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Managing Dairy Cows in an Extreme Warm Environment an Israeli's perspective

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Topics I will talk about:

- Israel climate and dairy industry.
- Cooling cows in Israel.
- How we evaluate the effectiveness of cooling treatment.
- "Successful farm" – "Zeelim" farm, located in the south of Israel.
  (reaching high production and good fertility in the summer).
- The economics of cooling cows in Israel – is it cost effective to invest in cooling the cows ?

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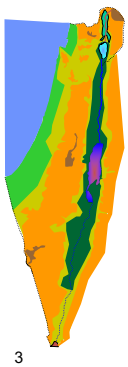
Israel topography and climate



Altitude (meters)

Jordan Valley — 0 - <400

Coastal Plain — 0 - 200; 200 - 400

Mountain Range — 400 - 600; > 600

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Describing climate conditions in USA and Israel

(characterized by hours above threshold - THI 70)

State	Hours above THI 70 (%/year time)	Total hours/year (100% = 8760 h)
Washington	6%	525 h/y
Florida	49%	4,300 h/y
Israel (average)	45%	3,940 h/y
Range	35% - 60%	2,800 – 5,250 h/y

Economic Losses from Heat Stress by US Livestock Industries
St-Pierre et al J. Dairy Sci. 86: (2003).

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Distribution of dairy farm in Israel

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Israel Dairy Sector

- 130,000 "Israeli Holstein" Cows
- Local genetics (85 % of inseminations with local bulls)
- 800 dairy farms (160 coop. and 640 family farms)
- 100% Artificial Insemination
- Most of the farms are "compost barn", with zero grazing
- Participation in DHI - 85% of the cows
- Average milk yield in 2021 - 12,300 Kg (27,100 lib.) per cow/year (3.90% Fat, 3.40% Protein)

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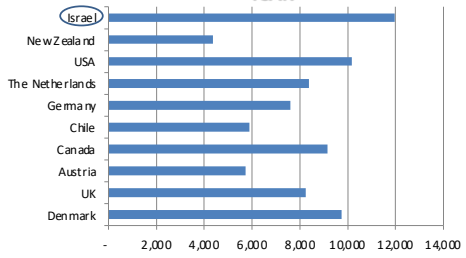
Milk Production in the world (Kg/cow/year) ICAR



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Improving feed efficiency is the main economic factor influencing farm profitability, when mitigating heat stress from the cows in the summer

short and long term effects

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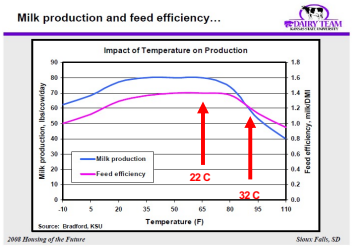
Short term effect

Milk production and feed efficiency…



- 22 ◦C – 1.4 lib. milk/lib. DM
- 32 ◦C - 1.2 lib. milk/lib. DM
- Decrease feed efficiency by 15%

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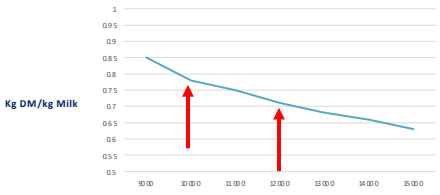
Long term effect, by increasing per cow annual production

(results from a survey realized in 40 Israeli dairy farms along 20 years)



- 10,000 kg - 0.78 kg DM/Kg milk (0.35 lib.)
- 12,000 kg - 0.70 kg DM/Kg milk (0.31 lib.)
- Improved feed efficiency by 10 %

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Means for mitigating heat stress

- Prevent direct and indirect solar radiation (shades)
- Direct cooling **(cooling the animal)**
  - Wetting
  - Forced Ventilation
  - Combination of wetting and ventilation
- Indirect cooling **(cooling the environment)**
  - High pressure fogging (Tunnel ventilation)
  - Evaporative panels (Tunnel and Cross ventilation)

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The sites for cooling the cows

- "Waiting yard" (before and between milking sessions)
- "Special cooling yard" (between milking sessions, mostly in large scale farms)
- "Feeding line" (after and between milking sessions)
- * "Resting area" (during resting time)

* - Use only forced ventilation

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Cooling in waiting yard

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Cooling in feed line

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Effect of intensive cooling on cow's body temperature

(cows averaging 25 kg/cow/day)

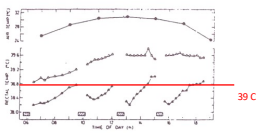

Figure 4. Daytime changes in rectal temperature (temp) when cows were kept in the shade or kept in the shade and cooled five times per day for 30 min; ○, shaded only; ●, shaded and cooled five times per day.

