Institute of Agricultural Engineering

Real-time animal response to climate changes Research and application

PLF Lab - ARO - Israel

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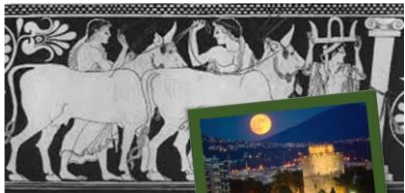
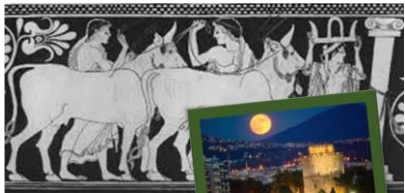
Agenda:

1. Project goals
2. Sensor base cooling results
3. Conclusions and discussion



Project goals:

1. Study the individual cow heat stress response – **sensor based**
2. Transforming rumen temperature to vaginal temperature (**Statistic model**)
3. Design sensor base cooling method for **forced cooling** purposes (production/welfare)

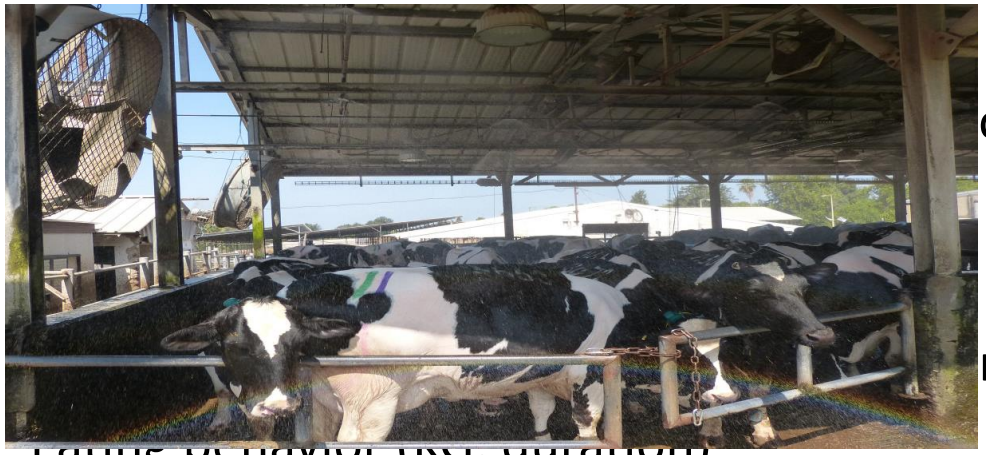


Materials and Methods

2016: **8 cooling vs. 5 cooling per day**

2017: **Sensor-based** cooling vs. **pre-defined, fixed timing** cooling (3 cooling)

1. ARO, Volcani, research dairy barn
2. od days".
3. r)
   - Eating behavior (kG, duration)
   - Thermal humidity index (temperature, humidity, radiation, wind).
   - Severino Pinto ATB Germany(respiration, rectal temperature, heart rate)



A cooling is: 1 min. shower and 4 min. fan x 9 times = 45 min

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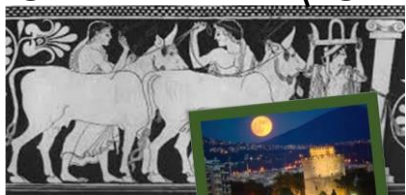

Results
(Summer 2016, Summer 2017)

