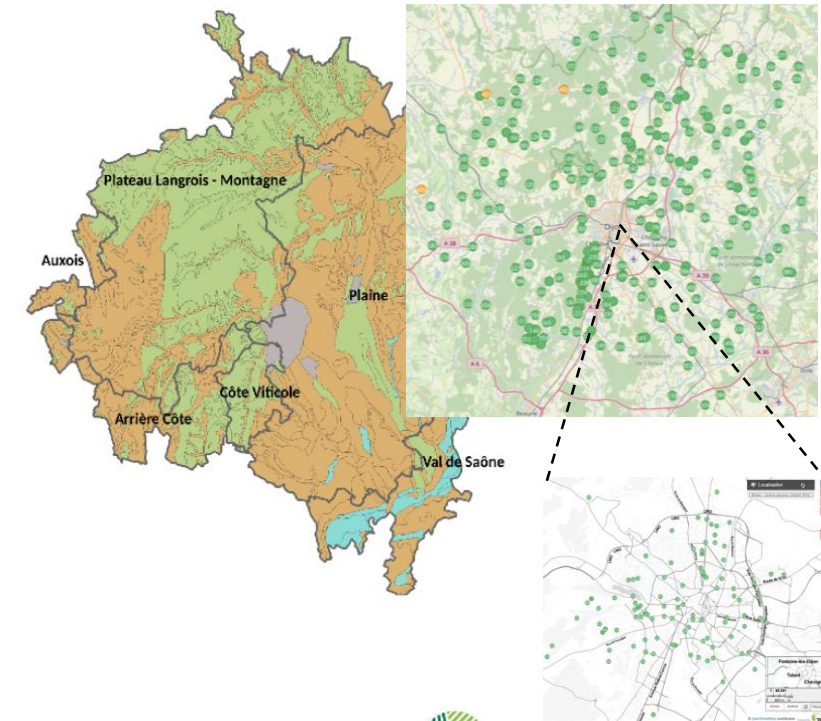


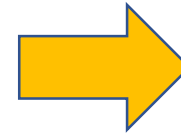
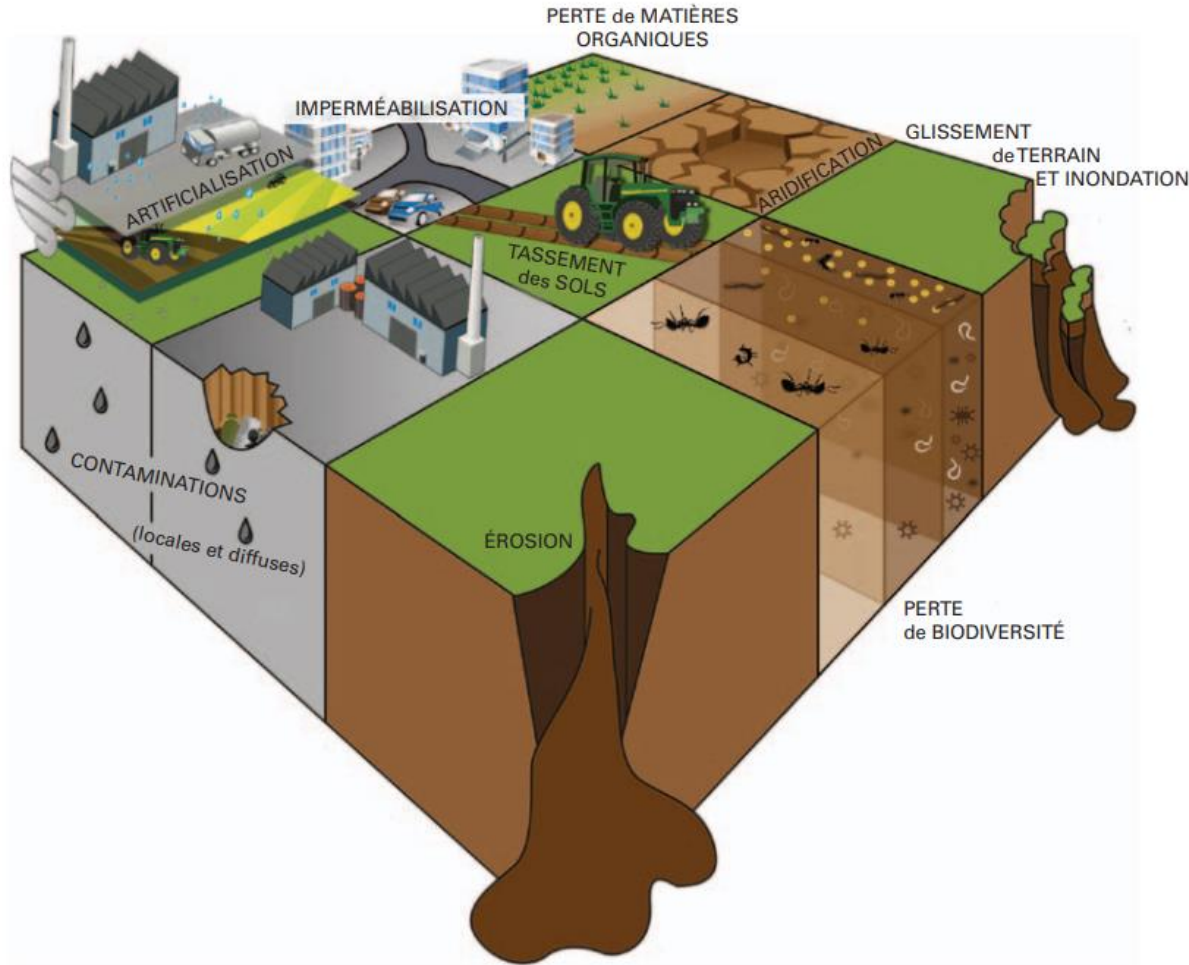
# Distribution and determinism of soil microbial Biodiver-city across a French metropolis

Amélie Christel, Samuel Dequiedt, Nicolas Chemidlin-Prevost-Bouré,  
Florian Mercier, Julie Tripied, Gwendoline Comment, Christophe  
Djemiel, Lionel Bargeot, Eric Matagne, Agnès Fougeron, Jean-Bertrand  
Mina Passi, Lionel Ranjard, Pierre-Alain Maron



# Context : increase of urbanisation

Expansion of urban population → more than **70%** of world's population by 2050



**Pollution**

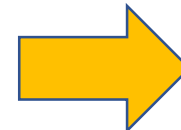
**Artificialization**

**Loss of biodiversity**

# Ecosystems services provided by soil



- Support of infrastructure
- Support of production
- Regulation
- Cultural services





# Restore the soil to its place in the ecological transition



## Return of nature to cities



Well-being of urban populations

Urban sustainability

**Soil biodiversity** = crucial  
to create new models of urban development



Ecosystem with **biological patrimony**  
able to provide **ecosystem services**



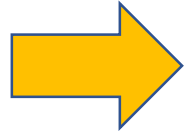
**Soil**



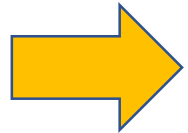
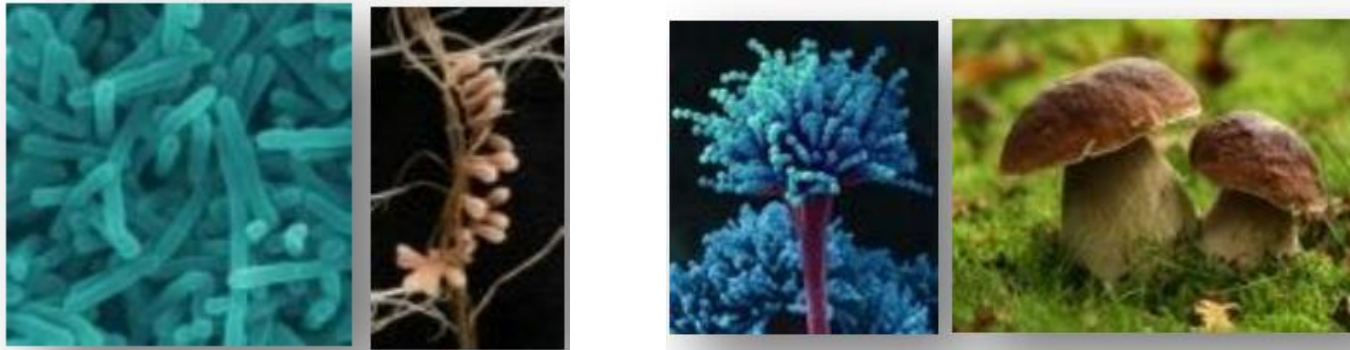
Only support



# Our objectives



**Improve knowledge about microbial ecology in urban soils**



**Identify the drivers of microbial soil parameters in urban soils**

→ To provide feedbacks for urban planners and decision makers to plan sustainable urban amenities

