Australian Government
Department of Agriculture and Water Resources

AUSTRALIAN Pork

Providing chilled drinking water to lactating sows using a modified milk vat

Final Report
APL Project 2006/2154

July 2007

Department of Primary Industries and Fisheries
Sara Willis and Gary Collman
PO Box 102
Toowoomba QLD 4350

Acknowledgements

This project is supported by funding from Australian Pork Limited and the Department of Agriculture and Water Resources. The technical assistance from the management and staff at UQ Gatton Piggery is gratefully acknowledged.

Table of Contents

List of Tables

List of Figures

1 Background to Research

It is generally recognised by the pork industry that the higher the body weight of a piglet at weaning, whatever its age, the higher the growth rate will be thereafter; with less time taken to slaughter. The primary determinant of piglet growth rate and hence weaning weight is the milk yield of the sow.

High ambient air temperatures have a direct effect on feed intake, milk yield, and the growth rate of piglets (Black et al., 1993; Mullan et al., 1992), therefore reducing heat stress can be beneficial to the performance of both sows and their litters. Attempts are made by producers to reduce the effects of heat stress by drip cooling, building insulation, fan ventilation and diet modification, yet little consideration is given to the temperature of the water offered to sows. Producers mistakenly assume that if nipple drinkers are provided, sows have access to water 24hr/day and must be drinking whatever they require.

For optimum performance, Kruger et al. (1992) recommended that drinking water for pigs should be below 20°C. Recordings of drinking water temperature taken on piggeries during the 2003/2004 summer showed temperatures to be as high as 40oC (Willis and Collman, 2004).

A previous project using water coolers to provide cooled water to lactating sows (1800.70) showed a positive association between water temperature, water intake, feed intake and weaner weight gain, even though the coolers had difficulty maintaining water temperature around 20°C when the inlet temperature was above 30°C. The use of a modified milk vat is considered to be a more economic and effective commercial tool for maintaining a constant temperature.

2 Objectives of the Research Project

The objectives of this project were to:

1. verify that the performance of lactating sows and their litters can be improved by providing cooled drinking water during the summer period
2. provide producers with a cost benefit analysis and recommendations for using a milk vat to supply cooled water

3 Introductory Technical Information

Water temperature is rarely considered even though it could result in sows consuming less water and eating less feed. It is assumed that sows with access to water 24hr/day must be drinking what they need.

However, this is not necessarily true. Cargill (2002) found a positive correlation between air temperature and water intake when the water temperature was 21°C, but a negative correlation between air temperature and water intake when the water temperature was 33°C. Based on these data it appears that as air temperature increases, water intake with warm water decreases and water intake with cooler water increases. In other words, sows may be similar to humans and prefer warm drinks when it is cold and cool drinks when it is hot.

High drinking water temperatures would be expected to lead to sows eating less and producing less milk for the litter: resulting in lower weaning weights and possibly higher preweaning mortality rates. Furthermore, inadequate feed intake during lactation could also result in the deterioration of the sow's body condition.

Recordings of drinking water temperature taken at the University of Queensland Gatton piggery during Jan/Feb 2007 were as high as 36°C in the farrowing shed even though it has sandwich panel insulation and white PVC water lines located approximately 0.5 m below the roof.