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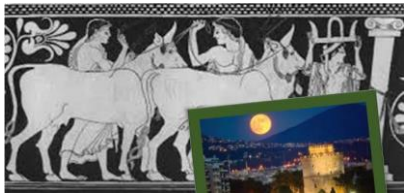
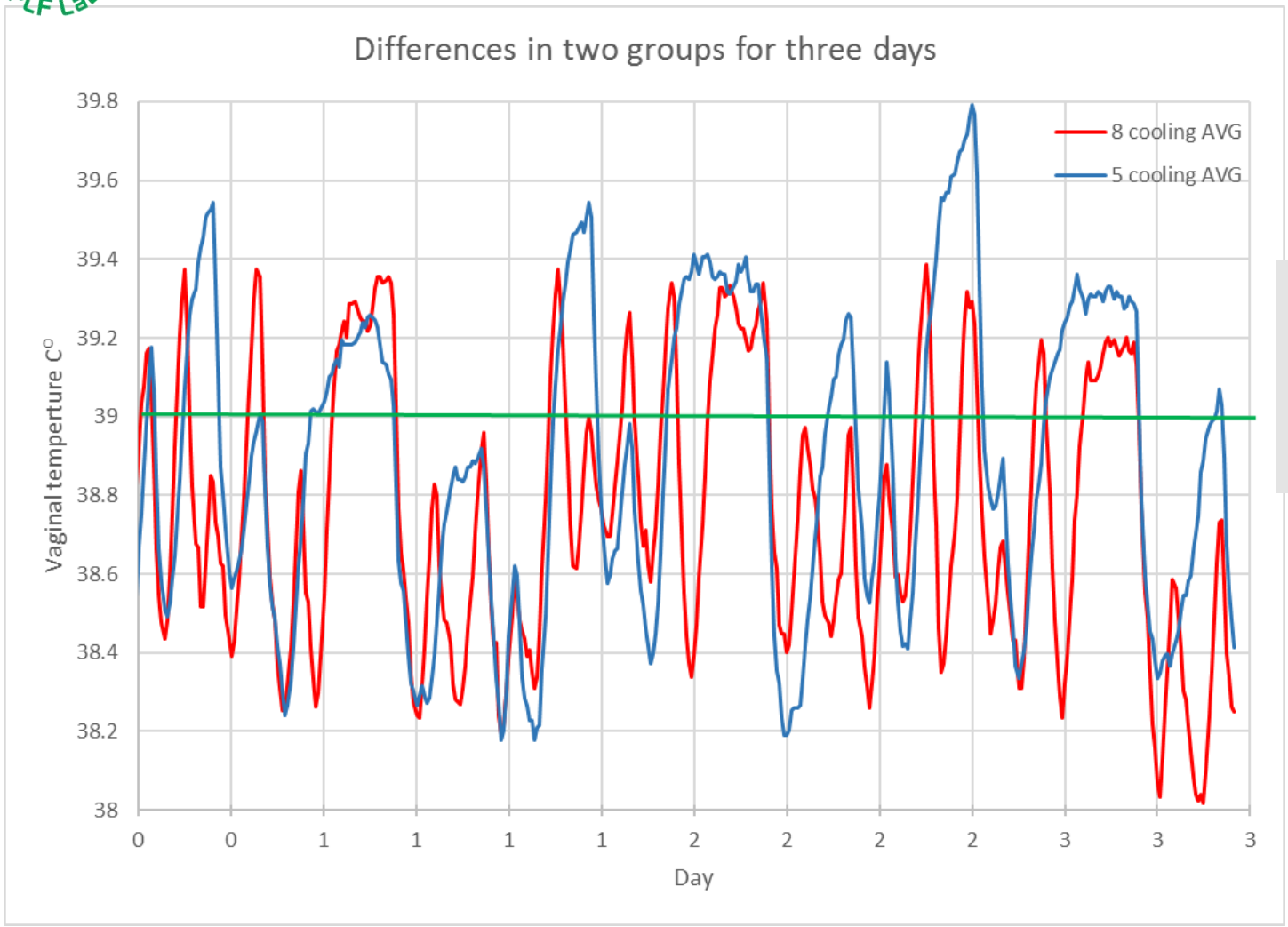
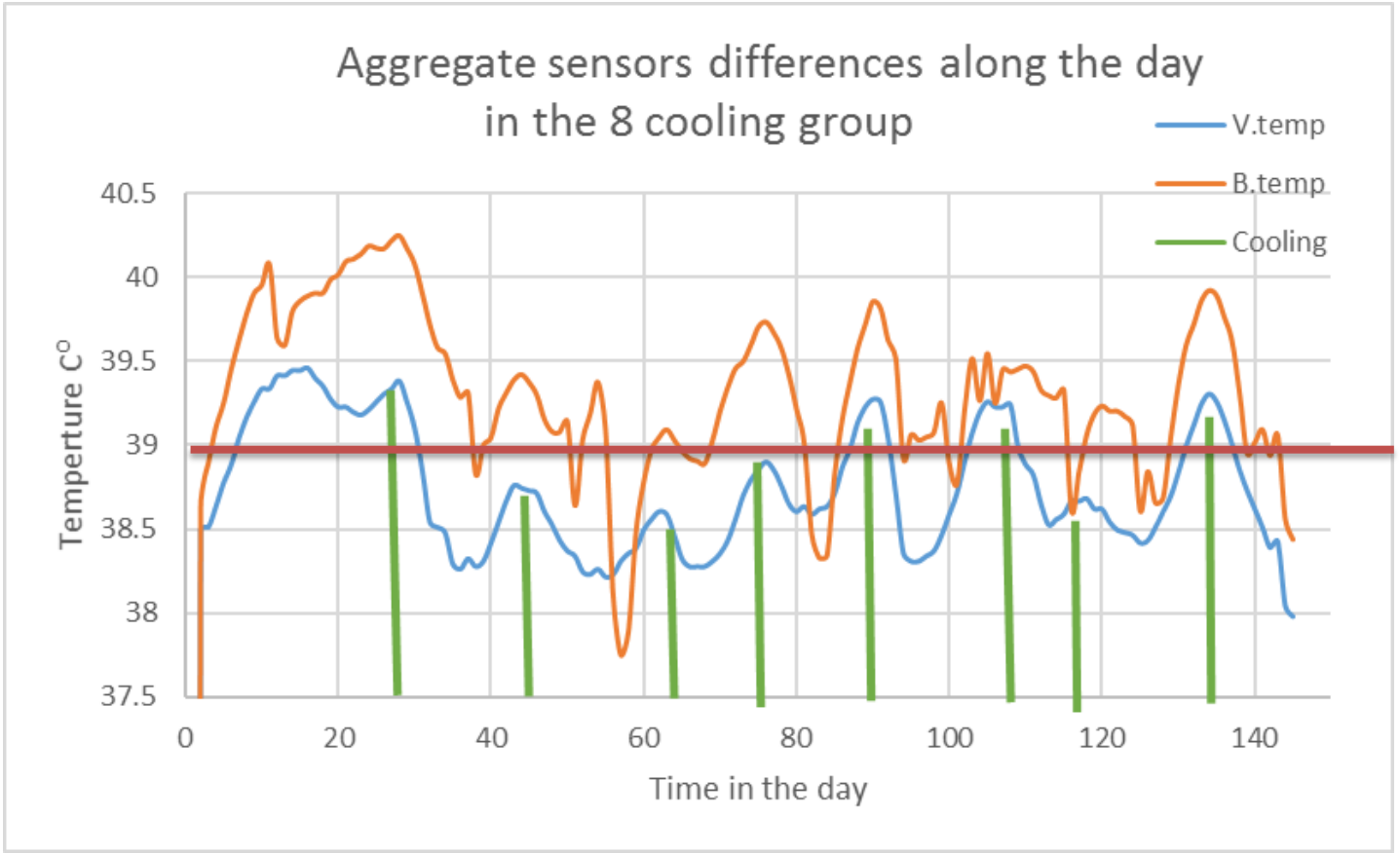


