News from the dark side

Soil carbon cycling under drought

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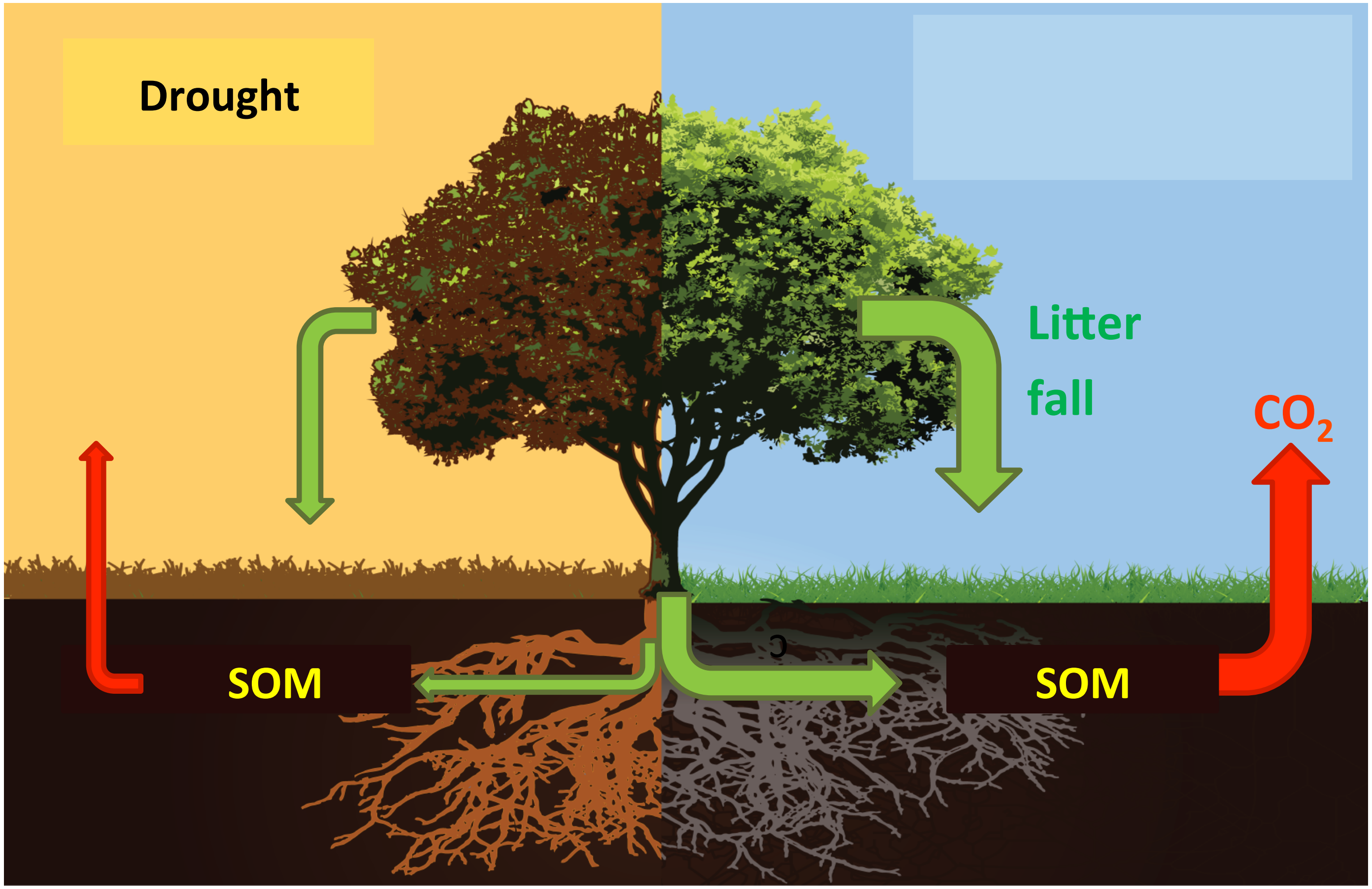
Forest Soil s and Biogeochemistry WSL

