



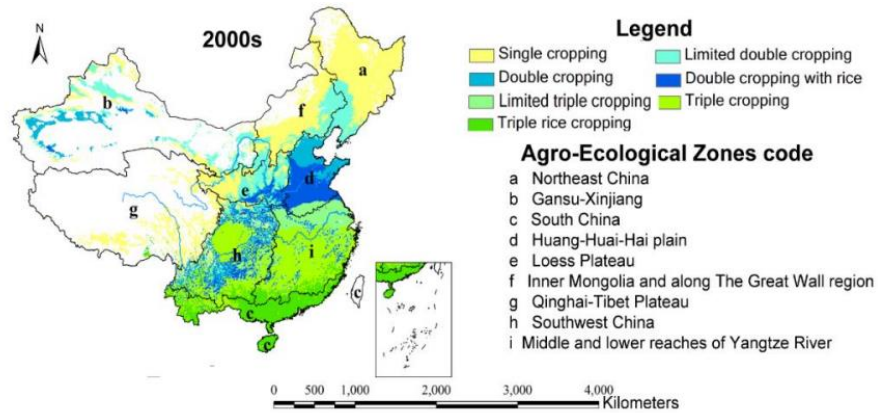
# Crop rotation and fertilization shape the maize root-microbiome relationships with distinct mechanisms

**Lingjuan LI**

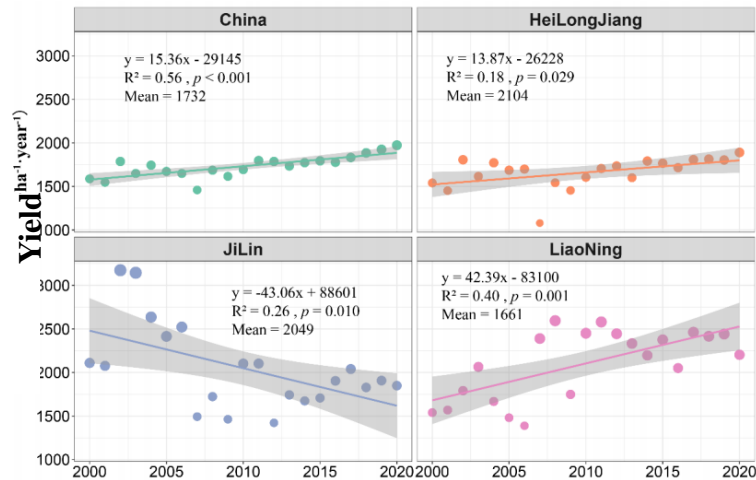
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# Background

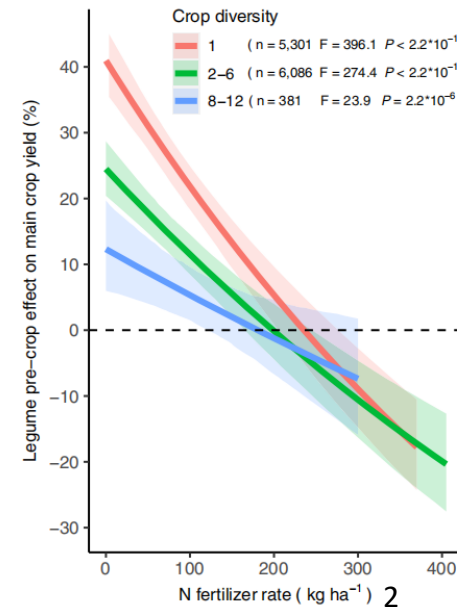


Zeng et al. 2016 In book: Crop Rotations



China Statistical Yearbook

The sustainable development of agriculture depends on the adoption of efficient and environmentally friendly land management practices.

