Cooling cows in robotic dairy farms

The case of Bandioli farm, Italy

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Cooling means to reduce heat stress from cows have been developed over the last four decades in Israel and around the world, and are applied to a different degree of success in many farms in the world.

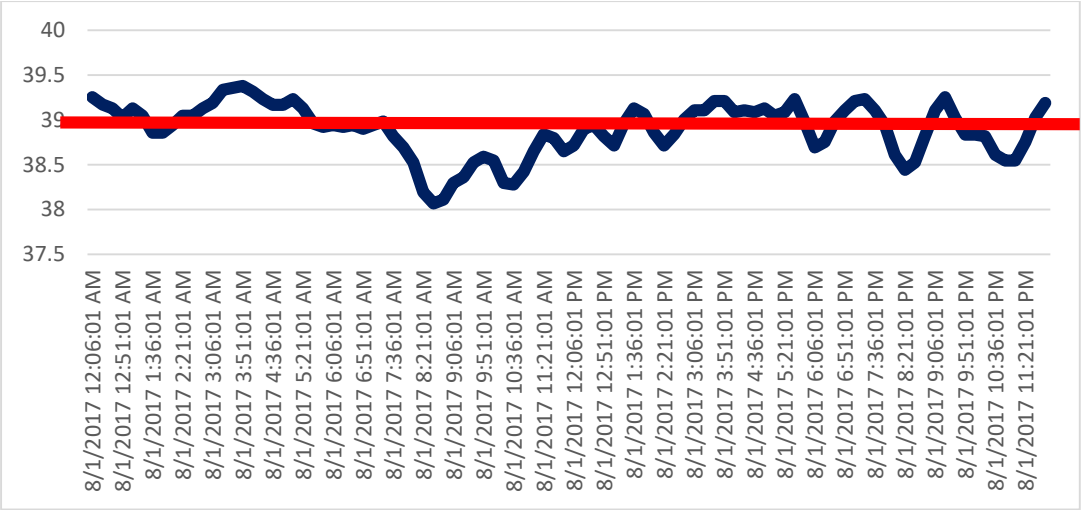
Cooling cows in the farm is based largely on the daily routine, which includes cooling the cows in the waiting yards before and between milking sessions, as well as in the feeding line, around feeding time.
In farms with robotic milking, there are no milking hours defined, and each cow is milked and eat at different hours during the day.
In the spring of 2016, I was invited to consult on heat stress relief, a robot dairy farm belonging to the Bandioli family and located near the town of Mantova, north Italy. The farm is located in a warm and humid region, with almost 4 months per year where cows suffer heat stress in all or great part of the day. The farm contains of 500 high-yielding cows, which are housed in a free stall barns and milked by eight milking robots.

The cooling treatment provided to the cows before my arrival was mainly forced ventilation, operating over the free stalls, provided by ceiling and side fans, as well as small number of fans that operated in combination with sprinklers, in the feed line. In tests I conducted during my visit, I found that the quality of wetting and force ventilation speed did not meet the requirements. Since my visit was held near the beginning of the summer, it was agreed that the improvement of cooling in the summer of 2016 will focus on improving the existing cooling treatment given to the cows, by increasing wind speed and improvement of wetting means. Also, an "operation protocol" was elaborated with farm manager, adapting the cooling treatment to special farm conditions.

The cooling management introduced in the summer of 2016 contributed to an improvement in the performance of the cows, so we estimated that the improvement in cow's performance was not the maximum that can be reached. Following the positive response of the cooling introduced in summer of 2016, farm owners decided to improve the cooling treatment given to the cows by adding wetting and forced ventilation means in the feeding areas, in front of the milking robots and in the feed line. Cooling was operated at all cooling sites at all hours of the day, including at night.

In order to evaluate the effectiveness of the cooling treatment given to the cows, the vaginal temperature of a random sample of cows was monitored, making use of intra vaginal data loggers, inserted to cow's vagina, attached to CIDR devices.
Temperature was monitored every 10 minutes, and daily graph was drawn, as can be seen in figure 1.

