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Influence of composts on soils and plants

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Influence of composts on soils and plants

- Effects on chemical and physical properties of soils
- Effects on plant health
- Vegetables: effects on soil fatigue
- Arboriculture: phytosanitary effects
- Conclusions

Effects on chemical and physical properties of soils

Effects on chemical and physical properties of soils

› Nutrients input (macro- und micro-nutrients)

	Digestate for agricultural use	Compost for agricultural use	Compost for horticultural use	Compost for covered cultures
total N [g/kg DM] median (minimum; maximum)	**15.3** (9.4; 20.3)	**16.6** (8.7; 26.0)	**14.6** (9.2; 27.6)	**15.1** (8.6; 25.2)
total P [g/kg DM] median (minimum; maximum)	**3. 6** (2.0; 8.0)	**3.0** (1.7; 6.1)	**3.0** (1.3; 12.7)	**3.3** (2.1; 8.8)
total K [g/kg DM] median (minimum; maximum)	**12.5** (6.4; 20.8)	**12.0** (5.7; 25.2)	**11.6** (2.2; 20.7)	**10.7** (5.5; 27.8)
total Mg [g/kg DM] median (minimum; maximum)	**6.8** (3.7; 9.7)	**4.8** (3.6; 10.3)	**6.5** (4.4; 10.7)	**6.5** (4.4; 13.3)
total Ca [g/kg DM] median (minimum; maximum)	**46.6** (23.0; 57.8)	**53.1** (24.0; 83.7)	**64.0** 35.0; 91.5)	**44.5** (69.4; 29.5)
Total Fe [mg/kg DM] median (minimum; maximum)	**8.9** (3.7; 12.3)	**8.8** (2.9; 16.7)	**10.1** (5.4; 14.7)	**12.0** (6.1; 15.8)

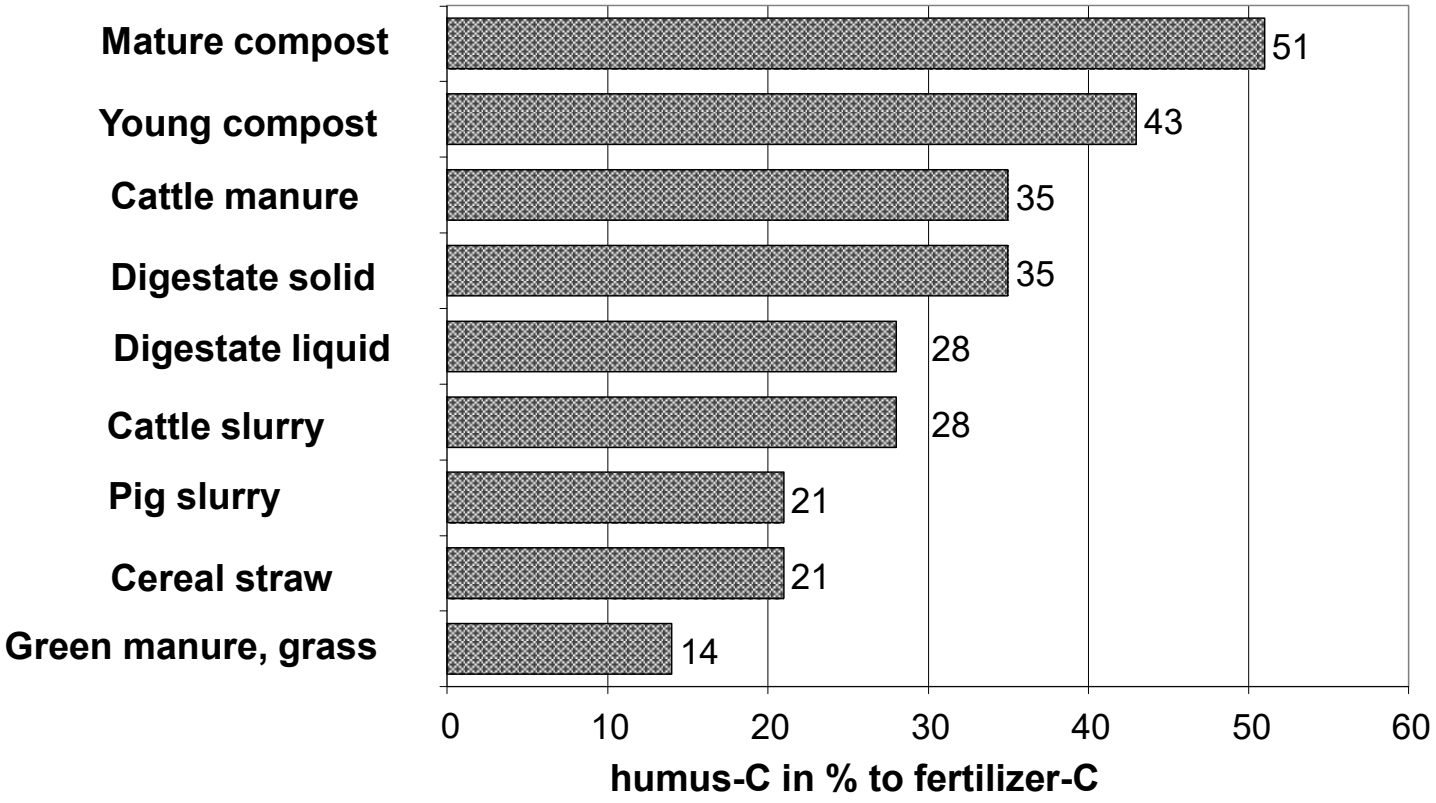
Source: Kupper & Fuchs, 2007

Effects on chemical and physical properties of soils

- Nutrients input (macro- und micro-nutrients)
- Input of stable organic matter to the soil

Effects on chemical and physical properties of soils

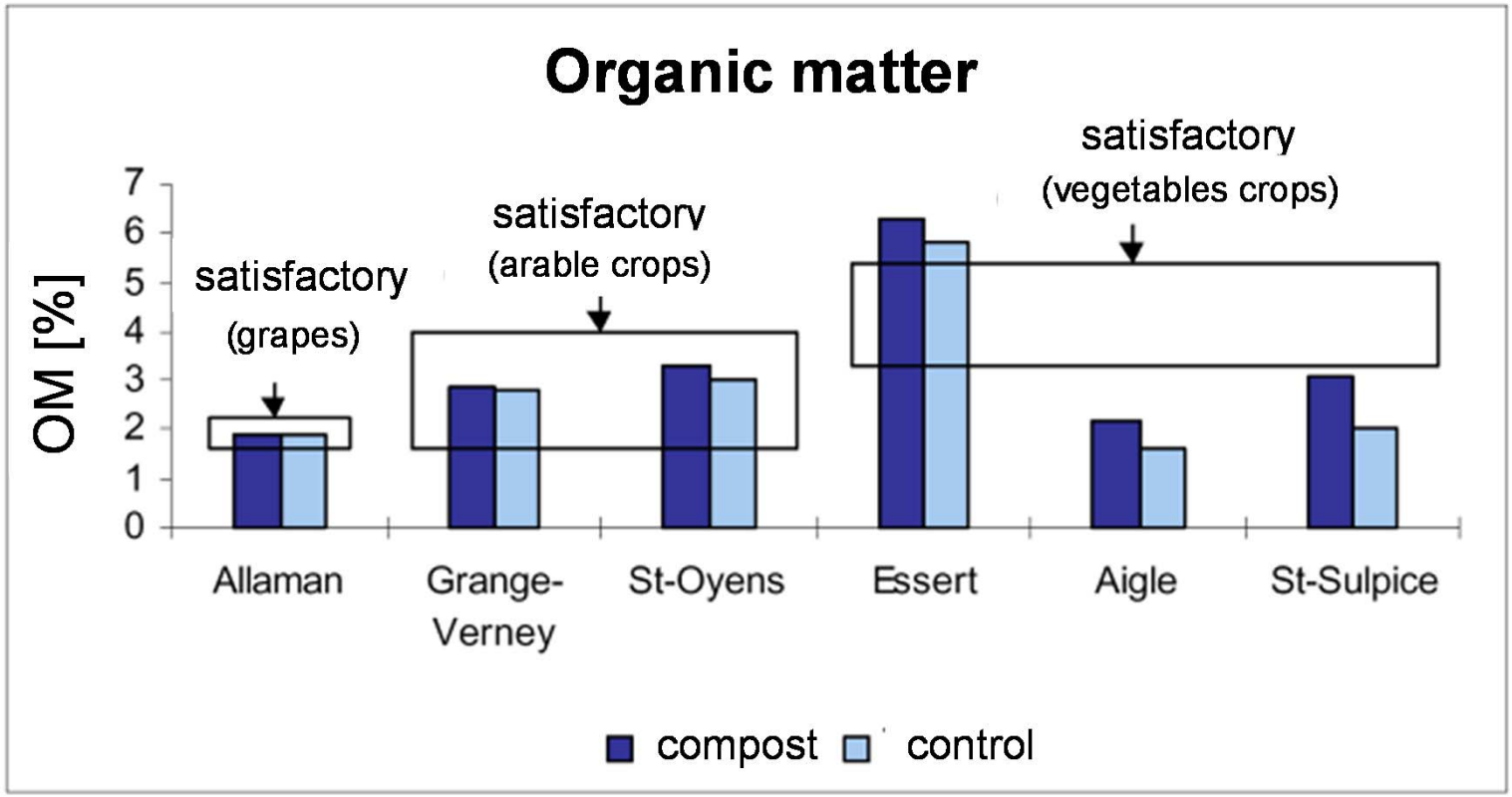
› Input of stable organic matter to the soil



Effectiveness of humus reproduction for organic carbon of different organic fertilizations (according to Reinhold 2006)

Effects on chemical and physical properties of soils

› « Essais-Vitrines»: Influence on soil organic matter



Effects on chemical and physical properties of soils

› Influence on soil organic matter

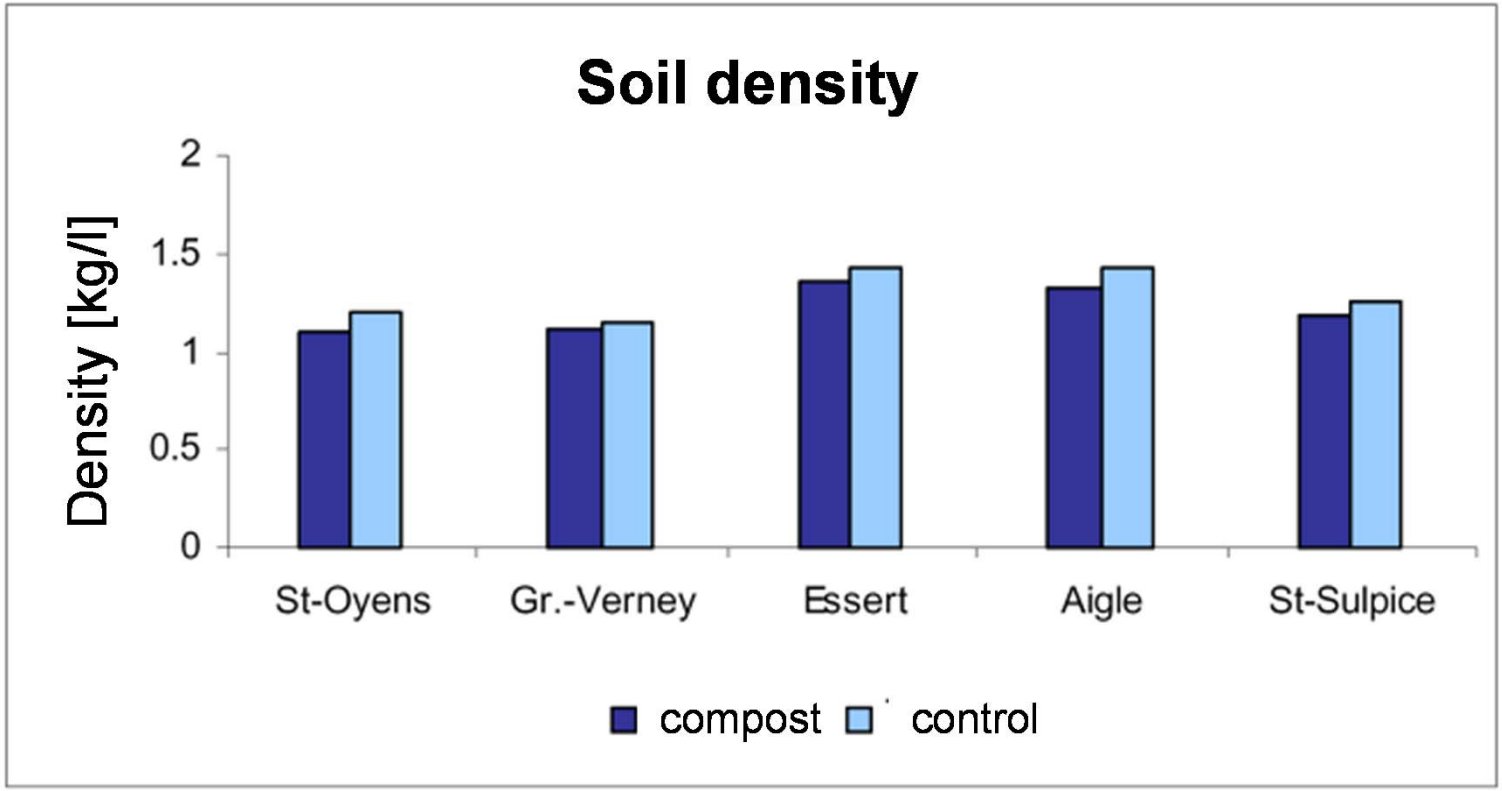
Bibliography	Testduration	Compost quantity	Effect on OM content of the soil [in % of control]
Aichberger and al., 2000	9 years	15-40 t FM / ha	+12%
Bragato and al., 1998	5 years	7,5-15 t FM / ha	+ 21 %
Jenkinson and al., 1987	140 years	manure 35 t /ha and year	+ 176 %
Kjellenberg and Granstedt, 2005	33 years	4 t FM / ha and year	+ 8 to + 25 %
Compost Diffusion, 1999	7 years	40-100 m^3 / year	+10 % to 37 %

