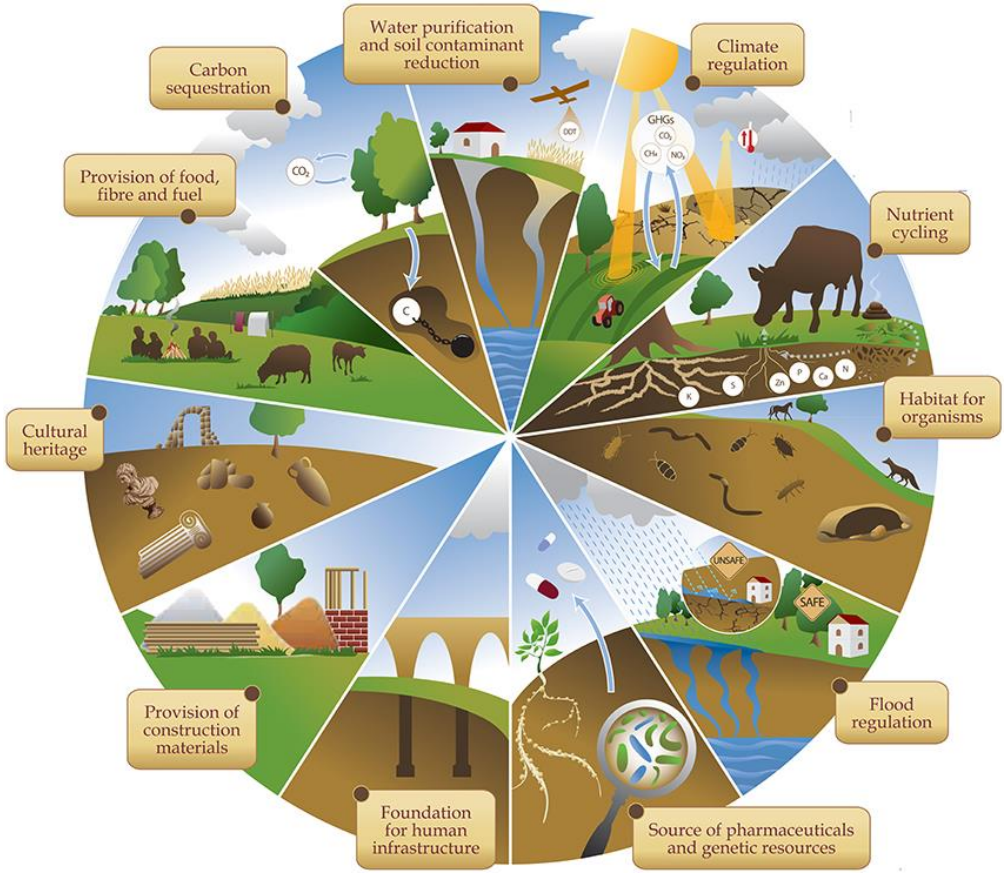
Consequences of soil multitrophic groups promoted by organic input management for ecosystem multifunctionality

Xiaoyun Chen, Bingbing Wan, Baijing Zhu, Manqiang Liu

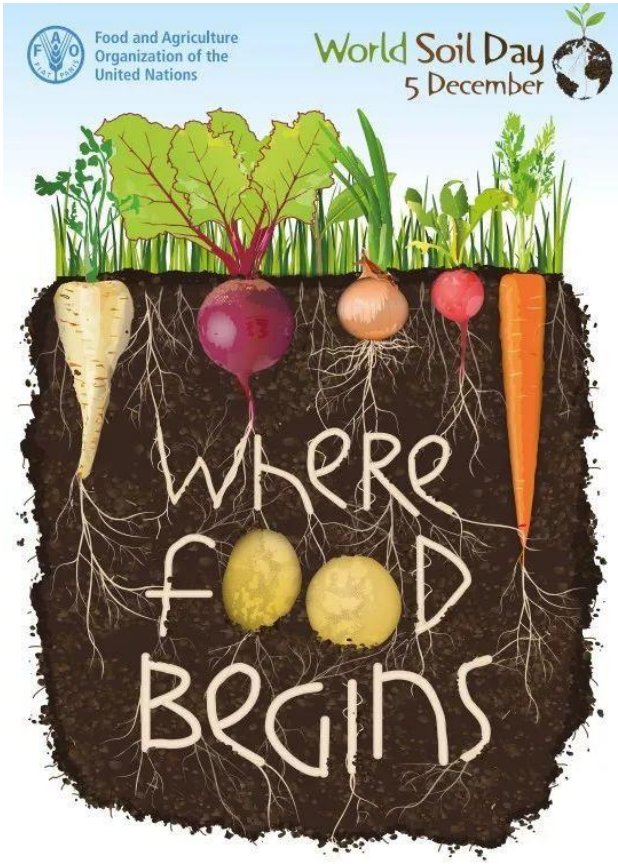
Nanjing Agricultural University, Nanjing, China

Background: the important of role of soil in agriculture ecosystem

- Soil provides various ecosystem services, which is the basis of human food security and development.



