Factors Associated with Average Daily Gain, Fever and Lameness in Beef Bulls at the Saskatchewan Central Feed Test Station

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ABSTRACT

Data obtained from the Saskatchewan Central Feed Test Station in Saskatoon, Saskatchewan, Canada were examined for evidence of factors related to average daily gain and the diseases occurring in 326 beef bulls during the 1983-84 test.

Average daily gain was found to be significantly associated with breed, pen assignment and initial test weight but was not associated with disease or age upon arrival at the test station. Lameness was associated with breed and initial weight, while fever (suspected respiratory disease) was associated with age. The predicted odds of lameness was approximately seven times greater in the animal with the heaviest as compared to the lightest initial test weight and the predicted odds of fever was approximately five times greater in the youngest as compared to the oldest animal.

RÉSUMÉ

Cette étude consistait à analyser les données obtenues de la station centrale d'épreuve des jeunes taureaux de boucherie de la Saskatchewan, à Saskatoon, Saskatchewan, Canada, quant aux facteurs reliés au gain de poids quotidien moyen et à l'incide maladies, chez 326 jeunes taureaux de boucherie, au cours du test de la saison 1983-84.

Le gain de poids quotidien moyen s'avéra significativement associé à la race, au parc et au poids de la première pesée, mais non à la maladie ou à l'âge des jeunes taureaux, au moment de leur arrivée à la station d'épreuve. La boiterie se révéla associée à la race et au poids de la première pesée, tandis que la fièvre, probablement imputable à une maladie respiratoire, s'avéra associée à l'âge. La probabilité de boiterie se révéla environ sept fois plus élevée chez les sujets les plus lourds, lors de la première pesée, que chez les plus légers. La probabilité de fièvre s'avéra par ailleurs environ cinq fois plus grande chez les sujets les plus jeunes que chez les plus âgés.

INTRODUCTION

The record of performance (ROP) bull test program in Canada is designed to evaluate potential sires for growth rate (1,2). The group test system is meant to allow the comparison of bulls originating from different herds and environments with respect to their genetic merit for growth rate. A common environment and feeding regime are used to ensure that differences between growth rates of the bulls are due to differences in genetic makeup. However, variations may occur in the history, management and health status of individual bulls in any given test. For the most part, assessment of the effects of these variables upon the average daily gain (ADG) has not been done.

The effect of nonfatal disease upon weight gain in young beef animals in an ROP station in Great Britain was studied by Thomas *et al* (3) and production losses due to pneumonia, enteric disease, salmonellosis and infectious bovine keratoconjunctivitis were documented. Although the circumstances of this study differ from the nature of the bull test system in Canada, the results suggest a possible influence of both disease and management procedures upon ADG. If such variables influence ADG in Canadian bull test stations, this would be of interest to both those concerned with the ROP test system and to beef cattle producers.

This study had two main objectives: first, to analyze one year's data from an ROP test station in Saskatchewan to determine if factors, other than genetic merit, could be shown to have a significant effect upon ADG; and second, to determine if any of the factors under study predisposed the animals on test to disease.

MATERIALS AND METHODS

DATA

This data set is composed of health and disease records of bulls at the Saskatchewan Central Feed Test Station during the 1983-84 test. Three hundred and twenty-six bull calves from ten different beef breeds and averaging seven months of age at the beginning of the test period were admitted to the station on October 15 and 16, 1983. Upon arrival they were assigned to one of 12 pens. Each owner

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submitted from one to 15, but most commonly three, animals for testing.

All of the bulls from a given owner were assigned to the same pen. In so far as possible, pens were comprised of a single breed. Where this was not possible, pens were made up of animals from breeds of similar body type and size. The basic effect of this procedure was that bulls were assigned to pens based upon their breed or breed-type.

Prior to admission the calves had been subjected to a variety of vaccination regimes for infectious bovine rhinotracheitis and clostridial diseases and many had been treated for ectoparasites with one of four different parasiticides. Regardless of history, all animals were vaccinated intranasally for both infectious bovine rhinotracheitis (IBR) and parainfluenza-3 (PI3) viruses when they arrived at the test station. All those animals that had not been treated with a parasiticide were given Ivermectin (Ivomec, MSDAGVET, Mississauga, Ontario).