Effects on chemical and physical properties of soils

- Nutrients input (macro- und micro-nutrients)
- Input of stable organic matter to the soil
- Effect on soil structure

Effects on chemical and physical properties of soils

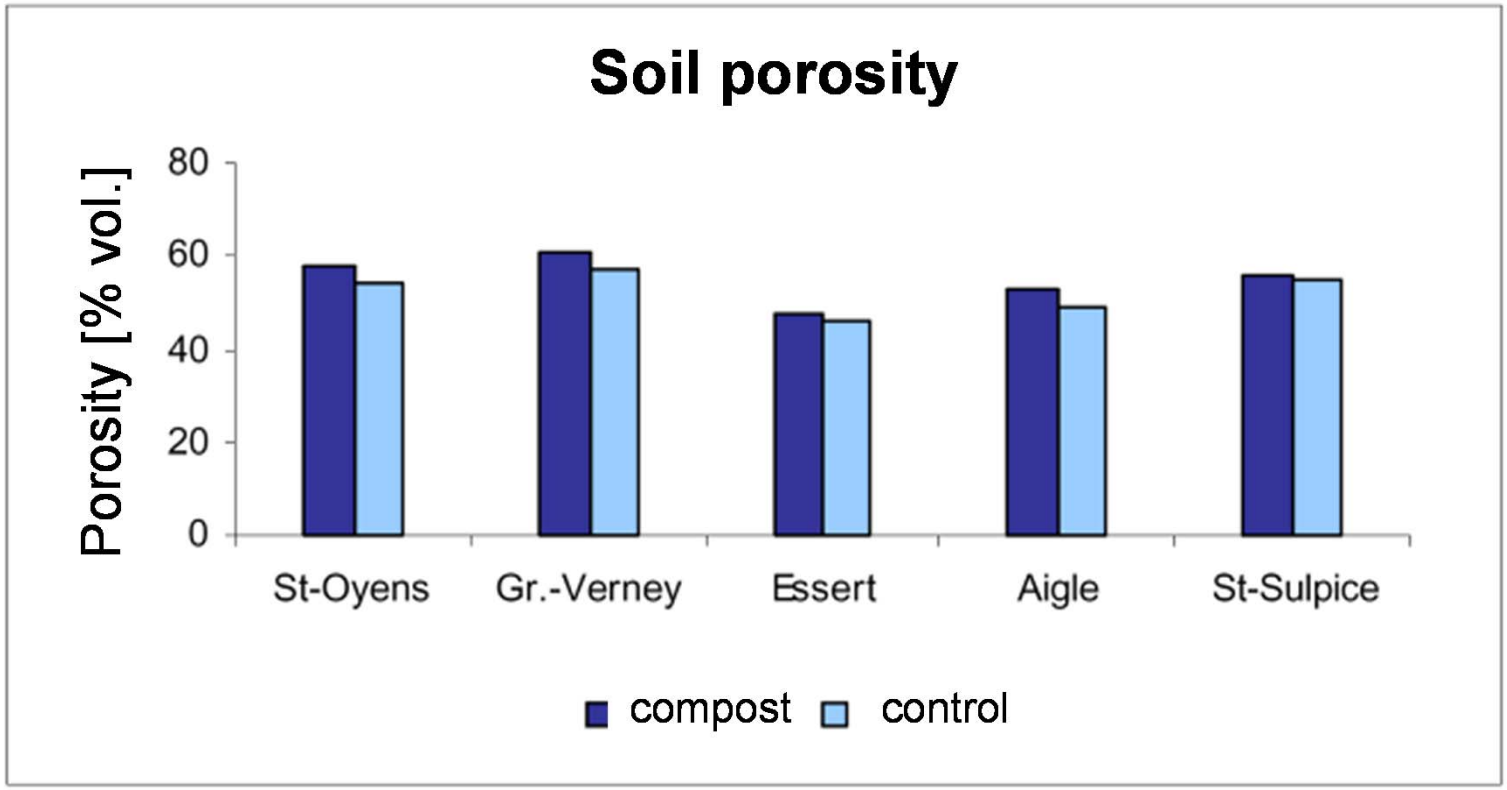
› « Essais-Vitrines »: Influence on soil density



› Soil management is easier, observations of FiBL pointed to a potential saving of fuel (less resistance in compost treated soils) in a test of compost application in fruit growing

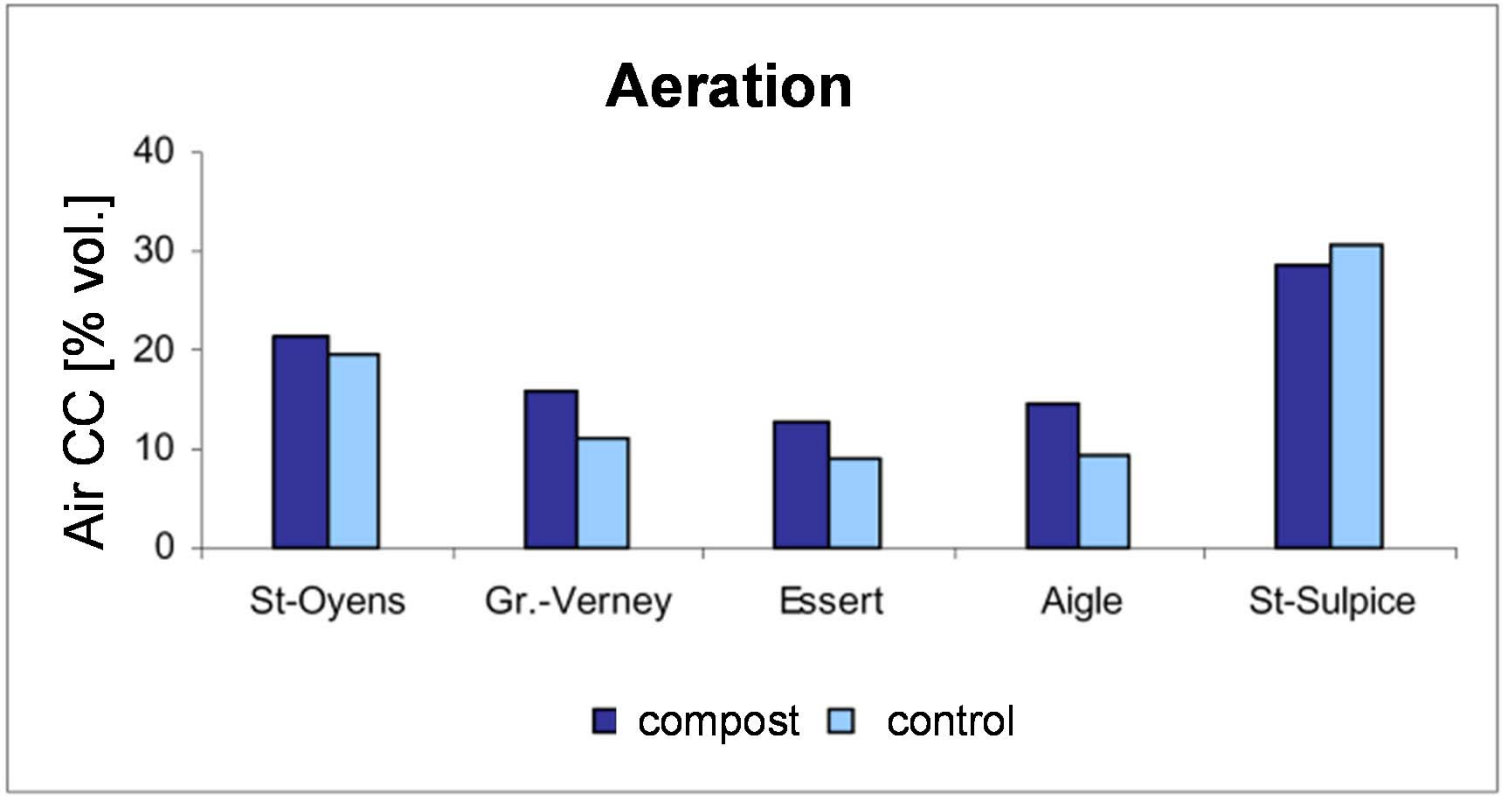
Effects on chemical and physical properties of soils

› « Essais-Vitrines »: Influence on soil porosity



Effects on chemical and physical properties of soils

› « Essais-Vitrines »: Influence on soil aeration



Effects on chemical and physical properties of soils

- Nutrients input (macro- und micro-nutrients)
- Input of stable organic matter to the soil
- Effect on soil structure
- Effect on water infiltration and water retention
  - Effect on water capacity of soil
    - Compost Diffusion, 1999: + 6%
    - Eyras et al., 1998: +20 to +25%
    - Gagnon et al., 1998: +3 to +5%
    - Shiralipour et al., 1996: + 3% to +16%

Effects on chemical and physical properties of soils

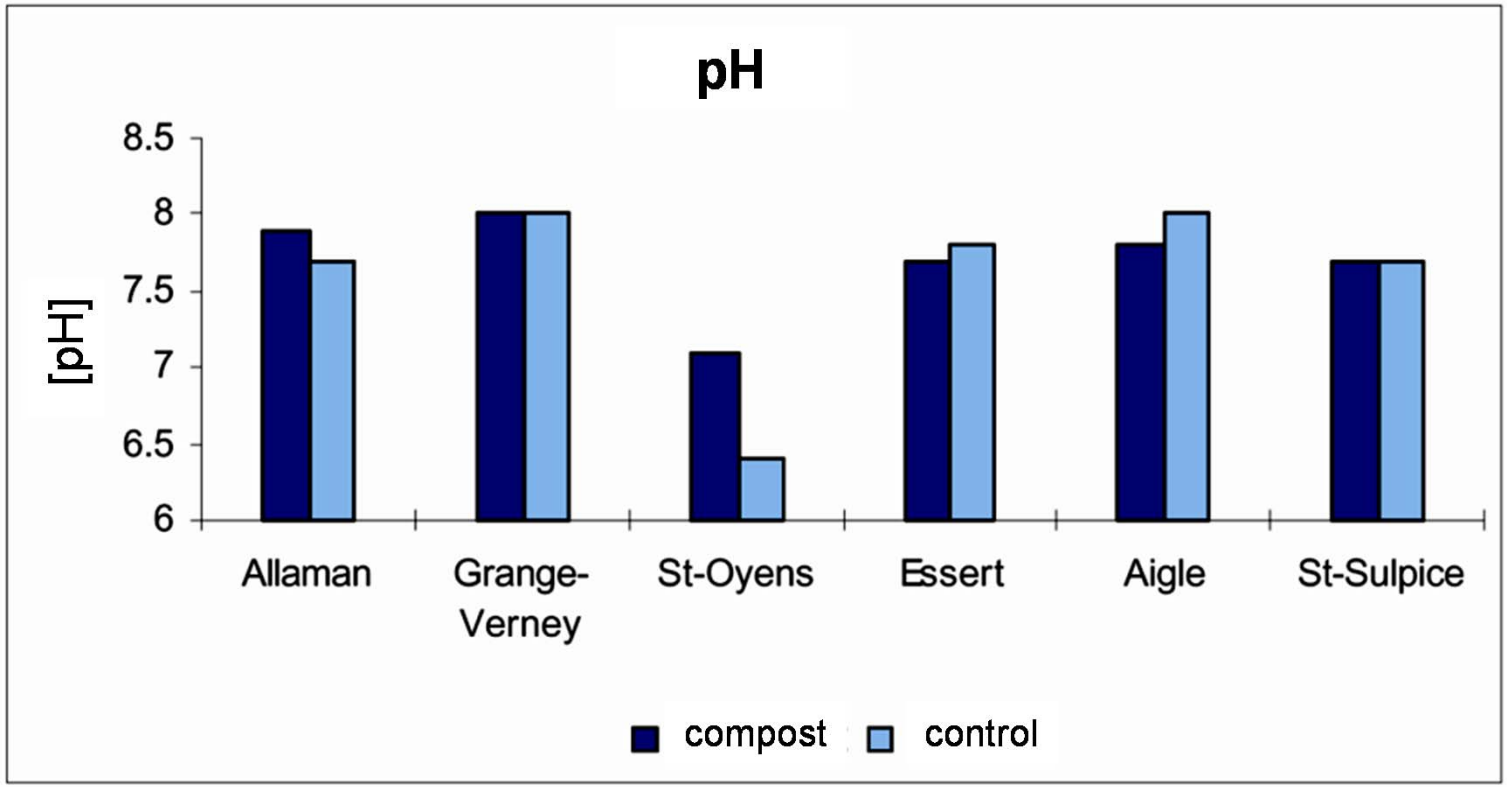
- Nutrients input (macro- und micro-nutrients)
- Input of stable organic matter to the soil
- Effect on soil structure
- Effect on water infiltration and water retention
- Reduction of erosion
  - Diminution of wind erosion
    - Hartmann, 2002: -30 to -50%
    - De Vos, 1996: erosion with 4 Beaufort without compost equal to that of 6-7 Beaufort with compost
  - Diminution of water erosion
    - Ojeda et al., 2003: -50%
    - Bazzoffi et al., 1998: -10 to -50%