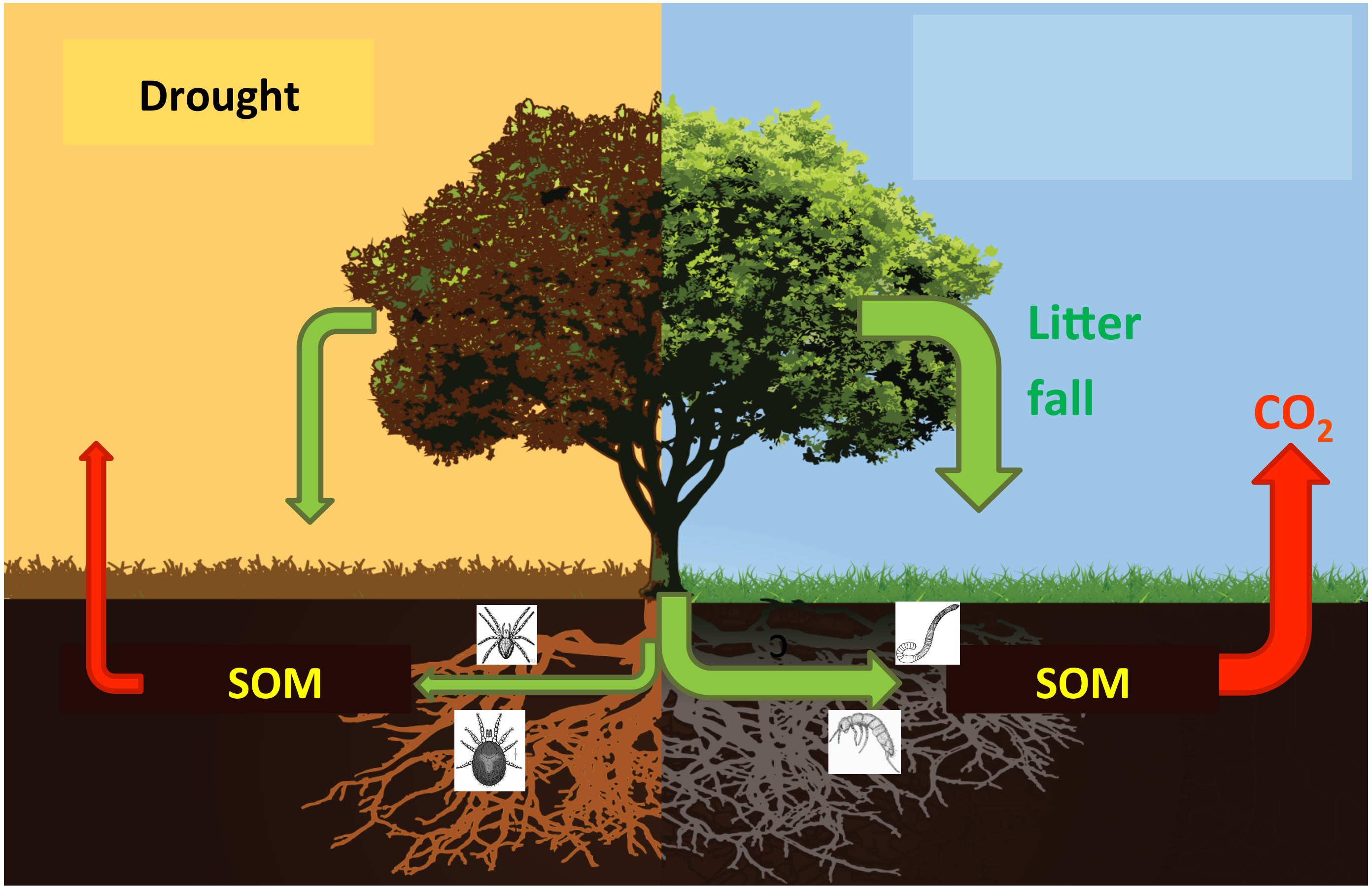
Drought effects on SOM cycling



- Drought decreases plant + soil biotic activity

→ Net effects on SOM-pools uncertain

Drought effects on SOM cycling



- Drought decreases plant + soil biotic activity
→ Net effects on SOM-pools uncertain

+ Composition of above- and belowground community change

Objectives

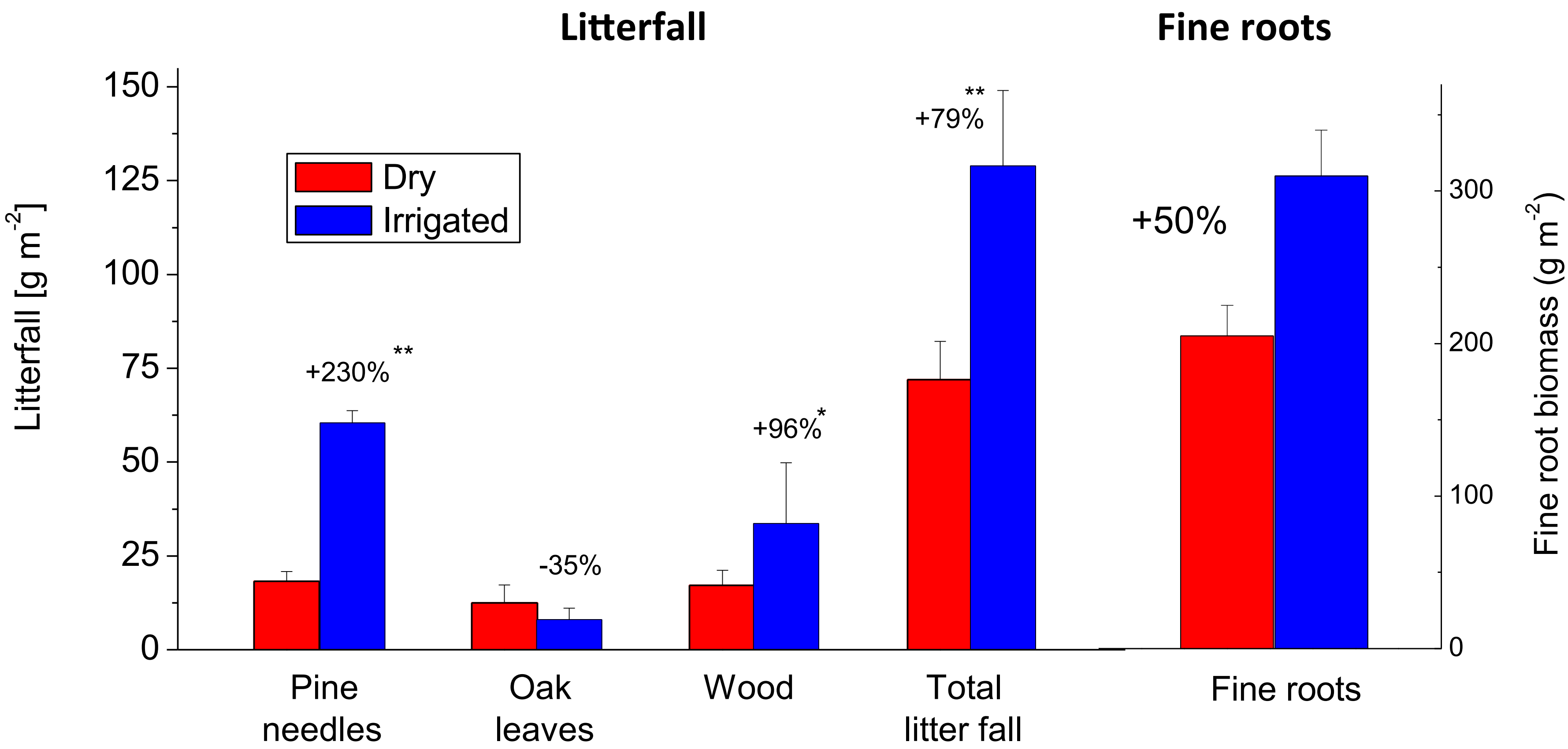
What are the effects of repeated drought on

