Institute of Sugar Beet Research

Impact of self-propelled harvesters with different harvesting techniques on sugar beet storage stability.

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Introduction

In Europe, sugar beets are stored in unprotected field piles for up to 80 days. Storage of sugar beets is accompanied by sucrose losses and accumulation of invert sugars (Jaggard et al., 1997). Previous studies (Liebe and Varrelmann, 2013) have shown a perfect correlation between root rot displaying tissue in longitudinal cuts and sucrose losses as well as invert sugar content. In addition, storage rot/invert sugar was observed to increase following mechanical damage (unpublished observations; Bugbee and Cole, 1976; Bugbee, 1982). In practical harvesting, the strength of injuries mainly depends on the harvesting technique. During harvest, sugar beets receive injuries from defoliation or topping, tap root breakage and bruising. The wounds generated represent entry sites for microorganisms (wound pathogens and saprophytic colonizers). Therefore it is hypothesized that harvesting technique has a major influence on storage rot development and white sugar yield loss. To detect possible effects of different self-propelled harvesters on injuries and subsequent root rot formation, sugar beets were sampled from a harvester demonstration field trial. The harvesters applied different scalping and cleaning technologies and it was aimed to obtain a first idea from non-randomized a strip trial which harvesting technology causes the least sucrose losses and storage rots in stored sugar beets.

Material and Methods

One sugar beet cultivar was grown in a non-randomized strip trial in the field Dobieszów (Poland). Sampling and unloading in field piles was carried out by eight different self-propelled harvesters. Harvesters were equipped with different scalping and cleaning technologies (Tab. 1). An amount of 100 sugar beets per harvester were sampled in three replicates from the field piles and transported to Göttingen (Germany). Before storage, 20 sugar beets in five replicates per harvester were rated visually for injuries at the tap root, root-neck, root-crown and tap root breakage. Only the number of injured sugar beets was rated. Storage was conducted at 8 °C and 80 % relative humidity in climate containers for five and 12 weeks. Each variant included 20 sugar beets in five replicates. Stored beets were rated visually for number of beets displaying rot symptoms on the surface. Freshly harvested and stored sugar beets were washed and processed to brei. Beet brei filtrates were analyzed for sucrose, invert sugar and melassogenic substances in an automatic beet laboratory 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	Defoliation	Sieve belt
3	Minimal-topping	Turbines
4	Minimal-topping	Turbines
5	Minimal-topping	Turbines
6	Minimal-topping	Turbines
7	Minimal-topping	Turbines
8	Minimal-topping	Turbines

Results and Discussion

Visual rating for injuries of the freshly harvested beets did not result in significant differences between harvesters (data not shown). After five weeks the parameter sugar content displayed slight differences between the different treatments (Fig. 1). Only harvester 5 differed significantly from harvester 1. However, no differences in invert sugar content were observed (Fig. 2). After 12 weeks of storage, significant differences in sugar content and invert sugar were observed. Sugar content ranged from 14,4 to 16,3 % (harvesters 8 and 4). Harvester 8 differed significantly from harvesters 1, 2, 3, 4 and 5. Significant differences were displayed by harvesters 6 and 7 in relation to harvesters 1, 2, 3 and 4. Invert sugar content ranged from 3 to 61 mmol/kg (harvesters 1 and 8). Harvester 8 was significantly different from all other variants. Harvesters 1 and 2 harvested beets with significantly less invert sugar than harvesters 4, 5, 6, 7 and 8. As well harvesters 6 and 7 differed significantly from harvesters 1, 2 and 8.

