

Heat Lamp Usage by Neonatal Piglets

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ASL-R1394

Summary and Implications

Dynamic heat lamp usage (HLU) of neonatal piglets exposed to 250W, 175W, and 125W heat lamps was measured during four production seasons. The 24-hour HLU patterns were measured at one and two weeks of age for each production season, and expressed as the percentage of litter mates using the heat lamp. HLU was significantly higher ($P < 0.05$) during the day (an overall average of 28%, 31%, and 39% for 250W, 175W, and 125W, respectively) than at night (13%, 24%, and 24%, respectively). HLU declined with increasing piglet age, and the magnitude depended upon the lamp size (from 30% to 11% for 250W, 34% to 22% for 175W and 33% to 30% for 125W). The results suggest that a *variable*, as opposed to a constant, heating source during the lactation period should be used to maximize both piglet comfort and energy utilization efficiency of the heat lamps.

Introduction

Infrared heat lamps of 250W have traditionally been used to provide a constant, localized heat source to piglets from birth to weaning. Recently, smaller wattage heat lamps have been promoted by manufacturers and utility companies to improve energy efficiency and possibly pig comfort (Xin et al., 1996). To evaluate the adequacy of a heat lamp, a study of the piglet thermoregulatory behavior in response to the heat lamp is warranted. For instance, when piglets are subjected to a comfortable heat source, they display normal, or perhaps natural, behavior. Conversely, if the piglets are exposed to an inadequate heating source (hot or cold), their normal behavior would be forced to change to adapt to the less desirable environment.

Harmon and Xin (1995) suggested that piglets at birth should be provided with a 32~35°C (90~95°F) thermal environment and decreased to 30~31°C (86~88°F) at three weeks of age. Morrison et al. (1987) used an operand procedure to monitor the behavior of piglets subjected to 250W infrared heat lamps in a series of environmental temperatures when housed on four types of floors, and found that the piglets showed diurnal variation in heat demand. However, the study used 28-day old nursery pigs. Little information was found that

delineates the behavioral responses of neonatal piglets to different sizes of heat lamps.

The objective of this study was to measure the dynamic heat lamp usage (HLU) behavior of neonatal piglets subjected to 250W, 175W, or 125W heat lamps during the four seasonal production climates. The results were expected to provide insights into development of heat lamp operational strategies and an intelligent controller that would improve both thermal comfort of the piglets and energy use efficiency of the heat lamps.

Materials and Methods

This study was conducted on a 1,100-sow farm located near Ogden, Iowa (Xin et al., 1996). Three identical farrowing rooms, 14 crates per room, were used. Each room was equipped with the radiant heat lamps of 250W, 175W, or 125W. The heat lamps generally were turned on the day before farrowing began and were located in the back of the crates. They were relocated to the front of the crates when the piglets were two days old. The heat lamps were suspended 45 cm. (18 in.) above the floor, which provided a heated area of 50 cm. (20 in.) in diameter. Perforated metal and bare concrete floors were used, respectively, in the back and the front of the crates.

Heat lamp usage (HLU), defined as piglets lying in the heated area, was recorded with programmable photo cameras (Canon model T70 with command back¹) every 20 minutes for a 24-hour period from a randomly selected crate in each room. The measurements were made when the piglets were one week and two weeks old. During each 24-hour recording episode, two cameras were loaded with 36-exposure slide films. The cameras were programmed to take pictures for the first and second 12-hour period, respectively. Light from the heat lamps provided sufficient illumination for the cameras and no flash light was needed. The 20-minute sampling interval was adequate for recording dynamic behaviors of the piglets (Zhou et al., 1996a, Zhou et al., 1996b).

The discrete behavioral photographs were visually examined to determine the number and thus percentage of litter mates utilizing the heat lamps at each observation time. The same behavioral state was assumed to continue until the next observation time (Hull, 1960).

Four farrowing cycles—one cycle per winter, spring, summer, and fall season—were recorded for each type of heat lamp. The data were subjected to analysis of variance and Duncan's multiple mean comparison (SAS, 1994).

¹ Use of company or product names is for presentation clarity and does not imply endorsement by the authors or their affiliation, nor exclusion of other products that may be suitable for the application.

Results and Discussion

Table 1 lists the average HLU as influenced by the heat lamp size, production season, piglet age, and time of the day. Figures 1 to 3 depict the diurnal hourly HLU patterns of 7- and 14-day-old piglets under 250W, 175W, and 125W heat lamps, respectively, during spring season. Figures 4 to 6 show the typical resting patterns of 1-week and 2-week-old piglets subjected to 250W, 175W, and 125W heat lamps, respectively.