1. Soil C fluxes (in- and outputs) **?**

2. Above and belowground diversity **?**

3. Soil organic matter pools and distribution **?**

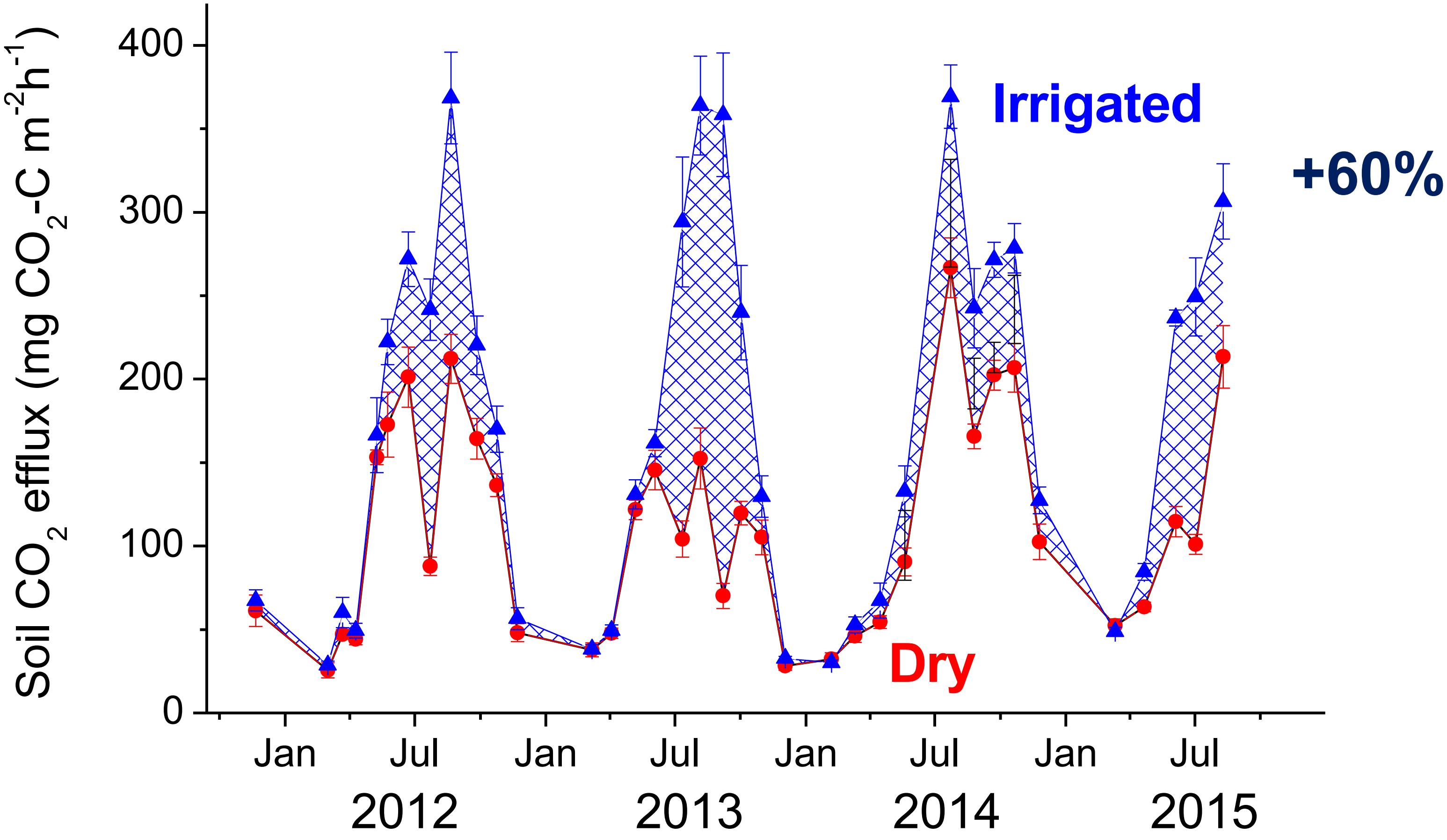
Litterfall: species specific responses



Winter 2014; n=4 plots with 5 traps

Herzog et al. (2014): PLOSOne

Soil CO_2 efflux

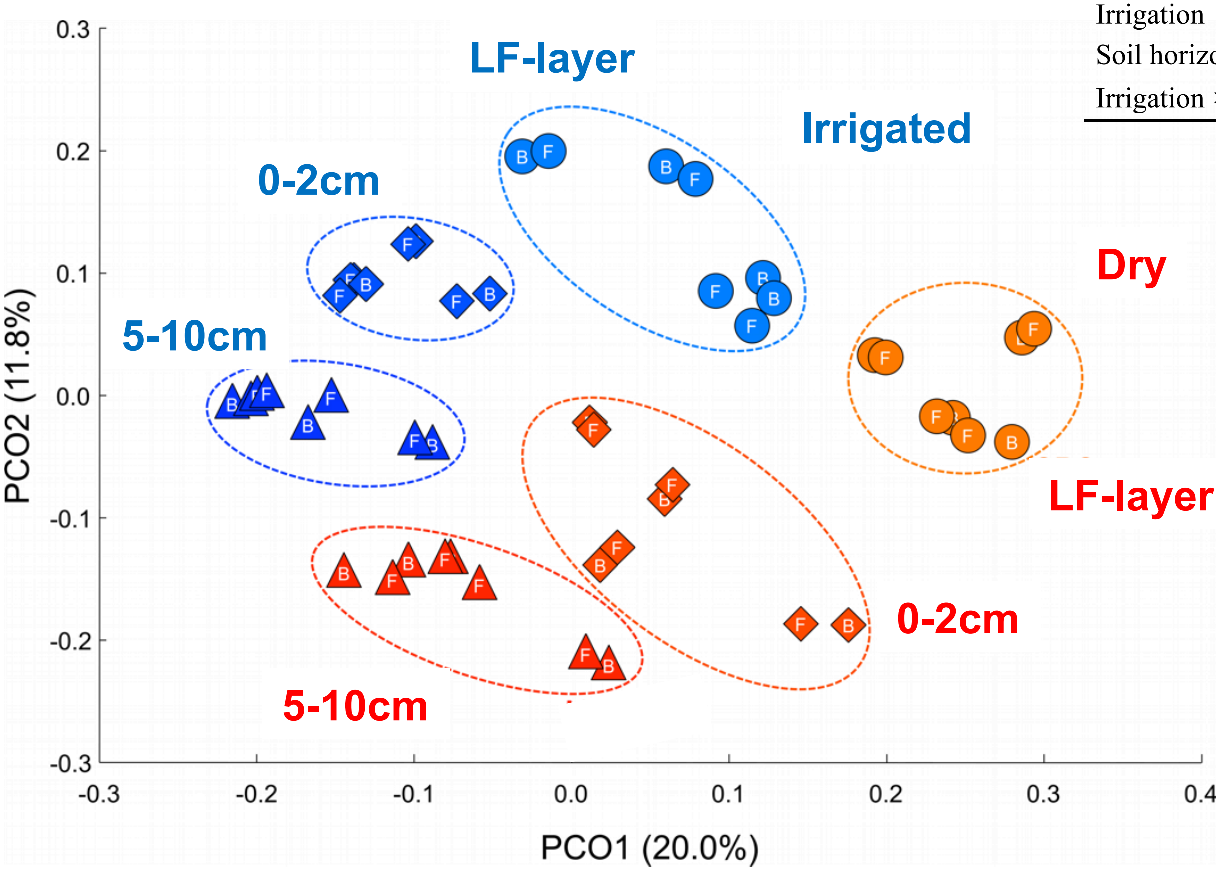


n=4 per treatment; 4 collars per plot

A. Zürcher & F. Hagedorn

Irrigation alters bacterial and fungal β-diversity

PERMANOVA	Bacteria F(P)	Fungi F(P)
Irrigation	**3.40 (<0.001)**	**3.85 (<0.001)**
Soil horizon	**2.88 (<0.001)**	**2.83 (<0.001)**
Irrigation × soil horizon	1.06 (0.305)	1.10 (0.265)