# A project of territory development 'ProDij'

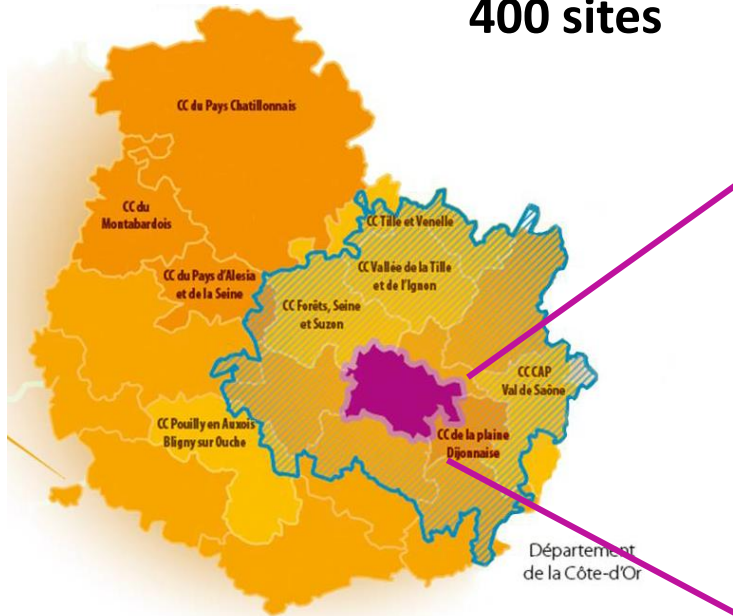


## Territoire d'Innovation « Dijon, Alimentation durable 2030 »

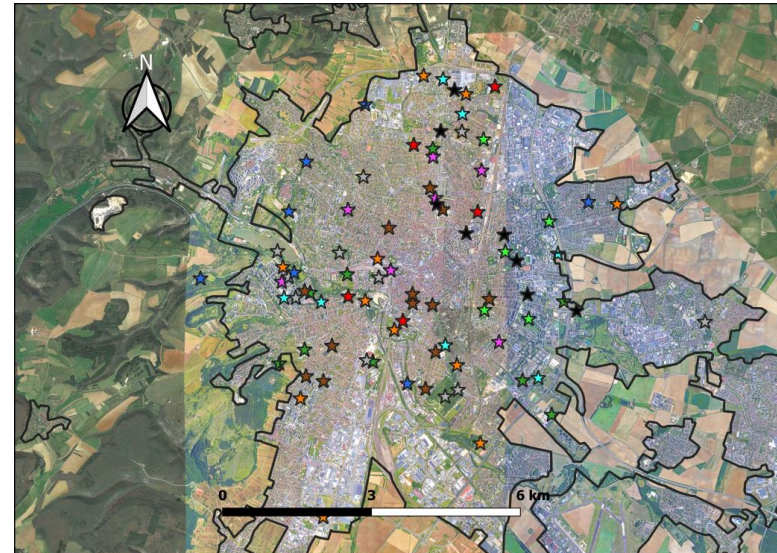


Urban area of Dijon  
**3000 km<sup>2</sup>**

**400 sites**



Dijon Metropole



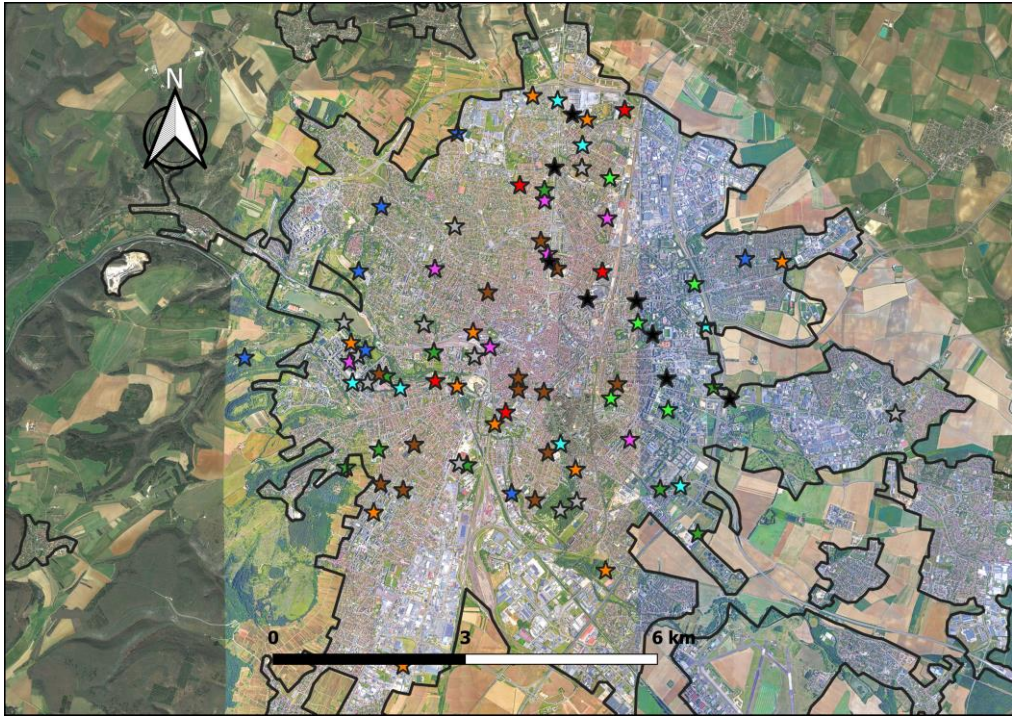
**78 urban soils**



# Sampling strategy - A mosaic of urban land uses distributed across the city

78 soils

Spring 2021



Public leisure	Traffic sites	Urban agriculture
Urban meadow	Road sides	Allotment garden
Public parks	Tramway railway	Community garden
Squares	Roundabouts	
School		

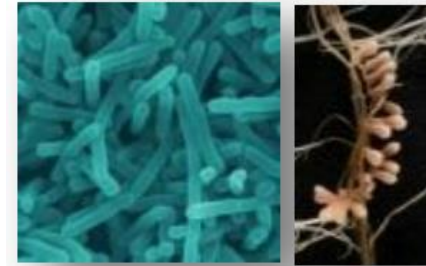




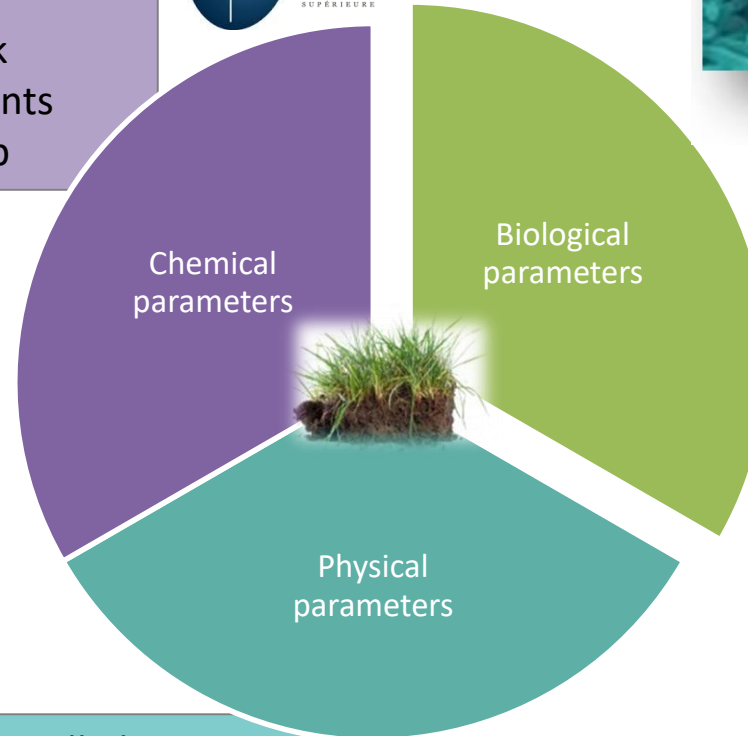
# Analytical strategy

**INRAE**  
Laboratoire d'Analyses des Sols d'Arras

Contents C, N  
Ratio C/N  
Nutrients (N,P,K)  
pH  
Carbon stock  
Organic pollutants  
Cd, Ni and Pb



