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Electric Power Saving Fan Options for Cow Cooling

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Introduction. Heat stress can lower dairy cow performance each summer. Various cooling methods have been used to alleviate this problem. Commonly fans are used together with water misting or drenching in milk barn wash/holding pens and rest/feeding areas. A popular practice is to use a low volume 36 inch high speed (LVHS) fan for this purpose. This type fan is effective when placed in rows for directional air movement. However, they are known to have a relatively high electrical power demand. Fan options exist that could move an equal amount of air with less power. The objective of this report is to show comparisons of some fan types during the summer on commercial dairies.

Methods. Three experiments were made over two summers on Tulare County dairies in the San Joaquin Valley of California. These farms were typical of the area and averaged 2,000 Holstein cows/dairy. Temperature and humidity were recorded on automated data loggers and temperature/humidity heat stress index (THI) were calculated. Cow behavior was visually monitored at predetermined times and intervals and monthly milk yield recorded. Spreadsheets were developed for fan comparisons regarding installation and electrical power demand costs. Comparisons were between the LVHS fans, 20 ft. high volume low speed (HVLS) ceiling fans, and 5 ft. low volume low speed ceiling fans.

Results. A reduction ($P<.05$) in relative humidity and a decrease ($P<.10$) for temperature and THI were seen with fans on than when off in the milk barn wash/holding pen. Randomly counted afternoon cow respirations rates in this pen increased faster ($P<.01$) with fans off than on. This increase in respiration rate was negatively (-0.78) correlated with milk yield, while the effect was minimal (-0.09) with the fans on. Regression analysis showed with a THI of 80 and 90 there were respective drops in milk yield of 0.3 and 0.6 gallons/cow daily with fans off as compared to fans on. Two HVLS fans would move an equal air volume of 12 LVHS fans to ventilate this 200 cow pen, with 86% less electricity. This HVLS saving would pay LVHS replacement costs within 3 years (Table 1).

In a second experiment, using the same 6:1 fan ratio in a 1,000 cow free stall barn, a similar electrical saving was observed with the HVLS fans than the LVHS model (Table 1). Barn temperature was higher ($P<.05$), humidity lower ($P<.05$) and THI higher ($P<.10$) in the afternoon than evening. Differences between fan types were minimal. Regression analysis and correction for days in milk (DIM) showed identical milk yields of 90 lbs/cow daily at 150 DIM. However, a 2 lb/cow/day advantage ($P<.05$) at 75 DIM for LVHS cows and a 2 pound advantage ($P<.05$) for HVLS cows with 225 DIM were observed. There was a higher ($P<.01$) percentage of cows with HVLS fans laying in free stalls during both afternoon and evening than animals with LVHS fans, and a higher ($P<.01$) percentage of cows standing in barn lanes with LVHS fans than with the HVLS model.

In a third experiment, the LVHS fan was compared to the 5 ft.ceiling fan (C), or a combination of the two (LVHS+C), or a group of cows with no fans. The two types of fans were on a 1:1 equal air movement basis. As in the 2nd experiment, there were 290 cows/group and all animals had water emitters over feed stanchions with time/temperature automatic control and all fans set at 80°F on/off. Differences between groups for barn temperature, humidity and THI were not significant. However, no fan average milk yield at 150 DIM was lower (P<.05). Differences between fan options were not significant when corrected for DIM and lactation number. Milk yields were 60.9, 62.1, 63.5 and 49.8 lbs/cow daily for LVHS, C, and LVHS+C and no fans respectively. More (P<.01) cows laid in free stalls with ceiling fans and more (P<.01) cows stood in barn lanes with LVHS fans. An 83% electrical power saving was seen with the 5 ft. ceiling fan than the LVHS fan (Table 1).

Table 1. Comparative Dairy Fan Option Install Cost and Electrical Saving Estimations.*

Experiment #1	Milking Barn 200 Cow Wash & Holding Pen	
Fan Type & Model	3 ft. LVHS	20 ft. HVLS
Power Demand, kW/fan	0.538	0.440
Fan Run, hrs./yr.	4,000	4,000
Fan Air Volume Ratio	12	2
Fan & Install Costs, $/fan	700	5,325
Energy Cost/yr. @.10$/kwh	2,582	352
Power Demand Costs, $/yr.	307	42
Experiment #2	1,000 Cow Free Stall Barn	
Fan Type & Model	3 ft. LVHS	20 ft. HVLS
Power Demand, kW/fan	0.538	0.440
Fan Run, hrs./yr.	2,000	2,000
Fan Air Volume Ratio	100	17
Fan & Install Costs, $/fan	700	5,325
Energy Cost/yr.@.10$/kwh	10,760	1,496
Power Demand Costs, $/yr.	2,560	356
Experiment #3	1,000 Cow Free Stall Barn	
Fan Type & Model	3 ft. LVHS	5 ft. Ceiling
Power Demand, kW/fan	0.538	0.090
Fan Run, hrs./yr.	2,000	2,000
Fan Air Volume Ratio	100	100
Fan & Install Costs, $/fan	700	330
Energy Cost/yr.@.10/kwh	10,760	1,800
Power Demand Costs, $/yr.	2,560	428

*Values based on observed usages at time of experiments and costs as of 9/23/01.

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