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SUPPLEMENTARY INFORMATION

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Formation of soil organic matter via biochemical and physical pathways of litter mass loss

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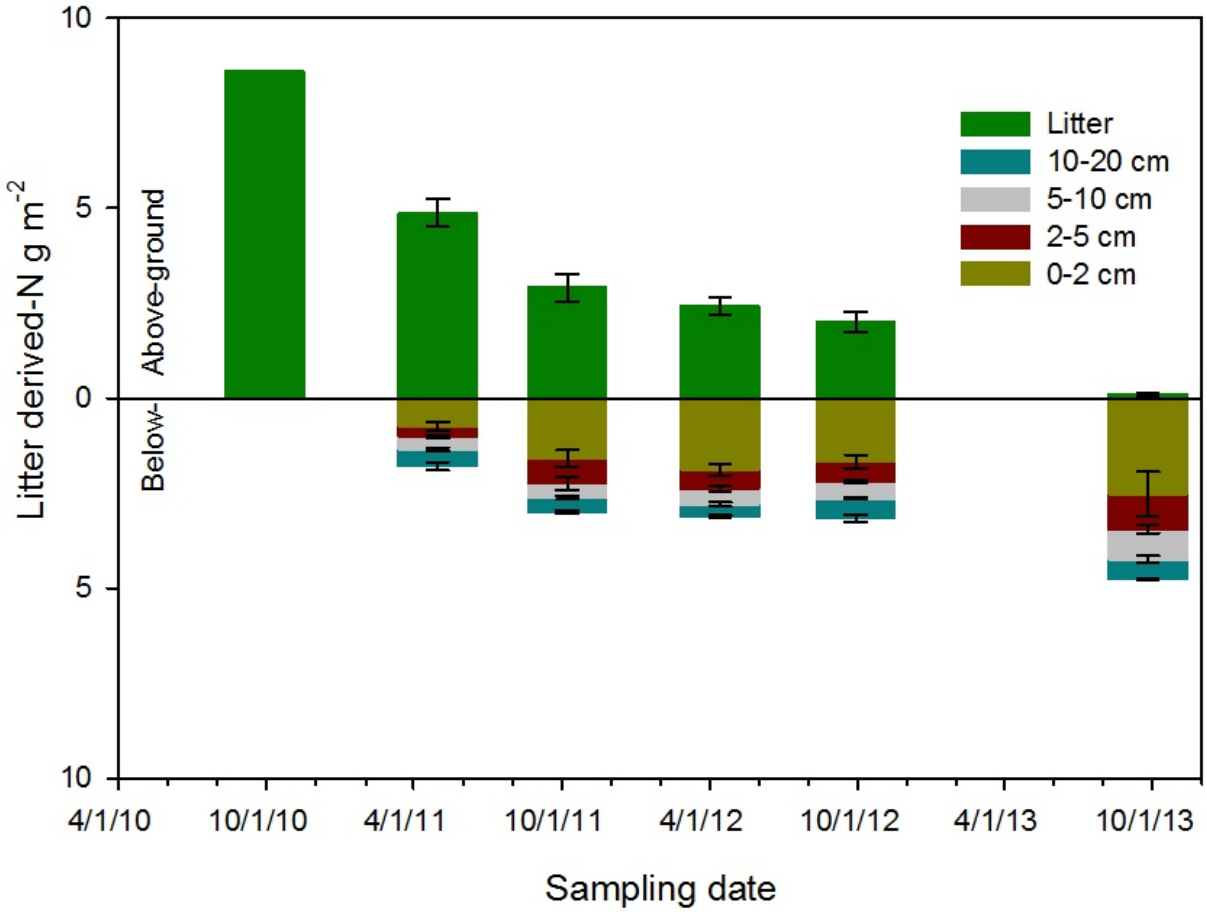
Supplementary Figures



Supplementary Figure 1: Dynamic of *Andropogon gerardii* litter N loss from the soil surface and recovery of litter-derived N in the mineral soil. In September, 2010, the equivalent of 8.6 g N m^{-2} litter was placed on the soil surface, were it decomposed for three years with sampling at 7, 12, 18, 24 and 36 months. At each sampling the amount of litter-N remaining on the soil surface and recovered in the 0-2, 2-5, 5-10 and 10-20 cm mineral soil layers was quantified by applying the isotopic mass balance to the litter and soil N pools. Data are means (n=4) with standard errors.

