Disentangling the effects of litter quantity and quality on soil biota structure and functioning: application to a cultivated soil in Northern France

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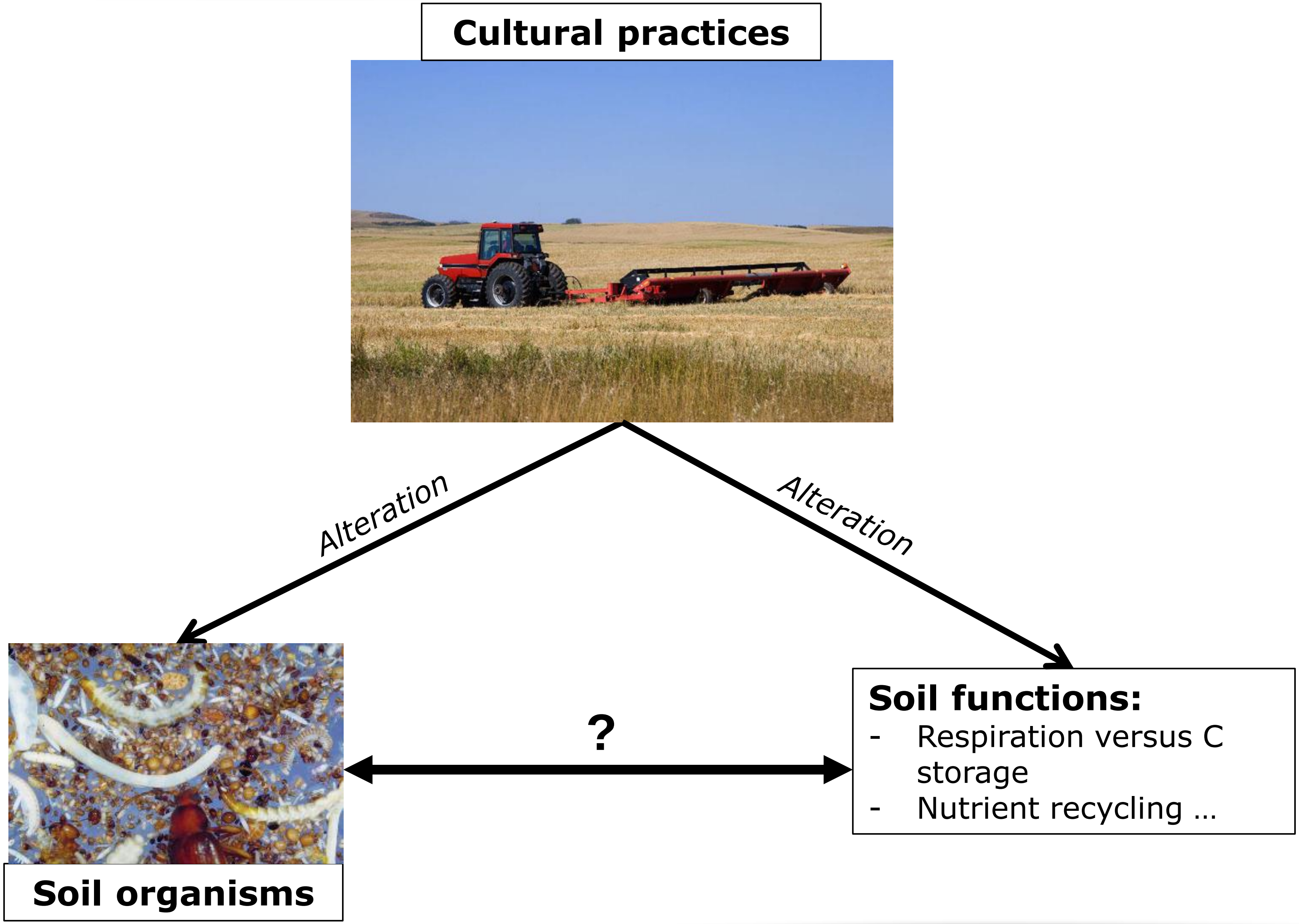
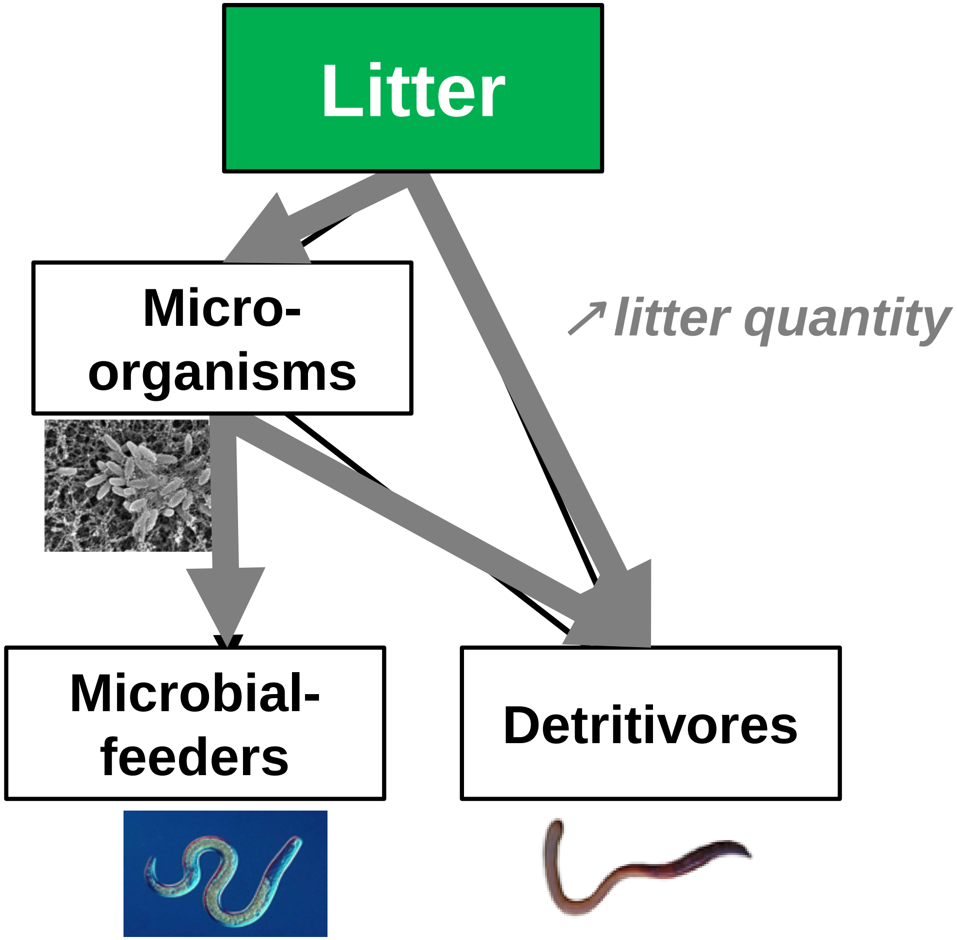
Impacts of cultural practices on soil biota