After a 28 day period of adjustment to their new surroundings and the bull test ration, the animals were weighed for the first time (Wt1) and the test was started. Over the next 140 days the animals were fed the test ration *ad libitum* and weighed every 28 days. The ration was fed as a complete mix. It contained 12-13% protein, 62-63% total digestible nutrients (TDN) and was formulated from barley silage and oats. Minerals and vitamins were added to meet current National Research Council recommendations (4).

An individual health record was maintained for each animal by the employees of the test station. Although some general veterinary advice regarding health management was supplied by clinicians from the Western College of Veterinary Medicine, the daily diagnosis and treatment of animals and the maintenance of the health records were carried out by the employees of the station. Four animals were lost from the study: two were culled with limb fractures, one with chronic, undifferentiated diarrhea and one died suddenly following rupture of an intra-abdominal abscess.

THE ANALYSIS

Statistical analysis was performed using either the Statistical Analysis System (SAS) (5) or the Biomedical Computer Programs (BMDP) (6). The name and definition for each variable is presented in Table I. Simple regression (5) was used to test for unconditional associations between ADG and all variables listed in Table I. Conditional associations of ADG with all but four of the variables (BIRTH WEIGHT, CALVING EASE, WEANING AGE and TEMPERATURE) listed in Table I were subsequently tested using stepwise, multiple, least squares regression (5) with dummy variables being created for all categorical variables. The deleted variables each contributed to a greater than 15% loss of cases from the analysis due to missing values and were deleted because their use would have reduced the sample size unduly, possibly resulting in biased regression coefficients.

To detect variables capable of distorting or suppressing the associations of interest, the significance level for initial inclusion of variables in the regression model was set at 15% ($p < 0.15$). Only those continuous variables or those groups of dummy variables that remained significant at the 5% ($p < 0.05$) level were allowed to remain in the final model. The General Linear Model (GLM) was used to test the significance of the partial regression coefficients for all variables and all first order interaction terms (5). It was also used to determine the final model. As a final step in the regression analysis, the residuals were analyzed to check homoscedasticity, normality, outlying values and influential cases.

Stepwise, multiple, logistic regression (6) was used to assess the conditional associations between those variables indicated (*) in Table I and two disease outcomes, FEVER and LAMENESS. Individual variables were allowed to enter these two logistic models if they explained a significant portion of the residual variation, based on an estimated F, with $p < 0.15$. The p-value for re-

TABLE I. Description and Definition of Variables Used in the Analysis of Historical, Management and Health Data on 326 Beef Bulls Entering the Saskatchewan Central Feed Test Station in October 1983

Variable	Definition
*DISTANCE	Distance transported (km) from farm to test station
*AGE	Age (days) upon arrival at test station
*PEN	Pen number
*BREED	Breed of bull
BIRTH WEIGHT	Birth weight (kg)
CALVING EASE	Ease of calving
WEANING AGE	Age at weaning (days)
TEMPERATURE	Rectal temperature on arrival (°C)
*IBR	Vaccination status for IBR prior to arrival at the test station
*PARASITICIDE	Insecticide used to treat for ectoparasites
*CLOSTRIDIAL	Vaccination status for clostridial diseases
*Wt1	Weight (kg) on test day 0
Wt2	Weight (kg) on test day 28
Wt3	Weight (kg) on test day 56
Wt4	Weight (kg) on test day 84
Wt5	Weight (kg) on test day 112
Wt6	Weight (kg) on test day 140
ADG	Average daily gain = (Wt6-Wt1)/140 (kg)
FEVER	Rectal temperature ≥ 40°C
DURFEV	Duration of fever (days)
RECFEV	Recurrence of fever after at least ten days since the first occurrence[a]
DURREF	Duration of recurrent fever (days)
LAMENESS	Clinical evidence of lameness
DURLAM	Number of days treated for lameness
RECLAM	Recurrence of clinical lameness after at least 20 days since the first occurrence[b]
DURRELAM	Number of days treated for recurrent lameness
OTHER	Clinical evidence of other diseases

