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ADAPTATIONAL STUDIES ON HEREFORD CATTLE IN MALAYSIA III. Effect of Rainfall

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RINGKASAN

Kertas ini membincangkan kajian mengenai penyesuaian lembu-lembu Hereford di Malaysia, terutamanya mengenai kesan hujan terhadap haiwan ini.

Pemilihan haiwan, perlakuan-perlakuan, pengambilan data dan parameter-parameter yang telah digunakan di dalam kajian ini adalah sebagaimana yang telah dilaporkan di dalam kertaskerja yang terdahulu.

Kemajuan yang berkesan dan positif telah didapati di dalam kajian kesan-kesan hujan terhadap penyesuaian haiwan-haiwan ini secara keseluruhannya. Purata suhu rektum (RT) bagi haiwan-haiwan ini ialah 39.17°C dengan haiwan-haiwan T1 menunjukkan nilai RT yang terendah sekali iaitu 38.99°C. Terdapat perbezaan-perbezaan nilai RT bagi haiwan-haiwan yang dibuang lapisan bulu mereka tetapi perbezaan ini tidaklah berkesan. Dalam perlakuan ini, haiwan-haiwan di perlakuan C, walaubagaimanapun, memberikan nilai RT yang terendah sekali iaitu 39.07°C. Keputusan-keputusan bagi RHTC telah menunjukkan kecenderungan yang sama sebagaimana keputusan-keputusan bagi RT, dengan purata keseluruhannya ialah 84.70 dan yang terbaik sekali ialah 88.35 bagi haiwan-haiwan di T1. Pembuangan lapisan bulu juga didapati tidak berkesan.

Tidak ada perlakuan yang menunjukkan perbezaan-perbezaan yang berkesan di dalam kadar denyutan jantung bagi haiwan-haiwan di dalam keadaan hujan.

Nilai RR juga tidak menunjukkan sebarang perbezaan yang nyata di antara perlakuan-perlakuan dari segi pengurusan tetapi memberikan perbezaan yang sangat nyata ($P<0.01$) di antara perlakuan-perlakuan pembuangan lapisan bulu. Haiwan-haiwan di dalam perlakuan C memberikan nilai RR 60.6, sementara purata keseluruhannya ialah 65.7.

Bagi BIA, perlakuan-perlakuan dari segi pengurusan juga tidak memberikan perbezaan yang nyata. Di dalam perlakuan-perlakuan pembuangan lapisan bulu, cuma haiwan-haiwan di dalam perlakuan C memberikan nilai BIA yang terendah iaitu 3.59, sementara purata keseluruhannya ialah 3.80. Walau bagaimanapun, di dalam perkara ini, tindakbalas (interaction) di antara pengurusan x perlakuan-perlakuan pembuangan lapisan bulu telah memberikan perbezaan-perbezaan yang nyata ($P<0.05$), dengan haiwan-haiwan di dalam CT2 memberikan nilai BIA yang terendah sekali, iaitu 3.34.

Faedah dan keuntungan yang didapati dari hujan, dan cara menyembur atau merenjis air kepada haiwan-haiwan untuk menambahkan keselesaan dan pengeluaran juga dibincangkan.

INTRODUCTION

Since the importation of Herefords into Malaysia, in April 1978, studies on the heat tolerance (PATHMASINGHAM, MURUGAIYAH and NASIR, 1978) and the effect of hair-coat clipping on their adaptability (PATHMASINGHAM and NASIR, 1979) have been reported. The hair-coat clipping was carried out to improve the comfort of the animals as a management procedure. To extend the investigations into improving conditions of the environment for these animals, the effect of water on the bodies of these animals was considered.

As part of the adaptational studies on the Hereford cattle, the animals were left out in the rain, to see what effects would be produced, regarding their comfort. If the

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results proved to be significant in increasing the physiological comfort of these animals, then spraying, sprinkling, or splashing water could be incorporated in their management, especially if it can be done economically. This method of cooling the animals' bodies has been tried successfully by MINETT (1947), SEATH and MILLER (1948), FRYE, *et al.*, (1950), DOBINSON (1951), MILLER *et al.*, (1951), MORRISON *et al.*, (1973) and reviewed by PAYNE (1955).