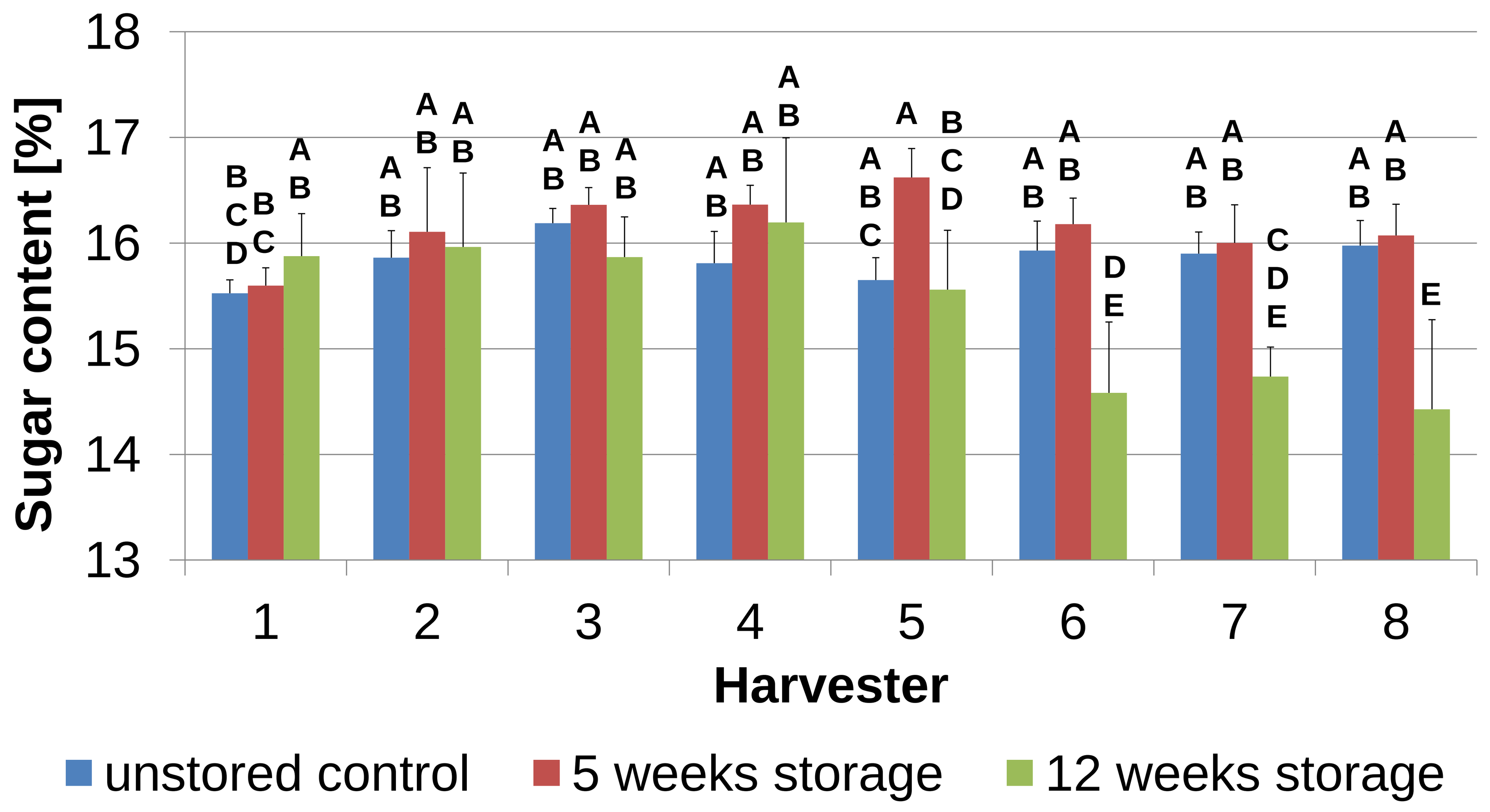

Fig. 1: Sugar content of sugar beets harvested with different harvesting technology and stored for 0, 5 and 12 weeks. The error bars show the standard deviation. Treatments with the same letter are not significantly different (n=5; Tukey P<.05).