FAO, 2015



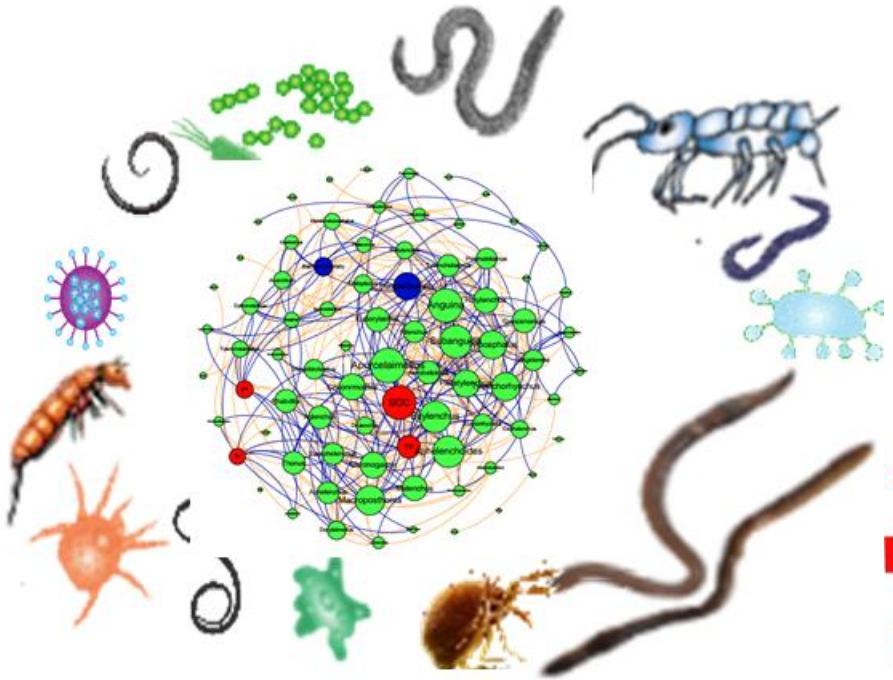
FAO, 2014

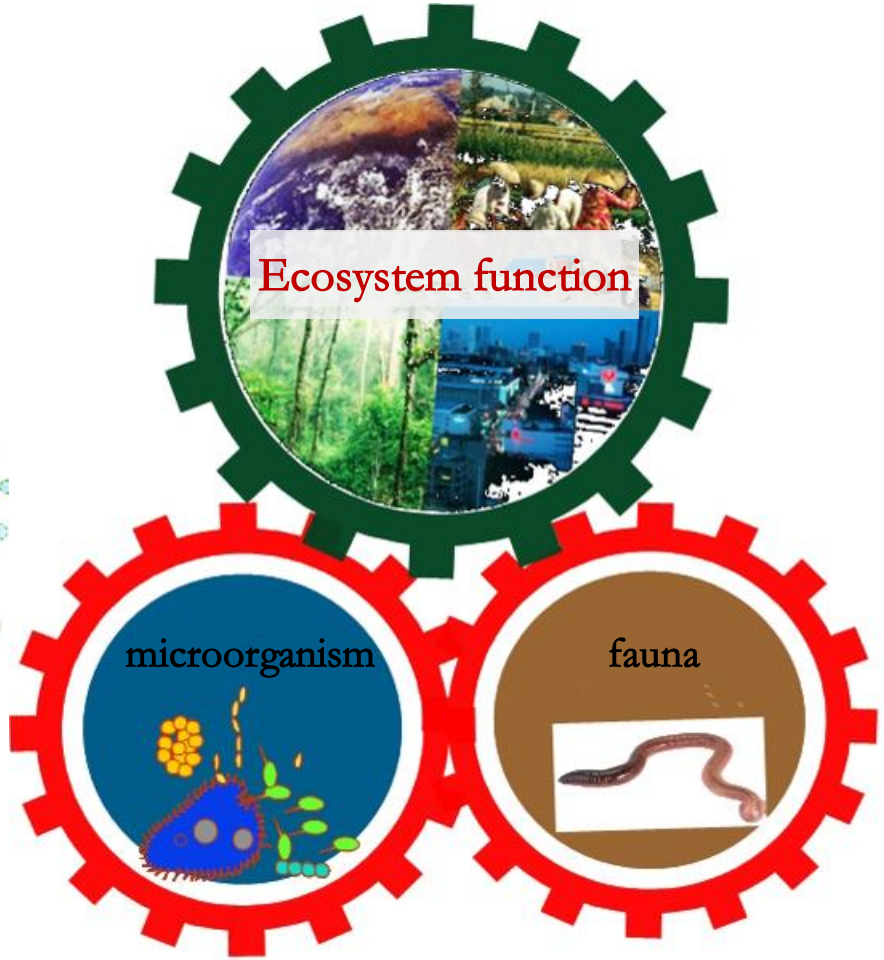
Background the important of organic amendments

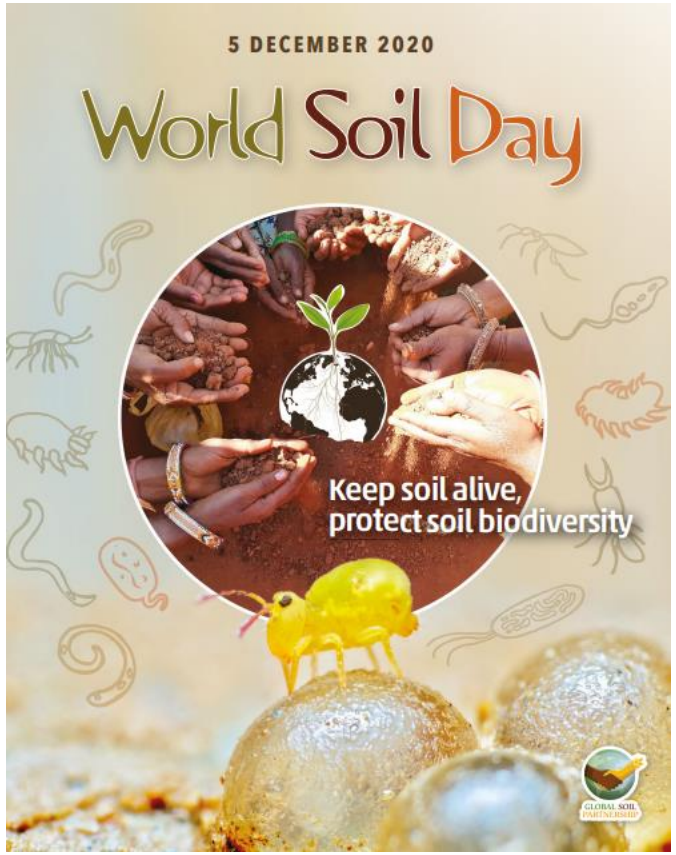
- In the intensive agricultural ecosystem, fertilization is indispensable in agricultural management to boost crop production.
- Organic amendments could increase soil carbon and help mitigate climate change, as well as to support soil health and regenerative agriculture.

