Characterization of litter decomposition in urban green spaces

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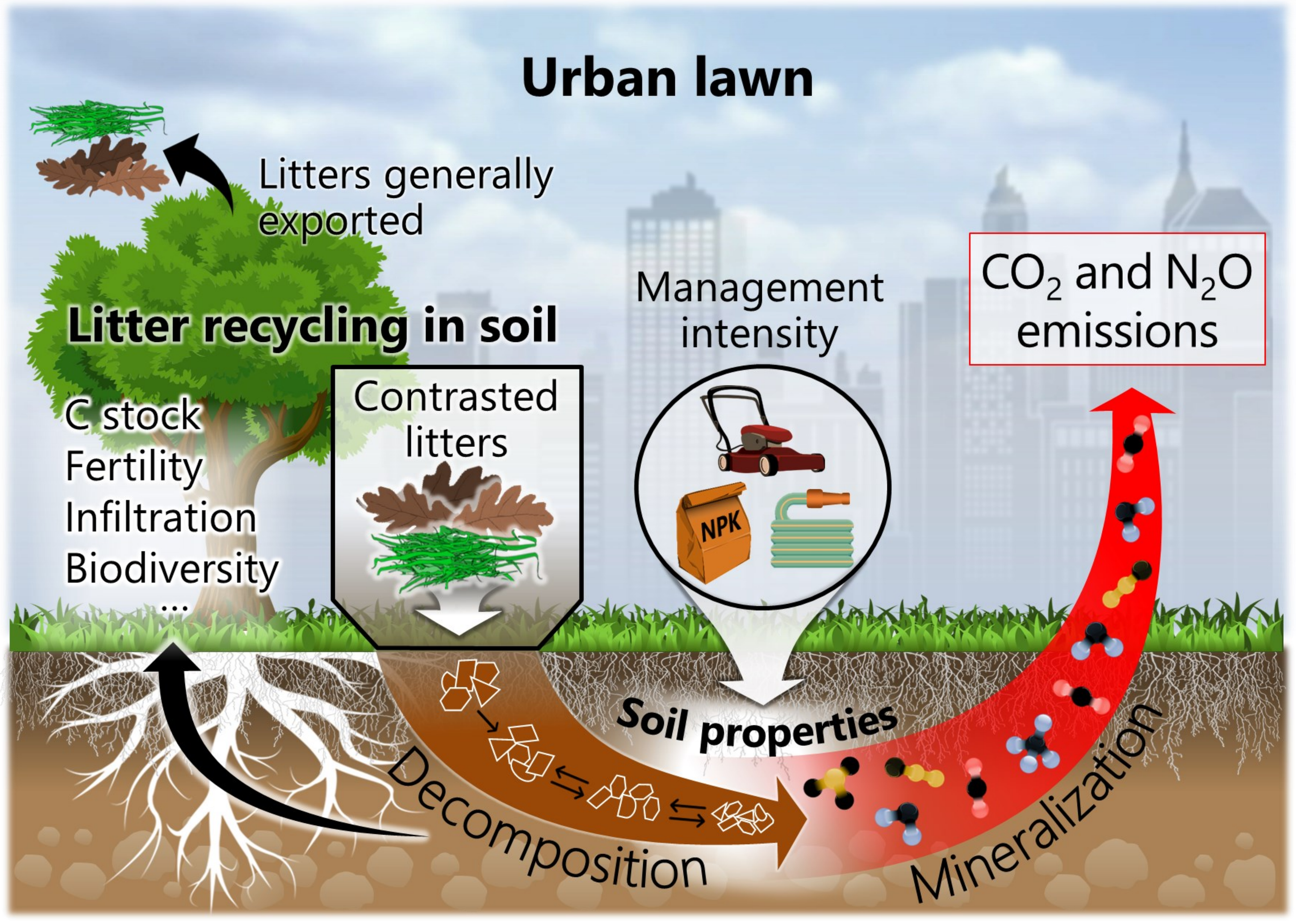
Context & objectives

