Biological control of strawberry crown rot is substrate dependent

Juho Hautsalo[1], Mauritz Vestberg, Päivi Parikka, Sanna Kukkonen, Saila Karhu, Riitta Kemppainen and Risto Tahvonen

[1]MTT Agrifood Research Finland, Plant Production, Antinniementie 1, FI-41330 Vihtavuori, juho.hautsalo@mtt.fi

Introduction

Phytophthora cactorum crown rot has become a limiting factor worldwide for strawberry cultivation and new control strategies are needed. Arbuscular mycorrhizal fungi (AMF) have previously reduced symptoms of strawberry crown rot and red steele [1]. Plant growth promoting rhizobacteria have been shown to lower disease incidence of strawberry crown rot and earlier in vitro studies at MTT in Piikkiö suggest that also endophytic *Pseudomonas spp.* isolated from strawberry have the potential to decrease the damage caused by crown rot [2]. In disease control, the growing medium composition should also be considered. For example, composts have been shown to suppress several soil borne pathogens such as *Pythium* and *Phytophthora* [3]. The contribution of three mycorrhizal strains, *Pseudomonas fluorescens* and different growing media to strawberry crown rot control was examined.

Material and methods

Two pot experiments were conducted in a greenhouse at MTT in Jokioinen. In the first experiment, the crown rot suppressiveness of three AMF strains: *Claroideoglomus claroideum* BEG31, *Glomus hoi* V307 and Myko-Ymppi (*Rhizophagus intraradices)* on three different growing media was conducted in summer of 2012. The second experiment testing Myko-ymppi, *P. fuorescens* and two compost amendments was carried out in 2013. Micropropagated strawberry cultivar 'Jonsok' was used as a test plant, inoculated with *Phytophthora cactorum* isolate five weeks after establishment. The growing media used in the experiments were:

A=modified OECD medium for biotests (sand + kaolin + perlite + sterilized dark peat, 7.5 + 1 + 1 + 0.5)

B=optimized medium for AMF colonization (sand + sterilized dark peat + perlite + Bara-clay (Baramineraler, Sweden), 4 + 2 + 3 + 1)

C=medium favoring AMF colonization and (especially) spore formation (sand + attapulgite-clay, 1 + 1)

D= manure/wood fiber compost (Humuspehtoori Oy, Finland) made from chicken and horse manure plus wood industrial residue (compost+sterilized dark peat+sand, 1 + 4 + 1)

E= sewage sludge compost (Mustankorkea Oy, Finland) compost made from sewage sludge, peat and wood chips (compost + sterilized dark peat + sand, 1 + 4 + 1)

F= peat based control medium (sterilized dark peat + sand, 5 + 1)

Dry weight of strawberry and disease symptoms (Fig 1) and were measured five weeks after the disease inoculation.

Results and discussion

On growing medium C there was no significant difference between the *Phytophthora* inoculated and the control plants indicating disease suppression (Fig 3). However, this medium was not optimal for strawberry growth. Plants on growing medium B showed the strongest crown rot symptoms (Table 1) and the highest growth reduction due to *P.cactorum* (Fig 3). Clear symptoms and growth reduction was also recorded in medium A but a positive effect of mycorrhiza can be seen on symptoms. However, plant growth measured by dry weight in experiment 1 was not significantly affected by AMF inoculations (df=90, F=1.37, P=0.2578). The growth was strongly dependent on growing medium (df=20, F=74.66, P<0.0001) and influenced by *Phytophtora cactorum* (df=5, F=82.85, P=0.0003).

Mycorrhizal inoculation increased strawberry growth in experiment 2 (Figs 2 and 5) but no clear disease suppression can be seen from the symptoms, although better growth due to successful AMF colonization is proposed to be one of the mechanisms of mycorrhiza induced biocontrol. Diseased and control plants grew equally well in the manure/wood fiber compost suggesting that it is a disease suppressive growing medium (Fig 4). *P. fluorescens* inoculated plants showed equal or worse symptoms than the control plants and their growth was also clearly weakened on the control and on the manure/wood fiber compost media. Sewage sludge compost increased strawberry growth clearly and had also disease suppressiveness.

Conclusions

- Biological control of strawberry crown rot with AMF is substrate dependent
- Composts can be suppressive to crown rot

References

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Table 1. Crown (scale 0-1) and root discoloration medians (0-3, 0=no discoloration, 1 or 3 strongly brown) and plant vigor (0-5, 0=dead, 5=completely healthy) of different treatments of 'Jonsok' strawberries inoculated with *P. cactorum* and measured at the end of experiments 1 and 2.

