection dates for both pine (R2= 0.717, P<0.01) and rosemary (R2= 0.819, P<0.01) litter. We propose that between-sites differences in soil influx into litterbags were mainly driven by soil water erosion in this Mediterranean ecosystem.
These results suggest that soil infiltration into litterbags was a major driver of decomposition in this Mediterranean ecosystem, and confirm that models emphasizing climatic variables, litter quality, and photodegradation miss other salient parameters in semiarid ecosystems, such as rates of soil movement that may cause fragmentation or abrasion to litter, and facilitate decomposer colonization and microbial activity increasing the surface area available for microbial attack.