Effects on chemical and physical properties of soils

- Nutrients input (macro- und micro-nutrients)
- Input of stable organic matter to the soil
- Effect on soil structure
- Effect on water infiltration and water retention
- Reduction of erosion
- Effect on soil pH

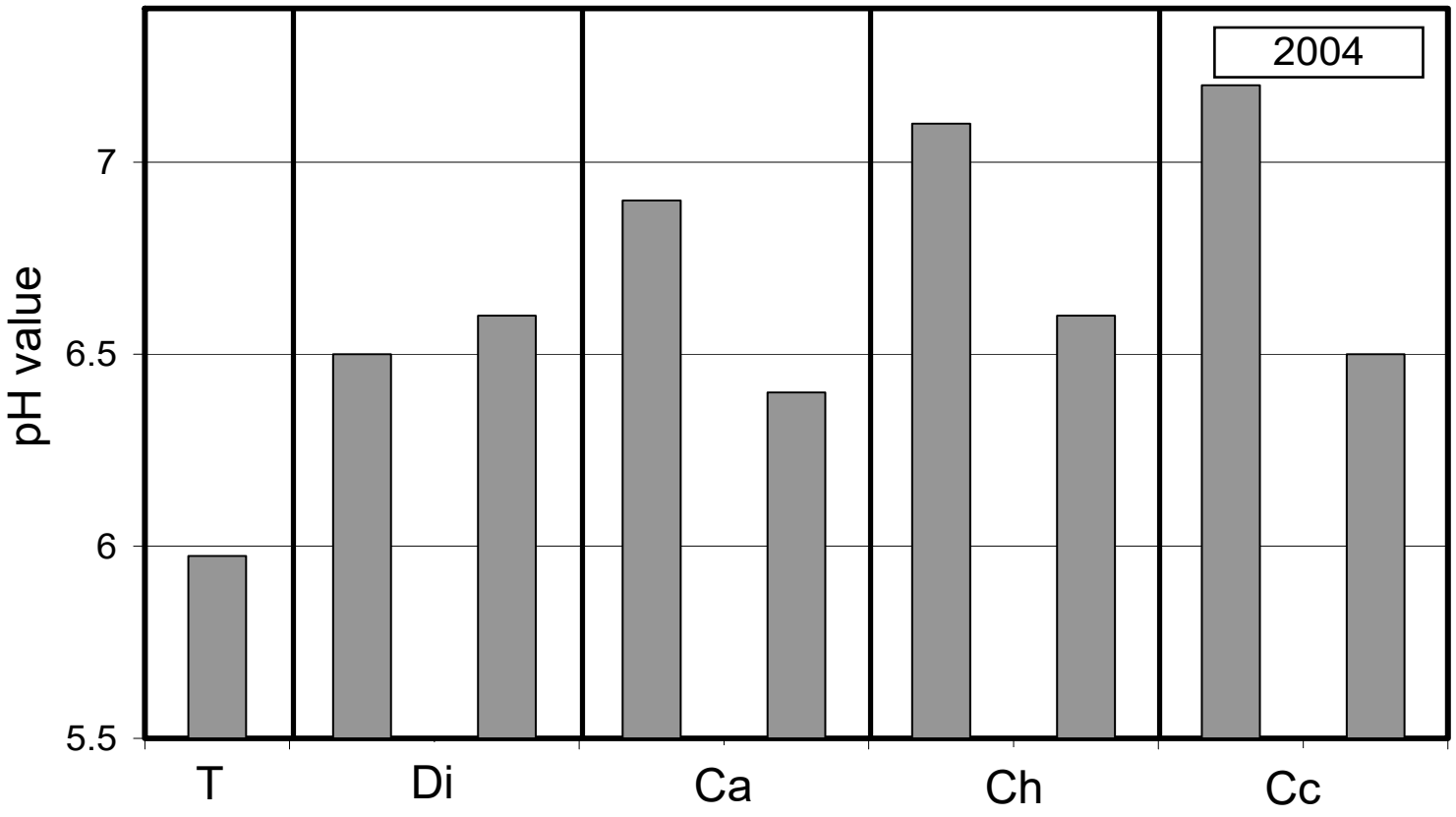
Effects on chemical and physical properties of soils

› « Essais-Vitrines »: Influence on soil pH



Effects on chemical and physical properties of soils

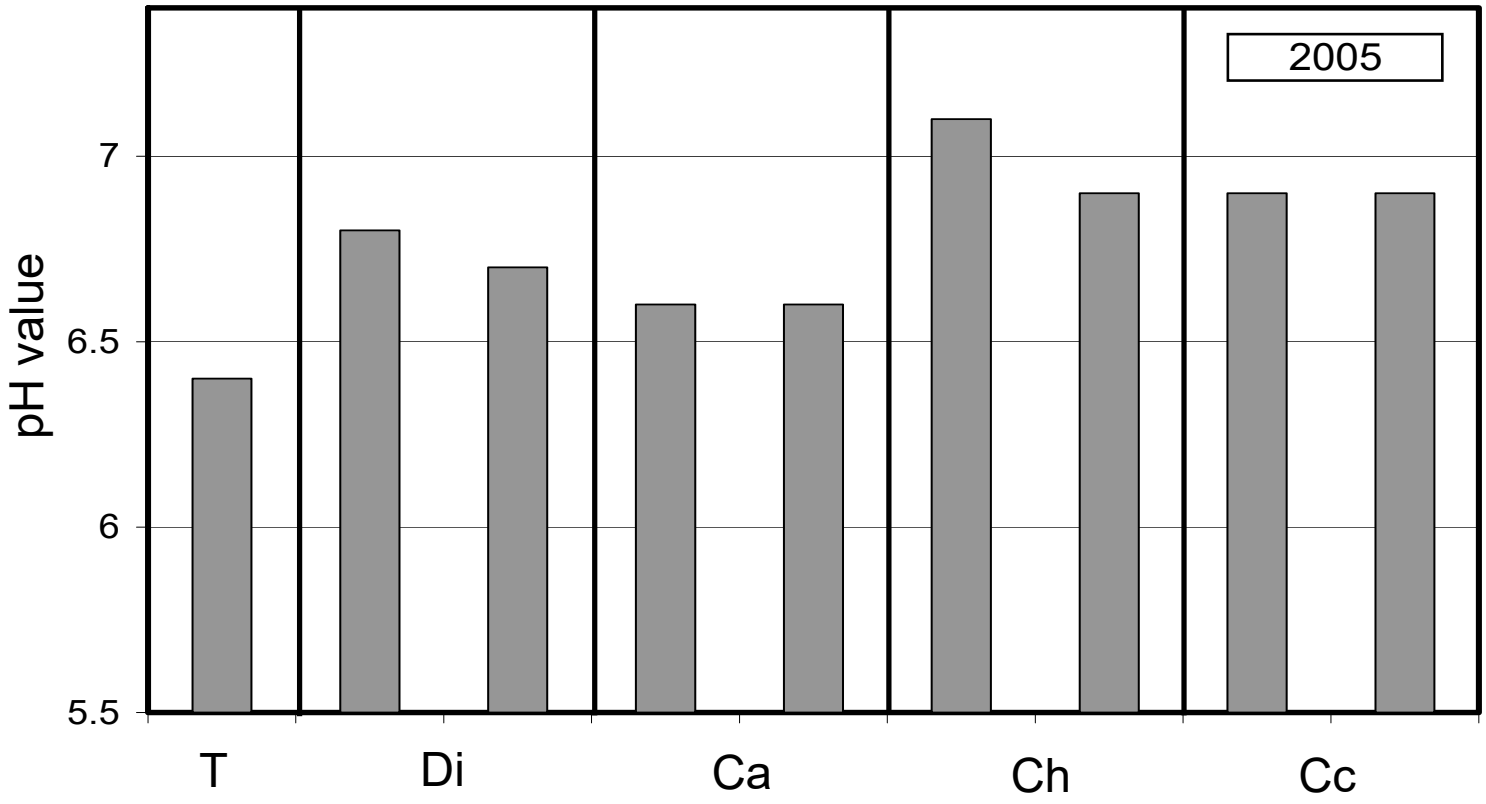
› Project FOEN: heavy soil



Di: digestate; Ca: compost for agricultural use;
Ch: compost for horticultural use; Cc: compost fur covered cultures

Effects on chemical and physical properties of soils

› Project FOEN: sandy soil



Di: digestate; Ca: compost for agricultural use;
Ch: compost for horticultural use; Cc: compost fur covered cultures

Effects on chemical and physical properties of soils

- Effect on soil pH
  - Allowed compost quantity (CH): 25 tons DM / 3 years
  - Correspond to 1'500 CaO (500 kg / year)
  - Correspond to the usual quantity of maintenance liming
  - Enough to redress pH value ?

    In some soils yes (FiBL trials 2004-2005: +0.5 - +1 units)

Effects on chemical and physical properties of soils

› Nutrients input (macro- und micro-nutrients)

› Input of stable organic matter to the soil

› Effect on soil structure

› Effect on water infiltration and water retention

› Reduction of erosion

› Effect on soil pH

> Effects of compost on soil biology

Effects on chemical and physical properties of soils

- Effects of compost on soil biology
  - Indirect through influence of soil characteristics
  - Supply of nutrients for soil microorganisms
  - Supply of compost microorganisms to the soil

  - Improvement of the microbial balance in the soil
  - Improvement of the soil microbiological activity

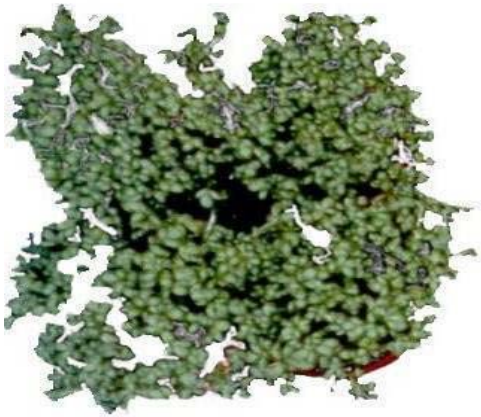
Effect on plant health

Effect on plant health

- Indirect effect
  - Supply of macro- and micro-nutrients
  - Soil structure
  - Regulation of water balance
  - Protection against erosion
  - Influence of soil microflora (supply of substrates)

