Potential of organic soil amendments to control soil borne pathogens

Joeke Postma[1], Mirjam Schilder[1], Stefan Jansen[2], Milan Franssen[3], Jaap Bloem[1], Johnny Visser[1], Gerard Korthals[1], and Tess van de Voorde[1]

[1]Wageningen University and Research; [2]Deltares; [3]Delphy

Introduction

Soil suppressiveness against plant pathogens is a promising strategy to control diseases and crop losses. Since organic amendments can enhance soil suppressiveness, the potential of a large variety of organic products to enhance disease suppression was evaluated in two standardized bioassays. In addition, characteristics of the organic products and some soil indicators were measured.

Research questions

- Which organic products can enhance disease suppression in soil?
- Which properties of organic products are relevant for disease suppression?

Material and methods

- 24 organic products of different origin were selected (Table 1).
- Characteristics of these products were analysed: such as pH, organic matter (OM), chemical composition, respiration rate (Oxitop), and organic fractions (Rock-Eval pyrolyse) (Fig. 1). Data of all analyses are reported in WPR-1183, https://doi.org/10.18174/579469.
- Products were added to arable sandy soil (Vredepeel, 4% OM), max. dosages corresponded to 0.2 g N/kg soil. Unamended soil (C) and soil fertilized with nitrogen (N) were used as controls.
- Disease suppression was assessed in pot experiments after the inoculation with pathogens (see Fig. 2).
- Potentially mineralizable N (PMN) and hot water extractable carbon (HWC) served as soil quality indicators representing labile N and C.

Table 1. Organic amendments with their origin between brackets.

1 Hairmeal (animal)	9 Cellulose +/-N (sewer)	17 Chitin-shrimp (animal)
2 Feathermeal (animal)	10 Biochar (sewer)	18 Mushroom powder (fungus)
3 Bonemeal (animal)	11 Humic acids (groundwater)	19 Mushroom residues (fungus)
4 Humic acids (animal)	12 Kaumera (sewer)	20 Pleurotis+straw +/-N (fungus)
5 Greencompost (plant)	13 Tradiphos® (sewer)	21 Insect exuviae (animal)
6 Brassica seedmeal (plant)	14 Digestate (plant)	22 Insect frass (animal)
7 Sludge (river)	15 Dredge (plant + soil)	23 Cow manure+wood (animal)
8 Sludge (river)	16 Coffee pellets (plant)	24 Cow manure fresh (animal)

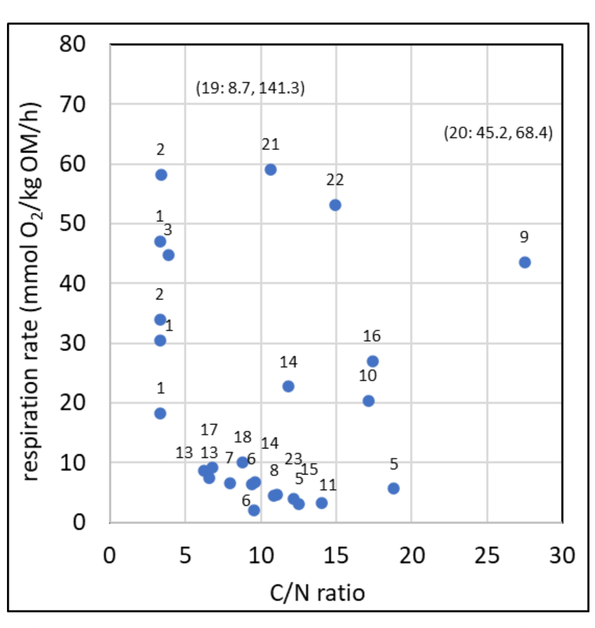

Figure 1. C/N ratio and respiration rate of the organic products; product numbers as in Table 1. Values of products 19 and 20 are outside the scale, values are given between brackets.

Figure 2. Bioassays to assess disease suppression of soil with organic amendments: (A) damping off in cress by *Pythium ultimum,* (B) disease spread in sugar beet by *Rhizoctonia solani* AG2-2IIIB.