The piglets in all cases displayed a circadian pattern in HLU. Specifically, HLU was significantly less ($P < 0.05$) at night (1900 to 0600h, averaging 20% overall) than during the day (0700 to 1800h, averaging 33% overall). The reduced nocturnal HLU found in this study agreed with the results from Baldwin and Ingram (1968) and Curtis and Morris (1982) who reported that piglets housed in groups rarely turned on a heat source at night. They further reported that even when housed at 14°C, piglets elected to huddle rather than use supplementary heat. Morrison et al. (1987) also found that piglets drastically reduced their demand for supplementary heat between 2400 and 0500h. The diurnal variation in thermal needs by the piglets offers producers an opportunity to reduce the heat lamp operation at night thus improving energy use efficiency.

HLU markedly declined from one week of age to two weeks of age, especially for the 250W and 175W heat lamps (averaging 32% at one week of age and 17% at two weeks of age). Thus, supply of a constant heat source for the piglets during the entire lactation period would be inadequate for the piglets to exercise their natural, comfortable behavior; and would result in energy inefficiency. The variation in HLU also appeared to be affected by the ambient temperature, with lower ambient temperature enhancing HLU. Because there was only one replicate for each season, statistical comparison of seasonal effects on HLU was impossible. More data are needed in this regard.

The piglets generally avoided staying directly under the 250W heat lamp (Figure 4), spread fairly uniformly under the 175W heat lamp (Figure 5), and huddled under the 125W heat lamp (Figure 6). These resting behaviors imply that the amount of heat supply was excessive for the 250W heat lamp, adequate for the 175W heat lamp, and insufficient (at least part of the time) for the 125W heat lamp. In fact, the excessive heat (and possibly light intensity) of the 250W heat lamp was believed to be the primary cause of the higher piglet mortality for the 250W treatment. It was speculated that these piglets spent more time around the sow, and consequently were more likely to have been crushed by the sow. A follow-up study is

now in progress to verify the assumption and to further quantify the variable thermal needs of the piglets as related to age and ambient temperature.

Acknowledgment

Funding for this study was provided by the Iowa Energy Center and is sincerely appreciated.

References

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Table 1. Heat lamp usage (HLU) of neonatal pigs in response to heat lamp size, production season, age, and time of the day.

Season	Age (day)	250W			175W			125W		
		Time of Day			Time of Day			Time of Day		
		D	N	24-hr.	D	N	24-hr.	D	N	24-hr.
Winter	7	62	26	44	37	5	21	34	6	20
	14	23	5	14	37	21	29	40	11	25
Spring	7	48	22	35	48	53	50	56	49	52
	14	17	6	12	47	41	44	58	41	50
Summer	7	12	9	10	41	50	45	19	14	17
	14	11	7	9	2	5	4	12	8	10
Fall	7	36	25	31	25	14	19	45	39	42
	14	14	5	9	13	7	10	50	21	36
Yr. Avg	7	39 ¹	20 ¹	30 ¹	38 ¹	31 ¹	34 ¹	38 ¹	27 ¹	33 ¹
	14	16 ²	6 ²	11 ²	25 ²	18 ²	22 ²	40 ²	20 ²	30 ²
Overall	(7&14)	28 _a	13 _b	20 ^a	31 _a	24 _b	28 ^b	39 _a	24 _b	31 ^b

D = day; N = night; 24-hr. = day and night.

Column means with different superscript numbers within the heat lamps differ significantly (P<0.05).

Row means with different subscript letters within the heat lamps differ significantly (P<0.05).

Row means with different superscript letters among the heat lamps differ significantly (P<0.05).

Figure 1. Hourly average heat lamp use of 7- and 14-day-old piglets under 250W heat lamp.

