Ecology of Soil Microorganisms 2015

An indicator for disease suppression:
linking soil chemistry to microbiology using dissolved organic carbon fractionation

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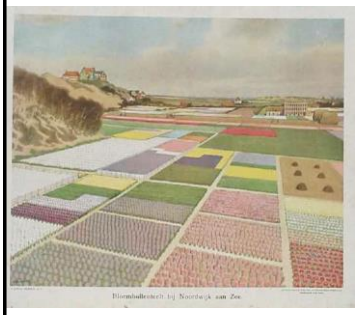
Dutch flower bulb production

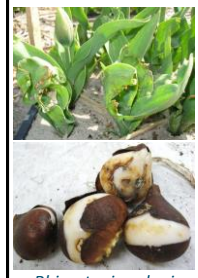
Important cultivation area behind the Dutch dunes



Dune area has been levelled, resulting in arable land:

- Sandy soil
- pH 7, calcium rich
- Soil organic matter 1%
- Groundwater at -50 cm
- Exclusively bulb crops rotation 1:4

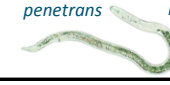
Soil borne diseases are a huge problem



Rhizoctonia solani

Pythium spp.

Pratylenchus penetrans



Meloidogyne hapla

Suppression of *Pythium* root rot in iris

General disease suppression: competition for food and space.

Untreated soil *with* natural microflora

Sterilized soil *without* microflora

Destruction of the soil microflora eliminates disease suppression.

A key role for soil organic matter

Addition of organic matter may stimulate the soil microflora:

- Increase microbial biodiversity, biomass and activity
- Stimulate general disease suppression.

Organic matter and disease suppression

Field trial

Three levels of soil organic matter (SOM) by incorporation of 95% peat + 5% cattle manure

- 10 g/kg SOM
- 20 g/kg SOM
- 30 g/kg SOM

Organic matter and disease suppression

Soil samples from the field trial were tested in bioassays for disease suppression

Pythium root rot in Hyacinth

Meloidogyne hapla in Lettuce

Bioassay for disease suppression

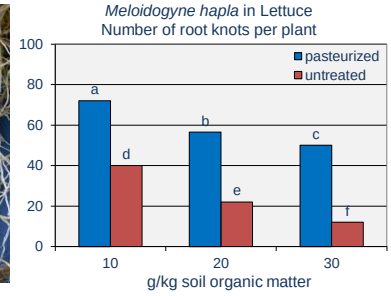
Example: root knot nematode (*Meloidogyne hapla*)

Add nematodes (J2, 600/pot)
Susceptible crop (Lettuce)

After 6 weeks:
Count root knots

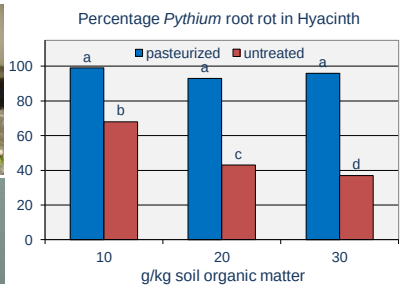
Few root knots > good suppression

Suppression of *Meloidogyne hapla*



Less root knots in the presence of the natural soil microflora
Less root knots at higher % SOM

Suppression of *Pythium intermedium*



No disease suppression without natural soil microflora
Less disease at higher SOM

Soil parameters as indicator for disease suppression?

Chemical:

- *N, C/N*
- *P-PAE, P-Al, Pw*
- *Ca, K, Mg, Na, Cu, Mg, Mn, Zn*
- *S, C/S*
- *CEC*
- *$CaCO_3$*
- *pH*
- *SOM*
- *C-organic*
- *C-anorganic*

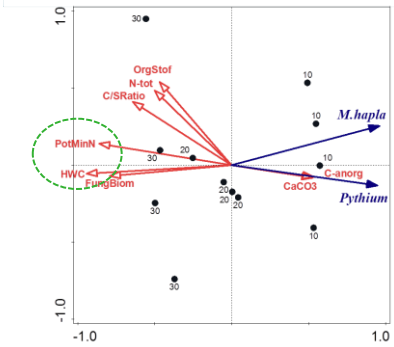
Physical:

- *Soil texture - particle size distribution*

Biological:

- *Fungal biomass*
- *Fungal activity %*
- *Bacterial biomass*
- *Fungi/bacteria ratio*
- *Potential mineralizable N*
- *Hot water extractable C (16 h at 80°C)*

Best of all physical, chemical and biological parameters



Root infection by:

- *Pythium* (%)
- *M.hapla* (# knots/plant)

Soil parameters

SOM levels:

- 10 g/kg
- 20 g/kg
- 30 g/kg

RDA-plot: variation accounted for 94%

Field trial: different organic amendments

Amendments (amount dry matter):

- No organic amendment

- Compost (10 ton/ha) standard practice

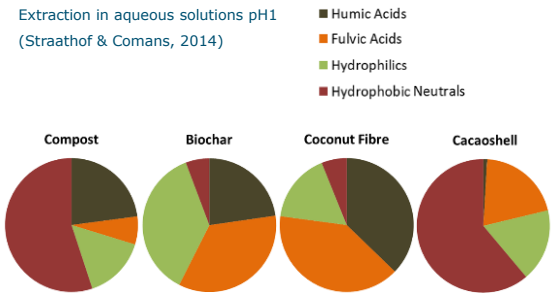
- Biochar (35 ton/ha)

- Coconut fibre (29 ton/ha)

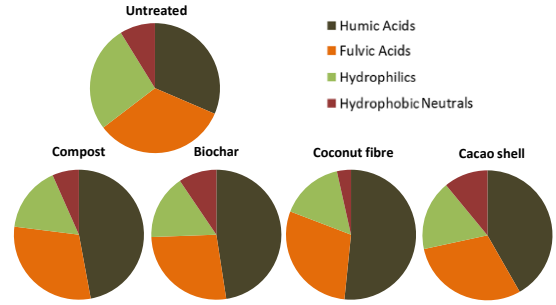
- Cacao shell (29 ton/ha)

Proportions of DOC-fractions as a percentage of total DOC in organic amendments

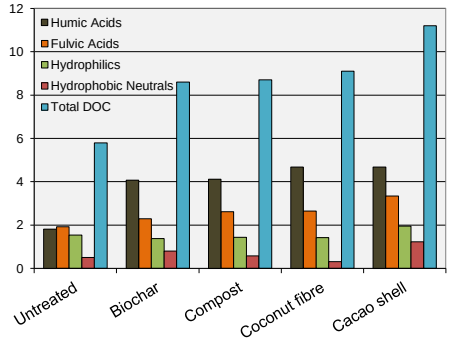
Extraction in aqueous solutions pH1 (Straathof & Comans, 2014)



Proportions of DOC-fractions as a percentage of total DOC in soil (1 month after amendment)

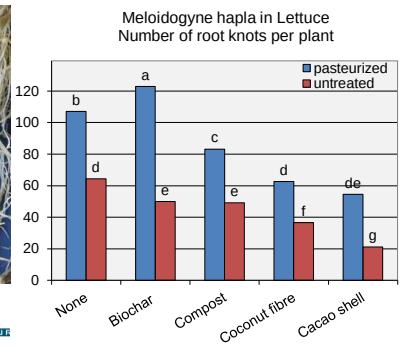


DOC-fractions and total DOC (mg C/l soil solution)

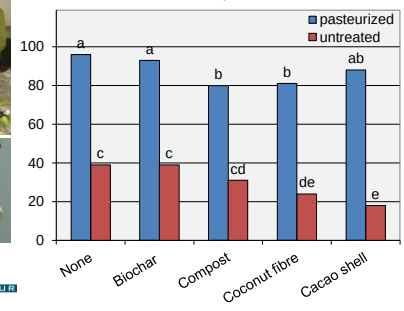


Field trial - organic amendments

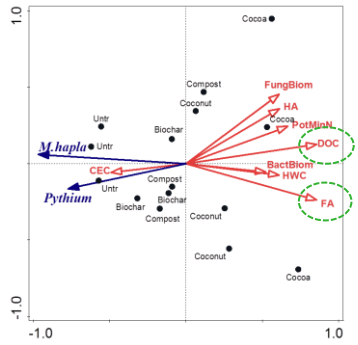
Suppression of *Meloidogyne hapla*



Suppression of *Pythium intermedium*



Best of all physical, chemical and biological parameters



RDA-plot: Variation accounted for 84%

Indicator for disease suppression?

Best indicators (variation accounted for in RDA-plots) for disease suppression against *Pythium* and *M. hapla*:

- Total DOC
- Fulvic acids

- *Cause or result?*
- *Other pathogens?*
- *Other soil types?*
- *Representative sampling?*
- *Relevant sampling time?*
- *Threshold values?*
- *Predictive value?*

Thanks to

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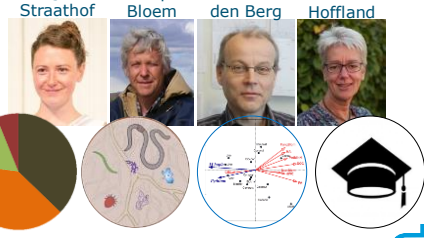

Productschap Tuinbouw

Ministerie van Economische Zaken

Thank you for your attention

Questions?