

# Effects of recurring drought periods on microbial functioning in mountain grassland

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## Affiliations:

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<sup>2</sup>University of Innsbruck, Institute of Ecology

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# Background

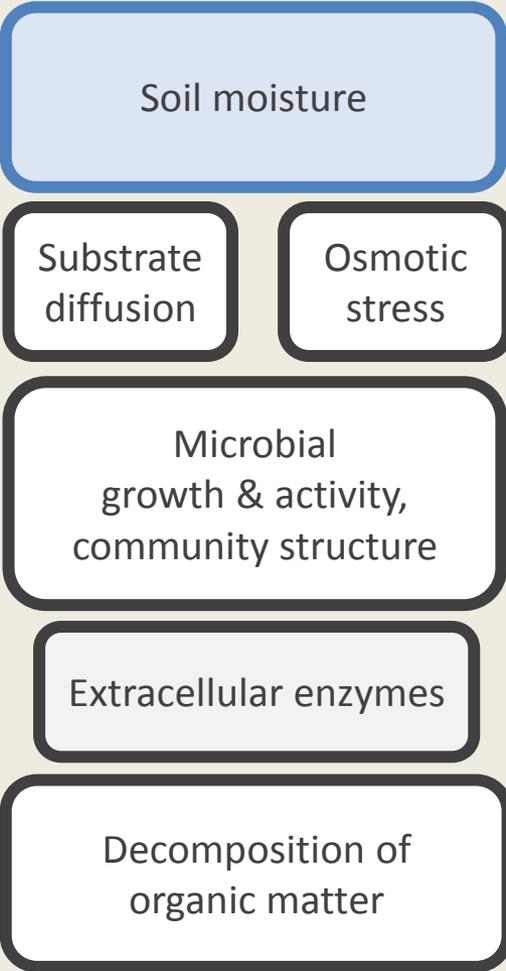
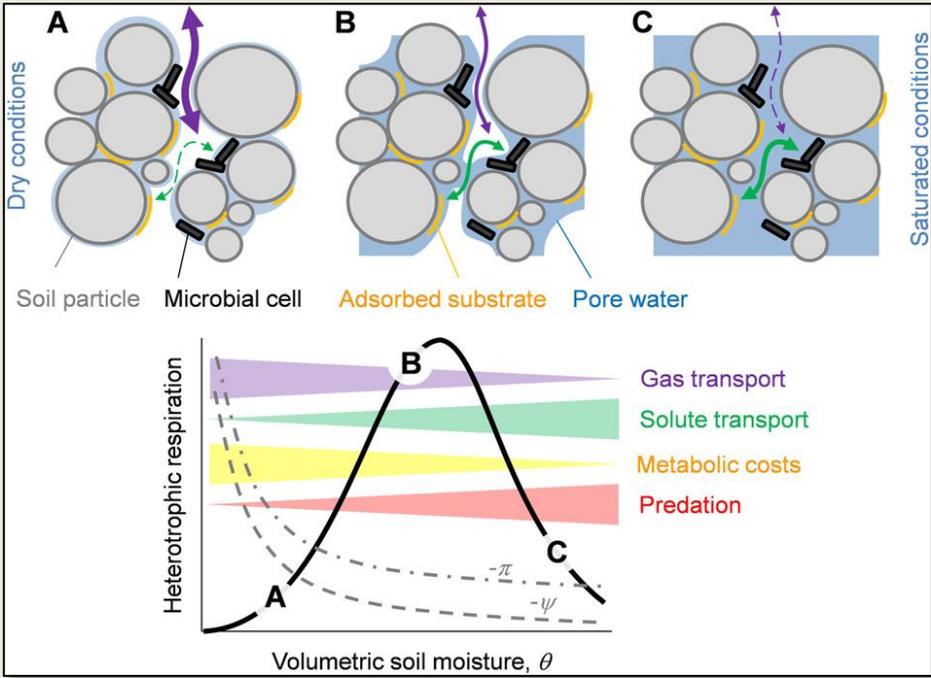


Figure from: Moyano *et al.* 2013, SBB 59, 72-85

# Background



- Irregular rainfall timing
- Higher probability of dry or drought periods
- Affect soil carbon and nutrient cycling

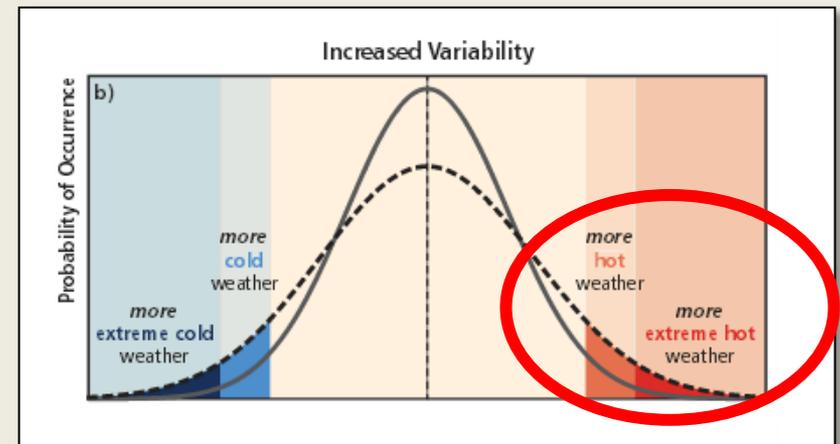
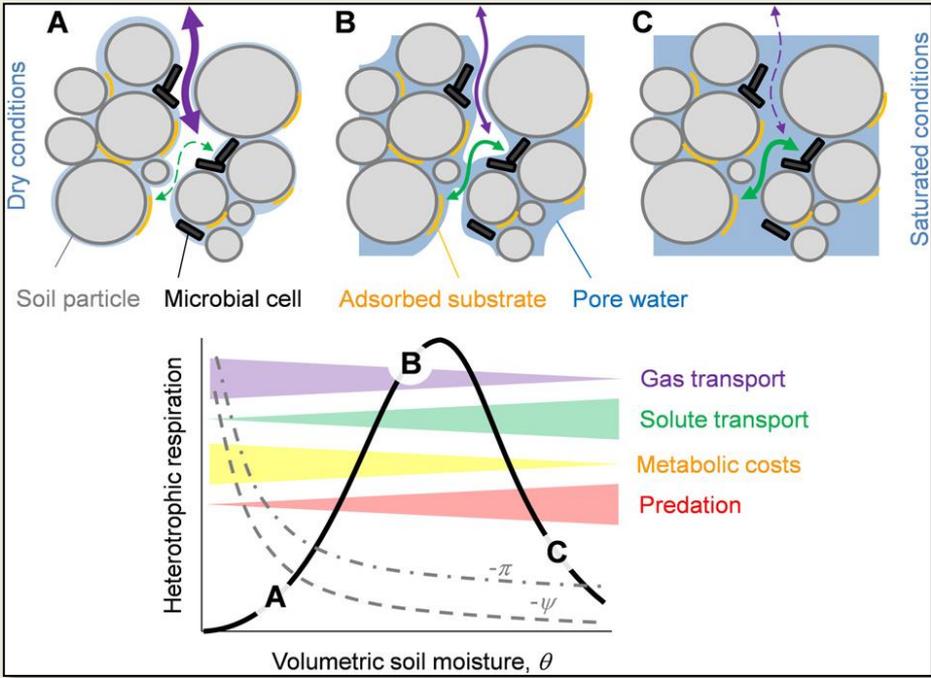


Fig. SPM 3; IPCC SREX 2012

# Background



Soil moisture

Substrate diffusion

Osmotic stress

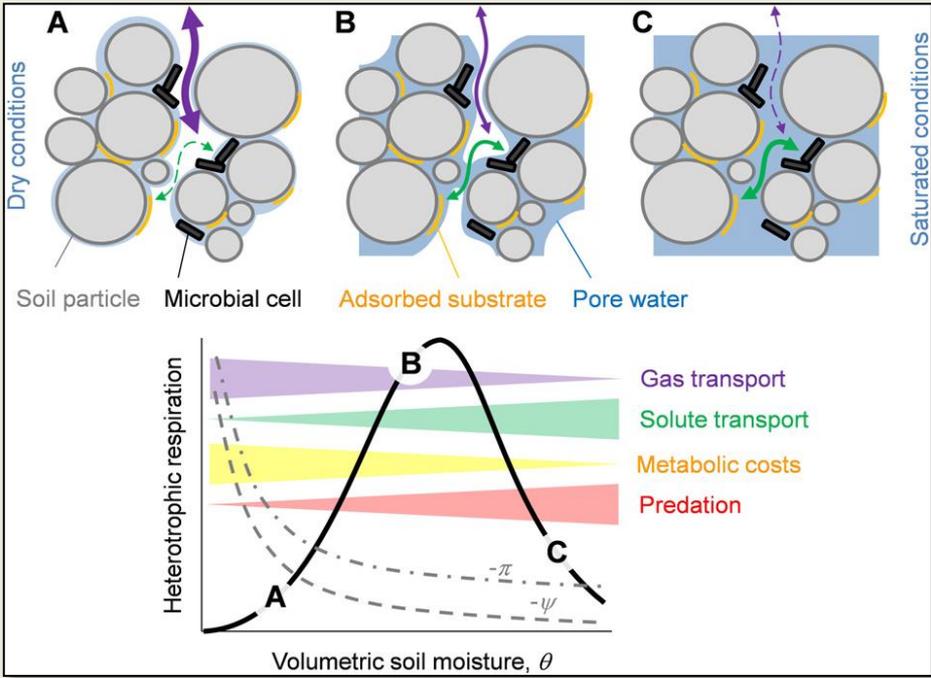
Microbial growth & activity, community structure

