Litter-fall causes nitrous oxide emissions

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Outline

• Introduction
  ▪ Litter-fall: what, how, fate?
  ▪ N transformations
  ▪ Nitrous oxide (N₂O)

• Objectives of the experiment

• Experimental setup and methodology

• Results and conclusion
Introduction

90% of the total farm area in New Zealand is under pastoral system grazed under a rotational grazing system mainly of ryegrass and clover.

Litter-fall occurs (Pal et al. 2012)

Close observation of dairy animals during grazing showed that herbage
- although harvested, could fall from their mouth onto the soil,
- could be sheared due to hoof movement and fall onto the soil.
- these processes are termed ‘litter-fall’ which creates pasture ‘litter’.
Introduction (contd.)
Pasture litter, similar to any other plant material, contains nitrogen and carbon, which during decomposition is released back to the soil or lost as nitrous oxide.
Nitrous oxide ($N_2O$):

- *Laughing gas* & greenhouse gas
- 298 times higher GWP than CO$_2$, 60% of the total GHG emissions
- Also precursor of stratospheric ozone depletion
Materials and methods

Experimental Site – pasture site at Lincoln University
Materials and methods (contd.)

$^{15}$N-labelled ryegrass plants grown in a glasshouse
Materials and methods (contd.)

Litterbag preparation
## Materials and methods (contd.)

<table>
<thead>
<tr>
<th>Treatment notation</th>
<th>Pasture clipping</th>
<th>Litter addition</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Shoots</td>
<td>Roots</td>
</tr>
<tr>
<td>Control</td>
<td>× (pasture–5cm high)</td>
<td>×</td>
</tr>
<tr>
<td>C</td>
<td>✓</td>
<td>×</td>
</tr>
<tr>
<td>CL</td>
<td>✓</td>
<td>✓ (chopped–1cm)</td>
</tr>
<tr>
<td>SL</td>
<td>× (sieved soil–4mm)</td>
<td>✓</td>
</tr>
<tr>
<td>SR&lt;sub&gt;0&lt;/sub&gt;</td>
<td>× (sieved soil)</td>
<td>×</td>
</tr>
<tr>
<td>SR&lt;sub&gt;2&lt;/sub&gt;</td>
<td>× (sieved soil)</td>
<td>×</td>
</tr>
</tbody>
</table>

× denotes absence of pasture clipping and/or litter addition.
✓ denotes presence of pasture clipping and/or litter addition.
Surface-placed ryegrass litter produced >70% of litter-derived N$_2$O. Litter-$N$ contributed to both the $^{15}$N enrichment of soil NO$_3^-$ and N$_2$O emissions. 38–75% of the cumulative emissions occurring within 4–10 d of treatment application. EF = 1.2% ~ 1% default value of IPCC. N$_2$O produced via ammonification followed by a coupling of nitrification and denitrification during litter decomposition.

**Future research:**

Field studies - different pasture species and different litter-fall rates
Thank you!!!

Questions please