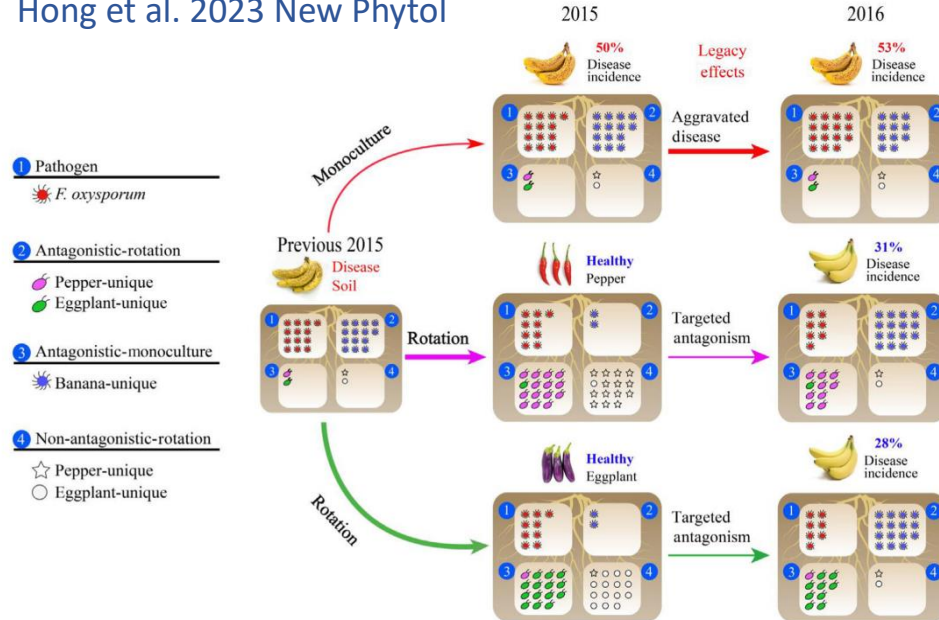


Zhao et al. 2022 Nat. Commun.

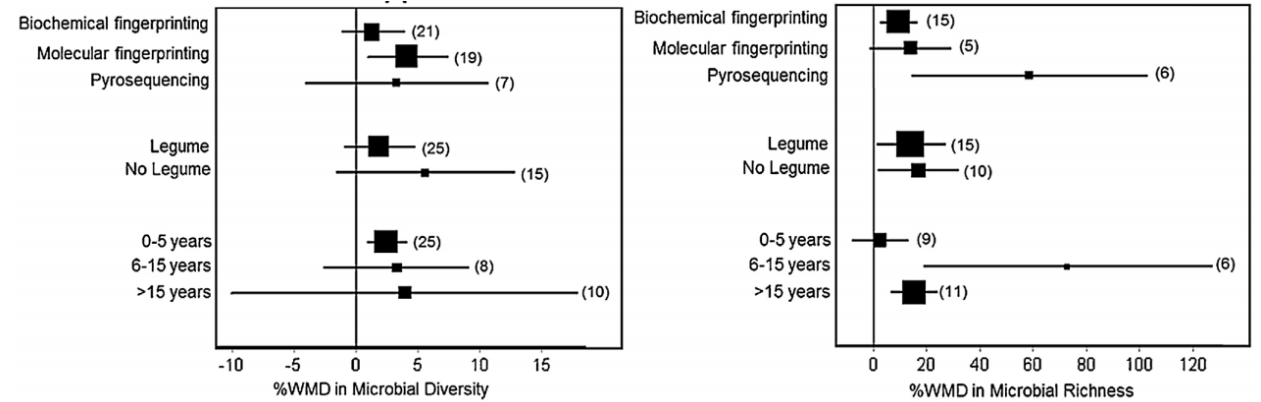
# Crop rotation suppresses disease



Hong et al. 2023 New Phytol



Venter et al. 2015 Pedobiologia



The addition of legumes to rotation had no consistent effects on microbial diversity or richness.



## Current issues

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The inadequate assessment of microbial communities in studies about fertilization and cropping managements is making it difficult to put practical improvements in place.

**Functional characteristics**

**Beneficial taxa**

**Metabolites**

### Hypotheses:

- H1) Fertilization treatments affect more functions of soil microbial communities than cropping by largely altering microbial community structure.
- H2) Crop rotation controls the abundance of fungal pathogens by enriching beneficial bacteria and fungi in maize rhizosphere.
- H3) Crop rotation can shape rhizosphere microenvironment by mediating the composition of metabolites.



# Experiment design

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**Site:** Hailun Agricultural Ecological Experimental Station

**Year:** 2012

**Cropping:** (1) CC: Continuous cropping, maize (*Zea mays* L.) (2) RC: Rotational cropping, soybean (*Glycine max* L.) + maize