Results :Vaginal temperature (2016)



Rumen VS vaginal temperature (2016)



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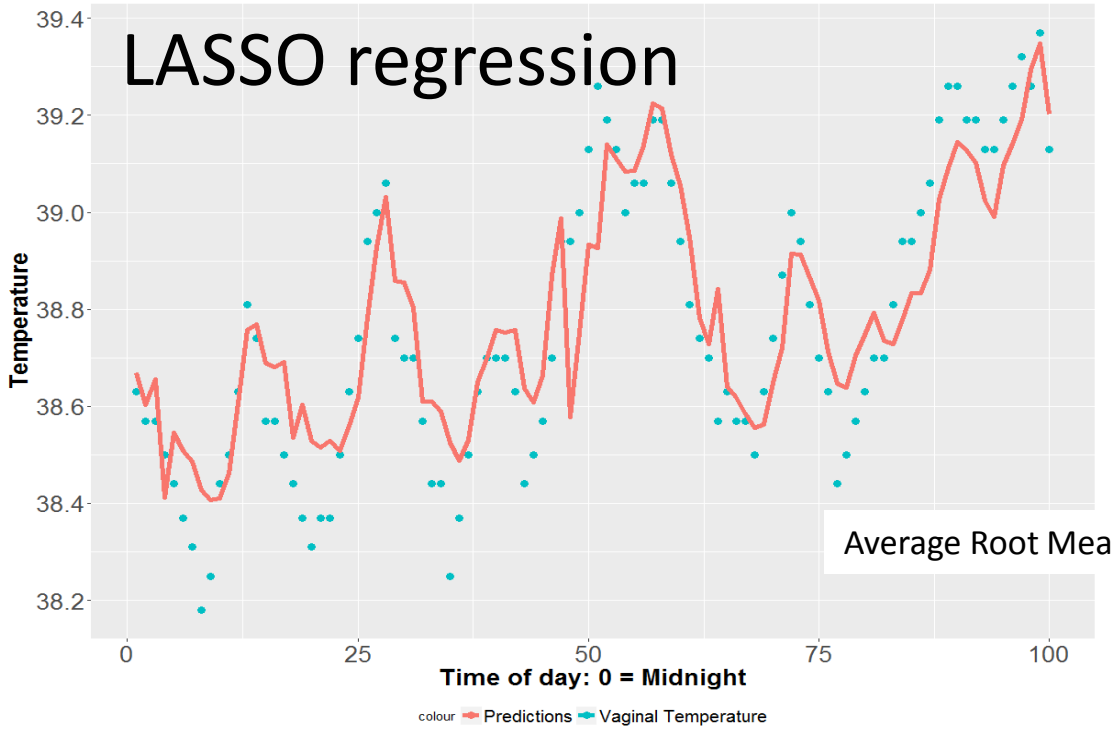
Materials and methods – algorithm (2016)

How to “exchange” vaginal with bolus temperatures ?

$$\sum_{i=1}^{n}[y_i-(\beta_0+\sum_{j=1}^{k}\beta_j x_{ij})]^2+\lambda\sum_{j=1}^{k}\left|\beta_j\right|=\left\|\mathbf{Y}-\mathbf{X}\boldsymbol{\beta}\right\|_2^2+\lambda\left\|\boldsymbol{\beta}\right\|_1$$



