Effects of long term soil organic matter restitution mode on soil heterotrophic respiration and soil biological properties.

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1. Introduction.

- Soil heterotrophic respiration (SHR) is an important process to study given the possibility of a positive feedback to global change in the future.
- Agricultural soils are potentially large sources of CO₂, on which crop management has a considerable influence.

**Objectives:**
- Does long-term (> 50 years) application of different organic matter restitution modes (OM-RM) cause differences in SHR fluxes?
- Do different OM-RM imply different responses of SHR to temperature and soil moisture content?


**A. Study field:**
- Situated in Liroux, near Gembloux.
- 6 different OM-RM (RM1, RM4, RM6) applied since 1959.
- 6 plots (repetitions) in each treatment: 10 by 70 (or 60) m.
- All plots ploughed over 0-25 cm depth.

**B. Studied OM-RM:**
- RM1: CONTROL (exportation of all crop residues).
- RM4: MANURE (input of manure every 3 to 4 years).
- RM6: RESTITUTION OF CROP RESIDUES (after each crop season).

**C. Experimental design:**
- Soil CO₂ flux measurements in weeded areas (3 m by 3 m, blue squares in Fig.1) in 3 out of the 6 repetition plots. In 2011, we focused on the two most contrasted treatments, for which we increased the number of measurement points.

<table>
<thead>
<tr>
<th>Measurement campaigns</th>
<th>2010</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement period</td>
<td>2 April – 30 July</td>
<td>5 May - onwards</td>
</tr>
<tr>
<td>Studied OM-RM</td>
<td>RM1, RM4, RM6</td>
<td>RM1, RM4</td>
</tr>
<tr>
<td>Number of measurement points/plot</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>Total number of points/treatment</td>
<td>12</td>
<td>18</td>
</tr>
</tbody>
</table>

**D. Measurements:**
- Soil CO₂ fluxes: Dynamic closed chamber system (Li-Cor Li-6400XT equipped with a 6400-09 Soil Chamber (Li-COR Biosciences Inc., US)).
- Soil temperature: 5 cm depth.
- Soil moisture content: 0-5 cm depth.

3. Results.

**A. Temporal evolution of soil CO₂ fluxes, temperature and moisture content.**

**B. Soil CO₂ fluxes vs Soil temperature.**

**C. Soil CO₂ fluxes vs Soil moisture content.**

**4. Discussion**

- No differences appear between the treatments in terms of SHR fluxes.
- Problem of spatial variability
- Both years, impact of drought, low fluxes, smaller differences, more difficult to put forward.
- Important response to rain events in 2010:
  - Possibly due to re-solubilization of labile carbon.

**5. Perspectives**

A. Soil microbial properties will be studied between treatments, for example:
- Basal respiration
- Labile C and N
- Metabolic profiles
- Microbial biomass

B. In the Manure treatment, soil CO₂ fluxes will be compared with and without fresh manure input.

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