

Use of microorganisms to improve plant growth and *Verticillium dahliae* tolerance of *Acer* sp.



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1 Introduction

Maples (*Acer* sp.) are important ornamental trees in urban areas which are often planted along streets and in parks and gardens. Unfortunately, they are, like many other dicotyledonous plants, highly susceptible to *Verticillium dahliae*, a fungal soil-borne pathogen that can cause significant wilt damages and dieback. Sometimes, symptoms first occur several years after infection. This is disastrous in case of perennial plants, which generally are very valuable. Until now, curative measures such as fungicides are not available and soil decontamination is eco-unfriendly. An

alternative research approach is the preventive application of antagonistically acting microorganisms, that can directly or indirectly control *V. dahliae* in planta and might in addition improve the overall plant fitness and growth. Here, we tested different endophytic microorganisms including arbuscular mycorrhizal fungi, *Piriformospora indica*, *Trichoderma* sp., *Pseudomonas* sp., and *Bacillus* sp. on plant development and *V. dahliae* tolerance of the two maple species *Acer campestre* and *Acer platanoides*.

2 Experimental setup



Overview of treatments used in the experiments

- A – without treatment** (negative control)
- B – *Verticillium dahliae* isolate E38/05** (positive control), kindly provided by Prof. Christian Neubauer and Benedikt Heitmann (Hochschule Osnabrück, Germany)
- C – Bactiva NP** (*Bacillus megaterium*, *Pseudomonas fluorescens*, *Trichoderma* sp.), produced by Bactiva Inc., Laredo, Texas, USA
- D – INOQ Hobby mycorrhiza** (*Glomus etunicatum*, *G. intraradices*, *G. claroideum*), produced by INOQ GmbH, Schnega, Germany
- E – MYKOaktiv-bio + AMN Verde fertilizer** (*Glomus* sp.), produced by Mack bio-agrar GmbH, Fellbach, Germany
- F – Promot WP** (*Trichoderma harzianum* isolate T-22, *T. koningii*), produced by Mack bio-agrar GmbH, Fellbach, Germany
- G – AMN BonaVita Bac** (*Bacillus amyloliquefaciens* isolate AMN 18), produced by Mack bio-agrar GmbH, Fellbach, Germany
- H – *Pseudomonas* sp. isolate AL5**, kindly provided by Dr. Irmtraut Zaspel, Thünen Institute of Forest Genetics, Waldsiedersdorf, Germany
- I – *Pseudomonas* sp. isolate Wu6**, kindly provided by Dr. Irmtraut Zaspel, Thünen Institute of Forest Genetics, Waldsiedersdorf, Germany
- K – *Piriformospora indica***, kindly provided by PD Philipp Franken, Leibniz-Institute of Vegetable and Ornamental Crops, Großbeeren, Germany

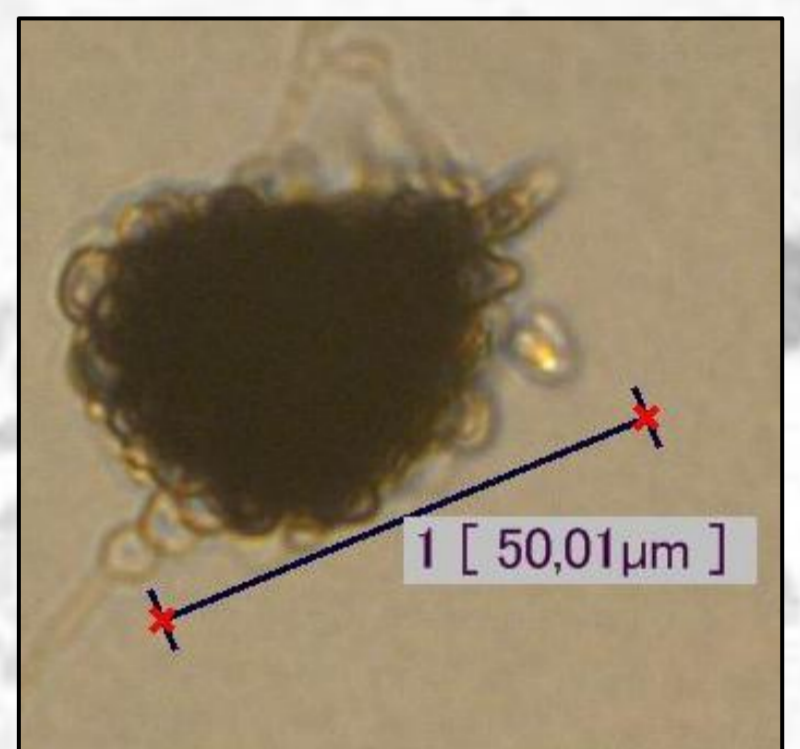


Fig. 3: Microsclerotium of *V. dahliae* grown from an infected shoot segment of *A. platanoides* (treatment B).