Experiment	Growing medium	Treatment	Crown discoloration	Root discoloration	Plant vigor
1	A	Control	0,8	2	1,5
		BEG31	0,3	3	3
		V307	0	3	3
		Myko-Ymppi	0,3	2,5	5
	B	Control	0,3	2,5	0
		BEG31	0,3	3	0
		V307	0,7	1	0
		Myko-Ymppi	1	3	0
	C	Control	0	1,5	3
		BEG31	0	1	3
		V307	0	1	3
		Myko-Ymppi	0	1	0
2	D	Control	0	0	5
		Myko-Ymppi	0	0	3,5
		Pseudomonas	0,5	1,8	1,5
		Combination	0,1	0	5
	E	Control	0,3	0,5	3
		Myko-Ymppi	0,5	2	2,5
		Pseudomonas	0,4	1	2
		Combination	1	3	0
	F	Control	1	3	0
		Myko-Ymppi	1	3	0
		Pseudomonas	1	3	0
		Combination	0,4	2	2

Figure 1. Wilted plant after *Phytophthora* inoculation

Figure 2. Growth effect of AMF in the control (no *Phytophthora*, growing medium F) of experiment 2.

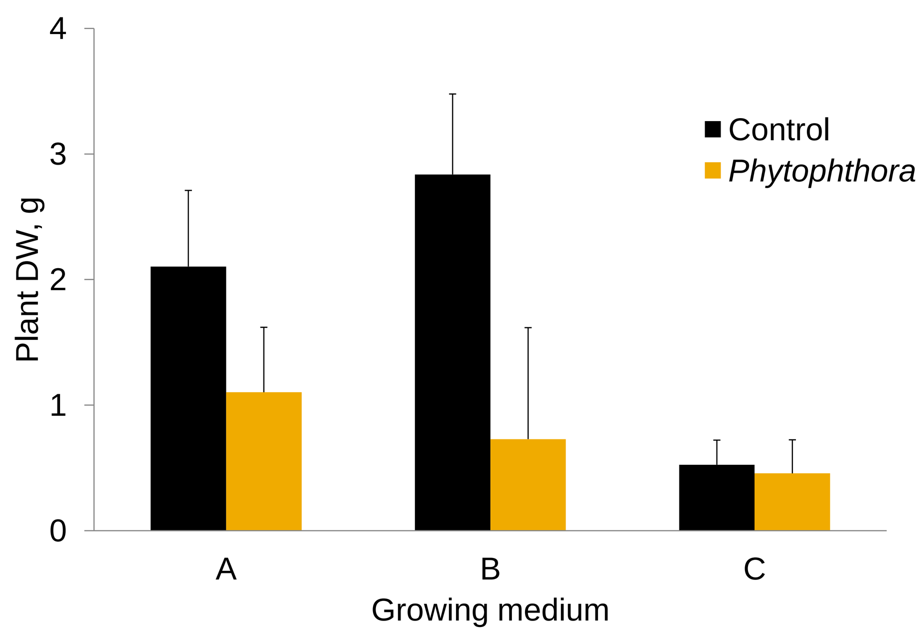

Figure 3. Impact of *P. cactorum* inoculation vs. control on mean shoot dry weight (DW) of 'Jonsok' strawberries growing on three growing media (see Table 1) in experiment 1.

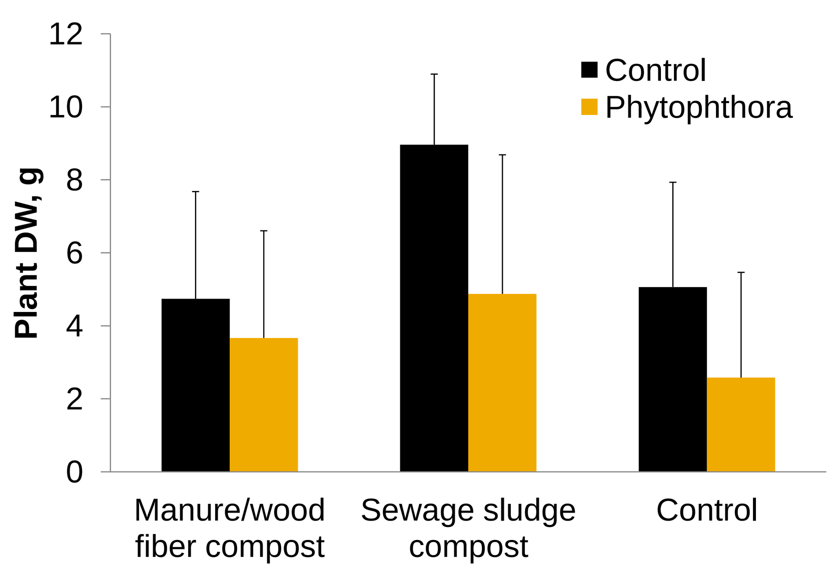

Figure 4. Impact of *P. cactorum* inoculation vs. control on mean shoot dry weight (DW) of 'Jonsok' strawberries growing on three growing media in experiment 2.