- Direct effect
  - Compost microflora influences soil microflora

Effect on plant health

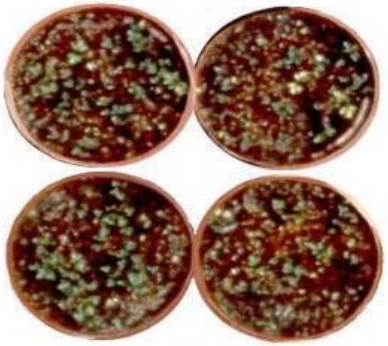


control

P. ultimum
+ 30% compost A

P. ultimum
+ 30% compost B

Pythium ultimum

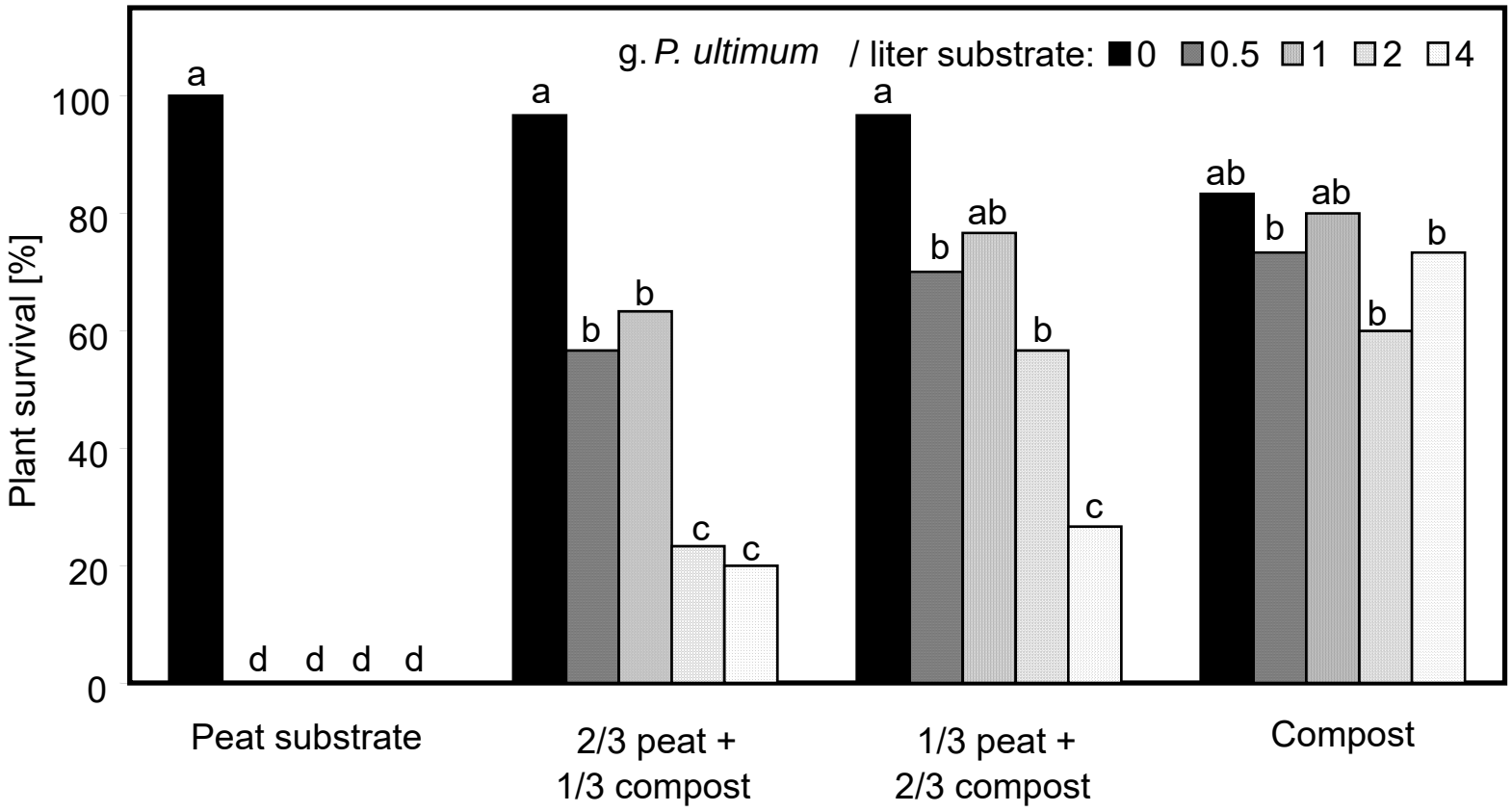


P. ultimum
+ 30% compost A
heat treated

P. ultimum
+30% compost B
heat treated

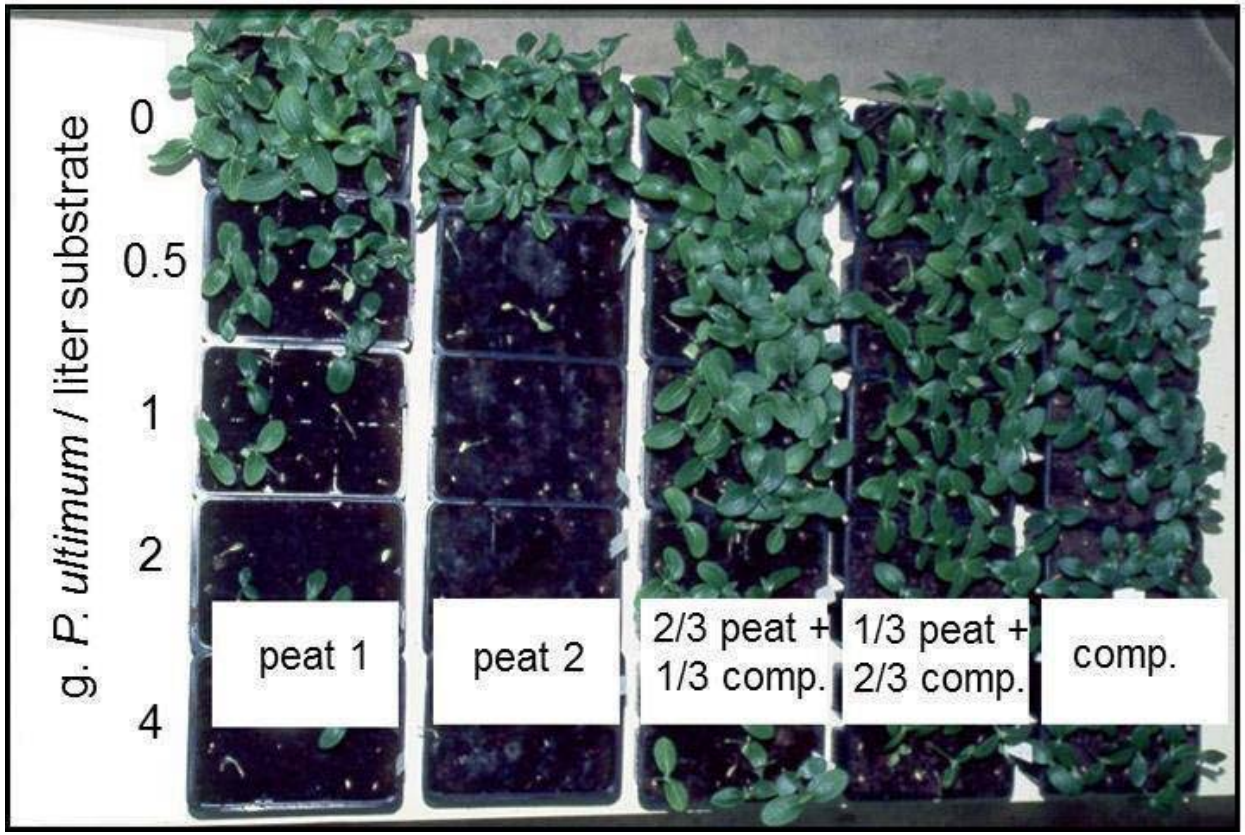
Effect on plant health

>Compost in culture substrate



Effect on plant health

>Compost in culture substrate



Effect on plant health

>Compost in culture substrate

Effect on plant health

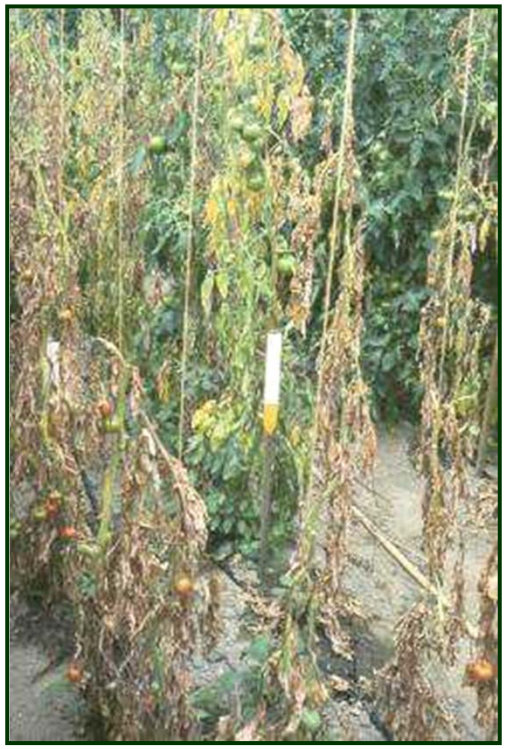
- Compost in culture substrate
  - Buffers the system microbiologically
  - Prevents pathogen invasion
  - Reduces disease incidence drastically
  - Secures plant production

Effect on plant health

>Compost after soil steaming

Effect on plant health

>Compost after soil steaming



Effect on plant health

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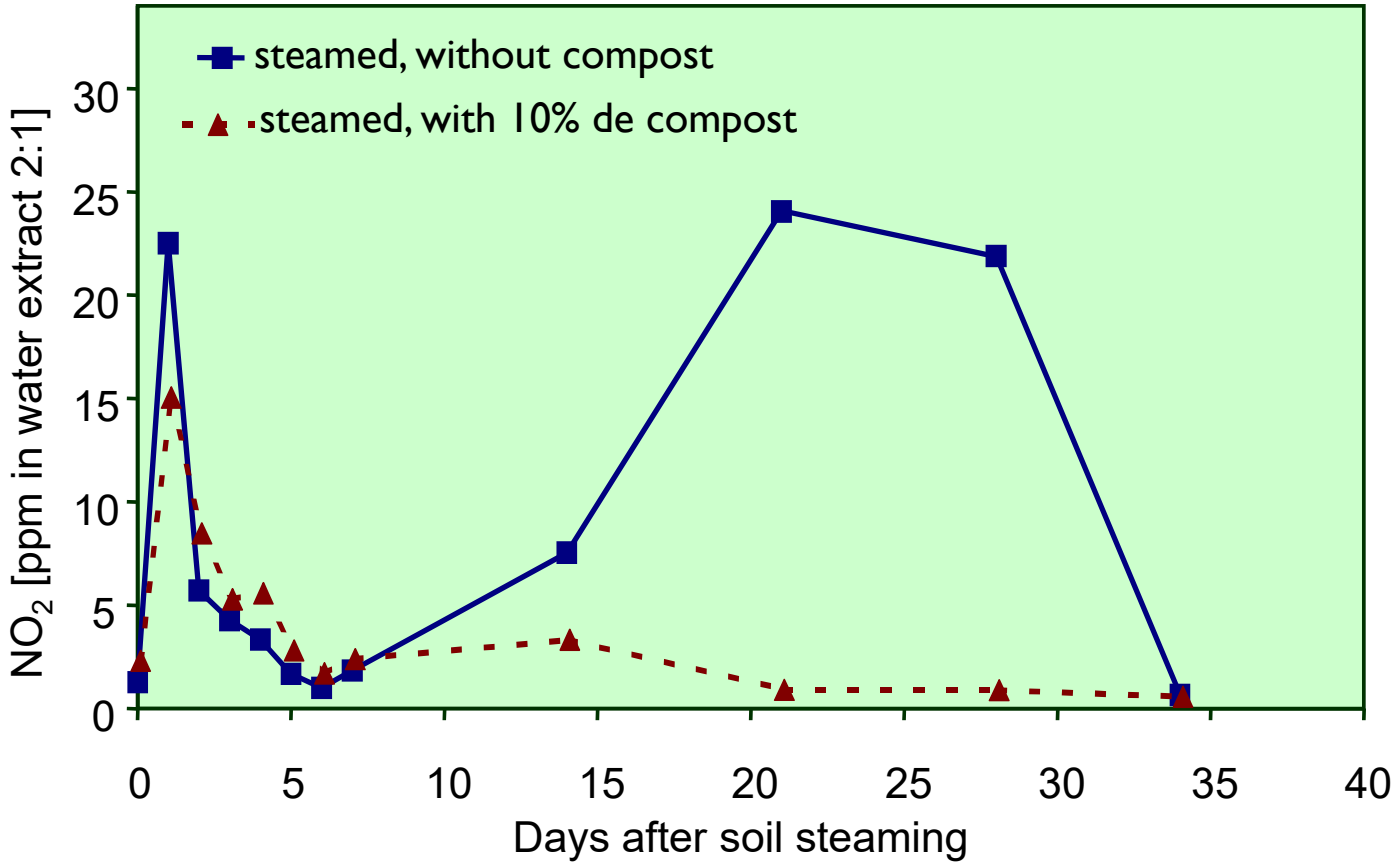

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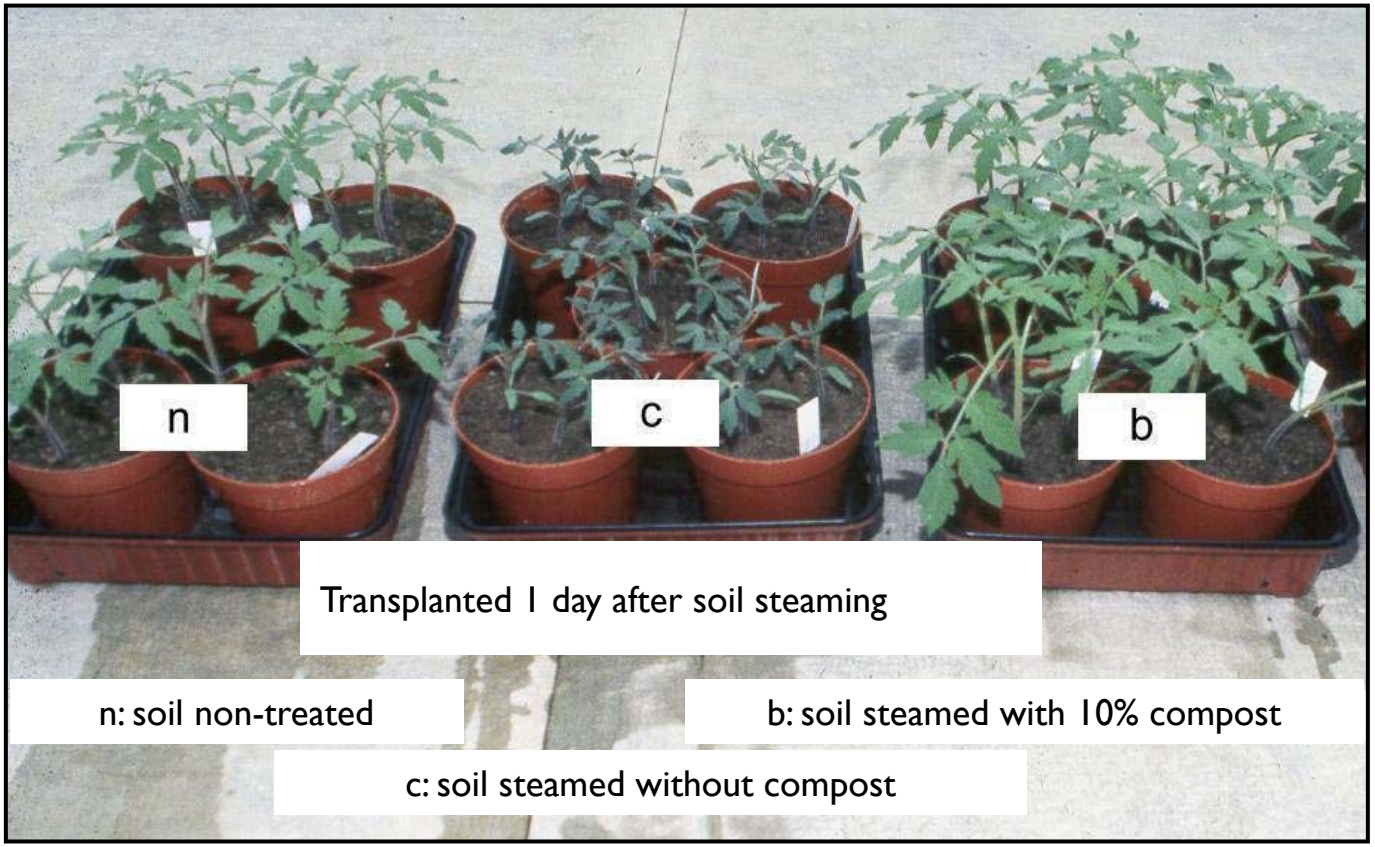

