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Soil biodiversity and disease suppression in relation to organic matter management

Gera van Os, Jaap Bloem, Henk van Reuler, Jan van der Bent and Wim van den Berg

Introduction

In the Netherlands, flowerbulbs are grown on sandy soil with low soil organic matter content (SOM < 1 g.kg^{-1}) and fast SOM degradation (6-10% yr $^{-1}$). This soil is very conducive to soil borne diseases. Addition of organic matter may stimulate the soil microflora and enhance disease suppression.

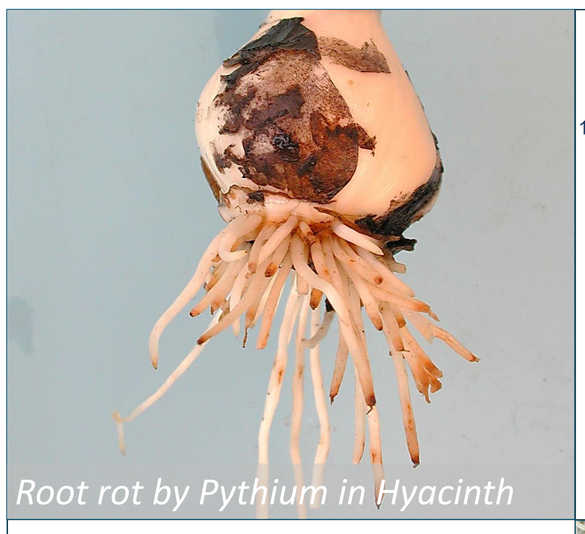
Field experiments

In two controlled field experiments, three levels of SOM were established: c. 10, 20 and 30 g.kg^{-1} by incorporation of a peat-manure mixture (95%-5%). A third field trial was performed at five commercial farms, with annual application of 30 or 60 t.ha $^{-1}$ compost and incorporation of the green manure crop *Avena strigosa* 'Luxurial' (Bristle oat). After three years, soil physical, chemical and biological characteristics were determined. Also, soil samples were tested in bioassays for disease suppression.

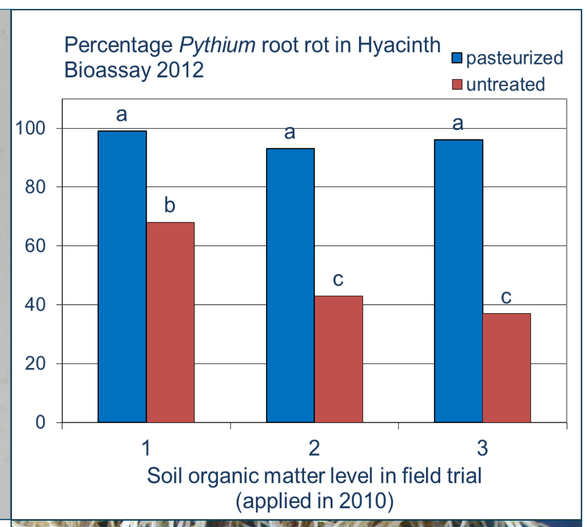
Bioassays for disease suppression

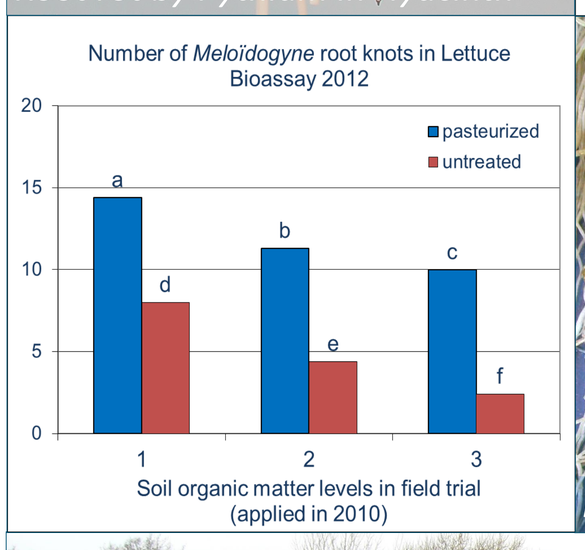
Soil samples were pasteurized (2 h 70°C) or not and artificially infested or not in bioassays with four pathogens and test crops:

- *Pythium intermedium* in Hyacinth 'Pink Pearl'
- *Rhizoctonia solani* AG2-t in Tulip 'Gander'
- *Pratylenchus penetrans* in Narcissus 'Tête-a-tête'
- *Meloïdogyne hapla* in lettuce 'Arcadia'



