Effect of repeated organic residue applications on soil microorganisms involved in N cycle and their activities at the plot scale: consequences on ecosystem services

**Introduction**

Use in agriculture of municipal or agricultural residues (Organic Waste Product, OWP):
- Addition of mineral and organic N in soil
- Impact on N cycle and associated ecosystem services (soil fertility, water quality, air quality, climate regulation)?

**Material and Methods: the field experiment**

**QualiAgro (78, France)**

**Sampling, methods and measures**

- Loamy soil on carbonated loesses
- Initial characteristics (1998): pH=6.9, organic N=1.1 g/kg, C/N=9.5
- Crop succession: wheat-corn (residuals exported for wheat, incorporated for corn)
- OWP application after wheat in September every 2 years; Doses equivalent to 41 ChA (10 à 20 ChA DM/ha)

**Treatments:**
- C: Control without OWP application
- CN: Control without OWP application enriched with N
- OWP: Municipal solid waste compost
- GWS: Co-compost of green waste and sewage sludge
- BIO: Bio-waste compost
- FUM: Farm yard manure

**Table 1. Average characteristics of OWP applied on QualiAgro site between 1998 and 2011**

<table>
<thead>
<tr>
<th>Units</th>
<th>MSW</th>
<th>GWS</th>
<th>BIO</th>
<th>FYM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Matter</td>
<td>%FM</td>
<td>69±12</td>
<td>63±8</td>
<td>70±8</td>
</tr>
<tr>
<td>Applied quantity</td>
<td>1 DM ha⁻¹</td>
<td>12±0.3</td>
<td>16.4±2.7</td>
<td>19.1±4.2</td>
</tr>
<tr>
<td>Organic Carbon</td>
<td>g kg⁻¹ DM</td>
<td>308±45</td>
<td>265±44</td>
<td>208±47</td>
</tr>
<tr>
<td>Total Nitrogen</td>
<td>g kg⁻¹ DM</td>
<td>17.6±2.0</td>
<td>23.5±2.7</td>
<td>17.4±4.5</td>
</tr>
<tr>
<td>Mineral Nitrogen</td>
<td>g kg⁻¹ DM</td>
<td>0.4±0.2</td>
<td>2.6±0.9</td>
<td>0.5±0.3</td>
</tr>
<tr>
<td>Organic Nitrogen</td>
<td>g kg⁻¹ DM</td>
<td>17.2±1.9</td>
<td>20.9±2.5</td>
<td>16.9±4.2</td>
</tr>
<tr>
<td>Inoc²</td>
<td>%OM</td>
<td>48.8±13.1</td>
<td>77.6±8.7</td>
<td>75.5±6.3</td>
</tr>
</tbody>
</table>

²Lashermes et al. 2009.

**Effect of OWP on denitrifying populations**

- **Most efficient OWP = GWS and BIO** → potential substitution of mineral fertilizer.
- **Increased mineral N available compared to control (Kg N/ha) = increased mineral N at sampling + enhanced organic N mineralization from increased soil organic matter and from recently applied OWP.**

**Effects of OWP on nitrifying bacterial populations (AOB) carrying amoA gene**

- **Stimulation of nitrifying bacterial populations at short term in GWS plot probably because of the high initial proportion of NH₄⁺ in the GWS compost (Table 1).**

**N₂O emissions**

- **Very low fluxes of N₂O: 0.02 to 0.3 % of N applied after 72 days.**
- **MSW>BIO>GWS>FYM>CN.**

**Perspectives**

Measure of the potential NH₃ volatilization and estimation of nitrates leaching following OWP application to be able to make the environmental balance of this practice.

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