Litter quantity effects on soil food web

Crop residues → Main trophic resource for arable soil organisms *(Kim & Dale, 2004)*



Adapted from Holtkamp et al. (2008)

∆ quantity:

crop residues exportation / restitution

↓

↗ Microbial biomass

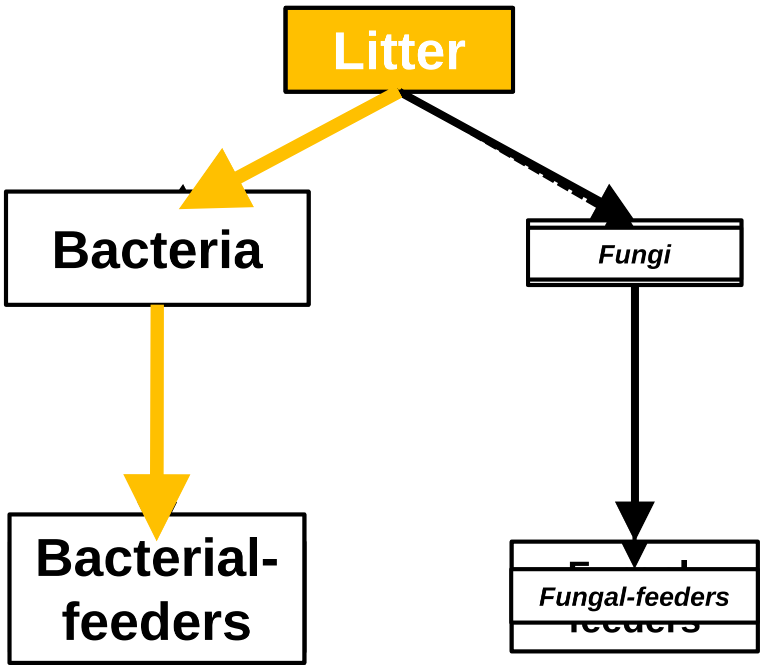
(Spedding et al., 2004; Govaerts et al., 2007)

→ Few information at the higher trophic levels

Is litter quantity increasing the biomass of soil fauna?

