A case study on water consumption in livestock production in Hungay

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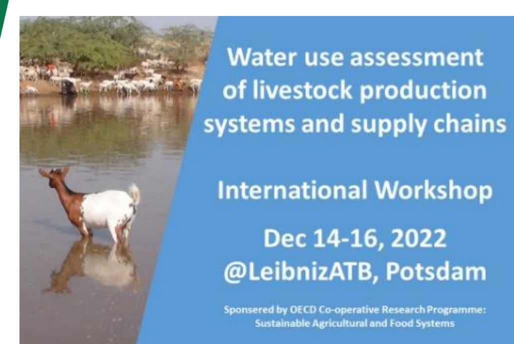
MAGYAR AGRÁR- ÉS ÉLETTUDOMÁNYI EGYETEM



Hungarian University of Agriculture and Life Sciences

– The largest agricultural university in Hungary
– Located in four campuses nationwide
– All aspect of agriculture represented
– Composed of 22 institutes and numerous research centers

Institute of Environmental Sciences

– Agro-Environmental Research Center
– Research Center of Irrigation and Water Management
– Department of Water Management and Climate Adaptation

Institute of Animal Sciences

– Department of Animal Breeding Technology and Animal Welfare

MAGYAR AGRÁR- ÉS ÉLETTUDOMÁNYI EGYETEM

Environmental and food safety of agricultural technologies
(pesticides, mycotoxins and GMOs related to environmental, animal and human helath)

Water management

Environmental hazard identification and characterization

Improving biosecurity compliance in poultry farms

Horizon 2020
Grant Agreement n. 101000728

www.netpoulsafe.eu

ITAVI

Project leader

NetPoulSafe

- *Networking European poultry actors for enhancing the compliance of biosecurity measures for a sustainable production*
- *EU: 7 large poultry producig countries (France, Spain, Italy, Hungary, Belgium, the Netherlands and Poland)*

Partner poultry producers in Hungary

Broader connection to animal breeding

Compliance with **biosafety**

Regular **visits to farms**

Other sectors as well – ruminants (cattle), poultry and small livestock (rabbit)

Chemical safety – organic microcontaminants, antibiotic resistance, etc.

Water management

- Water footprint in feed (maize)
- Water intake by dairy cows
- Water use assessment

