

# Functional diversity of earthworms in 3 Mediterranean agroforestry systems

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## Introduction

Through their functional traits, earthworms play key roles on the functions that determine soil health in agrosystems. Previous studies in agroforestry systems showed that earthworm density and biomass are higher in the agroforestry tree rows compared to crop alleys (Cardinael et al, 2019).

However, earthworm functional trait diversity remains undescribed in such systems, which are inherently diverse in their structure and management. The objective of the present work was to characterize earthworm communities and functional traits in three different Mediterranean agroforestry systems in France.

## Material and methods

We studied the abundance, biomass and functional diversity of earthworms on **three experimental sites** and their associated controls near Montpellier, France:

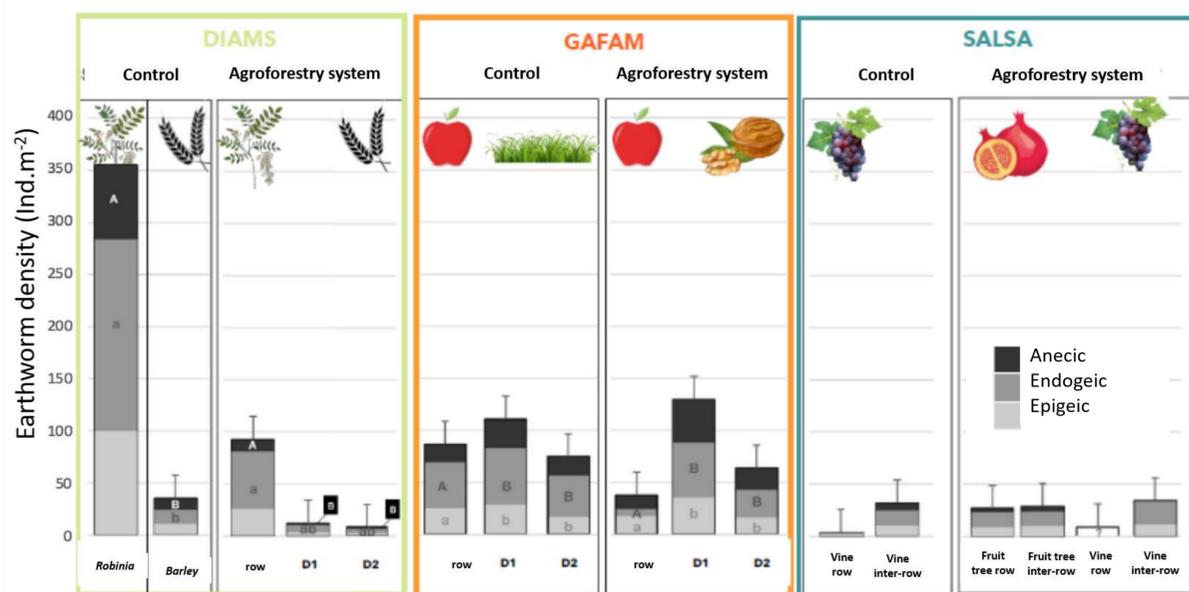
- DIAMS, a silvoarable system associating *Robinia pseudoacacia* rows and 15 m wide arable crop inter-rows
- GAFAM, an association of walnut and young understory apple trees planted in rows separated by 6 m wide grassy inter-rows
- SALSA, an agroforestry vineyard where fig and pomegranate tree rows are associated with vine rows.

Individuals were **hand sorted** from 25x25x20 cm soil monoliths. Earthworms were **identified at species level** with an *Xper3* identification key. Memberships (%) to **ecological categories** were attributed according to Bottinelli et al. (2020).

The **Functional diversity (Fdis) index** was calculated on earthworm traits (Table 1) using the FD package.