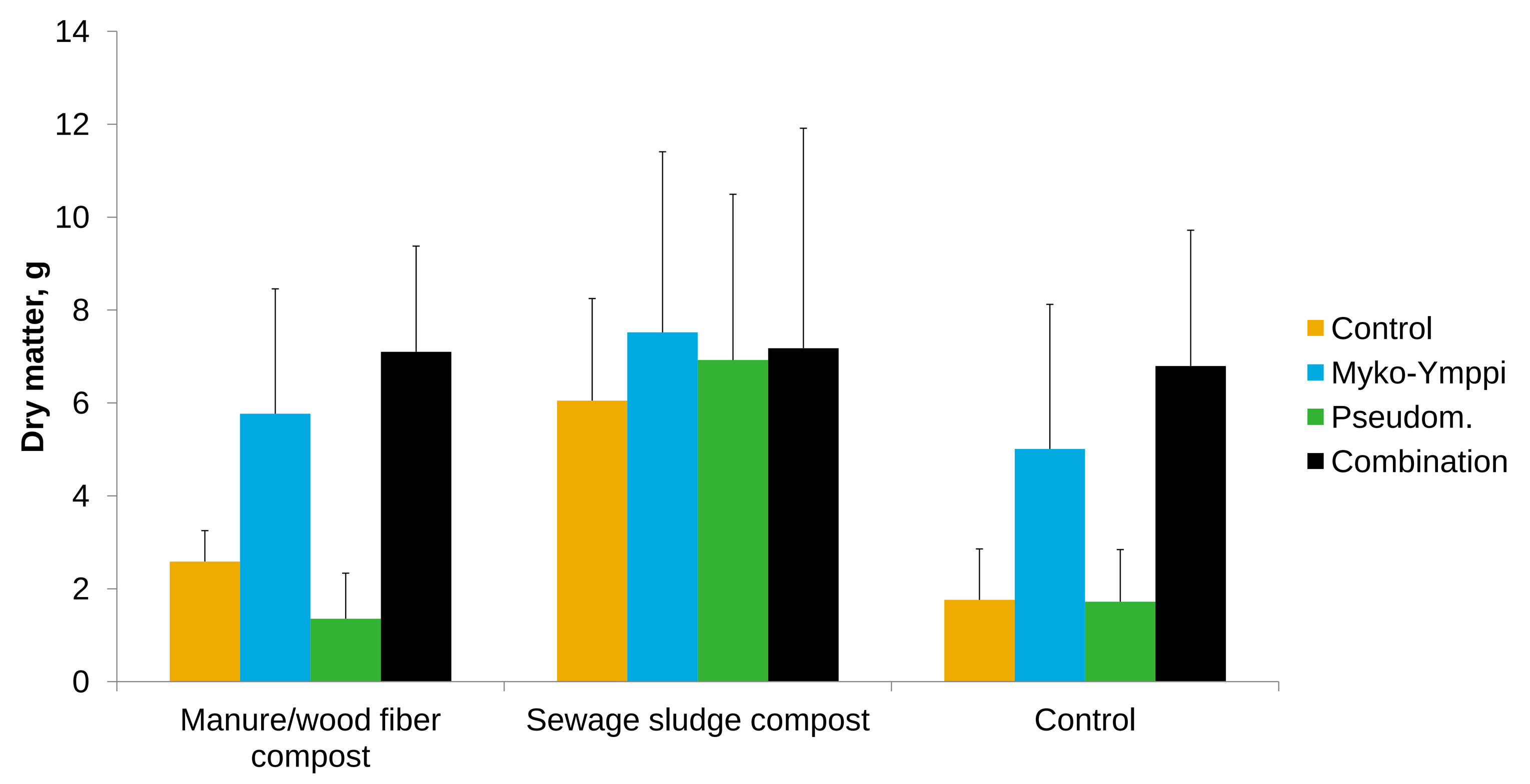

Figure 5. Impact of microbial treatments vs. control on mean dry weight (DW) of 'Jonsok' strawberries growing on three growing media amended or not with compost. In the manure/wood fiber compost and the control growing medium, plants inoculated with Myko-Ymppi and a combined microbial treatment showed significantly higher growth than the uninoculated control.

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