Biological postharvest control in sugar beets

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Introduction
Postharvest diseases of fruits and vegetables contribute significantly to a deterioration of quality and nutrient composition, mycotoxin contamination and reduction of the market value of the products. Sugar beets stocked in clamps before processing are strongly affected by spoilage mainly caused by saprophytic fungi. The microbial growth of fungi such as Fusarium, Botrytis and Penicillium is associated with sucrose loss up to 0.1% sucrose per day [1].

Objectives
- Advanced strategy to maintain intactness of freshly harvested and stored sugar beets.
- Antagonistic and volatile organic compounds (VOCs) producing bacterial consortia as a biological treatment.

Antagonistic and VOCs producing bacteria to control fungal growth

Investigating the fungal community
Fungi causing spoilage and isolated from beet clamps in Austria and Germany were characterized morphologically and identified using partial 18S rRNA gene sequencing. Identified fungal genotypes were very similar from German (n=8) and Austrian (n=11) beet clamps (Fig. 1). Main spoilage was due to Fusarium sp. and Penicillium sp. Identified fungal isolates were further used for screening experiments.

Screening for bioactive bacterial strains
Bacterial isolates from healthy sugar beets were tested using dual cultures for their antagonistic activity against fungal isolates. 13.1% (257 of 1955) showed antagonistic activity against the main fungal isolates. Antagonists were further combined to bacterial consortia and analyzed in VOCs assays [2] for their volatile activity (Fig. 2, I). Lab scale trials using preselected consortia on sugar beets showed a growth inhibiting effect on several fungal isolates (Fig. 2, II).

THE CONCEPT
Biological control consortia (BCC)
To prevent fungal growth on the sugar beets during storage biological control consortia (BCC) consisting of antagonistic and VOCs producing bacteria (different Bacillus sp.) are sprayed on the beet surface during harvest. This way, fungal growth starting in peel lesions and cuts is reduced and the loss of white sugar content will be minimalized (Fig. 3). Treated sugar beets were analyzed using CFU counts and qPCR measurements (Unibac II (all bacteria); BLS342f/BACr833r (Firmicutes specific primers)) (Fig. 4).


The concept of biological control consortia (BCC) consists of antagonistic and VOCs producing bacteria that are applied on the beet surface to prevent fungal growth. The effectiveness of the BCC is monitored using CFU counts and qPCR measurements.