This paper presents results of the study of the effect of rain on the adaptation of Hereford cattle in Malaysia.

EXPERIMENTAL PROCEDURE

Animals

All eighteen in-calf Hereford heifers used in the study of hair-coat clipping (PATHMASINGHAM and NASIR, 1979) were used in this study. The recordings for the effect of rainfall were also taken during the same period, of 8th to 22nd August 1978.

Management and Treatments

The management treatments of T1 (24-hour shade), T2 (optional shade) and T3 (day shade and night grazing) and hair-coat clipping treatments of N – no clipping, H – head and neck clipping, and C – complete clipping, were identical to the previous study reported (PATHMASINGHAM and NASIR, 1979). The feeding regimes and all records taken of animals and environment, and procedures adopted were the same. Calculations of RHOAD's (1944) Heat Tolerance Coefficient, and BENEZRA's (1954) Index of Adaptability were as described previously (PATHMASINGHAM, *et al.*, 1978). However, unlike the previous two studies, animals in this study were allowed to stand in the rain, practically throughout the day. Thus, all the animals were well soaked, and had completely wet bodies throughout the day, when recordings were taken.

Statistical Analysis

After the analysis of variance, 'F' tests were then conducted to determine significance levels of the different treatments. Finally, Least Significant Difference (LSD) tests were done at 0.05 and 0.01% levels.

RESULTS

As in the previous studies (PATHMASINGHAM *et al.*, 1978 and PATHMASINGHAM and NASIR, 1979), all parameters recorded at 0800 and 2000 hours were omitted, as they were found to be of no practical significance. All data presented here, represent means of records taken at 1130, 1430 and 1630 hours only.

The means of atmospheric temperature, relative humidity and wind velocity are presented in *Table 1.*

The overall means of all animal parameters, under the different management and hair-coat clipping treatments are presented in *Table 2.*

TABLE 1: MEAN OF ENVIRONMENTAL RECORDS

	Atmospheric Temperature (°C)	Relative Humidity (%)	Wind Velocity (ms^{-1})
Mean	28.74	85.00	4.19
S.E.	±1.25	±6.24	±1.11

TABLE 2: OVERALL MEANS OF PARAMETERS FOR THREE TIMES OF THE DAY – WET DAY

Parameter Treatment	Rectal Temperature (°C)		Pulse Rate		Respiration Rate		Rhoad's Heat Tolerance Coefficient		Benezra's Index of Adaptability	
	Mean	S.E.	Mean	S.E.	Mean	S.E.	Mean	S.E.	Mean	S.E.
T1F	38.99	±0.04	71.6	±2.96	66.4	±2.14	88.35	±1.32	3.67	±0.13
T2F	39.06	±0.09	72.1	±3.11	60.9	±3.04	86.40	±1.69	3.67	±0.13
T3F	39.45	±0.09	75.5	±2.57	69.7	±5.18	79.39	±1.56	4.06	±0.22
N	39.19	±0.12	73.2	±2.36	73.6	±4.12	84.75	±2.61	4.05	±0.26
H	39.23	±0.15	69.6	±3.07	62.8	±2.34	83.27	±2.64	3.76	±0.10
C	39.07	±0.06	76.3	±2.68	60.6	±2.60	86.13	±1.13	3.59	±0.09
Mean	39.17		73.0		65.7		84.70		3.80	
S.E.	±0.06		±1.62		±2.18		±1.25		±0.10	

The results of the analysis of variance and 'F' test values, for treatment effects on the different animal parameters are presented in *Table 3*.

Table 4 gives the comparative effects of treatment means.

In the comparison for Benezra's Index, the T x H interaction was significant at 0.05%. The differences between interaction means are given in *Table 5*.