- Cow: 3304
- RMSE: 0.128

Borrowed from
Shlomi Goldshtain
Master work

Average Root Mean Square Error =0.162°C

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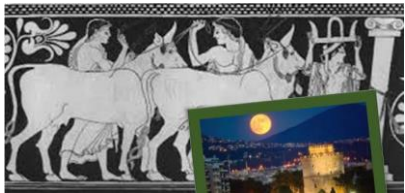
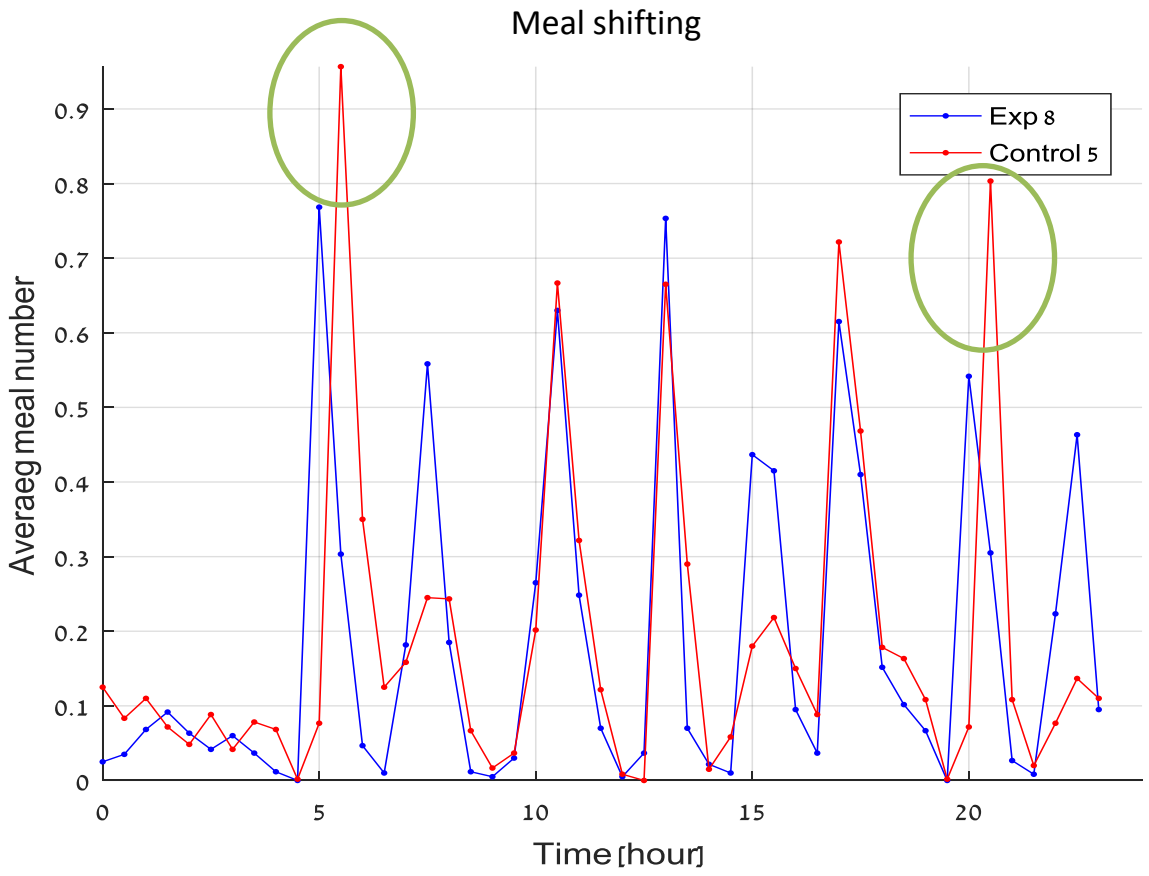
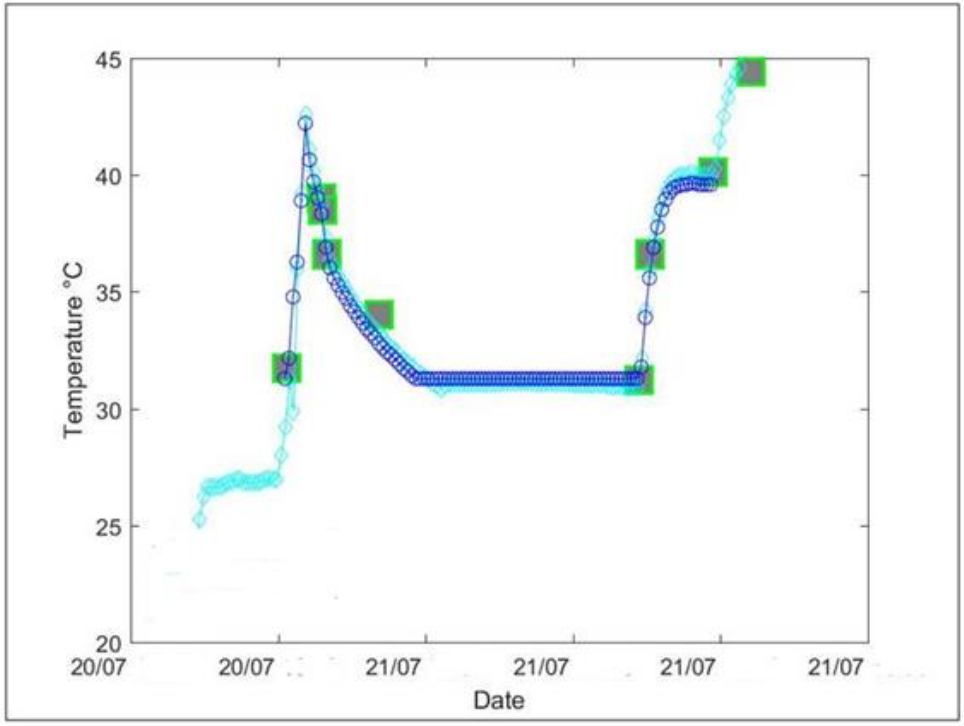