**auréa**  
AgroSciences



Microbial parameters  
- Soil molecular biomass  
- Diversity

**INRAE**

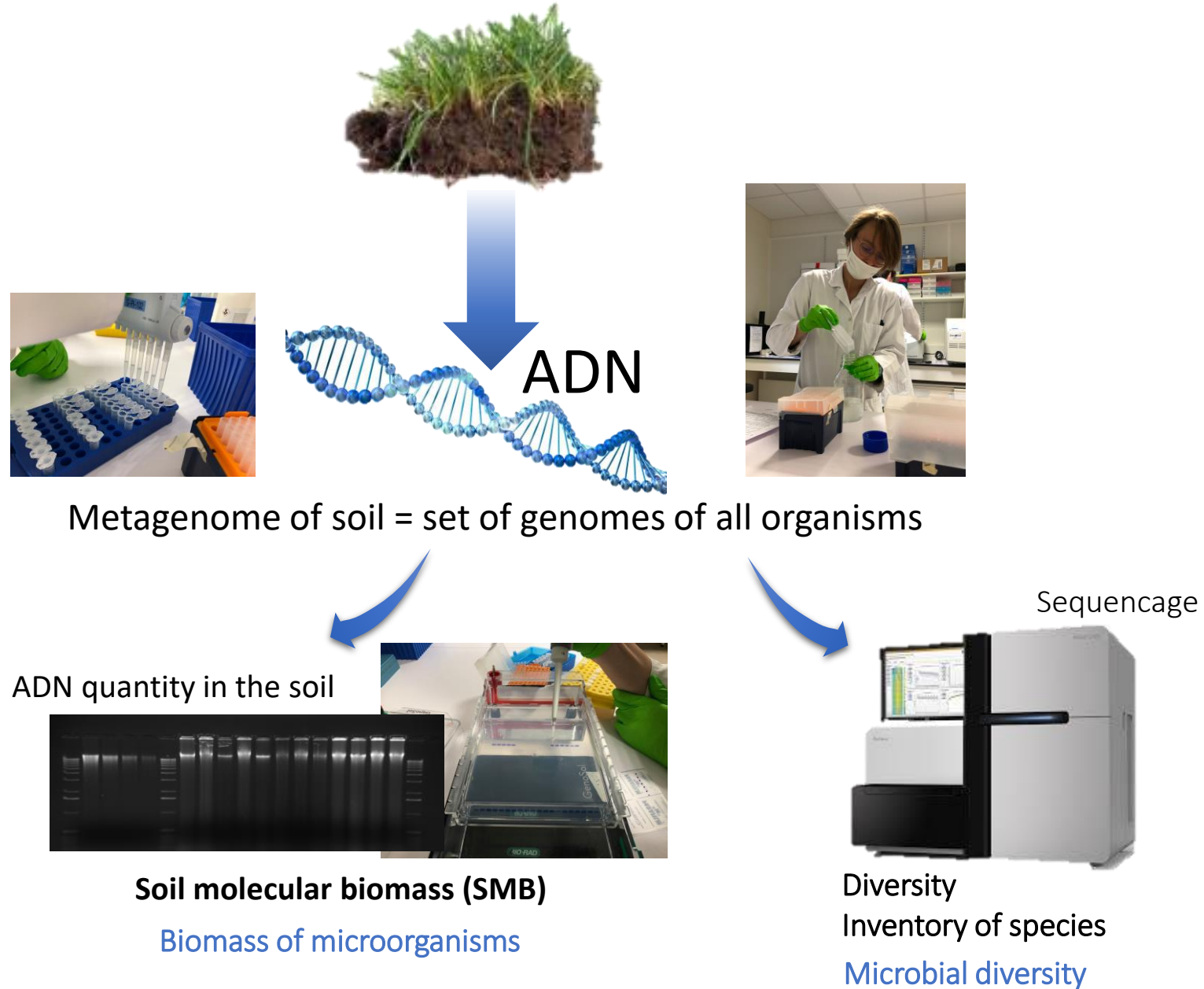
**GenoSol**  
PLATEFORME

**Agroécologie**  
Dijon  
Unité de Recherche

Bulk density



# Analytical strategy - Soil molecular ecology



Dequiedt *et al.* 2011  
Terrat *et al.* 2015  
Djemiel *et al.* 2020

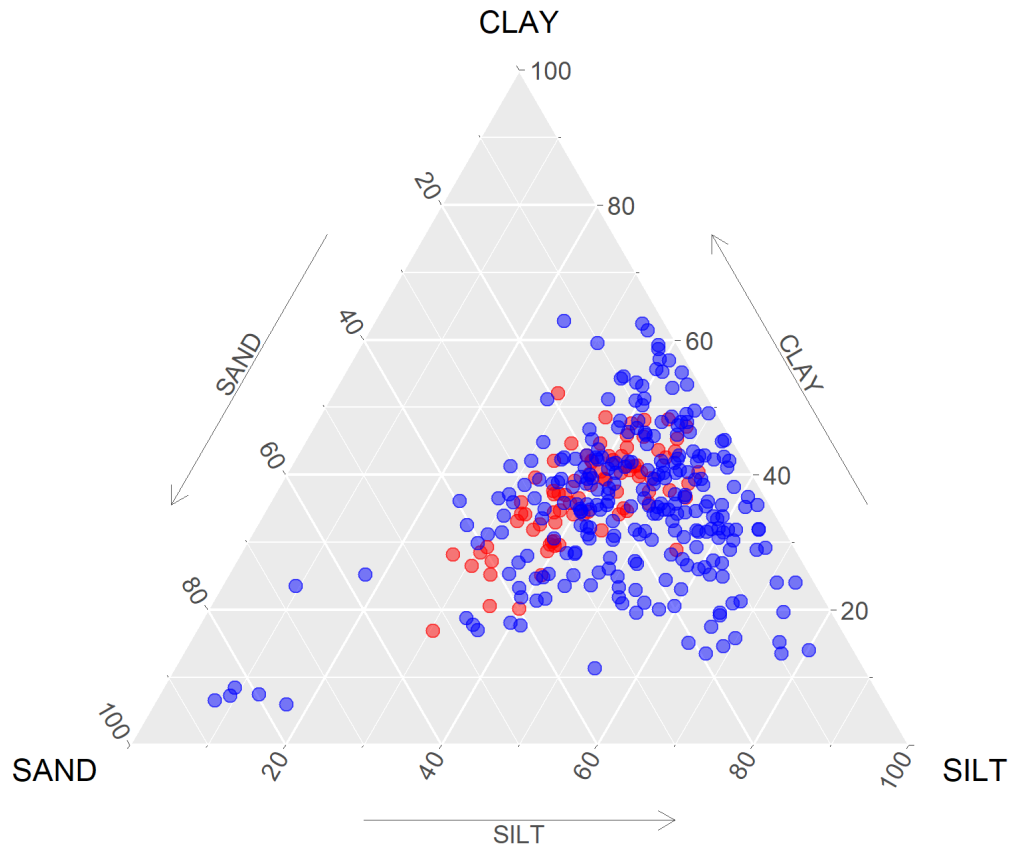
# Results - The characteristics of soils in Dijon



Rural  
area



Urban  
area



Urban soils in Dijon  $\neq$  technosoils

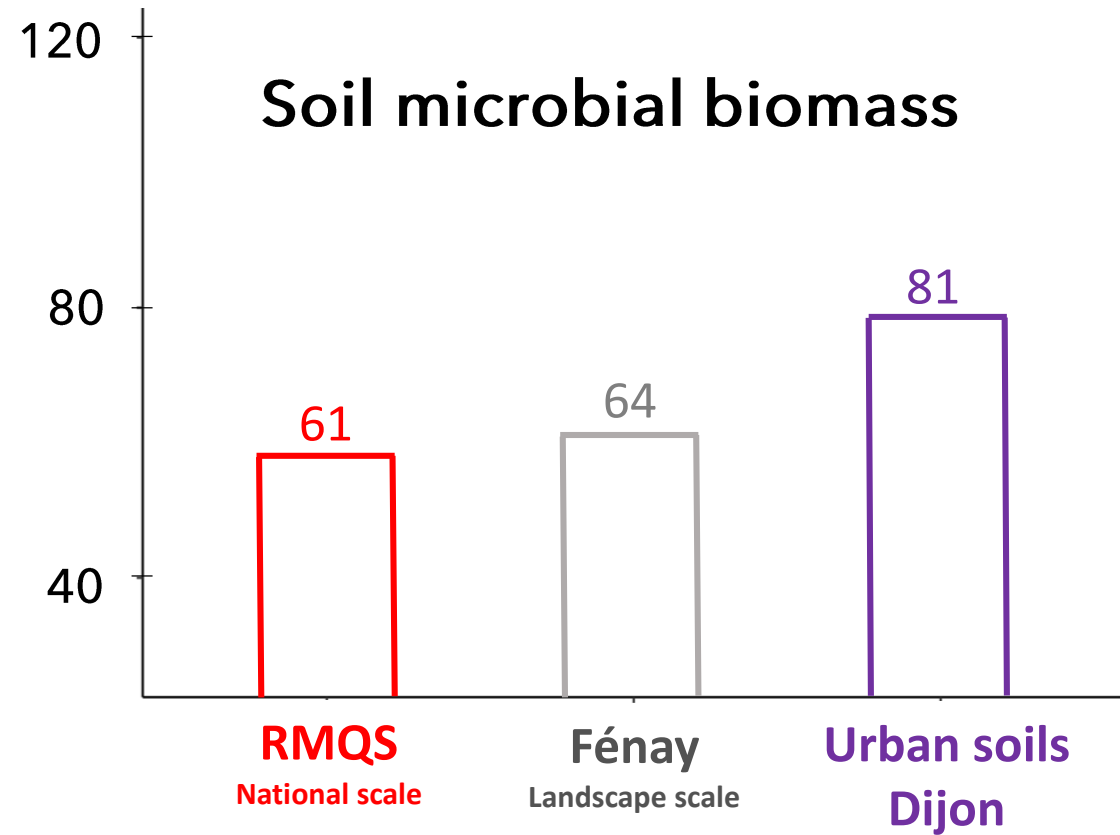
Alcalin pH : from 7.7 to 8.3

Rich in organic carbon : mean 34.6 g/kg



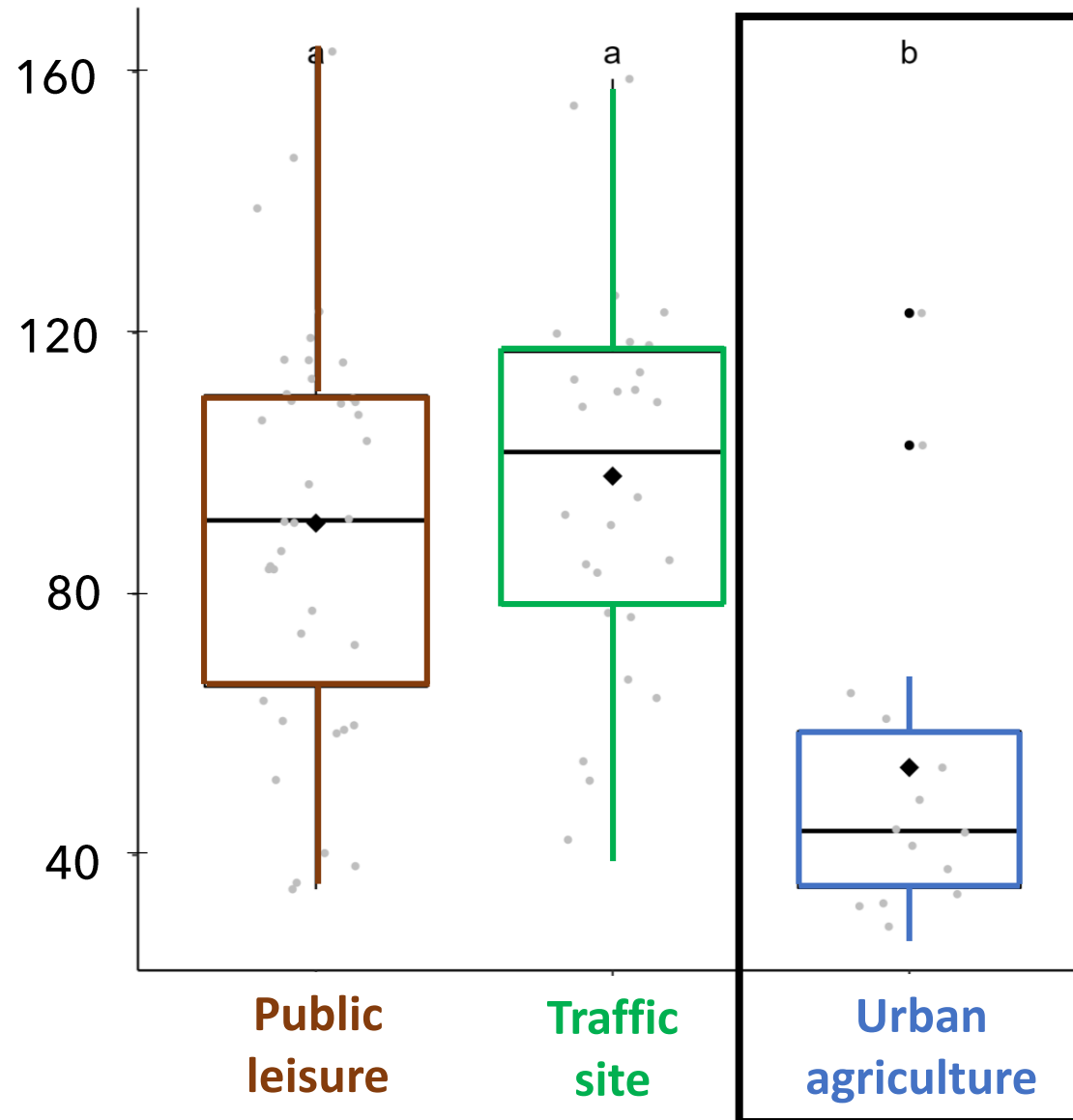
# There is microbial life in urban soils!