Background biota

- Soil biota regulates nutrient cycling and plant performance, becoming the core of terrestrial ecosystem.



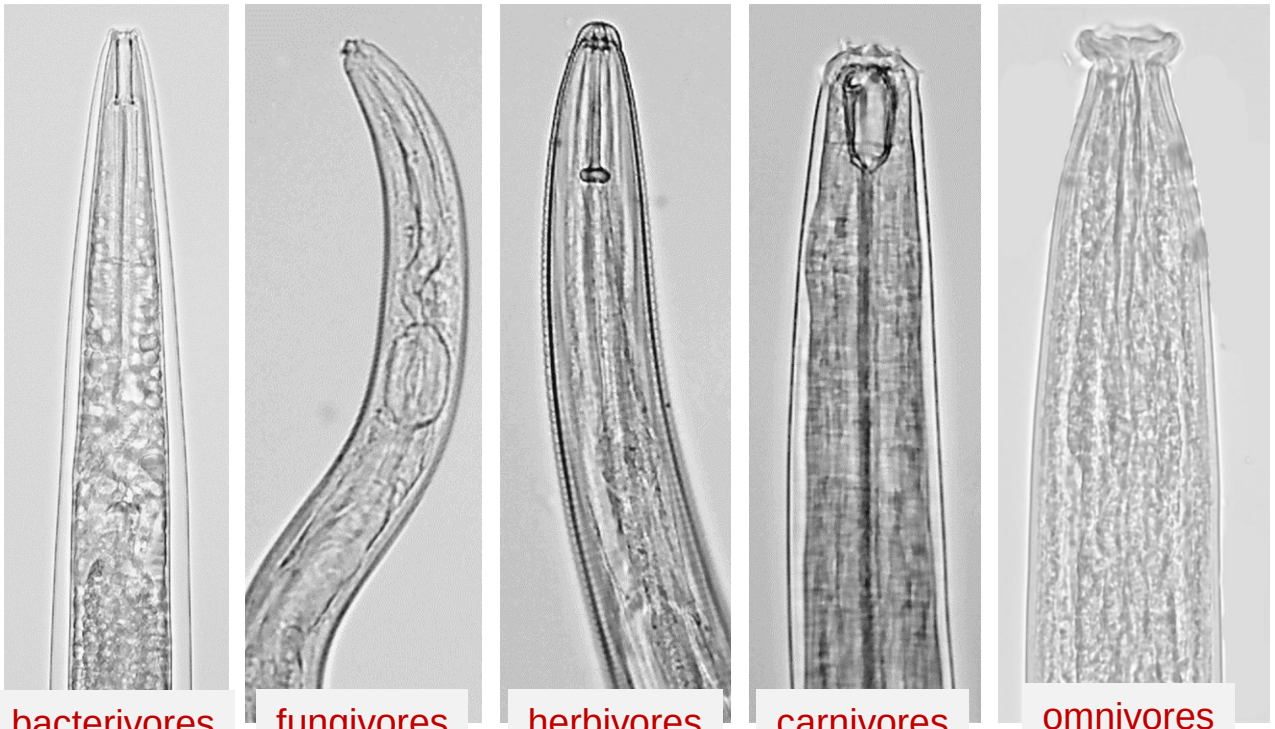


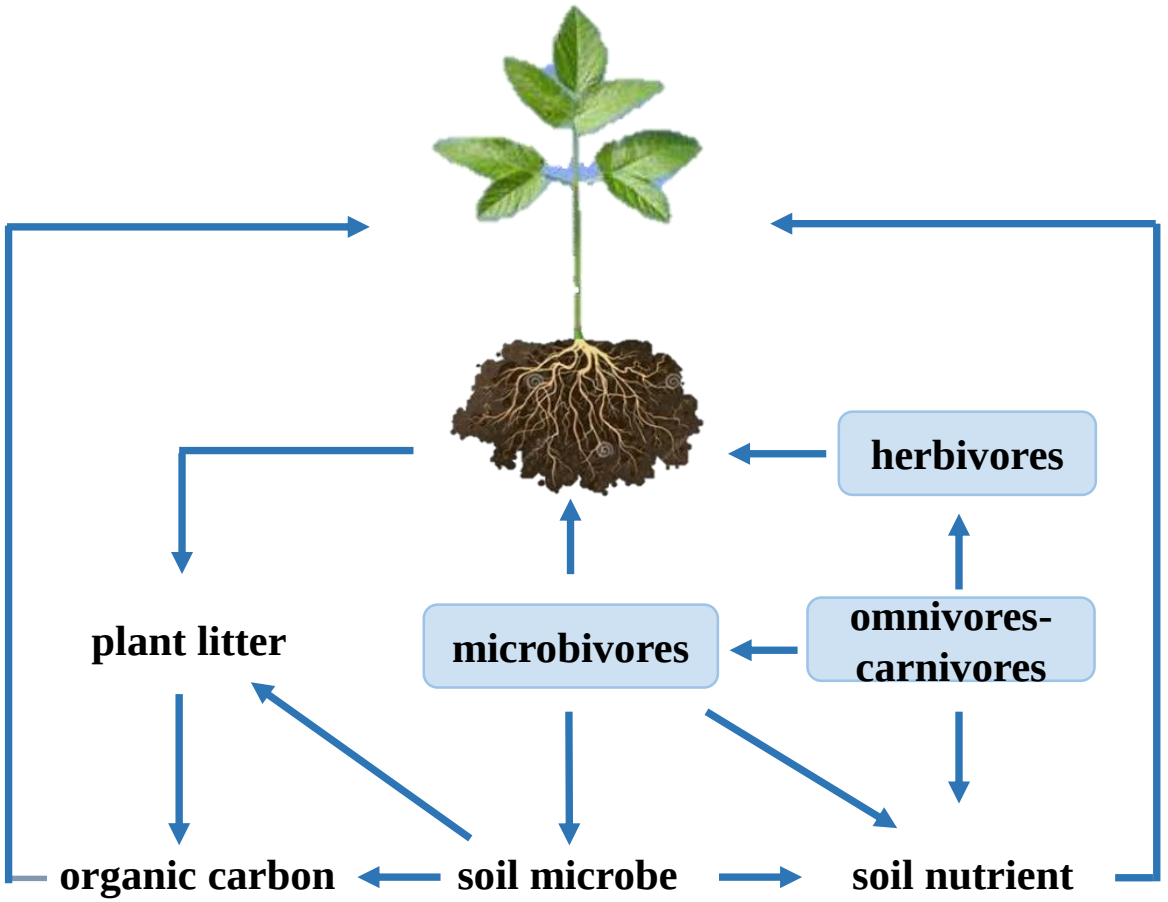


Background

soil nematodes

- Soil nematodes occupy diverse positions in the soil food web, driving different soil ecosystem functions.