* = Variables used in the logistic regression analysis
[a]Two animals had a second recurrence of a fever but this was not considered in the analysis
[b]No animal had a second recurrence of lameness

TABLE II. Historical and Management Data on 326 Beef Bulls Entering the Saskatchewan Central Feed Test Station in October 1983

	Mean	SD	Min	Max	Range	Missing[a]
Continuous Data						
Birth weight (kg)	42.2	6.4	30	62	32	103
Age at weaning (days)	202.7	23.6	141	250	109	44
Age on arrival (days)	208.0	23.1	160	260	100	0
Distance transported (km)	230.9	80.7	21	427	406	6
Rectal temperature on arrival (°C)	32.9	0.5	37.7	40.6	2.9	55
Average daily gain (kg/day)	1.51	0.18	1.03	2.17	1.14	4
Wt1 (kg)	306.2	39.4	218	438	220	0

Categorical Data	*Frequency*	*Percent*
Ease of calving		
unassisted	245	75.2
easy pull	16	5.0
hard pull	8	2.5
surgical	5	1.5
missing	52	16.0
Vaccination[b] for infectious bovine rhinotracheitis prior to arrival at test station		
none	191	58.6
intramuscular	58	17.8
intranasal	75	23.0
missing	2	0.6
Vaccination for clostridial disease prior to arrival		
no	48	14.7
yes	278	85.3
missing	2	0.6
Treated with a parasiticide at or prior to arrival		
Trichlorphon[c]	10	3.1
Crufomate[d]	18	5.5
Fenthion[e]	66	20.2
Ivermectin[f]	226	69.3
Missing	2	0.6

[a]Values missing from the data set
[b]Route of administration
[c]Neguvon, Haverlockhart Laboratories, Shawnee, Kansas
[d]Ruelene, Dow Chemical, Richmond Hill, Ontario
[e]Spotton, Cutter Animal Health, Mississauga, Ontario
[f]Ivomec, MSDAGVET, Mississauga, Ontario

moval of variables from the models were also set at $p < 0.15$. Subsequently, all significant main effects were forced into the models and all biologically plausible, first order interaction terms, involving the significant main effects, were then made available for inclusion. The F-to-enter and F-to-remove were set at 0.15 and 0.10 respectively. Brown's statistic was used to assess the adequacy of the logistic models for the data and Hosmer's statistic was used to assess goodness of fit (6).

TABLE III. Frequency of Clinical Abnormalities and Treatment of 326 Beef Bulls Entering the Saskatchewan Central Test Station in October 1983

Diagnosis	Frequency	Mean Number of Days Treated[a]	Rate
Fever	42	1	12.9[b]
Recurrent fever	5	2	11.9[c]
Lame	56	1	17.2[b]
Recurrent lameness	5	1	8.9[c]
Other disease	26	NR[d]	7.7[b]

[a]All cases were treated
[b]Rate = (number of new cases of disease) ÷ (number of animals at risk)
[c]Rate = (number of recurrences) ÷ (number of first occurrences)
[d]NR = not recorded

RESULTS

DESCRIPTIVE STATISTICS

The descriptive statistics are presented in Tables II, III and IV. The most common clinical abnormalities reported (Table III) were fever (12.9%) and lameness (17.2%). The majority of animals with a fever were thought to be suffering from respiratory disease. They were all treated with parenteral antibiotics until the rectal temperature fell below 40°C, with the median duration of treatment being one day. Lame animals were those showing clinical evidence of lameness. All lame animals were treated with parenteral antibiotics but their rectal temperatures were not recorded. The mean duration of all treatments for lameness was one day. The recurrence rates for fever and lameness were 11.9% and 8.9% respectively. The rates of disease and ADG by breed are presented in Table IV. As the assignment of the bulls to PENs was largely based upon BREED, this resulted in significant correlations between these two variables.

FACTORS ASSOCIATED WITH ADG

Four independent variables (BIRTH WEIGHT, CALVING EASE, WEANING AGE and TEMPERATURE) were excluded from the regression analysis because their values had not been recorded for at least 16% of the animals. Of these, only BIRTH WEIGHT (missing values = 31%) was unconditionally related to ADG ($r = 0.43$). None of the four variables were related to the occurrence of disease. Although Wt1 was not as strongly correlated with ADG as was BIRTH WEIGHT ($r = 0.32$ vs $r = 0.41$) and did not precede every case of disease, it was considered an appropriate surrogate for the variable BIRTH WEIGHT.