Litter quality effects on soil food web

Crop residues → Main trophic resource for arable soil organisms *(Kim & Dale, 2004)*



Adapted from Holtkamp et al. (2008)

↗ litter quality

Δ quality:

choice of the crop in the rotation
(Sauvadet et al., 2016)

→ Few information on fauna in cultivated soil

Is litter quality increasing the bacterial energy channels?

How can litter quantity and quality affect soil food web composition and functions in cultivated soils?

Litter incorporation (0-15 cm) into 8 m² plots (4 blocks)

- Without litter
- 5 $t.ha^{-1}$ Pea
- 10 $t.ha^{-1}$ Pea
- 10 $t.ha^{-1}$ Barley

Labile – high quality litter

Quantity effect

Quality effect

Recalcitrant – low quality litter

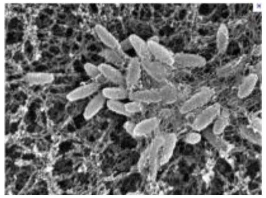
→ Results presentation after 7 months

Material and methods

Food web composition *(mg C . m^{-2})*

Bulk soil 0 – 10 cm

Total microorganisms & fungi



Microbial biomass C & Ergosterol

Soil corers 5 cm ø – 10 cm depth

Nematodes

Baermann extraction

Collembola

Mites

Berlese-Tullgrenn extraction

Hand sorting *(soil cubes 25 cm x 25 cm x 25 cm)*

Earthworms

Macroarthropods

Food web functions

Incorporated litterbags (8cm depth)

Litter mass loss

Bulk soil 0 – 10 cm

Soil N mineral content
Enzymatic activities *(Bell et al., 2013)*

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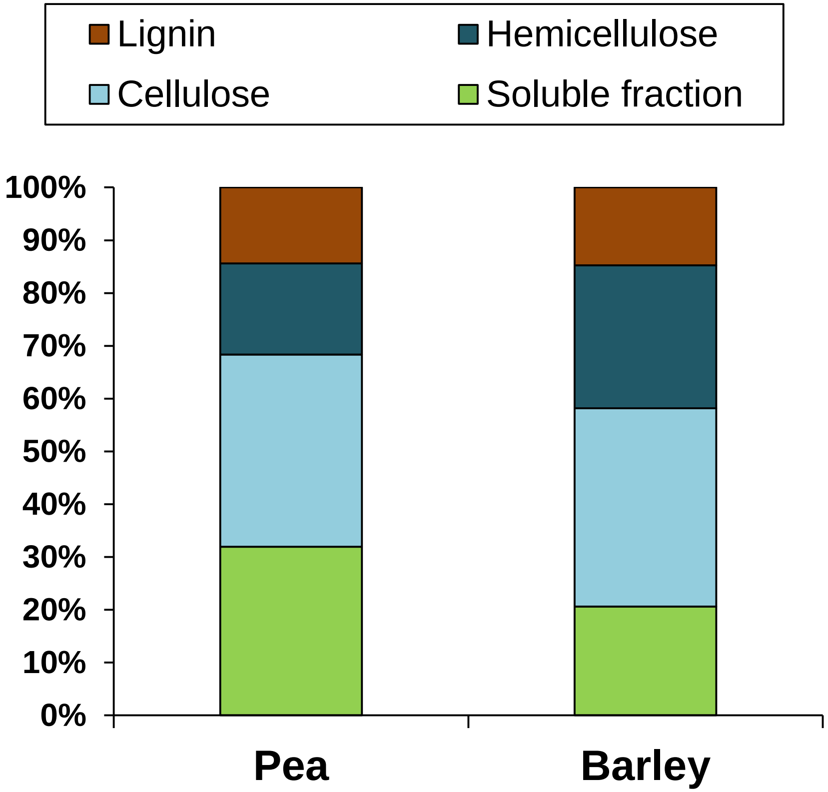
- *C hydrolytic enzymes*
- *N hydrolytic enzymes*
- *Oxidative enzymes*