I. Rectal temperature (RT)

In rainfall, only the management treatments had significant effects. The animals in T3 had a mean RT of 39.45°C which was significantly ($P<0.01$) higher than animals in T1 and T2. The animals in T1 and T2 did not show any differences between them.

Hair-coat clipping did not produce any significant differences between animals in terms of RT.

II. Rhoad's Heat Tolerance Coefficient (RHTC)

The effects produced were identical to those for RT, as RHTC is derived directly from RT. Animals in T1 had the best RHTC of 88.35, whilst animals in T3 had RHTC of 79.39.

The effects of hair-coat clipping were nonsignificant.

III. Pulse Rate (PR)

No differences were produced by either management or hair-coat clipping treatments on the pulse rate of all animals tested.

IV. Respiration Rate (RR)

Management treatments did not have any effect on RR of the animals. However, significant ($P<0.01$) differences were produced by both the H and C hair-coat clipping treatments against no hair-coat clipping (N). The RR for H and C animals were 62.8 and 60.6 respectively, whilst the N animals had a mean of 73.6.

V. Benezra's Index of Adaptability (BIA)

The effects of management treatment were insignificant. The effect of hair-coat clipping and the interaction between hair-coat clipping and management treatments were, however, significant at 5% level ($P<0.05$).

Only the animals with completely clipped hair-coats (C) were significantly ($P<0.05$) better off than those in the N treatments. They had a mean BIA of 3.59. The animals in the H treatment had a comparatively good BIA value of 3.76.

TABLE 3: 'F' VALUES OF THE EFFECTS OF TREATMENTS ON THE DIFFERENT ANIMAL PARAMETERS

Source	'F' Values				
	Rectal Temperature	Pulse Rate	Respiration Rate	Rhoad's Coefficient	Benezra's Index
Treatment (T)	8.4941 **	0.6110 ns	3.7632 ns	7.4883 *	4.0334 ns
Haircut (H)	0.9742 ns	1.5896 ns	9.1963 **	0.6894 ns	4.3008 *
T x H	0.4824 ns	1.2733 ns	2.8614 ns	0.3529 ns	4.2981 *

* P∠0.05
** P∠0.01
ns not significant.

TABLE 4: COMPARATIVE EFFECTS BETWEEN TREATMENTS ON THE DIFFERENT ANIMAL PARAMETERS

		Management			Hair-coat Cliping	
		T2	T3		H	C
1)	Rectal Temperature					
	T1	0.07 ns	0.46 **	N	All comparisons not	
	T2	–	0.39 **	H	significant.	
2)	Respiration Rate					
	T1	All comparisons not		N	10.78 **	12.95 **
	T2	significant.		H		
3)	Rhoad's Coefficient					
	T1	1.94 ns	8.96 **	N	All comparisons not	
	T2	–	7.02 *	H	significant.	
4)	Benezra's Index					
	T1	All comparisons not		N	0.29 ns	0.46 *
	T2	significant.		H	–	0.17 ns

* P∠0.05
** P∠0.01
ns not significant.

TABLE 5: DIFFERENCES BETWEEN INTERACTION (T x H) MEANS FOR BENEZRA'S INDEX OF ADAPTABILITY

$\bar{X}$	T1	T2	T3
N	3.45	3.98	4.73
H	3.72	3.69	3.76
C	3.76	3.34	3.69

$SE\bar{X}$ = 0.2735
LSD (0.05) = 0.6187
LSD (0.01) = 0.8889

The interaction between management treatments and hair-coat clipping treatments produced a very significant advantage for animals in the CT2 combination with a BIA value of 3.34 which was the lowest recorded overall. The animals in NT3 produced the highest BIA value of 4.73 which was the poorest, and which was significantly ($P<0.05$) poorer than all the other interactions.

