

Compatible mixture of antagonistic bacteria developed for biological control of *Pectobacterium* spp. and *Dickeya* spp. in potato

Robert Czajkowski, Dorota M. Krzyzanowska, Tomasz Maciąg, Joanna Siwinska, Sylwia Jafra

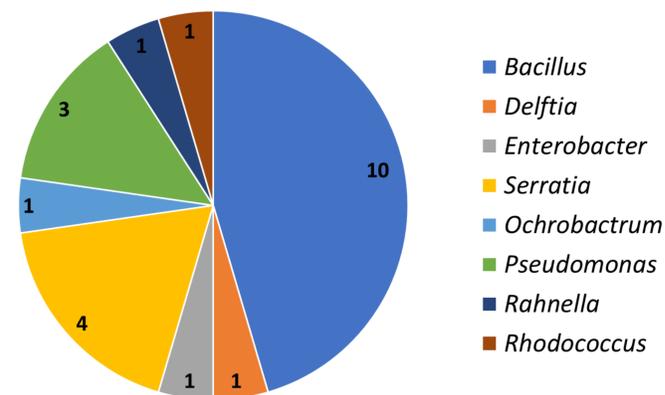
Introduction

Potato (*Solanum tuberosum* L.) is the fourth main food crop in the world after rice, maize and wheat both in the area cultivated and total production. From all pathogens infecting potato, bacteria are recognized as the most important problem. Of the bacterial pathogens of potato, **Soft Rot** *Pectobacteriaceae* (SRP: *Pectobacterium* spp. and *Dickeya* spp. formerly *Erwinia* spp.) causing **potato soft rot** and **blackleg** are regarded among the most important bacterial pathogens in Europe. **These diseases led to estimated losses of ca. 10 to 40% crop (ca. 250M Euro) annually worldwide.** At the moment we still lack commercial control products to be used specifically against SRP bacteria in agriculture. **Our project aimed to develop an efficient biocontrol product based on a mixture of antagonistic bacterial strains to be used for protection of (seed) potato tubers against SRP bacteria under disease provocative conditions**

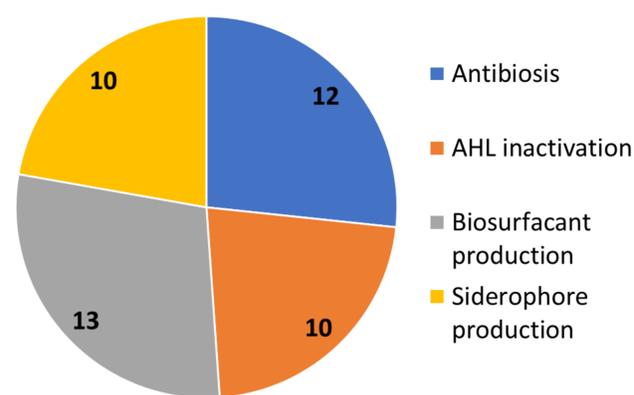


Antagonistic bacterial strains

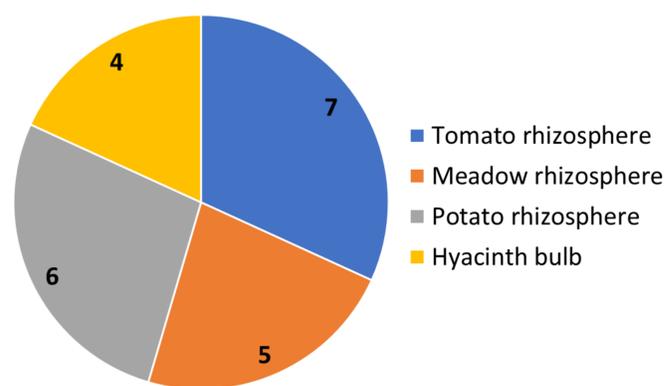
Twenty two antagonistic strains selected from our previous studies and belonging to **8 genera**:



Expressing **different modes of antagonistic action** (usually more than one) against SRP bacteria:



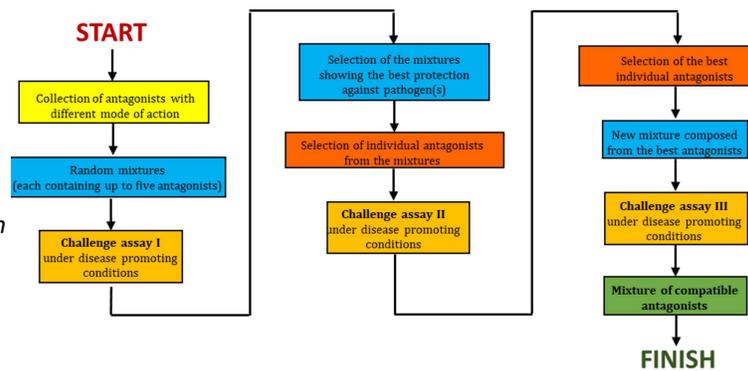
Isolated from **4 different** environments:



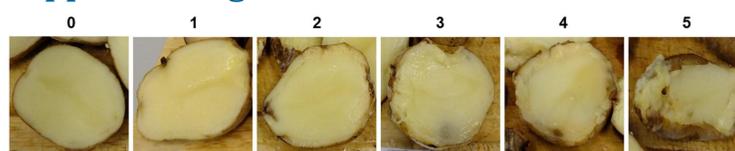
The mixture of bacterial isolates described herein, for protection of potato tubers and ornamental plants against soft rot caused by pectinolytic *Pectobacterium* spp. and *Dickeya* spp., is the object of the patent application P.423806, which has been filed with the Polish Patent Office by University of Gdansk, Poland with inventors Robert Czajkowski, Dorota M. Krzyzanowska, Tomasz Maciąg, Joanna Siwinska and Sylwia Jafra

Evaluation of soft rot symptoms on potato tubers

Workflow for the development of the effective mixtures containing different antagonistic strains

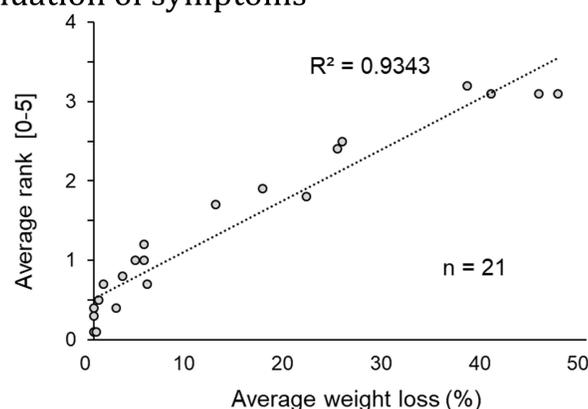


The **six-rank disease severity scale** was developed to evaluate rotting of potato tubers due to the presence of SRP bacteria and **for evaluation of protection effect of the applied antagonists**:



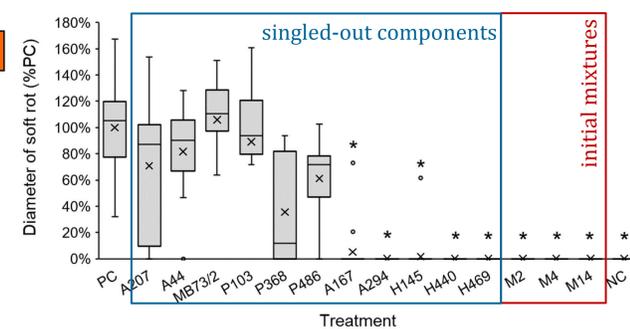
- Scale 0** - no symptoms
- Scale 1** - rotting localized only superficially (at the periderm) and on less than 25% of tuber surface
- Scale 2** - symptoms present on 25 to 50% of tuber surface
- Scale 3** - symptoms present on 50 to 90% of the tuber, with additional detachment of the periderm from the core
- Scale 4** - symptoms present on > 90% of the tuber surface and/or reaching the tuber core
- Scale 5** - whole tuber macerated

This scale **correlated** ($R^2=0.9343$) with the average potato tuber weight loss due to soft rotting offering a reliable and fast method for evaluation of symptoms

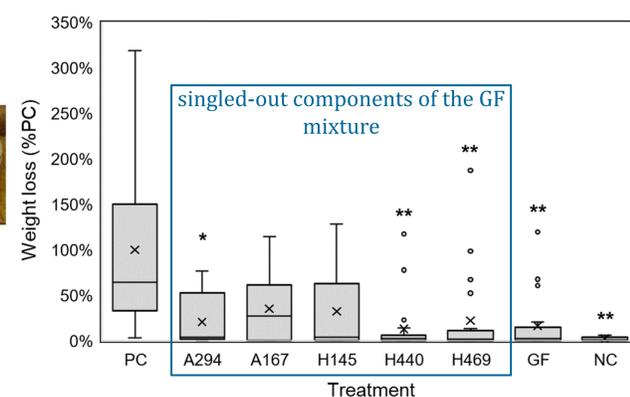


Efficacy tests with SRP on potato tubers

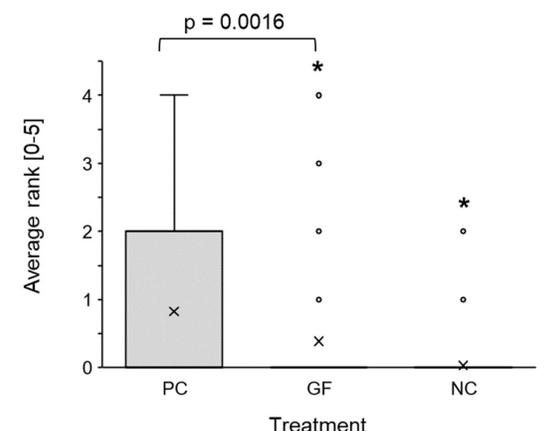
Protective effect of selected mixtures and their singled-out components against a mixture of SRP bacteria



Reduction of tuber weight loss to soft rot by the application of antagonists in a whole tuber injection assay



Efficacy of the developed GF (the Great Five) mixture in suppressing soft rot symptoms on vacuum-infiltrated potato tubers



Conclusions: Mixtures of antagonistic bacterial strains express better performance than individual antagonists in biocontrol of SRP in potato. The **GF mixture** containing 5 antagonists (A294, A167, H145, H440 and H469) reduced soft rot by 46% ($p=0.0016$) under disease favorable conditions