µg DNA/g soil



# Effect of urban land use on soil microbial biomass

## Soil microbial biomass



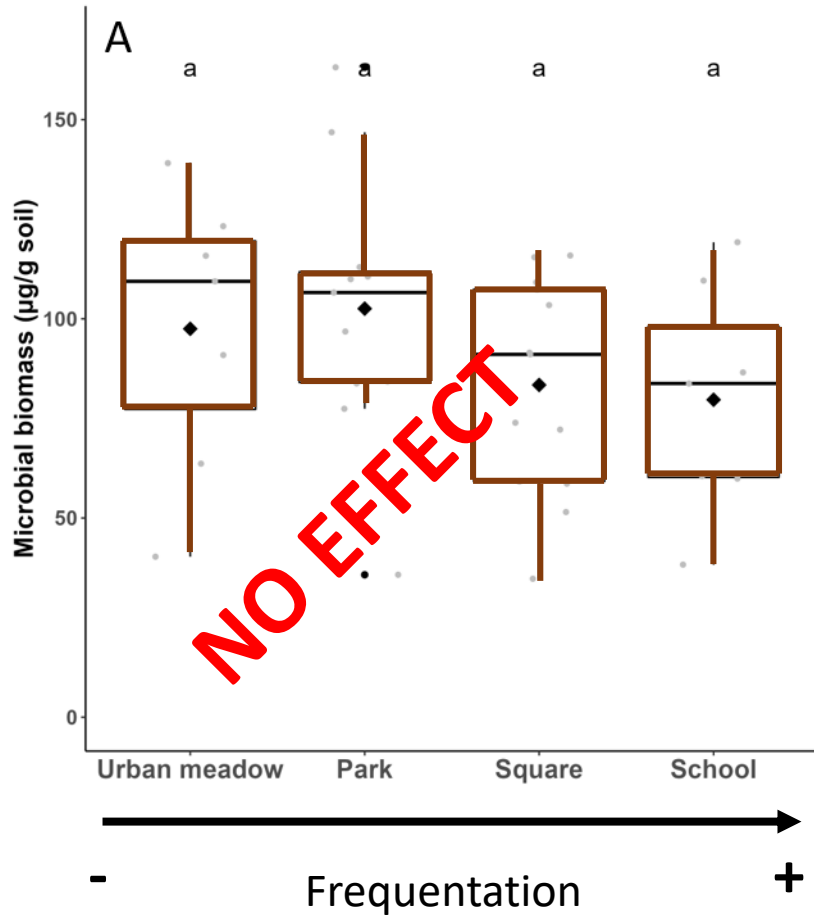
**Lower** soil microbial biomass in **urban agriculture**