**Fertilization:** (1) CK: Control; (2) NPK: inorganic fertilizers; (3) NPKS: NPK + straw incorporation

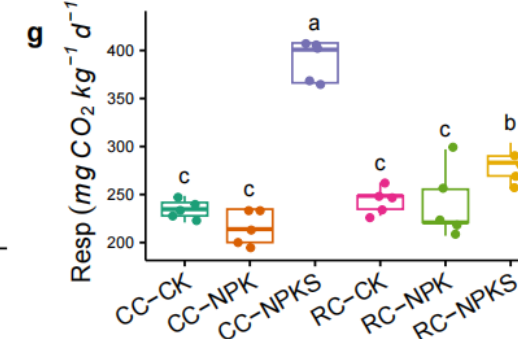
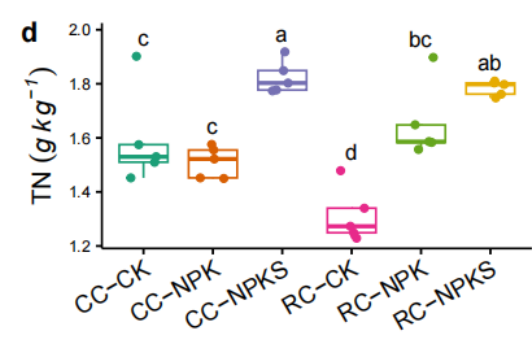
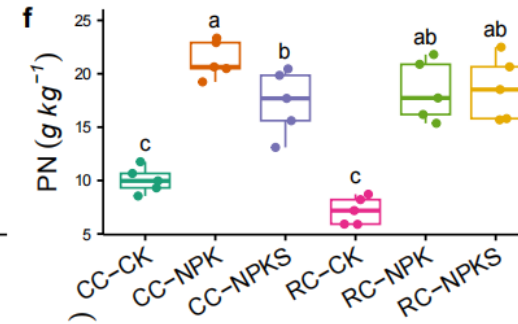
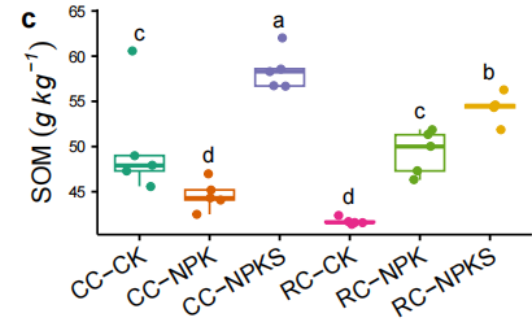
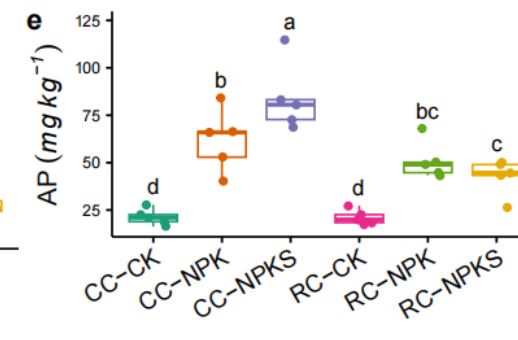
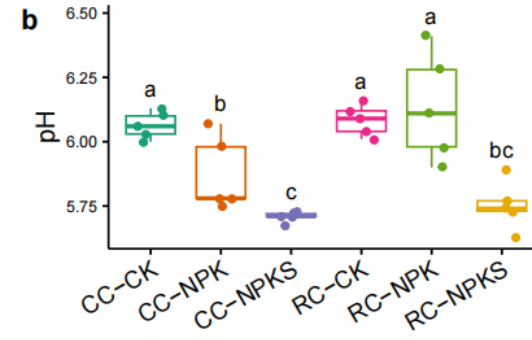
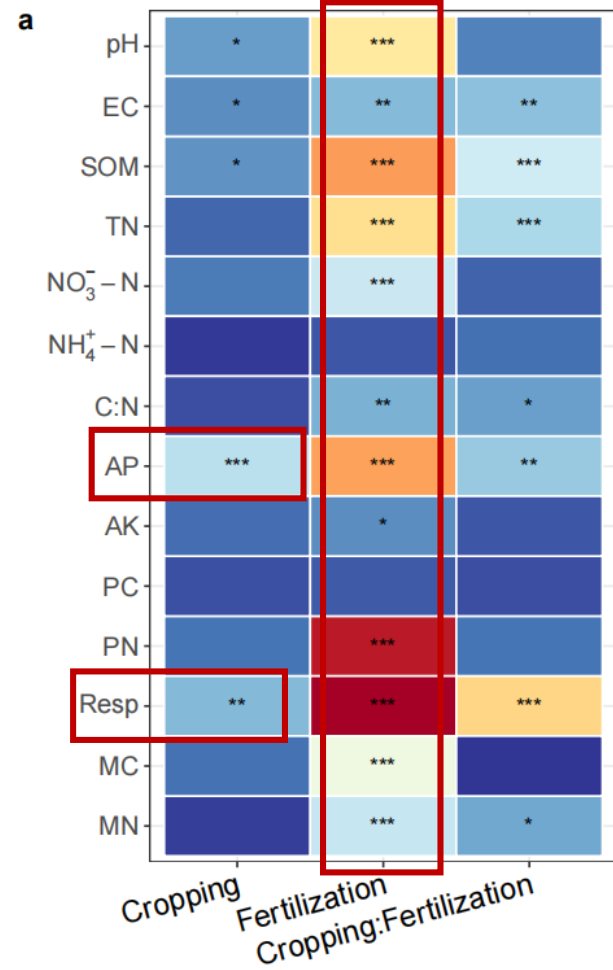
**Plots:** randomized split plots (one plot: 30 m × 30 m) with five replicates