Extracellular enzymes

Decomposition of organic matter

Figure taken from: Moyano *et al.* 2013, SBB 59, 72-85

# Background



Soil moisture

Substrate diffusion

Osmotic stress

Microbial growth & activity, community structure

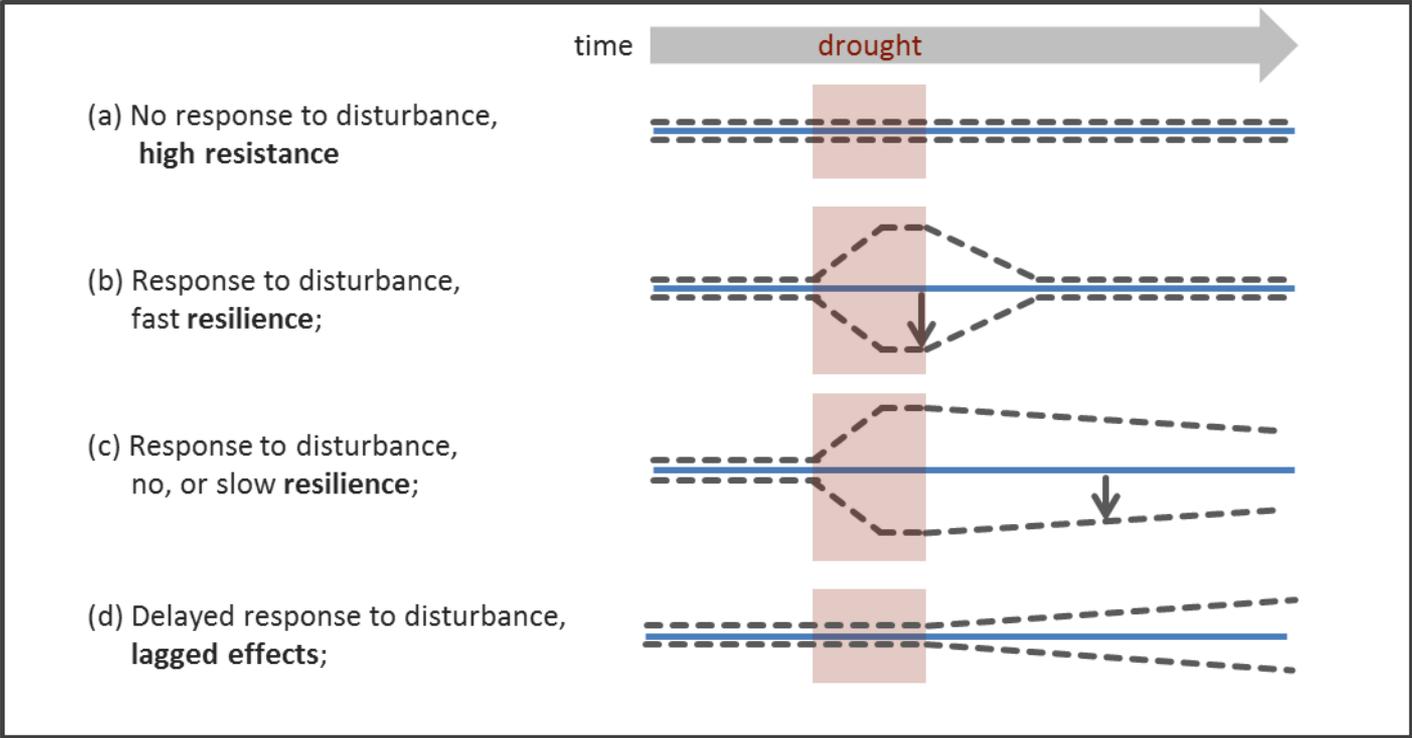
Extracellular enzymes

Decomposition of organic matter

Figure taken from: Moyano *et al.* 2013, SBB 59, 72-85



## Possible responses triggered by drought



# Background



- How does drought alter the potential microbial activity and shifts microbial functioning?
- Can we detect lasting effects or adaptations when soils are exposed to recurrent droughts?



## Study site



- **Subalpine meadow**

Neustift, Stubai Valley, Tyrol

- **Extensive agricultural management**

annually harvested

- **Rain-exclusion since 2008**

~ 1/3 of annual precipitation excluded

Dystric cambisol  
1850 m a.s.l

MAT (°C)	3.0
MAP mm	1097.0
C (%)	6.6
N (%)	0.7
C:N	10.1
pH	4.9

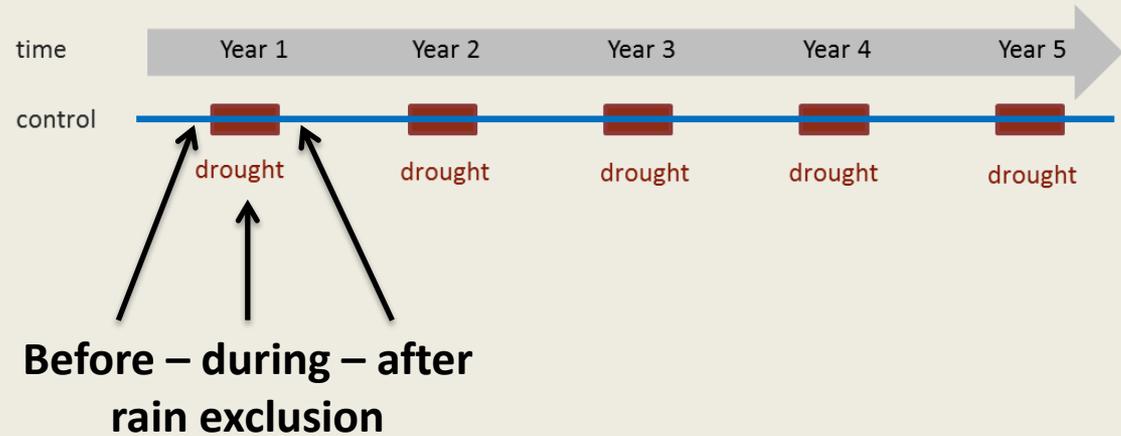
# Study site and experimental setup



## Experimental set-up - sampling

**2011**  
Ambient controls & 1<sup>st</sup> summer drought  
3<sup>rd</sup>  
4<sup>th</sup>

**2012**  
Ambient controls & 2<sup>nd</sup> summer drought  
5<sup>th</sup>



# Study site and experimental setup



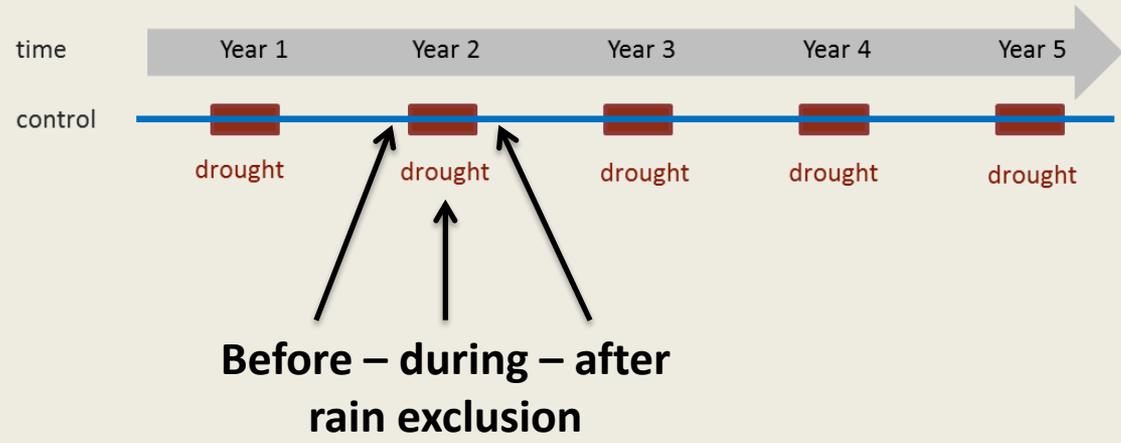
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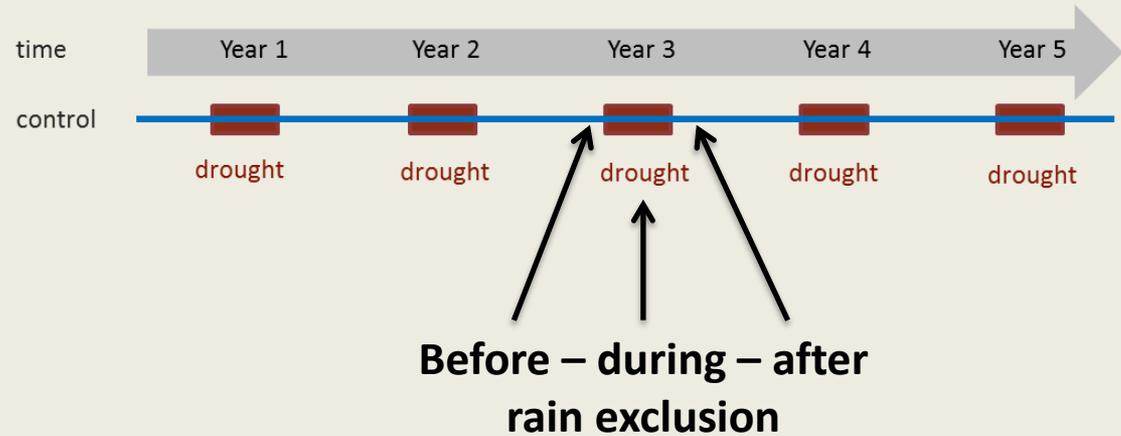
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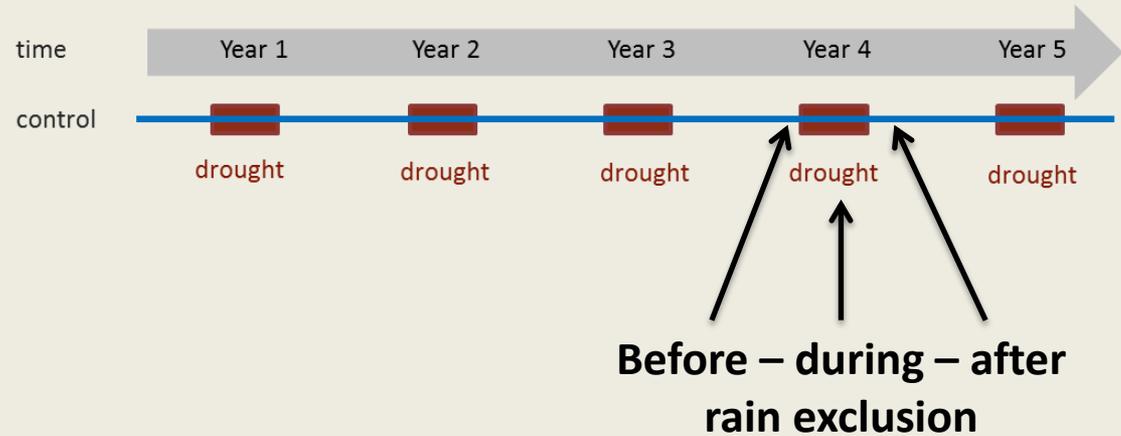
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# Study site and experimental setup



