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Effect of genotype and environment on the development of root rots during long-time storage of sugar beets

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Introduction:

Severe root rots are a serious problem during storage of sugar beets by causing a loss of sugar and accumulation of invert sugars (glucose + fructose). Beside the temperature, it is supposed that the development of root rots during storage is mainly influenced by genotype and environment (e.g. harvest technique, soil, weather), but relatively little is known about the variance caused by each of these factors. In order to develop postharvest disease management strategies, it is crucial to understand their effects on the development and severity of root rots.

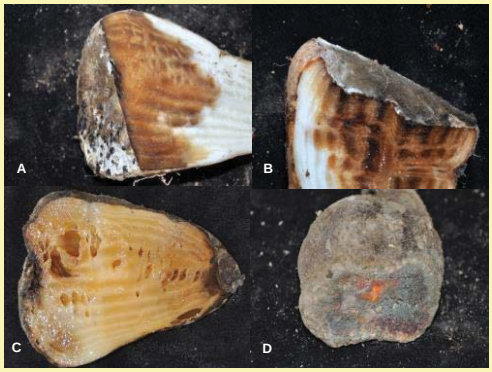

Fig. 1: Root rot symptoms on sugar beets stored for 13 weeks at 8°C (A and B) and 20°C (C and D).

Material and Methods:

Three sugar beet cultivars were grown in five different environments. After harvest, healthy looking beets were selected and stored at different temperatures (20°C and 8°C) for 13 weeks. At the end of storage, sugar beets were longitudinally cut and the percentage of rotten surface was rated. Furthermore, the amount of recoverable sucrose (white sugar yield) and invert sugar (glucose + fructose) was determined.

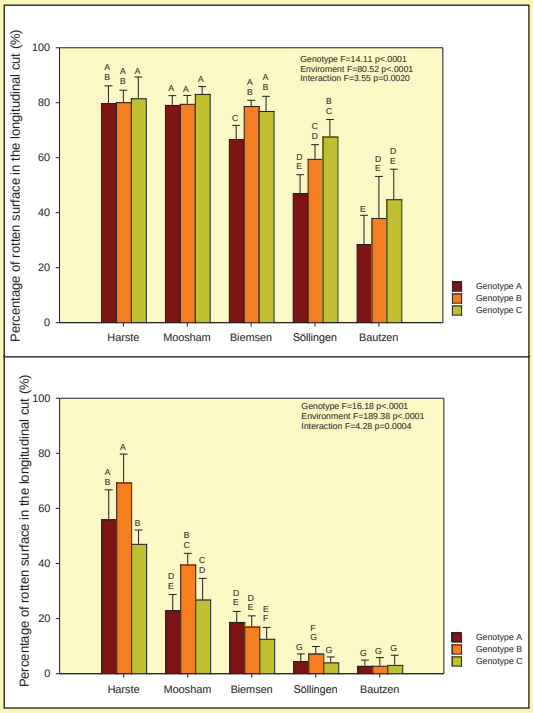

Fig. 2: Effect of genotype and environment on the percentage of rotten surface after 13 weeks storage at 20°C (top) and 8°C (bottom) (n=5, α=0,05, error bar=standard deviation).

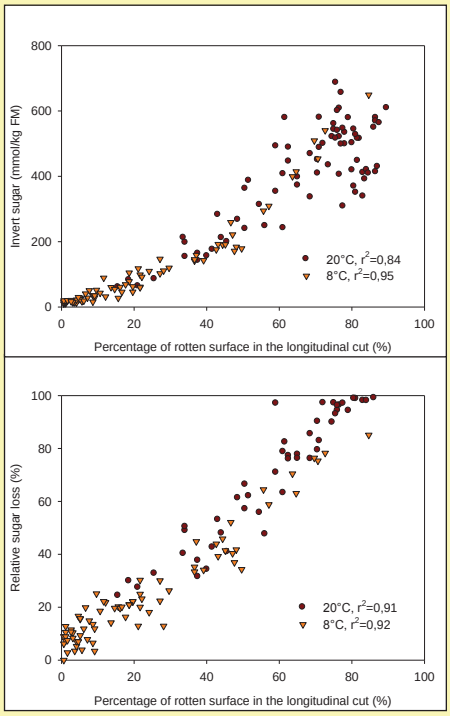

Fig. 3: Effect of root rot severity on the invert sugar concentration (top) and the relative sugar loss (bottom) after 13 weeks of storage at 8°C and 20°C.

Results:

After 13 weeks of storage various root rotting symptoms were observed on sugar beets along with an intensive growth of fungi and bacteria (Fig. 1). Root rots caused by bacteria were evident by the wet consistence of the sugar beet tissues whereas fungi produced mainly dry rots. By rating the root rot severity, it was possible to describe differences between genotypes and environments at both temperatures (Fig. 2). The occurrence of root rots heavily depended on the environment and therefore, significant differences between genotypes were only observed in certain environments as shown by the significant genotype*environment interaction. Furthermore, the results also show that there is a tremendous effect of root rot severity on quality parameters of stored sugar beets (Fig. 3). An increased colonization of sugar beet tissue by fungi and bacteria goes along with an increase in sugar loss and invert sugar concentration. Additionally, a complete loss of sugar could be observed when the percentage of rotten surface in the longitudinal cut exceeded 80 %.

Conclusions:

The results clearly demonstrate that temperature and environment are the major factors influencing the severity of root rots. Therefore, it can be concluded that artificial storage conditions as well as root rot rating will allow breeders to select cultivars with less susceptibility to storage root rots. Finally, the results highlight for the first time the strong influence of postharvest rot on sugar yield, technical quality and the potential for future genotype improvement.