Litter decomposition

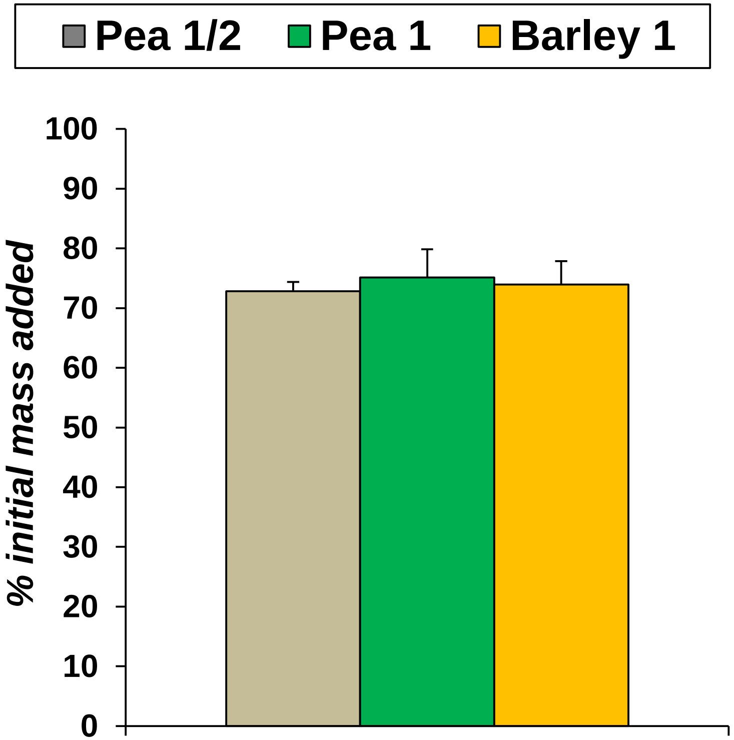
Litter initial qualities



C/N ratio:
55 ± 0

C/N ratio:
101 ± 4

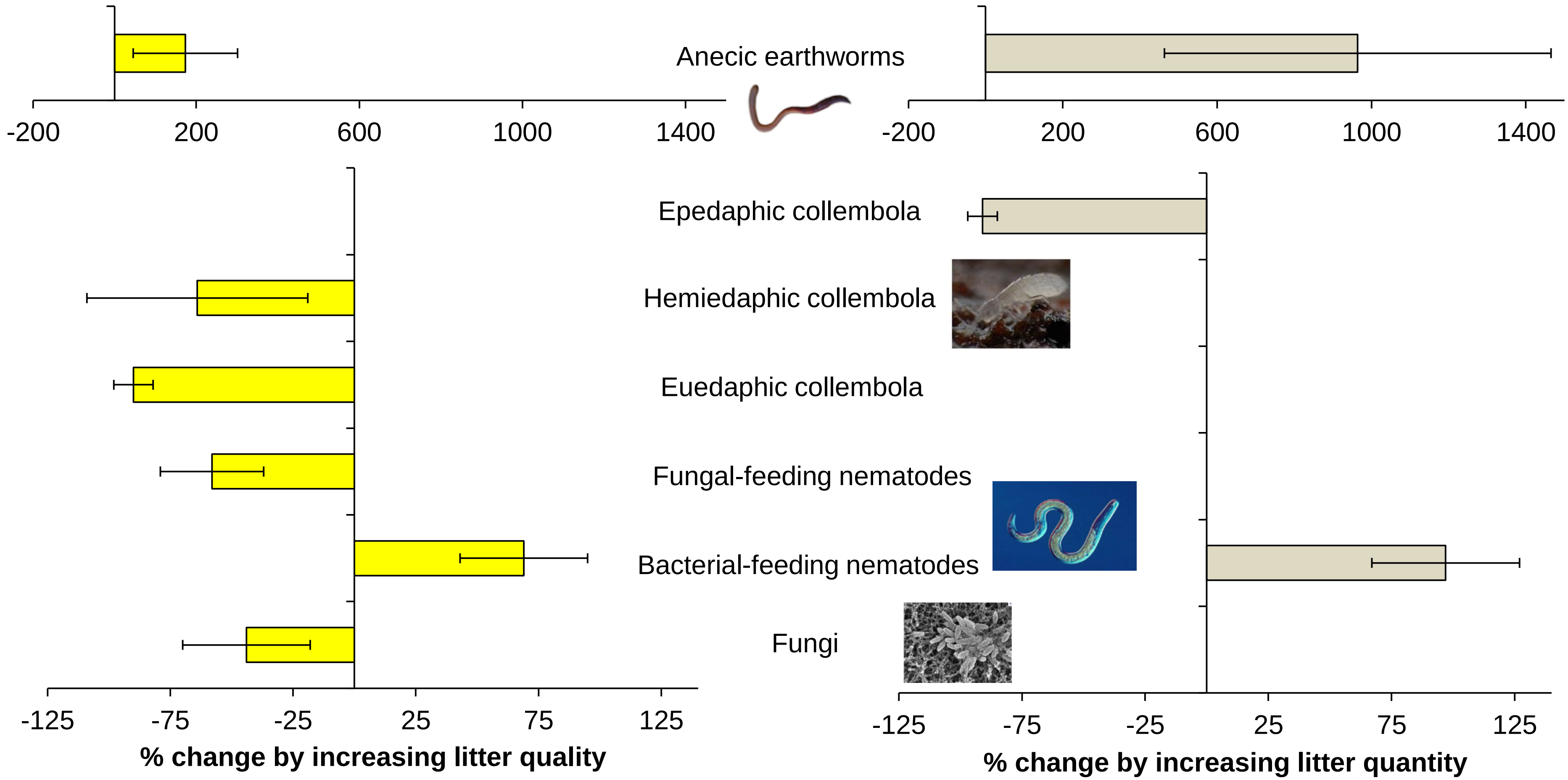
Litter mass loss after 7 months



