Phosphorus mobilization and biocontrol of plant pathogens combined in one strain - results of a fungal and a bacterial inoculant

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Background

Soil microbial communities are essential for healthy crop growth. Especially plants grown in fresh growing media (potting soil, stone wool, hydroponics) lack plant-specific rhizosphere micro-organisms. Inoculation with beneficial bacteria or fungi can support plant growth and protect plants from infection with plant-pathogens.

Here we demonstrate how two important crops, strawberry and tomato grown in potting soil, benefit from microbial inoculants.

Fungal inoculant

Phytophthora cactorum is an important disease in strawberry cultivation, both in plant propagation and fruit production (Fig. 1, 2). Potting soil and other substrates used for strawberry are free of mycorrhiza.

Fig. 1. Strawberry plants infected with *Phytophthora cactorum.*

Fig. 2. Internal symptom.

Two mycorrhiza species, *Rhizophagus irregularis* and *Glomus etunicatum* (delivered by Dr. H. von Alten, University of Hannover), were mixed through potting soil. The mycorrhiza *R. irregularis* was able to reduce infection of *P. cactorum* with approximately 50% compared to control plants without mycorrhiza. There were fewer plants with brown roots and also fewer plants with internal symptoms of crown rot (Fig. 3). After *R. irregularis* inoculation, 40% of the strawberry roots contained mycorrhiza when they were 6-weeks old. The other mycorrhiza strain was less effective.