# Effect of urban sub-land use on soil microbial biomass

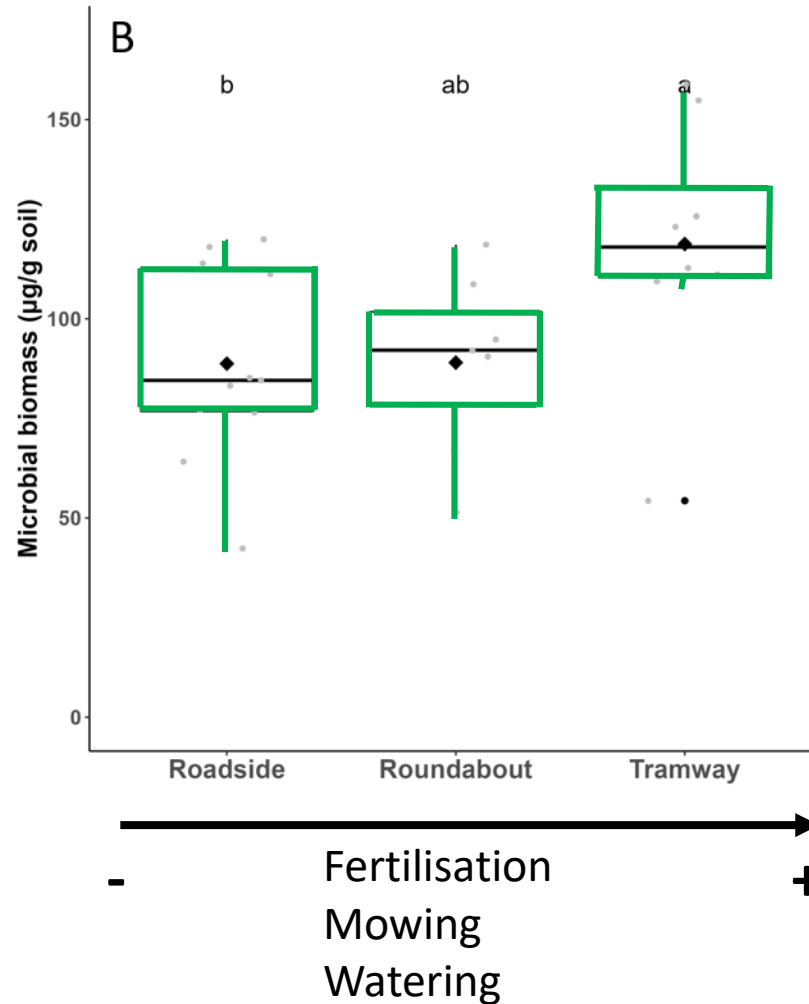
## Public leisure



Public leisure

→ No effect of frequentation

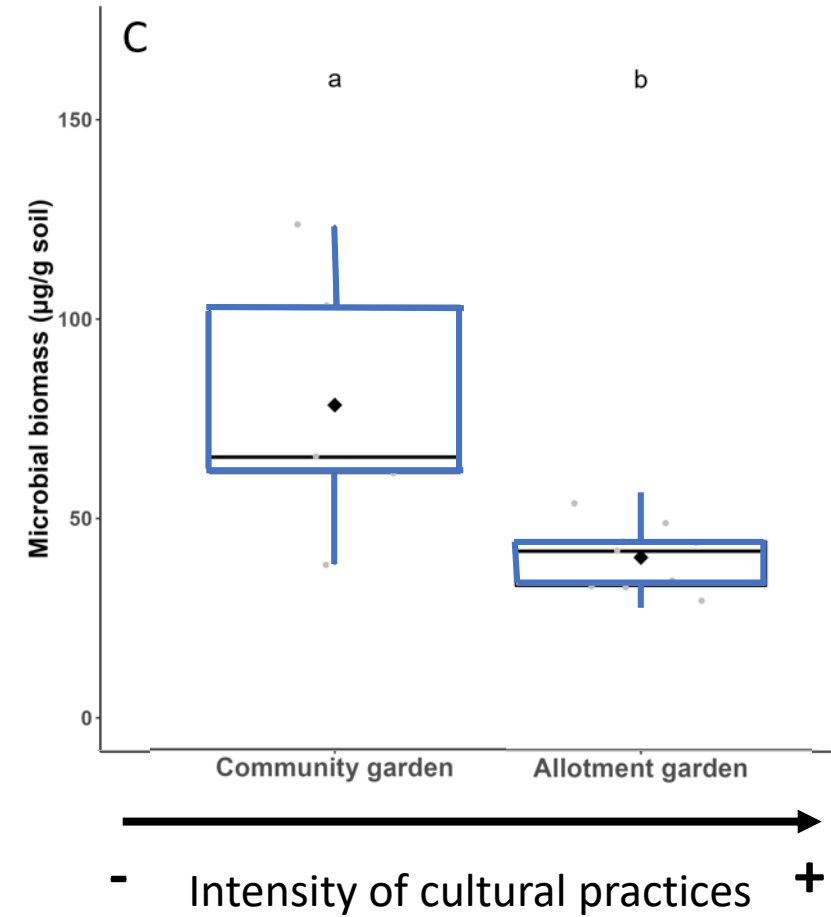
## Traffic site



Traffic

→ Benefits from care according to tramway soil

## Urban agriculture



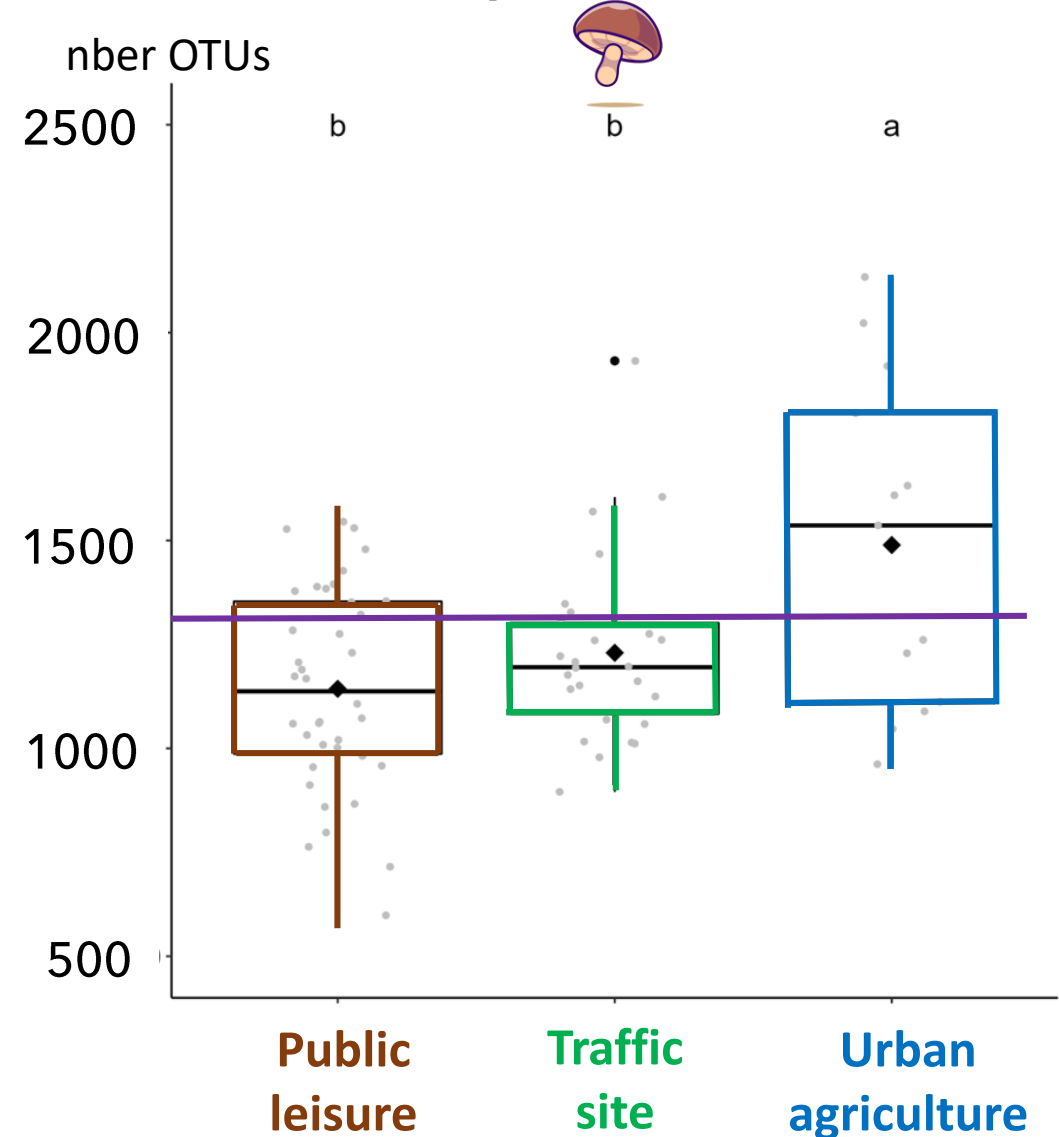
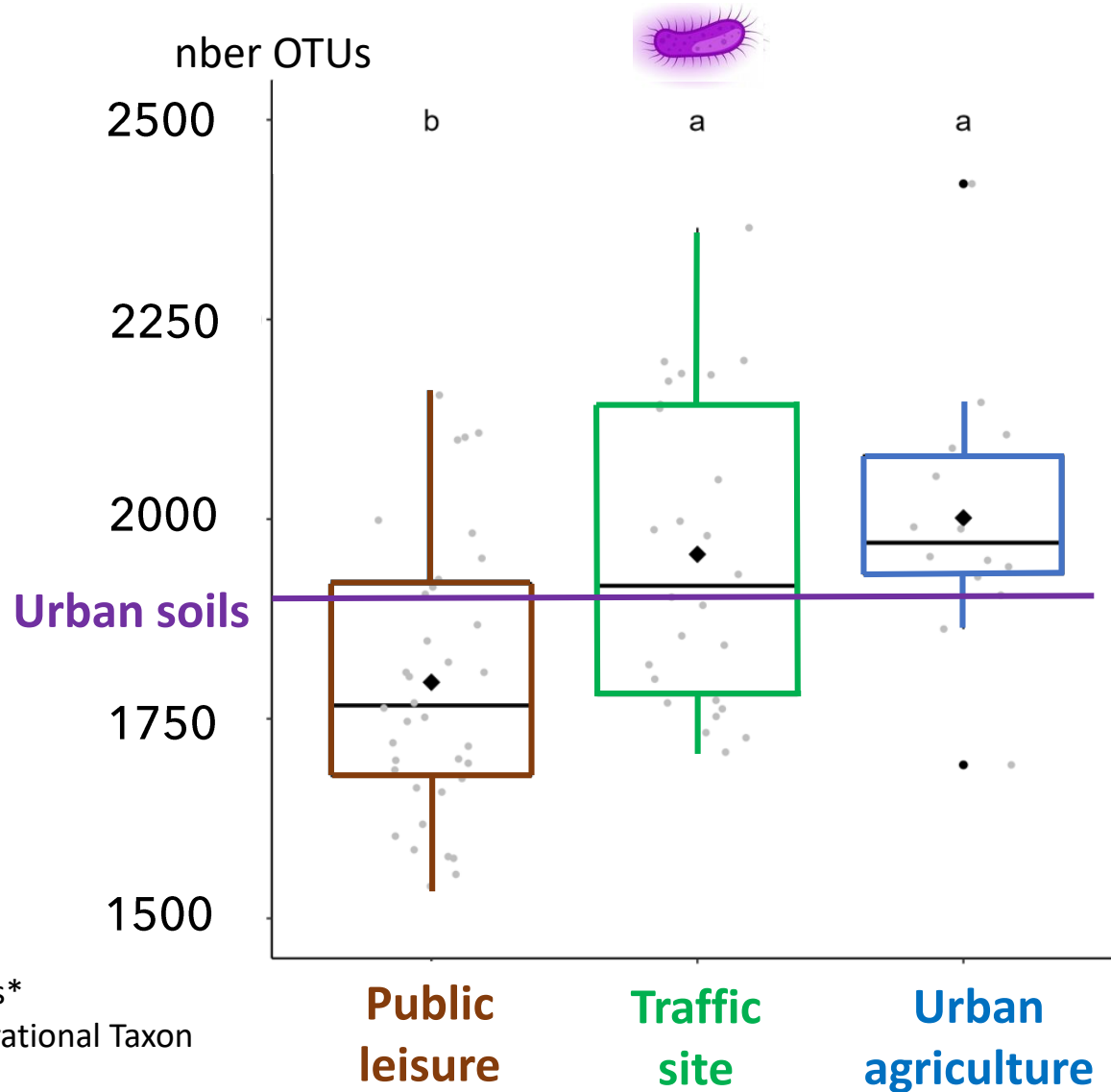
Urban agriculture