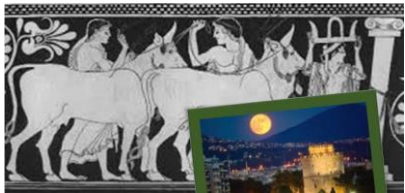
Meals along the day (2016)



Materials and Methods
sensor validation

Two different manufactures - in the lab

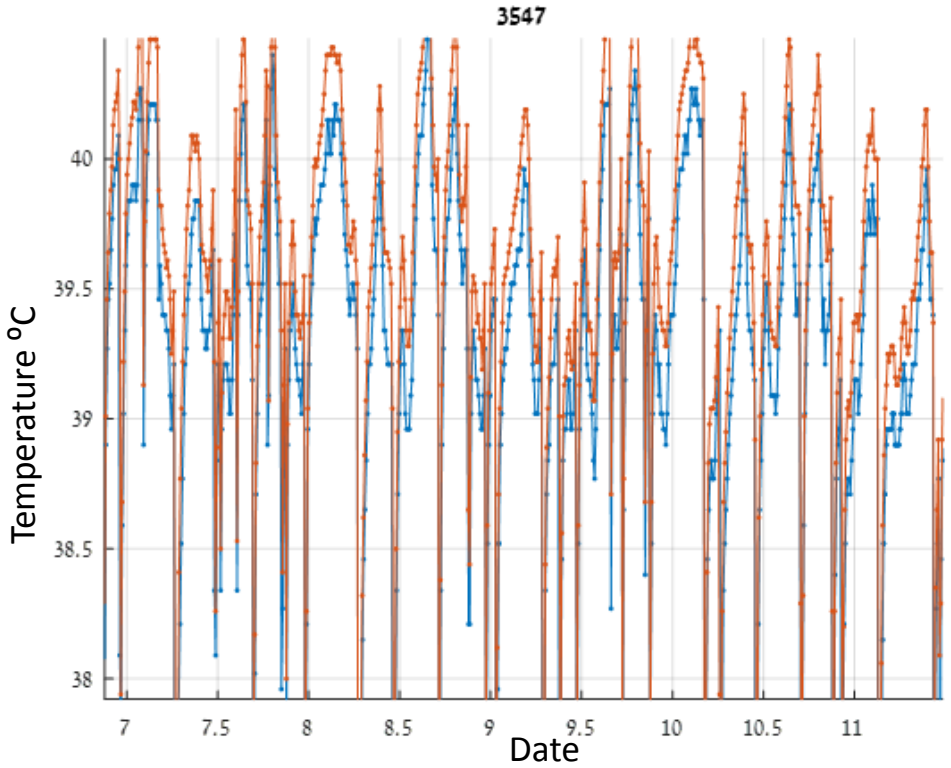




Materials and Methods
sensor validation

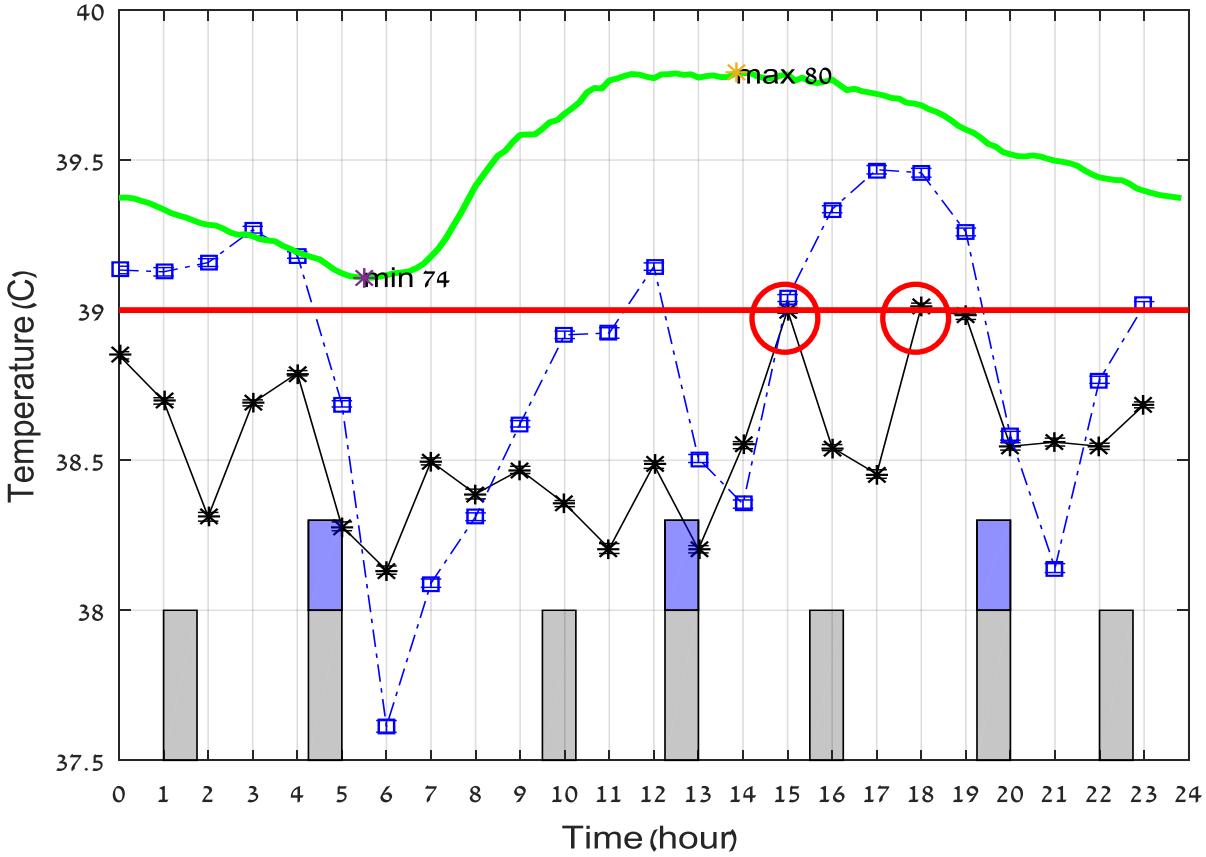
Two different bolus manufactures in a one single cow