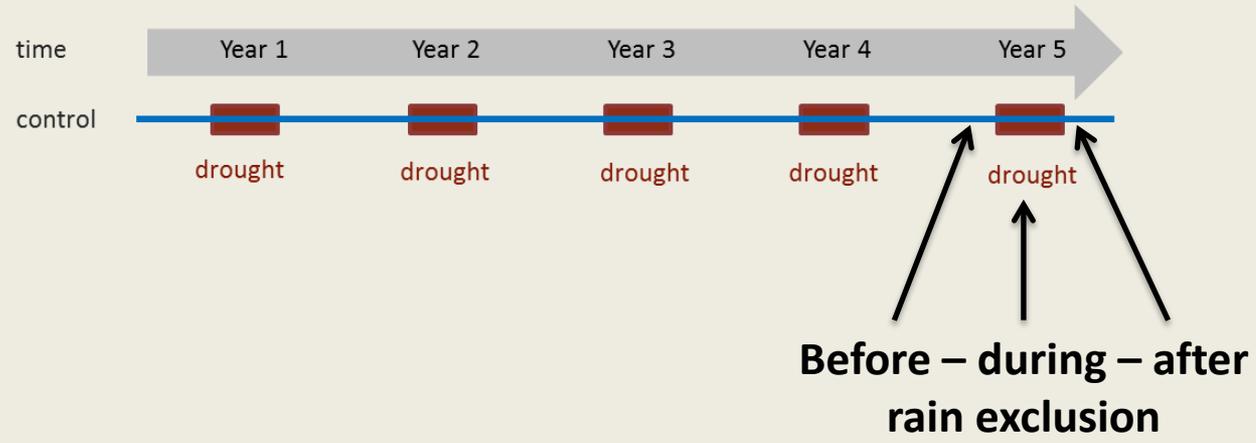
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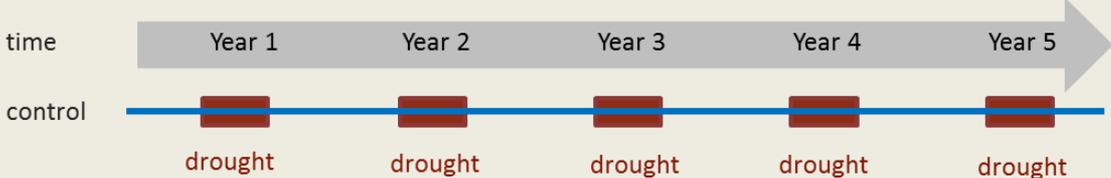
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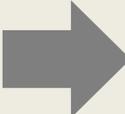


## Experimental set-up - sampling



Potential rates of:

- Cellobiohydrolase (**CBH**)
- Leucine-amino-peptidase (**LAP**)
- Phosphatase (**PHOS**)
- Phenoloxidase (**POX**)



Potential microbial functioning

Soil parameters:

- SWC
- Organic C & N pools

# Results

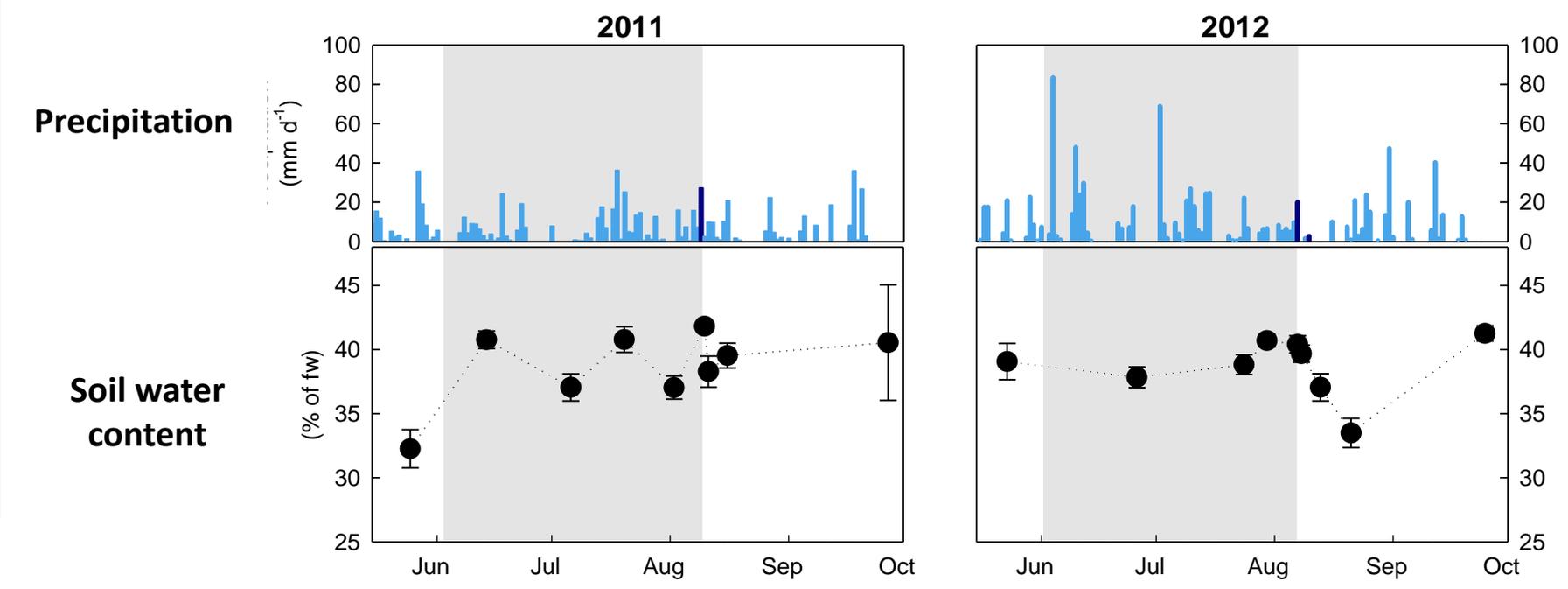


## Ambient conditions

# Results



## Ambient conditions



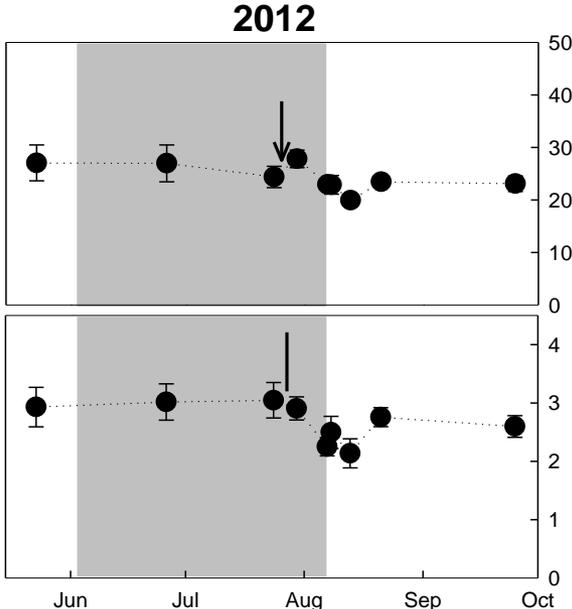
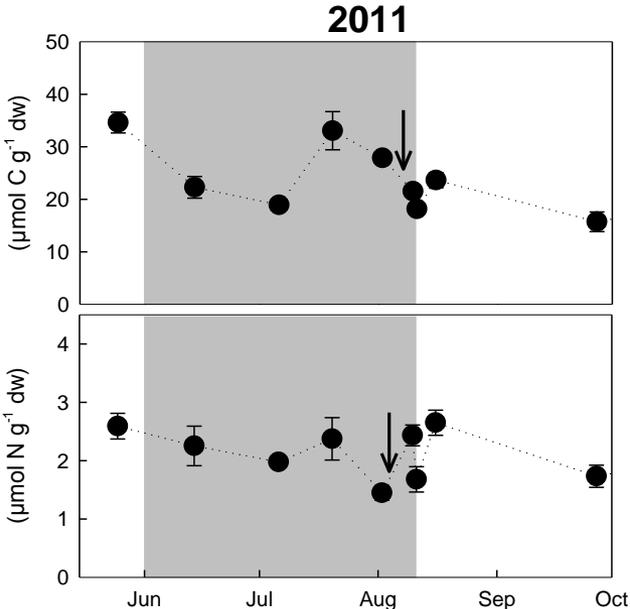
Year: ns  
Sampling date: \*\*\*  
Interaction: \*\*\*

# Results



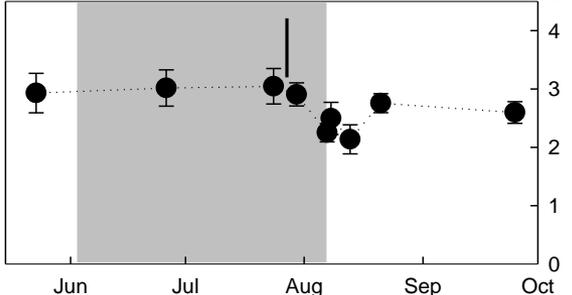
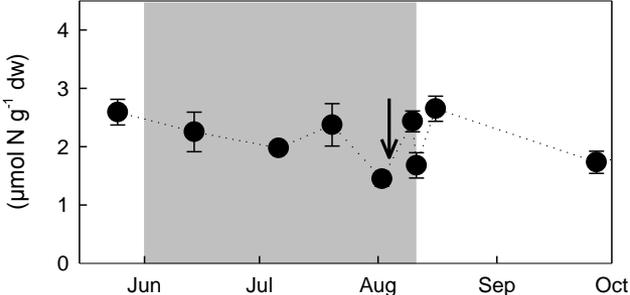
## Inter & intra-annual variability