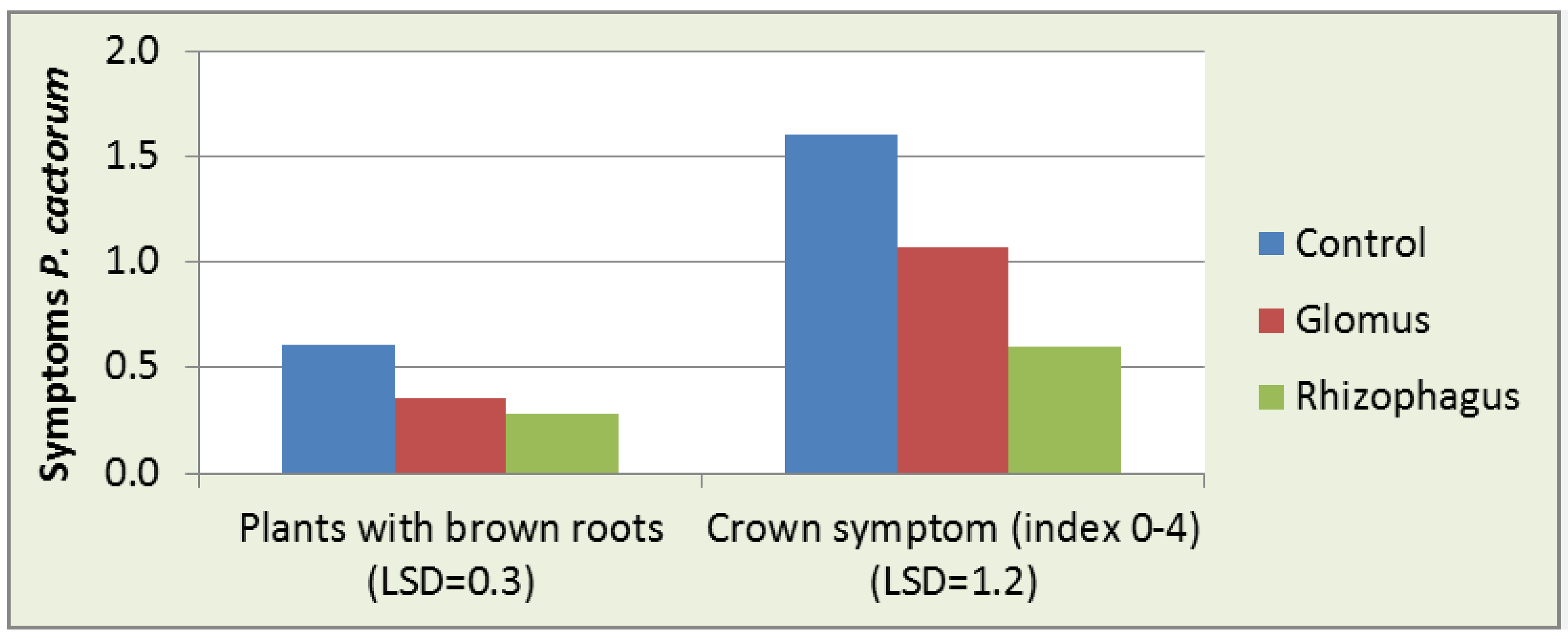

Fig. 3. *Phytophthora cactorum* symptoms in strawberry plants with and without inoculated mycorrhiza strains.

Bacterial inoculant

Pythium is causing root rot and damping-off in many crops, including tomato (Fig. 5). *Pseudomonas chlororaphis* strain 4.4.1 was selected for its capacity to inhibit fungal growth and to colonize *Pythium* hyphae (Fig. 4), as well as solubilizing phosphorus. Inoculation of this strain into potting soil protected tomato plants against infection by *Pythium aphanidermatum* (Fig. 6). The number of healthy plants increased with 30 to 105 % compared to the control in three independent greenhouse experiments.
Strain 4.4.1 also enhanced phosphorus (P) uptake by the tomato plants. Plants contained 15 to 35 % more P when strain 4.4.1 was inoculated. The effect was most distinct when an insoluble P-fertilizer was mixed through the potting soil together with strain 4.4.1.

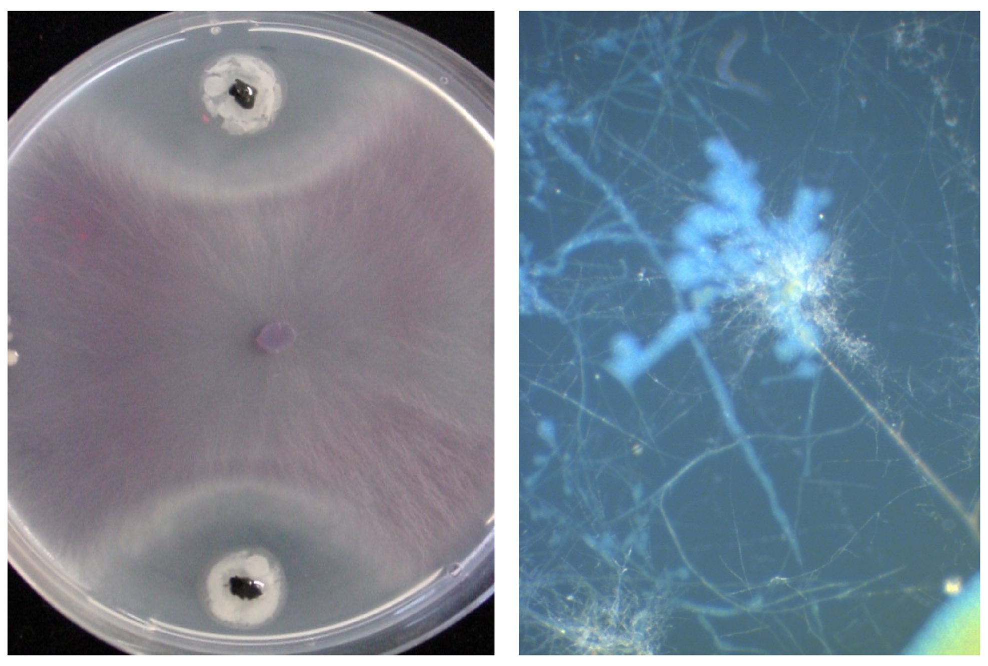

Fig. 4. *Pseudomonas chlororaphis* inhibiting *Fusarium* and colonizing *Pythium* mycelium.

