Application of the Endophyte *Piriformospora indica* in Hydroponic Cultures

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Introduction

Piriformospora indica (Basidiomycota, Sebacinales) (Fig. 1, 2) is a root endophytic fungus with a broad host spectrum. This plant root colonizing fungus has been discovered in the Indian Thar desert and was shown to provide strong growth promoting activity during its symbiosis with a broad spectrum of plants. *P. indica* colonizes the cortex of roots and induces also resistance against fungal leaf pathogens.
In order to determine the potential of *P. indica* to induce resistance against a virus, *Pepino mosaic virus* (PepMV) (Fig. 3), primarily tests were conducted to:
a) determine the applicability of *P. indica* in hydroponic system
b) select a suitable tomato cultivar

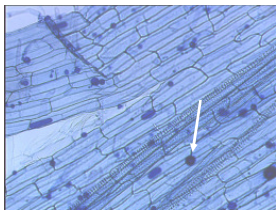

Fig. 1: Tomato roots from hydroponic culture stained with trypan blue to visualize colonization with *P. indica* (arrow)

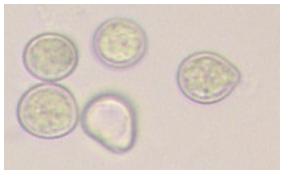

Fig. 2: Spores of *P. indica* isolated from PDA

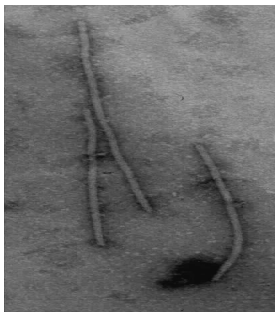

Fig. 3: PepMV Particles (length 500 nm, width 12 nm), visualized by negative staining

Materials and Methods

Application of *Piriformospora indica*

Tomato plants were grown in greenhouse in a recirculating hydroponic system (Fig.4) under standard conditions. Seedlings (cv. Hildares) were planted in gullies at seven leaf stage (PAR: 11.16 Mol m-2 d-1; day/night temperature: 24/18°C; relative air humidity: 75%). Either spores (Fig. 2) or hyphae of *P. indica* were inoculated pre-cultured on Complex Medium or Potato Dextrose Broth for nine weeks. Root colonisation with *P. indica* was detected after staining roots with trypan blue (Fig. 1). Plant growth characteristics were determined as well.

Infectiosity of PepMV in Tomato

Tomato cultivars from Syria (Syrian local variety 1, Syrian local variety 2, T3, T7, T9) Europe ((Counter F1, Hildares F1, Goldene Königin, Master F1, Frühzauber, Balkonstar, Gnom F1) and the USA (Backmor, Rawan) were mechanically inoculated with two PepMV-isolates: PepMV-Peru (DSMZ PV-0554), PepMV-France (isolated from infected French tomato imports). Tomato plants were cultivated in a greenhouse in standard substrate for 10 weeks. PepMV was detected by DAS-ELISA. Plant growth characteristics were determined.

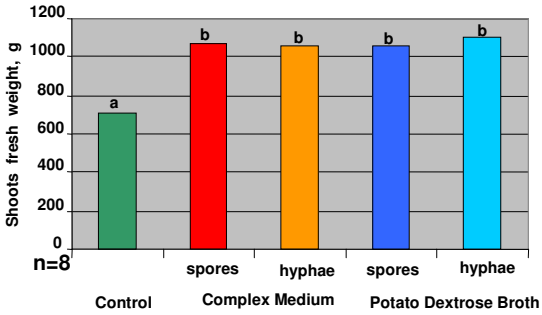

Fig. 6: Influence of the inoculums source of *P. indica* on the promotion of tomato growth measured by the fresh weight of shoots

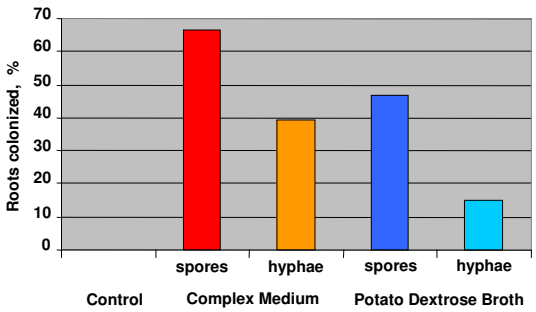

Fig. 5: Colonization of tomato roots with *P. indica* dependent on the inoculum source

Fig. 4: Tomatos cultivated in hydroponics - testing facility

Results

The inoculum source of *P. indica* significantly influenced the spread of the fungus within the roots (Fig. 5). However, root and shoot fresh weights were significantly promoted in all plants of the *P. indica* infected varieties compared with the control plants (ANOVA test) (Fig. 6).

Three weeks after PepMV inoculation all tomato cultivars were tested PepMV-positive independent of the inoculated virus strain. Results revealed no differences in the susceptibility of the cultivars. The virus can reduce biomass (shoots and roots) as well as yield (fruits fresh and dry weight) significantly up to 30%, particularly in the PepMV-susceptible cultivar Hildares (data not shown).
This confirms that the cultivar 'Hildares' can be used in further experiments as a model organism because it is susceptible to PepMV and the endophytic fungi. Furthermore, plant growth of this cultivar is not impaired by cultivation in hydroponic systems showing unterminated growth.

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