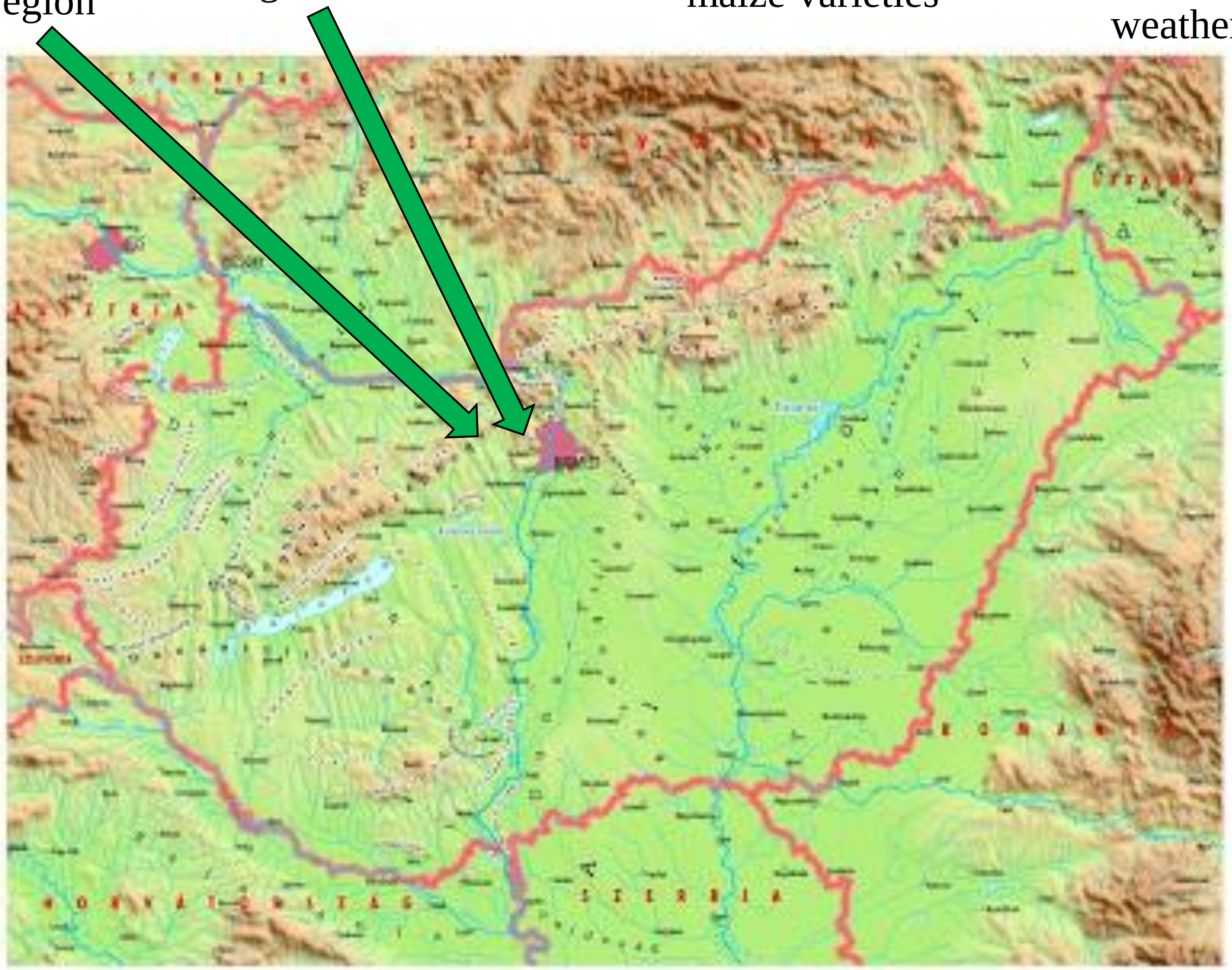
Materials and Methods

Zsámbék region

Nagykovácsi region

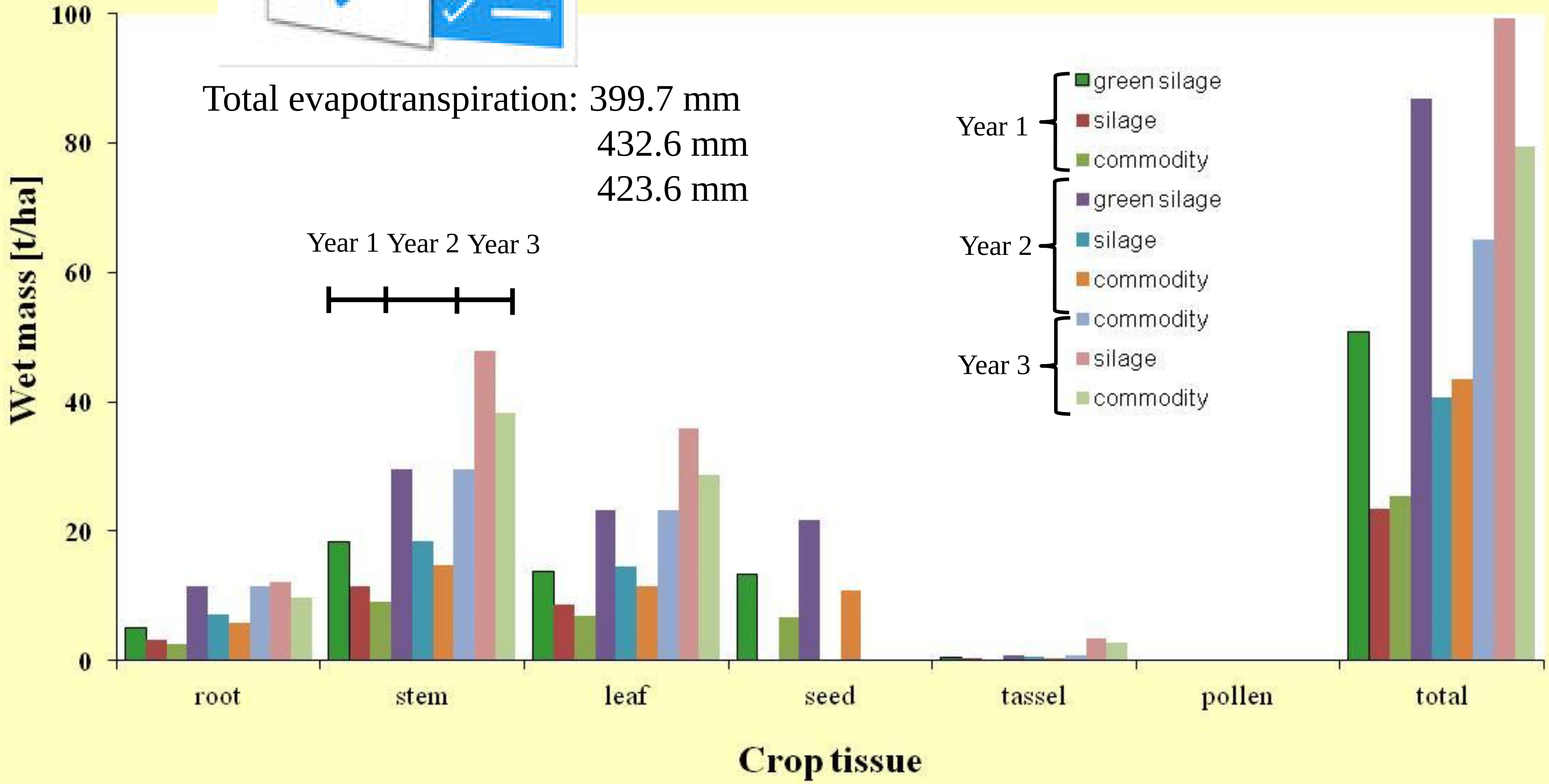
Different commercial maize varieties

Various years and weather conditions

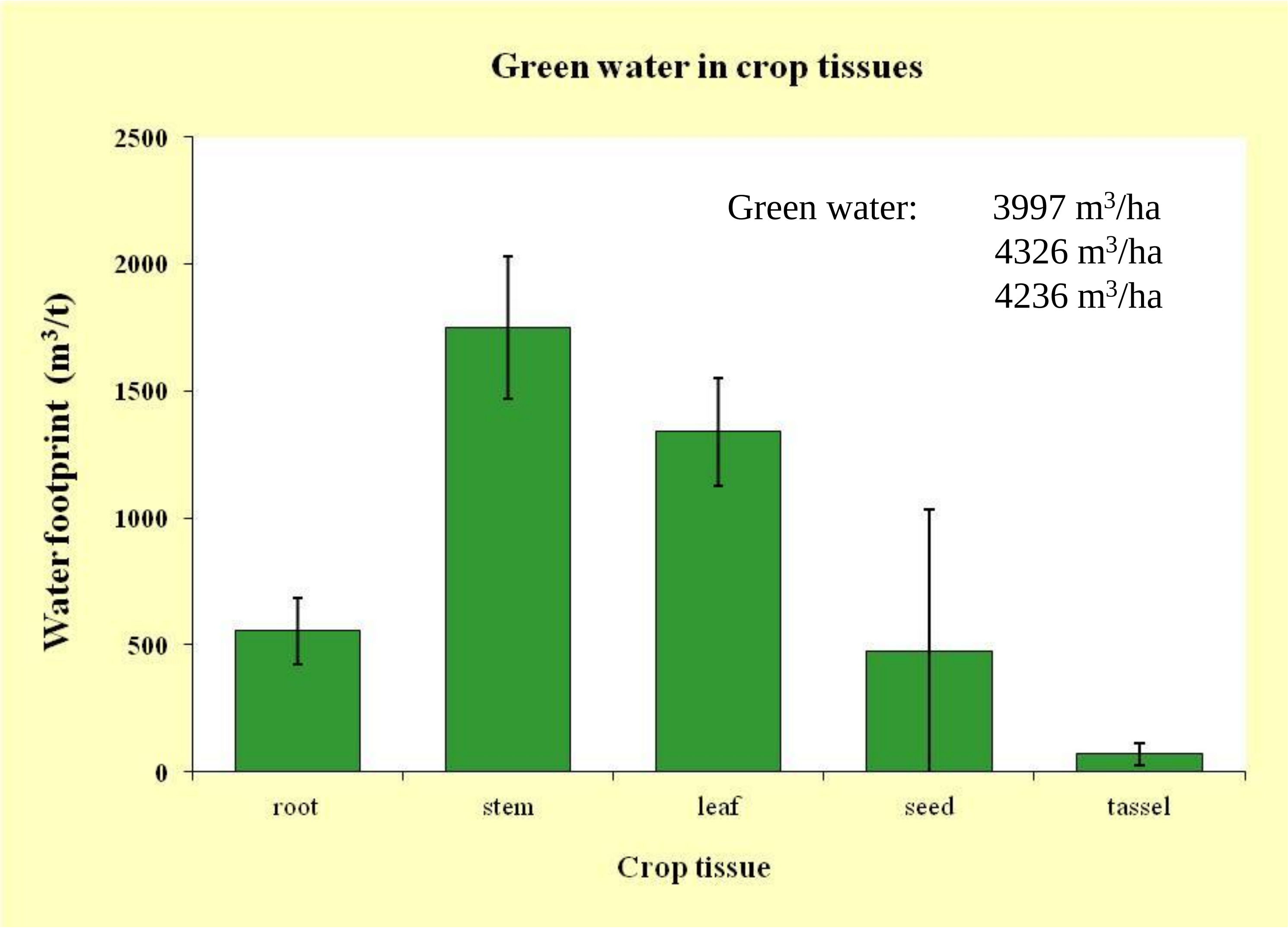


Cultivation types:	plant/ha
commodity	60 000
green silage	120 000
silage	75 000

Cultivation of maize varieties



Cultivation of maize varieties

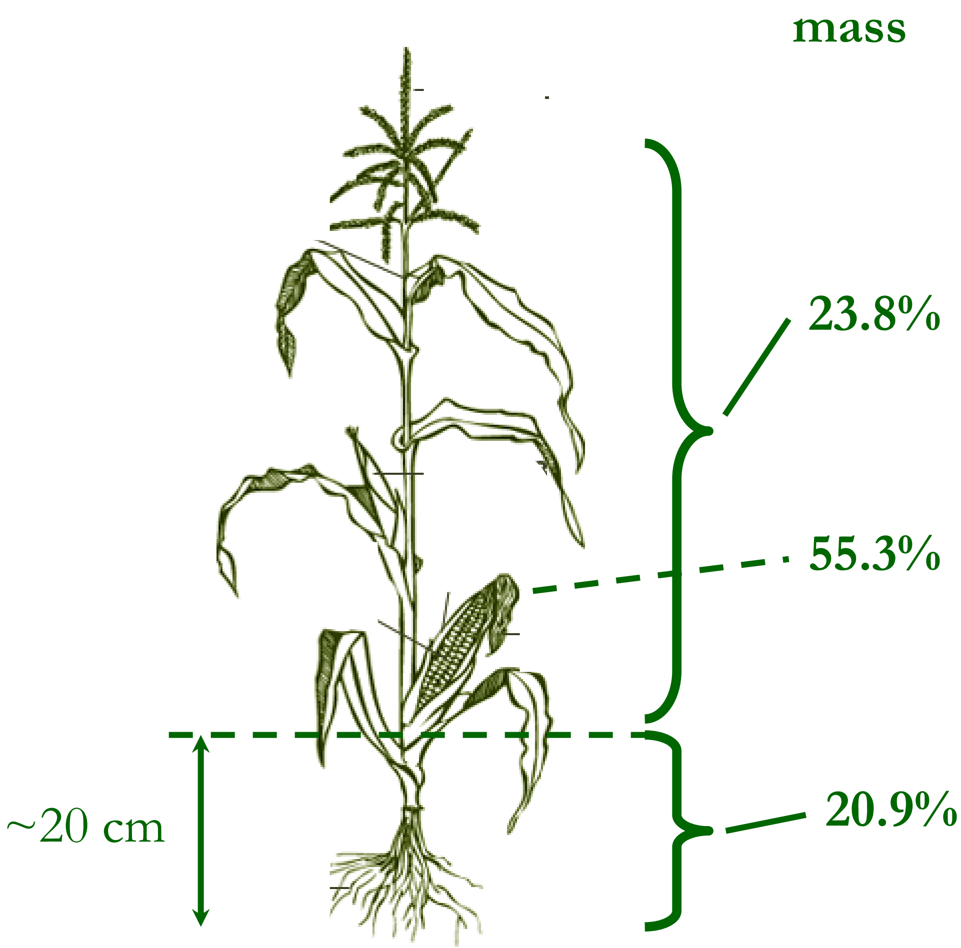


Water footprint of maize

- produce *vs.* biomass

75 thousand corn stem/ha
(mid-term ripening variety)

30-50 t/ha fresh weight
(11-19 t/ha dry weight)



4186 ± 773 m^3/ha green water

84-140 m^3 green water/t fresh weight maize

Biomass in stubble

„traditional" harvest

21% biomass in stubble

shredding harvest