**Sample collection:** August 2021, bulk soil + rhizosphere soil + root samples

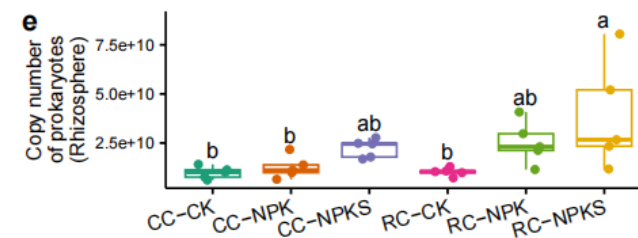
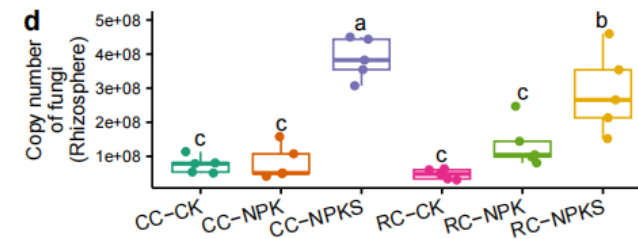
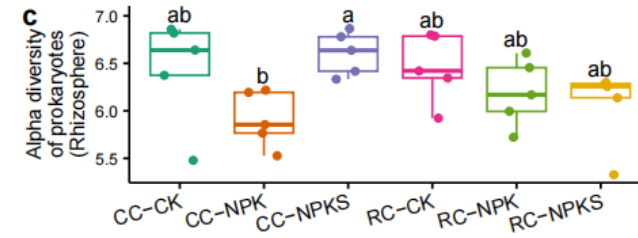
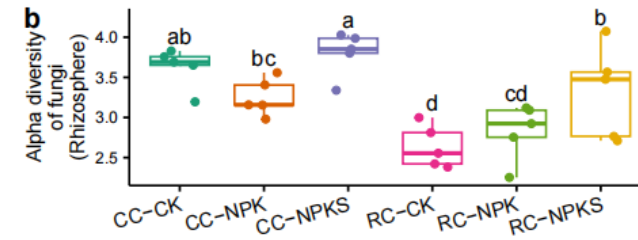
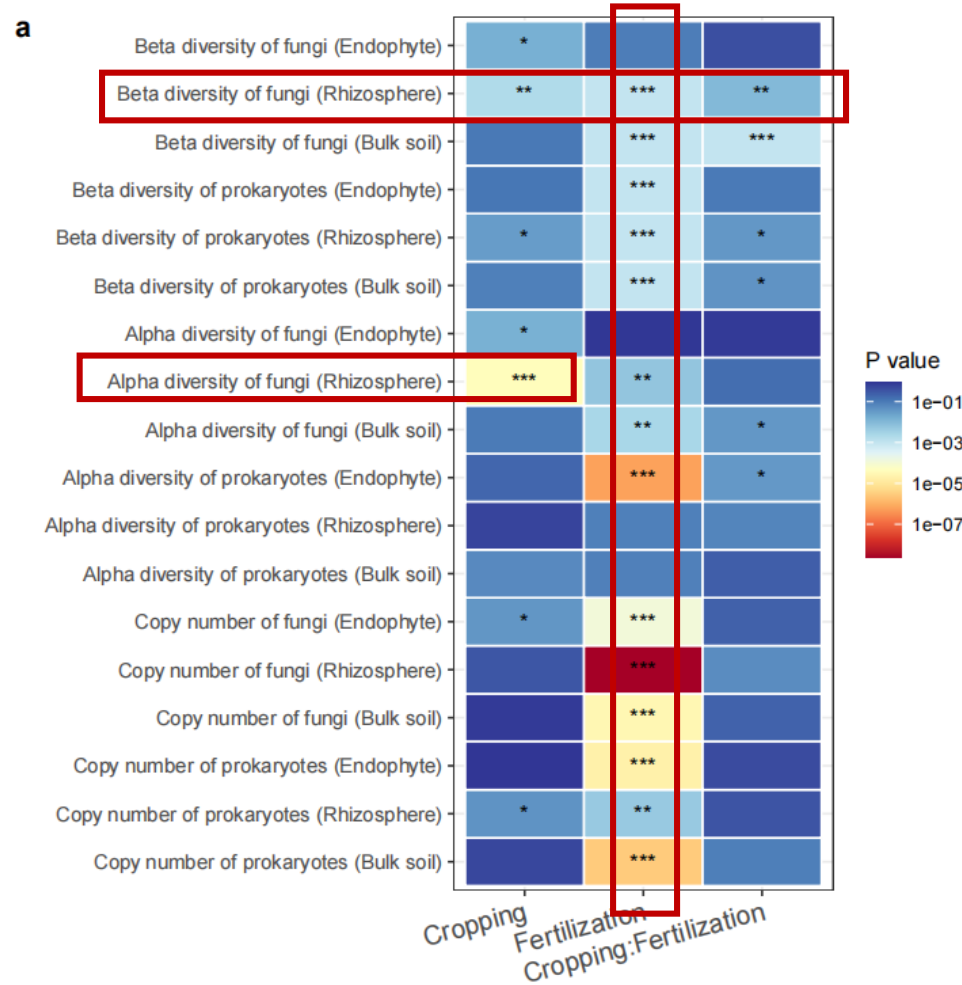
**Mesaurements:** Physicochemical analysis, qRT-PCR, amplicon sequencing (16S rRNA gene + ITS fragment), shotgun metagenomic sequencing (bulk soil + rhizosphere soil), non-targeted metabolome (bulk soil + rhizosphere soil)