Results

Pythium suppression was partly enhanced by N addition itself (Fig. 3 left: fertilized control soil (N) versus unamended control (C)). Since organic amendments also contain N, many of the products showed lower disease levels compared to C. However, hairmeal (1), brassica seedmeal (6), cellulose+N (9+N), digestate (14), chitin-shrimp (17), mushroom residues (19), and pleurotis+straw+N (20+N) showed an additional disease reduction compared to the fertilized control soil (N), indicating additional effects due to the organic amendment. There was a significant negative correlation between the Pythium disease and PMN values in the soil. This is in line with the expectation that general suppression is the main mechanism controlling Pythium damping off, being linked to microbial biomass and activity.

Rhizoctonia suppression was not significantly influenced by N fertilization itself and relatively few organic amendments enhanced suppression compared to the fertilized control soil (N), i.e. hairmeal (1), feathermeal (2), cellulose+N (9+N) and pleurotis+straw with and without N (20, 20+N) (Fig. 3 right). There was no significant linear relation between Rhizoctonia disease and PMN. Also other product characteristics did not point at one potential indicator for Rhizoctonia suppression.

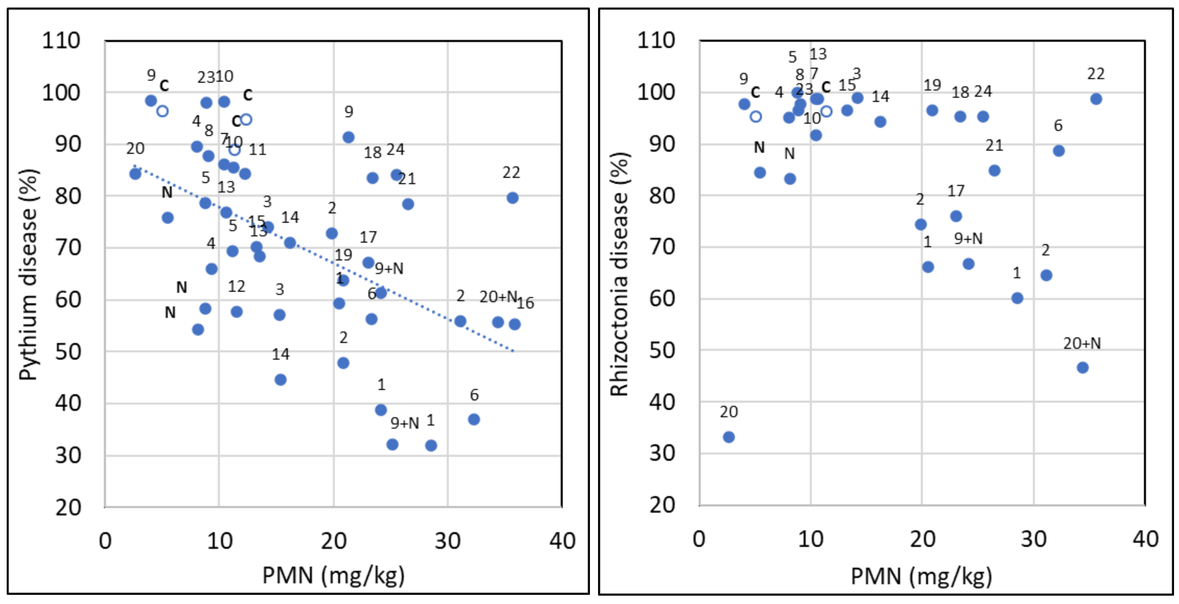

Figure 3. Pythium and Rhizoctonia disease in infested soil in relation to Potentially Mineralizable N (PMN) in soil without amendment (**C**, open symbol), N fertilized soil (**N**) or soil with organic amendments (product numbers as in Table 1).

Conclusions

- Several organic products enhanced Pythium disease suppression, and this correlated with potentially mineralizable N (PMN) in soil.
- Only a few organic products enhanced Rhizoctonia suppression.
- A lower C/N ratio in the organic products, but not the respiration rate, correlated to some extend with disease suppression.

Acknowledgements

We thank all companies and organisations for supplying the organic products. Research was part of the projects LWV19166 and KB-34-008-001. We acknowledge funding by Topsector Agri&Food, Dutch Ministry of Agriculture, Nature and Food Quality, BO Akkerbouw, Darling Ingredients, BVOR, P.H. Petersen Saatzucht Lundsgaard, AquaMinerals, GMB BioEnergie, Cirkellab, and Delphy.

Wageningen University & Research
Postbus 16, 6700 AA Wageningen
Contact: joeke.postma@wur.nl
T + 31 (0)317 480664
www.wur.nl/