DISCUSSION

The effects of hair-coat clipping on the comfort and adaptability of Herefords have been discussed (PATHMASINGHAM and NASIR, 1979). The results have been positive in improving the heat tolerance of these animals. To further increase their comfort, the effect of water on their bodies was considered. Hence, the animals were allowed to stand in the rain, and some of their physiological parameters were measured.

The overall effect of rainfall and water on the animals' bodies have again produced a significant improvement in their comfort. In the context of a rainfall or wet situation itself, the management treatments and hair-coat clipping have produced differences in effects. In general, all parameters recorded on the animals have produced better results and effects than those recorded on a hot day.

The overall mean rectal temperature of all animals was 39.17°C, with animals in T3, having a significantly ($P<0.01$) higher RT than those in T1 and T2. Though there were differences due to hair-coat clipping, they were not significant.

The effects of rainfall are both direct and indirect. Directly, the rain water, being colder than the surrounding air (PAYNE, 1955), cools the animals. MINETT (1947) has reported that the effect of natural rain was to lower the body temperature of hill cattle by 0.89–2.1°C, and that this effect of cooling is more prominent during the drying period rather than during the shower itself. SEATH and MILLER (1948) also reported that rain cools animals rapidly. Indirectly, the evaporation of rain water from the animals' bodies, assisted by the prevailing wind at Serdang of 4.19 ms^{-1}, has obviously helped in reducing the RT of these animals.

The results obtained for RHTC show the same trend as obtained for RT. The T3 animals had the lowest RHTC. The T1 and T2 animals had significantly better RHTC than the T3 animals. None of the hair-coat clipped treatments produced any significant effects. However, animals in the C treatment had best RHTC values. The effects produced for RHTC are affected by the same conditions as for the RT results.

The effect of rainfall on pulse rates produced no significant differences for both the management and hair-coat clipping treatments.

The overall mean for RR was 65.7. The management treatments showed not significant effects due to the rainfall. The effect of rainfall on the different hair-coat clipping treatments produced very significant differences. Animals in the N treatment had the highest RR. This was significantly higher than those in the H and C treatment, which did not differ significantly when compared with one another. The results suggest that a coat of hair on the animals' bodies had a retention effect on the water, in that, the hair binds the water and prevents easy evaporation, hence not aiding the evaporative cooling effect. On the other hand, a hair coatless animal, 'releases' the water for evaporation much easier and aids the evaporative cooling effect on the animal. This effect reduces stress and hence the RR of these animals are lower (PAYNE, 1955). This same effect is also produced by clipping the hair on the head and neck alone, as is shown by the insignificant differences between the H and C treatments. However, this evaporative cooling on a rainy day is not large or significant enough on the animals to produce a lowered internal body temperature as was seen in the RT results.

The effects of rainfall on the RR of all animals, especially those with hair-coat clipping, are further reflected in the BIA

results obtained. Animals in the C treatment had a significantly ($P<0.05$) better BIA value, as compared to the other treatments. Though no significant differences were produced between treatments, the interaction between management and hair-coat clipping treatments did produce significant differences at the 5% level. In this comparison, animals in T2 with C treatment, produced the best overall BIA values which was significant when compared with the other interactions. Animals in T3 with no hair-coat clipping (N) produced the poorest BIA value, indicating the significance of management and hair-coat clipping treatments, even in a rainy or wet situation.

The results of this study hence indicate the usefulness of wetting animals for increasing their physiological comfort, which would in turn increase the productivity of these animals (MORRISON, *et al.*, 1973). The results produced in rainfall, would actually be less because the environment would also have been cooler, hence exerting less stress on the animals. On a normal hot day, however, the effect of wetting or spraying these animals would be expected to produce more significant results. In this respect MORRISON *et al.*, (1973) have reported that cattle cooled by sprinkling water, ate more feed and gained weight faster than did uncooled cattle on a hot day. Also, analyses of carcasses revealed that such cooled cattle produced slightly lower body fat and higher protein than other cattle in a hot environment (MORRISON *et al.*, 1973).

