Impact of harvest technology on storage rot formation and invert sugar accumulation during long-term storage of sugar beet

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Introduction

In Europe, sugar beets are stored in unprotected field piles for up to 90 days. During storage, the processing quality is significantly reduced due to storage rot formation and invert sugar accumulation. Storage rot as well as invert sugar content were observed to increase following mechanical damage (Bugbee and Cole, 1976; Bugbee, 1982). Injuries received during harvest (defoliation/topping, tap root breakage and bruising) represent entry sites for wound pathogens and other saprophytic microorganisms. Therefore, it was hypothesized that harvest technology may have a major influence on storage rot development and white sugar yield loss. To obtain a first impression of possible effects of different self-propelled harvesters on storage rot formation and the accompanying increase in invert sugar content, sugar beets were sampled from a harvester demonstration field trial and stored under controlled conditions.

Material and Methods

In 2014, sugar beet cultivar 'Primavera' was grown in the field in Dobieszów (Poland) for a harvester demonstration trial. Sampling and unloading in field piles was carried out by eight self-propelled harvesters equipped with different scalping and cleaning technologies (Tab. 1). An amount of 300 sugar beets per harvester were sampled from the field piles, transported to Göttingen (Germany) and divided into subsamples in five replicates of 20 sugar beets per harvester and storage duration. Before storage, sugar beets were rated visually for injuries. Storage was conducted at 8°C and 80% relative humidity in a climate container for five and 12 weeks. At each examination date, sugar beets were rated visually for storage rot formation. Subsequently, sugar beets were washed and processed to brei. Beet brei filtrates were analyzed for sucrose, invert sugar and melassogenic substances in an automatic system (Venema, Groningen, The Netherlands) according to standard protocols (Burba and Georgi, 1975, 1976; ICUMSA, 2003).

Tab. 1: Harvester technologies

Harvester	Scalping technology	Cleaning technology
1	minimal-topping	turbines
2	minimal-topping	turbines
3	minimal-topping	turbines
4	minimal-topping	turbines
5	minimal-topping	turbines
6	minimal-topping	turbines
7	minimal-topping	turbines
8	defoliation	rollers

Results and Discussion

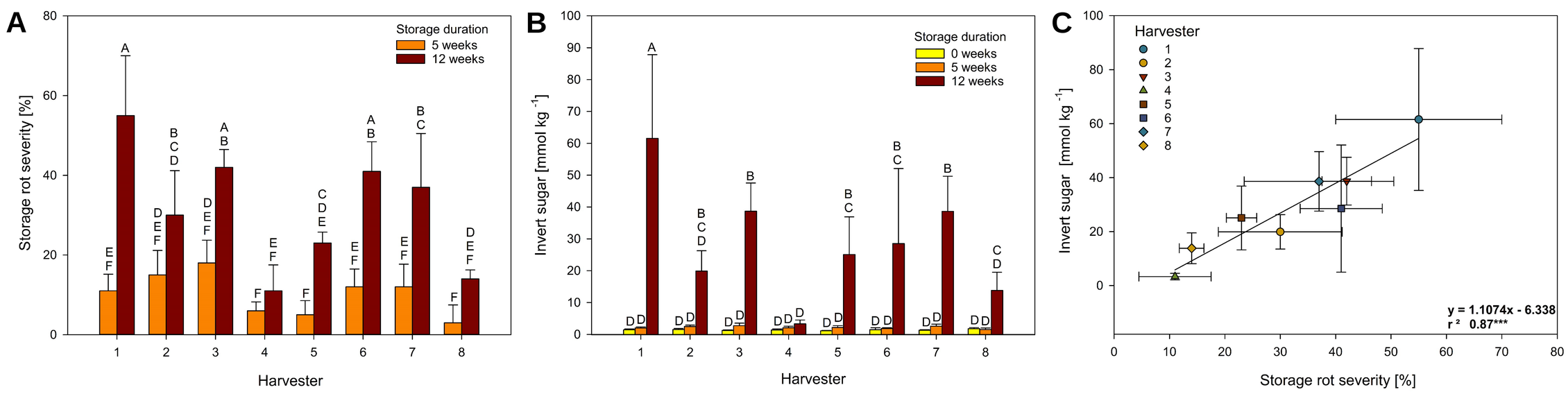

Fig. 1: Storage rot severity (A) and invert sugar content (B) of sugar beets harvested with different harvest technologies and stored for 0, 5 and 12 weeks. The error bars show the standard deviation. Treatments with the same letter are not significantly different (n=5; Tukey P<0.05). In sugar beets stored for 12 weeks both parameters correlated with an r^2 of 0.87 (C).

Visual rating for injuries of the freshly harvested beets did not result in significant differences between harvesters (data not shown). Also no differences in storage rot formation and invert sugar content were observed after 5 weeks of storage (Fig. 1 A and B). However, after long-term storage of 12 weeks, sugar beets harvested by the different harvest technologies differed significantly in storage rot formation as well as in invert sugar content (Fig. 1 A and B). The invert sugar content ranged from 3 to 61 mmol kg^{-1}. With an r^2 of 0.87 (Fig. 1 C), the results support the findings of Liebe and Varrelmann (2013), who showed a perfect correlation between root rot displaying tissue and invert sugar content.

Based on these results, the harvesters could be divided into two groups, with low (i.e. <20 mmol kg^{-1}) and high (>20 mmol kg^{-1}) invert sugar contents in sugar beets after storage, suggesting a significant impact of harvesting technology on storability. However, two harvesters with opposing technologies, harvester no. 4 and harvester no. 8, caused the least increase in storage rot formation and invert sugar accumulation; thus complicating the interpretation. An experimental error cannot be excluded due to the strip plot design without field repetitions. To permit clear conclusions on the impact of harvest technology, the experiment has to be repeated in a completely randomized design.

Literature:

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