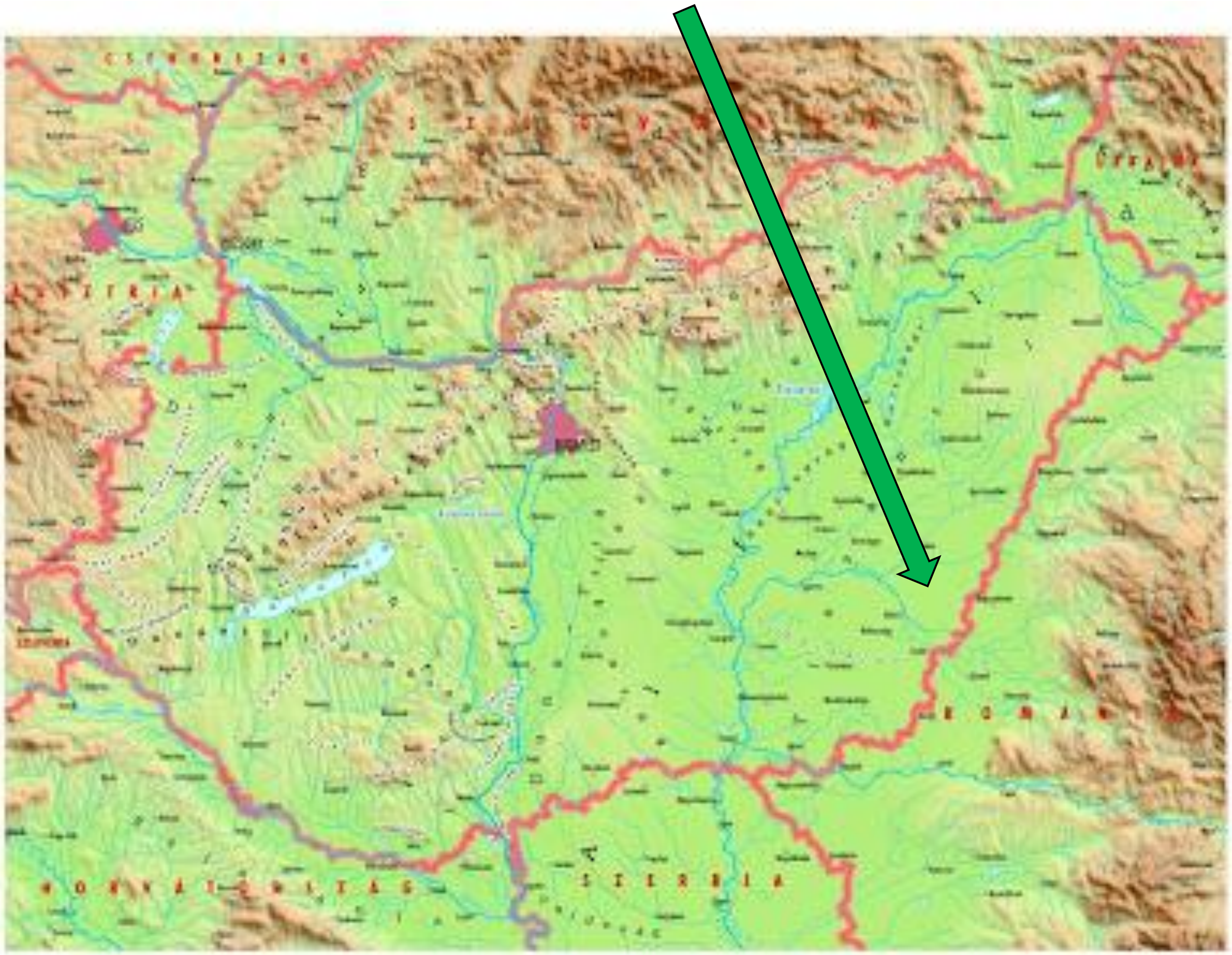
45% biomass in stubble

Materials and Methods

Drinking water intake
lactating Hungarian Simmental cows

Southern Great Plain,
Békés County

Jul 1-31, 2019 and 2020



Feed daily
- 8 kg corn silage
- 3 kg grass hay
- 3 kg alfalfa hay
- 6.1 kg concentrate
  (49% corn, 33% barley,
  16% soybean meal,
  2% feed supplement
  with dextrose and $CaCO_3$)

Feed: moderate dry matter content (13.3 kg),
high proportion of fodder concentrate (about 50% of the net energy for lactation),
adequate crude fiber content (18% of the dry matter content) to heat stress

Dairy cow water intake experiments

Drinking water: 12-14^{o}C, *ad libitum* (in automatic drinker with a flow meter), colorless/odorless, no visible impurities.24-hr consumption registered at 6 PM.