**Extr.  
Organic C**



**Year:** ns  
**Sampling date:** \*\*\*  
**Interaction:** ns

**Extr.  
Organic N**

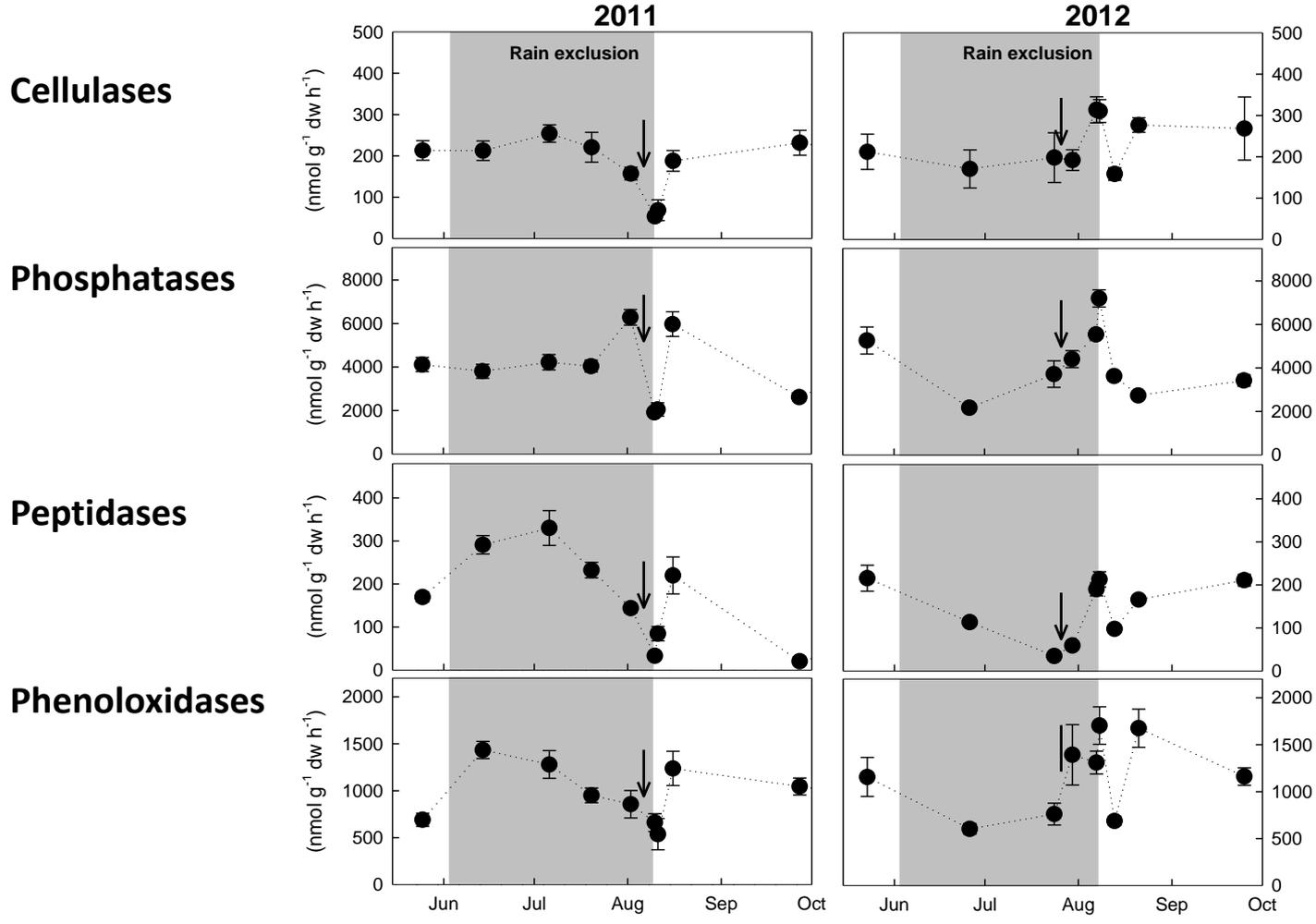


**Year:** \*\*\*  
**Sampling date:** \*\*  
**Interaction:** \*

# Results



## Inter & intra-annual variability



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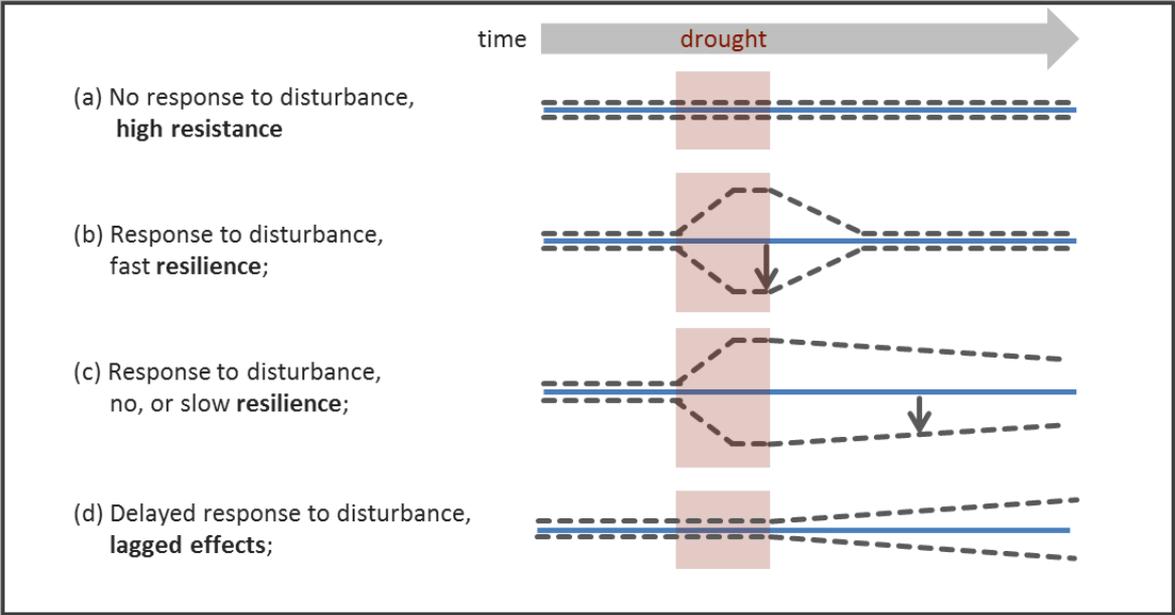
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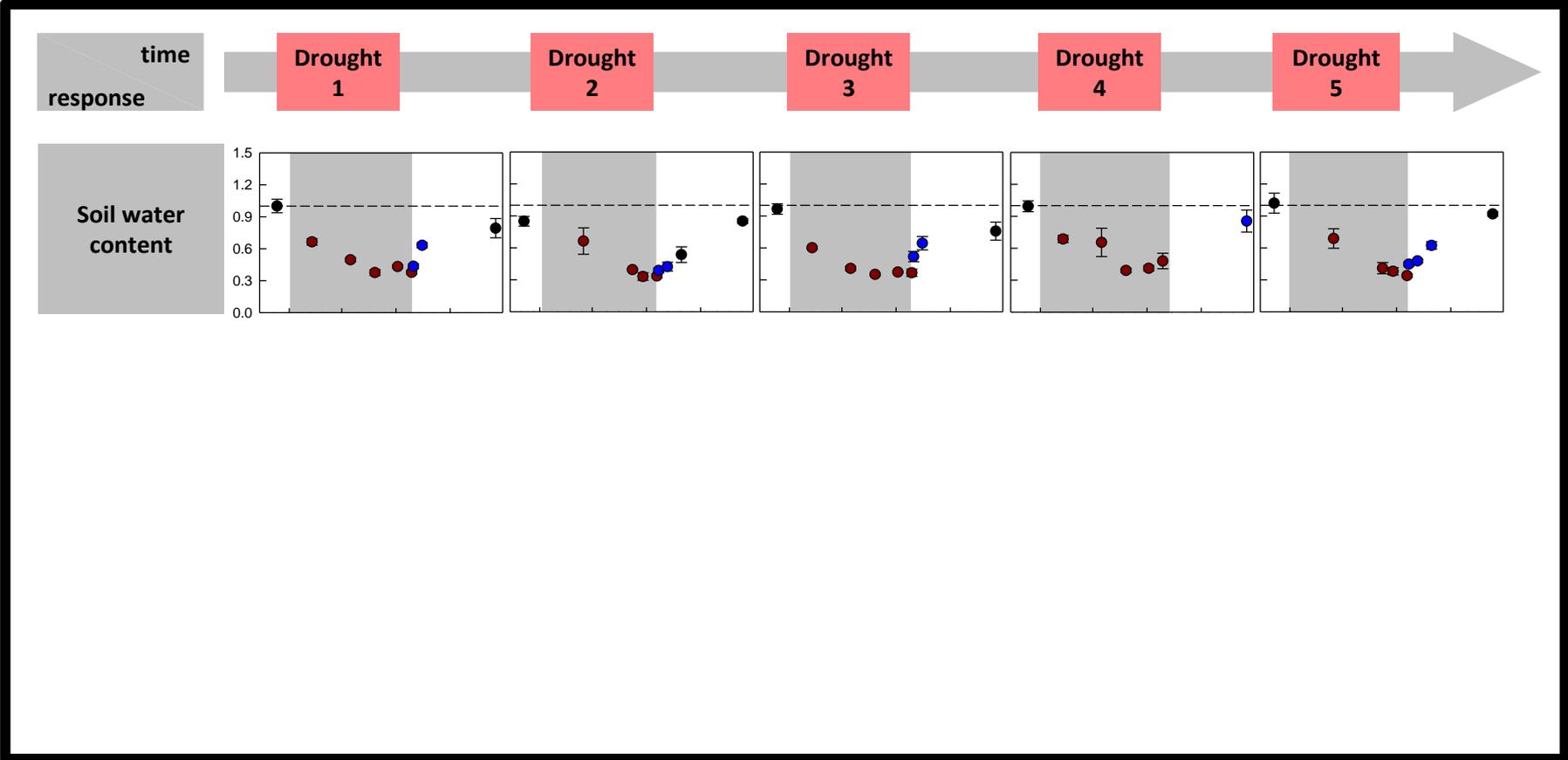
$$\text{Response ratio} = \frac{\text{drought}}{\text{ambient control}}$$