→ Impacts of historical practices

# There is microbial diversity in urban soils!

## Bacterial richness

## Fungal richness



OTUs\*  
Operational Taxon  
Unit  
Dunn *et al.* 2011  
Terrat *et al.* 2017

Mean of bacterial richness : 1918 OTUs

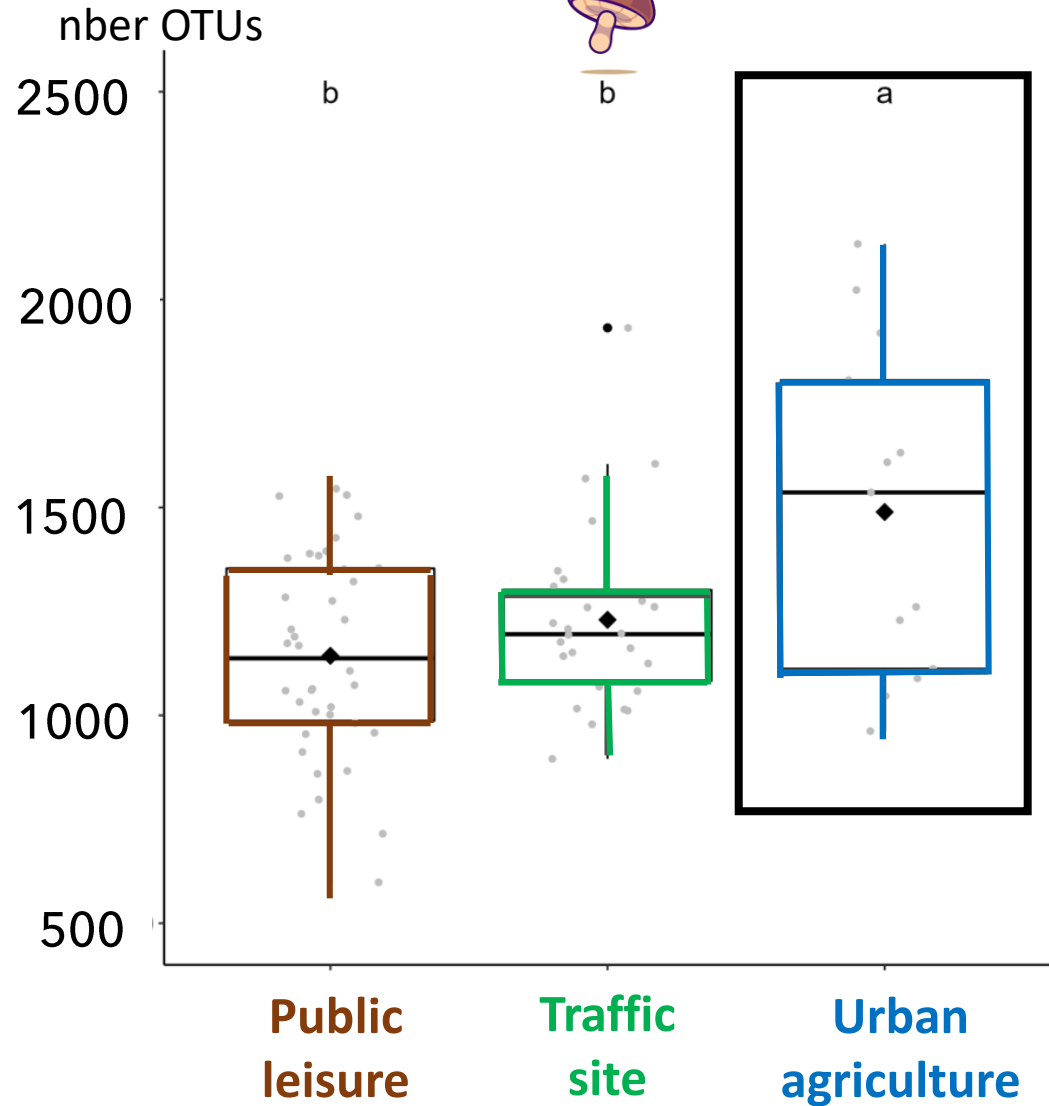
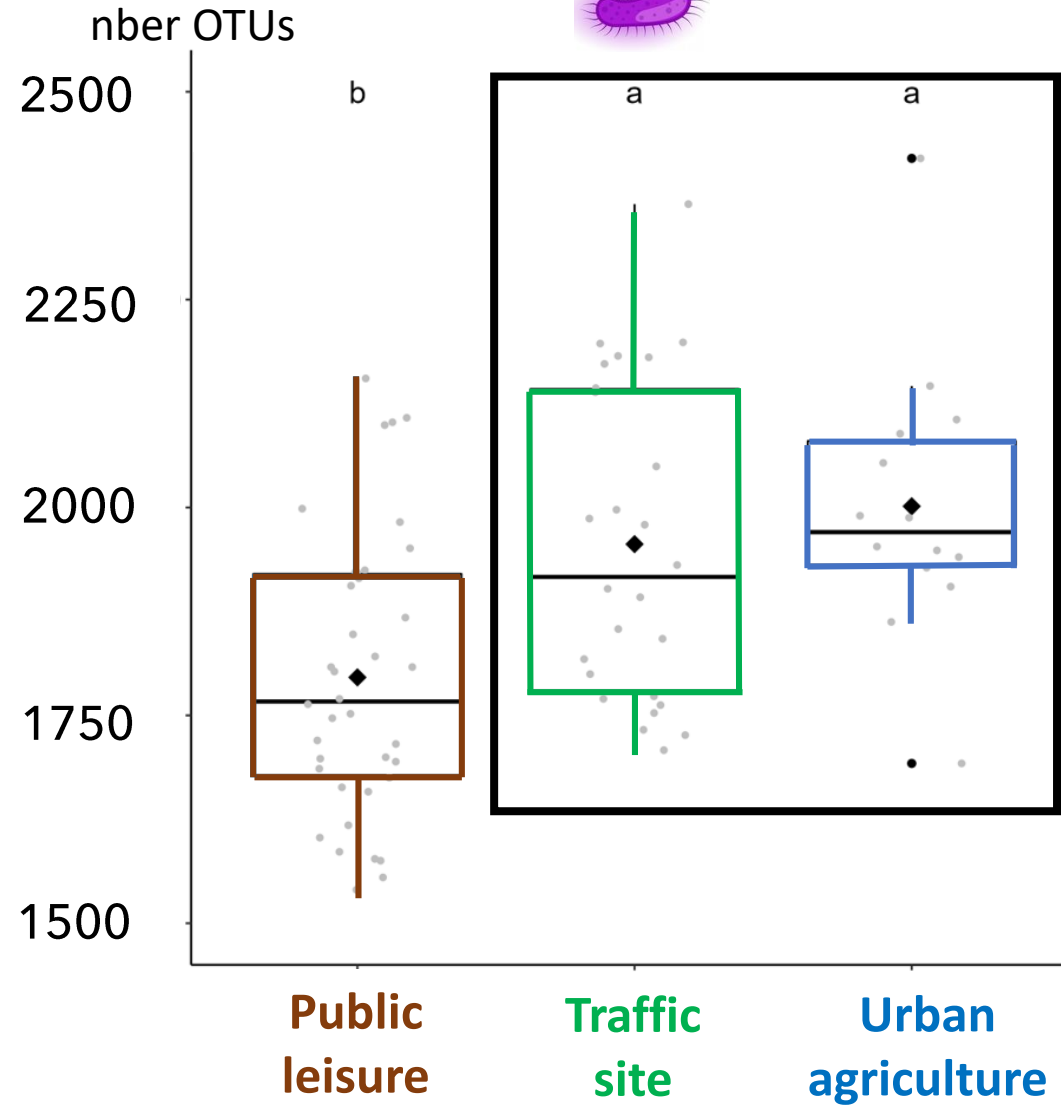
Mean of fungal richness : 1287 OTUs



# Effect of urban land use on microbial diversity

## Bacterial richness

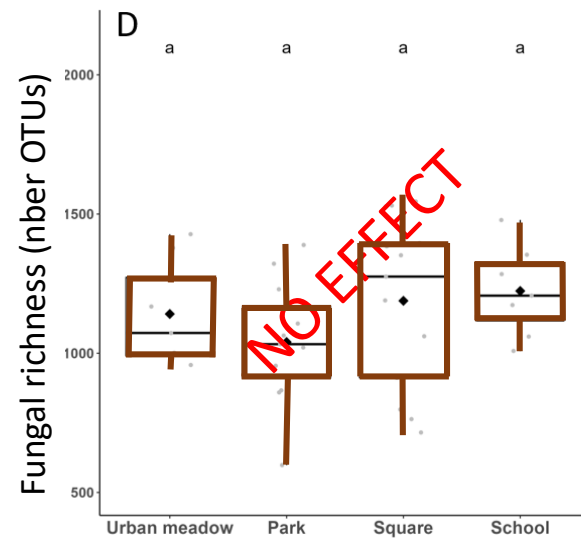
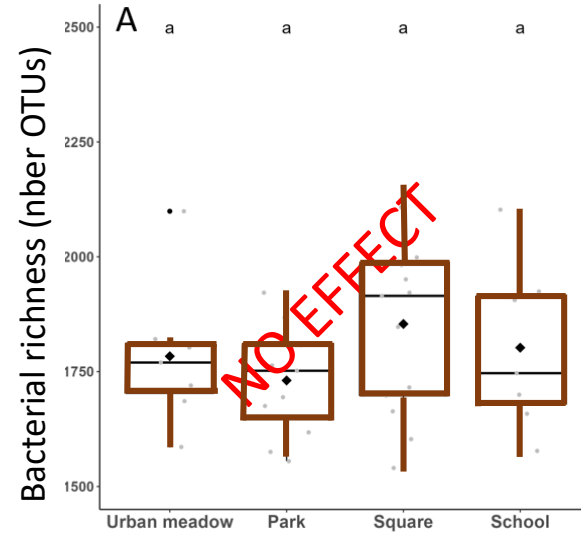
## Fungal richness