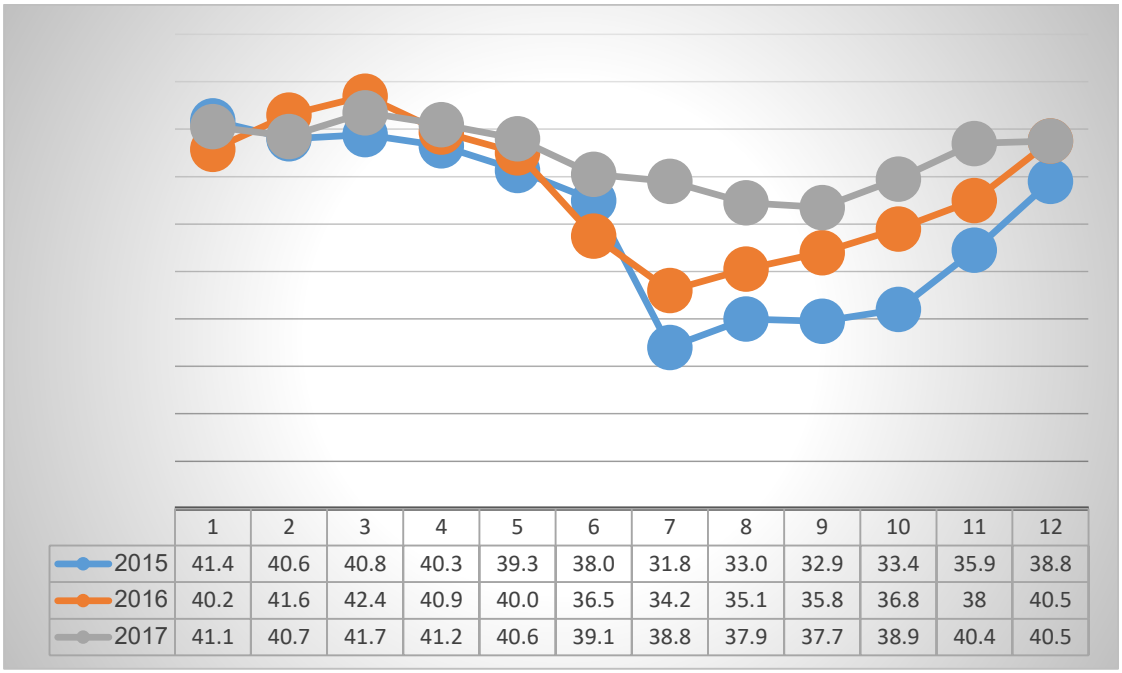
Figure 1 – Vaginal temperature C, of 10 milking cows in Bandioli farm, monitored every 10 minutes, in typical summer days in August, in summer 2017.



As can be seen in figure 1, cow's average body temperature of the cows was maintained most of the day below 39, considered as threshold for normal body temperature, and didn't exceed 39.5 C, along all day time.