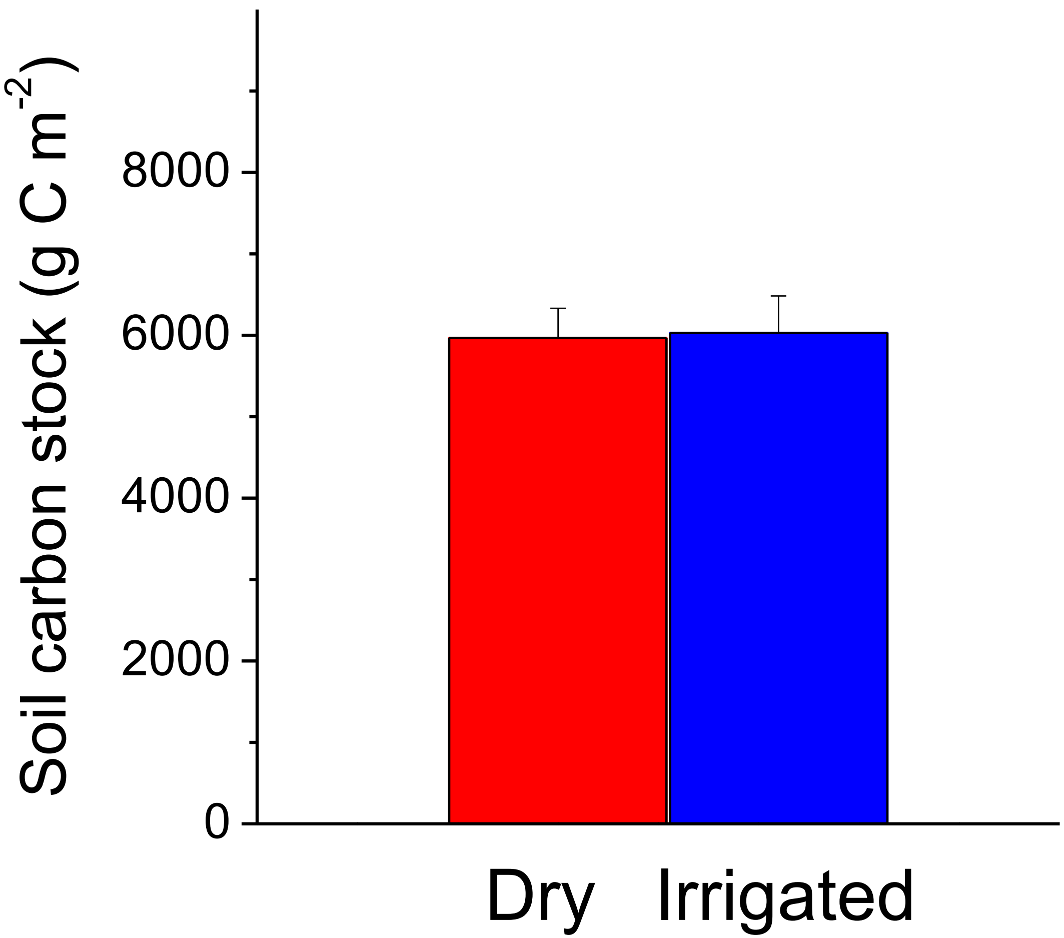


→ More bacteria with a oligotrophic life strategy under drought

454 pyrosequencing

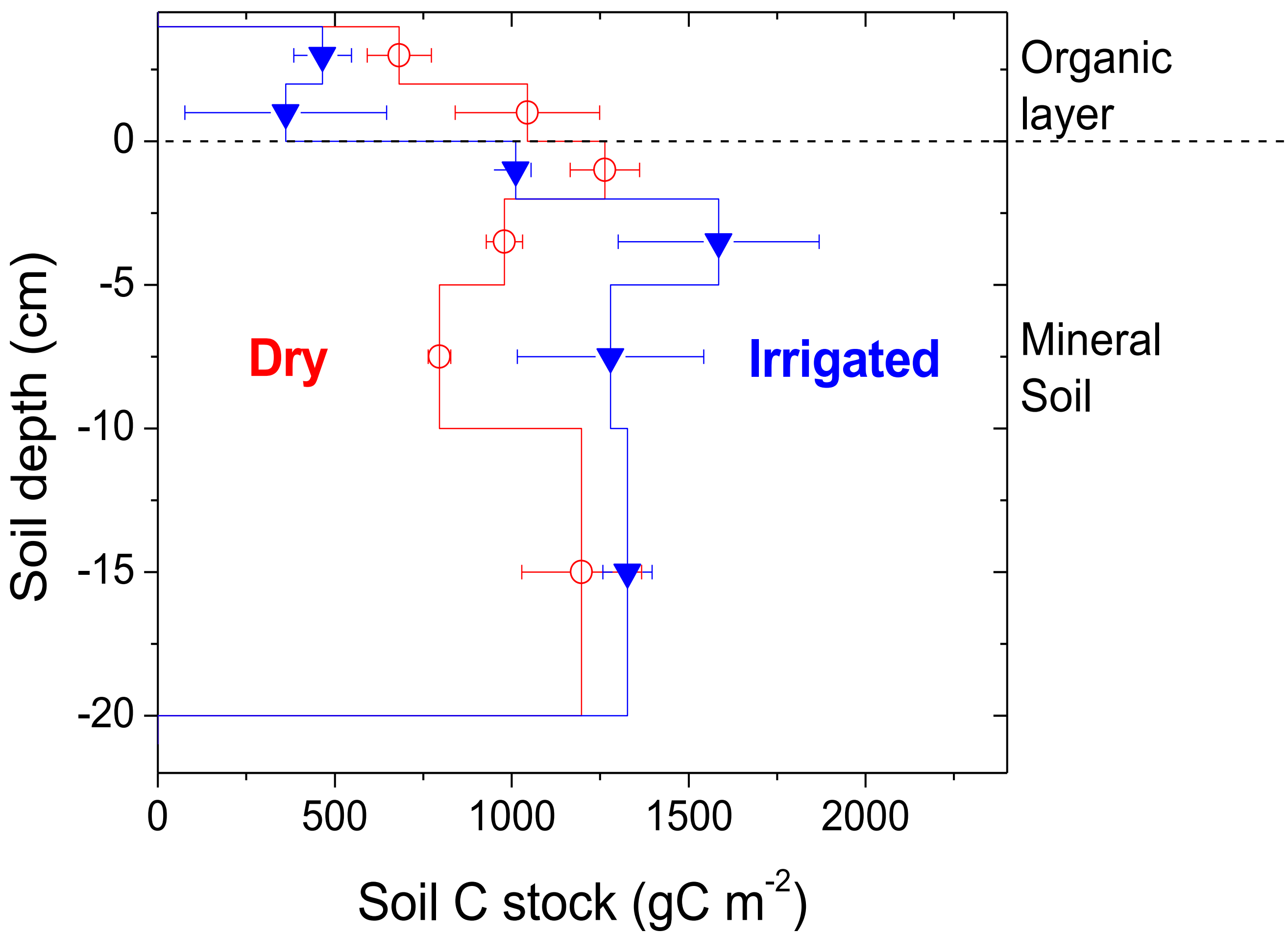