Increasing microbial diversity with increasing soil management intensity

# Effect of urban sub-land uses on soil diversity

## Public leisure



Frequency

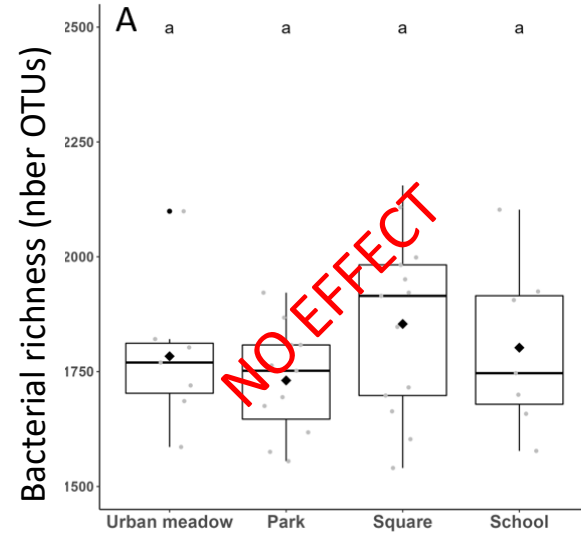
-

+

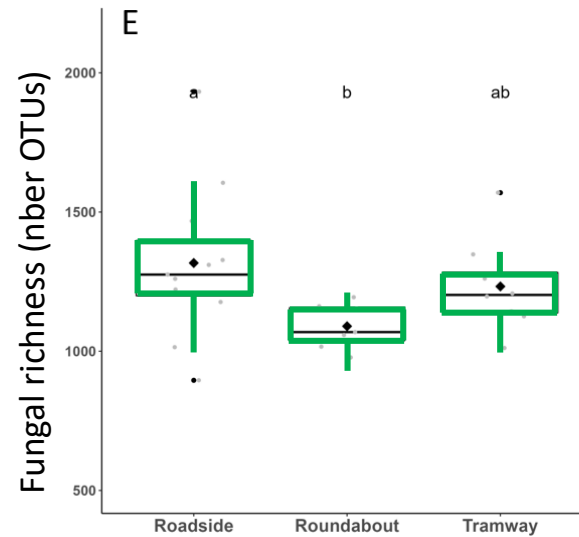
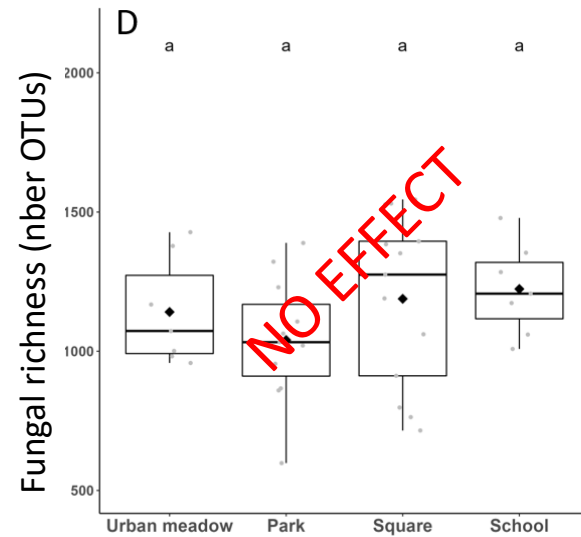
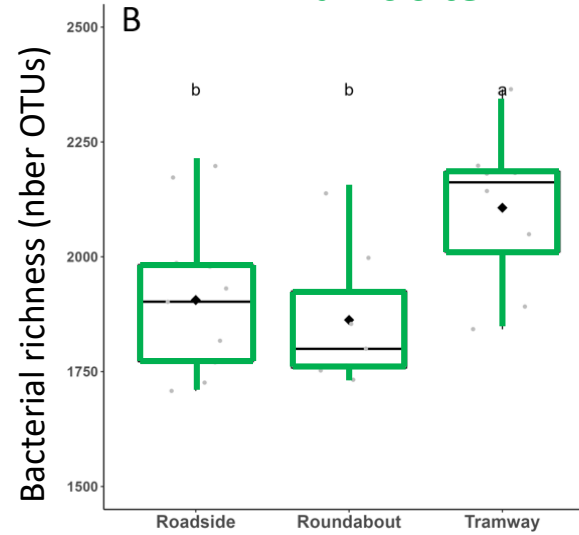


# Effect of urban sub-land uses on soil diversity

## Public leisure



## Traffic site

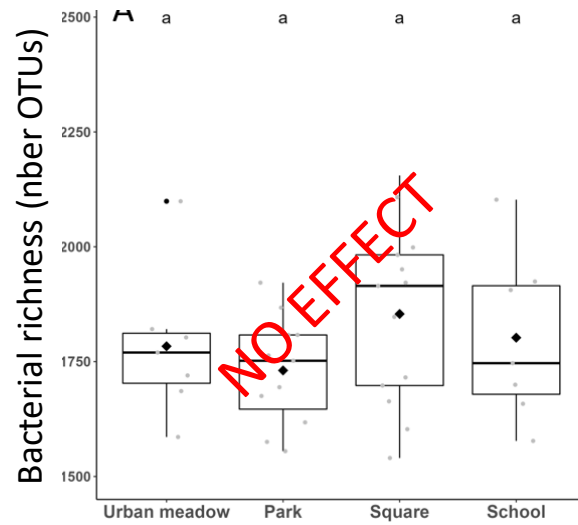


- Fertilisation +  
Mowing  
Watering

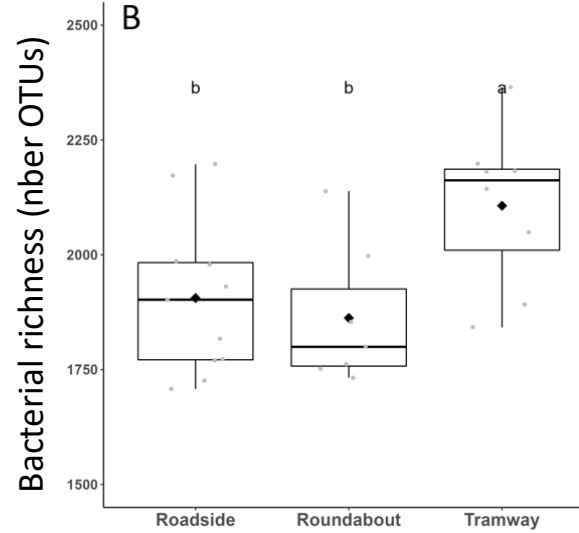


# Effect of urban sub-land uses on soil diversity

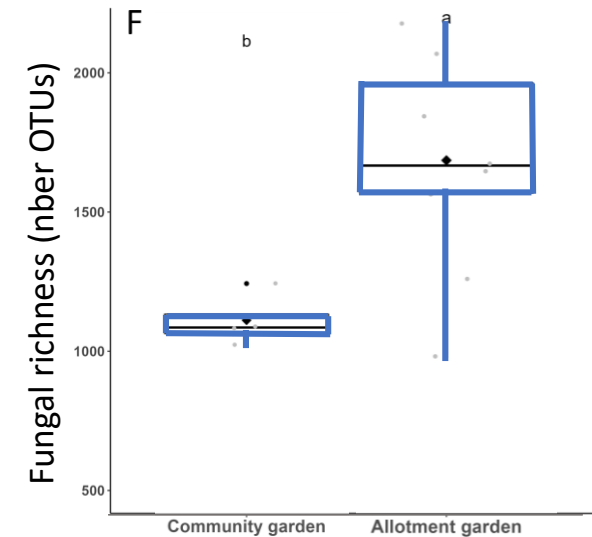
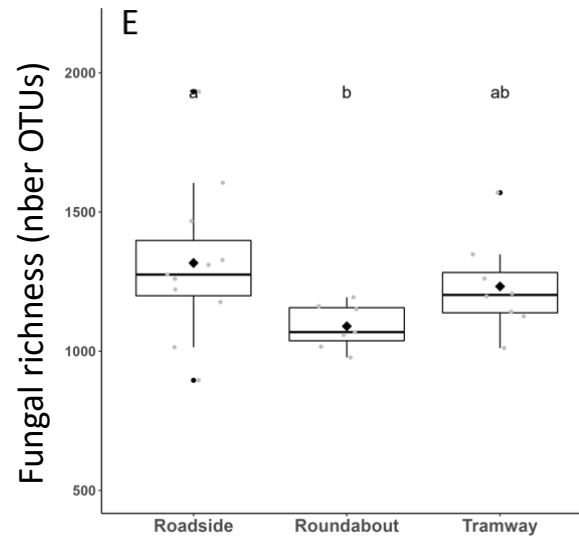
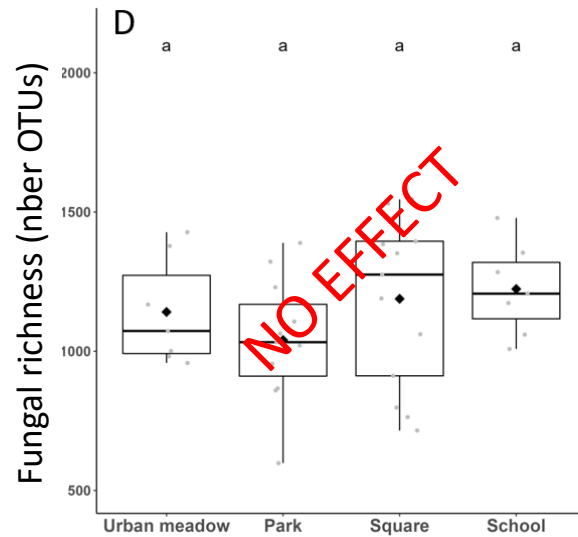
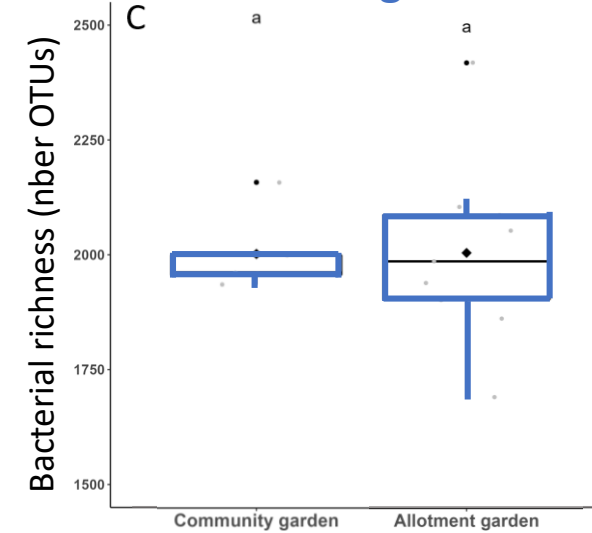
Public leisure