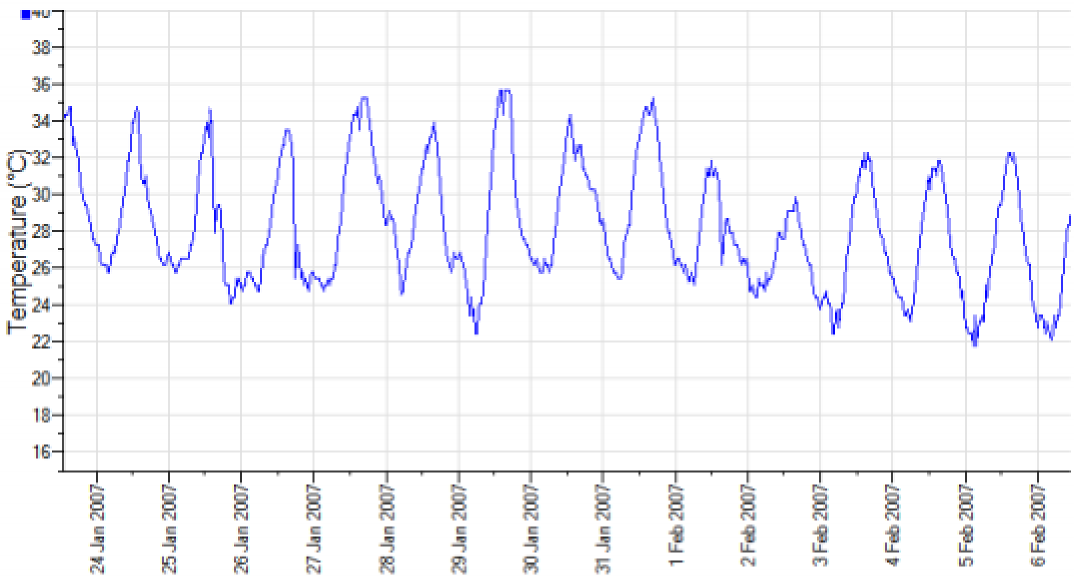

Figure 1 The water temperature recorded in the farrowing shed at the University of Queensland's Gatton piggery during late January and early February 2007

4 Research Methodology

The project was conducted at the University of Queensland's Gatton piggery, a high health status herd during the summer of 2006-2007 (December 2006 to March 2007).

The project involved 108 multiparous sows and their litters. There were 3 replications of 2 treatments (18 sows/treatment): one with drinking water cooled to 20°C and the other with the standard shed drinking water (uncooled). Treatments were randomly applied to pens (Figure 2) and then approximately 7 days prior to farrowing, sows were randomly allocated to one of the two treatments. The average parity for each treatment group was 3.6.

Sows were fed ad libitum with a mash diet from 5 days after farrowing. Refusals were removed and weighed to determine individual sow feed intake. Weight and size of litters were recorded post-fostering (2 days after farrowing) and at weaning (average age of 24 days). Sow bodyweight was recorded and backfat thickness determined at the P2 position (65 mm off the mid line at the level of the last rib) by a RENCO LEANMETER at farrowing and weaning. Oestrus detection was carried out from 3 days after weaning and days to mating recorded. The data were analysed by ANOVA analysis.

