

Marc and betaine of sugar beet in relation to sucrose concentration during the growing season

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Introduction

Sucrose storage during sugar beet growth is influenced by exogenous factors such as weather conditions and nutrient supply and their interactions with genotype.

Water content, sucrose and non-sugar dry matter of the beet root depend on its cell size and structure which may be represented by its concentration of water insoluble compounds or marc, respectively.

Apart from that, sucrose accumulation in the storage parenchyma tissue is also limited by the concentration of osmotically active substances that balance the high osmotic potential of sucrose within the cells.

Material and Methods

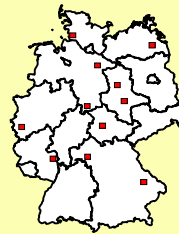


Fig. 1: Location of the field trials 2000 and 2001

In 2000 and 2001, a trial series was carried out at commercial farm fields at eleven locations in Germany (Fig. 1).

Brei samples were taken from six subsequent harvests between June and November. Sucrose was measured polarimetrically, beet marc by drying after hot water extraction of soluble cell compounds, and betaine colorimetrically.

Results

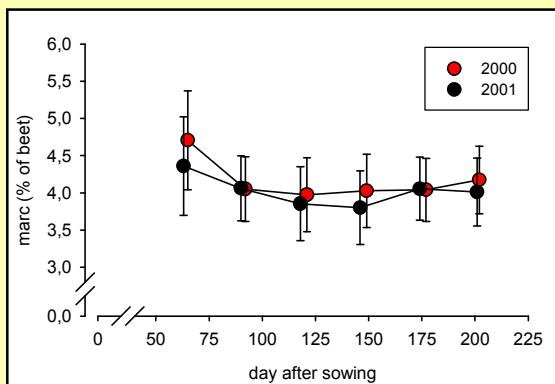


Fig. 2: Marc concentration of sugar beet during the vegetation period; 13 trials in 2000 and 14 trials in 2001. The vertical bars indicate ± 1 sd.

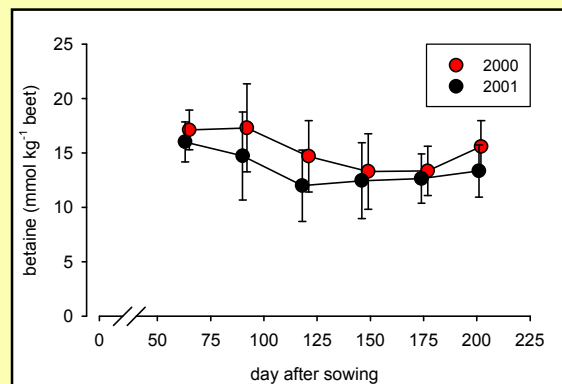


Fig. 3: Betaine concentration of sugar beet during the vegetation period; 13 trials in 2000 and 14 trials in 2001. The vertical bars indicate ± 1 sd.

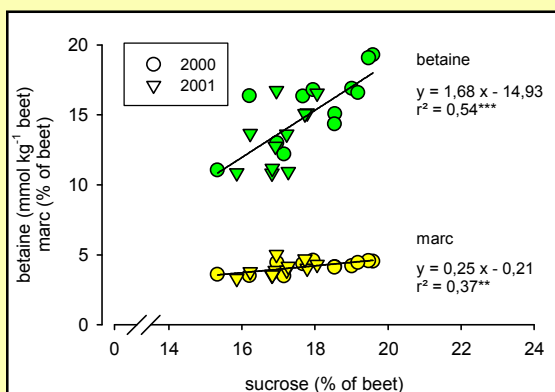


Fig. 3: Relationship between sucrose, marc and betaine concentration of sugar beet 200 days after sowing; 12 trials in 2000 and 11 trials in 2001

r (Pearson)	sucrose x marc	sucrose x betaine	marc x betaine
65 dps	-0,20 ns	0,55 ***	0,29 **
90 dps	0,31 **	0,49 ***	0,53 ***
120 dps	0,58 ***	0,67 ***	0,61 ***
150 dps	0,71 ***	0,69 ***	0,62 ***
175 dps	0,58 ***	0,67 ***	0,53 ***
200 dps	0,57 ***	0,66 ***	0,60 ***

Table 1: Correlation between sucrose, marc and betaine concentration of sugar beet at different harvest dates (dps: days past sowing); Pearson's coefficient of correlation, $n = 92$ or 108

Conclusion

- Betaine and marc were positively correlated with sucrose concentration during the entire vegetation period under different environmental conditions and with different genotypes.
- Increasing sucrose concentration in the vacuole gives rise to higher betaine concentration in the cytosol. It is concluded that betaine plays an important role for osmotic balance within the cells of sugar beet.
- Sucrose and marc increased in parallel due to beet cell structure. High sucrose concentration in sugar beet can only be achieved by forming cell structures to obtain the optimal cell volume for sugar storage.