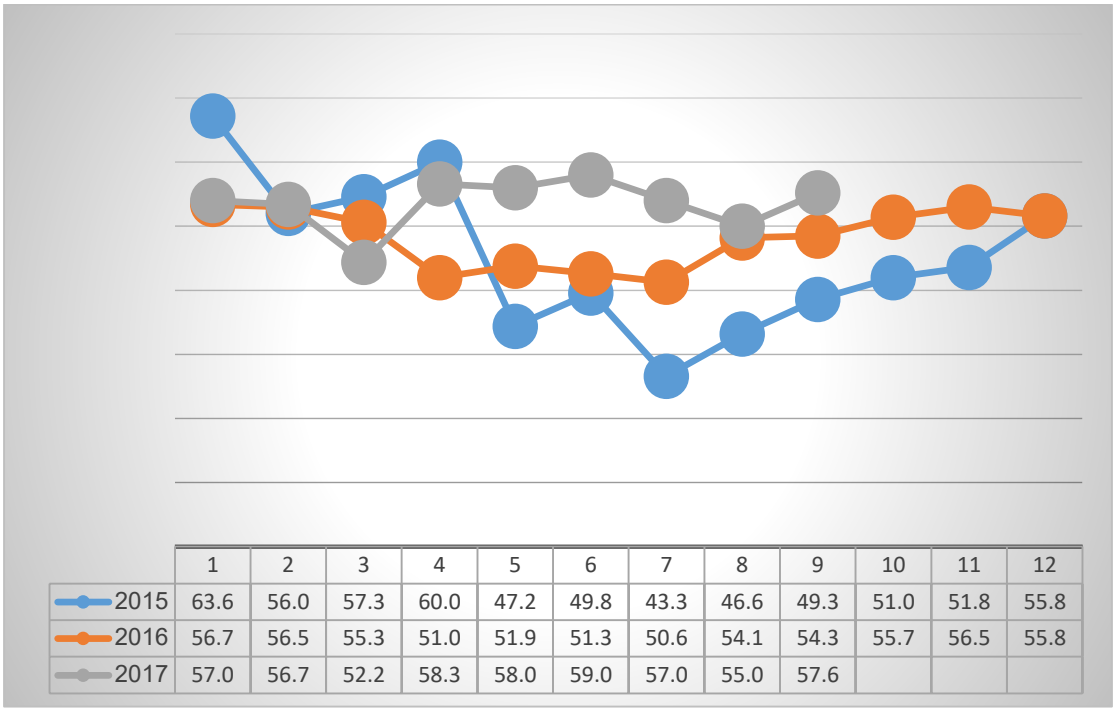
The effect of cooling on cow's performance, in 2015, before we start working on cooling improvement, 2016 with partial cooling and 2017, with complete cooling treatment are presented in figures 2 - 4.

Figure 2 - Average daily milk yield of all cows in the herd (lit/day), in different months of 2015 (before staring intensive cooling), 2016 (with partial cooling) and 2017 (with maximum cooling).



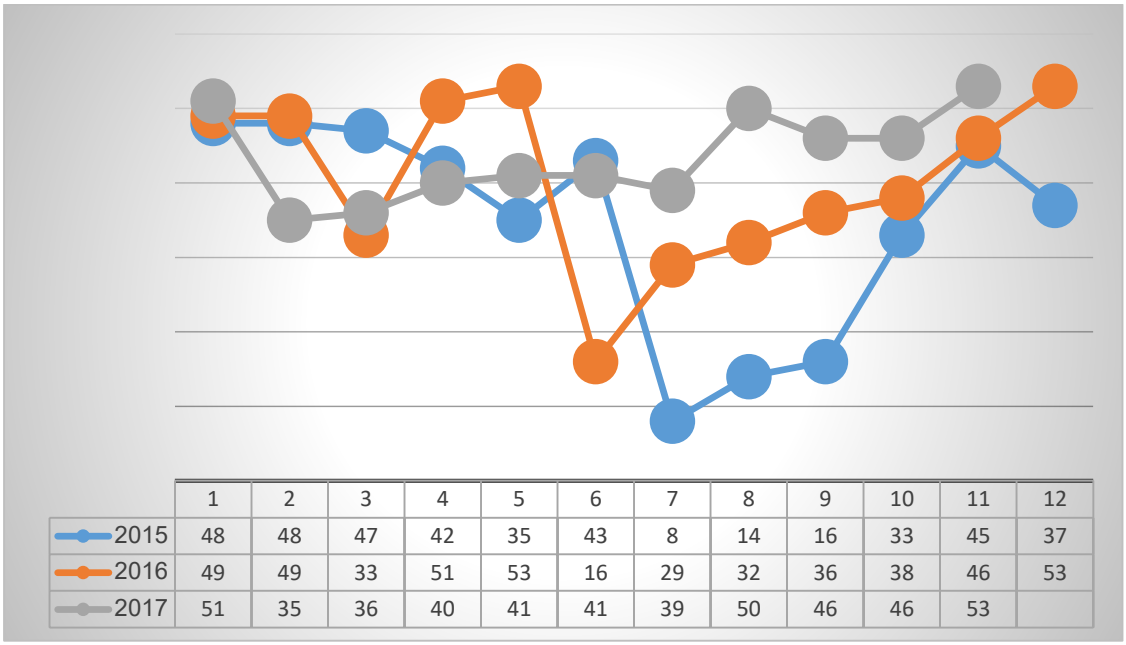
	1	2	3	4	5	6	7	8	9	10	11	12
2015	41.4	40.6	40.8	40.3	39.3	38.0	31.8	33.0	32.9	33.4	35.9	38.8
2016	40.2	41.6	42.4	40.9	40.0	36.5	34.2	35.1	35.8	36.8	38	40.5
2017	41.1	40.7	41.7	41.2	40.6	39.1	38.8	37.9	37.7	38.9	40.4	40.5

Figure 3 - Average daily peak yield of adult cows (lit/day), in different months, in 2015 (before starting intensive cooling), 2016 (with partial cooling), and 2017 (with maximum cooling).