Journal of Dairy Science Vol. 69, No. 12, 1986

Flamenbaum et al , Journal of Dairy Science Vol 69:314, 1986

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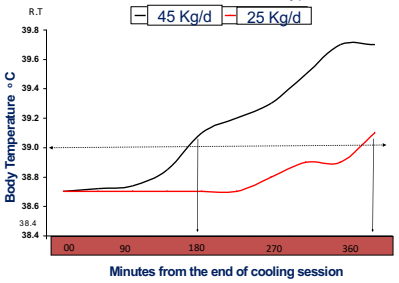
How frequently we need to cool the cows ?

Body temperature after intensive cooling session in cows with different daily production



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J. Dairy Sci. 95:3736–3742
http://dx.doi.org/10.3168/jds.2011-5054

Performance and welfare of high-yielding dairy cows subjected to 5 or 8 cooling sessions daily under hot and humid climate

H. Honig, J. Miron, H. Lehrer, S. Jackoby, M. Zachut, A. Zinou, Y. Portnick, and U. Moallem[1]
Department of Ruminant Science, Institute of Animal Sciences, the Volcani Center, PO Box 6, Bet-Dagan, 50250 Israel

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Table 4. Resting and standing time measurements

Item	Treatment[1] 5CS	8CS	SEM	*P*-value
Cooling time, min/d	225	360		
Lying time, min				
Session 1[2]	254.4	251.2	5.0	0.15
Session 2[3]	111.1	122.3	4.2	<0.001
Session 3[4]	113.1	115.8	4.2	0.15
Total lying time, min/d	474.5	484.4	10.9	0.004
Activity time, min				
Session 1[2]	65.6	81.3	2.2	<0.001
Session 2[3]	87.1	99.8	2.3	<0.001
Session 3[4]	94.3	109.9	2.4	<0.001
Total activity time, min/d	131.7	148.8	4.2	<0.001
Standing time,[5] min/d	833.8	806.8	10.4	<0.001
Lying bouts[6]	11.9	11.9	0.32	<0.001

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Table 3. Rumination time, rectal temperature, and respiratory rate measurements

Item	Treatment[1] 5CS	8CS	SEM	*P*-value
Rumination time, min/d	409.6	440.1	8.4	<0.001
Rumination time/DMI, min/kg	16.6	16.5	0.41	0.02
Rumination time/NDF intake, min/kg	98.9	97.0	2.4	0.02
Respiratory rate, breaths/min				
Morning	54.6	49.1	1.12	<0.001
Afternoon	83.0	50.0	1.44	0.001
Rectal temperature, °C				
Morning: 0630 h	38.51	38.35	0.04	<0.001
Afternoon: 1530 h	39.30	38.22	0.05	<0.001

[1]Dairy cows under heat load were exposed to either 5 or 8 cooling sessions per day (designated 5CS or 8CS, respectively) in the holding area. Each cooling period lasted 45 min, comprising cycles of 30 s of showering and 4.5 min of ventilation.

Journal of Dairy Science Vol. 95 No. 7, 2012

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Table 2. Least squares means of DM and energy intakes, milk and milk solids yields, energy output in milk, and energy balance and efficiency

Item	Treatment[1] 5CS	8CS	SEM	*P*-value
DMI, kg/d	24.7	27.0	0.32	<0.001
NE_L intake, Mcal/d	44.6	48.0	0.58	<0.001
Milk yield				
Milk, kg/d	36.6	40.1	0.92	<0.001
Milk energy output, Mcal/d	29.9	33.1	0.44	<0.001
FCM (4%), kg/d	32.4	36.0	0.64	<0.001
Milk solids contents and yields				
Fat, %	3.35	3.37	0.09	0.71
Protein, %	3.15	3.15	0.04	0.80
Lactose, %	4.71	4.76	0.03	0.009
TS, %	11.2	11.3	0.12	0.24
Fat, kg/d	1.19	1.32	0.03	<0.001
Protein, kg/d	1.12	1.25	0.02	<0.001
Lactose, kg/d	1.70	1.91	0.05	<0.001
SCC ($\times 10^3$)	182.0	113.0	56.0	0.11
Efficiency and energy balance				
Milk/DM, kg/kg	1.49	1.50	0.039	0.54
Energy balance, Mcal/d	8.9	10.0	0.53	<0.001

[1]Dairy cows under heat load were exposed to 5 or 8 cooling sessions per day (designated 5CS and 8CS, respectively) in the holding area. Each cooling period lasted 45 min, comprising cycles of 30 s of showering and 4.5 min of ventilation.