Traffic site



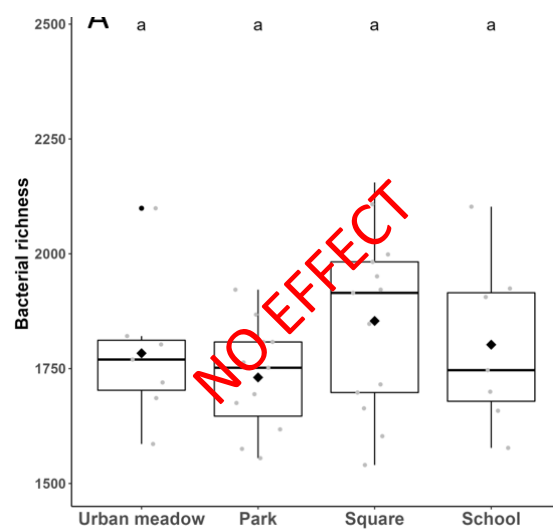
Urban agriculture



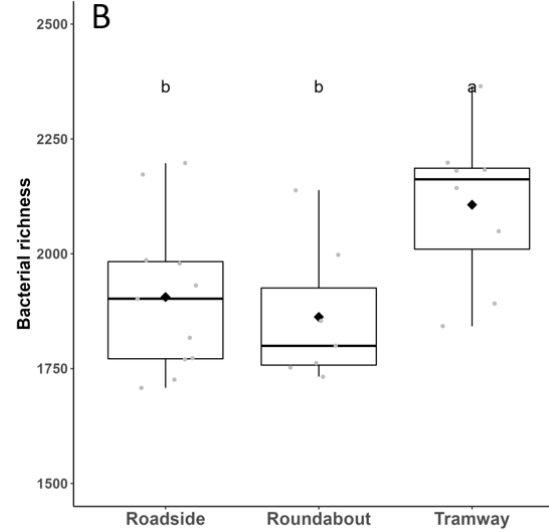
Intensity of cultural practices

# Effect of urban sub-land uses on soil diversity

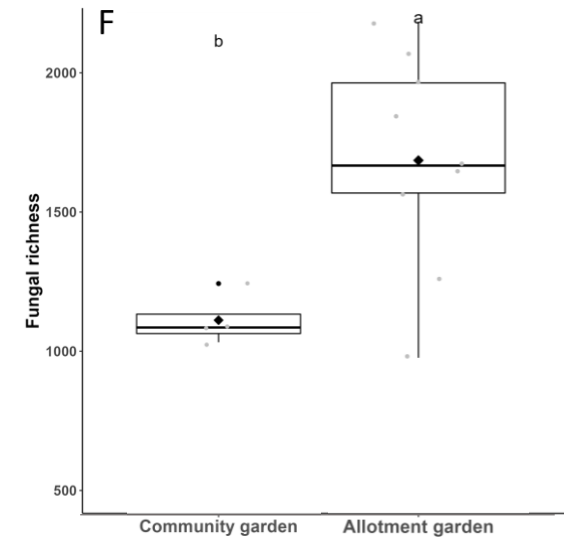
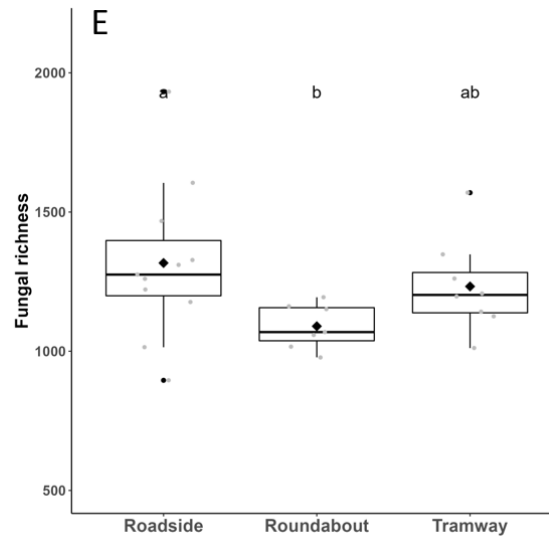
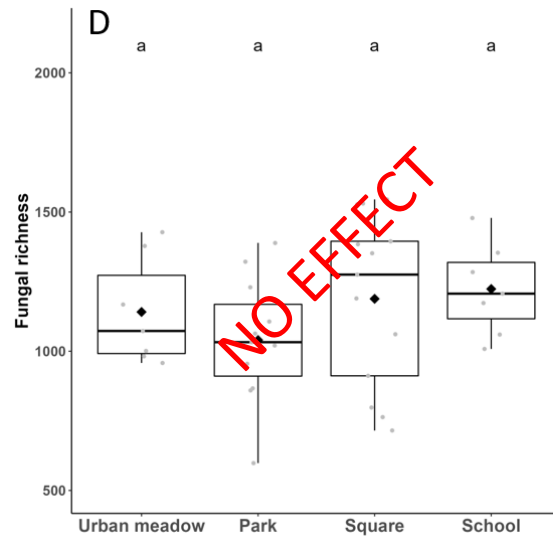
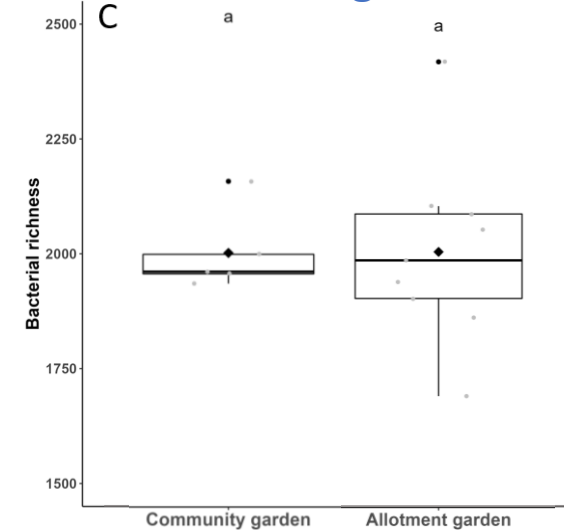
## Public leisure



## Traffic site



## Urban agriculture



Effect of sub-land uses when there are differences in soil management practices



# Effect of urban land uses on microbial composition

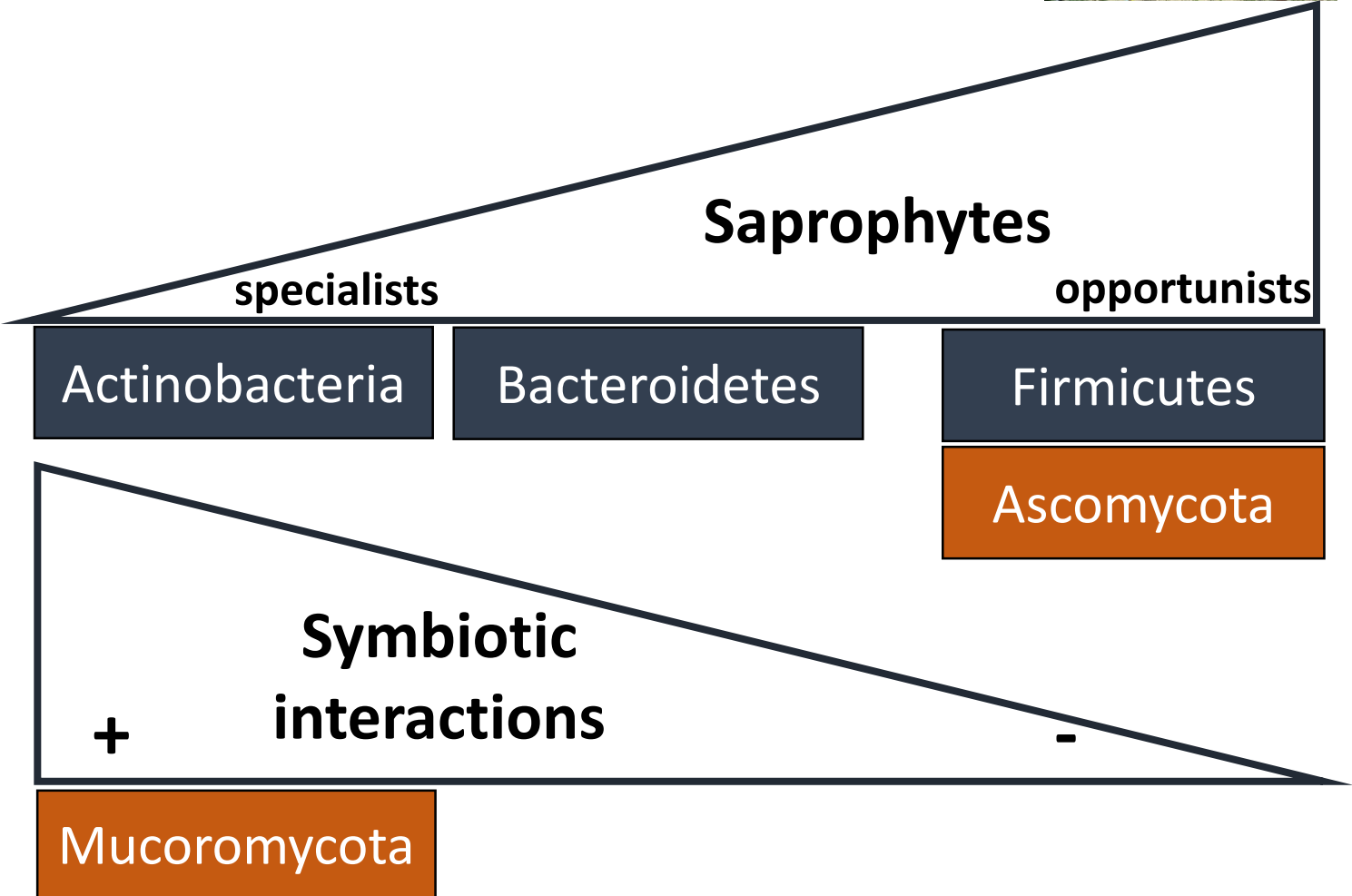
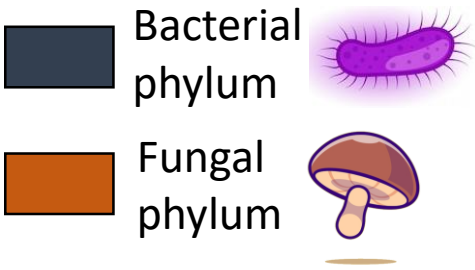
Public leisure



Traffic sites



Urban agriculture



Dequiedt *et al.* 2011  
Tardy *et al.* 2015  
Maron *et al.* 2018  
Karimi *et al.* 2018  
Stoma *et al.* 2020

## Conclusion

- Rich and diverse microbial life in urban soils
- Higher diversity : Not in less perturbed land use

### Useful results for urban planners and decision makers

- ✓ Effect of land use historicity
- ✓ Effect of soil management practices
- Permanent vegetal cover 😊
- Tillage / frequent fertilization inputs ☹️

ProDij : destined to be replicated  
Urban soil referentiel → diagnostic





# Thank you for your attention