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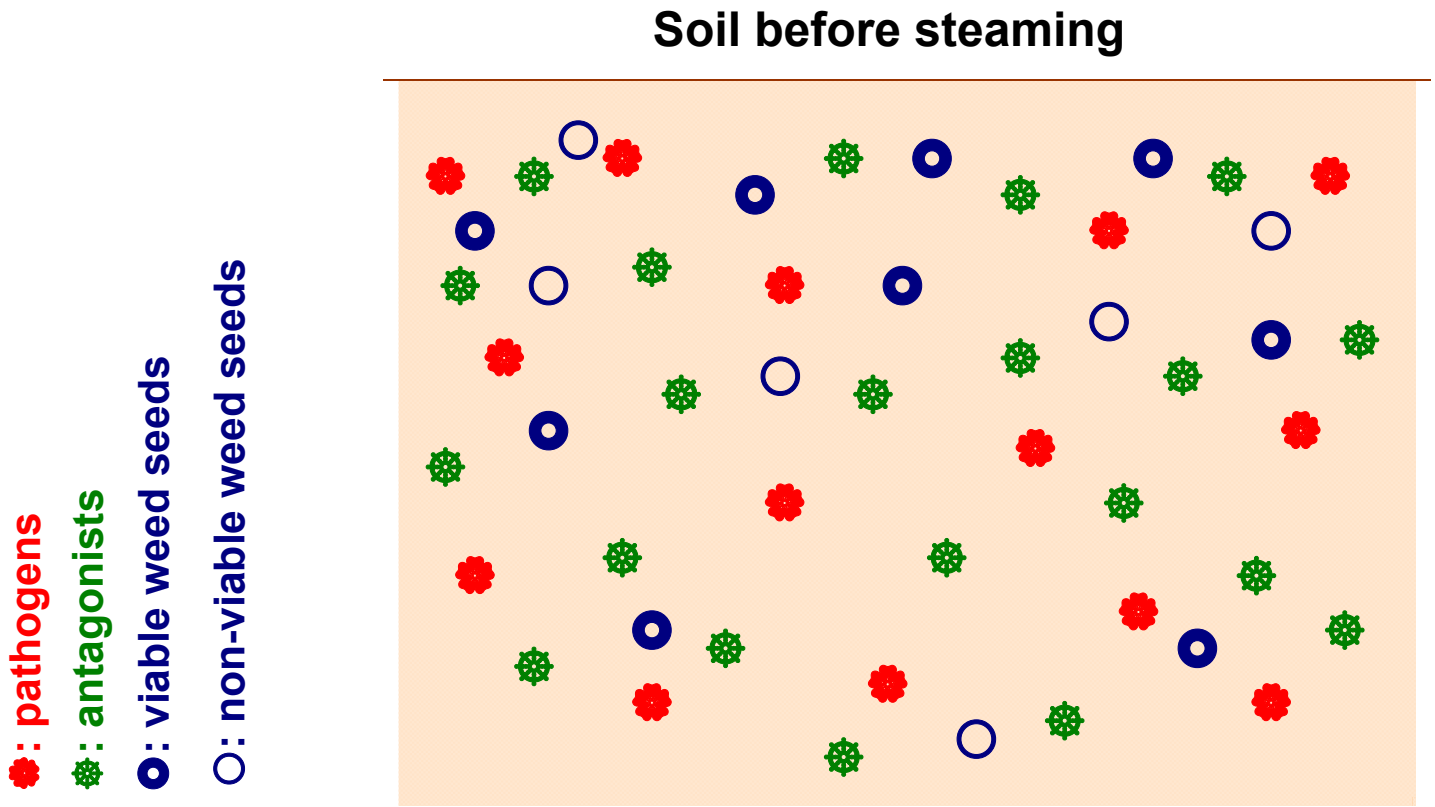

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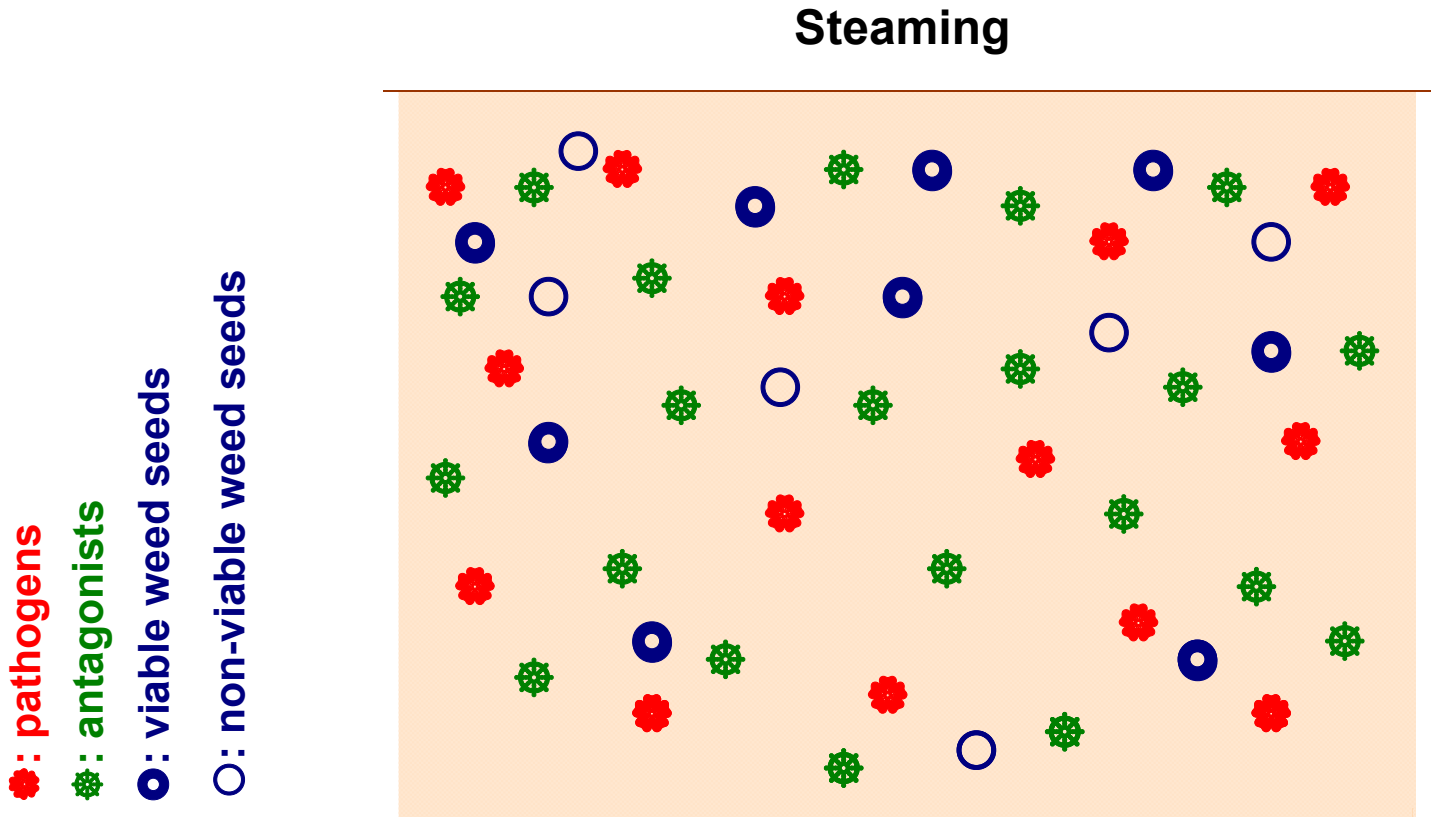

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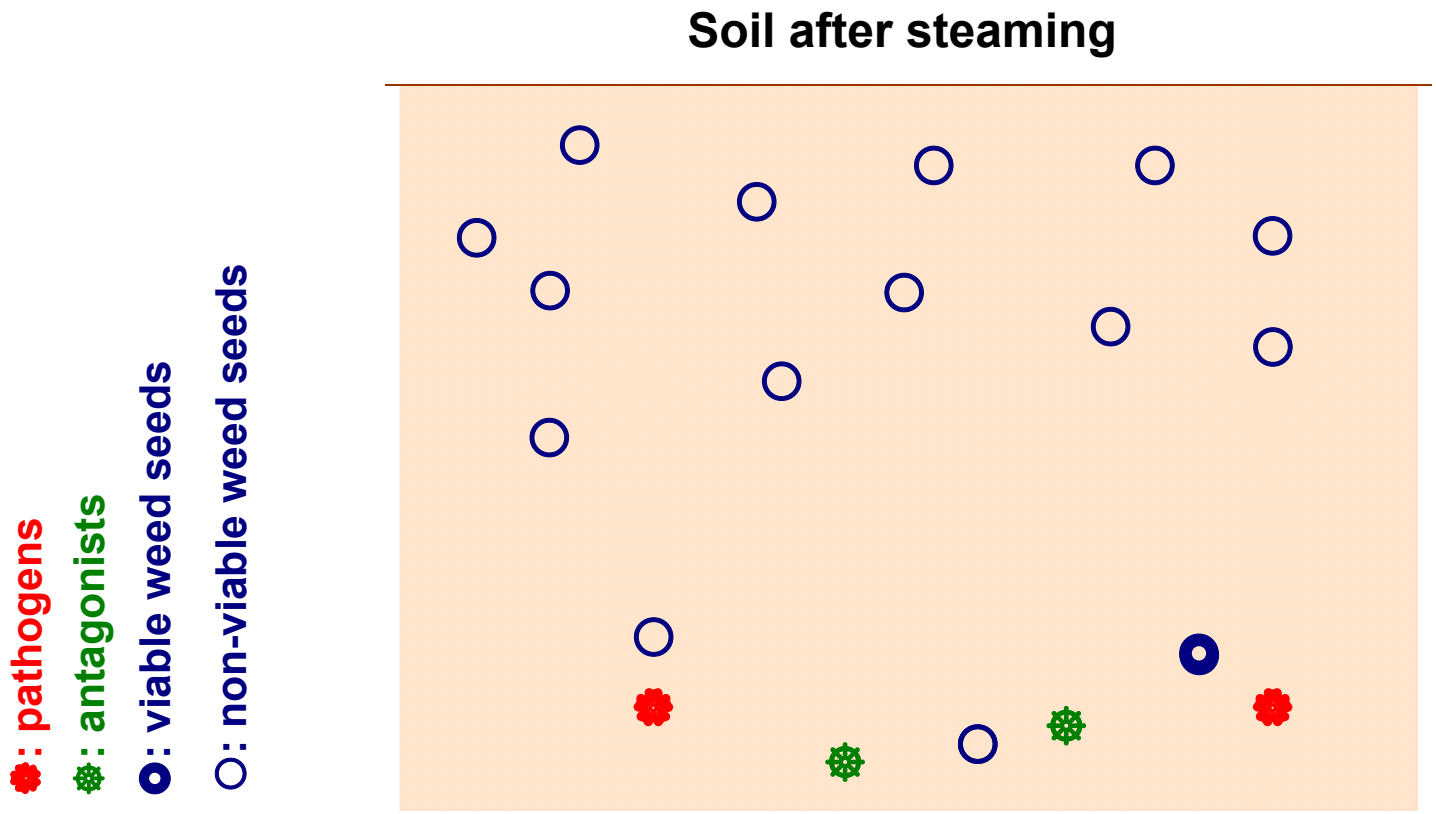