# Results



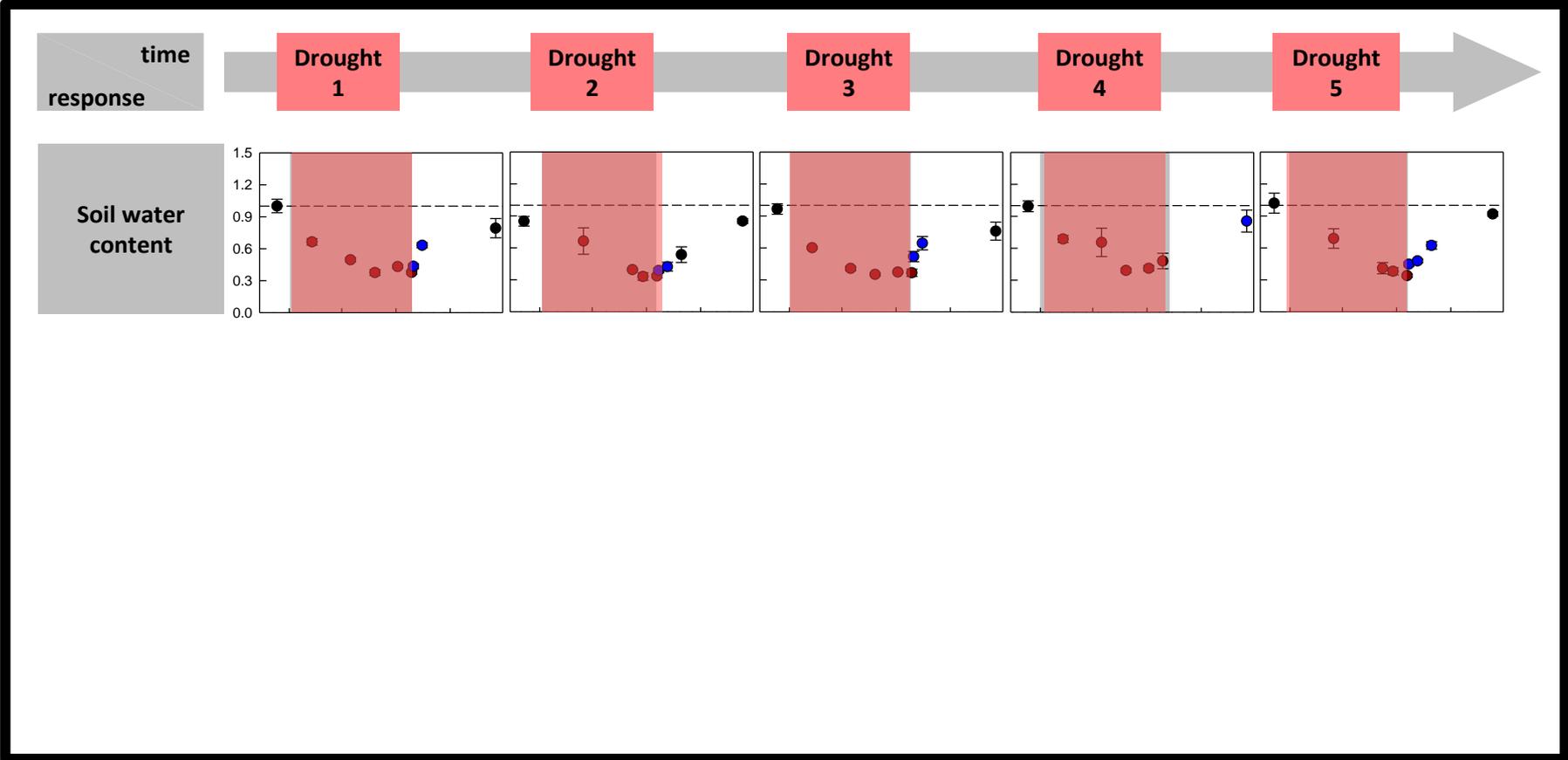
## Soil water and extractable organic carbon & nitrogen