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Common cooling protocol in Israeli dairy farms

1. **Forced ventilation (wind speed of 3 m/sec).**
2. **Cycles of 30 - 60 seconds wetting every 5 minutes, when fans operating continuously.**
3. **"Cooing sessions" of 45 - 60 minutes each.**
4. **6 cumulative hours of "Cooling time" per day.**
5. **Cooling provided every 4 hours.**
6. **Dry cows are cooled for 4-6 cooling sessions of 30 minutes each**

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Evaluating the effectiveness of cooling treatment

Long term – by using S:W ratio index

Short term – by monitoring cow's vaginal temperature

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The "summer : winter ratio index"

(developed in collaboration with Israel Cattle Breeders Association DHI)

comparing cow's productive and reproductive parameters, between : summer (Jul. – Sep.) and winter (Jan. – Mar.)

A ratio close to 1.0, means that farm is **"successful"** in cooling the cows in the summer

A ratio below 0.9, means that farm is **"failing"** to cool the cows in the summer

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Summer : winter ratio in Israeli dairy farms (sort by milk S:W ratio)

(comparing farms which are "successful" in cooling" their cows, to those "failing" to do it)

Parameter / Type of farm	"successful" farms	Average cooperative farms	"failing" farms
Winter milk productuin (kg/cow/day)	39.8	38.3	39.4
Summer milk productuin (kg/cow/day)	39.4	36.4	34.7
Summer : wintwer ratio (Milk)	0.99	0.95	0.88
Conception Rate in winter (%)	44.4%	42.7%	42.9%
Conception Rate in summer (%)	33.8%	20.0%	14.3%
Difference in CR W-S, in percentage units	-11	-23	-29
Farms	10	162	10

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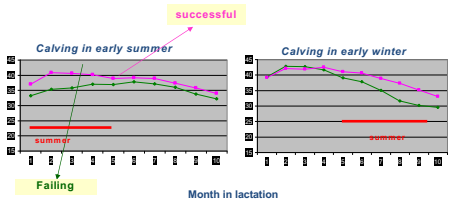
Lactation curves of "successful" and "failing" farms

Flamenbaum & Ezra - Hoard's Dairyman- August 10, 2009



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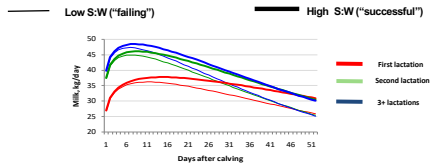
Lactation curves of cows in herds with different S:W ratio

De Vries, Flamenbaum and Ezra 2009, H.S Memorial conference , Israel



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Annual milk production, 2009 Vs 2021

Year	"failing" farms	"successful" farms	Diff. (kg)	Change (%)
2009	11,080	11,800	720	6.5 %
2021	12,100	13,100	1000	8.3 %

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J. Dairy Sci. 102
https://doi.org/10.3168/jds.2018-16170

Comparing dairy farm milk yield and components, somatic cell score, and reproductive performance among United States regions using summer to winter ratios

Jenna M. Guinn,[1] D. T. Nolan,[1] P. D. Krawczel,[2] C. S. Petersson-Wolfe,[3] G. M. Pighetti,[2] A. E. Stone,[1,4] S. H. Ward,[4,5] J. M. Bewley,[6] and Joao H. C. Costa[1*]
[1]Department of Animal and Food Sciences, University of Kentucky, Lexington 40506
[2]Department of Animal Science, University of Tennessee, Knoxville 37996
[3]Department of Dairy Science, Virginia Polytechnic Institute and State University, Blacksburg 24061
[4]Department of Animal and Dairy Science, Mississippi State University, Starkville 39759
[5]Department of Animal Science, North Carolina State University, Raleigh 27607
[6]Alltech, Nicholasville, KY 40356

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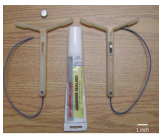
Monitoring cow's body temperature by using intra vaginal data loggers

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"Cooling quality"
(Accumulated hours where body temperature is above thresholds)
(a survey in 12 dairy farms, 36 cows monitores per farm)

Parameter	Short time above threshold	Middle time above threshold	Long time above threshold
Hours > 39.2 C	4.3	6.3	9.2
Range of hours > 39.2 C	1.8 – 5. 0	5.9 – 6.5	7.9 – 10.4
Summer CR in first insemination (%)	43	32	30
Summer CR in all inseminations (%)	33	26	21
Diff. W-S all inseminations (% units)	- 12	- 17	- 20
S:W Milk production ratio	0.96	0.94	0.90

Gershon et. al - Israel Annual Dairy Conference – Jerusalem 2018

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"Zeelim" dairy farm in the warm south of Israel

highly "Successful" in cooling the cows in the summer

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Zeelim dairy farm location

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About Zeelim Dairy farm

- **350 Israeli-Holstein cows in milk**
- **Cows milked 3 times/day, where each milking session last for 4 hours.**
- **Farm 305 days production data in 2021:**