Background

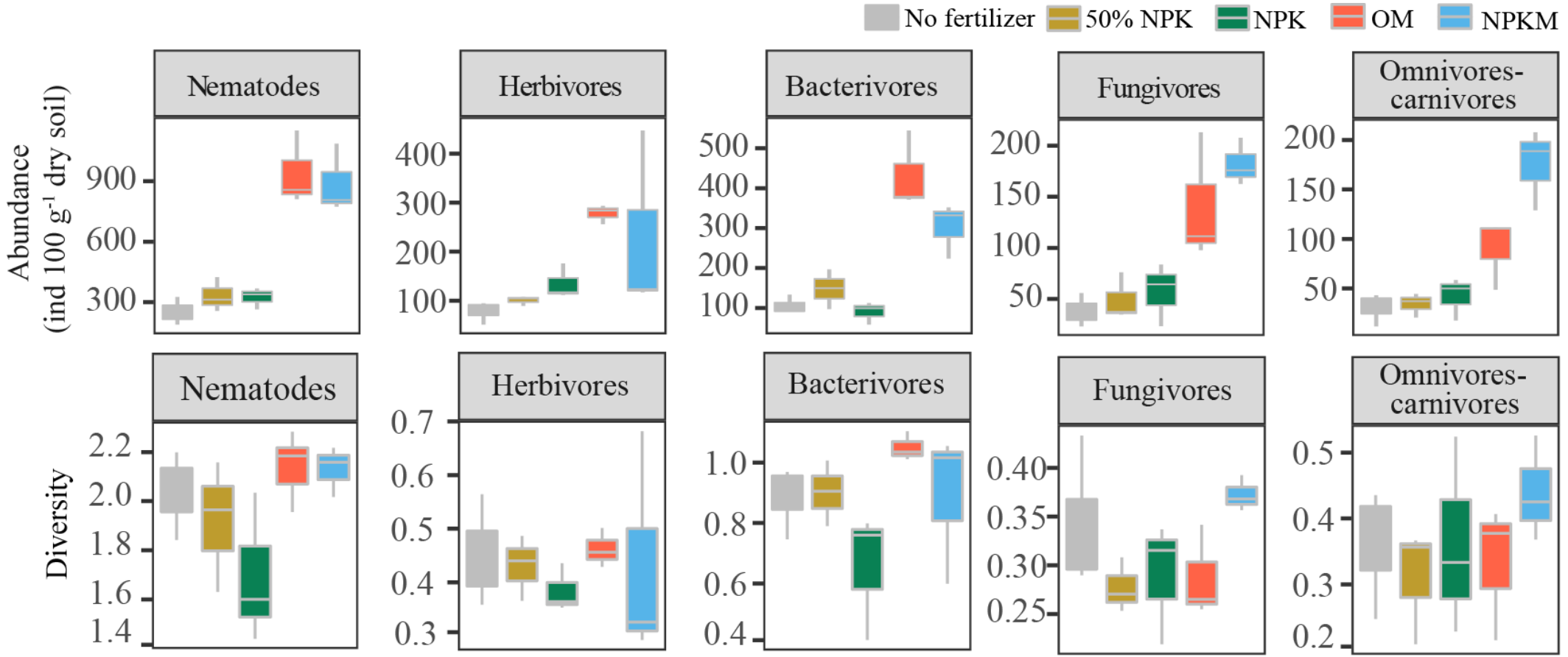
- **Question:** how do organic amendments and mineral fertilizers affect soil nematode multitrophic biodiversity (abundance and trophic groups) and further affect soil multifunctionality?

- **Hypothesis:** Increased nematode multitrophic biodiversity through nematode food webs under organic amendment would promote soil multifunctionality.

Field experiment

Treatment	Fertilizer application rate（kg/ha）			compost application rate（kg/ha）
	N	P_2O_5	K_2O	Pig manure
No fertilizer	0	0	0	0
50% NPK	90	45	75	0
NPK	180	90	150	0
Organic amendment (OM)	0	0	0	22500
50% NPK + OM (NPKM)	90	45	75	22500