Animals milked twice daily at 7 and 18 hours. The bulk milk was weighed and the daily milk production was converted to 1 cow.

External body temperature measured non-contact, (Medisana TM-750 thermometer),.individually, once daily at 3 PM (at the end of the warmest period).

Dry air temperature (Td) and **relative humidity** (H) determined simultaneously with a digital measuring instrument, daily at 3 PM.

Wet air temperature (Tw) calculated online (using a h-x calculator) to calculate temperature-humidity indices THI1 and THI2.

$$\text{THI1} = (0.15 \times \text{Td} + 0.85 \times \text{Tw}) \times 1.8 + 32$$

$$\text{THI2} = (0.35 \times \text{Td} + 0.65 \times \text{Tw}) \times 1.8 + 32$$

Td, Tw (^{o}C)

THI1 or THI2 are recommended in Hungary (limit values THI1: 68, THI2: 69).

Statistical data processing was performed by regression analysis using the formula:

$$r = \sum(x-\bar{x})\times(y-\bar{y}) \;/\; \sqrt{[\sum(x-\bar{x})^2\times\sum(y-\bar{y})^2]}$$

Conditions

During study period: **mild heat stress**, mean of THI1 =70

Correlation of daily water intake (WI)
with dry air temperature (Td),
wet air temperature (Tw),
relative humidity (H),
temperature-humidity indices (THI1 and THI2),
external body temperature (BT) and
milk production (MP)..

Description

Water circulation in the body of dairy cows **very intense**

Total water demand of a cow producing 35 kg/day milk at 28°C:

133 liter, of which approx. 115 liter (>85%) drinking water.

Body water content: 50-80% → avg. 430 kg/adult animal.

133 liter is ~30% – daily body water change

Milk: 25.6 liter of water/day – 19.2% of the daily water exchange

other water losses: excretion, heat regulation

Heat stress: the balance between heat production and heat loss is unhinged

no longer able to compensate for the increase in **ambient temperature**

not only tropical, subtropical and Mediterranean climates – also under the temperate climate

Degree of heat stress in cows affected by **relative humidity**

as evaporation in humid air is less effective for cooling

Indicators: **temperature-humidity indices** (THI1 to THI6)

- taking air temperature and humidity into account together

Description

Daily water intake **in feed**:
strongly affected by **chemical composition**
– potassium (electrolytes), nitrogen (crude protein)
.
Body increases total water intake (not only the drinking water intake)

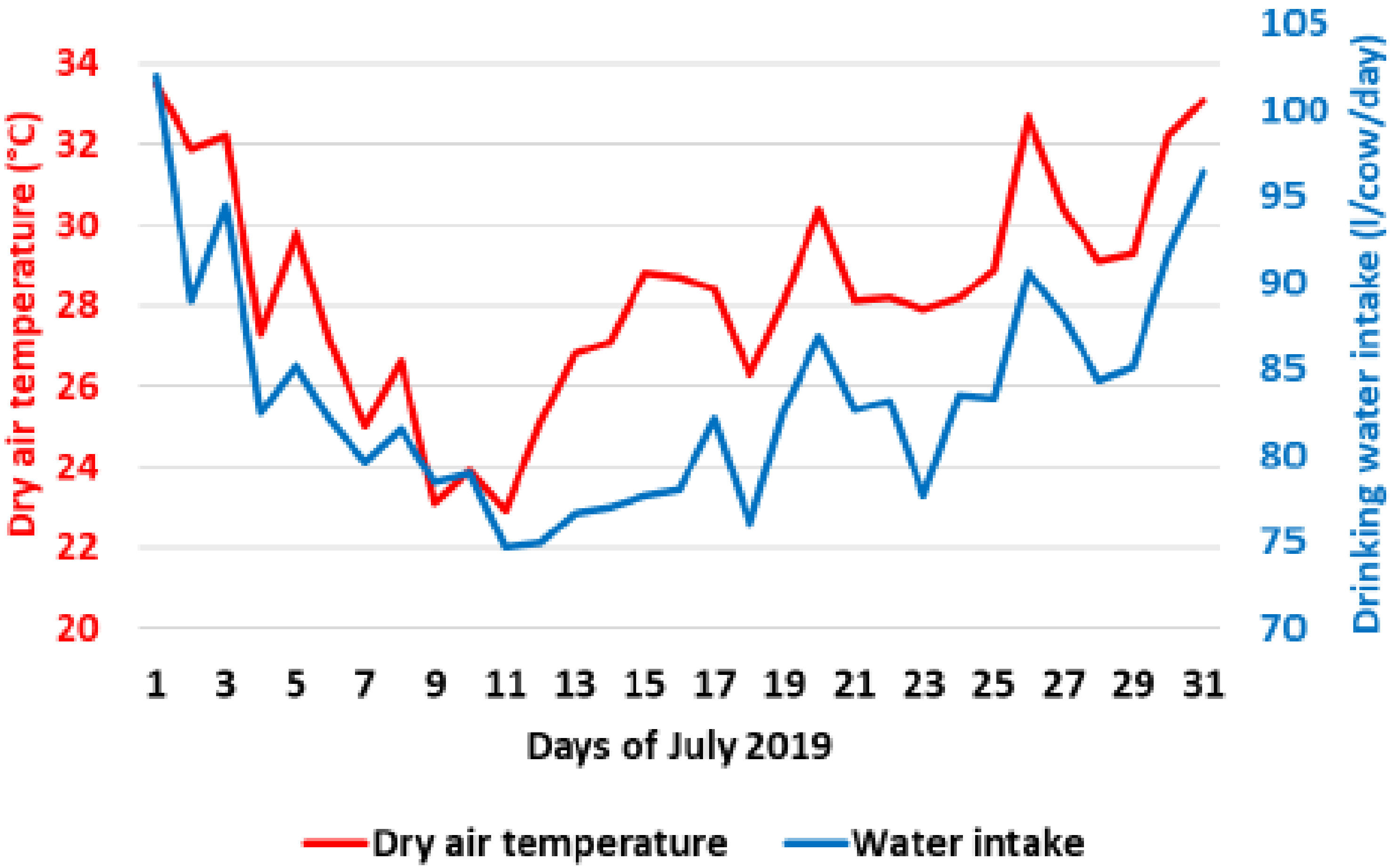
Macroelements (Na^+, K^+, Ca^{2+}, Mg^{2+}, Cl^-) in drinking water are **well tolerated**
but beyond a limit **reduce water consumption** → also dry matter intake and production

Temperature of the drinking water strongly affects **daily water intake**

During heat stress, sufficiently cold (10°C) drinking water can effectively help reduce body temperature → reduces drinking water consumption)
In winter, heated (30 °C) drinking water.