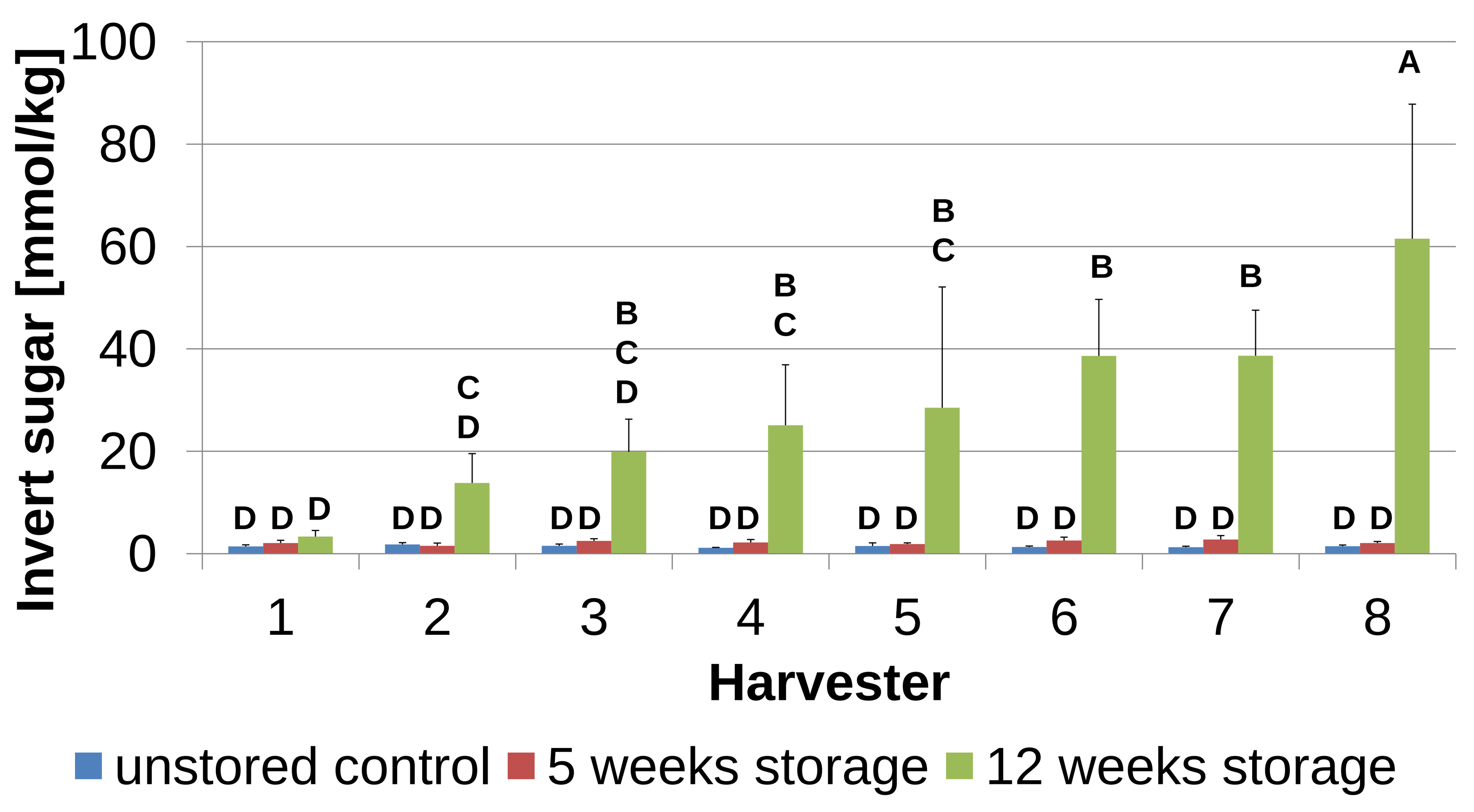

Fig. 2: Invert sugar content of sugar beets harvested with different harvesting technology and stored for 0, 5 and 12 weeks. The error bars show the standard deviation. Treatments with the same letter are not significantly different (n=5; Tukey P<.05).

Based on these results, the harvesters could be divided into two groups, with low and high white sugar losses in harvested sugar beets after storage. It is possible that differences in the white sugar losses could be attributed to differences in cleaning and scalping technologies. Harvester 2, equipped with sieve belt and defoliation technology revealed low white sugar losses, while the majority of the other harvesters, equipped with turbines and minimal-topping technology, revealed higher sugar losses in sugar beets after storage. There is the possibility that the cleaning procedure using sieve belts causes less injuries and entry sites for microorganisms than turbine cleaning. The exception was harvester 1 that used turbine and minimal-topping technology and harvested beets displaying the lowest white sugar loss after storage. Differences in storage rot infestation, sugar content and invert sugar could not always be explained by injury intensity of different harvesting technologies. Possibly the visual injury rating was unable to detect all injuries that contributed to storage rot development. However, an experimental error cannot be excluded, due to the non-randomized strip plot design. To permit clear conclusions on the harvester technology, the experiment should be repeated in a completely randomized design.

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