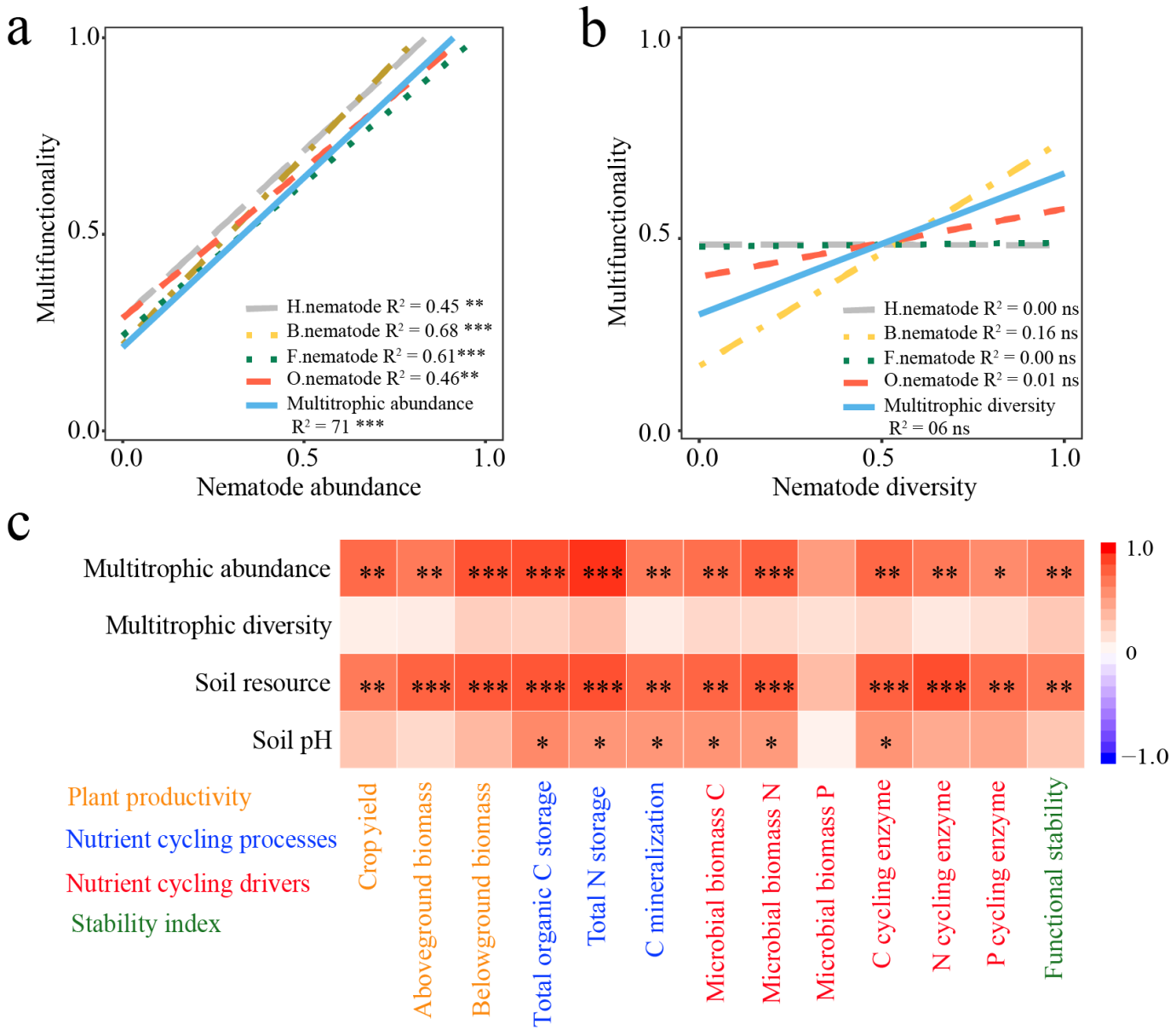
Nematode abundance and diversity



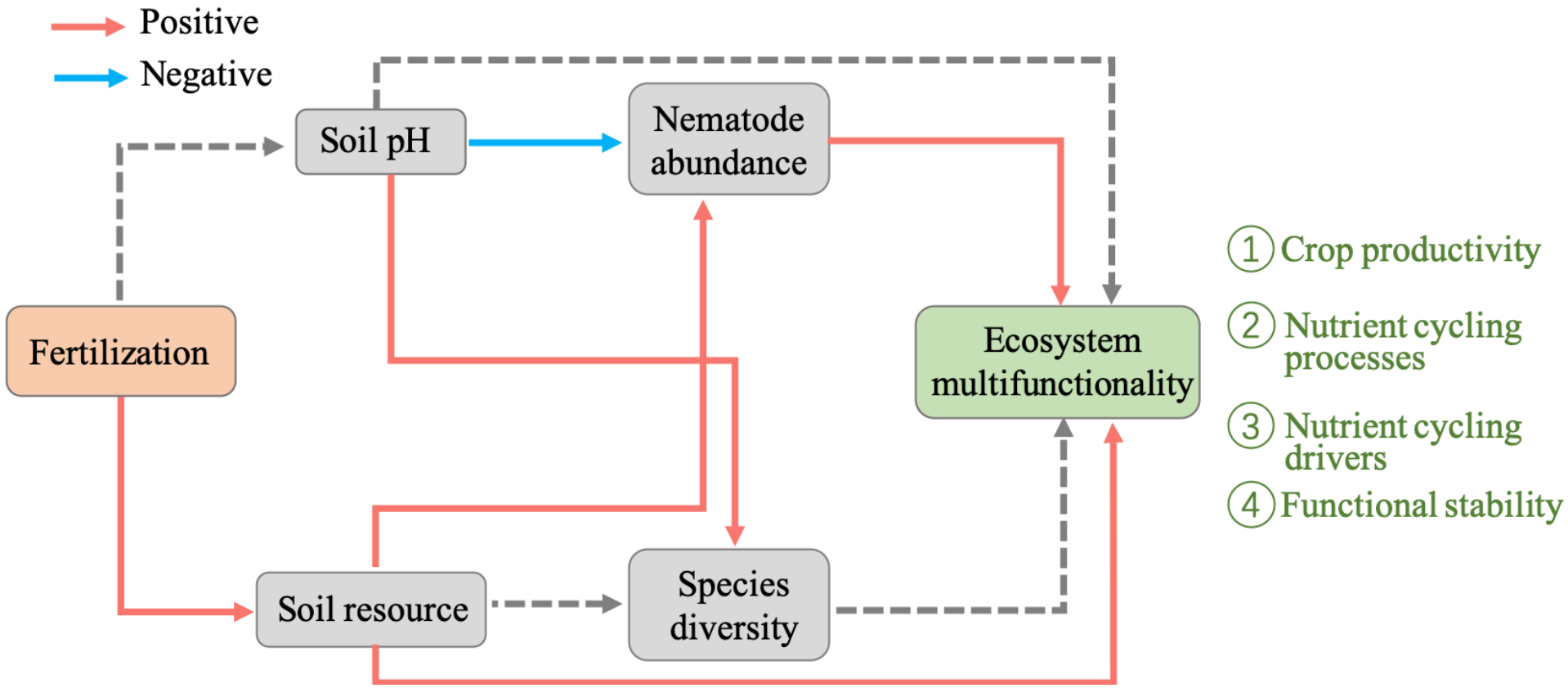
- Organic amendments increased nematode abundance and supported a higher diversity of multiple trophic groups than mineral fertilization.