Quality – quantity effects on soil food web composition

Quality effects: Barley → Pea 10t.ha^{-1}

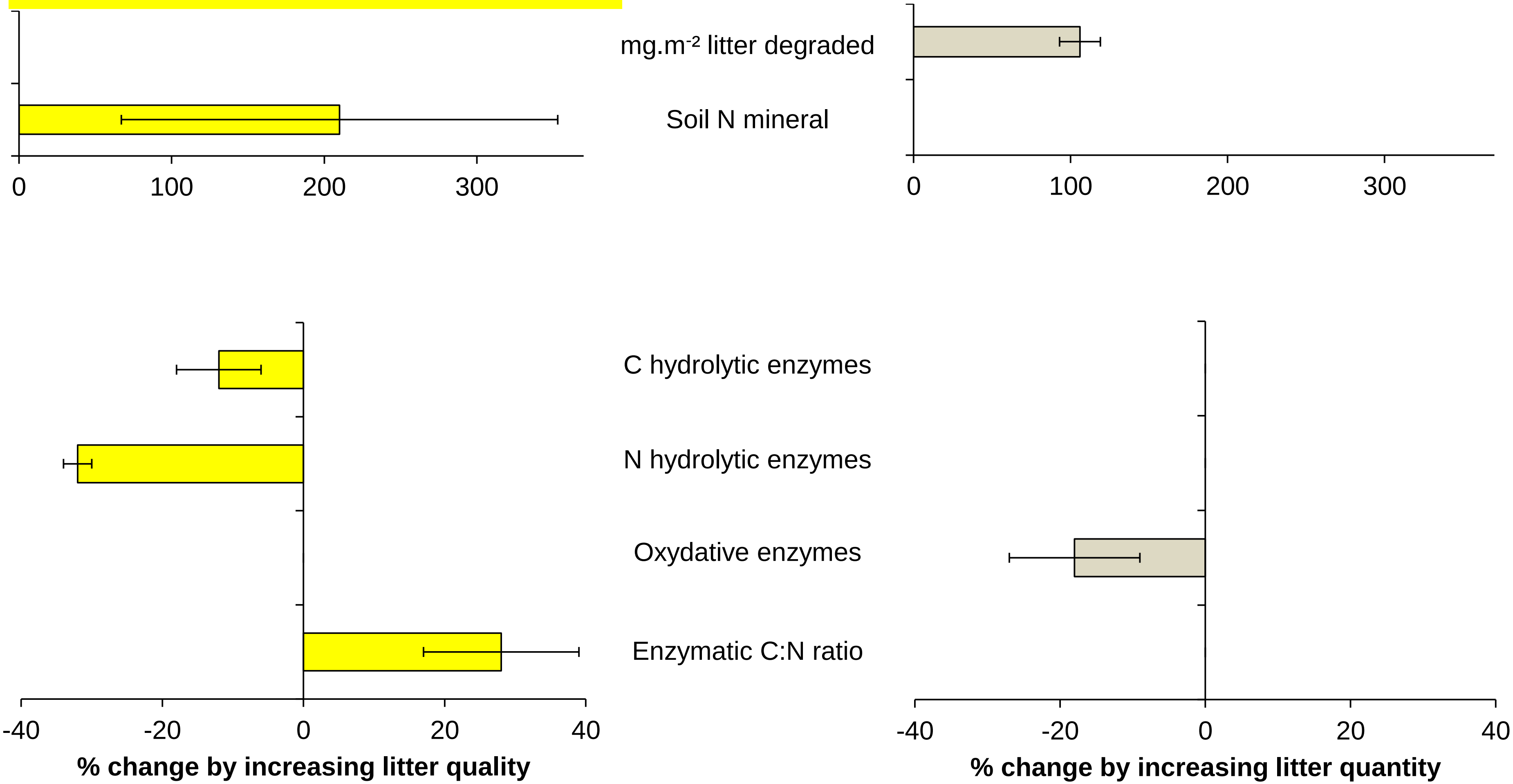
Quantity effects: Pea 5 t.ha^{-1} → 10 t.ha^{-1}