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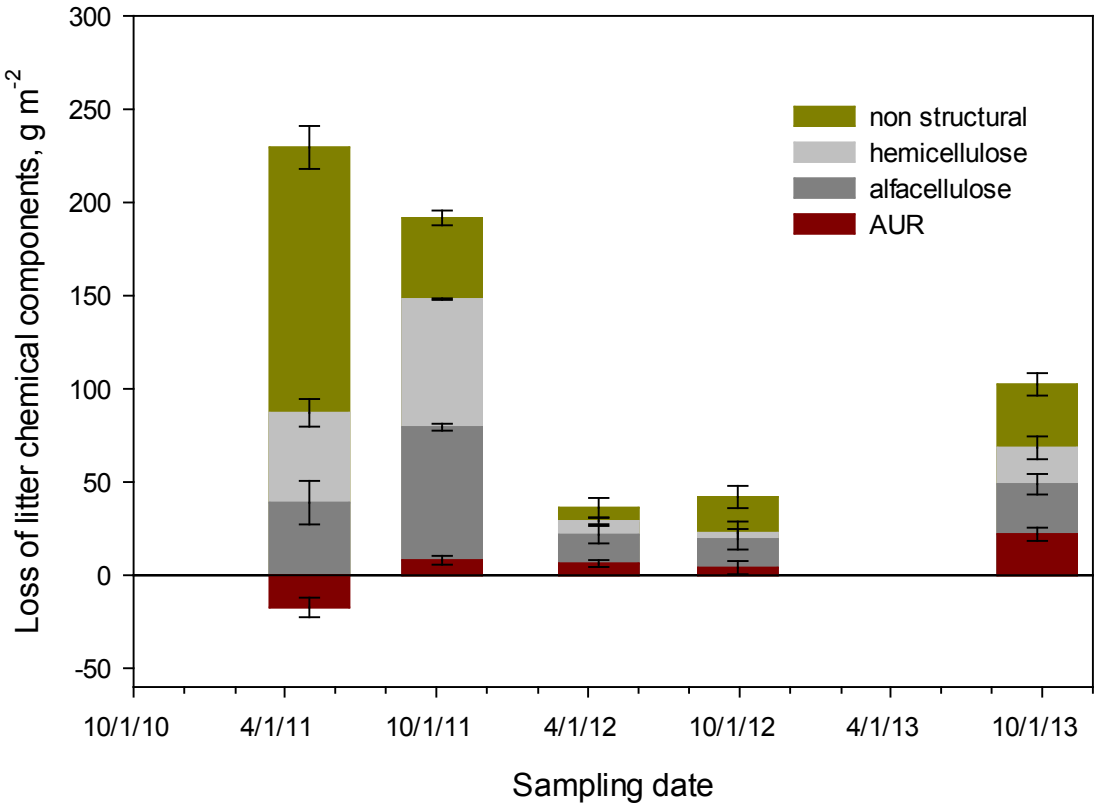
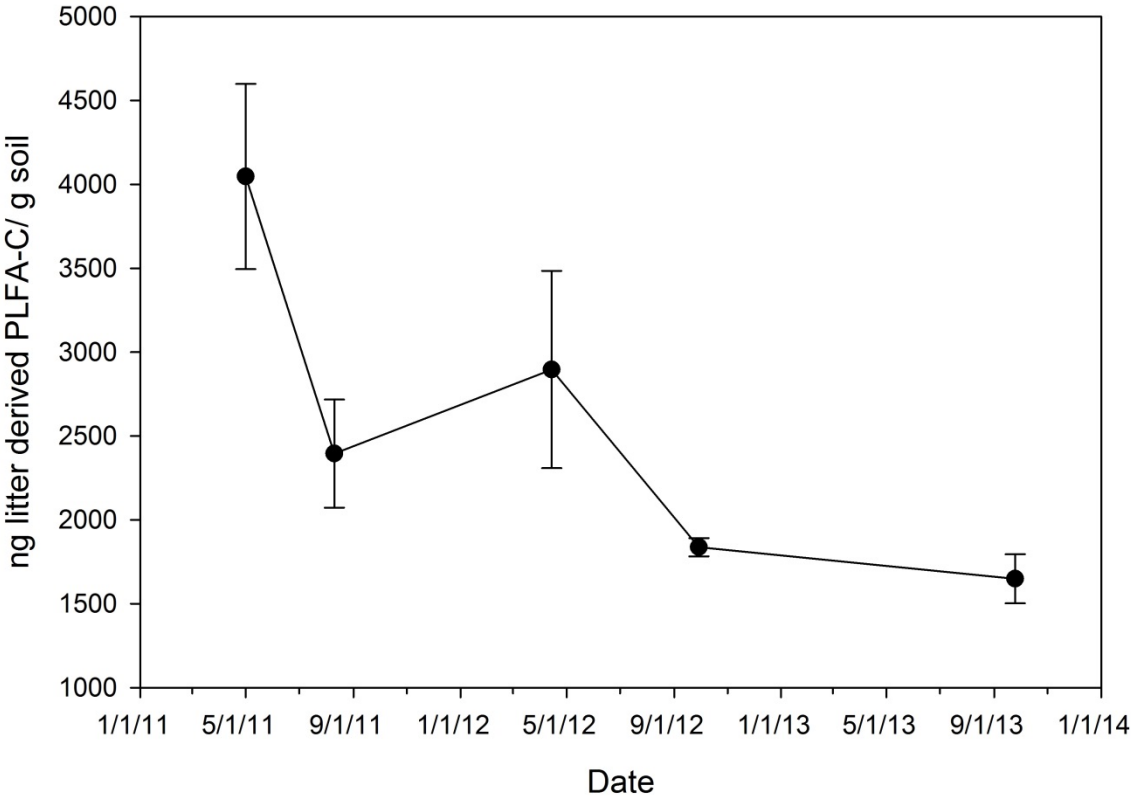