B. Frey & M. Hartmann (unpublished data)

Soil organic carbon stocks



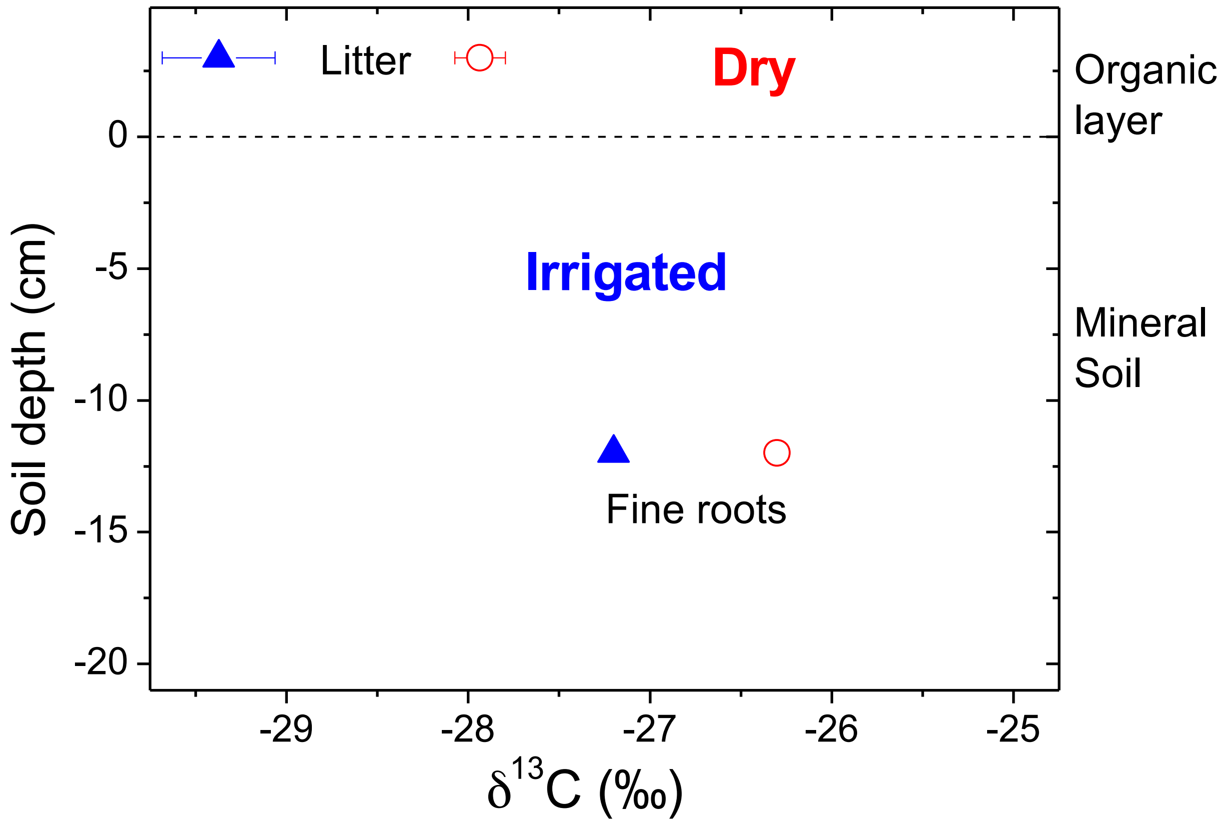
$P_{Drought}$<n.s.; n=4 plots per treatment, 4 profiles per plot, total n= 32 profiles