Fig. 5. Tomato seedlings infected with *Pythium aphanidermatum.*

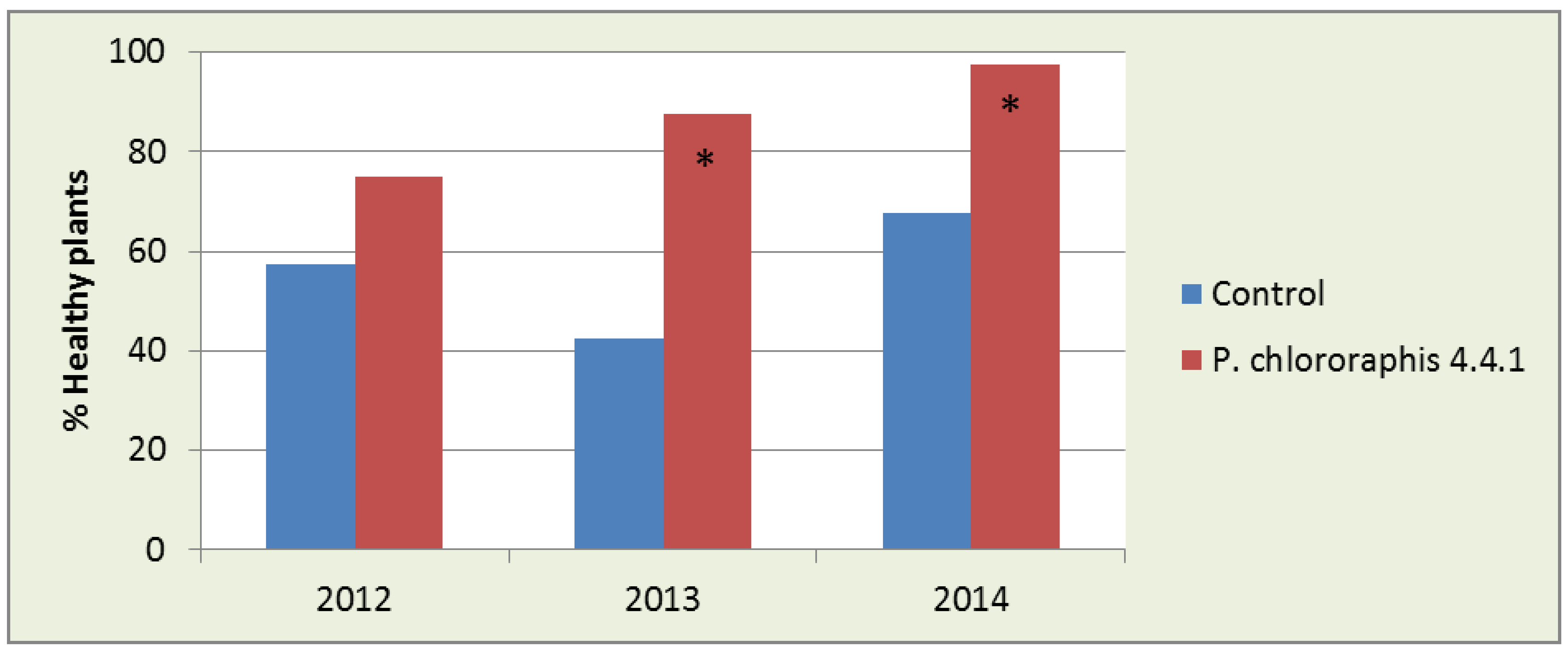

Fig. 6. Percentage healthy tomato plants in potting soil infested with *Pythium aphanidermatum;* the soil was treated with or without *Pseudomonas chlororaphis* strain 4.4.1.

Conclusions

- Mycorrhizal fungi are mainly known for supporting phosphorus uptake by plants. A strain of *Rhizophagus irregularis* was also capable of reducing *P. cactorum* infections in strawberry plants.
- *Pseudomonas* species are generally selected as biocontrol agents. A *P. chlororaphis* strain controlled *Pythium* infection in tomato. Meanwhile it mobilized insoluble phosphorus and enhancing P-uptake by the plants.

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