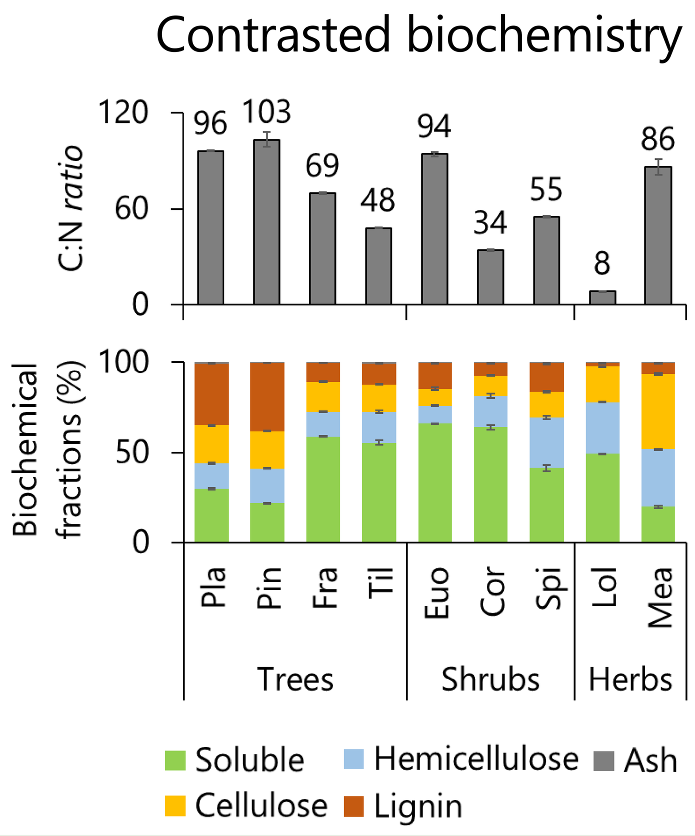
In urban lawns, above-ground litters (i.e., broadleaves, herb cuttings) are generally exported to maintain lawn ecosystems. It is likely that recycling litters on lawns (i.e., nature-based solution) contribute to improving ecosystem services provided by urban green spaces by carbon (C) sequestration and soil fertility (Ferlauto et al., 2024). Nevertheless, emission of nitrous oxide (N_2O), a strong greenhouse gas, during litter decomposition in the soil can offset the benefits of litter recycling (IPCC, 2019).

- Objective 1 : Understand how **litter degradability** (i.e., CO_2 emissions) is influenced by **urban litter characteristics** (i.e., biochemistry) and **soil management intensity** during their decomposition ;
- Objective 2 : Understand how **potential N_2O emissions** are influenced by these factors.



Materials & methods

Characteristics of 9 typical litters



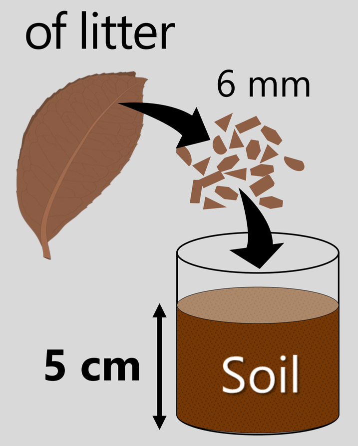
Properties of 2 lawn soils

	Low intensity (LI) lawn	High intensity (HI) lawn	
Org. C	1.8	6.0	%
Tot. N	0.2	0.5	%
NO_3^-	9.0	20	mg kg^{-1}
pH	5.8	6.7	
Density	1.4	0.8	g cm^{-3}
WHC	22	71	g H_2O g^{-1}
	Sandy loamy	Sandy loamy	

Experiments in controlled conditions (15°C and θ)

Microcosm

3 T ha^{-1} of litter



Fixed at *in situ* **densities**

CO_2 fluxes

Optimal ψ for **mineralization**

NaOH traps

For **90 days**

N_2O fluxes

Optimal ψ for ***in situ* production**

IR gas analyzer

For **14 days**

Results & discussion

Net cumulative CO_2 fluxes (kg C ha^{-1})

