Spatial variation of earthworm communities and soil organic carbon in temperate agroforestry

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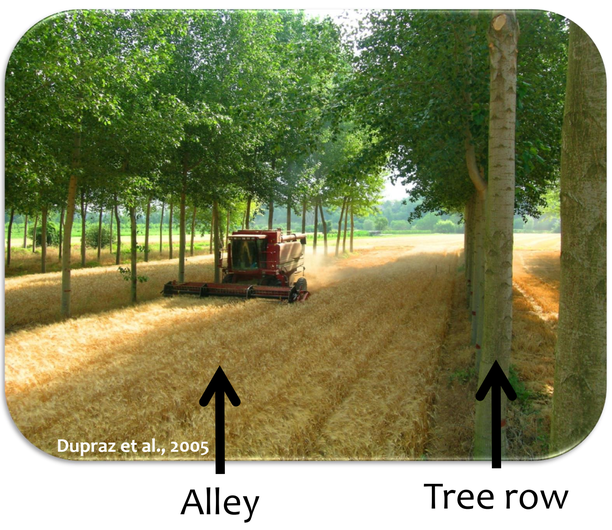
Context & problematic



Agroforestry systems in temperate regions :
Silvoarable systems associating parallel tree rows and annual intercrops

Soil Organic Carbon (SOC) usually increased in silvoarable systems compared to treeless agricultural fields

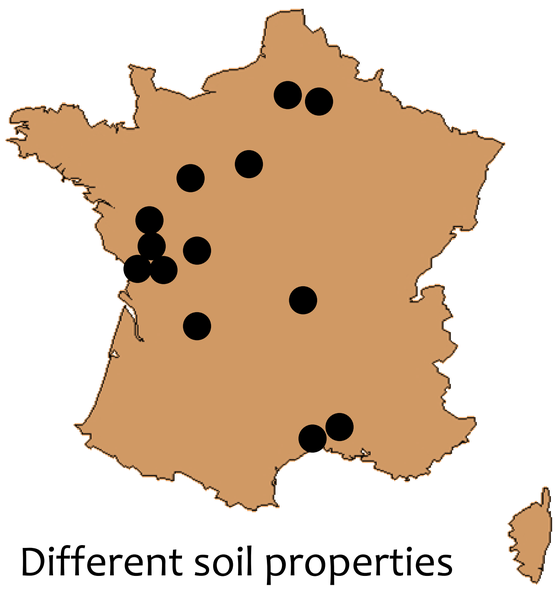
Earthworms communities impacted by
Soil characteristics (Bouché, 1972; Lee, 1985)
Soil occupation (Decaëns, 2008; Cluzeau, 2012)
Agricultural practices (Chan, 2001, Pélosi, 2014)

Several studies in tropical agroforestry systems (Hauser, 1993; Hauser et al. 1998; Fonte et al. 2010)

Do temperate agroforestry systems influence earthworm abundance, biomass and richness ?

Materials & methods

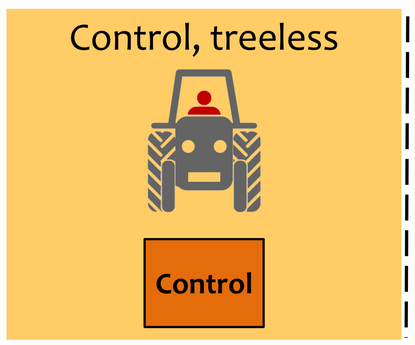
13 agroforestry systems in France



Different soil properties and agricultural practices

Earthworms and SOC sampled in three modalities :

- **Control** (treeless system)
- **Alley** (agroforestry system)
- **Tree row** (agroforestry system)



Earthworms sampling and lab. analysis

Sampling protocol was repeated 3 times
24000 earthworms collected, identified to the species level (Bouché, 1972) and weighed.