Root rot by Pythium in Hyacinth



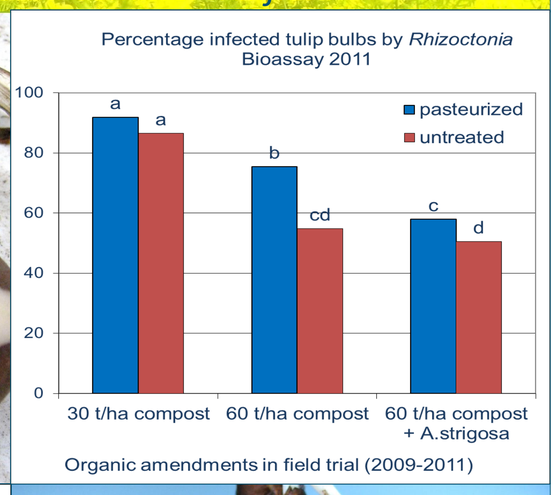


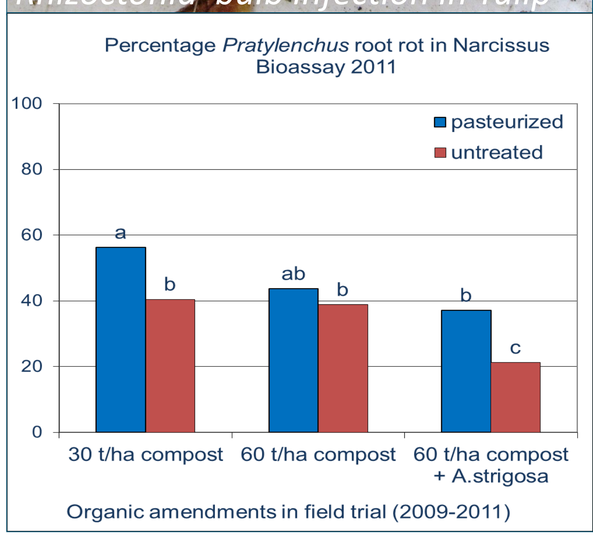
Root knots by M. hapla in lettuce

Field experiment with three levels of soil organic matter

Bulb growers discussing a field trial on a commercial field

Rhizoctonia bulb infection in Tulip

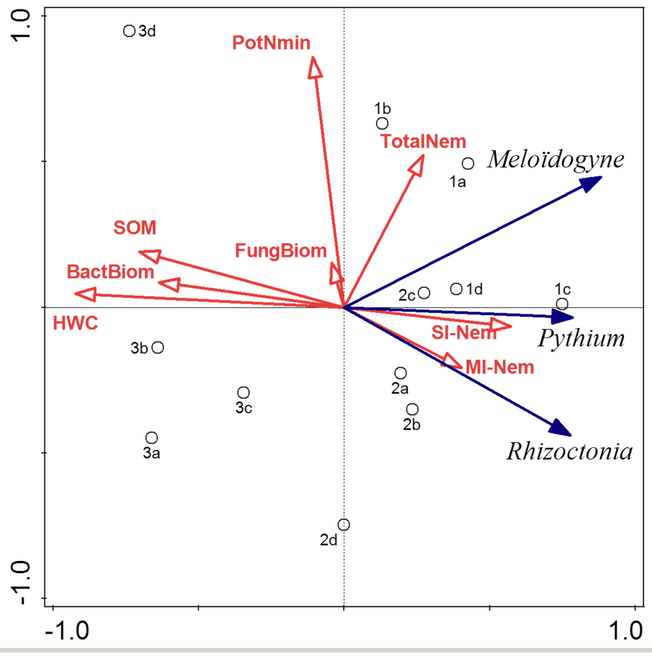




Root rot by Pratylenchus in Narcissus

Overall conclusions from three field trials

- The natural soil microflora played a significant role in the disease suppression against all tested pathogens.
- Disease suppression showed positive correlations with (biplot):
  - Soil organic matter content (SOM), affected by amendments of peat, compost and a green manure crop;
  - Hot water extractable carbon (HWC), depending on the pathogen.
- Biodiversity of nematodes, i.e. Shannon-index (SI) and Maturity-index (MI), showed variable correlation with disease suppression and SOM, depending on pathogen and field trial.



Redundancy analysis
(Canoco 5)

Total variation accounted for: 84%

Blue arrows (bioassays): Severity of infection by
- *Meloïdogyne*
- *Pythium*
- *Rhizoctonia*

Red arrows (variables): Selection of soil parameters

Circles (samples from field trial): applied SOM levels, a-d replicates

Wageningen University and Research Centre, Applied Plant Research
PO Box 85, 2160 AB Lisse, The Netherlands
Dr G.J. (Gera) van Os gera.vanos@wur.nl +31 (0)6 30573432

Ministerie van Economische Zaken
Duurzaam Bodemleven
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