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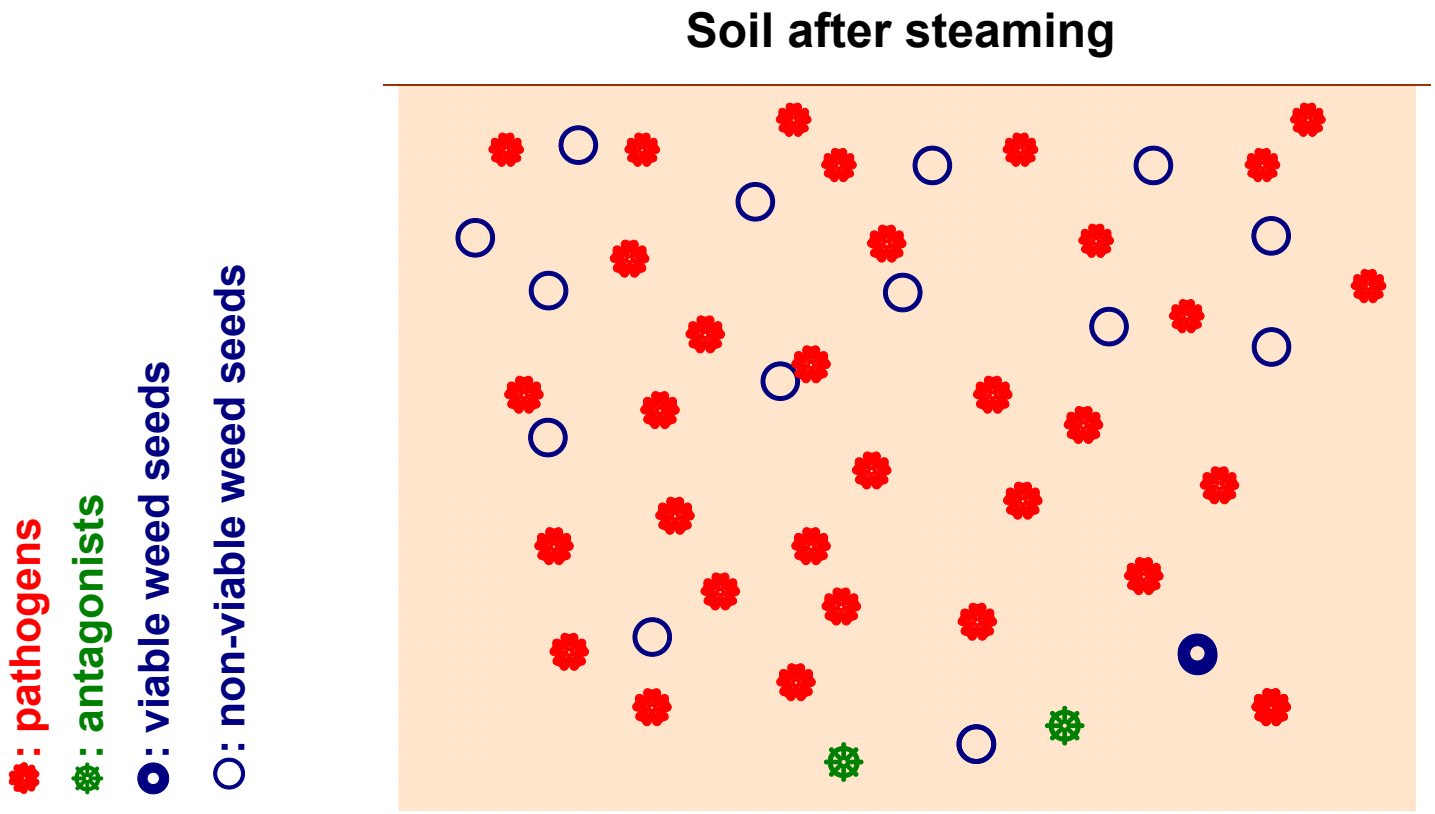

Effect on plant health

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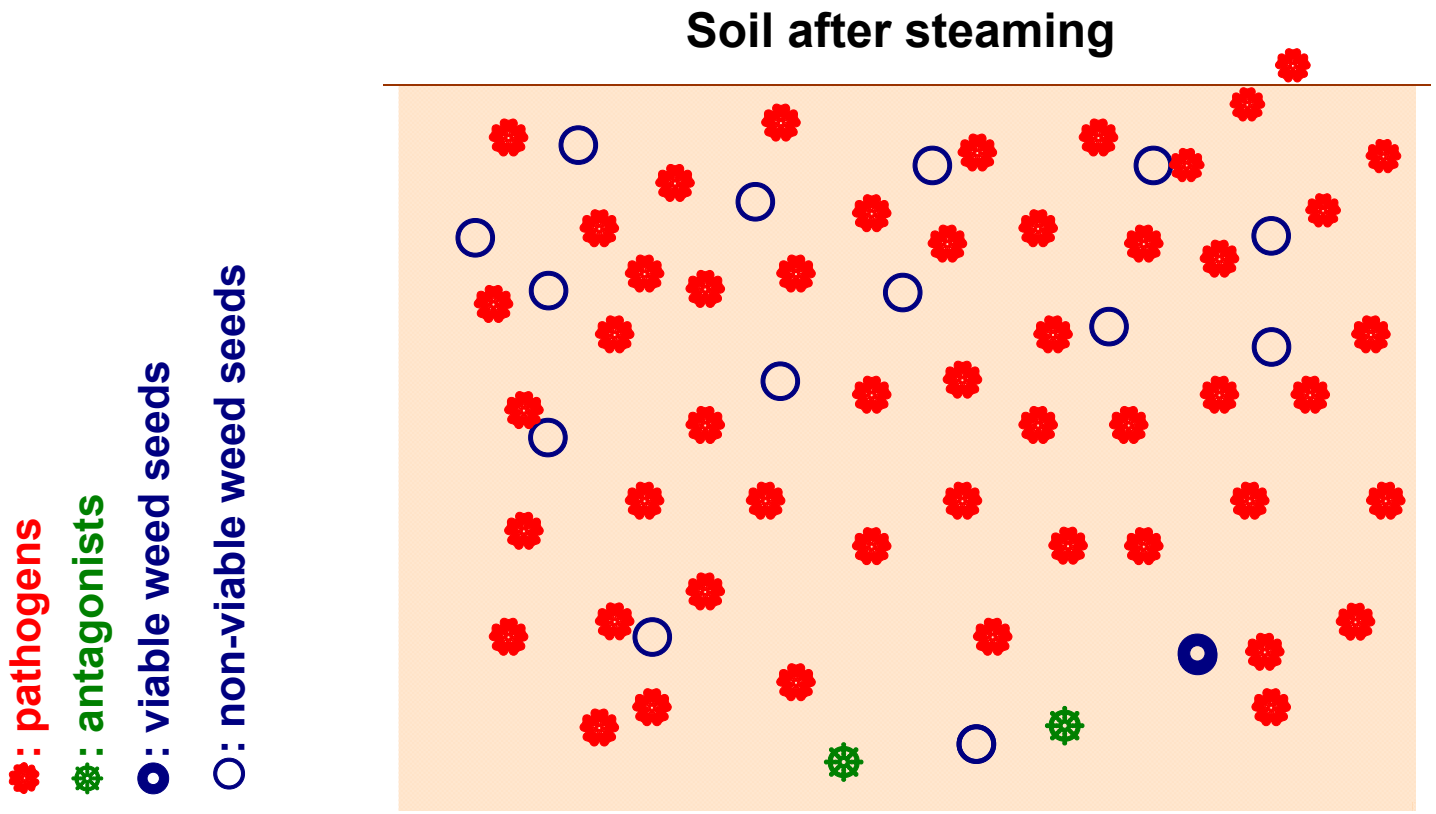
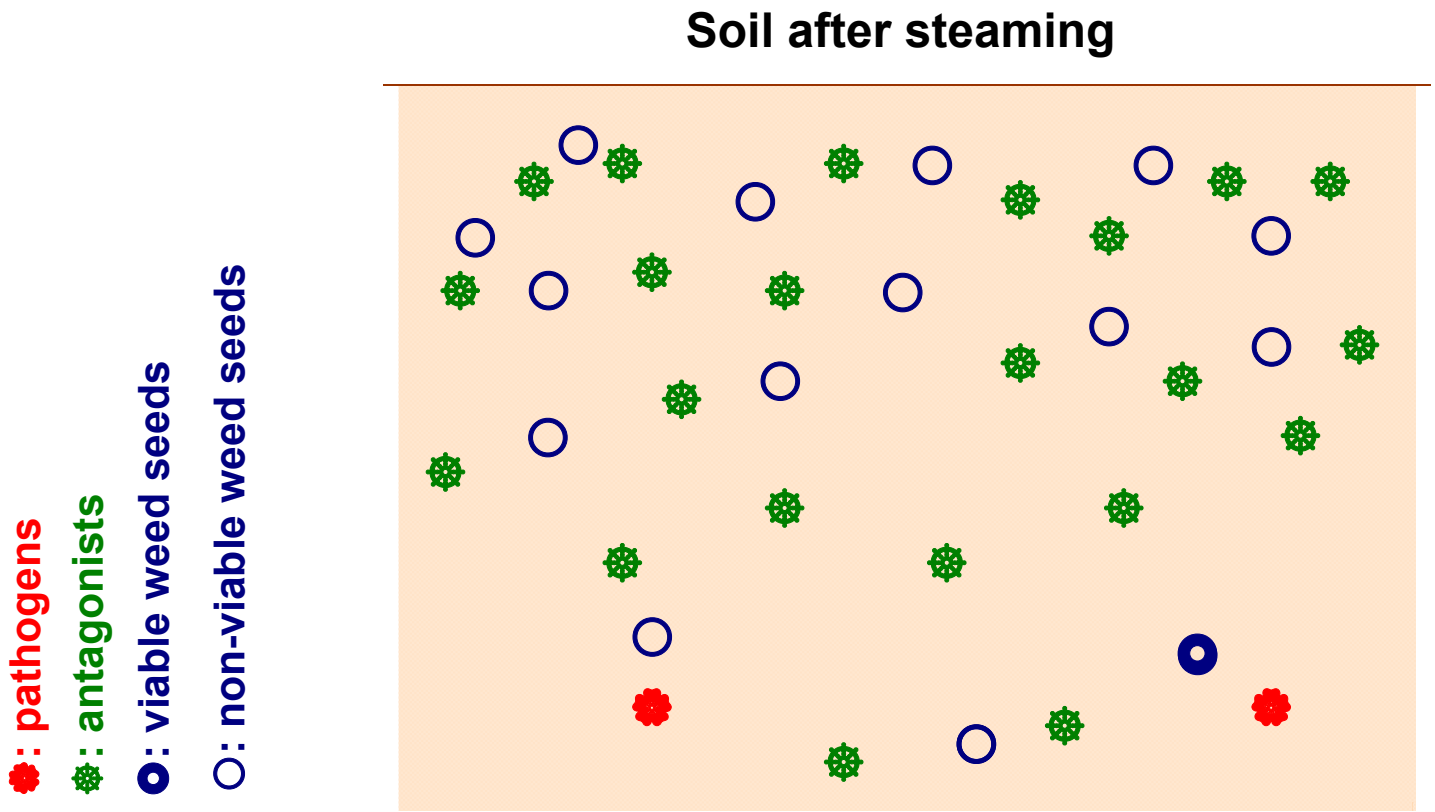