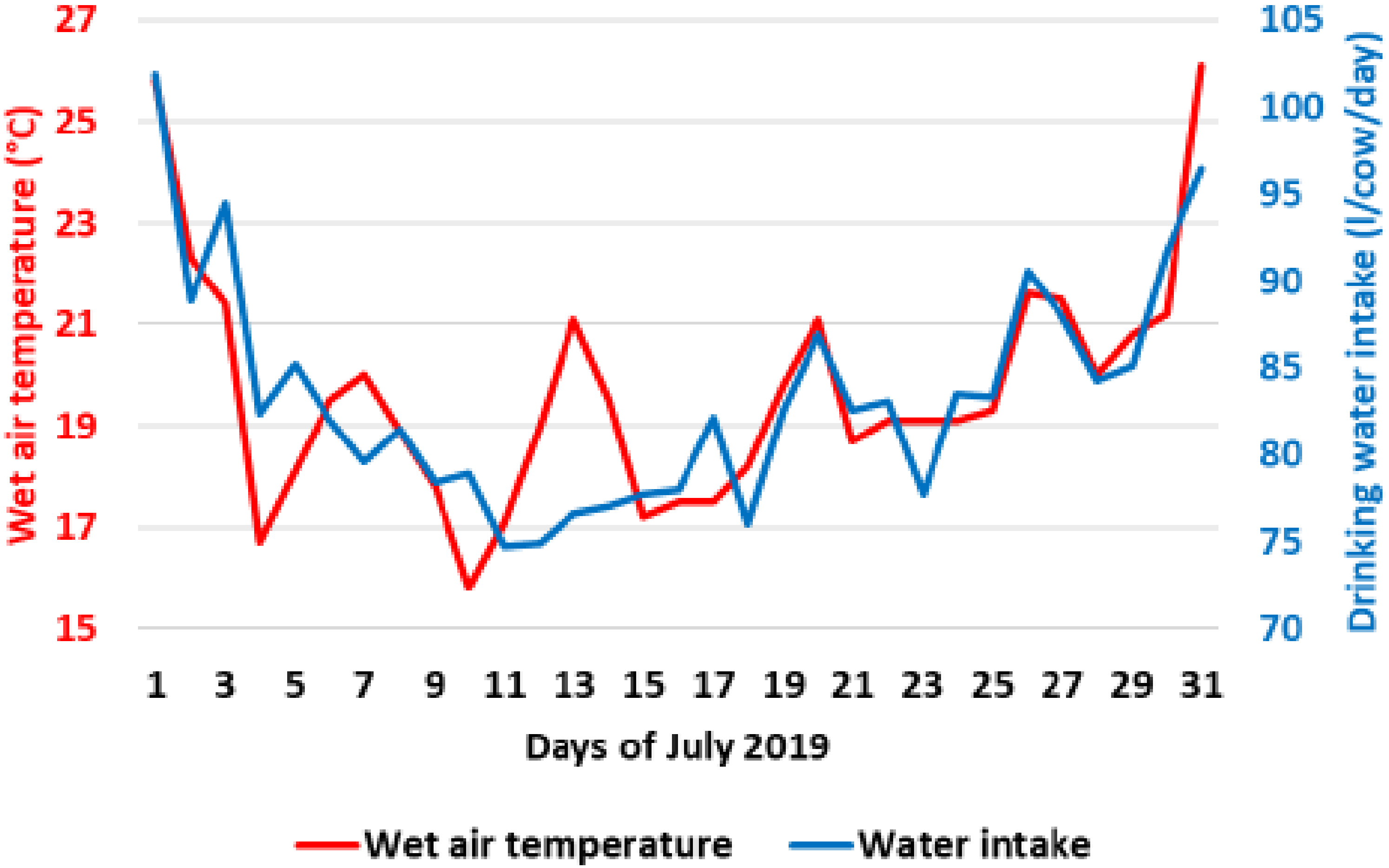
WI was more closely related to Td (r = 0.87), than to Tw (r = 0.80) and was not related to H (r = -0.10)
Correlations between WI-THI1,and WI-THI2 were strong (r = 0.84 and 0.88)
WI was less associated with BT (r = 0.51), than with weather indicators, but this association was also significant ($p < 0.01$).
Very strong negative correlation was found between WI and MP (r = -0.91); r (WI, MP . THI1) = -0.70; r (WI, MP . Td) = -0.58.

Correlations



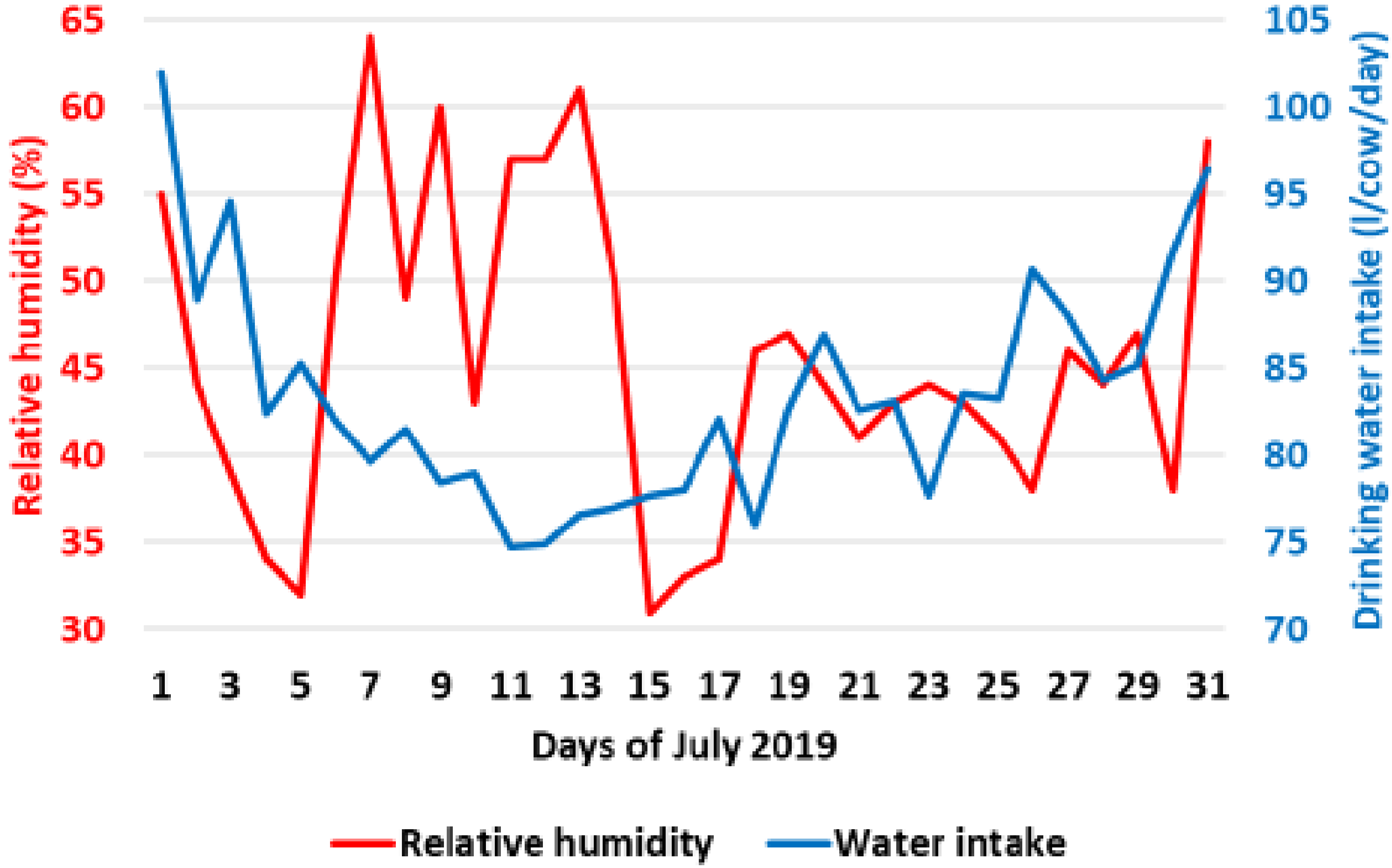
Relationships between the water intake and dry air temperature