	1	2	3	4	5	6	7	8	9	10	11	12
2015	63.6	56.0	57.3	60.0	47.2	49.8	43.3	46.6	49.3	51.0	51.8	55.8
2016	56.7	56.5	55.3	51.0	51.9	51.3	50.6	54.1	54.3	55.7	56.5	55.8
2017	57.0	56.7	52.2	58.3	58.0	59.0	57.0	55.0	57.6			

Figure 4 – Conception Rate (%), of adult cows, inseminated in different months, in 2015 (before starting intensive cooling), 2016 (with partial cooling) and 2017 (with maximum cooling).



	1	2	3	4	5	6	7	8	9	10	11	12
2015	48	48	47	42	35	43	8	14	16	33	45	37
2016	49	49	33	51	53	16	29	32	36	38	46	53
2017	51	35	36	40	41	41	39	50	46	46	53	

The information described in Figures 2 through 4 clearly shows the gradual improvement in cow's performance during the summer due to the improvement in cooling intensity in summers 2016 and 2017. The average daily milk production per cow was similar during the winter and spring months (January-May), in the 3 years studied. As of June, a gap began to open between the 3 years, reaching a difference of 5 to 8 liters per day in summer 2017, with complete cooling, as compared to summer 2015, before beginning the intensive cooling). A similar picture is obtained for peak lactation of adult cows, with 10 liters per day higher in peak lactations reached in summer 2017, as compared to summer 2015, before intensive cooling started.

Especially impressive was cooling effect on conception rate in the summer. Unlike summer of 2015, when the conception rate fell to less than 15 percent in inseminations given in the summer, the conception rate in summer 2017 was more than 40 percent, near 25 percentage units higher than summer of 2015, almost with no difference from conception rates reached in winter months of that year.

The results obtained during the last two summers in the Bandioli farm confirm that, by continuously activating the cooling systems in all "cooling sites" (combining wetting and forced ventilation in waiting areas in front of the robots and the feeding lines), can significantly improve milk production and fertility during the summer months, reaching levels which are close to those achieved during the winter months.

The special requirements for cooling cows in robot farms (usually, the use of more water and electrical power per cow), brought us to conduct an economical study, making use of a special computer program which I developed recently, in order to evaluate the cost-benefit of investing in cooling the cows, milked by robots. The calculation was based on real result from Bandioli farm, with an increase of 900 liters in the average annual production per cow between 2015 and 2017 (an increase of 7%). I also estimated (based on previous researches) a 5% improvement in "feed efficiency" (feed conversion to milk), in the 120 summer days in the region, and a reduction of an average of 5 "open days" in calving interval, due to the improvement in cow's summer fertility, with an estimated value of 5 euros for every "open day". Milk price to the farm was of 0.42 euros and the food price of 0.24 euros per kilogram dry matter (DM) of milking cows mix. The total investment in purchasing farm cooling equipment was of 400 Euro per cow, and operation cost of the cooling system (mainly electricity), was of 40 Euros per cow per summer.

The operation of cooling system, as given in the Bandioli dairy farm, contributed to an additional annual net income (after covering all the expenses) of 245 euros per cow, and 120,000 euros per farm.

It can be concluded that the "mode of operation" of cooling in Bandioli robotic farms, characterized as "voluntary cooling" of the cows, enables a significant improvement in cow's performance in the summer and, although the obligation for "all day operation" of cooling system in all cooling sites and all daytime, and the high cost of operation resulting from that, the significant improvement in cow's performance, as reached in the "Bandioli study", justify the high investment and allow reaching a significant increase in farm profitability.