Soil Organic Carbon sampling

500-cm³ cylinder every 10 cm down 30 cm depth
Sampling protocol was repeated 3 times
Analysed using a CHN elemental analyzer

Statistical analysis

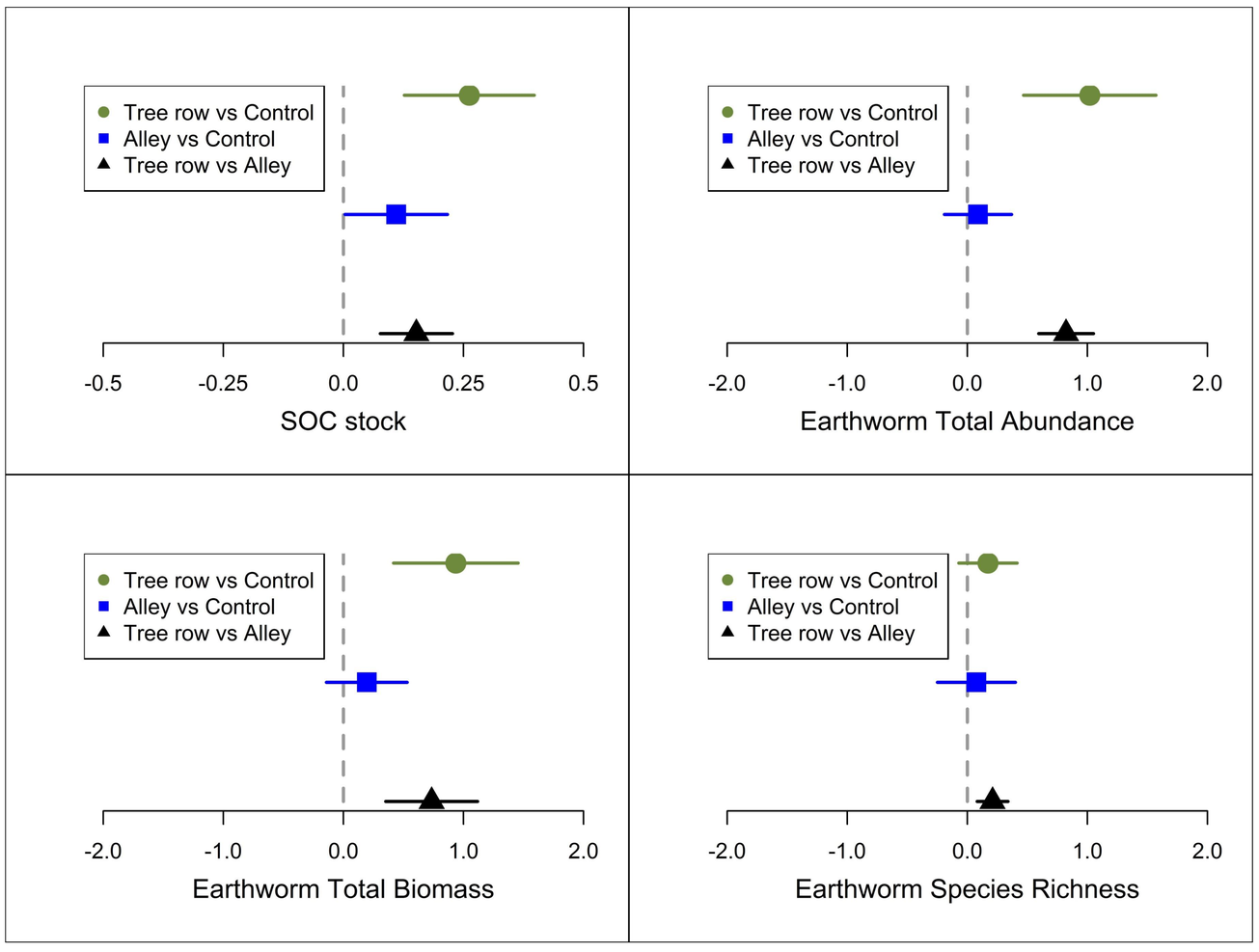
Statistical analyses commonly applied in meta-analysis (effect sizes)
For the adult earthworm individual mean weight, for each ecological category, differences between tree row, alley and control plot were assessed using a multiple linear model