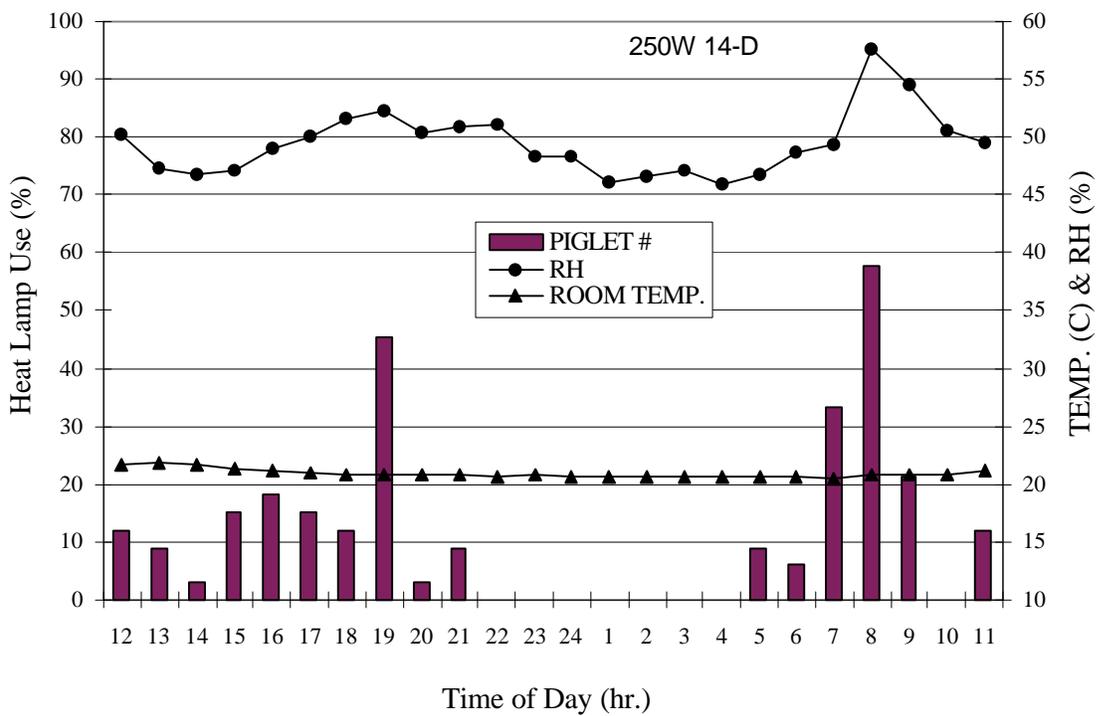
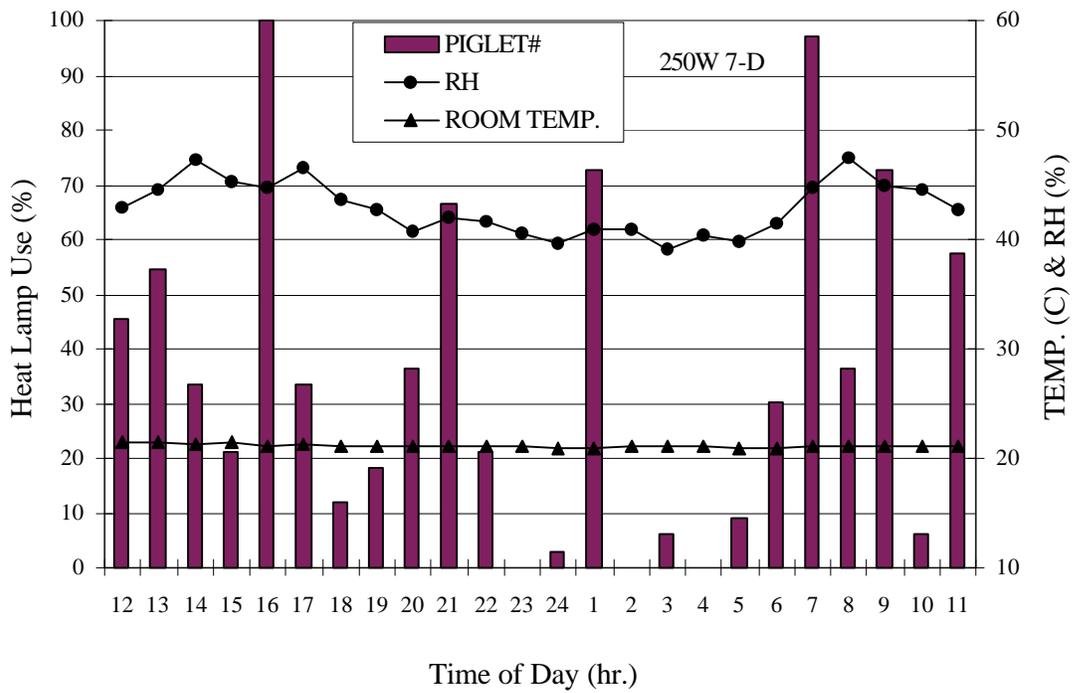


Figure 2. Hourly average heat lamp use of 7- and 14-day-old piglets under 175W heat lamp.