Correlations



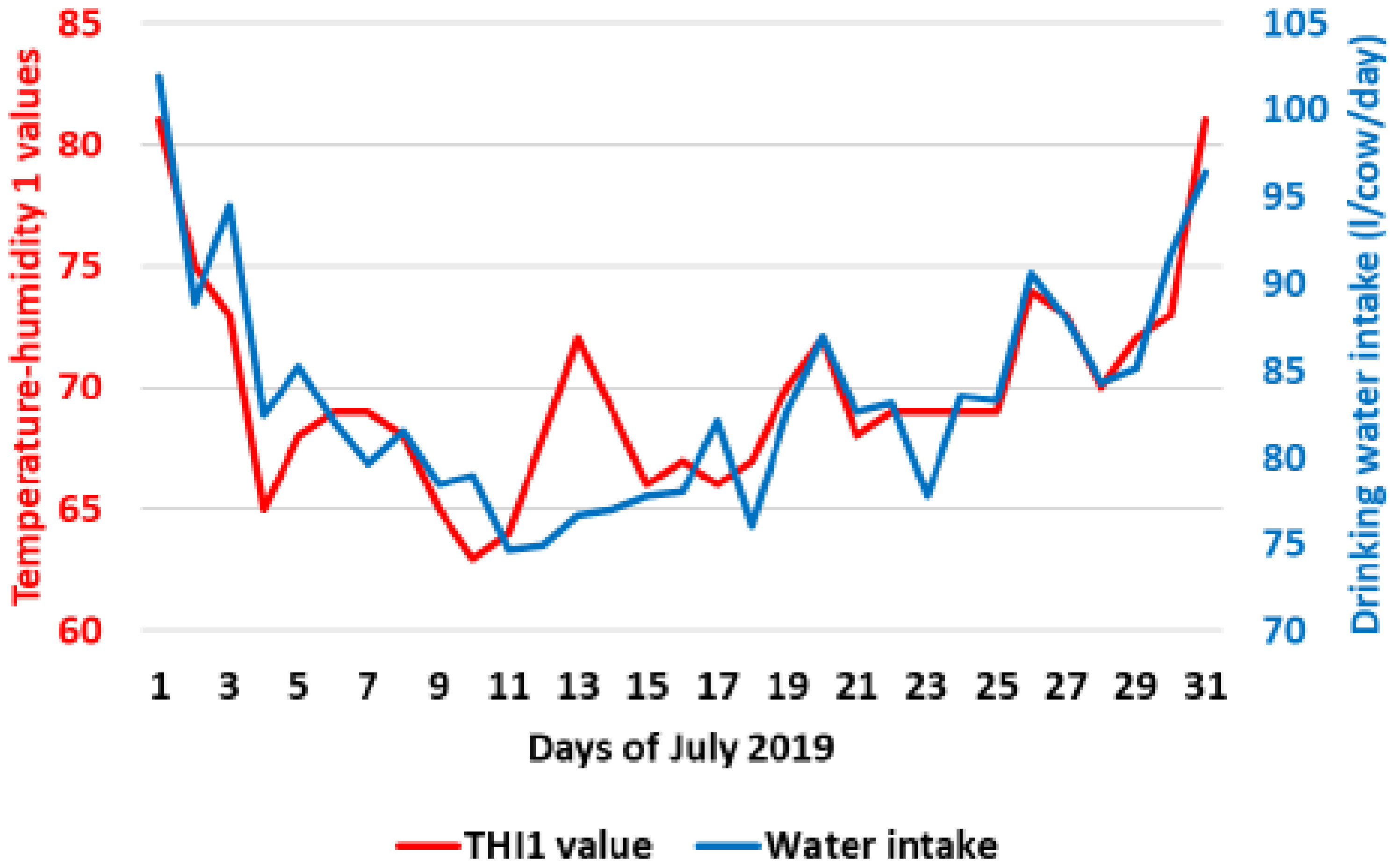
Relationships between the water intake and wet air temperature