Results

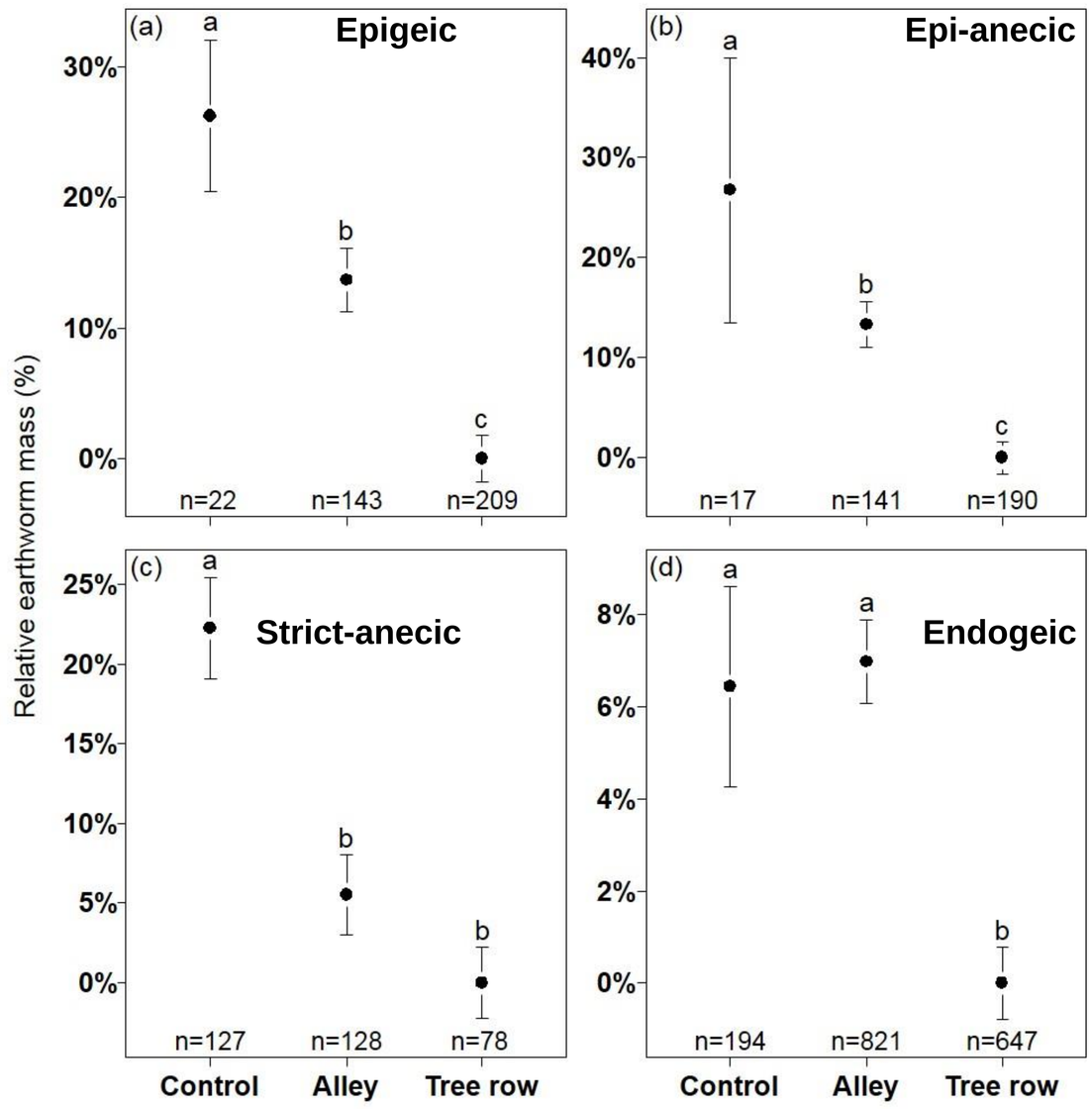
SOC, earthworm abundance, biomass and richness

Mean abundance of earthworms: (i/m² ± 95% CI)

Control	Alley	Tree row
238 ± 124	289 ± 85	595 ± 168



Individual mean weight



Highlights

SOC	Control < Alley << Tree row
Earthworm ab. & bm.	Control = Alley << Tree row
Earthworm richness	Control = Alley < Tree row
Individual mean weight	Control ≥ Alley ≥ Tree row

- **SOC stocks higher in tree row than in alley and control**
- **Earthworm abundance and total biomass higher in tree row than in alley and control**
- **Earthworm abundance and total biomass not different between alley and control**
- **Earthworm richness significantly higher in tree row than in alley**
- **Individual mean weight higher in the control than in the tree row**

Conclusion

Despite higher SOC stocks in the tree rows, the amount of available C per earthworm individual was lower compared to those in the control. **The absence of disturbance** (no tillage, no fertilizers, no pesticides) **in the tree rows rather than increased SOC stocks therefore seems to be the main factor explaining the increased total abundance, biomass, and diversity of earthworms**

REFERENCE: Cardinael et al., 2019 Biology and Fertility of Soils 55(2):171-183