Supplementary Figure 2: Amounts of non-structural, hemicellulose, alfa-cellulose and acid unhydrolyzable residue (AUR), proxy for lignin, lost by *A. gerardii* litter during decomposition. Data were calculated from the difference between the amount of each chemical pool in the litter residue at the day of sampling and the correspondent value at the sampling before. For the last sampling, the chemical composition represented that of the litter residue remaining at 24 months, since no mass was recovered at 36 months. Data are averages (n=4) with standard errors. At the beginning litter lost non-structural components and celluloses. Later, none of the chemical components was preferentially lost.



Supplementary Figure 3: Litter-derived C incorporated in microbial phospholipid fatty acids (PLFAs) in the 0-5cm soil, during decomposition of isotopically labeled *A. gerardii*. Data are averages (n=4) with standard errors. The highest litter-derived C incorporation was observed at the very beginning of the process and decreased through time. Little ^{13}C enrichment was found in microbial biomass by the end of the decomposition process, when the dominant part of the litter-derived C in the system was in the soil organic matter light fraction.

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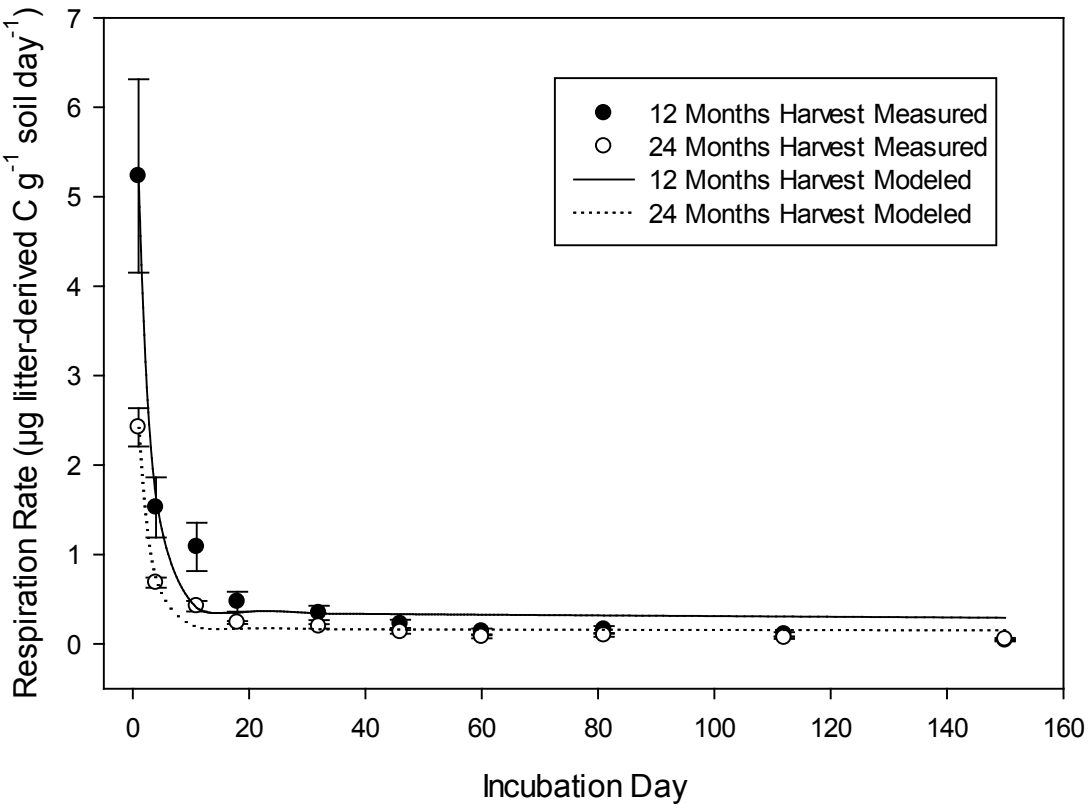