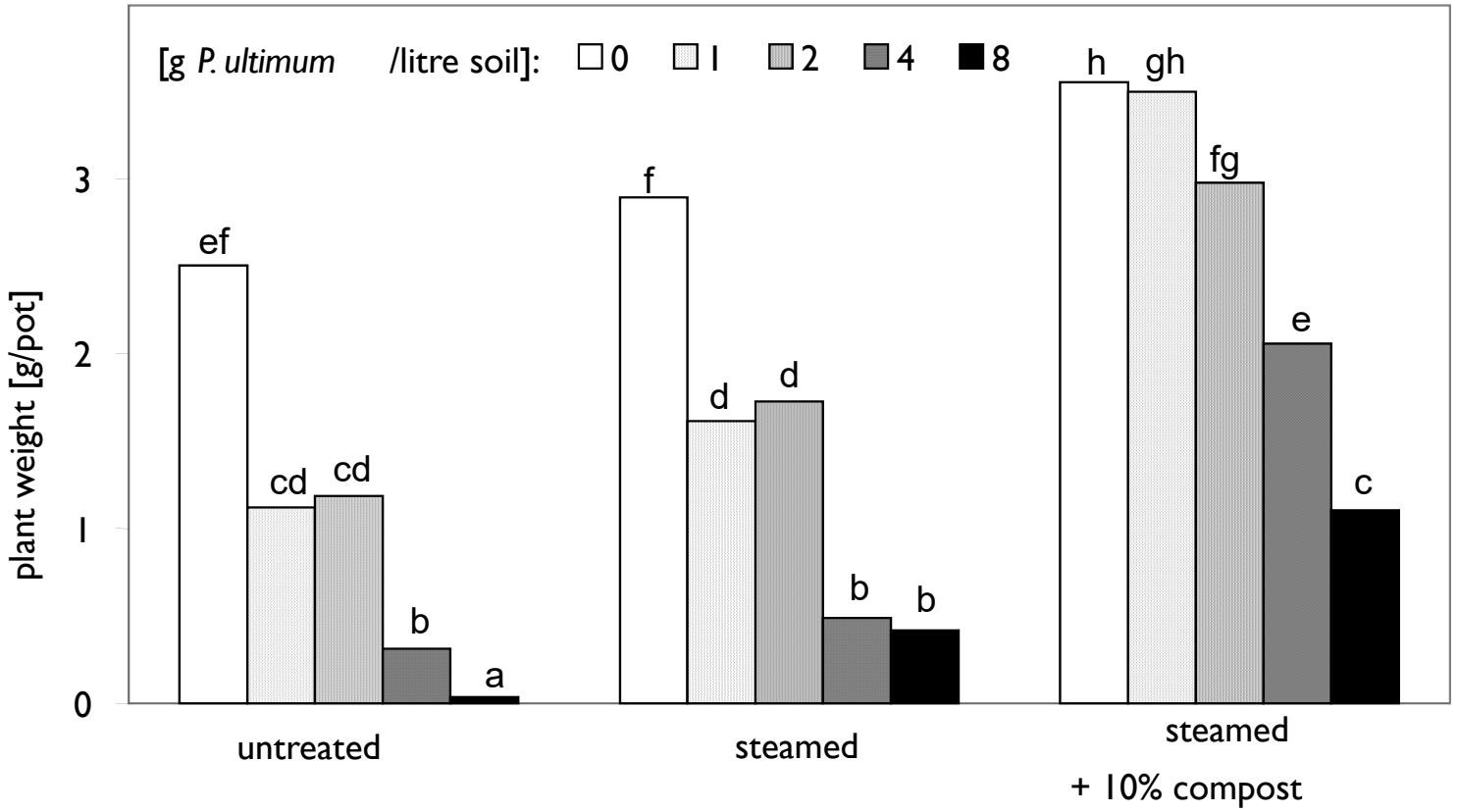
Effect on plant health

>Compost after soil steaming



Effect on plant health

>Compost after soil steaming



Effect on plant health

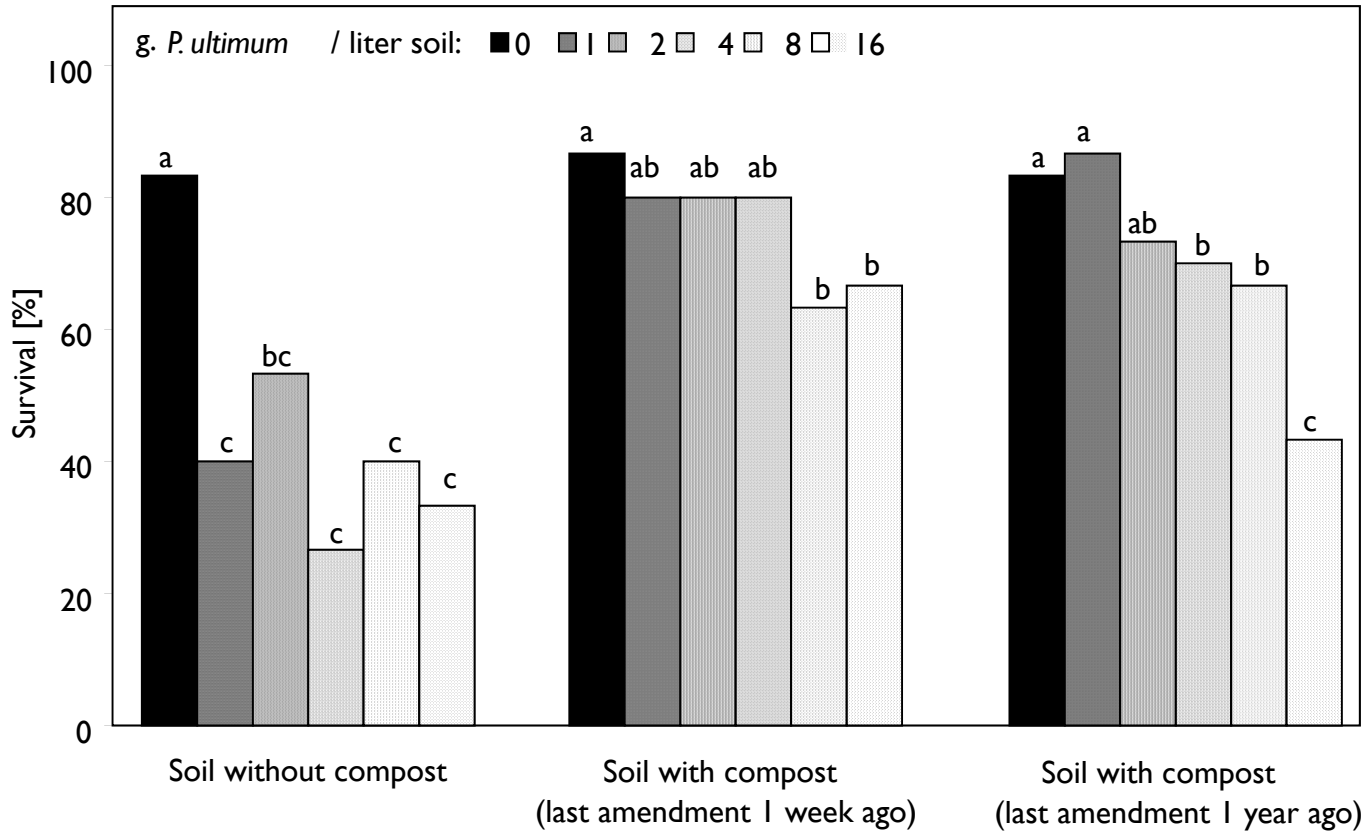
>Compost after soil steaming

Effect on plant health

- Compost after soil steaming
  - Detoxification of the soil
  - Allows earlier planting of seedlings
  - Prevents soil recolonisation with pathogens
  - Allows sustainable soil steaming