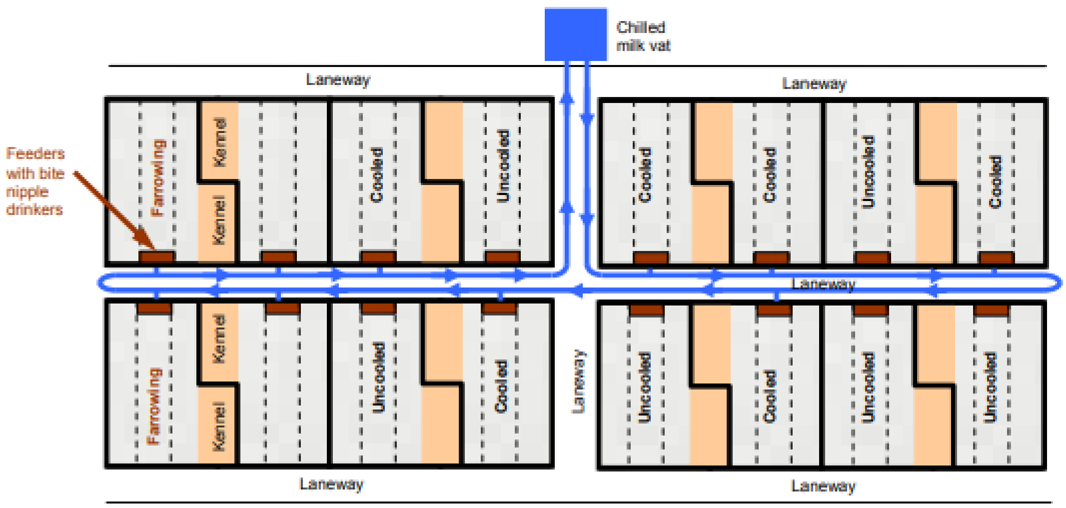

Figure 2 Trial design for distributing cooled water to farrowing pens

Sows were provided with either the standard shed drinking water, or cooled water (20°C) through nipple drinkers in the feeder. Cooled water was supplied by a mobile water chiller unit, developed from a second hand 1600L milk vat with a new refrigeration unit (Figure 3). It had a 3 phase power plug ready to connect into the existing water line and was mounted on a steel skid frame with lifting hooks for placement at the piggery. This is a complete mobile demonstration unit and will be able to be transported to other piggeries at the end of the trial. This will enable its use on another commercial farm (following appropriate sterilization protocol) next summer to provide extra on-farm information and to assist in promoting the technology.

The unit was connected to the piggery water supply with a float valve connection so that the unit was continually filled. Chilled water was continuously pumped from the vat through the shed and then unused water was returned to the vat. The distance the water circulated was about 100m. The cooled water lines were insulated with SUPA-LON refrigeration insulation (Figure 4).

Figure 3 Mobile water chiller unit

Figure 4 Insulated water lines

Water meters (Figure 5) were installed in 20 pens (10 cooled and 10 uncooled) to record individual water usage for each treatment. Drinking water temperature, ambient air temperature and humidity were recorded using data loggers.

Figure 5 Water meter

Figure 6 Liquid flow sensor

Water demand of selected sows was measured using a liquid flow sensor (Figure 6) placed directly in the water line. The sensor provides a pulsed output proportional to the flow rate. The number of pulses represents the number of litres or part thereof for a 1 second period. A drinking event was represented by flow rates > 55 pulses/sec. This allowed for leaking and dripping water nipples to be ignored. Figure 7 represents a frequency distribution for sows accessing both cooled and uncooled water for a 12 hour period.

5 Results

Sows on chilled water consumed more water but less frequently than sows on uncooled water. The sows receiving the cooled water used the nipple drinkers mainly at the first feeding time (7am) whereas the sows receiving the uncooled water used the drinkers constantly during the day, indicating that they may not have been as content as the sows receiving the cooled water.

