




Ecology of Soil Microorganisms
2015



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

Gera van Os

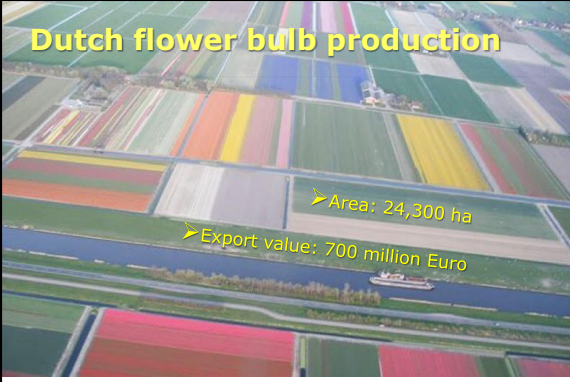
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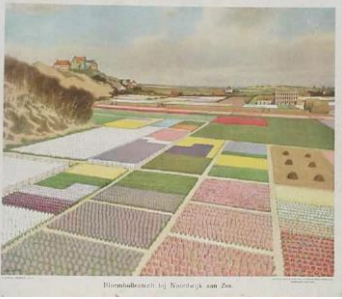
Dutch flower bulb production



➤ Area: 24,300 ha
➤ Export value: 700 million Euro

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Important cultivation area behind the Dutch dunes



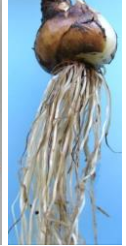
Dune area has been levelled, resulting in arable land:

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

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Soil borne diseases are a huge problem









Rhizoctonia solani Pythium spp. Pratylenchus penetrans Meloidogyne hapla

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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.

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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.


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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*)



After 6 weeks:
Count root knots

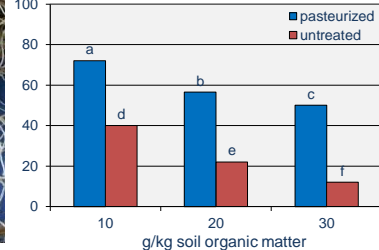
Add nematodes (J2, 600/pot)
Susceptible crop (Lettuce)

Few root knots > good suppression




Suppression of *Meloidogyne hapla*

Meloidogyne hapla in Lettuce
Number of root knots per plant

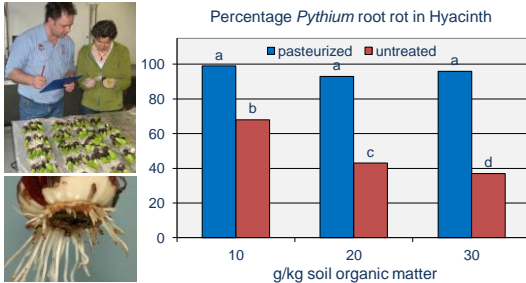


g/kg soil organic matter	pasteurized	untreated
10	~75 (a)	~40 (d)
20	~55 (b)	~25 (e)
30	~50 (c)	~15 (f)

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




Suppression of *Pythium intermedium*




Percentage *Pythium* root rot in Hyacinth

g/kg soil organic matter	pasteurized	untreated
10	~95 (a)	~70 (b)
20	~95 (a)	~45 (c)
30	~95 (a)	~35 (d)

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-AI, Pw
- Ca, K, Mg, Na, Cu, Mg, Mn, Zn
- S, C/S
- CEC
- CaCO₃
- pH
- SOM
- C-organic
- C-anorganic

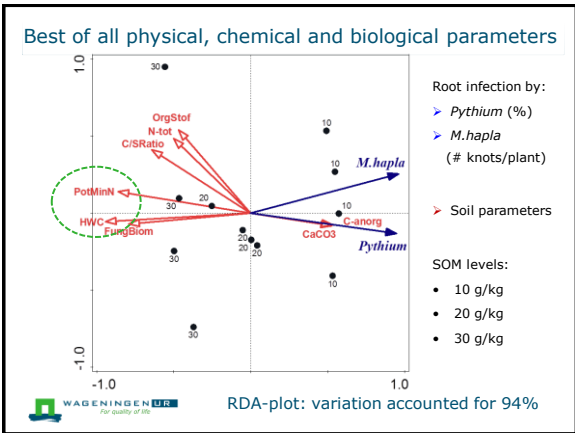
Physical:

- 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)