3 Results

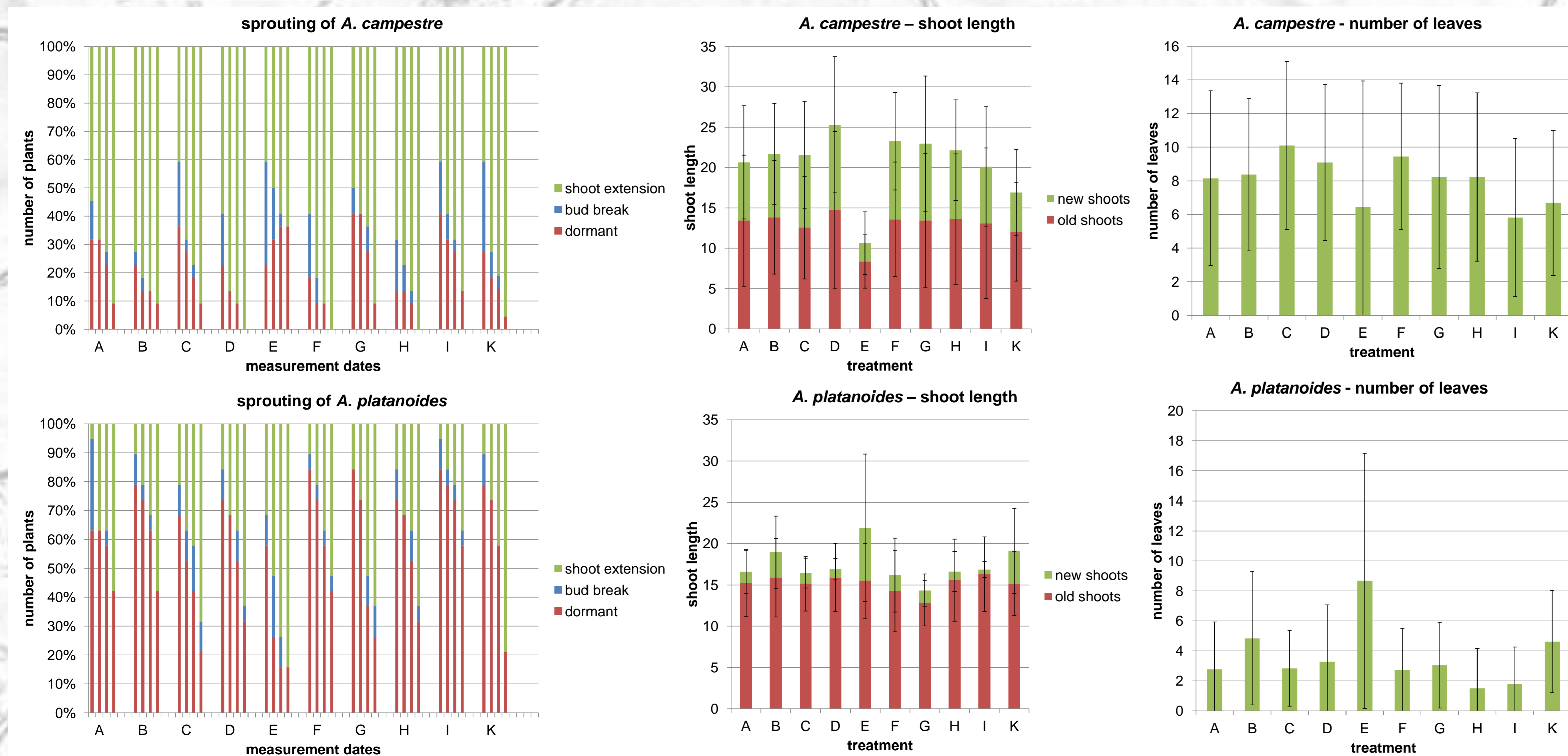


Fig. 1: Ratio of sprouting over time (from 2nd March 2012 in intervals of approximately three weeks), length of old and newly grown shoots and number of leaves of the different treatments of *A. campestre* (n=22) and *A. platanoides* (n=19). Bars represent mean values with standard deviations.

4 Conclusions and outlook

- Presence of beneficial microorganisms could be proven by PCR and microscopic analyses for treatments D (INOQ Hobby mycorrhiza), E (MykoAktiv-bio), G (AMN BonaVita Bac), H (*Pseudomonas* sp. AL5), I (*Pseudomonas* sp. Wu6), and K (*Piriformospora indica*).
- Except treatment E (MykoAktiv-bio + AMN verde fertilizer), no obvious effects of the beneficial microorganisms on plant growth were found.
- For *A. campestre*, no wilting symptoms or vascular discolorations were observed.