Relationships

- Nematode multitrophic abundance significantly promoted ecosystem multifunctionality, while nematode diversity was less related to multifunctionality.

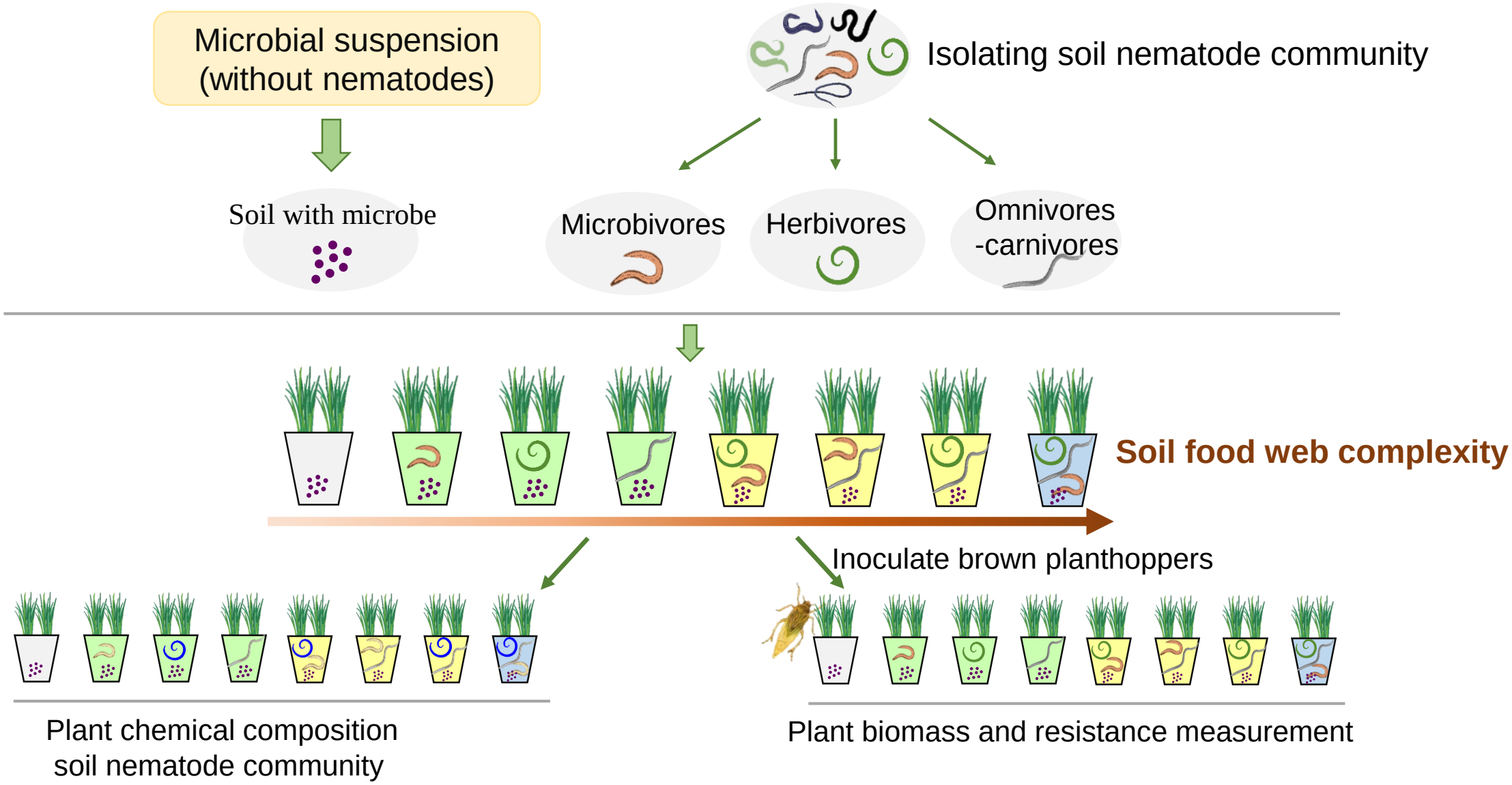


Summarization

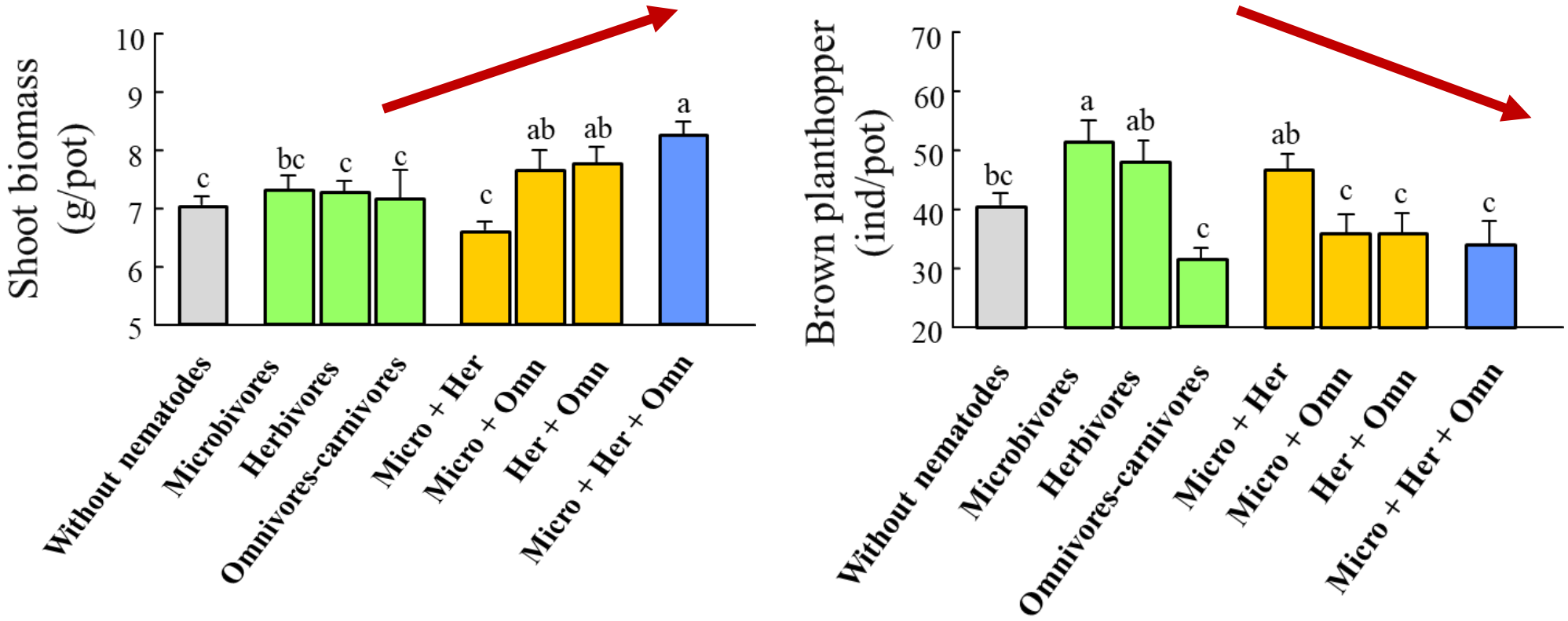


