

Isolating bacteria able to rapidly degrade fungicides used in fruit packaging industry: Tailored made inocula for the treatment of relevant agro-industrial effluents

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Introduction

Fungicides are used by fruit-packaging industries to control fungal infestations of fruits during storage. The application of dense fungicide solutions on stored fruits results in the production of large wastewater volumes which according to EU regulation should be treated on site before environmental release. Despite that these agro-industrial effluents in most cases are either land spread in adjacent fields or discharged in the municipal wastewater treatment systems. Both practices result in the extensive contamination of soil (levels of 12 g/kg have been monitored in such disposal sites) and surface water systems due to the limited capacity of the indigenous soil microbial community and the sewage treatment plants to degrade the fungicides contained in these effluents. The aim of the work of our group was to isolate novel fungicide-degrading bacteria which will be used as tailored-made inocula in biodepuration and bioaugmentation strategies.

Material and Methods

Since 2013 our group has isolated from contaminated soils bacteria, able to rapidly degrade pesticides contained in fruit-packaging industry effluents like:

- thiabendazole (a proteobacterial consortium) (Perruchon et al. 2017)
- iprodione (*Arthrobacter sp.*) (Campos et al. 2015)
- ortho-phenylphenol (*Sphingomonas haloaromaticamans*) (Perruchon et al. 2016)
- diphenylamine (*Pseudomonas putida*) (Perruchon et al. 2015)

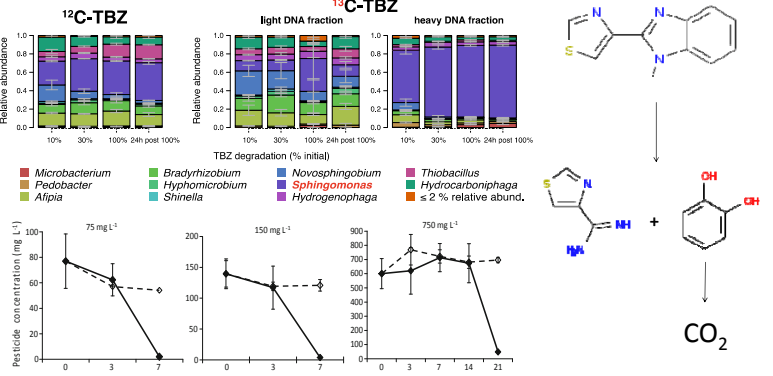


On going studies focus on the isolation of bacteria degrading imazalil & fludioxonil, also used in fruit – packaging plants

Results

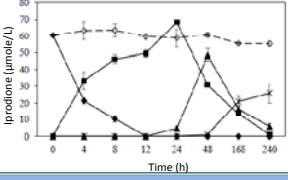
Thiabendazole (TBZ)– degrading consortium:

- Isolated from a TBZ-contaminated soil via enrichment culture
- Composed of at least 10 proteobacteria ribotypes with a *Sphingomonas* identified via SIP analysis as the main degrading strain
- Could degrade up to 750 mg/L of thiabendazole



Iprodione - degrading *Arthrobacter sp.*

Isolated from a Chilean soil and transforms iprodione (◆) to 3,5-DCA (*), via formation of two intermediate metabolites, 3,5-dichlorophenyl carboxa-mide (■) and 3,5-dichlorophenylurea acetate (▲)

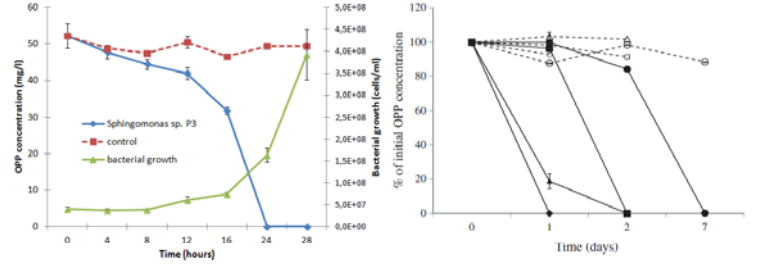


Acknowledgements

This research has been co-financed by the European Union and Greek national funds through the Operational Program Competitiveness, Entrepreneurship and Innovation, under the call RESEARCH – CREATE – INNOVATE (project Code: T1EDK - 02566 " Development and implementation of novel biobased methods for the treatment of pesticide-contaminated wastewaters from agro-industries".

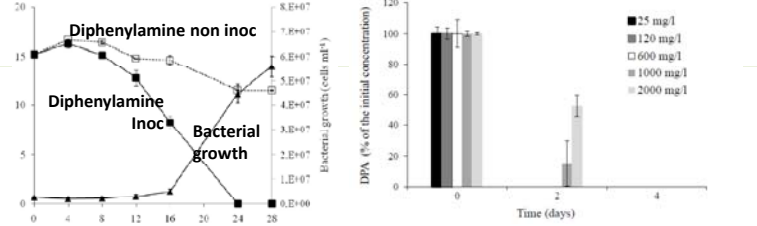
S. haloaromaticamans ortho-phenylphenol-degrader:

- Isolated from a contaminated soil
- Uses ortho-phenyl phenol as a C source and degrades it in 24 h
- Degrades up to 150 mg/L of ortho-phenylphenol in 7 days



P. putida diphenylamine degrading bacterium:

- Isolated from a contaminated soil
- Uses diphenylamine as a C and N source
- Degrade up to 2000 mg/L of DPA in 4 days



Bioaugmentation Applications

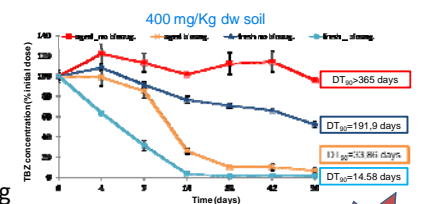
Bioaugmentation of biobeds

treated with TBZ-containing wastewaters with the Thiabendazole-degrading consortium optimized the dissipation of the fungicides by the biobed systems



Bioaugmentation of soils

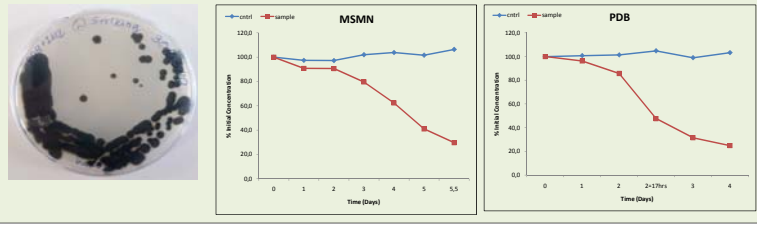
natural contaminated with thiabendazole with the Thiabendazole-degrading consortium achieved the dissipation of up to 400 mg/kg



Imazalil-degrading microorganisms



Enrichment cultures (MSMSN, PDA) from a contaminated soil lead to the isolation of a potent degrading strain degrading imazalil (20 mg/L) in 5 days



Conclusion: Our laboratory has an inventory of bacteria able to degrade all pesticides used in fruit-packaging industry except of fludioxonil, enabling their use as inocula in bioreactors for the treatment of effluents from the fruit-packaging industry