**Statistical analysis:** R (v4.3.0) with microeco package

# Fertilization generates large effects on multiple soil physico-chemical properties, while crop rotation mainly changed available phosphorus and soil respiration



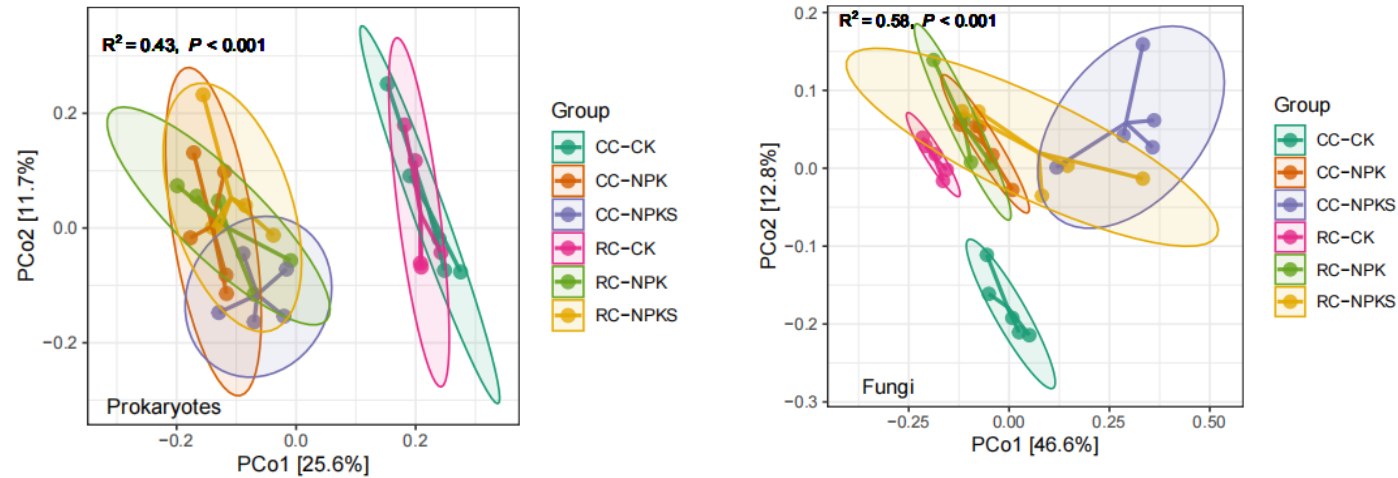
# Fertilization generates large effects on microbial richness and diversity in multiple compartments, while cropping mainly affects fungal alpha and beta diversity in rhizosphere soil



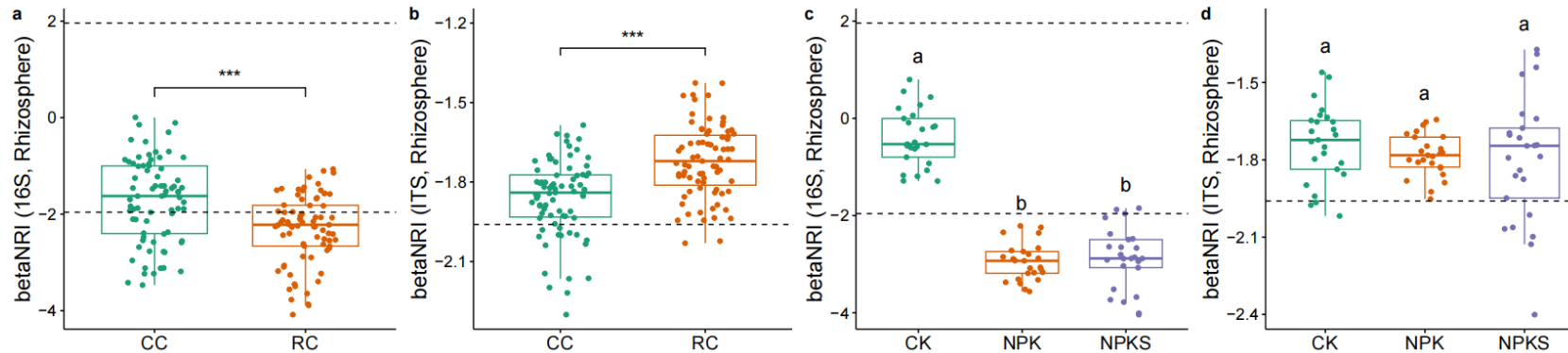
# Fertilization and cropping both had large effects on microbial community structures in rhizosphere soil