  (Numbers taken from Israel Cattle Breeders Association ICBA milk recording system)
- **Milk yield/cow (kg) – 14,600 kg (32,500 lib.)**
- **ECM (Economic Corrected Milk) – 15,034 kg (33,500 lib.)**
- **Milk Fat - 3.85%**
- **Milk Protein - 3.45 %**
- **SCC content – 180,000**

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General view of Zeelim dairy farm

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Summer management

- Walkways shaded, using plastic nets
- Water troughs located inside barns, in walkways and waiting/cooling yards (> 30 cm space per cow)
- Waiting/cooling yards space (2 square meters/cow)
- Feed distributed 3 times per day, and "pushed" every hour, 24/7
- The cows are cooled in waiting/cooling yard before each milking session (a total of 3 h).
- 3 more cooling sessions provided in the waiting/cooling yard, between milking sessions (3h).
- Feed line Fans + misters operated by "detecting sensors" 24/7, according to cows presence.

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Shade and water troughs in walkways

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Feed line cooling by 22" fans, installed 6 meters apart
4 misters (14X4 lit/h) in front of each fan

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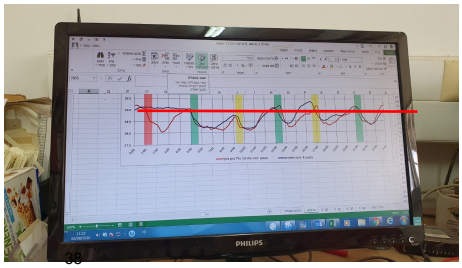
intra vaginal data loggers information downloaded to farm computer
Cow below 39.0 C, almost all day time during all summer



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S:W ratio, Zeelim dairy farm Vs all Israeli farms (2021)

	"Zeelim" farm	All coop farms (162)
Average summer milk (kg/cow/d) -	48.8 (107 lib.)	38.3 (84 lib.)
S:W Milk ratio –	0.99	0.94
S:W Peak lactation ratio -	0.98	0.94
S:W SCC (000) –	0.80	1.13
CR Winter (%) –	37%	36 %
CR Summer (%) –	34%	21 %

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Calculating the cost effectiveness of investing in the implementation of cow cooling system – the case of Israel

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A special software for calculation of the cost-effectiveness of investing in cooling the cows in the summer - Israel 2021 (in US$)

cost effectivness of cooling cows

			non cooled	cooled	
5.0%	expected increase production		5,000,000	5,250,000	farm anual prod
5%	expected improve feed efficiency		10,000	10,500.0	prod. Cow/year
500	number of cows in herd		500	500	cows inherd
			684,000	660,000	DM maint. Summe
			1,347,500	1,347,500	DM maint. Winter
		24,000	2,031,500	2,007,500	total DM
11.00	DM maintenance cooled		0.40	0.40	DM liter winter
11.40	DM maintenance non cooled		0.42	0.40	DM liter summer
		-67,123	2,032,877	2,100,000	total DM productio
120.00	summer days	-43,123	4,064,377	4,107,500	Total DM
245.00	winter days		0.813	0.782	Feed efficiency
0.40	cost 1 kg DM	-17,249	1,625,751	1,643,000	cost of feeding
		$/cow		80	amort+interest
	cost of cooling	$	-40,127		total payback
500	investment in equipment	$	-25,000		Elec/water/labor
	years payback				
3%	interest				
			162,500	3,250,000	3,412,500 total farm income
50	electricity, water, labor				
0.65	milk price farm gate		80,124		Total farm profit
			160		Total profit/cow

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The potential increase in per cow annual income in different implementation scenarios

- **New farm - Investing in equipment and in proper operation of cooling system:**
  - Increase 5% production and 5% feed efficiency - + 160 US$
  - Increase 10% production and 5% feed efficiency - + 400 US$
- **Existing farm - Investing only in proper operation of cooling system (equipment already existing):**
  - Increase 5% production and 5% feed efficiency - + 240 US$
  - Increase 10% production and 5% feed efficiency - + 485 US$
- **Investing in equipment and operation without reaching results -** - 85 US$

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In conclusion

The Israeli experience teaches us that:

1. Proper installation and operation of cooling system can eliminate completely the summer decline in milk production and significantly reduce summer decline in cow's fertility.
2. These results can be reached also in extremely warm climate conditions and with cows of very high production potential.
3. Investing in cow cooling, is one of the most profitable investments a farmer can do, but with the condition that cooling system is installed and operated properly !!!

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Thanks for your attention

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