Impact of drought on C forms and fluxes in the soil – plant continuum

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Occurrence of drought

Global warming is likely to increase the risk of drought stress in many parts of the world. Its occurrence limits plant productivity and thereby affects the soil compartment. However, the effect of drought on the soil system is poorly known.
Drought could impact organic matter formation through its effect on plants and soil.

How does drought affect C storage within the plant soil system?
Specific Objectives

- Evaluate changes in biogeochemical composition of plant material exposed to drought

- Assess the potential mineralisation of drought affected material once added to soil

- Evaluate the drought effect on the mineralisation on plant material of contrasting quality

- Determine drought effects on C flow in the plant-soil continuum
Study site

Long-term Observatory for Environmental Research (ORE), Lusignan, France

MAT : 10.5 °C
Annual rainfall: 600 mm
Flat temporary grassland
Cambisol with loamy texture
Drought stress resulted in an increase in N content leading to a decrease in the C/N ratio which was more prominent in *D. glomerata.*
Drought changes plant biochemical composition

F. arundinacea

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<th>Control</th>
<th>Drought</th>
<th>Temperature</th>
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<tbody>
<tr>
<td>Lignin/N</td>
<td>1.01</td>
<td>0.51</td>
<td>0.35</td>
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D. glomerata

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</thead>
<tbody>
<tr>
<td>Lignin/N</td>
<td>0.77</td>
<td>0.30</td>
<td>0.26</td>
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Drought and elevated temperature treatments resulted in decrease in lignin contents while increase in non-cellulosic sugar contents.
Drought effect on the mineralisation on plant material of contrasting quality

- Elemental C, N, their stable isotopes, VSC lignin and non-cellulosic sugars were analyzed.
Brown litter decomposition is slower than decomposition of green litter, especially in the early phase.

Drought reduces degradation of both litter types.
Drought effects on C flow and enzyme production

Total $^{14}$C activity
1480 K bq

(Kuzyakov et al. 2000)
Drought impact on $^{14}$C incorporation into dissolved organic carbon

Drought increases root exudation, except for M. sativa
Extracellular Enzyme Activity

Drought affects enzyme activity, especially those involved in the N cycle.
Drought effects on SOM formation

Drought affect the plant litter biochemistry
Sanaullah et al., 2014, Plant and Soil

Drought affect plant litter decomposition
Sanaullah et al., 2012, Plant and Soil

Drought affect soil enzyme activity
Sanaullah et al., 2011, Applied Soil Ecology

Drought affects C transfer in the plant soil system
Sanaullah et al., 2012, SBB

Drought effects on soil C storage are a combination of this different effects. Plant species specific responses need to be taken into consideration.
Acknowledgements

Funding:

- Higher Education Commission (HEC), Pakistan
- La Région Poitou-Charentes: Excellence Environnementale et Développement des Eco-Industries
- MEC program, Fondecyt, Chile

Technical support:
Xavier Charrier, Christophe De Berranger, Gerard Bardoux, Nicolas Pichot, Daniel Billou and Valérie Pouteau