Hence, the effect of cooling Herefords, and other European stock, especially in the productive stages, by sprinkling water, will have to be considered seriously for introduction into a management system for better production in a tropical environment like Malaysia.

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SUMMARY

The paper discusses the effect of rainfall on the adaptability of Hereford cattle in Malaysia.

All animals, treatments, recordings and parameters used for the assessment of adaptability in a raining situation, were as reported in part two of this study.

In the overall context of the effects of rainfall on the adaptability of these animals, there is a positive significant improvement. The overall mean of RT was 39.17°C, with T1 animals showing lowest RT of 38.99°C. There were differences in RT for animals in the hair-coat clipping treatment, but these were not significant. In this comparison, animals in C treatment, however, had the lowest RT of 39.07°C. The RHTC results showed the same trend as the RT results, with the overall mean being 84.70 and the best being 88.35 for animals in T1. The effects of hair-coat clipping were again insignificant.

None of the treatments produced significant differences in the pulse rate of the animals in a raining condition.

The RR values also did not show any significant differences between the management treatments, but showed very significant ($P<0.01$) differences between hair-coat clipping treatments, with animals in C treatment having a RR value of 60.6 whilst the overall mean was 65.7.

In terms of BIA, again the management treatments produced no significant differences. Of the hair-coat clipping treatments, only animals in treatment C had a significantly ($P<0.05$) lower BIA value of 3.59, whilst the overall mean was 3.80. In this instance, however, the management x hair-coat clipping treatments interaction produced significant ($P<0.05$) differences, with animals in CT2 having the lowest BIA value of 3.34.

The significance and advantages of rainfall, hence water, and spraying or sprinkling, on animals in terms of increasing their comfort and productivity is discussed.

REFERENCES

BENEZRA, M.V. (1954). A new index for measuring the adaptability of cattle to tropical conditions. *J. Anim. Sci., 13,* 1015 (Abstract).

DOBINSON, J. (1951). Heat tolerance in European breeds of cattle exposed to high environmental temperatures. *Anim. Breed. Abstr., 20,* No. 74.

FRYE, J.R. (Jr.), MILLER, G.D. and BURCH, B.J. (Jr.), (1950). The effect of sprinkling dairy cows on midsummer milk production. *Anim. Breed. Abstr., 19,* No. 1118.

MILLER, G.D., FRYE, J.B. (Jr.), BURCH, B.J. (Jr.), HENDERSON, P.J. and RUSOFF, L.L. (1951). The effect of sprinkling on the respiration rate, body temperature, grazing performance and milk production of dairy cattle. *J. Anim. Sci., 19:* 961–968.

MINETT, F.C. (1947). Effects of artificial showers, natural rain and wallowing on the body temperatures of animals. *J. Anim. Sci., 6:* 35–49.

MORRISON, S.R., GIVENS, R.L. and LOFGREEN, G.P. (1973). Sprinkling cattle for relief from heat stress. *J. Anim. Sci., 36:* 428–431.

PATHMASINGHAM, M., MURUGAIYAH, M. and NASIR, M.A. (1978). Adaptational studies on Hereford cattle in Malaysia. I. Heat Tolerance. *MARDI Res. Bull. 8(1):* 85–98.

PATHMASINGHAM, M. and NASIR, M.A. (1979). Adaptational studies on Hereford cattle in Malaysia. II. Effect of hair-coat clipping. *(In press).*

PAYNE, W.J.A. (1955). Some effects of improved management on dairy cattle in the tropics. *Anim. Breed. Abstr., 23,* No. 1

RHOAD, A.O. (1944). The Iberia Heat Tolerance test for cattle. *Trop. Agric. Trin., 21:* 162–164.

SEATH, D.M. and MILLER, G.D. (1948). A self-serving sprinkling device for cooling dairy cattle. *J. Anim. Sci., 7:* 251–256.

SEATH, D.M. and MILLER, G.D. (1948). Effect of water sprinkling with and without air movement on cooling dairy cows. *J. Dairy Sci., 31:* 361–366.