The results of stepwise, least squares regression of ADG upon DISTANCE, AGE, PEN, BREED, IBR, PARASITICIDE, CLOSTRIDIAL, Wt1 and the nine disease related variables listed in Table I showed a

TABLE IV. Descriptive Data by Breed for 322[a] Beef Bulls Entering the Saskatchewan Central Test Station in October of 1983

Breed Number	Breed	Number of Bulls	Owners per Breed	Pens[b]	Disease Rates[c] Fever	Lame	Other	ADG[d]	SE[e]
1	Angus	68	17	1,3,5	7.4	4.4	1.4	1.41	0.015
2	Charolais	68	21	6,8,9	14.7	22.1	5.9	1.64	0.020
3	Gelbvieh	14	4	12	0.0	20.0	6.7	1.50	0.041
4	Hereford	27	8	7	25.9	40.7	44.4	1.42	0.025
5	Maine-Anjou	31	11	10,11	6.5	16.1	3.2	1.65	0.030
6	Shorthorn	11	4	11	16.7	16.7	16.7	1.45	0.048
7	Tarentaise	12	2	11	8.3	25.0	8.3	1.30	0.037
8	Pinzgauer	12	3	12	0.0	25.0	8.3	1.42	0.041
9	Simmental	66	15	2,4,6	19.4	9.0	3.0	1.57	0.017
10	Limousin	13	3	3,5	15.4	38.5	0.0	1.29	0.038

[a]Four of 326 bulls did not complete the study
[b]Pens to which members of the breed were assigned
[c](Number of new cases) ÷ (number of animals at risk)
[d]Average daily gain (kg/day)
[e]Standard error of the mean average daily gain

conditional association ($p < 0.15$) of ADG with selected BREEDs, PENs, intranasal vaccination for IBR, Wt1, RECURRENT LAMENESS and RECURRENT FEVER. Using the GLM in a subsequent procedure, all of the dummy variables assigned to the categorical variables were included in the model as a group. When only those variables that were significant at the 5% level were allowed to remain in the model, the independent variables significantly associated with ADG were BREED, PEN and Wt1. The results of this procedure are shown in Table V and show that BREED, PEN and Wt1 (initial weight) were significantly related to ADG. The zero coefficients for Pen 5, Pen 7, Pen 9 and Pen 11 are the result of linear relationships between BREED and PEN arising from the fact that pen assignment was based upon the breed of the animals. Although BREED and PEN were significantly related to ADG it was not possible to separate the effects of these two variables from one another. As a result, the individual regression coefficients associated with these two variables will be biased.

FACTORS RELATED TO DISEASE

Using stepwise, multiple, logistic regression, FEVER was found to be significantly related to AGE at arrival and LAMENESS was conditionally related to BREED and Wt1 (Table VI). Only those odds ratios with 95% confidence limits that did not include 1 are shown. The methods of calculating the odds ratios and the confidence limits are indicated and if desired the standard errors of the coefficients can be calculated from the data presented in Table VI. There was no evidence of statistical interaction between BREED and Wt1.

The effect of breed upon lameness at each initial weight (Wt1) was calculated with the Angus breed as the baseline or reference group. The small, positive odds ratio associated with Wt1 reflects the fact that it is measuring the difference in odds of lameness in animals that differed in their initial weight by 1 kg. As an example and using data from Tables II and VI, the estimated difference in the logarithm of the odds of lameness between the lightest and heaviest animal would vary by a factor of 220