0.3°C difference



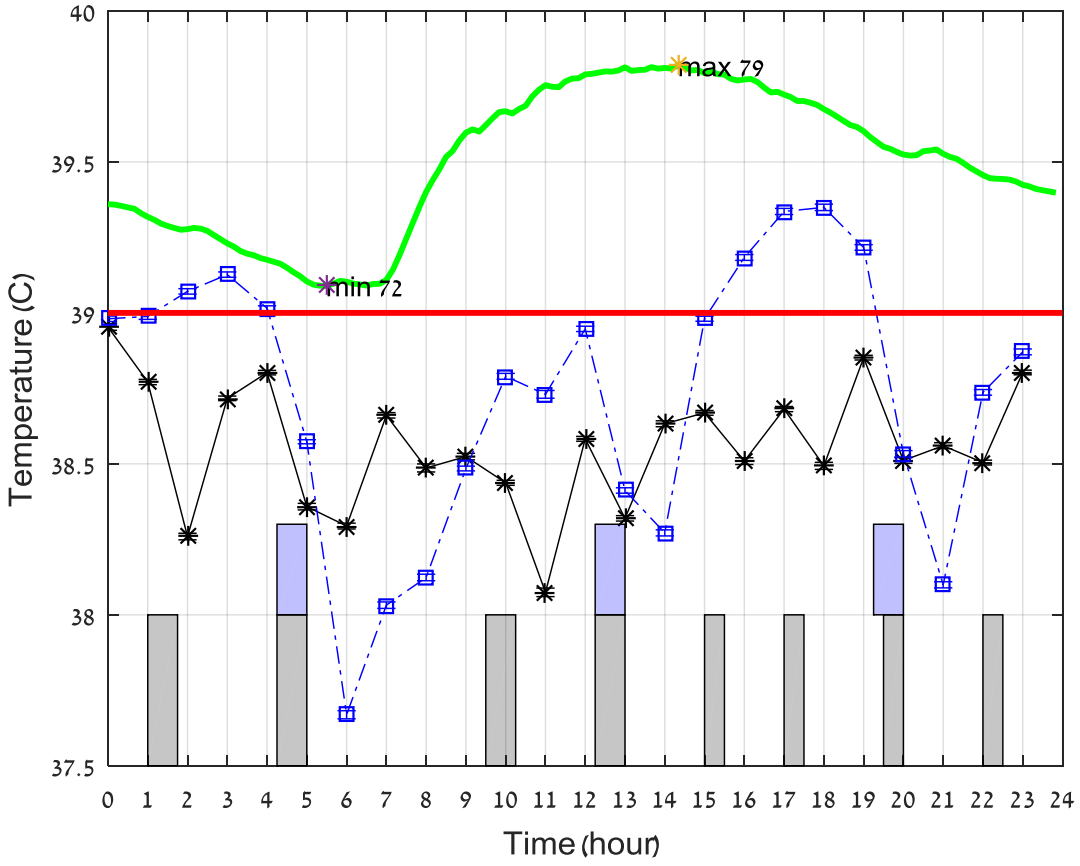
Repeat in **6** cows

Animal response to sensor-based cooling changes (2017)



Black- sensor base
Blue- time base
Green -THI

The preferred sensor-based cooling regime (2017)



Black- sensor base
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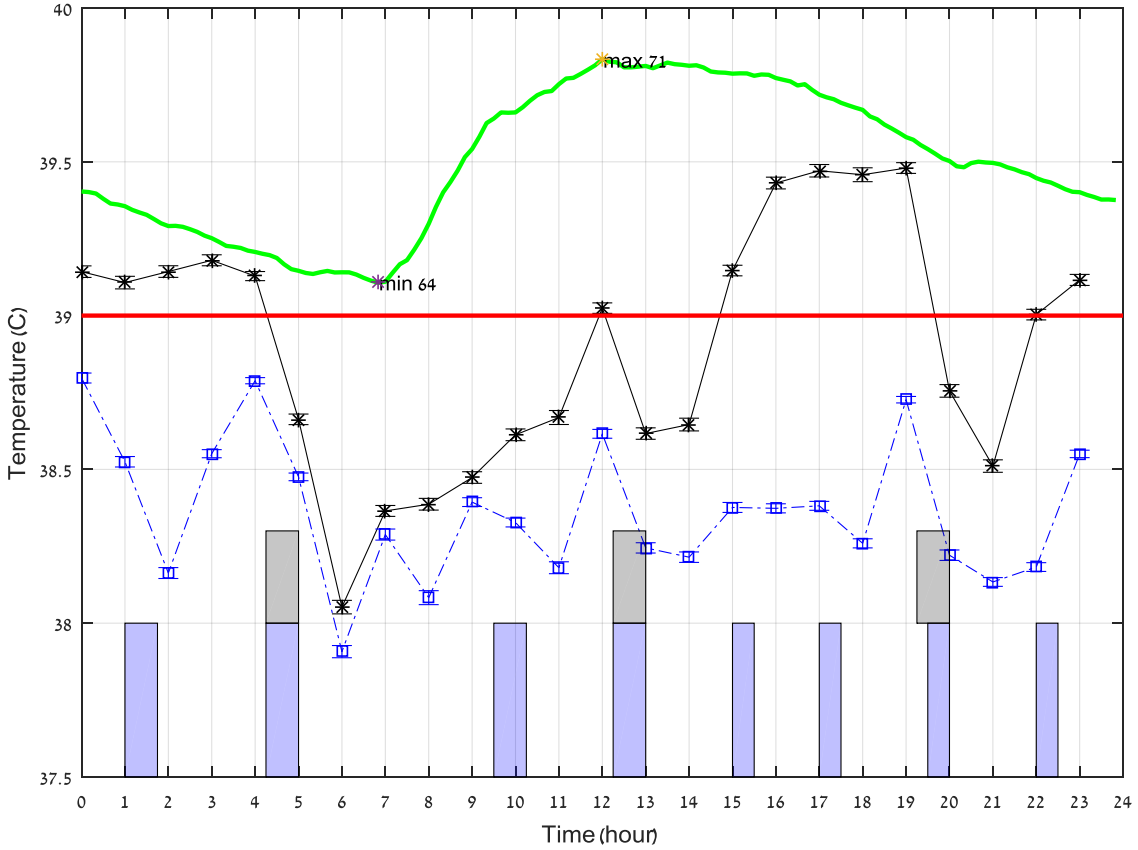
Animal response to crossover experiment (2017)

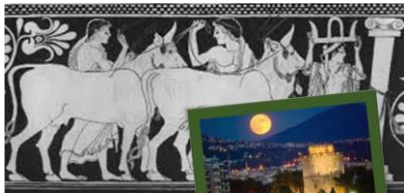


Black- time base
Blue- sensor base
Green -THI

Production performance

	Experiment (Sensor base)	Control (Time base)	SEM	P-Value
Fat (%)	3.65	3.43	0.01	<0.01
Protein (%)	3.23	3.13	0.00	<0.01
ECM (KG/day)	42.84	41.48	0.15	<0.01
FCM 4% (KG/day)	42.76	41.34	0.16	<0.01
Milk (KG/day)	45.33	45.40	0.19	0.67
DIM (days)	149.80	144.99	1.85	0.16
DMI (KG/day)	28.31	26.47	0.11	<0.01

Milk solids (fat, protein) were more affected then the milk volume.