Correlations



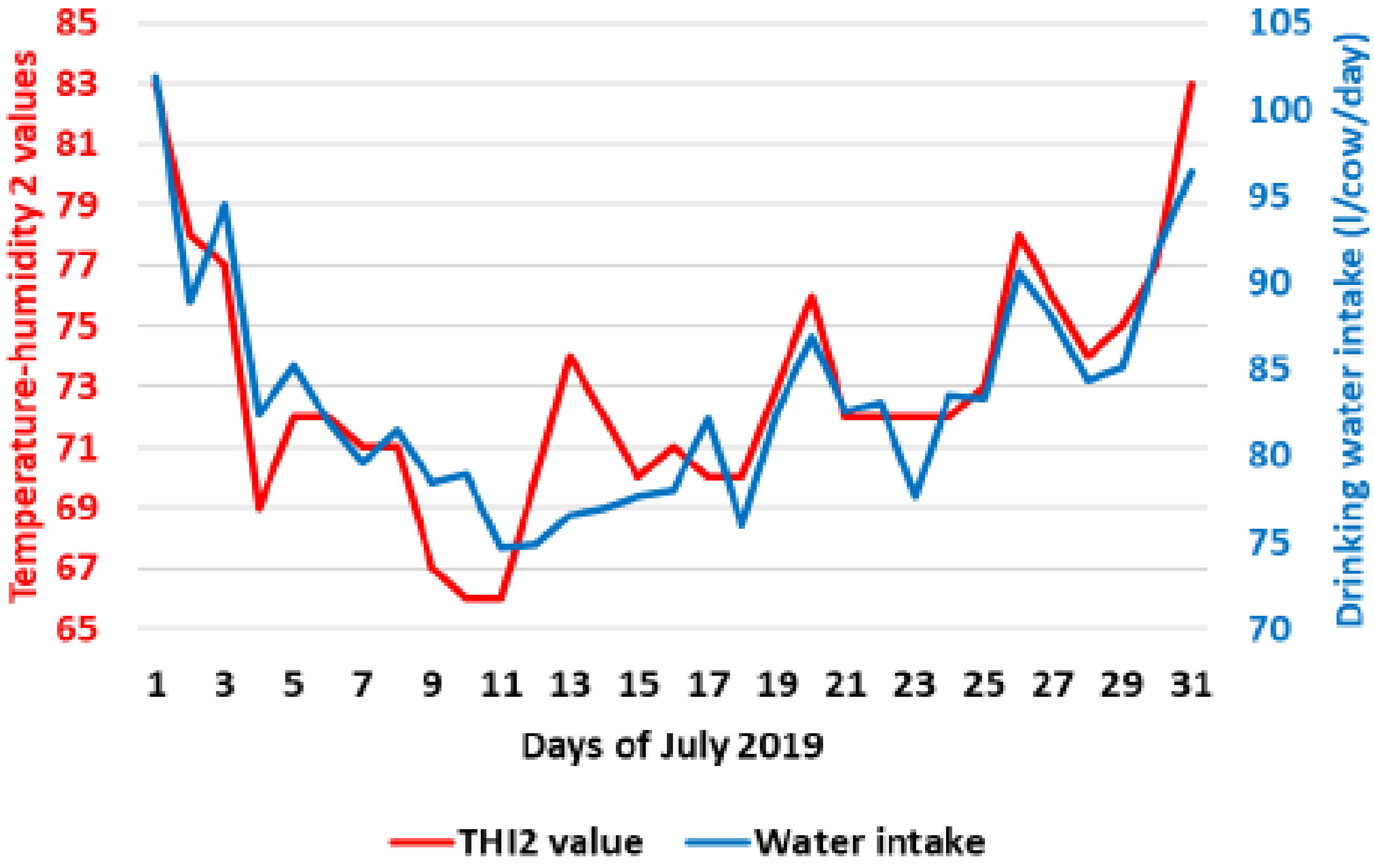
Relationships between the water intake and relative humidity of air

Correlations



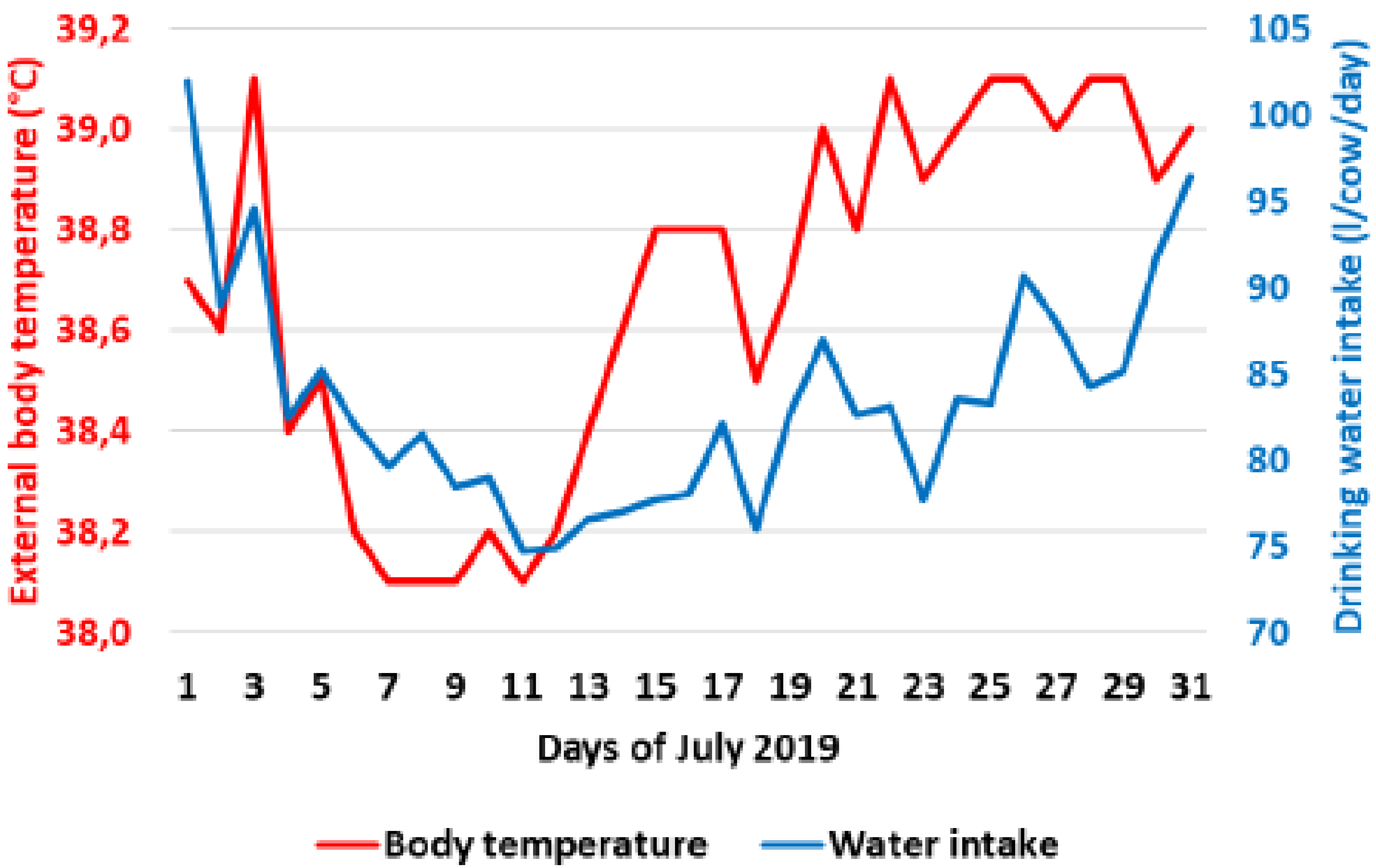
Relationships between the water intake and THI1 values