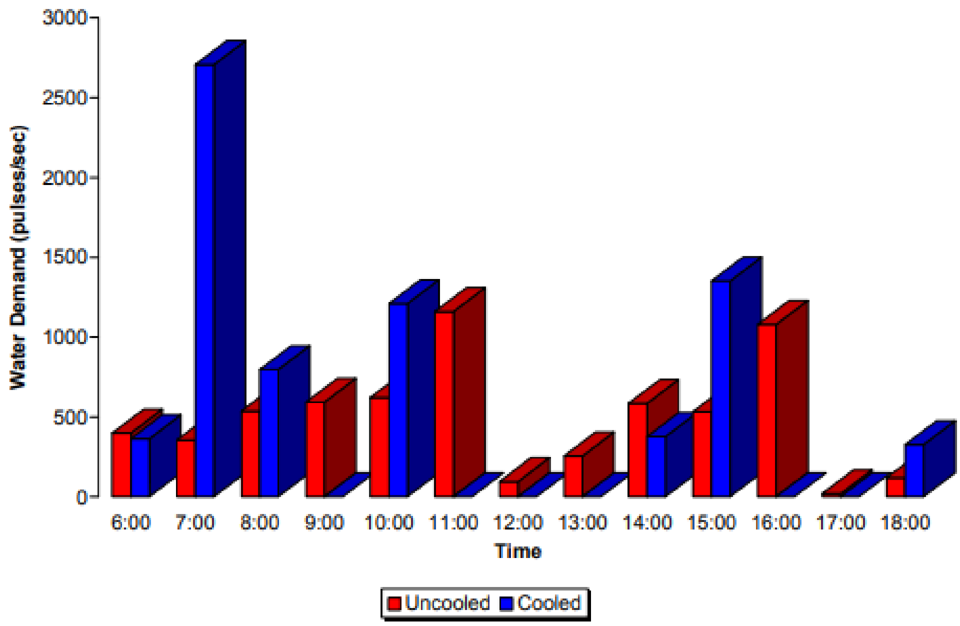

Figure 7 Water demand of selected sows receiving cooled and uncooled water

Throughout the experiment the temperature of the uncooled drinking water was similar to the ambient air temperature (18.3–35.7°C), while the cooled water was reasonably constant at 20°C (18-22°C) (Figure 7).

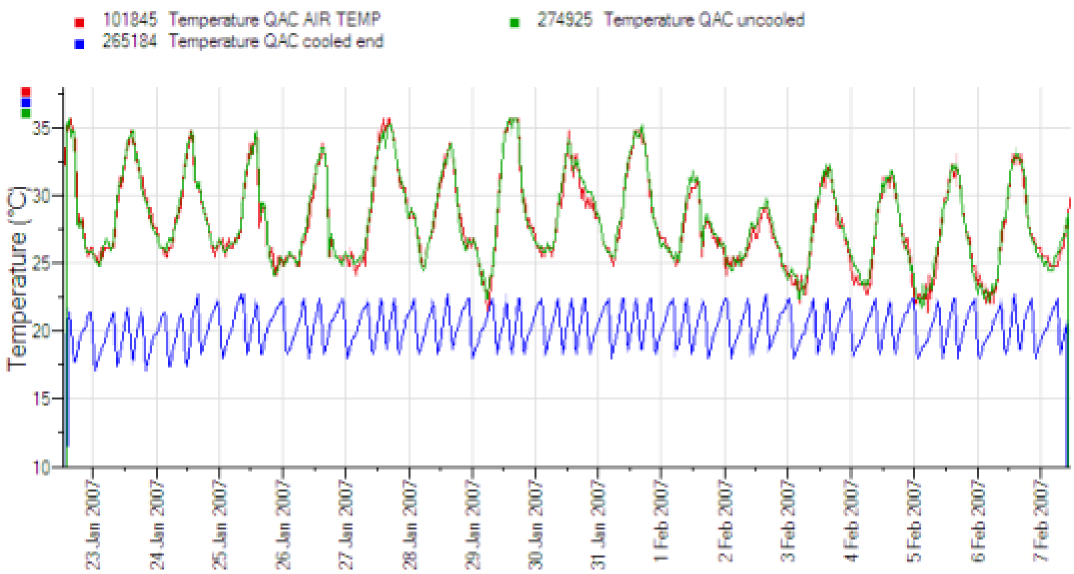

Figure 8 The ambient air temperature and water temperature recorded in the farrowing shed at the University of Queensland's Gatton piggery during late January and early February 2007

Compared to the water coolers used in the previous trial (Project 1800.70), the milk vat was much more successful at providing a constant source of cooled water (Figure 7). Figure 9 shows the variation in temperature experienced during the previous trial due to the coolers being unable to maintain water temperature around 20°C when the inlet temperature moved above 30°C.

