Response of transplanted Chernozems towards C addition after 21 years of identical climatic, topographic and management practices.

Soils and Crops - March 2016
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Long-term Transplanted Soils

- 36 different Chernozems
- Continuous cultivation-wheat
- N fertilizer - 0 and 60 kg N ha\(^{-1}\)
- Crop residue removal

Janzen et al., 2012
Continuous removal of crop residues for 21 years
Objectives

- To observe the microbial assimilation of soil incorporated C (cellulose) in different soils.

- To observe the influence of long term N fertilizer application on $^{13}$C labelled cellulose decomposition in different soils.
Effect of Residue Removal on Soil Total Organic C After 21 Years

- Cereal cultivated
- Native pastureland
- Dryland till-fallowed
- Manured (30 t ha⁻¹)

% Δ soil organic C (1990 - 2012)
Soil moisture level: 70% of field capacity

Temperature: 20°C

Incubation period: 72 days
Gas sampling and microbial analysis

Determination of $^{13}$C labelled decomposition

- Gas sampling
- $^{12}$CO$_2$ soil + $^{13}$CO$_2$ cellulose

Destruction sampling of soil microcosms

- Phospholipid fatty acid analysis
- $^{13}$C enriched PLFAs (Mass spectrophotometer)
## Results

**History of N addition increased C decomposition**

<table>
<thead>
<tr>
<th>Transplanted soil type</th>
<th>N History (kg ha(^{-1}))</th>
<th>Cumulative C-CO(_2) (mg kg(^{-1}) soil)</th>
<th>Effect of N addition</th>
</tr>
</thead>
<tbody>
<tr>
<td>cereal soil</td>
<td>0</td>
<td>965.80</td>
<td>5%</td>
</tr>
<tr>
<td></td>
<td>60</td>
<td>1013.89</td>
<td></td>
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<tr>
<td>pastureland soil</td>
<td>0</td>
<td>983.61</td>
<td>22.5%</td>
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<tr>
<td></td>
<td>60</td>
<td>1205.43</td>
<td></td>
</tr>
<tr>
<td>dryland till-fallowed</td>
<td>0</td>
<td>761.89</td>
<td>31%</td>
</tr>
<tr>
<td></td>
<td>60</td>
<td>998.96</td>
<td></td>
</tr>
<tr>
<td>manured 30 t ha(^{-1}) yr(^{-1})</td>
<td>0</td>
<td>969.61</td>
<td>16.5%</td>
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<tr>
<td></td>
<td>60</td>
<td>1128.90</td>
<td></td>
</tr>
</tbody>
</table>

Original soil fertility influenced the effect of N fertilizer application on soil C decomposition
Total microbial abundance

N fertilization enhanced C utilization

Soil type
- dryland tilled fallowed
- manured (30 t/ha)
- pastureland
- cereal cultivated

Total microbial abundance (nmol g⁻¹ soil)
Active bacterial abundance

Soil type:
- dryland TF-N+
- dryland TF-N-
- manured-N+
- manured-N-
- pasture-N+
- pasture-N-
- cereal-N+
- cereal-N-

Active bacterial abundance (μg $^{13}$C kg$^{-1}$ soil)

- 72 days
- 30 days
Microbial community structure
C application reduced the difference between microbial communities
Even after 21 years of identical conditions (limited C and N supply), C cycling of the transplanted soils is mainly governed by soil origin.

Impact of long term N fertilization on microbial C utilization varied depending on the soil origin.

Carbon application resulted similar microbial community structures among different soils under similar management conditions.
Implications

Land use and management have lasting effects on how soils function.
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