Supplementary Figure 4: Respiration rates of litter-derived C in the 2-5cm soil collected after 12 (●) and 24 months (○) of litter incubation. Respiration rates were measured in the laboratory under controlled conditions (25°C) and are expressed as means ± standard errors (n=4). Measured data were fit with a two pool model[1]. Models shown have an active pool of 6% and a stable pool of 94% (r^2=0.958) for the 12 months soil, and of 3% and 97%, respectively, (r^2=0.972) for the 24 months soil, indicating that the large majority of litter derived C pool in the mineral soil is stable.

Supplementary Tables

Supplementary Table 1: Litter-derived C pools in the light (LF < 1.85 g cm^{-3}) and heavy organo-mineral fractions, separated into a sand-sized (>53 μm), a silt and a clay fraction, of the 0-5 cm mineral soil, over three year of decomposition of isotopically labeled *A. gerardii* above-ground litter. Data are average ± standard errors (n=4).

Stage of decomposition	Litter-derived C g m^{-2}			
	Light fraction	Sand-sized	Silt	Clay
7 months	1.76 ± 0.33	0.90 ± 0.11	3.92 ± 0.19	1.75 ± 0.11
12 months	11.09 ± 0.61	2.39 ± 0.22	6.91 ± 0.37	2.19 ± 0.18
18 months	16.63 ± 0.76	4.04 ± 0.39	7.29 ± 0.37	2.73 ± 0.20
24 months	7.79 ± 0.33	1.88 ± 0.18	6.31 ± 0.24	2.17 ± 0.16
36 months	15.77 ± 0.59	7.66 ± 0.36	9.51 ± 0.36	2.62 ± 0.20

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Supplementary Table 2: C and N isotopic composition, reported as $\delta^{13}C$ and $\delta^{15}N$, of the bulk soil samples collected from the 0-2, 2-5, 5-10 and 10-20 cm soil depth layer at 7, 12, 18, 24 and 36 months after placement of isotopically labeled *A. gerardii* litter on the soil surface. Data are average ± standard errors (n=4).

