Kansas Agricultural Experiment Station Research Reports

Volume 0
Issue 2 *Dairy Research (1984-2014)*

Article 284

2001

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Recommended Citation

Smith, John F.; Harner, Joseph P.; and Brouk, Michael J. (2001) "Influence of freestall building orientation on comfort of lactating dairy cattle during summer heat stress," *Kansas Agricultural Experiment Station Research Reports*: Vol. 0: Iss. 2. https://doi.org/10.4148/2378-5977.3209

Influence of freestall building orientation on comfort of lactating dairy cattle during summer heat stress

Abstract

A trial was conducted during the summer of 2000 to evaluate the effect of freestall building orientation""east-west vs. northsouth"" on respiration rates of lactating dairy cows, temperature-humidity index (THI) in the barns, barn temperature, and barn humidity. Differences between ambient and barn temperature and THI were higher in east-west vs. north-south orientated barns. Respiration rates were higher in north-south than in east-west orientated structures. The magnitude of differences between barn and ambient temperatures and THI did not fully explain differences in respiration rates between north-south and east-west orientated barns. Other factors such as solar radiation, airflow, and animal stress may have contributed to the differences in respiration rates.; Dairy Day, 2001, Kansas State University, Manhattan, KS, 2001;

Keywords

Dairy Day, 2001; Kansas Agricultural Experiment Station contribution; no. 02-133-S; Report of progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 881; Dairy; Heat stress; Freestalls; Cow comfort

INFLUENCE OF FREESTALL BUILDING ORIENTATION ON COMFORT OF LACTATING DAIRY CATTLE DURING SUMMER HEAT STRESS

J. F. Smith, M. J. Brouk, and J. P. Harner[1]

Summary

A trial was conducted during the summer of 2000 to evaluate the effect of freestall building orientation—east-west vs. north-south—on respiration rates of lactating dairy cows, temperature-humidity index (THI) in the barns, barn temperature, and barn humidity. Differences between ambient and barn temperature and THI were higher in east-west vs. north-south orientated barns. Respiration rates were higher in north-south than in east-west orientated structures. The magnitude of differences between barn and ambient temperatures and THI did not fully explain differences in respiration rates between north-south and east-west orientated barns. Other factors such as solar radiation, airflow, and animal stress may have contributed to the differences in respiration rates.

(Keywords: Heat Stress, Freestalls, Cow Comfort.)

Introduction

Dairy cows housed in north-south vs. east-west orientated 4-row freestall barns are potentially exposed to more direct sunlight than those in barns orientated east-west. Figure 1 demonstrates how cows are exposed to direct sunlight throughout the day in a 4-row frestall barn orientated north-south. Concerns have been raised about the level of heat stress in freestall buildings orientated north-south vs. east-west.

Procedures

A trial was conducted during the summer of 2000 near Tulare, CA, to evaluate the effect of freestall buildings orientated east-west vs. north-south on respiration rates of lactating dairy cows, THI in the barns, barn temperature, and barn humidity. Six freestall barns (3, north-south and 3, east-west) on 6 farms were utilized to collect temperature and humidity readings every 15 min at four locations per barn. Ambient temperature and humidity were collected at two locations in close proximity to each freestall barn. All temperature and humidity data were collected using HOBO data loggers programmed to collect data every 15 min, 24 hr per day. Temperature and humidity data were collected continuously from April through August of 2000. Respiration rates were collected in the morning between 6 and 8 and between 2 and 4 in the afternoon on three different days. During each observation period, respiration rates were collected from 50 cows in each barn.

Results and Discussion

Average ambient temperature, humidity, and temperature humidity index (THI) of north-south vs. east-west freestall barns are presented in Table 1.

Average differences between ambient and barn temperature and THI were higher ($P<0.01$) in east-west vs. north-south structures (Table 2). Average temperature was 0.45°F higher and THI difference was 0.7 higher in east-west buildings. Relative

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humidity difference was 0.62% lower ($P<0.05$) in east-west vs. north-south barns.

Respiration rates were higher ($P<0.05$) in the morning and afternoon in north-south vs. east-west orientation (Table 3).

Conclusions

Temperature and THI were higher in east-west vs. north-south orientated barns compared to ambient conditions. Respiration rates were higher in north-south vs. east-west orientated structures. Differences in barn temperatures and THI did not explain differences in respiration rates between north-south and east-west orientated barns. Other factors such as solar radiation, airflow, and animal stress may have contributed to the differences in respiration rates.

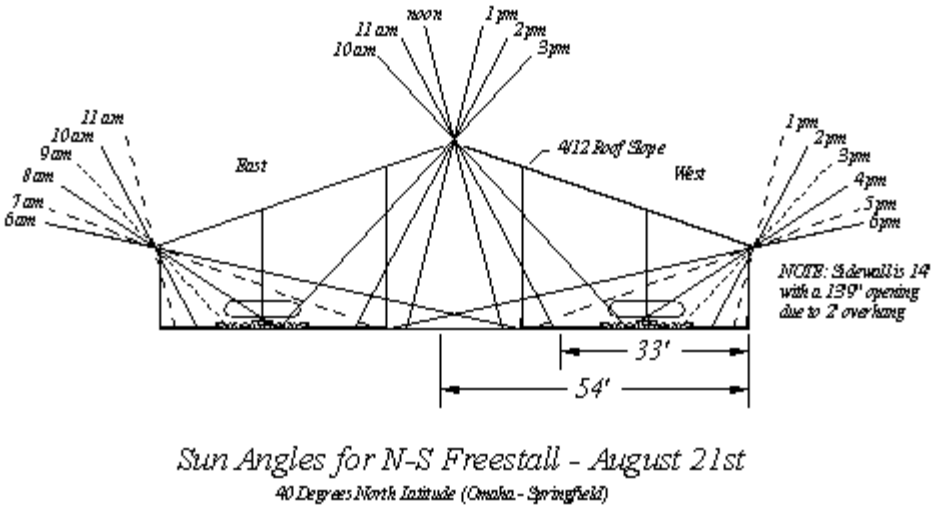

Figure 1. Sun Angles for a 4-Row Freestall Building Orientated North-South.

Table 1. Average Temperature, Relative Humidity and THI of East/West and North/South Barns for Three Days of Respiration Measurements

Item	E/W	N/S	Location effect (*P* value)
Ambient temperature, °F	73.6	73.4	0.57
Ambient relative humidity, %	54.4	53.3	0.06
Ambient THI	68.2	68.0	0.15

Table 2. Average Difference[1] between Barn and Ambient Temperature, Relative Humidity, and THI

Item	E/W	N/S	Barn effect (*P* value)
Temperature °F	+0.43	−0.02	0.01
Relative humidity, %	−0.28	+0.44	0.05
THI	+0.7	+0.4	0.01

[1]Differences in temperature, relative humidity, and THI between inside and outside the barns.

Table 3. Average Morning and Afternoon Respiration Rates of Cows Housed in N/S verses E/W 4-Row Freestall Barns Located in California

Barn type	Morning	Afternoon	Average
	---------- Breaths per min ----------		
East/West	52.2[a]	68.8[a]	60.5[a]
North/South	56.4[b]	77.4[b]	66.9[b]

[a,b]Means within the same column differ ($P<0.05$).