## Taxonomic beta diversity:



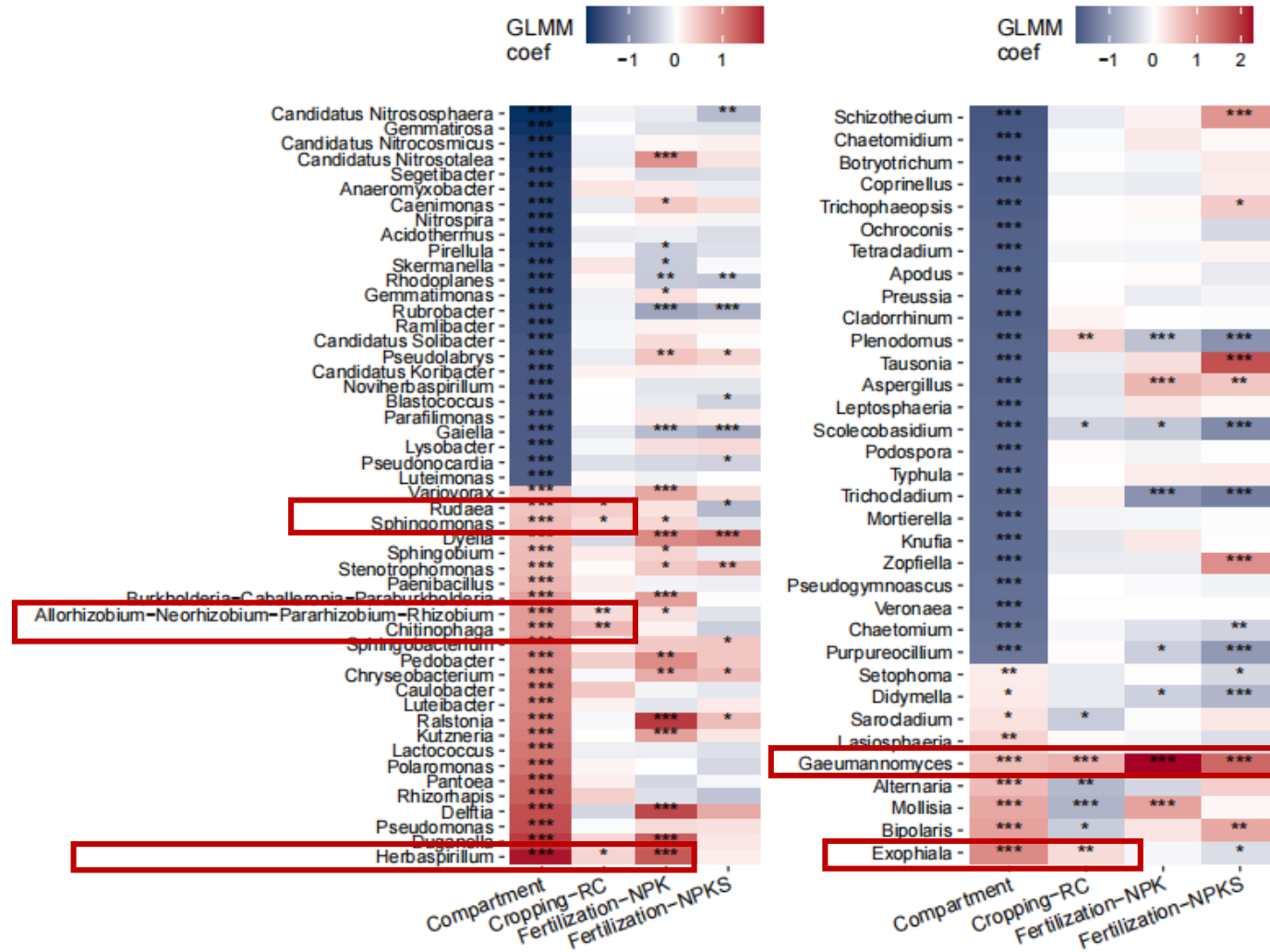
## Phylogenetic beta diversity:



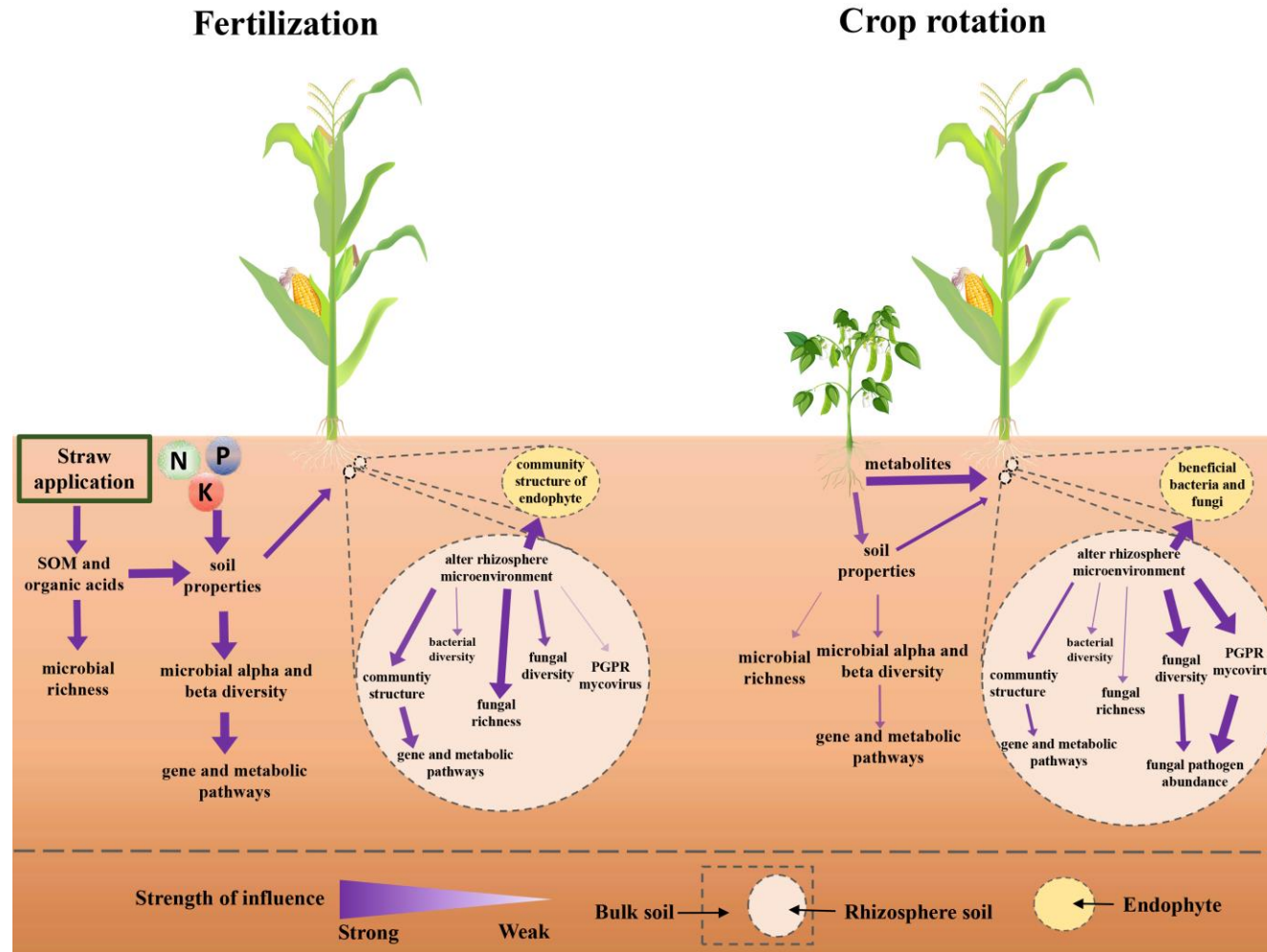




# Crop rotation enriched more beneficial prokaryotic and fungal genera



# Conclusion



# The bioremediation of cadmium-contaminated paddy soil through *Pseudomonas chenduensis* (MBR)



## Cadmium toxicity

Research has shown that cadmium affects the developing brain in children. Here are some other parts of the body it can effect.

### RELATED HEALTH ISSUES

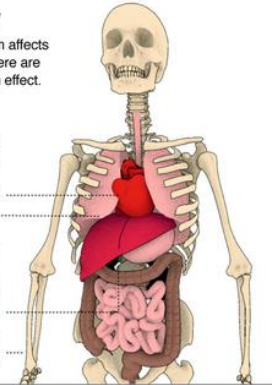
A recent study has linked it to breast cancer.

Cardiovascular disease

Obstructive pulmonary disease

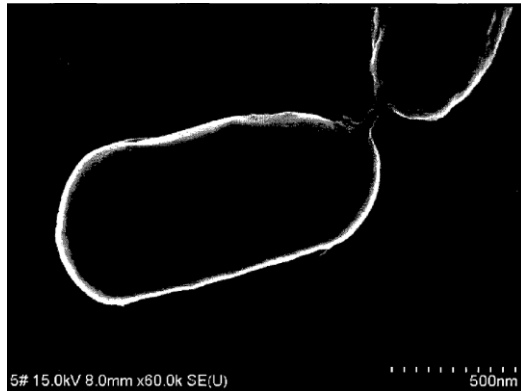
The kidneys lose function, which can also cause gout, a form of arthritis.

Bones lose density and fracture.

