Endophytic bacteria for improving biomass production of poplars

Regina Becker · Kristina Ulrich · Dietrich Ewald
Thünen Institute of Forest Genetics, Waldsieversdorf, Gemany

The Project

Aim of the study

Our study was carried out to analyze the effect of selected endophytic bacteria strains on different poplar clones under laboratory, greenhouse and field conditions.

Material & Methods

Poplar clones with different genetic background were inoculated with bacteria strains obtained from the strain collection of Thünen-Institute of Forest Genetics, Waldsieversdorf and University Graz.

Bacteria strains were grown at 26°C as overnight culture and adjusted to a cell density of 10^8 CfU/ml. *In vitro* plants free from cultivable bacteria were inoculated by wetting the base of the stem with the inoculum. Cuttings were placed into the inoculum for ~ 3 hours.

Conclusions

- Our first experiments confirmed the growth promoting capabilities of endophytic bacteria for improving biomass production of poplars.
- The effects of the introduced bacteria depend on the bacteria strain, the plant genotype and the environmental conditions.
- The effective use of the plant growth promoting bacteria requires more knowledge on the plant-microbe-interactions and the selection of strains that function optimally under specific conditions.
- Further studies are needed to develop strategies for the practical use.

Results

Test of bacteria strains for growth promoting traits such as N_2-fixation

Endophytic isolates from productive poplar clones were cultivated on N-free growth medium (Qubit). Bacteria able to grow without nitrogen were selected for further tests (Fig 1).
Metabolic Profiling was used to study the influence of the N_2-fixing strain *Paenibacillus* sp. 22 on the metabolism of *in vitro* poplar plants (Fig. 2). The strain induces a metabolic pattern similar to the symbiosis between rhizobia and legumes.

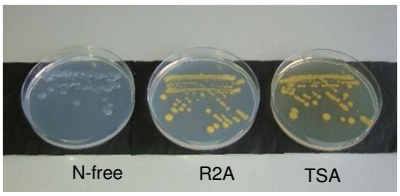


Fig. 1 Growth of a nitrogen fixing endophytic bacterium on N-free medium in comparison to R2A- and TSA-medium

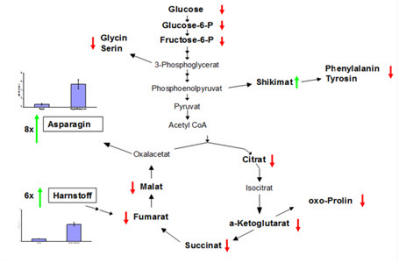
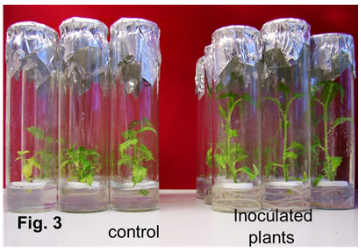


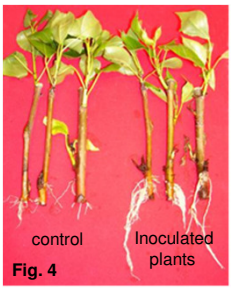
Fig. 2 *Paenibacillus* sp. 22 strongly effects the plant metabolism (Scherling et al., 2009)

Growth of poplar plants inoculated with endophytic bacteria strains



Effect of *Stenotrophomonas sp.169 in vitro* .

The presence of *Stenotrophomonas* sp.169 in sterile *in vitro* plants stimulated significantly the root and shoot growth (Fig. 3.) This effect was suppressed by using plantlets already colonized with indigenous *Paenibacilli* .



Effect of *Paenibacilus* sp. 22 – greenhouse, cuttings

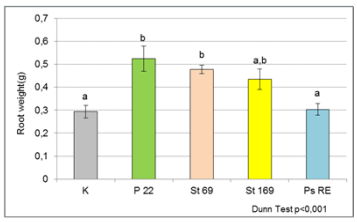


Fig.5 Root weight of poplar cuttings (Max 2) inoculated with different bacteria in comparison to the control in greenhous (K)
Different letters indicate significant differences.

Inoculation experiments in greenhouse revealed growth promoting effects of several bacteria strains. Best results on different clones were obtained by using *Paenibacillus* sp. 22 (Fig. 4,5).

Effect of *Stenotrophomonas sp.169* in field trail

Field trials with *Stenotrophomonas* sp. 169 and *Pseudomonas* 3RE 2-7 suggested an improved start of vegetation (Fig. 6). Treated plants of clone Max 3 reached a significantly increased biomass.

References: Scherling C, Ulrich K, Ewald D, Weckwerth W. (2009) A metabolic signature of the beneficial interaction of the endophyte *paenibacillus* sp. isolate and in vitro-grown poplar plants revealed by metabolomics. Mol Plant Microbe Interact. 22:1032-1037.

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