The effect of biochar and compost on plant pathogens and the microbial community in soil
## Compost vs biochar

<table>
<thead>
<tr>
<th><strong>Compost</strong></th>
<th><strong>Biochar</strong></th>
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<tbody>
<tr>
<td><strong>Organic soil amendments: recycling organic waste</strong></td>
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<tr>
<td>…by composting</td>
<td>….by pyrolysis</td>
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<tr>
<td>- with oxygen (aerobic decomposition)</td>
<td>- without oxygen</td>
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<tr>
<td>- phase 1: 50-70°C, phase 2 &lt; 40°C</td>
<td>- 200-600°C (thermal decomposition)</td>
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<tr>
<td>- → full of microbes, but large effect of high temperature</td>
<td>- → ‘sterile’, habitat for microbes</td>
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## Compost vs biochar

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<td><strong>C-source</strong></td>
<td>Source of stable organic matter</td>
<td>Long term carbon storage in soil → global warming</td>
</tr>
<tr>
<td><strong>Fertiliser</strong></td>
<td>&quot;Slow release fertilizer&quot;</td>
<td>Slow release or immobilisation</td>
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</table>
| **Effect on plant pathogens** | > 500 publications  
- Reported levels of disease suppression = variable  
- The mechanisms involved not fully understood | < 10 publications  
- Research group in Israel (Elad)  
- Induced resistance on strawberry and pepper – change in rhizosphere microbiology |
Research on compost & biochar vs pest & diseases @ ILVO

• 2003-2004: Resistance to air-born diseases and pests induced by compost in substrate cultivation of strawberry

• 2010-2013: FOD project: *Meloidogyne chitwoodi* = root knot nematode

• 2011-2015: PhD Negin Ebrahimi: The effects of soil amendments on survival and reproduction rate of *Globodera rostochiensis* and *G. pallida* = potato cyst nematode

• 2012-2016: EU project *Fertiplus*: reducing mineral fertilizers and agro-chemicals by recycling treated organic waste as compost and biochar
Strawberry & air-born diseases & pests

- **Treatments:**
  - Peat + mineral fertilizer (F)
  - Peat + 30% compost 1/ compost 2 (M1/M2)

- **Natural infections**
  - **fruit rot** (*B. cinerea*)
  - **powdery mildow** (*Sphaerotheca maculans f. sp. fragariae*)
  - **mites** (*Tetranychus urticae*)
  - **aphids** (*Chaetosiphon ragefolii*)
Strawberry & diseases & pests

2004

- % disease
- # per cm²

- **fruit rot**
- **powdery mildew**
- **aphids**
- **mites**

- **F**: 35% disease, 0 # per cm²
- **M1**: 20% disease, 20 # per cm²
- **M2**: 30% disease, 10 # per cm²
Strawberry & diseases & pests

- 4 days
  No clustering

- \(\approx 1\) month
  Clustering per object

- 3 months
  Clustering per substrate type

\(\text{St} = \text{pre-sterilized}\)
Meloidogyne on bean and carrots

- Less problems with root knot nematodes in soils with high concentrations of organic material

- Treatments (30 ton/ha)
  - wood chip compost
  - wood chip compost 80% + biochar 20%
  - non-amended soil
  - inoculation with J2 (high Pi and low Pi)

- Why compost + biochar?

Courtesy W. Wesemael

ILVO
Meloidogyne on bean and carrots

High Pi = 100 J2/100 cm³ soil
Low Pi = 10 J2/100 cm³ soil
Meloidogyne on bean & carrots

Pi = 40 J2/100 cm³ soil
Meloidoigne on carrots

Weight (g)

Soil (control)  Soil + compost (control)  Soil + compost + biochar (control)  Soil + Mc  Soil + compost + Mc  Soil + compost + biochar + Mc

Above ground plant part
Root system

Pi = 40 J/2/100 cm³ soil
Meloidogyne on bean

Pi = 40 J2/100 cm³ soil
Globodera on potato

- Treatments (30 ton/ha)
  - wood chip compost (15g/L)
  - wood chip compost (12g/L) + biochar (3g/L)
  - non-amended soil

- Visual assessment and the trehalose test to determine the **viability** of eggs and juveniles after 8, 12 and 16 weeks

- Determination of the **reproduction rate** after 16 weeks
Reproduction of *Globodera* spp.

Pi = 3.6 eggs and J2/g soil
Potato tuber weight

![Bar chart showing potato tuber weight under different amendments (Non-amended soil, Compost, Compost+Blochar) for G. pallida and G. rostochiensis.](image)
• EU FP7 project: www.fertiplus.be

• Aim = to reduce mineral fertilizers (N,P use) & agrochemicals (pest control)

• How = by recycling organic waste by composting and pyrolysis

• Various feedstocks

• Compost, biochar and biochar-blended compost
• ILVO–part: effect

1. on soil plant pathogens of vegetables (bioassays)
   • *Meloidogyne*, *Pratylenchus* & *Globodera*
   • *Rhizoctonia solani*, *Sclerotinia sclerotiorum* & *Verticillium dahliae*

2. on soil/rhizosphere microbiology
   • PLFA
   • DGGE
   • NGS

3. On the physico-chemical properties of the soil

4. correlation between 1-3?