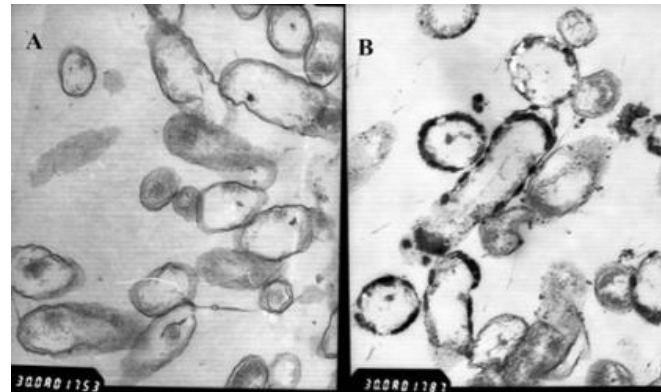


## Background

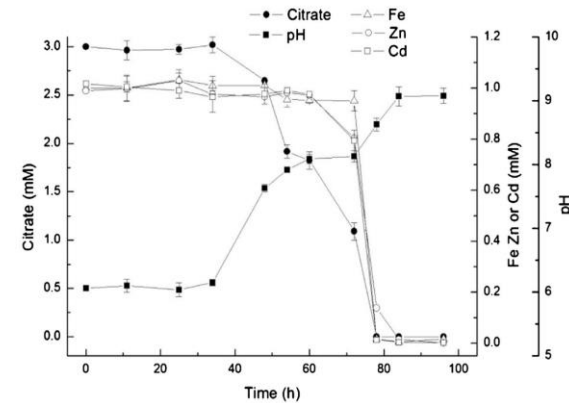
SOURCES: Dr. Aimin Chen; Casarett & Doull's Toxicology, (Curtis D. Klaassen); Environmental Health Perspectives, Dec. 2009 AP



*Pseudomonas chenduensis* sp. MBR



(Zhan et al. 2012)

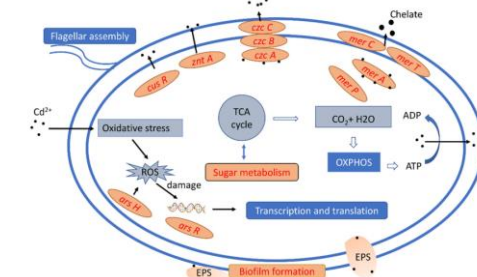
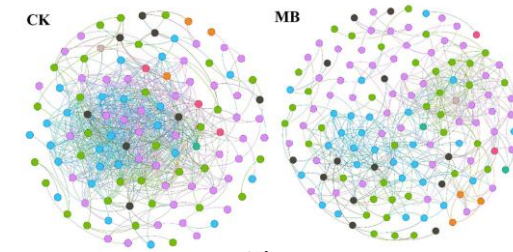
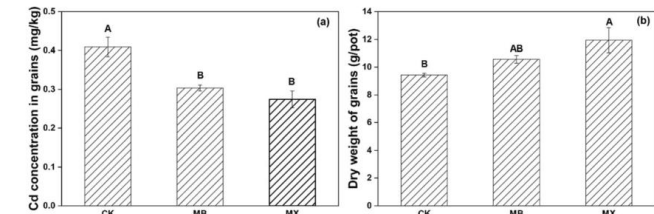


(Qian et al. 2013)

# The bioremediation of cadmium-contaminated paddy soil through *Pseudomonas chenduensis* (MBR)



- The introduction of MBR in soil significantly decreased **Cd bio-availability** and reduced **Cd accumulation in rice**.
- MBR **improved stability** of microbial community under Cd pressure.
- MBR **enhanced the roles of microbial communities** in transformation of Cd fractions, especially in rhizosphere soil.
- Elucidate **molecular mechanisms** underlying Cd bioremediation by MBR.





# Publications

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1. **Li, L.\*** et al. Longer dry and wet spells alter the stochasticity of microbial community assembly in grassland soils. *Soil Biology and Biochemistry* (2023): 108969. (IF=9.7)
2. **Li, L.\*** et al. More persistent weather causes a pronounced soil microbial legacy but does not impact subsequent plant communities. *Science of The Total Environment* (2023): 166570. (IF=9.8)
3. **Li, L.\*** et al. Resistance and resilience of soil prokaryotic communities in response to prolonged drought in a tropical forest. *FEMS Microbiology Ecology* 97.9 (2021): fiab116. (IF=4.519)
4. Lin, Q.#, **Li, L.#** et al. Functional conservation of microbial communities determines composition predictability in anaerobic digestion. *The ISME Journal*: 1-11 (# co-first author, IF=11.2)
5. **Li, L.** et al. Effects of *Pseudomonas chenduensis* and biochar on cadmium availability and microbial community in the paddy soil. *Science of The Total Environment* 640 (2018): 1034-1043. (IF=9.8)
6. **Li, L.** et al. Transcriptional response of *Pseudomonas chenduensis* strain MBR to cadmium toxicity. *Applied Microbiology and Biotechnology* 104.22 (2020): 9749-9757. (IF=5.560)
7. **Li, L.** et al. Dynamics and potential roles of abundant and rare subcommunities in the bioremediation of cadmium-contaminated paddy soil by *Pseudomonas chenduensis*. *Applied microbiology and biotechnology* 103.19 (2019): 8203-8214. (IF=5.560)

# Acknowledgements

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**Thank you!**