- In case of *A. platanoides*, several plants (of most treatments) showed vascular browning and few showed wilting symptoms. PCR analysis indicated a lack of *V. dahliae* gDNA in untreated plants but, however, only weak presence in treatment B (that lacks antagonistic microorganisms).
- To evaluate a potential antagonistic effect of the tested microorganisms, infection with *V. dahliae* should be improved.

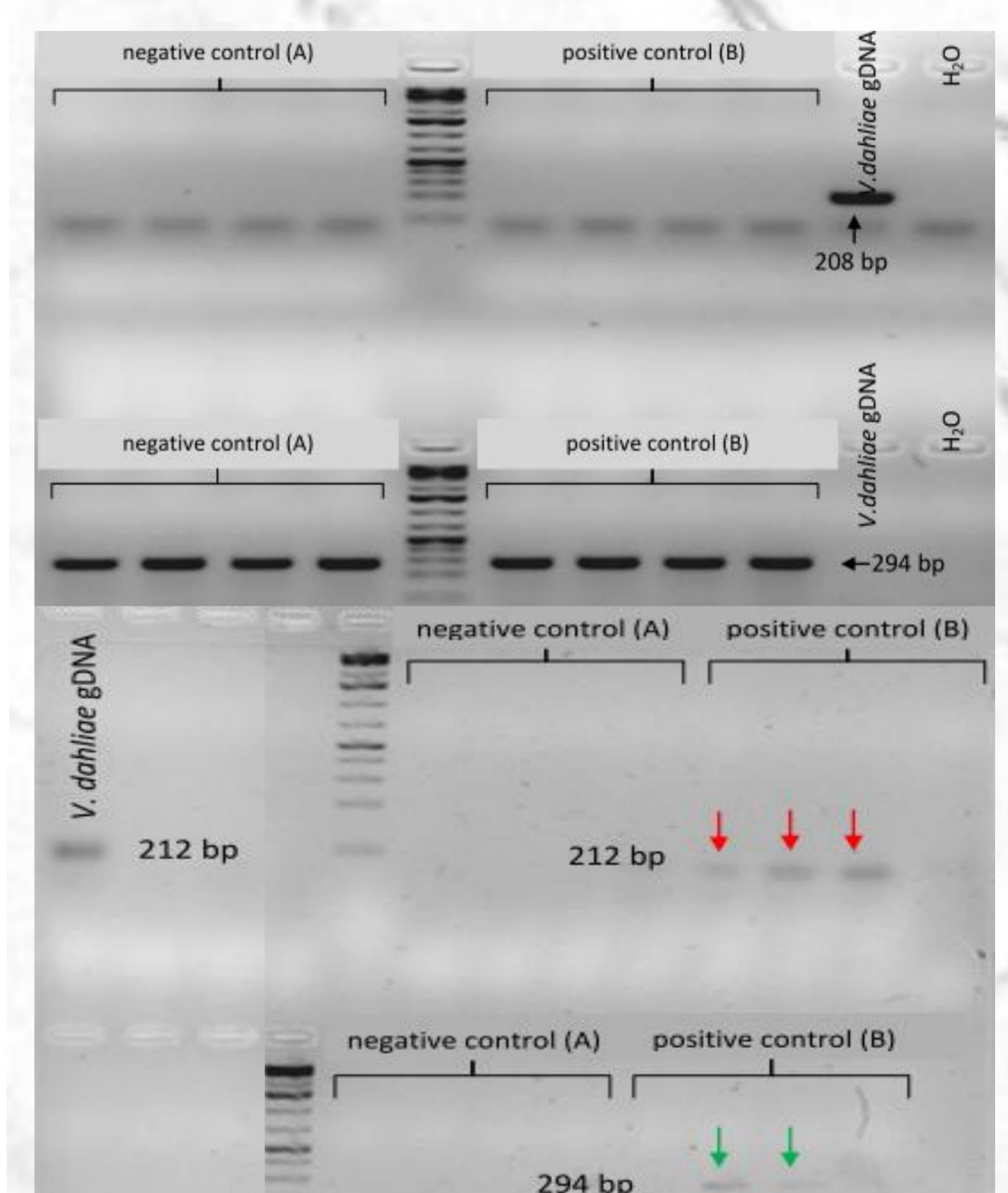


Fig. 2: Four biological replicates of treatment A (negative control) and B (only pathogen) of *A. campestre* (upper picture) and *A. platanoides* (lower picture), tested for presence of gDNA of *V. dahliae* in roots (upper row each, lower row shows reference gene for *Acer* sp.).