Fig. 1 Low intensity - 9 litters

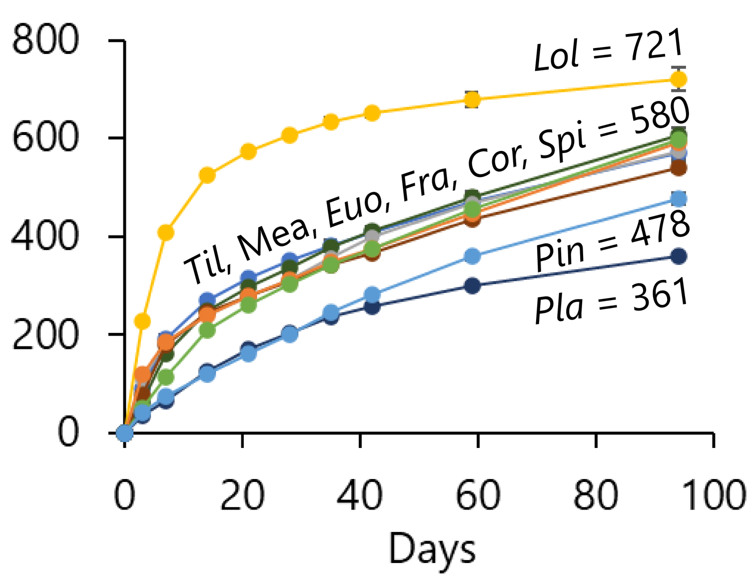
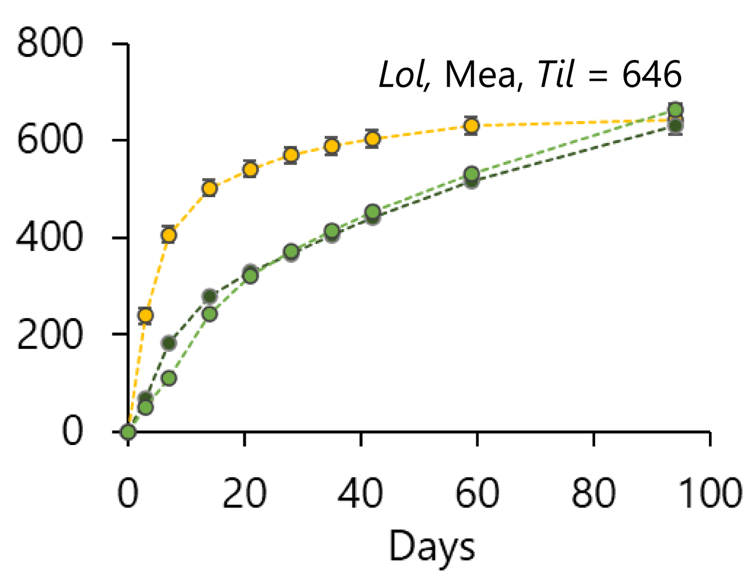


Fig. 2 High intensity - 3 litters



Net cumulative N_2O fluxes (kg N ha^{-1})

Fig. 3 Low intensity - 3 litters

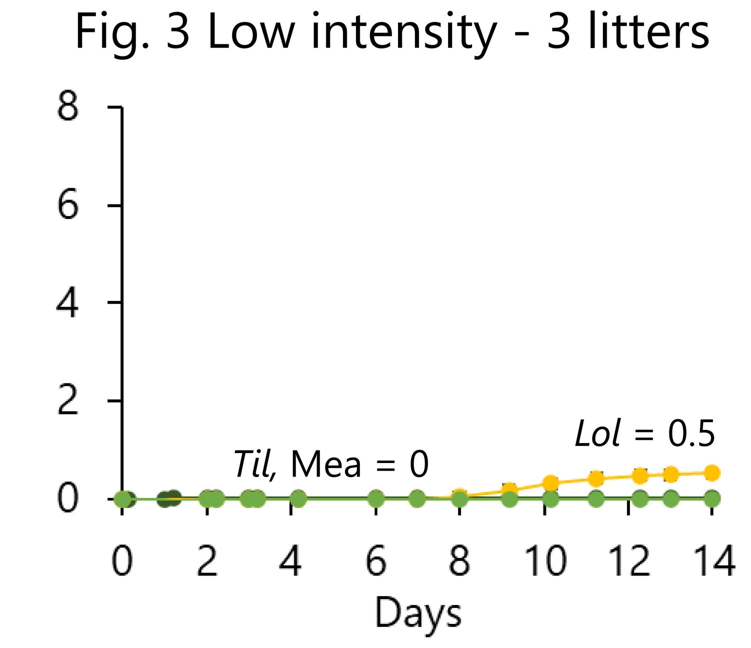
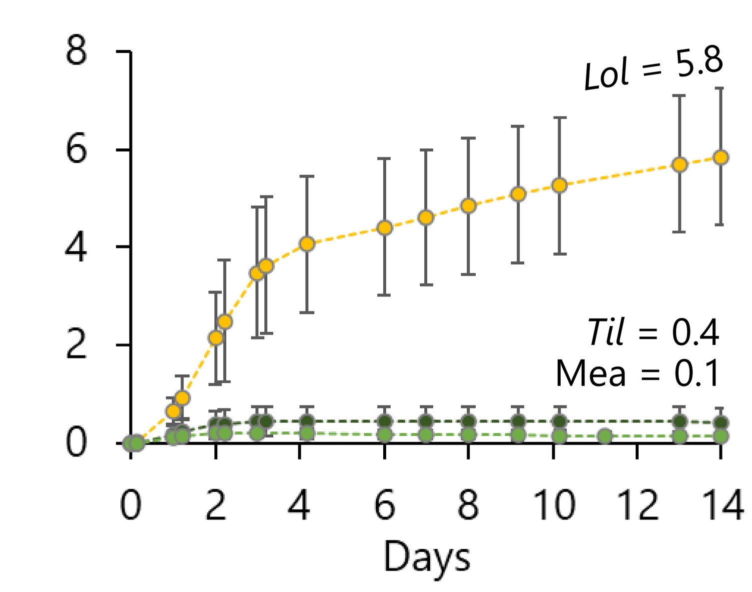