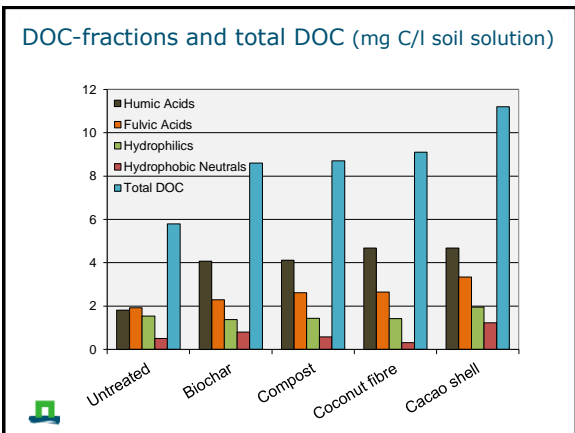
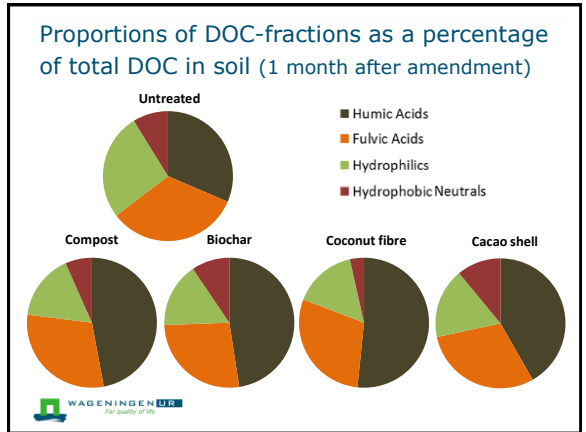
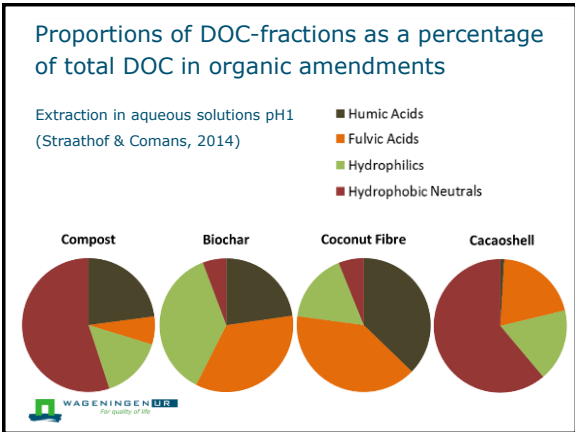


Field trial: different organic amendments

Amendments (amount dry matter):

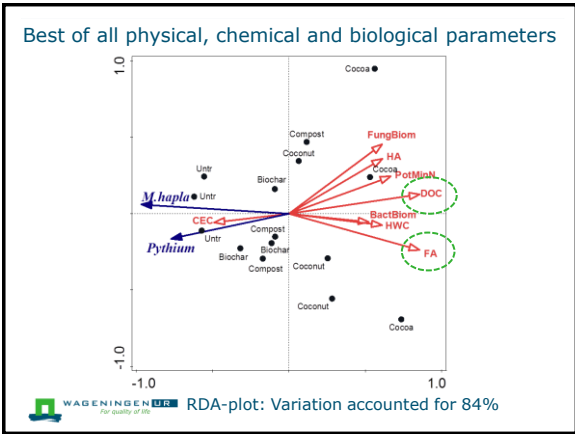
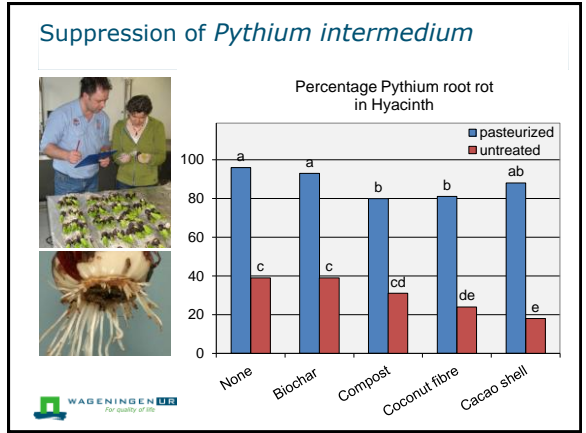
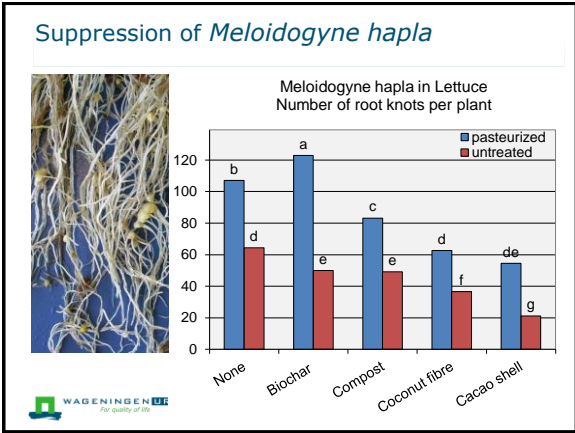
- No organic amendment
- Compost (10 ton/ha) standard practice
- Biochar (35 ton/ha)
- Coconut fibre (29 ton/ha)
- Cacao shell (29 ton/ha)

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Field trial - organic amendments

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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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Thank you for your attention

Questions?

Wageningen UR, CAH, Vrije Universiteit Amsterdam