

# Water use efficiency of three sugar beet genotypes in relation to cyst nematode infestation

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## Hypothesis

Water use efficiency (WUE) of the sugar beet genotypes susceptible (sus), tolerant (tol) and resistant (res) against *Heterodera schachtii* differs on sites with (+ nem) and without nematode infestation (- nem):

$$+ \text{ nem: } WUE_{\text{sus}} < WUE_{\text{tol, res}}$$

$$- \text{ nem: } WUE_{\text{sus}} > WUE_{\text{tol, res}}$$



Fig. 1: Left: Site without nematodes; Right: Site with nematodes.

## Material & Methods

Field experiments with 3 sugar beet genotypes (9 replicates) at 2 sites (one with and one without nematodes) started in April 2013. Microclimate and soil water content were recorded continuously. For each genotype, crop evapotranspiration (ETc) was calculated on a daily basis:

1. Calculation of the potential evapotranspiration  $ET_0$  for the reference surface grass, using the Penman-Monteith-Equation
2. Calculation of the two crop coefficients  $K_{cb}$  (transpiration) and  $K_e$  (evaporation) specifically for each genotype and site, using the dual crop coefficient approach according to Allen et al. (1998)
3. Calculation of the genotype specific crop evapotranspiration ETc:  $ETc = (K_{cb} + K_e) ET_0$

For calculation of WUE, daily ETc values from sowing to harvest were summed up and sugar yield was divided by these sums:

$$WUE = \frac{\text{Sugar yield}}{\text{Crop evapotranspiration}}$$

## Results & Discussion

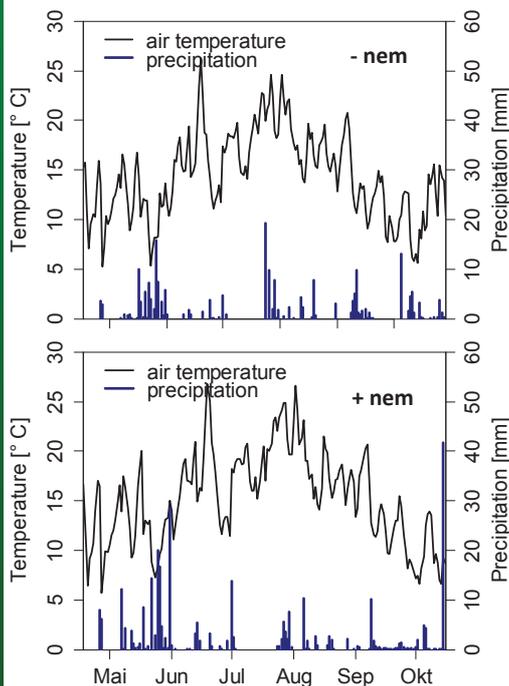


Fig. 2: Microclimate at the nematode free (- nem) and the nematode infested site (+ nem) during the growing period of sugar beets 2013.

- Cumulated precipitation and mean air temperature across the growing season were lower at - nem (219 mm, 14.4° C) compared to + nem (300 mm, 15.3° C) (Fig. 2)
  - Microclimatic differences increased ETc at + nem compared to - nem (Tab. 1)
- Different canopy development of genotypes caused only small differences in ETc:  $ETc_{\text{sus}} > ETc_{\text{tol}} > ETc_{\text{res}}$  (Tab. 1)
- Sugar yield (SY) was higher at - nem compared to + nem; the genotype effect was different between sites:
  - nem:  $SY_{\text{sus}} > SY_{\text{tol}} > SY_{\text{res}}$ ; + nem:  $SY_{\text{tol}} > SY_{\text{res}} = SY_{\text{sus}}$  (Tab.1)
- Differences in WUE closely followed the differences in SY (Fig. 3); differences in ETc were much less important
- WUE in general was high compared to other studies (1.3 g sugar per L H<sub>2</sub>O (Hassanli et al. 2010))

Tab. 1: Cumulated crop evapotranspiration (ETc) and sugar yield of different sugar beet genotypes at the nematode free (- nem) and nematode infested site (+ nem) 2013.

Site	Genotype	ETc [mm]	Sugar yield [t ha <sup>-1</sup> ]
- nem	Resistant	441	15.5 ± 0.7
	Tolerant	446	16.1 ± 0.7
	Susceptible	453	17.0 ± 1.0
	∅	447	16.1 ± 1.0
+ nem	Resistant	519	12.7 ± 1.3
	Tolerant	524	13.6 ± 0.9
	Susceptible	528	12.6 ± 1.7
	∅	524	12.9 ± 1.4

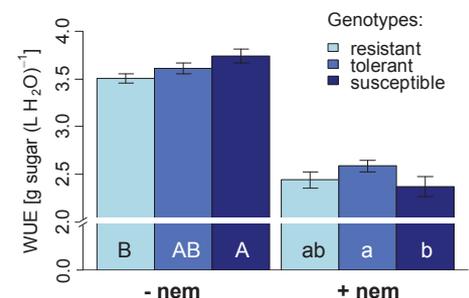


Fig. 3: Effect of genotypes on the water use efficiency (WUE, ± standard error) at the nematode free (- nem) and nematode infested site (+ nem) (ANOVA and Tukey test conducted at p<0.05).

## Summary & Conclusion

The site specific microclimate strongly affected cumulated crop evapotranspiration, while genotype effects were negligibly small.

→ Genotype effects on WUE were primarily due to differences in sugar yield.

## References

- Allen, R. G., Pereira, L. S., Raes, D., Smith, M., 1998: Crop evapotranspiration – Guidelines for computing crop water requirements - FAO Irrigation and drainage paper 56.
- Hassanli, A. M., Ahmadi, S., Beecham, S., 2010: Evaluation of the influence of irrigation methods and water quality on sugar beet yield and water use efficiency, Agricultural Water Management 97: 357-362.