Soil organic carbon stocks



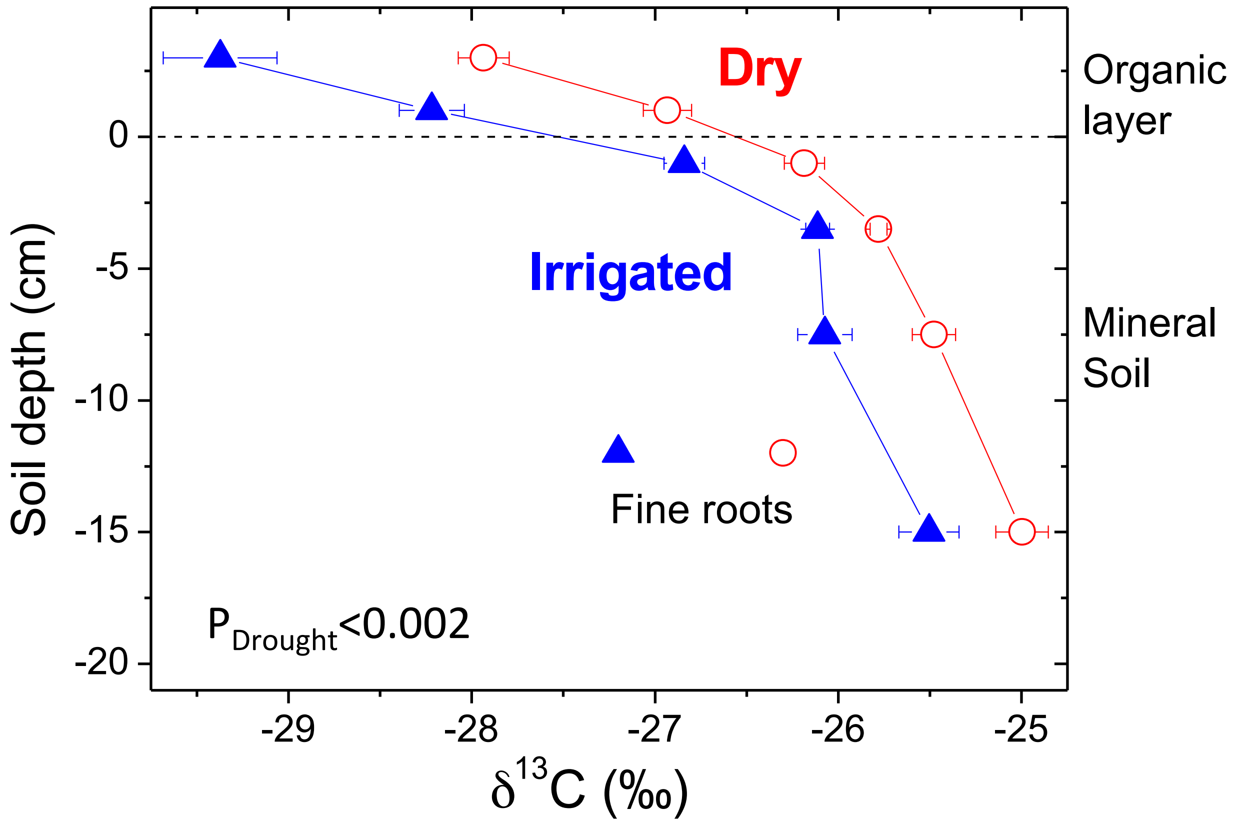
$P_{Drought\ X\ Depth}<0.02$; n=4 plots per treatment, 4 profiles per plot, total n= 32 profiles

Natural ^{13}C abundance



→ Smaller $\delta^{13}C$ in plants and litter under drought due to water saving

Natural ^{13}C abundance



→ Irrigation decreases $\delta^{13}C$ in soil → substantial input of 'new' C into soil

Soil organic carbon stocks

C- losses in organic layer, C gains in mineral soil under irrigation

1. **Increased litter decomposition + increased rhizodeposition**

2. **Stronger incorporation of litter in mineral soil by macrofauna (e.g. earthworms)**