TABLE V. The Regression of ADG upon the Significant Main Effects

Independent Variable	B[a]	SE B[b]	Prob < T[c]
R Square = 0.45[d]			
Angus	0.0727	0.0510	0.0184
Charolais	0.3637	0.0516	0.0001
Gelbvieh	0.1883	0.0659	0.0004
Hereford	0.1188	0.0558	0.0234
Maine-Anjou	0.1333	0.0661	0.0001
Shorthorn	0.1513	0.0722	0.0002
Tarentaise	-0.0018	0.0639	0.6584
Pinzgauer	0.1060	0.0837	0.0097
Simmental	0.2945	0.0512	0.0001
Limousin[e]	0.0000	—	—
PEN 1	0.0621	0.0454	0.1731
PEN 2	0.0009	0.0666	0.9898
PEN 3	0.0161	0.0441	0.7149
PEN 4	-0.0546	0.0664	0.4118
PEN 5	0.0000	—	—
PEN 6	-0.0987	0.0463	0.0336
PEN 7	0.0000	—	—
PEN 8	-0.0476	0.0389	0.2185
PEN 9	0.0000	—	—
PEN 10	0.2381	0.0763	0.0020
PEN 11	0.0000	—	—
PEN 12[e]	0.0000	—	—
Wt1	0.0005	0.0002	0.0165
(constant)	1.1453	0.0715	0.0

[a]Estimated regression coefficient
[b]Standard error of the estimated regression coefficient
[c]Significance of the partial *t*-test of the estimate B
[d]Coefficient of determination
[e]Reference dummy variable for the group

TABLE VI. Factors Associated with Disease in 322 Bulls Entering the Saskatchewan Central Beef Test Station in October of 1983

Dependent Variable	Independent Variable	B[a]	OR[b]	95% CL[c]
FEVER	AGE	-0.01653	0.98	0.97, 0.99
LAMENESS	Angus[d]	0.0000	—	—, —
	Charolais	1.6337	5.12	1.39, 18.9
	Gelbvieh	+	+	
	Hereford	2.8639	17.53	4.28, 71.7
	Maine-Anjou	1.5265	4.60	1.01, 20.9
	Shorthorn	+	+	
	Tarentaise	2.1504	8.59	1.47, 50.1
	Pinzgauer	+	+	
	Simmental	+	+	
	Limousin	2.7324	15.37	2.77, 85.4
	Wt1	0.00908	1.0091	1.0002, 1.0182

[a]Estimated regression coefficient. Values are only given for those estimates that are significant at $p \leq 0.05$. A '+' indicates a positive but nonsignificant coefficient

[b]OR = odds ratio (OR = expB). The odds of having fever for animals that differ in age by one year; the odds of lameness in animals of each breed, relative to the Angus breed, after controlling for the effects of differences in the initial weight; or the odds of lameness in animals that differ in their initial weight by 1 kg after controlling for the effects of differences in breed. A '+' indicates an odds ratio of > 1 but not significant

[c]95% confidence limits for odds ratio (95% CL = exp(B ± 1.96SE B)

[d]Reference variable for breed

(438 kg — 218 kg = 220 kg). Therefore, it can be estimated that the heaviest animal was about seven times [(exp(220 × 0.00908) = 7.37)] more likely to develop lameness than the lightest animal. With respect to FEVER, the predicted odds of disease in the youngest animal admitted to the test was about five times [(exp(-100 × -0.01653) = 5.22)] greater than the odds of disease in the oldest animal.

The p-values for the Brown statistic were acceptably high for both models (1.000 for the FEVER model and 0.648 for the LAMENESS model) indicating the appropriateness of the logistic model. The p-values for the Hosmer statistics were 0.946 and 0.156 respectively. This indicates good fit for the FEVER model but relatively poor fit for the LAMENESS model.

DISCUSSION

DESCRIPTIVE STATISTICS

Two main clinical abnormalities, FEVER and LAMENESS, occurred in this group of cattle. Published disease incidence rates from ROP stations could not be found but the 12.9% incidence of fever was relatively low compared to rates of respiratory disease generally reported in North American feedlots (7). All cases were treated with antibiotics until their rectal temperature fell below 40°C. None of the cases of FEVER were recorded as showing evidence of involvement of a system other than the respiratory system. Sixty percent of cases occurred in the first four weeks and 90% within the first eight weeks after arrival. Given these observations and recognizing that in the feedlot industry respiratory disease is reported as the most common disease during the first few weeks after arrival (8,9), it is presumed that most cases of fever were due to some form of respiratory disease. The low morbidity and short duration of treatment suggests minimal stress and a mild disease syndrome in most cases. The occurrence of a high rate of "other" diseases (44%) in the Herefords in pen 7 was largely due to an outbreak of ringworm that occurred in that pen.