- So organic fertilizer contributed to multifunctionality primarily by increasing soil resource thereby facilitating nematode abundance across multiple trophic groups.

Microcosm experiment design

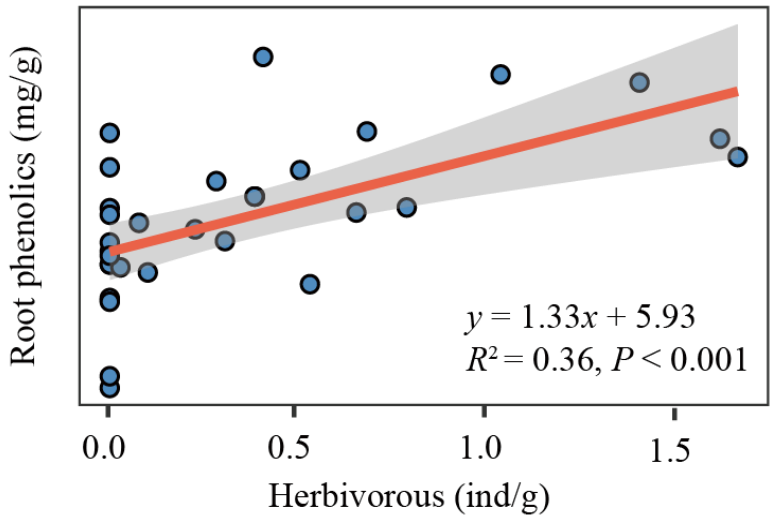


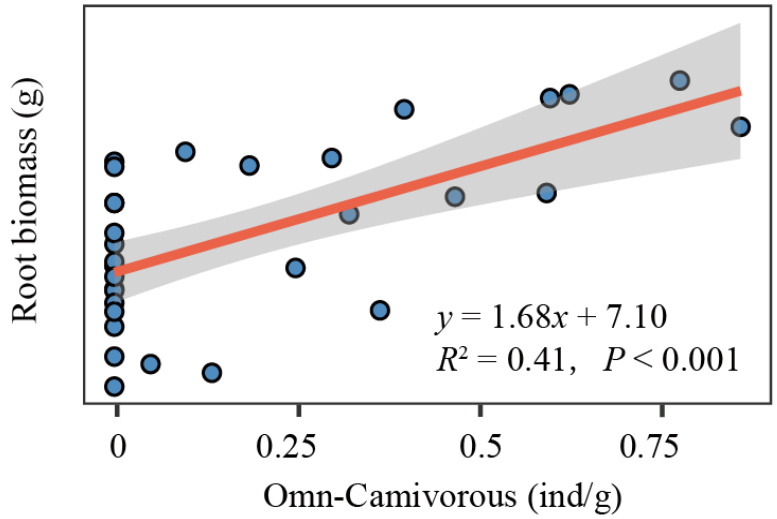
The proformance of plant biomass and aboveground herbivores