Table 1: Earthworm traits (individual or species-specific) assessed on the 1,183 collected individuals

measured	from literature
Individual traits	Species-specific traits
Body length (mm)	Type of prostomium
Body mass (mg)	Type of pigmentation
Number of segments	Type of typhlosole
Adults	Number of gizzards 1 (Lumbricidae) 2 ou 3 (Hormogastridae)
Juveniles	Type of setae

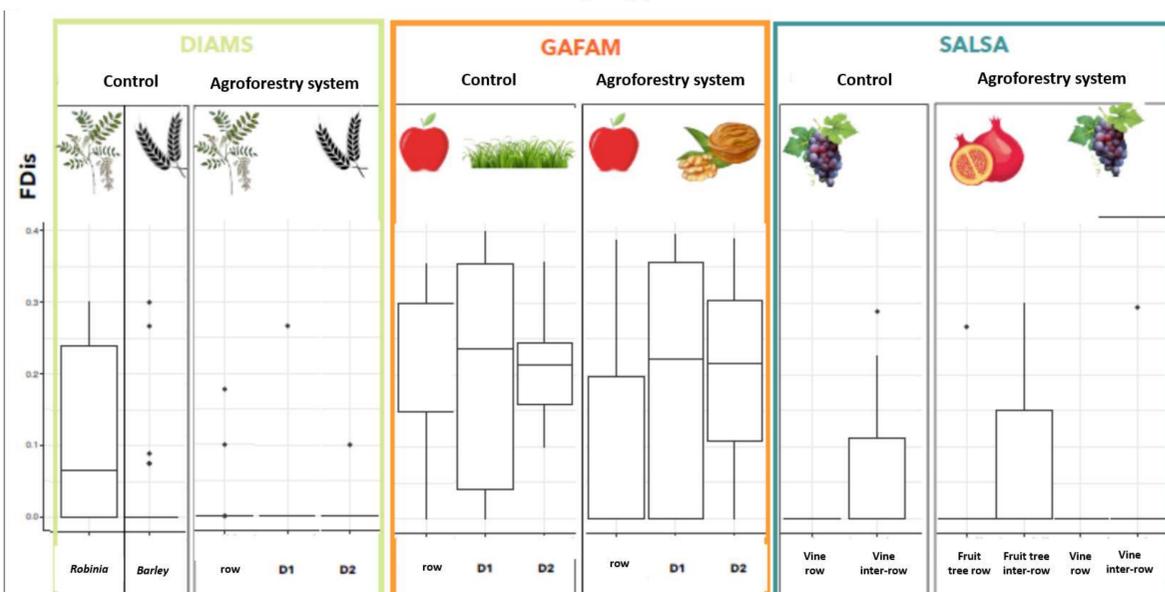


Sampling points

## Results and discussion

- On DIAMS, earthworm density is higher in the row compared to the alley, consistent to Cardinael et al. 2019. On GAFAM and SALSA, we observe, on the contrary, a higher density on the inter-rows than on the rows, in agroforestry systems and controls (Fig 2).

Fig 2. Mean earthworm density according to sampling point location. D1, D2: distances to the row (1,5 m and 3 m respectively). Different letters show significant differences between distances on each site for a given ecological category.



Sampling points

Fig 3. Earthworm functional diversity according to sampling point location. D1, D2: distances to the row (1,5 m and 3 m respectively).

- Functional diversity (Fdis) is significantly higher on GAFAM than on the other sites (Fig 3).

## Conclusion

- The structure of earthworm communities varied according to the type of agroforestry system, highlighting the importance of the soil cover or management (fragmented ramial wood on GAFAM rows, no till on SALSA inter-row), conventional tillage on DIAMS interrows).

### References:

Bottinelli, N., Hedde, M., Jouquet, P., & Capowiez, Y. (2020). An explicit definition of earthworm ecological categories – Marcel Bouché's triangle revisited. *Geoderma*, 372, 114361  
Cardinael, R., Hoeffner, K., Chenu, C., Chevallier, T., Béral, C., Dewisme, A., & Cluzeau, D. (2019). Spatial variation of earthworm communities and soil organic carbon in temperate agroforestry. *Biology and Fertility of Soils*, 55(2), 171-183.