Correlations



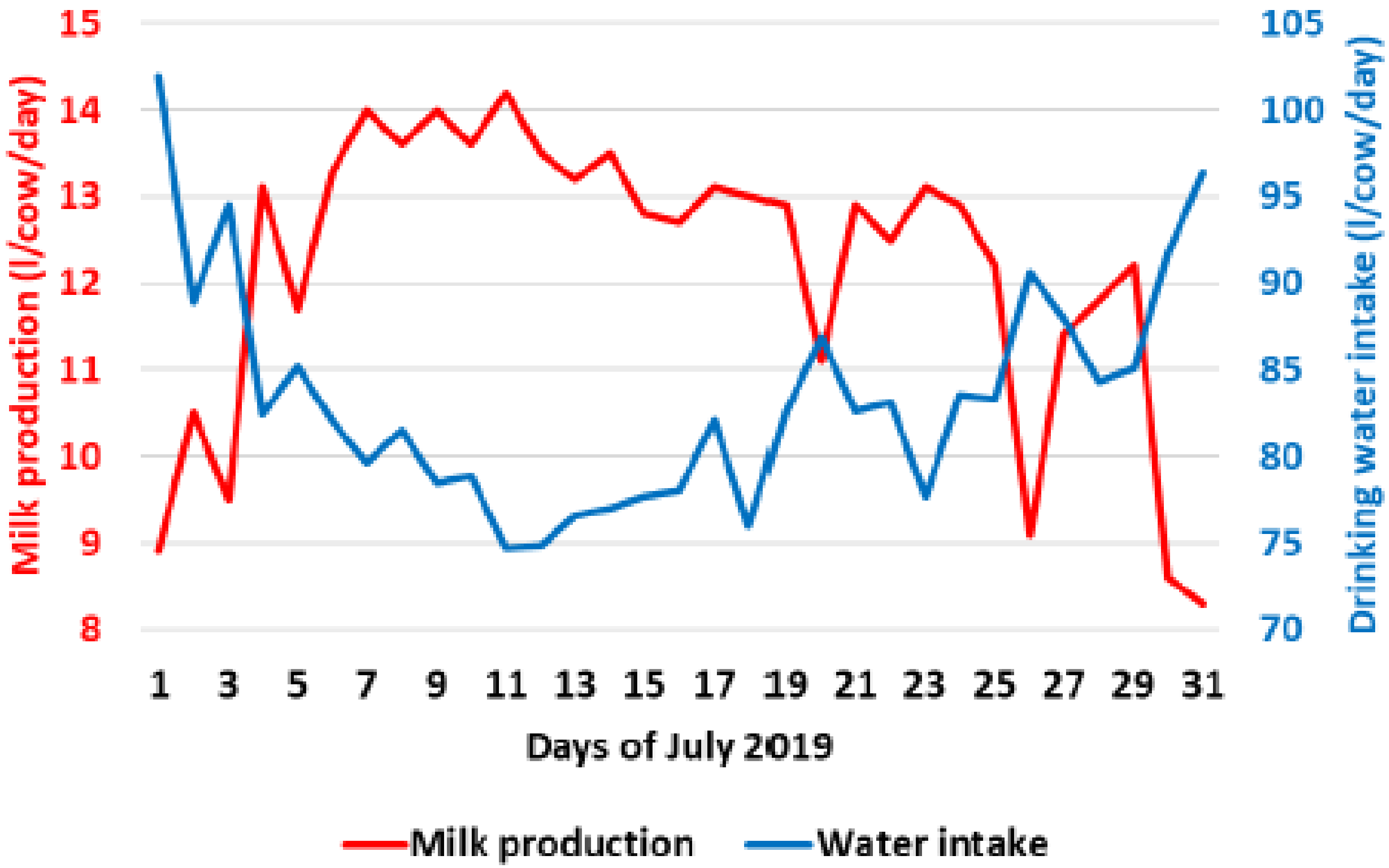
Relationships between the water intake and THI2 values

Correlations



Relationships between the water intake and external body temperature

Correlations



Relationships between the water intake and milk production

Correlations

Parameter		r	Explanation
WI	Td	0.87	Strong correlation
	Tw	0.80	Correlation
	H	-0.10	No correlation
	THI1	0.84	Strong correlation
	THI2	0.88	Strong correlation
	BT	0.51	Less associated, but significant ($p<0.01$)
	MP	-0.91	Very strong negative correlation
WI, MP	THI1	-0.70	Negative correlation
	Td	-0.58	Weak negative correlation

Conclusions

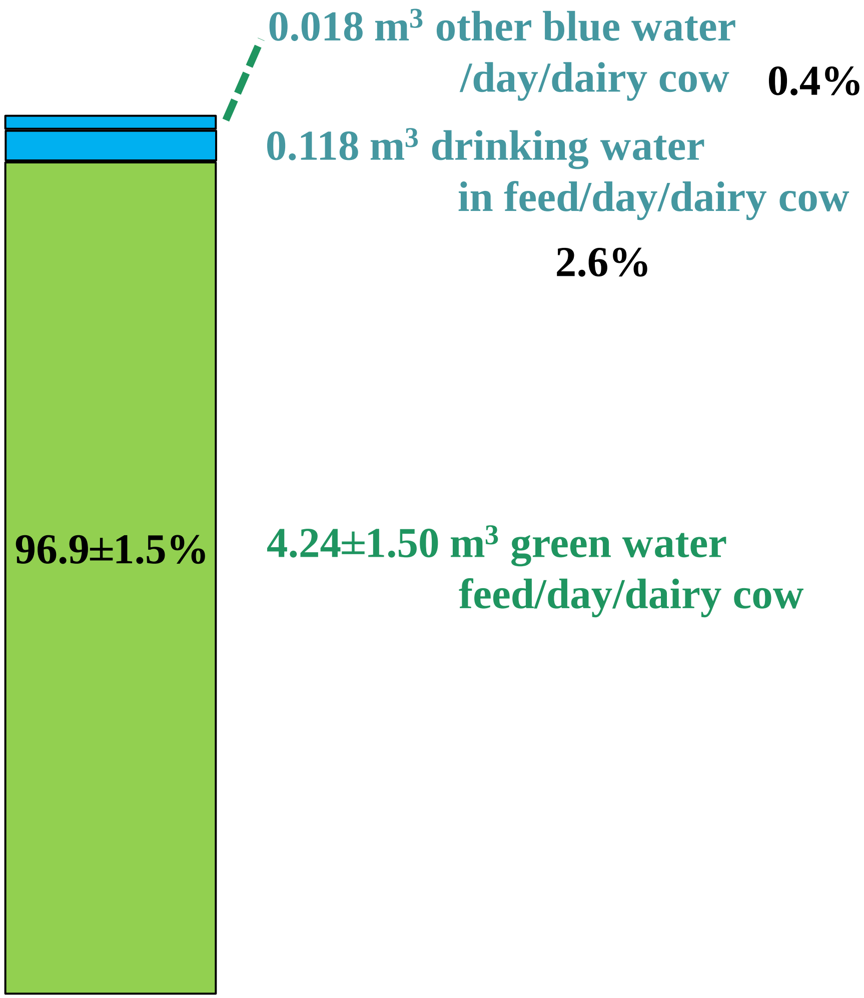
In the herd and conditions studied, the **intake of drinking water** was highly dependent on meteorological factors, especially on dry air temperature.

There is also a strong correlation with the wet air temperature and with the **two types of temperature-humidity indices** (THI1 and THI2), but there is no direct correlation with the relative humidity of the air.

Water consumption was **less related to** (external) **body temperature** than to ambient temperature.

The ratio of water excreted into milk to drinking water intake decreased sharply with increasing temperature. This ratio was mostly determined by the dry air temperature.

Overall, **water consumption is very minor relative to water content of the feed**.



Thank you for your attention
and
Happy Holidays!