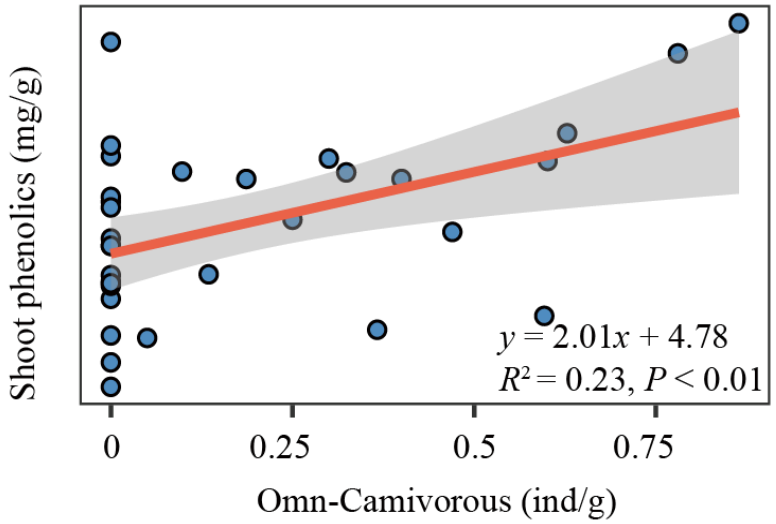


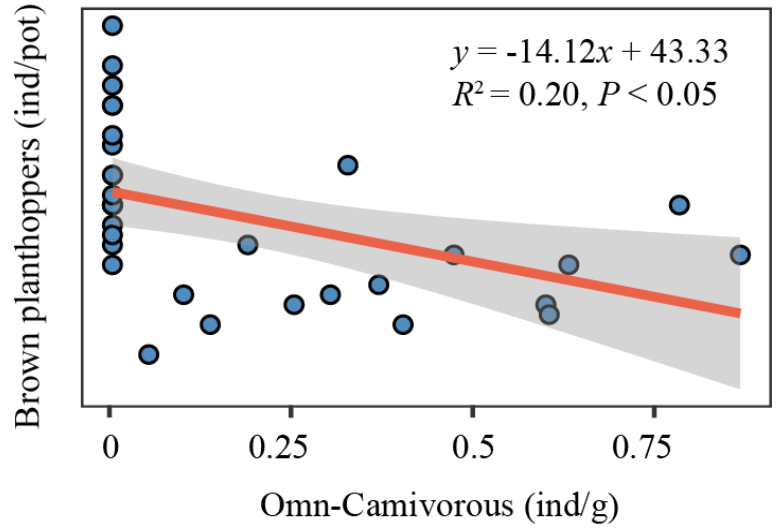
- Compared with the simplified soil food web, the complex soil food web could increase plant biomass, and reduce the abundance of brown planthopper.

Relationships



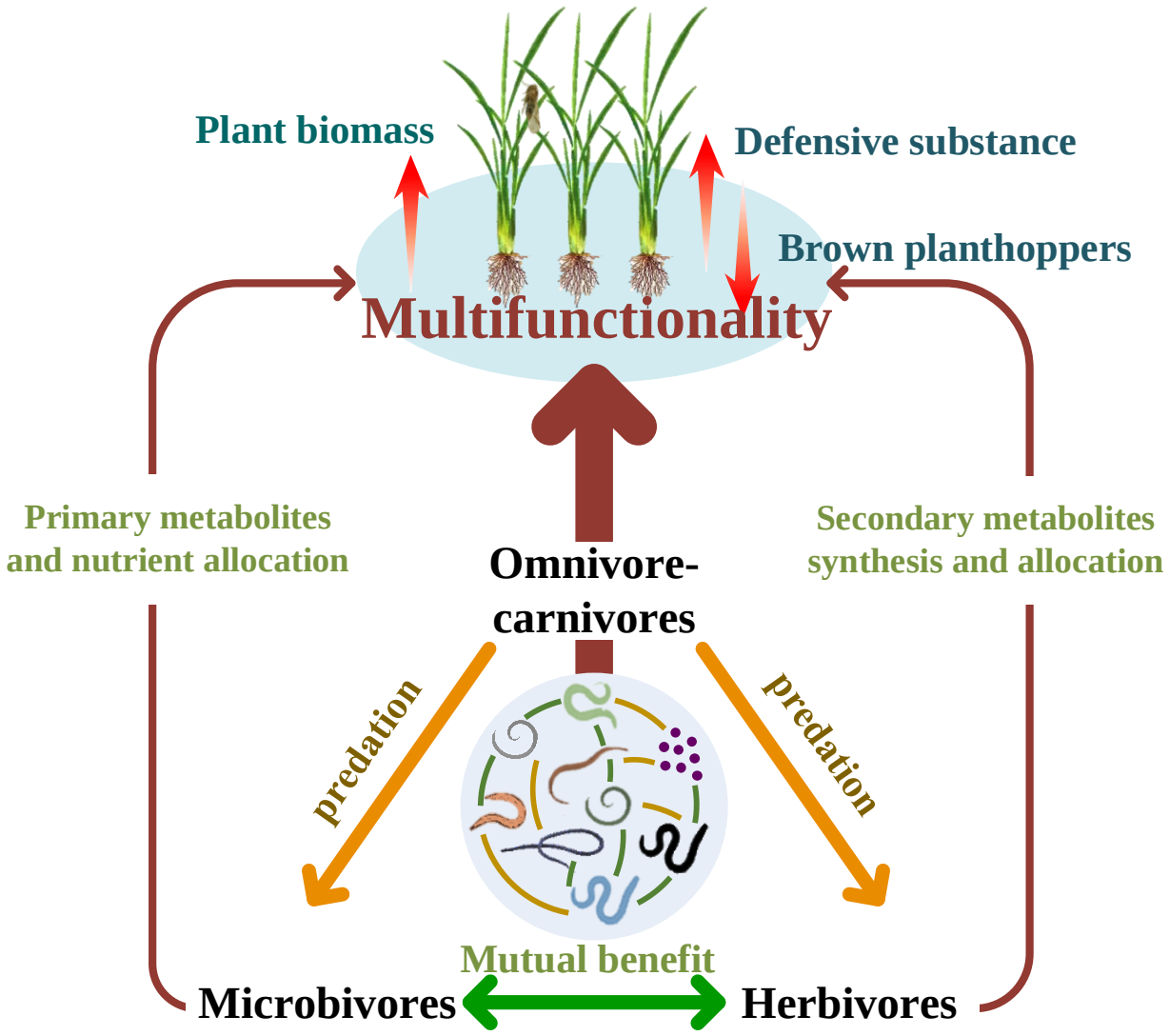






- The increase of omnivorous-carnivorous could increase plant biomass and enhance the defense ability of plants against pests.

Summarization



- The interaction of soil nematodes multitrophic groups could affect the plant growth and insect resistance.
- Overall, we provide direct experimental evidence for the multifunctional roles of soil multitrophic groups.

Take home message

- Organic management input consequently promoted soil biodiversity, especially higher-level trophic interactions, ultimately contributed to sustaining multiple ecosystem services including both crop productivity and pathogen control.
- Overall, our study corroborated organic management will be crucial to implement an ecologically multifunctional agriculture.

Thank you for attention!

土壤生态实验室

Soil Ecology Lab

https://soilecology.njau.edu.cn/