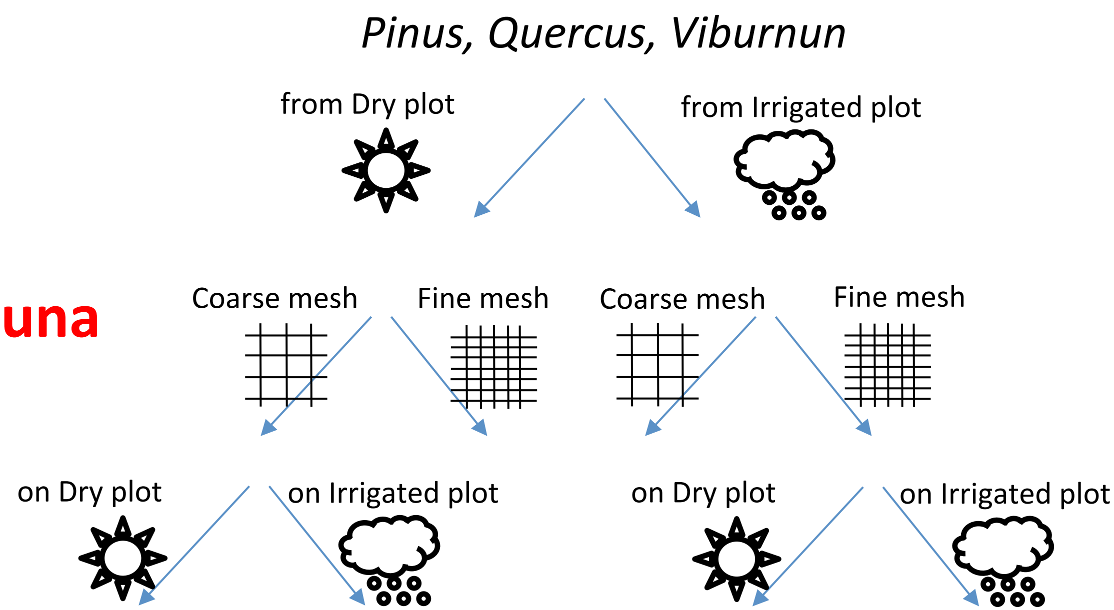
Litter decomposition: effects of irrigation, tree species and soil fauna

Species

Origin

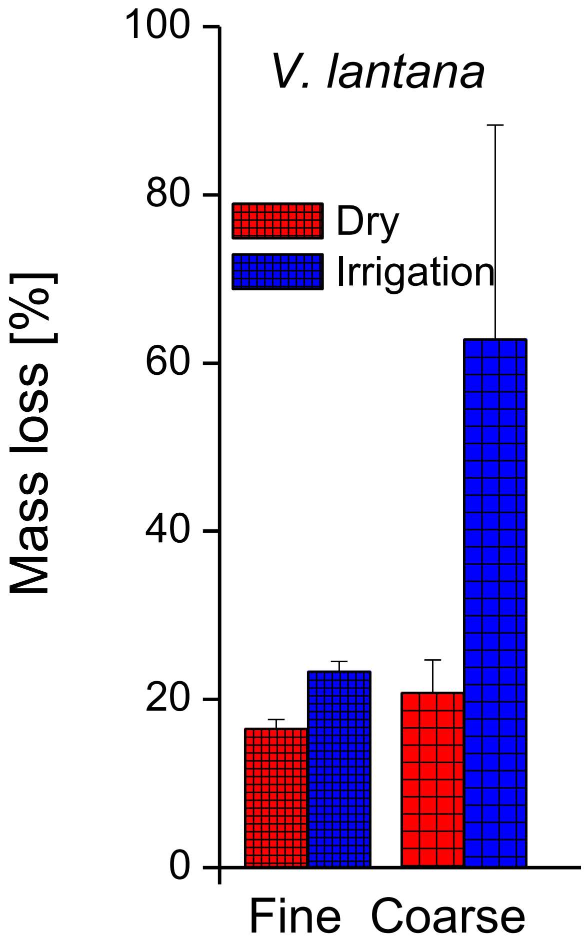
Macro vs. Microfauna

Irrigation



Total n = 580

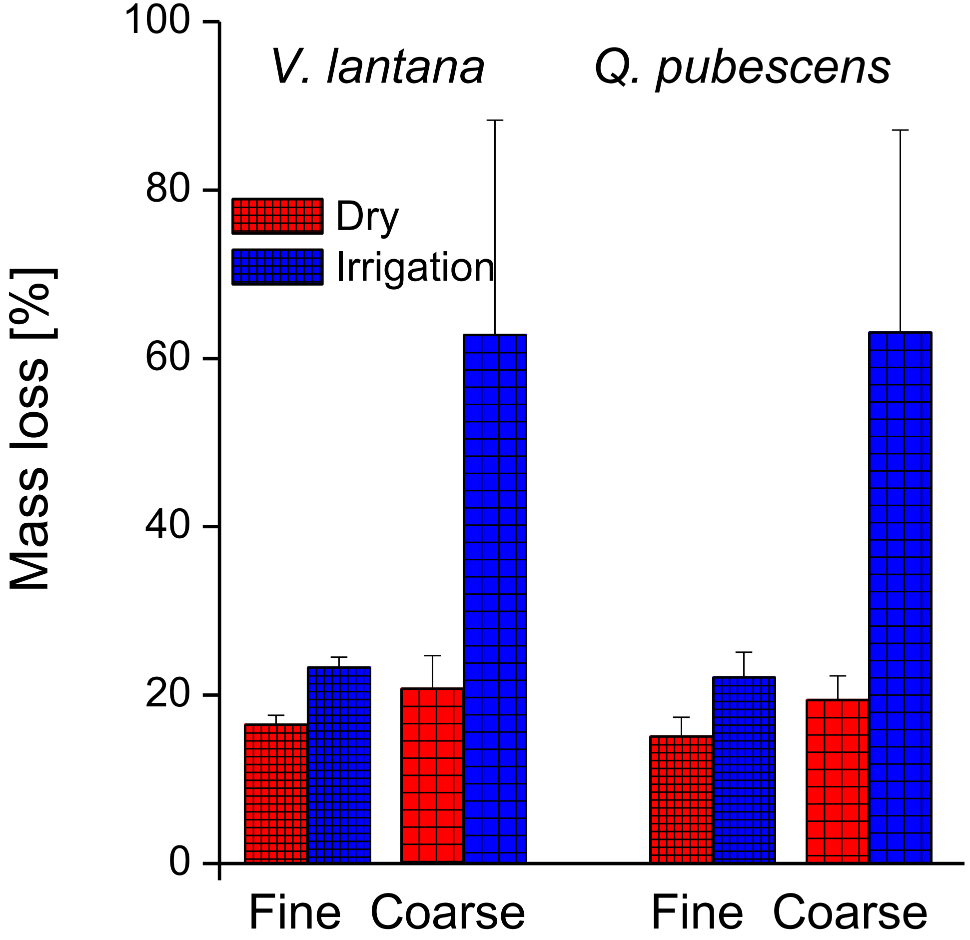
Litter Bag Mass loss: micro vs. macrofauna