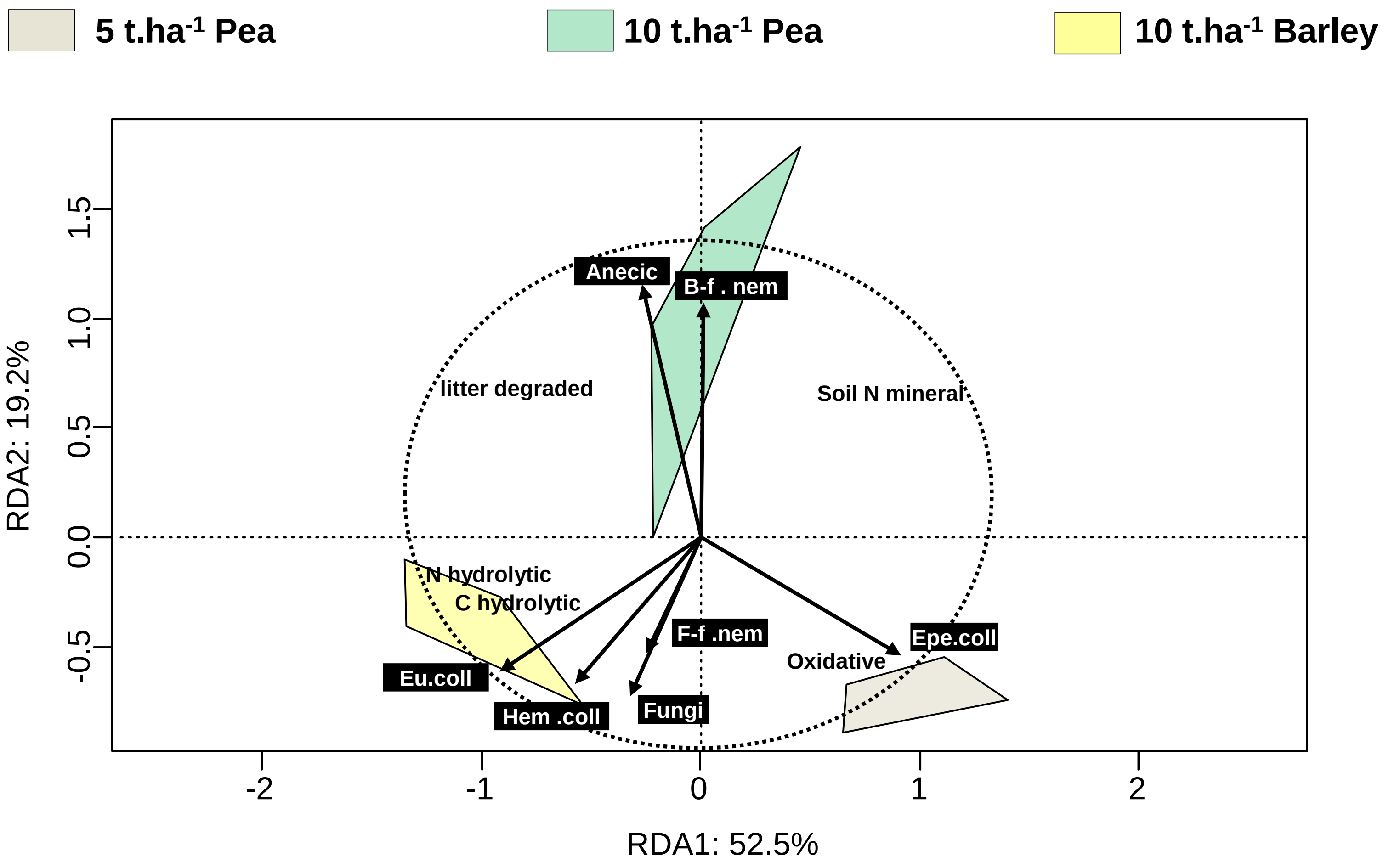
Quality – quantity effects on soil food web functions