Similar to FEVER, LAMENESS was crudely defined. All cases were treated with parenteral antibiotics but it is unlikely that each was due to a bacterial infection (e.g. footrot). It is more likely that other causes of lameness, including laminitis and minor injuries, contributed to the overall incidence of 17.2%. The short duration of treatment and low rate of recurrence again suggest that most animals were mildly affected.

FACTORS ASSOCIATED WITH ADG

Three factors, BREED, PEN and Wt1 (initial weight) were significantly associated with ADG. For BREED and Wt1 these results are consistent with previous analyses of Canadian ROP data (1,2,10) but the effect of pen assignment upon ADG was not expected. The reason for these pen effects could not be determined through analysis of this data set. Due to linear relationships between BREED and PEN the individual coefficients for these variables are biased and not readily interpretable. The confounding effects of BREED and PEN occurred because the design of the ROP test demanded that pen assignment be made according to breed or breed-type. The presence of significant pen effects in this preliminary study indicate that additional data should be analyzed to determine if these effects occur in other years.

Importantly, there was no evidence that either the diseases suffered by the bulls or their age when the test began had any significant effect upon overall ADG as a measure of genetic merit. The lack of an effect of AGE upon ADG is consistent with a recent study that showed that age has little influence upon ADG in Canadian ROP stations (1). It is recognized that although disease occurrence did not reduce overall ADG, short term effects followed by compensatory gains could have occurred.

All animals in the trial were treated with a parasiticide so there were no untreated animals available for comparison with them. Therefore, it was not possible to determine if parasiticides, in general, had an effect upon ADG. The analysis did show that there was no significant difference in ADG among the four different treatments.

The amount of variation in ADG explained by the model in Table V was acceptable (R square = 45%). The remaining, unexplained variation may have been largely due to the fact that heritability and a number of other predictors of ADG such as BIRTH WEIGHT, preweaning weight gains and pretest environment were not available for inclusion in the model (1,11). Inclusion of these variables would have increased the accuracy of ADG prediction but it is unlikely that this would result in any of the disease variables becoming significant.

FACTORS RELATED TO DISEASE

Of the factors examined, only AGE at arrival resulted in a significant increase in the odds of developing a fever. The age range of the calves was

100 days with the odds of disease in the youngest calf being approximately five times greater than that of the oldest calf. The older calves may have been immunologically more mature or more likely to have had previous exposure to common pathogens since waning of their maternal immunity than had the younger calves. There was a positive correlation between AGE and Wt1 so the selection of cases for clinical examination may have been biased towards smaller and therefore younger animals. Although difference in age has been reported as an important factor in respiratory disease morbidity, such results are based upon comparisons between calves and yearlings (12). The significant difference in the odds of disease over an age range of 100 days or less was an unexpected finding and deserves further investigation.

Other factors considered in this study that might have been expected to be associated with FEVER were the variables DISTANCE transported (9), PEN assignment and vaccination for IBR (13) prior to arrival. It is probable that most animals were transported directly from the farm of origin in small groups and over a relatively short period of time. Although some of the distances were considerable, the circumstances of transport probably minimized stress and therefore decreased the probability of transport contributing to an increased incidence of disease. Traditionally, diseases associated with the recent congregation of groups of cattle are considered infectious and therefore a pen effect upon the odds of disease should have been expected. Although FEVER did cluster in pens, this relationship became insignificant after controlling for the effect of AGE. These data suggest that clustering of these diseases in pens was due to the distribution of AGE among the pens rather than to some infectious property of the disease agents involved.

All of the animals in this study received an intranasal, modified live virus vaccination for IBR and PI3 upon arrival at the test station. In addition, about 18% of the animals had been vaccinated intramuscularly and 23% intranasally for IBR and PI3, prior to arrival at the test station. In the final model (Table V) there was no evidence that vaccination prior to arrival had either a positive or negative effect upon the incidence of FEVER.