$P_{meshsize\ x\ Drought}$<0.01

After 140 days; M. Vogel

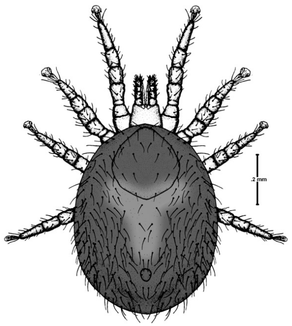
Litter Bag Mass loss: micro vs. macrofauna



$P_{\text{meshsize x Drought}} < 0.01$

After 140 days; M. Vogel

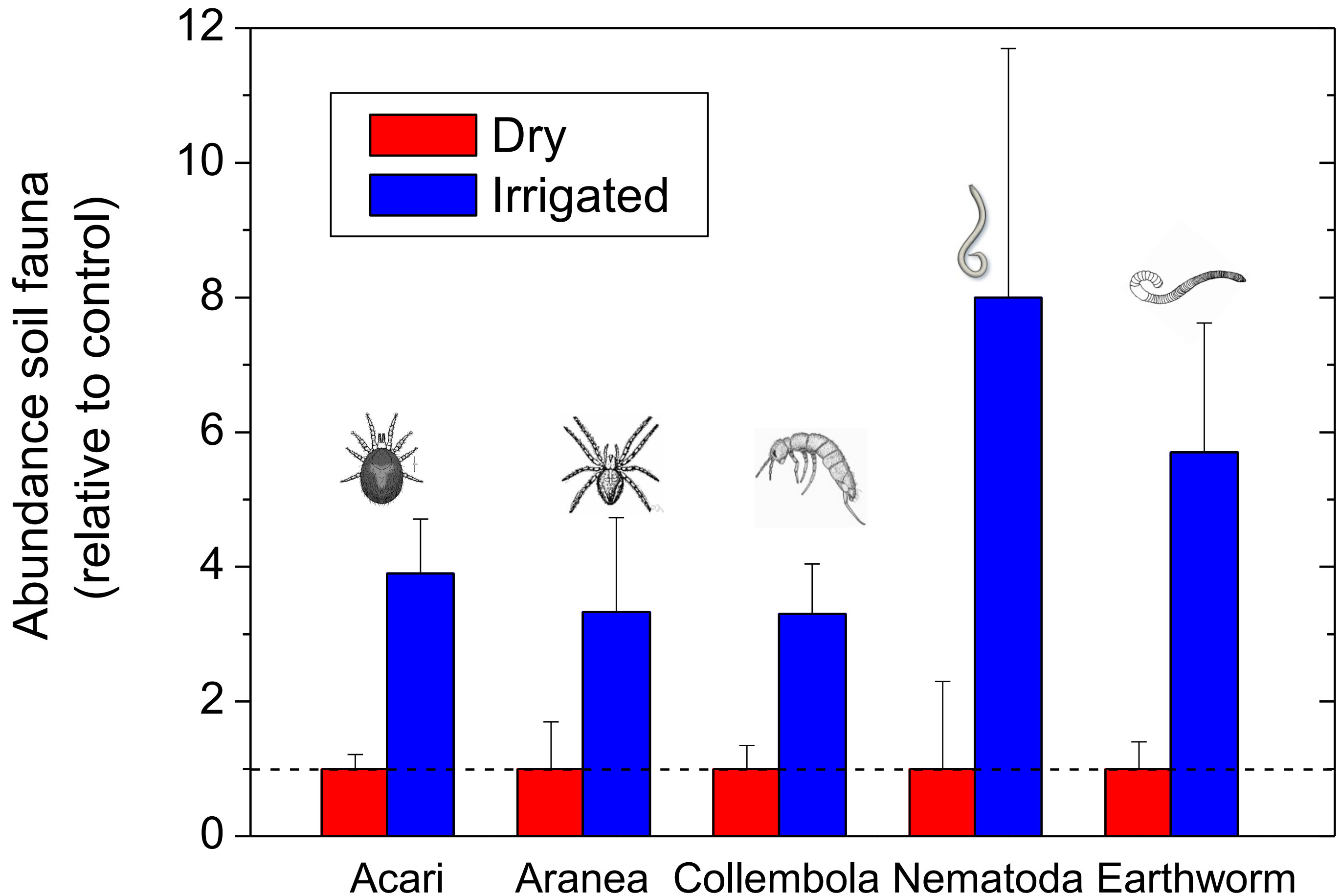
Responses of soil fauna



	Acari = Milben	Aranea = Spinnen	Collembola = Springschwanz	Nematoden = Fadenwürmer	Regenwürmer
Abundance	195/m²	0.7/m²	29/m²	5/m²	9/m²

August 2015, Stucky & Hagedorn, unpublished data

Responses of soil fauna



Litter layer August 2015, Stucky & Hagedorn, unpublished data

Summary

Long-term removal of drought by irrigation

1. increases C fluxes (litterfall, roots, soil CO_2 effluxes)
2. alters soil biota
3. has negligible effects on total SOC stocks but alters SOC distribution
4. macrofauna contribute to SOC redistribution

Thanks! Questions?