Fig. 4 High intensity - 3 litters



The 9 litters and 2 soils showed contrasted CO_2 and N_2O emissions.

CO_2 emissions were higher for **labile litters** with high N and low lignin contents (Fig. 1).

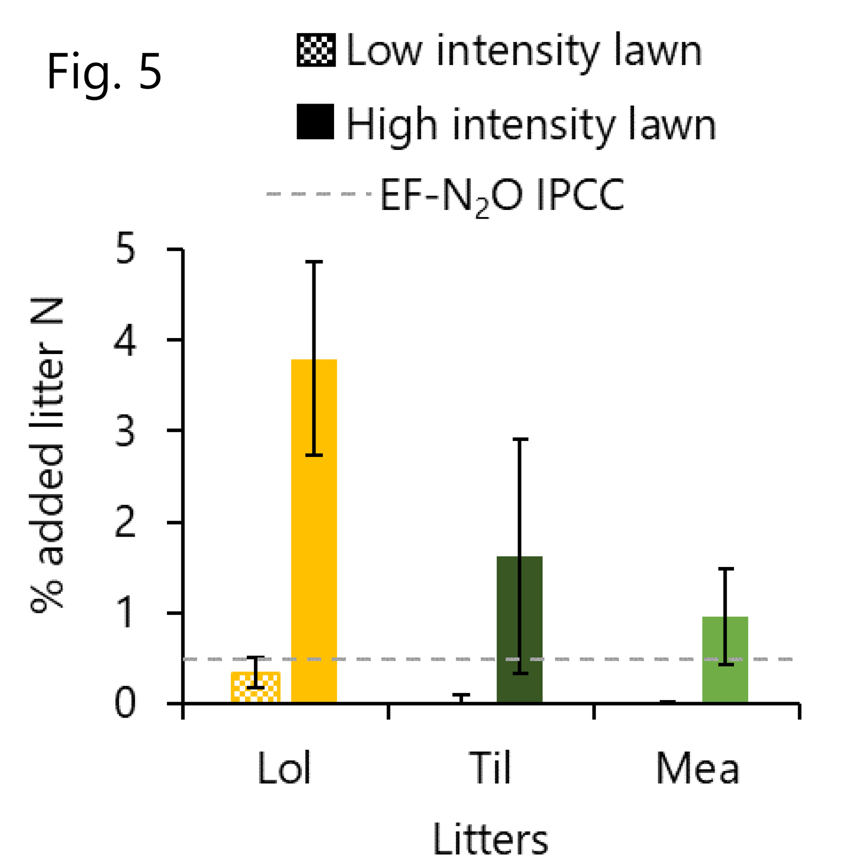
The decomposition of N-poor litters (*Tilia* and Meadow mix) emitted more CO_2 in HI lawn, likely due to its **higher soil NO_3^- content** (Fig. 2).

In the LI lawn, N_2O emissions were probably limited by the **low WHC and soil NO_3^-** content (Fig. 3).

In the HI lawn, *Lolium* (C:N = 8) induced **15 times higher N_2O emissions** than *Tilia* (C:N = 48; Fig. 4).

N_2O emission factors (EF-N_2O)

Fig. 5



Average EF-N_2O of litters was 0.1% on LI lawn and 2.1% on HI lawn (Fig. 5).

EF-N_2O considered for crop residues in wet climates by the **IPCC method (0.6%) underestimated EF-N_2O of litters in the HI lawn.**

Conclusion

- CO_2 and N_2O emissions were mainly influenced by **biochemical quality of litters and lawn management** respectively (Lashermes et al. 2022).
- Potential N_2O emissions induced by senescent litters (from trees and herbs) when recycled in soils appeared to be low. Particular attention needs to be paid to **the recycling of nonsenescent herbs (i.e. green) on rich soils, which can lead to high N_2O emissions** (Li et al. 2013).
- Considering the **high variability of urban soil properties** appears crucial when assessing their CO_2 and N_2O emission potentials.

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