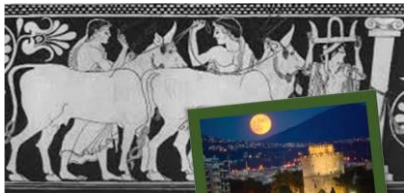
Conclusion Exp. 2017:

1. A sensor based cooling regime results with higher milk solids, and higher feed consumption (DMI).

2. The sensor-based cows changed their eating behavior and consequently their production.

3. The sensor-based cows had better thermoregulation (Av. 38.6^{o}C)

4. The sensor based cooling found to be an effective tool to ease heat stress.



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OptiBarn

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Thanks:

- **This experiment was funded by the EU OptiBarn project and the Israeli Dairy Board.**
- **I thank ARO dairy team for their help.**
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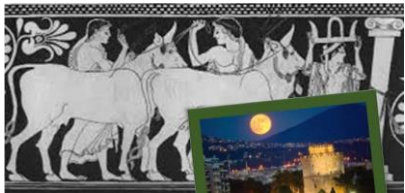
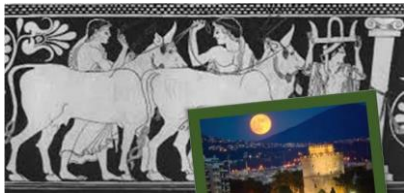
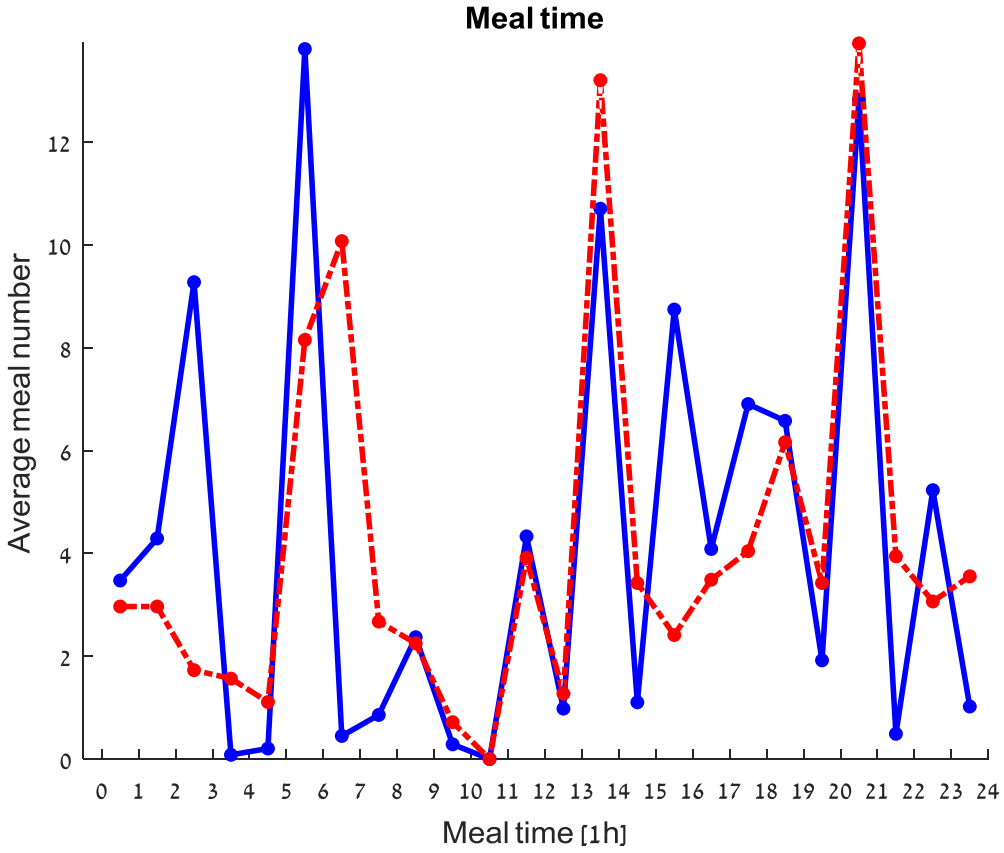


Production performance and Eating behavior

	Experiment (8 cooling)	Control (5 cooling)	SEM	P-Value
N (cows)	20	20		
DIM (days)	112	121.5		0.67
BW (KG)	621.8.84	622.6		0.8
FCM 4% (KG/day)	45.1	44.1	0.21	0.01
DMI (KG/day)	28.3	27.8	0.13	0.07
Time in stall (min./day)	194	188	0	0.06
Meal duration(min./meal)	24.2	23.5	0.0125	0.4
Laying time(min./day)	595	548	2.9	0.001



Meals along the day (group)



Blue- sensor base
Red- time base