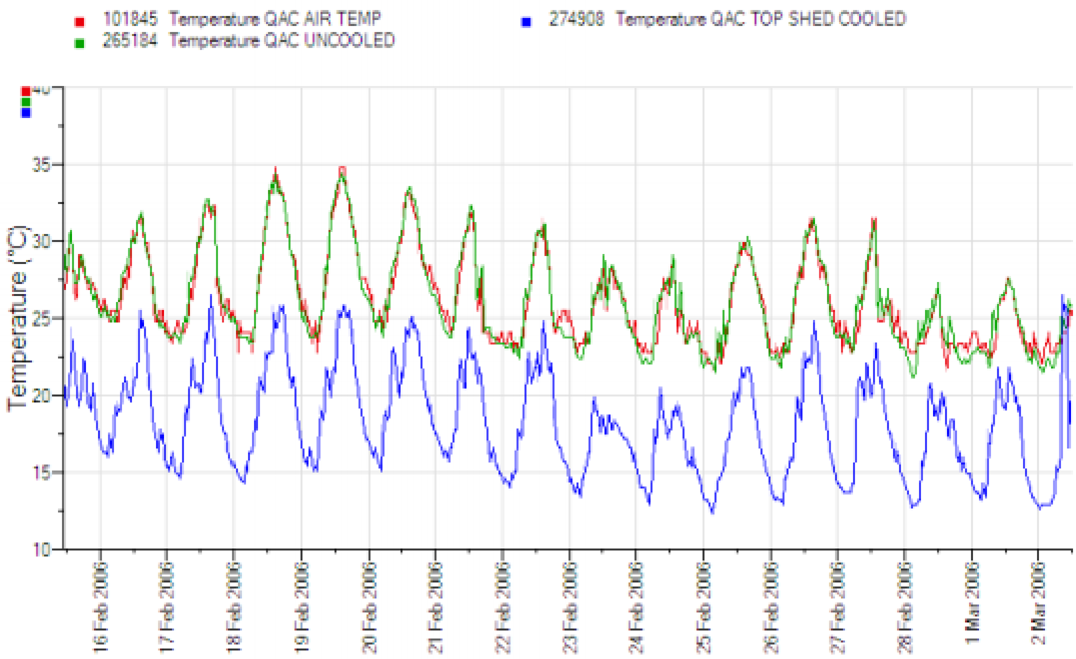

Figure 9 The ambient air temperature and water temperature recorded in the farrowing shed at the University of Queensland's Gatton piggery during late February 2006

The provision of cooled drinking water significantly ($P<0.05$) increased the daily water intake of sows (Table 1). Sows receiving chilled water consumed on average 38.5 L/sow/day while their unchilled counterparts consumed 31.9 L/sow/day.

There was also a significant effect ($P<0.05$) of water temperature on daily lactation feed intake, with the sows receiving chilled water consuming more feed (an increase of 0.252 kg/sow) than those receiving the unchilled water.

Litter size weaned did not differ between treatments, however there was a highly significant difference ($P<0.001$) between treatments on the weight of pigs weaned at 24 days of age and on piglet weight gain ($P<0.05$). Sows receiving the cooled water weaned piglets with an average weaning weight of 8.467 kg, while this receiving the unchilled water weaned piglets with a lower weaning weight (7.76 kg). Sows receiving the chilled water treatment weaned piglets with a significantly higher average weight gain (0.3285 kg/d) compared to those drinking unchilled water (0.3126 kg/d). These differences are probably attributable to the consumption of more feed and water by the sows in the cooled water group. The higher consumption of feed and water most likely resulted in a greater milk yield for these sows.

There was no significant ($P>0.05$) impact of treatment on preweaning mortality.

No differences were found in the loss of P2 bodyfat and body weight among treatment groups (P>0.05). Weaning to re-mating interval was not affected by the temperature of the drinking water.