# Results



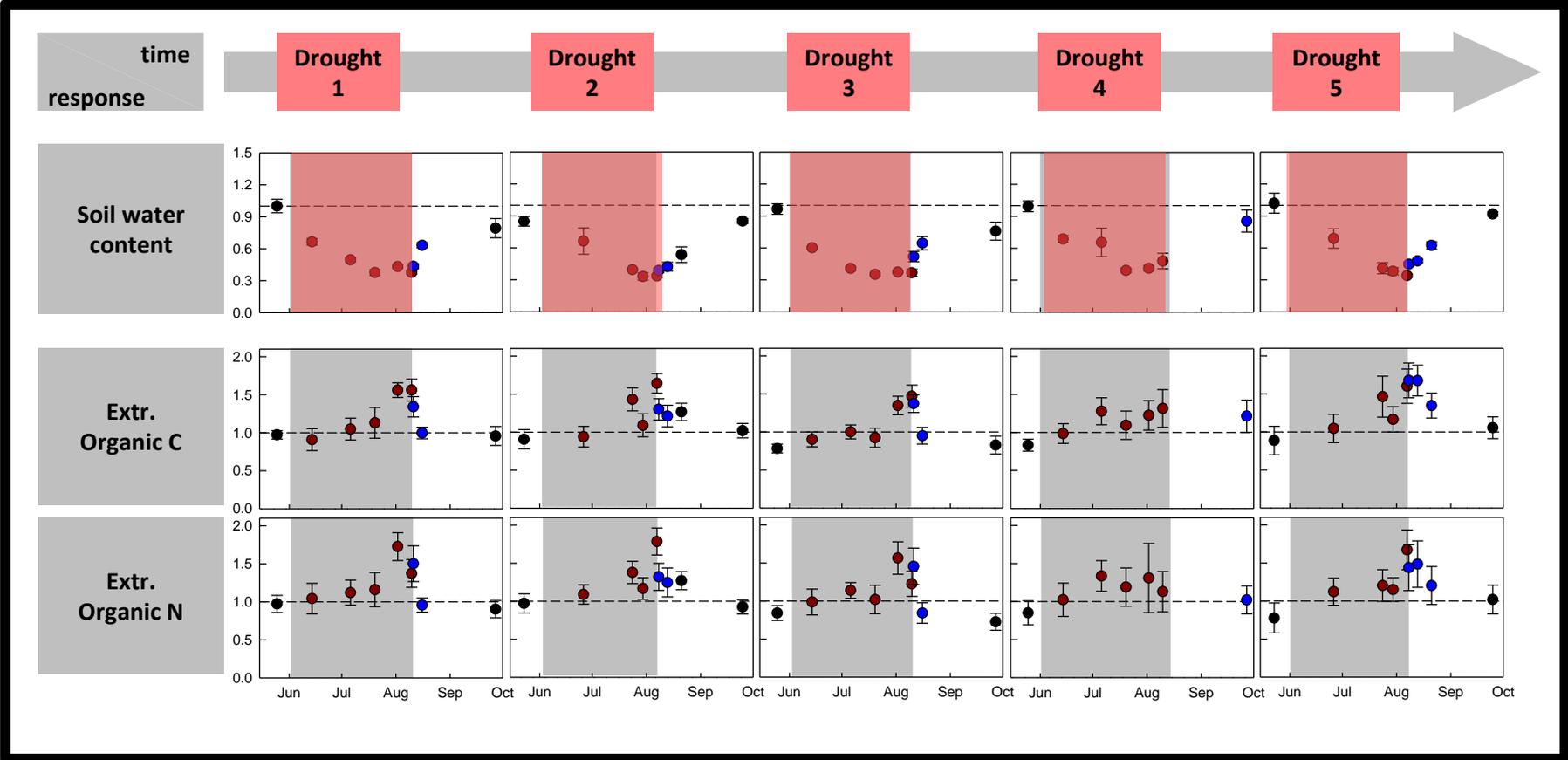
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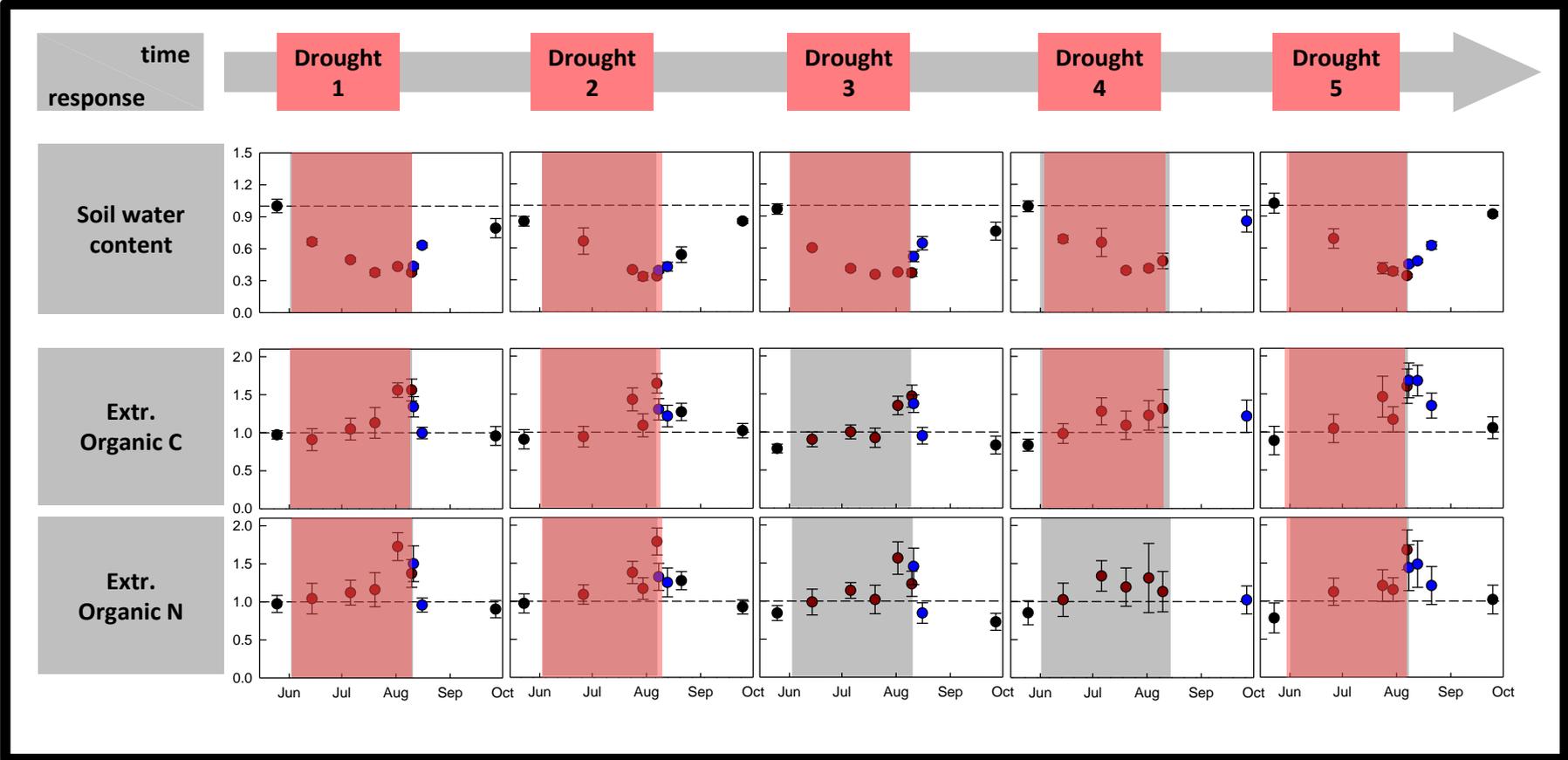
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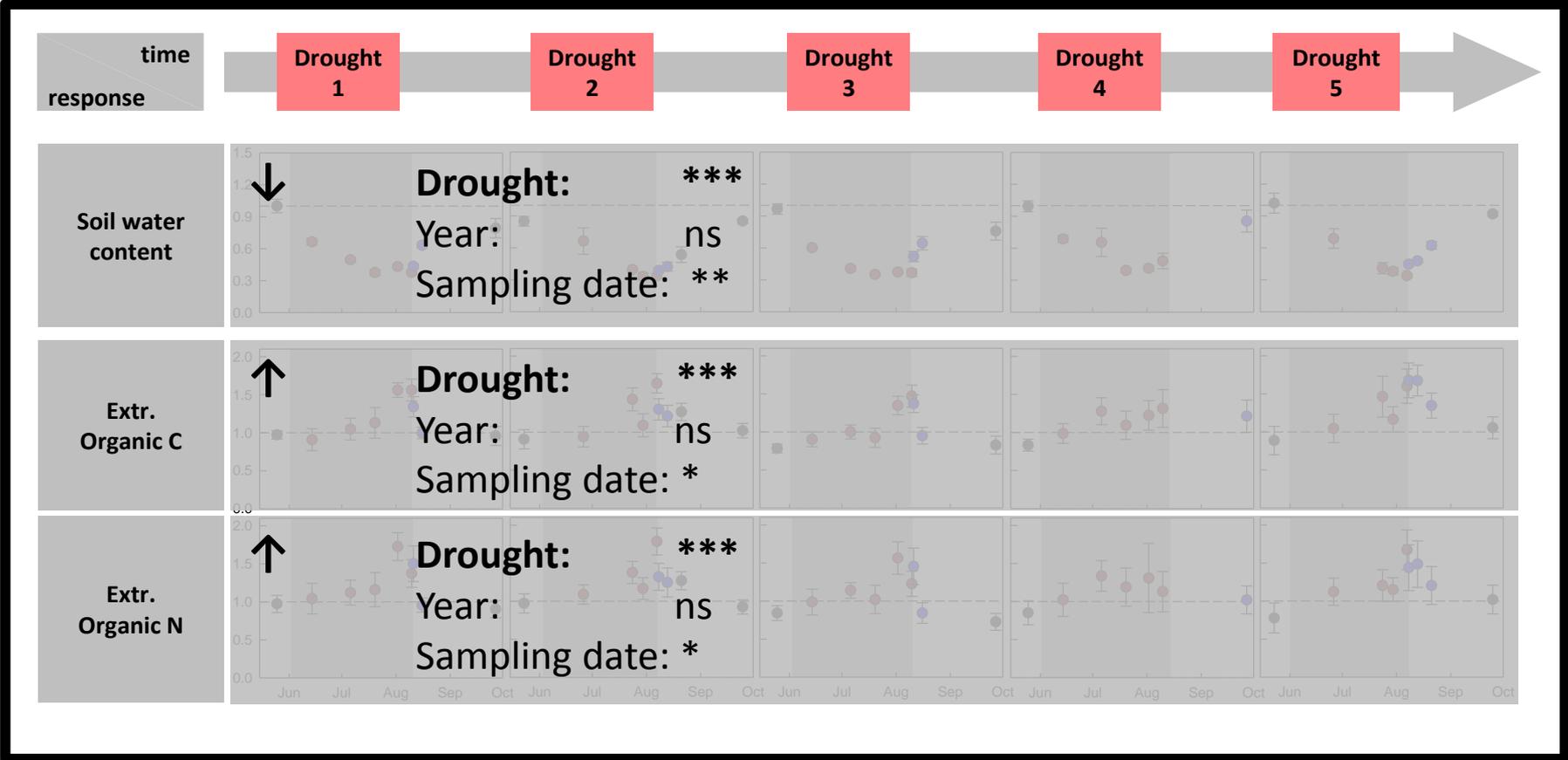
# Results