Quality effects: Barley → Pea 10 t.ha^{-1}

Quantity effects: 5 t.ha^{-1} → 10 t.ha^{-1}



Linking soil food web composition and functions



Conclusions

↗ Litter quality

↘ fungal : bacterial pathway

6 groups impacted
Amplitude change ≈ 85%

↘ N enzymatic demand from biota

Selection of biota with different N acquisition strategy?

↗ Litter quantity

↗ detritivores size

3 groups impacted
Amplitude change ≈ 385%

↗ amount of litter degraded by biota

Long term impact on soil C?

Possibility to use litter addition in specific quantity and/or quality to favor one specific ecosystem service or restore one specific functional group?

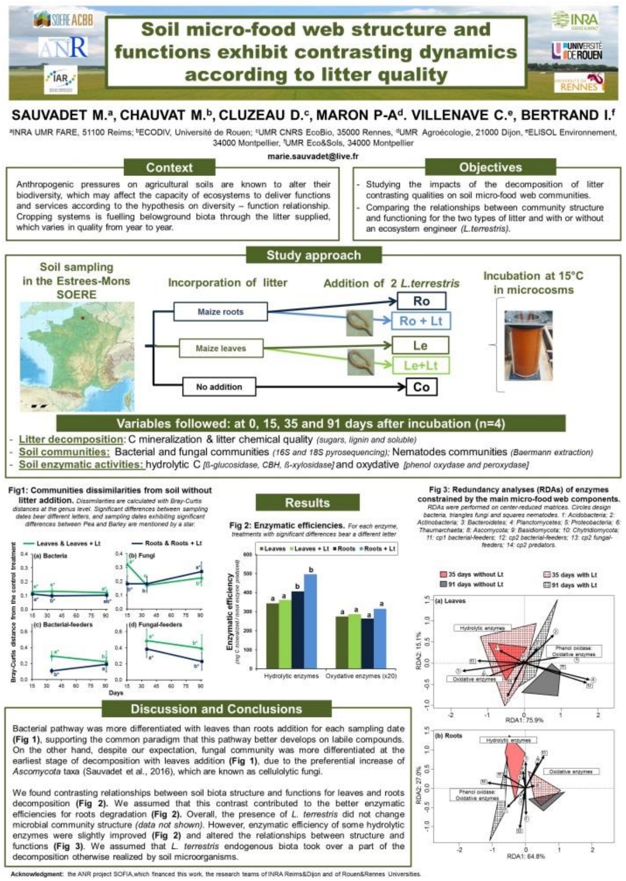
Acknowledgments

Projet SOFIA (Soil Functional diversity as an indicator of sustainable management of Agroecosystems)

Million S. & F., Alavoine G., Thiébeau P., Delfosse O., Habrant A., Portelette A., Chiter K., Henneron L., Brunet N., Chauchard B., Villenave C., Recous S., Lashermes G.

Acknowledgments

Poster: session 34



More informations:

- Sauvadet et al. (2016) Applied Soil Ecology, 107: 261-271

- Sauvadet et al. (2016) Soil Biology&Biochemistry 95: 262-274

Thank you for your attention