Harvest (months)	Soil depth (cm)	$\delta^{13}C$	$\delta^{15}N$
7	0-2	10.67 ± 0.69	136.52 ± 1.60
	2-5	-8.50 ± 0.40	39.13 ± 0.81
	5-10	-12.05 ± 0.24	21.20 ± 0.57
	10-20	-11.43 ± 0.30	15.24 ± 0.59
12	0-2	43.48 ± 1.01	292.12 ± 2.21
	2-5	-0.62 ± 0.75	91.69 ± 1.70
	5-10	-11.67 ± 0.25	23.18 ± 0.56
	10-20	-11.90 ± 0.17	13.68 ± 0.36
18	0-2	54.62 ± 0.99	345.85 ± 1.87
	2-5	-3.52 ± 0.47	71.01 ± 1.06
	5-10	-11.29 ± 0.27	25.16 ± 0.62
	10-20	-12.37 ± 0.21	12.12 ± 0.34
24	0-2	42.90 ± 0.94	307.56 ± 2.01
	2-5	-2.45 ± 0.32	72.98 ± 0.74
	5-10	-10.93 ± 0.24	26.95 ± 0.47
	10-20	-11.08 ± 0.20	17.47 ± 0.55
36	0-2	72.44 ± 1.52	464.68 ± 3.65
	2-5	5.98 ± 0.45	127.97 ± 1.32
	5-10	-9.28 ± 0.27	45.66 ± 0.78
	10-20	-12.42 ± 0.14	17.30 ± 0.30

Supplementary Table 3: Background soil values of C and N concentration for the 0-2, 2-5, 5-10 and 10-20 cm depth bulk soil and for the 0-2 and 2-5 cm depth SOM fractions used to determine the field C and N pools size, and background C and N isotope values used in the isotope mixing models. Data are average across 4 replicates and 5 sampling dates, with standard errors in brackets.

Sample	Soil depth	%C	%N	% of total soil	$\delta^{13}C$	$\delta^{15}N$
Bulk	0-2 cm	5.21 (0.075)	0.393 (0.006)	100	-16.2 (0.319)	1.712 (0.281)
Light fraction	0-2 cm	27.3 (0.510)	1.43 (0.023)	4.46 (0.169)	-18.4 (0.311)	-0.035 (0.317)
Sand sized	0-2 cm	6.15 (0.413)	0.399 (0.024)	10.1 (0.399)	-16.4 (0.181)	-0.026 (0.181)
Silt	0-2 cm	2.60 (0.149)	0.251 (0.017)	70.6 (0.477)	-15.3 (0.109)	1.070 (0.182)
Clay	0-2 cm	4.13 (0.173)	0.422 (0.027)	14.8 (0.353)	-15.3 (0.313)	3.635 (0.133)
Bulk	2-5 cm	4.41 (0.055)	0.340 (0.004)	100	-14.9 (0.098)	1.995 (0.206)
Light fraction	2-5 cm	25.9 (0.772)	1.23 (0.025)	2.74 (0.114)	-17.7 (0.193)	0.965 (0.882)
Sand sized	2-5 cm	5.05 (0.310)	0.356 (0.020)	9.11 (0.301)	-15.8 (0.134)	1.355 (0.494)
Silt	2-5 cm	2.60 (0.149)	0.232 (0.018)	73.3 (0.391)	-13.8 (0.514)	1.740 (0.177)
Clay	2-5 cm	4.25 (0.126)	0.474 (0.034)	14.9 (0.310)	-14.3 (0.079)	4.083 (0.200)
5-10 cm	Bulk	3.76 (0.052)	0.300 (0.004)	100	-14.0 (0.067)	2.923 (0.212)
10-20 cm	Bulk	3.27 (0.042)	0.271 (0.004)	100	-13.3 (0.074)	3.754 (0.219)

Supplementary References

1 Haddix, M. L. *et al.* The Role of Soil Characteristics on Temperature Sensitivity of Soil Organic Matter. *Soil Sci. Soc. Am. J.* **75**, 56-68 (2011).