## Soil water and extractable organic carbon & nitrogen



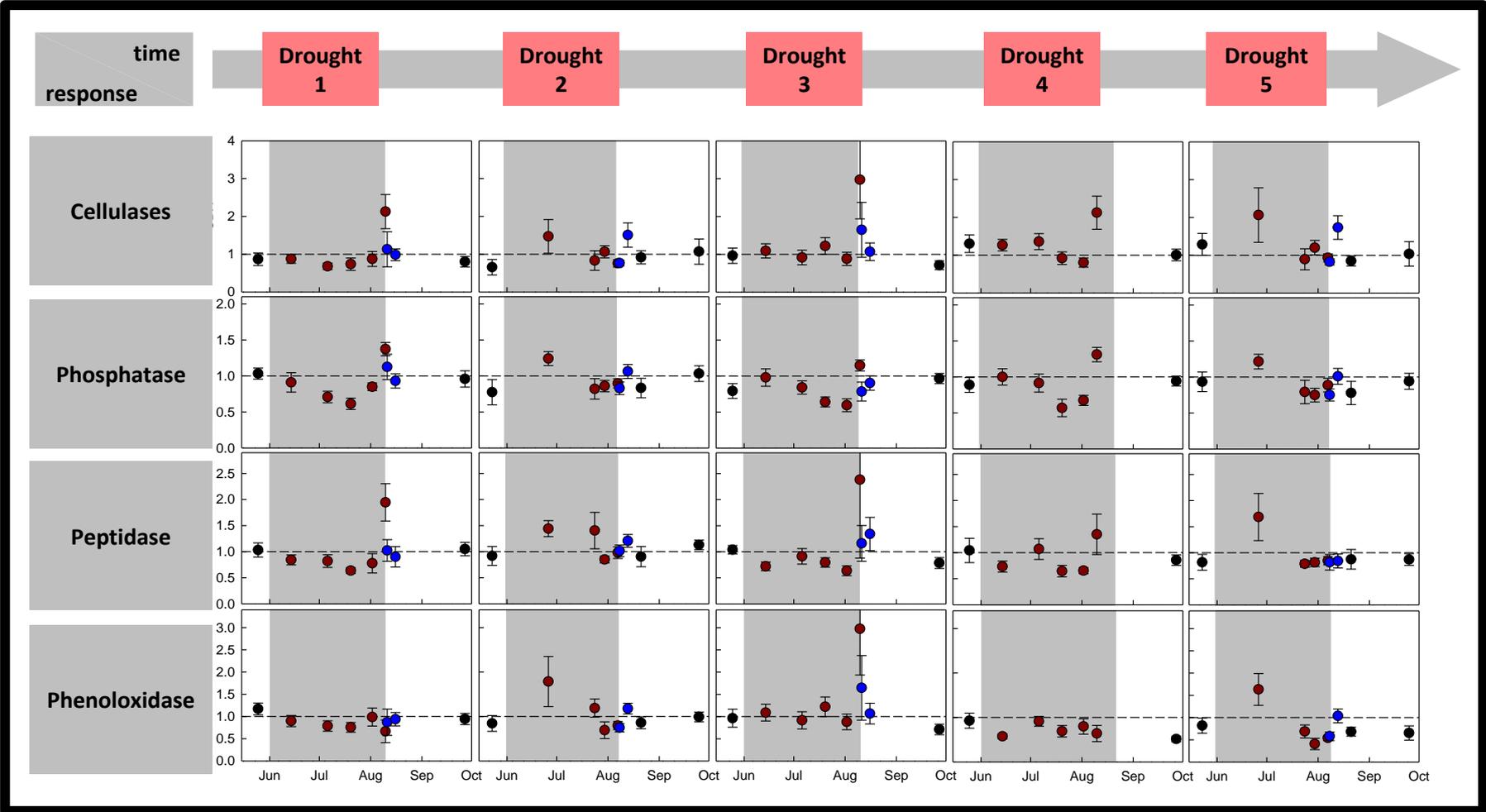
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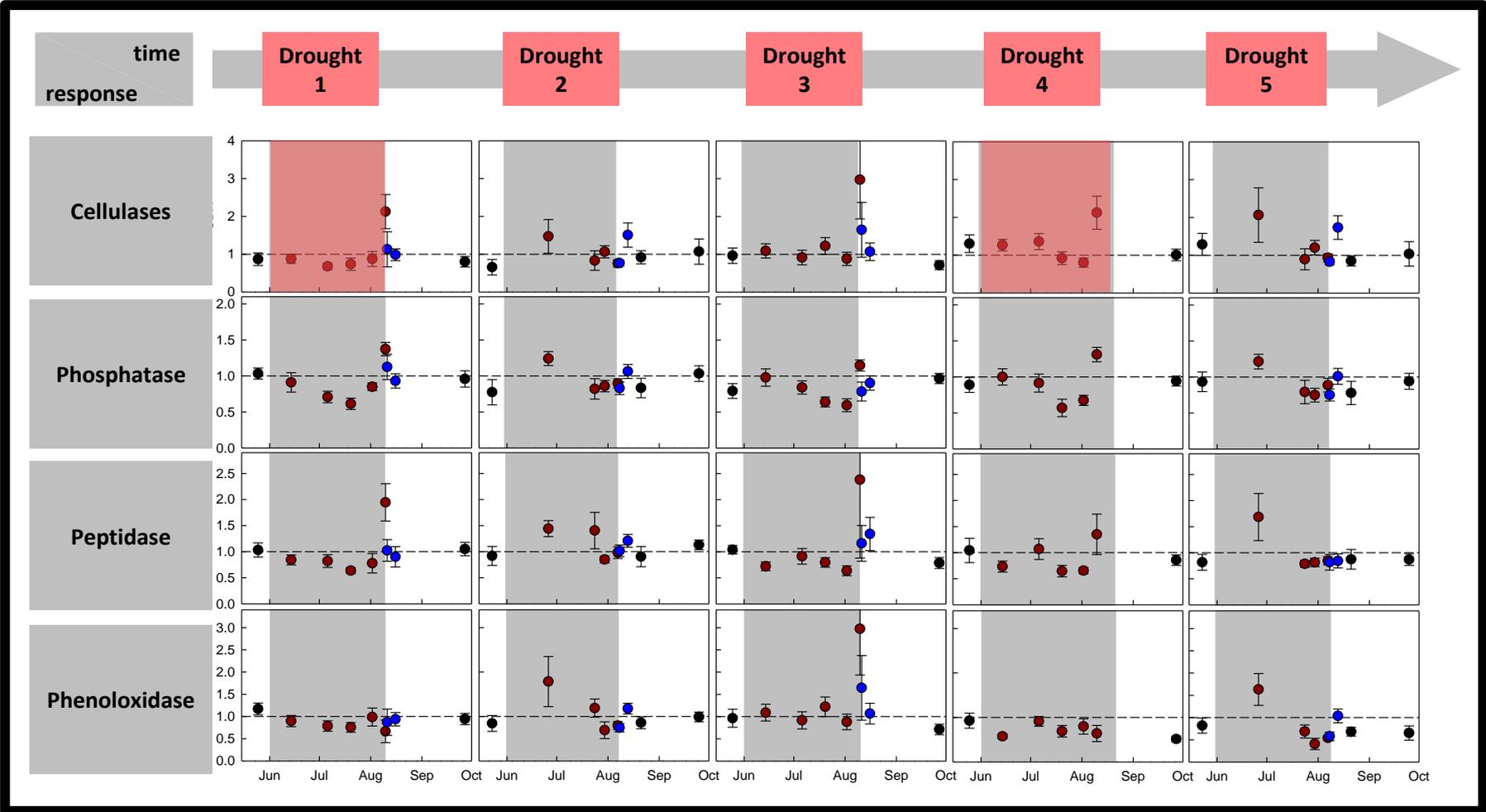
## Potential extracellular enzyme activity rates