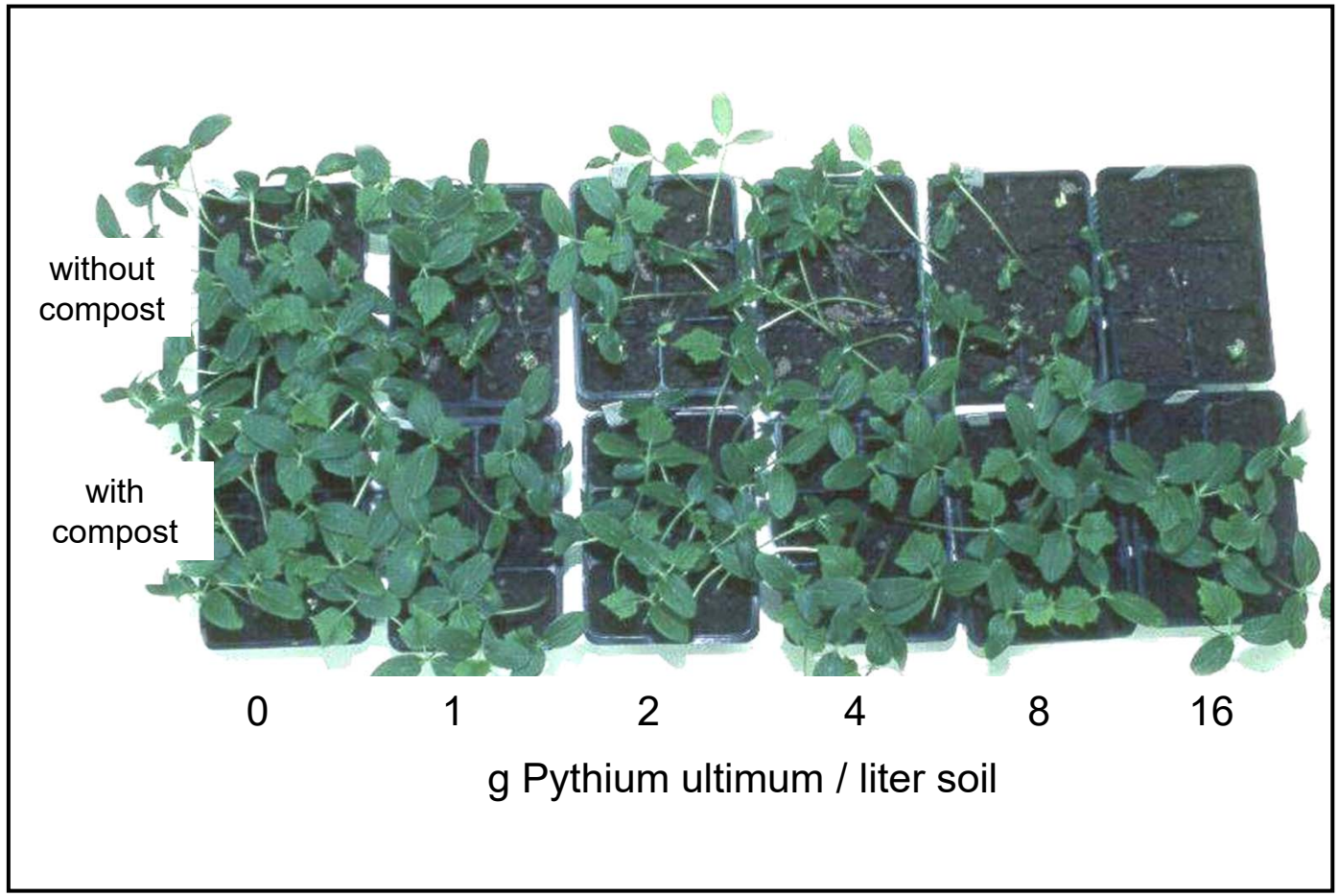
Effect on plant health

>Effect of compost in the field



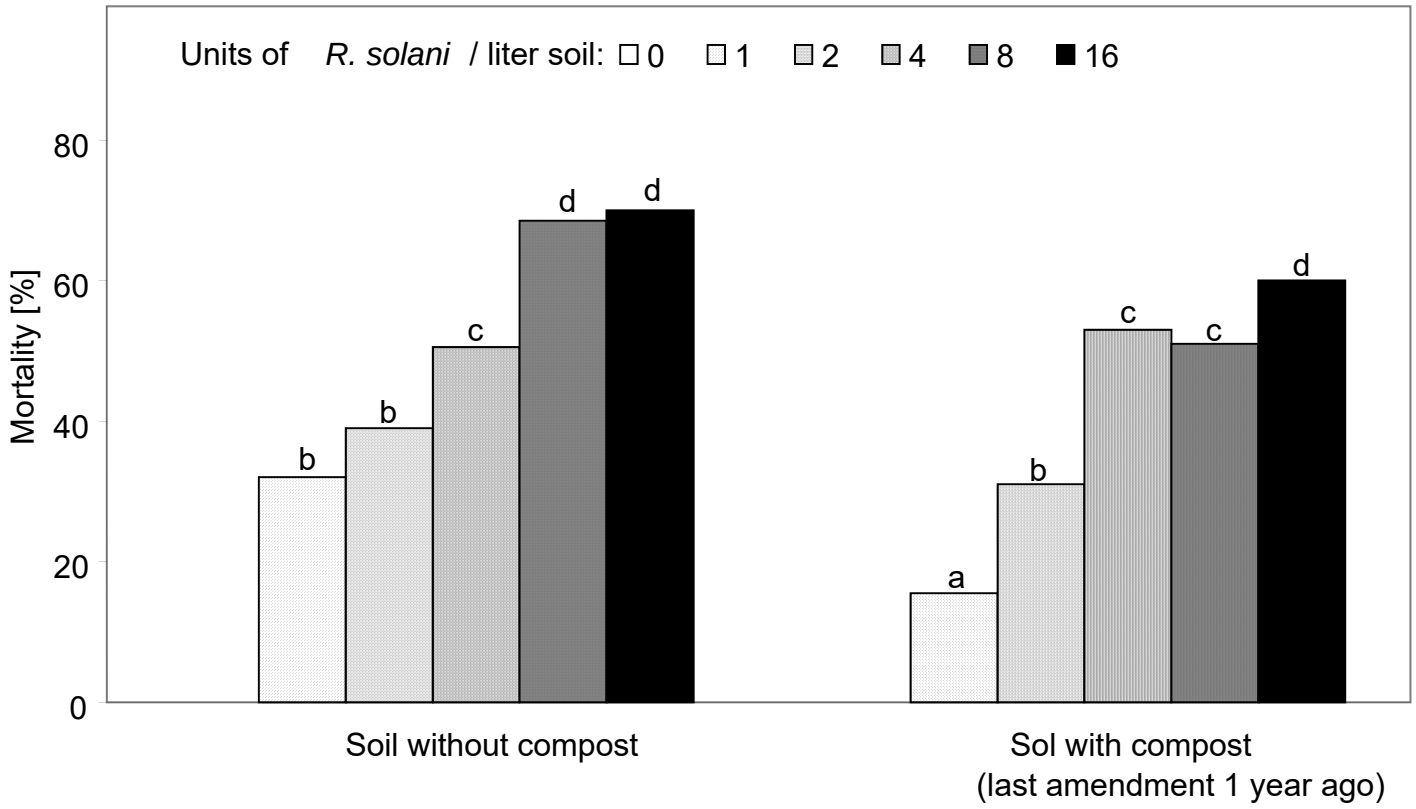
Effect on plant health

>Effect of compost in the field



Effect on plant health

>Effect of compost in the field

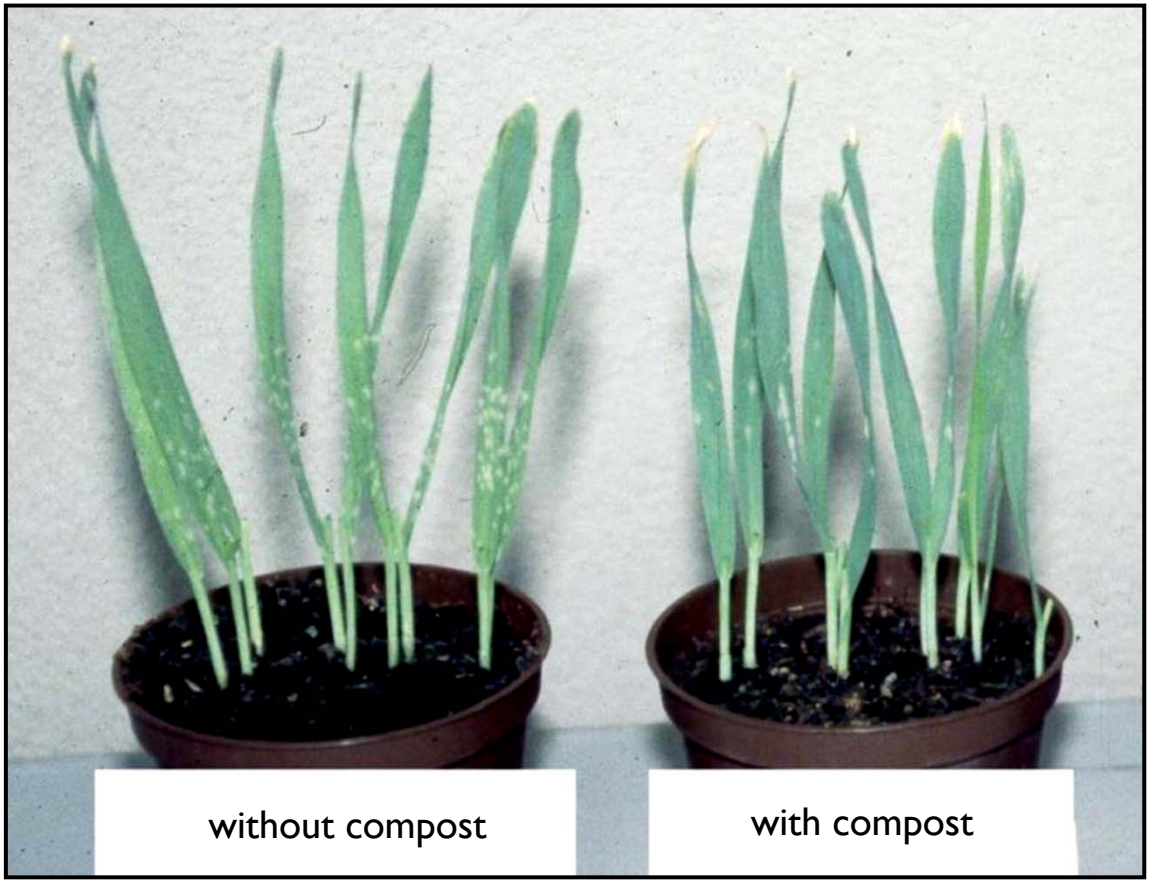


Effect on plant health

- Effect of compost in the field
  - Reduces disease incidence
  - The more intensively the field is cultivated, the more evident is the positive effect of compost on plant health

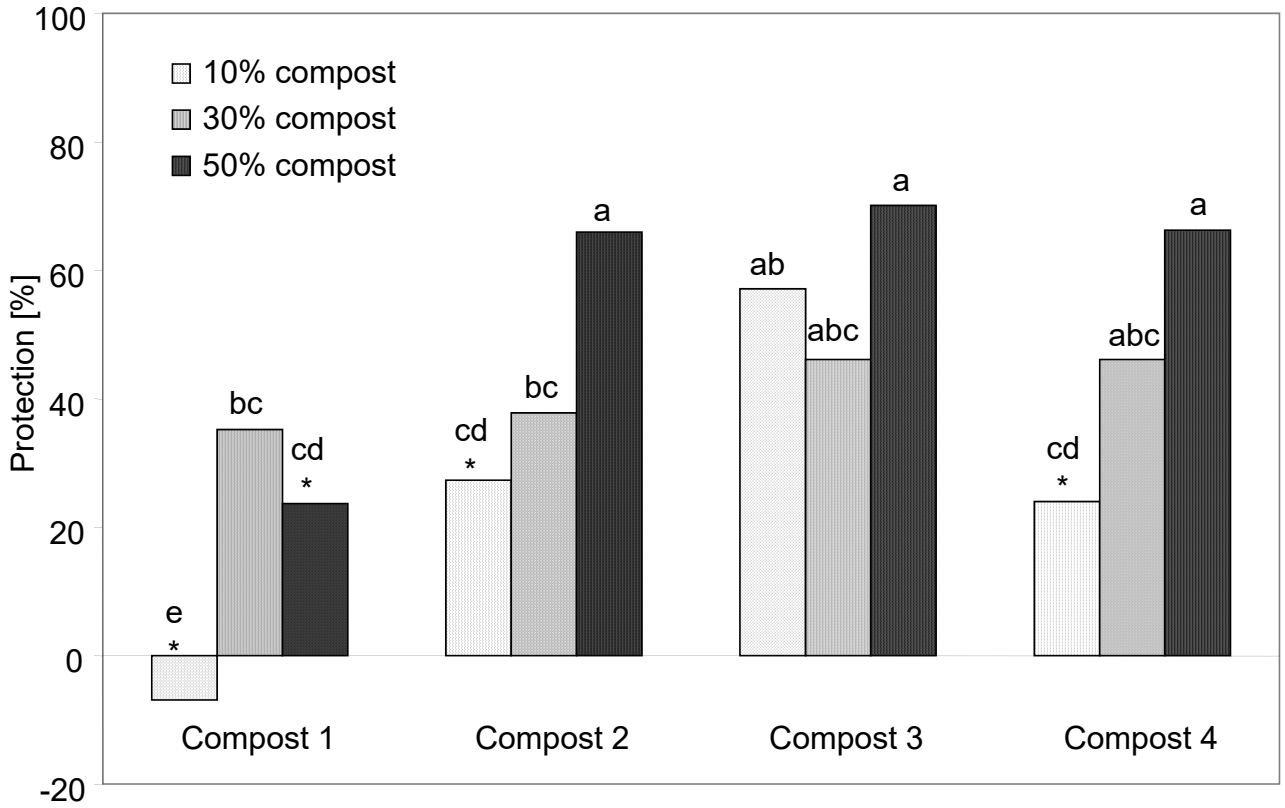
Effect on plant health

>Compost effect on the whole plant



Effect on plant health

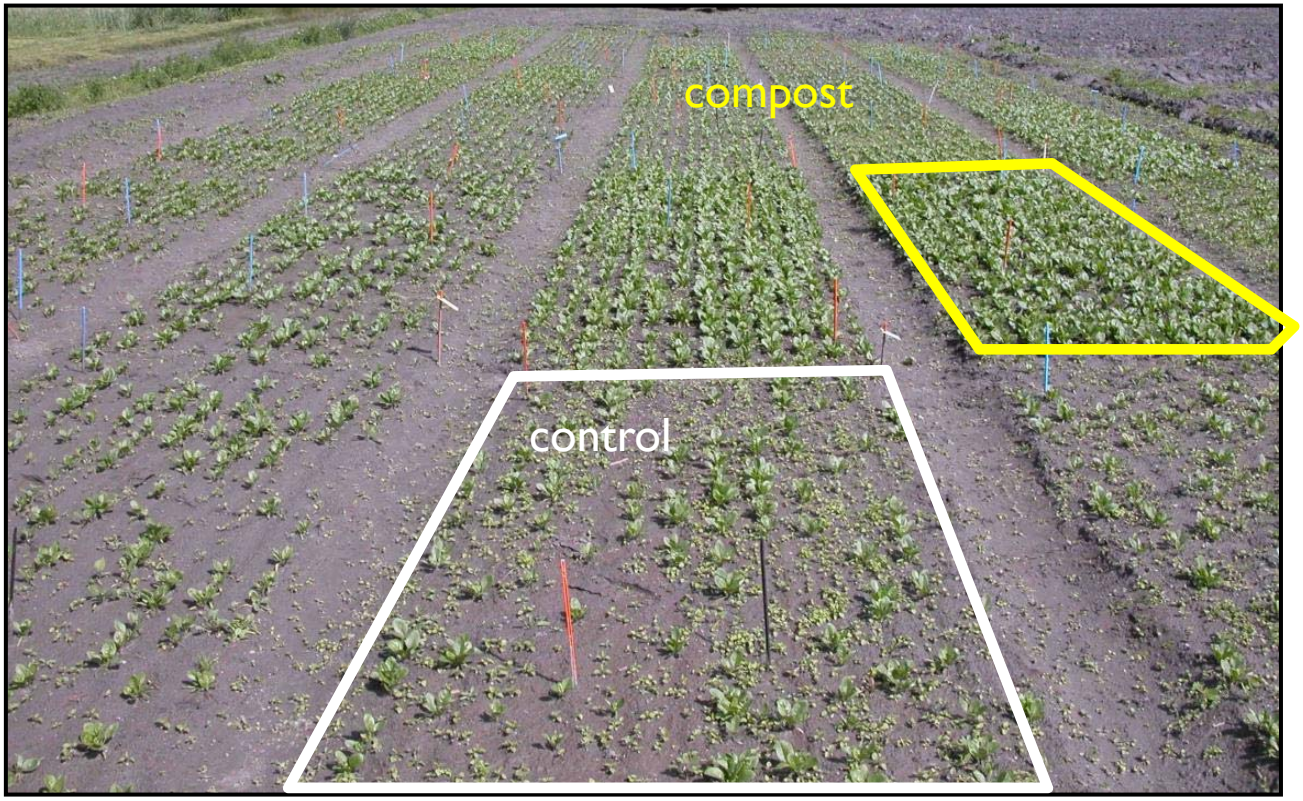
>Compost effect on the whole plant



Vegetables: effects on soil fatigue

Vegetables: effects on soil fatigue

>Spinach damping off



Vegetables: effects on soil fatigue

>Clubroot of crucifers

Vegetables: effects on soil fatigue

>Clubroot of crucifers

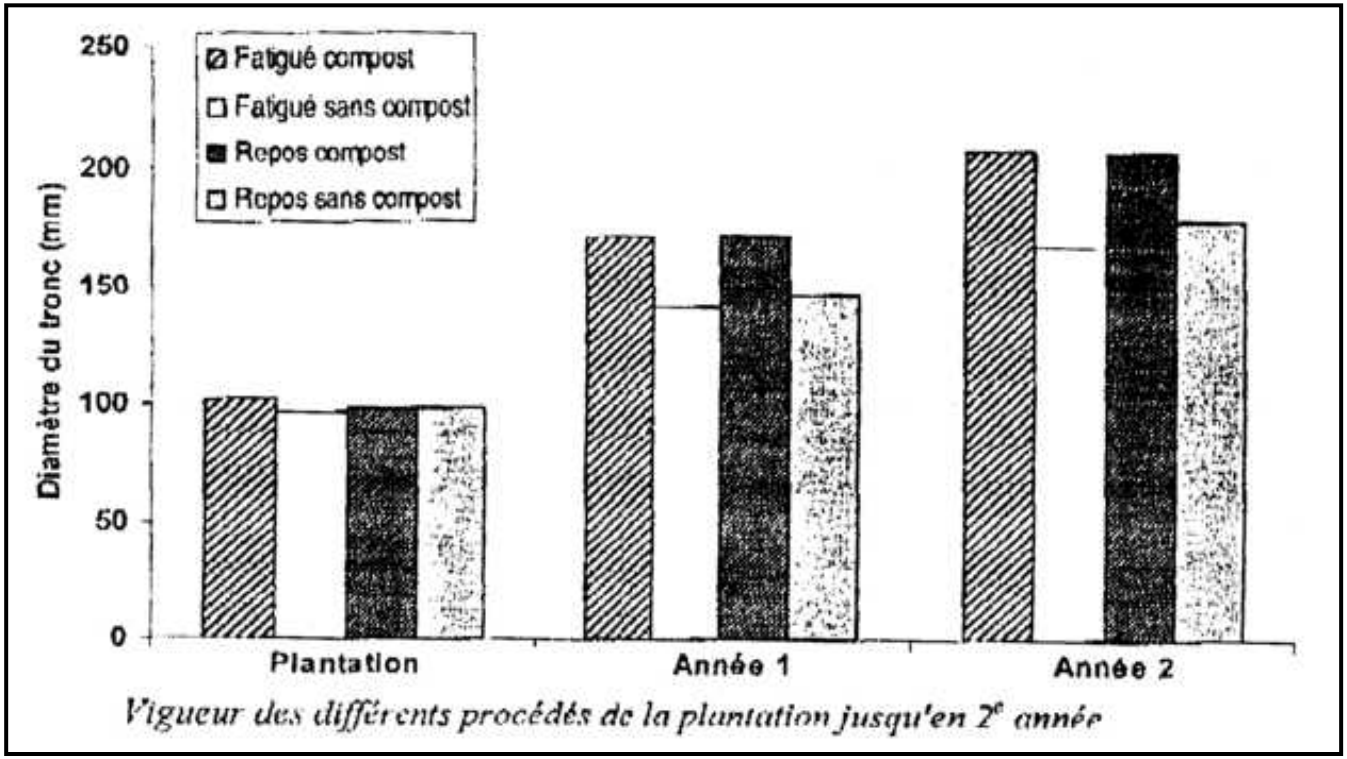
Compost (10%)

Sterilized compost (10%)

Arboriculture: phytosanitary effects

Arboriculture: phytosanitary effects

>New plantation in soils with fatigue



Vigueur des différents procédés de la plantation jusqu'en 2e année

Arboriculture: phytosanitary effects

>New plantation in soils with fatigue

Arboriculture: phytosanitary effects

> Diminution of root rot in cherry trees or of *Phytophthora* rot in raspberry

Photo: FAW

Arboriculture: phytosanitary effects

> Application in autumn to diminish the inoculum of apple scab in the following spring

Conclusions

Conclusions

- Positive effect of composts and digestates
  - Effect on the chemicals characteristics of soil
  - Effect on the physical chemicals characteristics of soil
  - Effect on the (micro-)biological characteristics of soil
- Phytosanitary effect

- The positive effects can be obtain with quality products and only when they are correctly used

Questions ? Discussion ?

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