LAMENESS was conditionally related to both BREED and Wt1. The low value for the Hosmer statistic indicates that the data for lameness did not fit the model well. A logical explanation for this is that one or more significant variables may not have been included in the model. After controlling for the effects of BREED, the predicted odds of LAMENESS in the animal with the highest initial weight was about seven times greater than the odds of disease in the lightest animal. A relationship between LAMENESS and both Wt1 and BREED makes sense intuitively if one assumes that increased weight leads to greater mechanical stress upon the foot and that differences in breed are associated with differences in hoof shape, size, conformation and composition. An increased incidence of footrot has been associated with specific breeds (14) and a heritable predisposition toward laminitis has also been suggested (15,16). However, LAMENESS was crudely defined in this study and therefore, in addition to searching for more variables significantly related to lameness, there is a need to examine additional data in which the case categorization is more precise.

In conclusion, neither the occurrence of disease nor the age of the bulls when they started on test appears to have had an effect upon their overall ADG or its usefulness as a measure of their genetic merit. Both average daily gain and the development of lameness were significantly influenced by a bull's breed and its initial test weight. In addition, the incidence of fever (suspected respiratory disease) was related to the age of the animal. The reader is cautioned that these results are preliminary in nature. Additional analyses of data from different tests and different stations are required to verify the results reported in this paper.

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REFERENCES

1. **TONG AKW.** Effect of initial age and weight on test daily gains of station-tested bulls. Can J Anim Sci 1982; 62: 671-678.
2. **WILTON JW, McWHIR J.** Individual and progeny measurements of growth in station and herd tests. J Anim Sci 1985; 61: 107-112.
3. **THOMAS LH, WOOD PDP, LONGLAND JM.** The influence of disease on the performance of beef cattle. Br Vet J 1978; 134: 152-161.
4. **KOOTS KR, COHEN RDH, NICHOLSON HH.** Yearly trends in the performance of bulls entered at the Saskatoon ROP bull test station. Can J Anim Sci (In press).
5. **SAS USER'S GUIDE:** Statistics, Version 5th Edition. Cary, North Carolina: SAS Institute Inc., 1985.
6. **DIXON WJ** (Editor). BMDP Statistical Software. Berkeley, California: University of California Press, 1983.
7. **KELLY AP, JANZEN ED.** A review of morbidity and mortality rates and disease occurrence in North American feedlot cattle. Can Vet J 1986; 27: 496-500.
8. **MARTIN SW.** Factors influencing morbidity and mortality in feedlot calves in Ontario. Vet Clin North Am (Large Anim Pract) 1983; 5: 75-86.
9. **MARTIN SW, MEEK AH, DAVIS DG, JOHNSON JA, CURTIS RA.** Factors associated with mortality and treatment costs in feedlot calves: The Bruce County beef project, years 1978, 1979, 1980. Can J Comp Med 1982; 46: 341-349.
10. **WILTON JW, BURGESS TD, BATRA TR.** Ultrasonic measurements of beef bulls in performance-testing programs. Can J Anim Sci 1973; 53: 629-636.
11. **PRESTON TR, WILLIS MB.** Intensive Beef Production. 2nd ed. New York: Pergamon Press, 1974: 124.
12. **CHURCH TL, RADOSTITS OM.** A retrospective survey of diseases of feedlot cattle in Alberta. Can Vet J 1981; 22: 27-30.
13. **MARTIN SW.** Vaccination: Is it effective in preventing respiratory disease or influencing weight gains in feedlot calves? Can Vet J 1983; 24: 10-19.
14. **MONRAD J, KASSUKU AA, NANSEN P, WILLEBERG P.** An epidemiological study of foot rot in pastured cattle. Acta Vet Scand 1983; 24: 403-417.
15. **LIVESEY CT, FLEMING FL.** Nutritional influences on laminitis, sole ulcer and bruised sole in Friesen cows. Vet Rec 1984; 114: 510-512.
16. **PETERSE DJ.** Laminitis and interdigital dermatitis and heel horn erosion: A European perspective. Vet Clin North Am (Food Anim Pract) 1985; 1: 83-91.