# Results



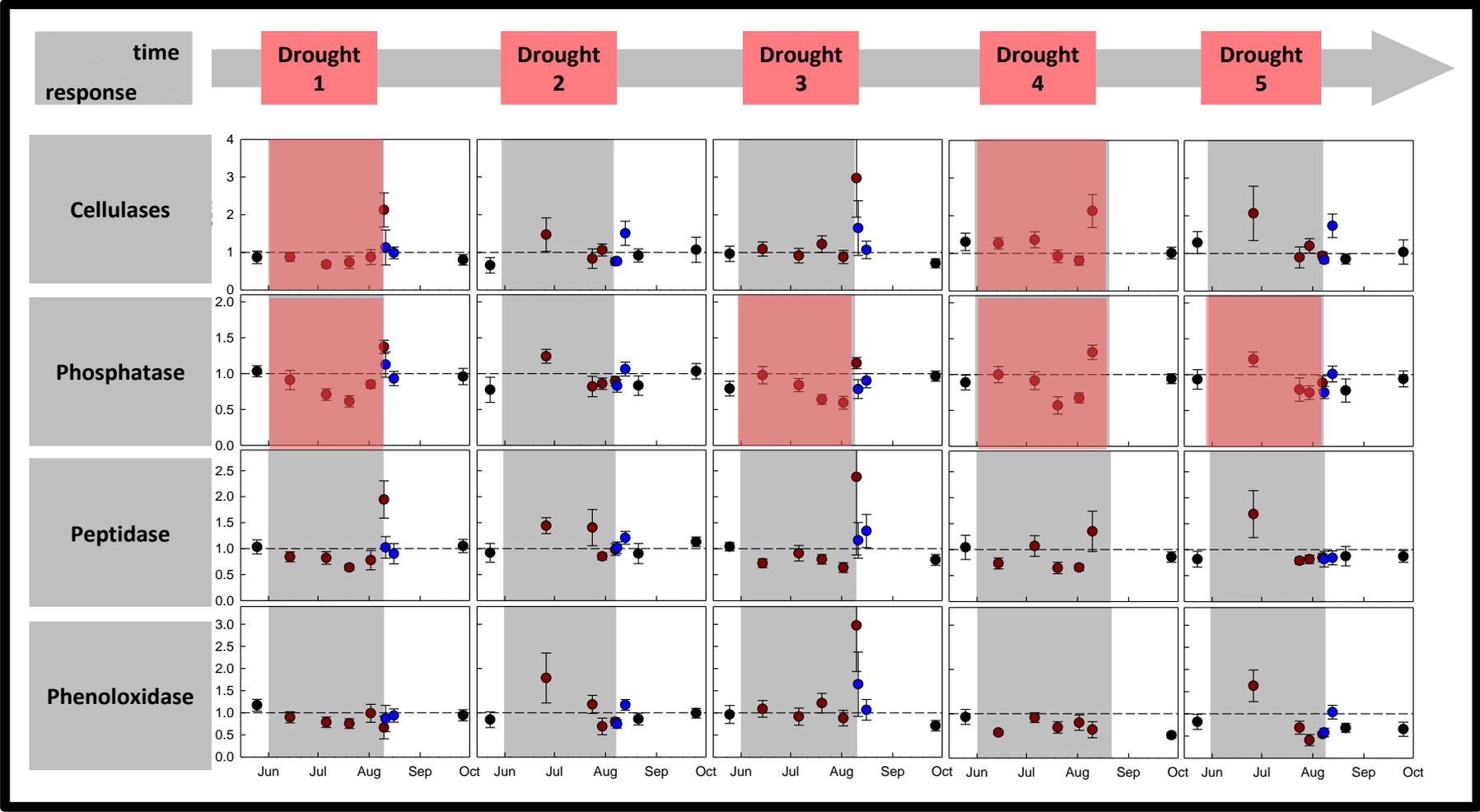
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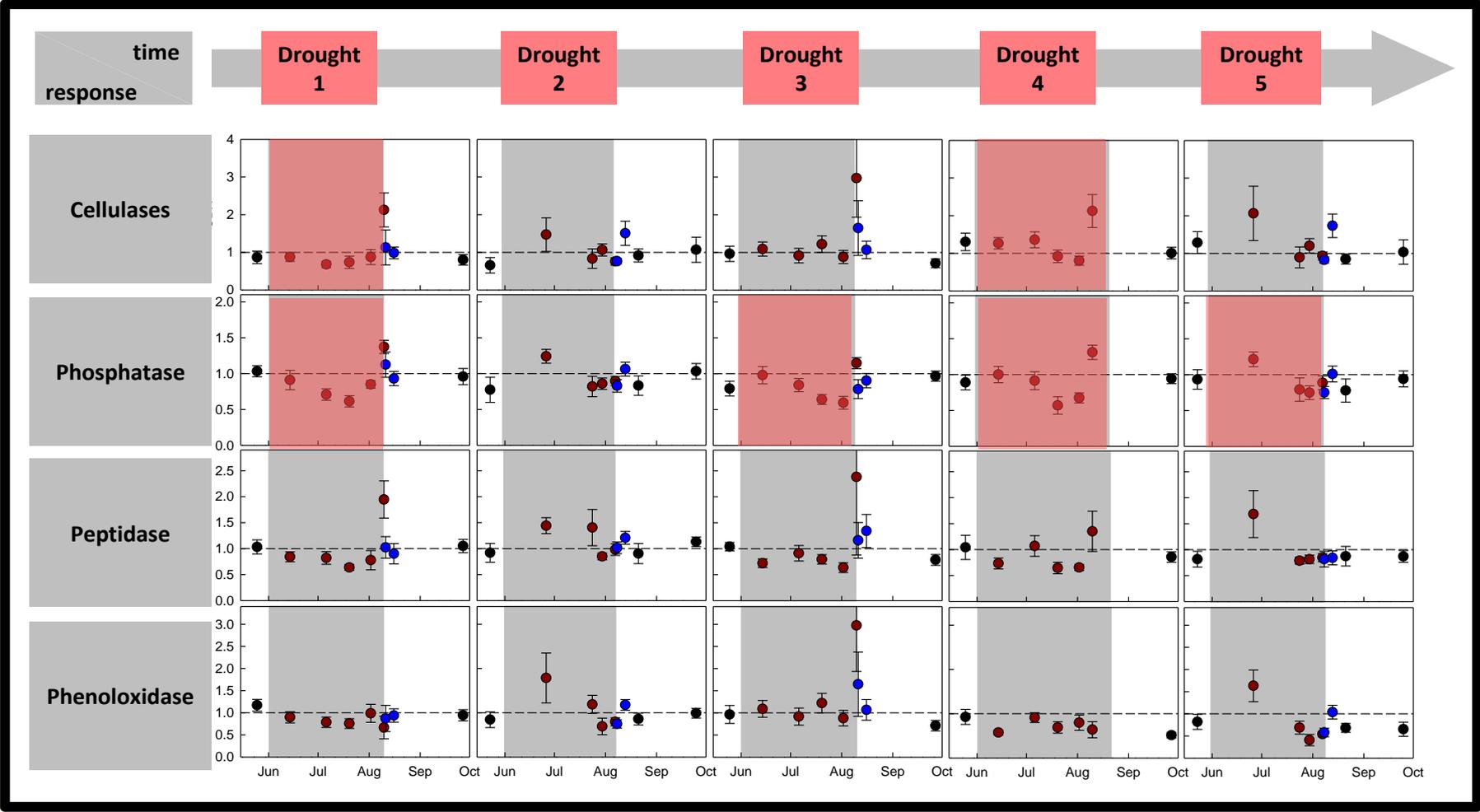
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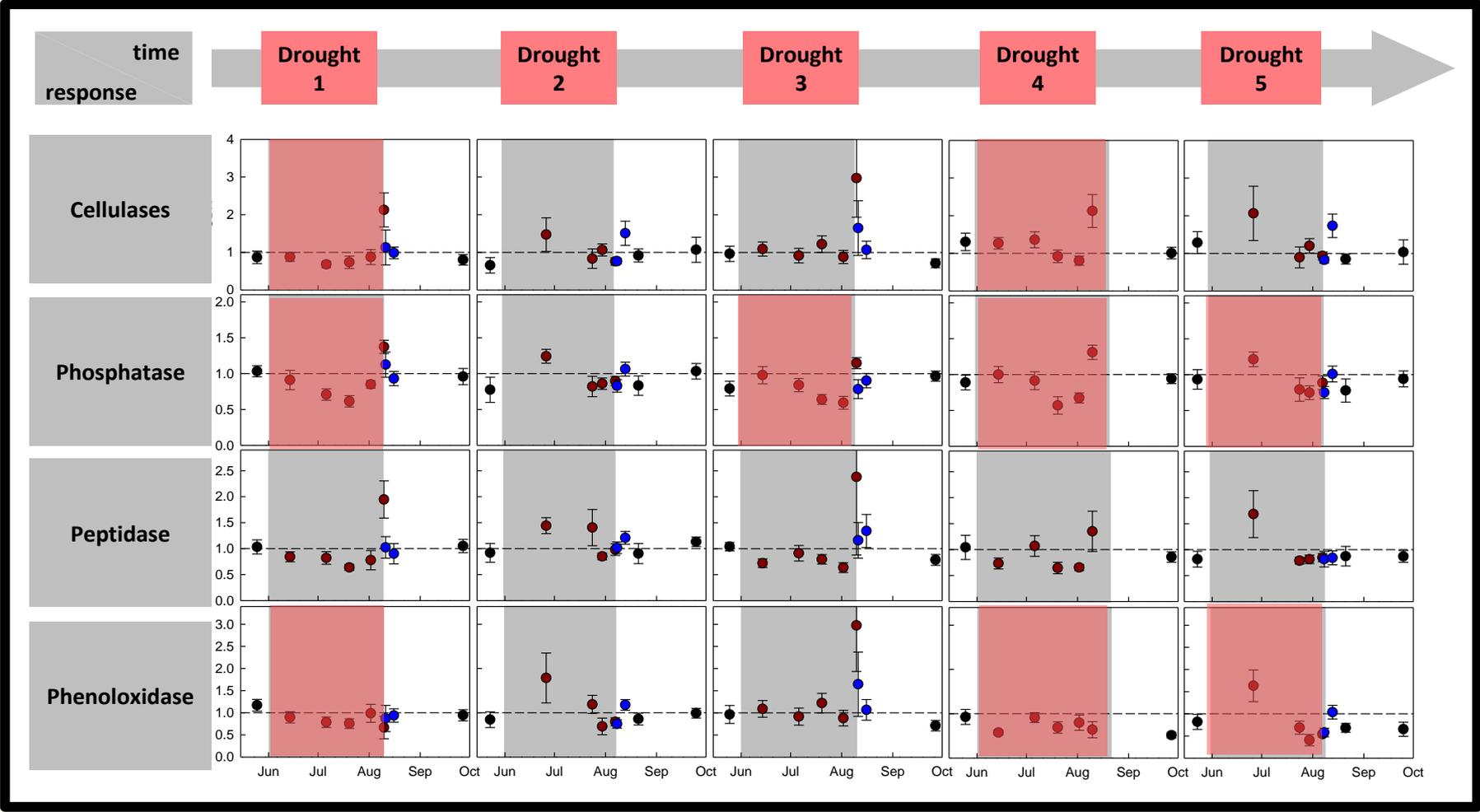
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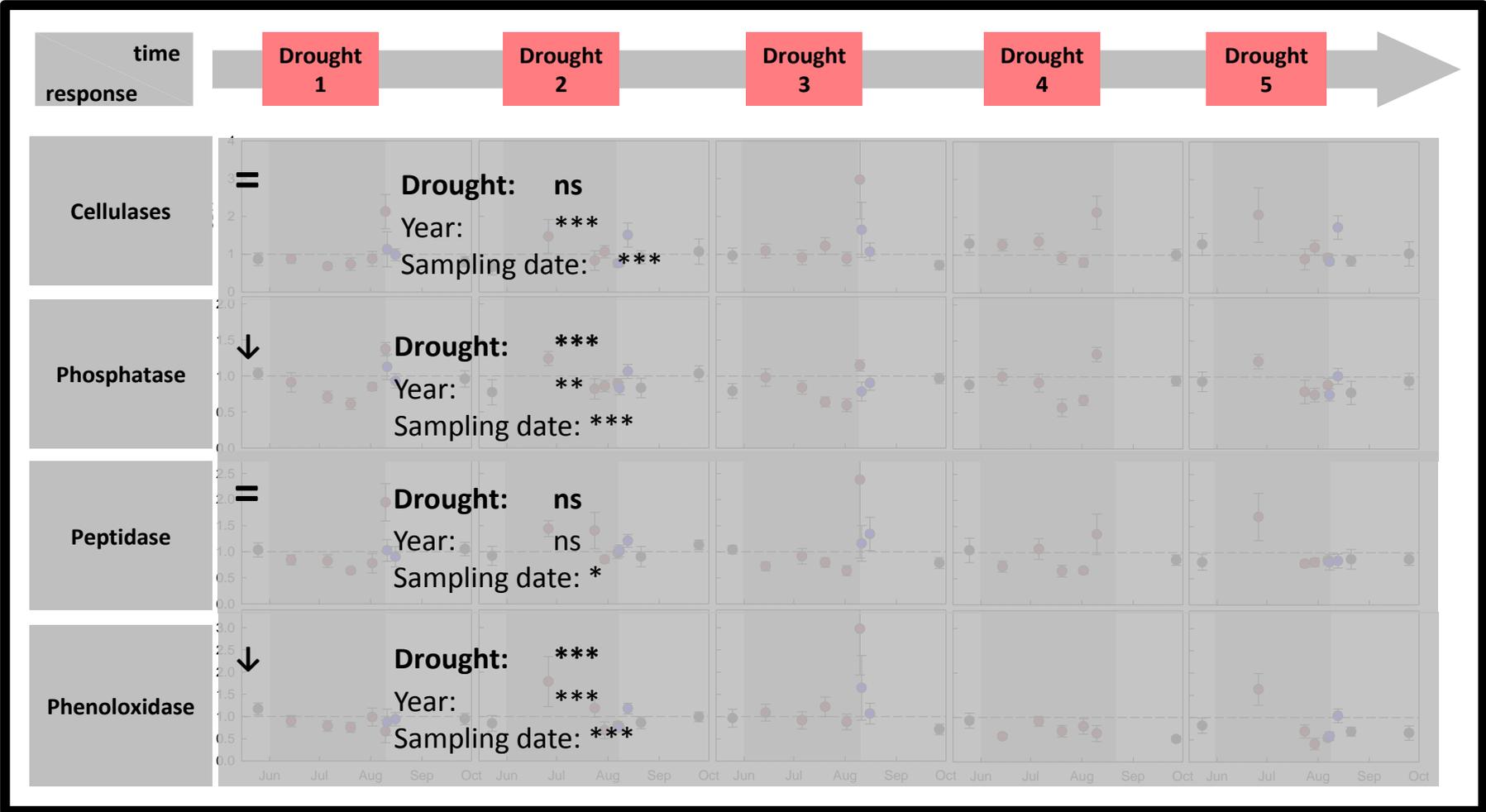
## Potential extracellular enzyme activity rates



# Results



## Potential extracellular enzyme activity rates



# Summary and Conclusions



- How does drought alter the potential microbial activity and shifts microbial functioning?
  - ✓ Distinct responses of different EEA rates
  - ✓ Indicates a functional shift
    - microbial community composition?
    - substrate availability?
- Can we detect lasting effects or adaptations when soils are exposed to recurrent droughts?
  - Not really at this level,
  - ✓ Highly resilient system,
  - ✓ high intra and inter-annual variability



**Thank you!**

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