Table 1 Average reproductive performance, daily lactation water and feed intake and growth performance of piglets in control and cooled drinking water treatments

	Control	**Cooled**	**SED**
No. sows	55	53	
Daily water intake (L/day)	31.9^{a}	38.5^{b}	3.07
Daily sow feed intake (kg/day)	6.08^{a}	6.33^{b}	0.1254
Number of pigs weaned/sow	9.76	9.97	0.247
Piglet weaning weight (kg)	7.76^{a}	8.467^{b}	0.1852
Piglet weight gain	0.3126^{a}	0.3285^{b}	0.00637
Pre-weaning mortality	8.91	8.01	1.827
Sow bodyweight loss farrowing to weaning (kg)	4.4	6.6	2.35
Sow P2 backfat loss farrowing to weaning (mm/sow)	1.76	1.7	0.332
Weaning to re-mating interval (days)	7.12	6.34	1.273

$^{a, b}$ within rows, means with different superscripts are significantly difference (P<0.05).

5.1 Cost benefit

Research has shown that the higher the bodyweight of the piglet at weaning, the higher the growth rate will be thereafter, the less time taken to slaughter and the lower the overall feed consumption (Mahan, 1991).

This project showed that sows provided with cooled drinking water during summer weaned piglets with significantly higher weaning weights and average daily gain compared to those sows receiving uncooled water. The difference in weaning weight of 0.7 kg between the treatments is particularly valuable given the rule of thumb that each 0.1 kg at weaning represents 1 day less to slaughter.

The chiller unit used in this trial was developed from a second hand 1600 l milk vat and refrigerated by a new “high ambient” condensing unit with a digital thermostat control. The cost with all fittings and refrigerant was $5,200. Additional costs included a return line (19 mm polythene pipe) and SUPA-LON insulation, bringing the total cost to $5,500.

Lactating sows need a considerable amount of water to produce the reported 8-16 kg of milk/ day. Daily water consumption is reported to vary from 20 to 40 l/d depending on factors such as ambient air temperature, diet, sow health, housing and stressors in the environment.

If lactating sows fed twice daily have a requirement of 40l/day and 60% of water is consumed within 3-4 hours of feeding (Klopfenstein et al., 1994: Mroz et al., 1995), then the peak load will be 24 l over two feeds or 12 L/feed. As a result, a 1600 l milk vat would be able to service 133 sow places.

A total cost of $5,500 for a 500 sow piggery (i.e. 85 farrowing pens) amounts to a cost of $65/farrowing crate. The AUSPIG model shows that an improvement of 0.7 kg in piglet weaning weight is worth $61/sow/yr and applying this just for the three month summer period is an improvement of $7,625 (Table 2), which would result in the capital costs being paid for in the first year.

Table 2 Performance and corresponding profit improvement from supplying cooled drinking water to sows during the summer months (500 sow piggery)

	Improvement in profit ($/sow/yr)*	**Improvement in profit for summer period ($)***
0.7kg increase in weaning weight	61	7625

*adjusted for the cost of the additional sow feed used (0.25kg/sow/d)

6 Implications & Recommendations

This trial has shown that there is considerable benefit in supplying lactating sows with cooled drinking water (approximately 20°C) in summer to improve the performance of their litters. A modified milk vat is a reliable and cost-effective tool for supplying cooled water.

7 Literature cited

Black, J.L., Mullan, B.P., Lorschy, M.L., and Giles, L.R. (1993). Lactation in the sow during heat stress. Livestock Production Science 35, p. 153-170.

Cargill, C., and Collman, G. (2002). Optimising water intake in pigs. Australian Pork Limited Project No 1615.

Kruger, I., Taylor, G., and Crosling, F. (1992). "Summer Cooling", NSW Agriculture, Tamworth, p. 76.

Mullan, B.P. (1991). The response of the breeding sow to the climatic environment. Manipulating Pig Production 111. Editor E.S. Batterham, Australian Pig Science, Werribee, p.167-177.

Willis, S., and Collman, G. (2005). Managing Water Supply to Pigs, Australian Pork Limited Project Number 1998.

Willis, S., and Collman, G. (2006). The effect of providing chilled water to lactating sows. Australian Pork Limited Project Number 1800.70.