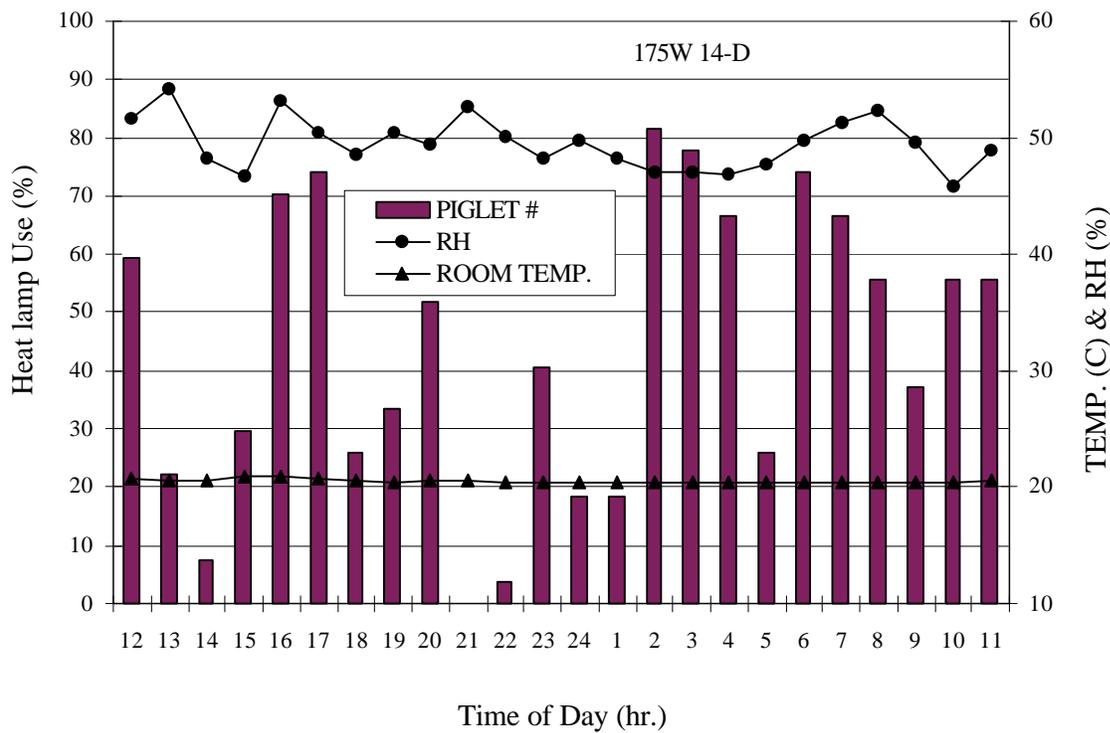
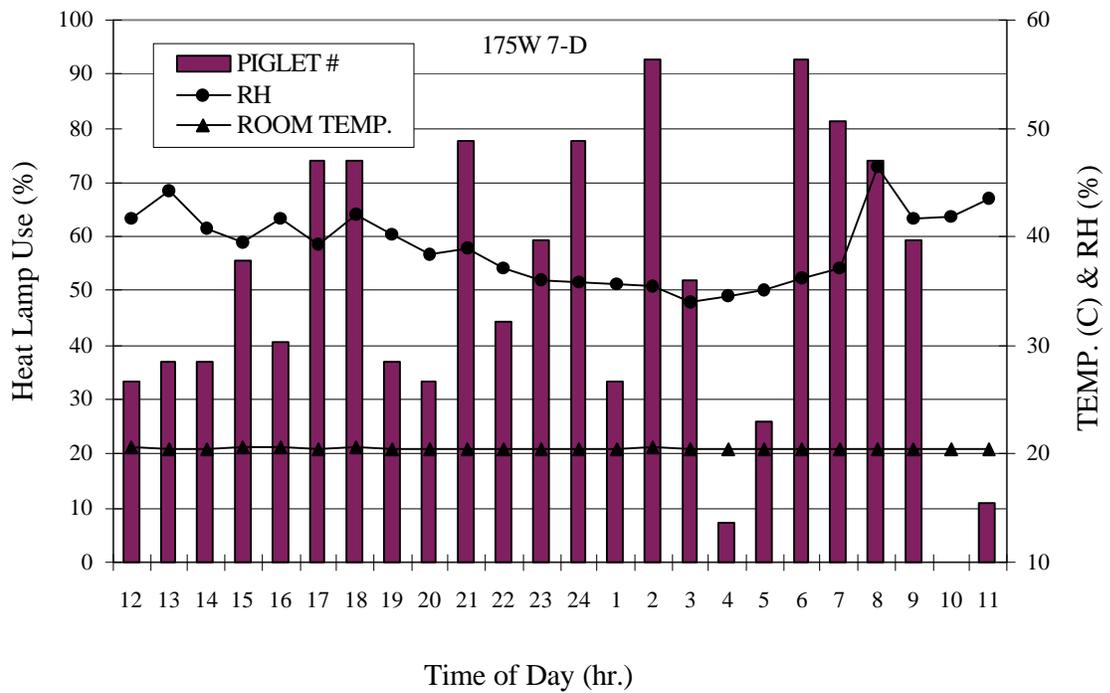


Figure 3. Hourly average heat lamp use of 7- and 14-day-old piglets under 125W heat lamp.

