S. Afr. J. Anim. Sci. 10, 125 133 (1980)

PREWEANING GROWTH OF BRITISH, BOS INDICUS, CHAROLAIS AND DUAL PURPOSE TYPE CATTLE UNDER INTENSIVE PASTURE CONDITIONS

Receipt of MS 29-02-1980

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(Key words: *Preweaning growth, beef breeds)*
(Sleutelwoorde: *Voorspeense groei, beesrasse)*

OPSOMMING: VOORSPEENSE GROEI VAN BRITSE-BOS INDICUS- EN DUBBELDOELTIPE BEESTE ONDER INTENSIEWE WEIDINGSTOESTANDE

Faktore wat vroeë groei beïnvloed, is in 'n kruisgeteelde beeskudde onder intensiewe weidingstoestande ondersoek 8 731 waarnemings op 2 plase is met behulp van die kleinste kwadraat-metode geanaliseer. Die effek van ras van vaar, koeitipe, ouderdom van die moer, jaar, seisoen en geslag op geboortemassa, was betekenisvol (P < 0,01). Al genoemde veranderlikes behalwe seisoen, het voorspeense groei, gemeet in terme van gemiddelde daaglikse toename, werklike speenmassa en gekorrigeerde 210 dae massa, betekenisvol beïnvloed. Die invloed van die vaar binne die Simmentaler ras is groter as dié van vaar binne die Charolais en Hereford rasse. Betekenisvolle ras van vaar x geslag, ras van vaar x jaar, koeitipe x jaar interaksie effekte op geboortemassa asook ras van vaar x jaar, ras van vaar x seisoen en koeitipe x jaar op voorspeense groei is gevind. Betekenisvolle regressies op dag van geboorte binne die kalfseisoen dui aan dat geboortemassa, gemiddelde daaglikse toename en gekorrigeerde 210 dae massa toegeneem het soos die kalfseisoen gevorder het.

SUMMARY:

Factors influencing preweaning growth were investigated in a crossbred beef herd reared under intensive pasture conditions. 8 731 records were analysed within 2 farms using the method of least squares. The effect of sire breed, type of dam, age of dam, year, season and sex of calf significantly (P < 0,01) influenced birth mass and all these effects, except season, significantly influenced growth to weaning as measured by average daily gain, actual weaning mass and adjusted 210 day mass. The influence of the sire-effect within the Simmentaler breed was greater than that within the Charolais and Hereford breeds. Significant interaction-effects between sire-breed x sex, sire-breed x year and dam-type x year were established for birth mass. Growth to weaning was affected by the interaction of sire-breed x dam type, sire-breed x year, sire-breed x season and dam-type x year Significant regression on day of birth within the calving season, indicated that birth mass, average daily gain and adjusted 210 day mass increased as the calving season progressed.

Meaningful relationships between preweaning growth and the economics of beef production have been established (Lindholm & Stonaker, 1957; Swiger, Gregory, Sumption, Bredenstein & Arthaud, 1965; Harwin & Lombard, 1974; Koger, 1976). Consequently the factors affecting preweaning growth have been investigated in a variety of environments in Southern Africa particularly under extensive conditions (Vorster, 1954; Bosman & Harwin, 1966, 1967; Bonsma & Skinner, 1969; Harwin & Venter, 1970; Hartzenberg, 1971, Mostert, 1972; Venter, 1977) and semi extensive conditions (Lombard, 1963, 1971; Heyns, 1960, 1974).

This investigation was implemented to assess the influence of various breeds on preweaning growth of beef cattle under intensive pasture conditions.

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Materials and Methods

The Johannesburg City Council operates 2 beef cattle farms on the Transvaal highveld utilizing the sewerage effluent emanating from the Johannesburg sewerage works. The beef herd is raised on a limited pasture intake system using irrigated annual and perennial rye grass (*Lolium* spp) pastures supplemented with *Eragrostis curvula* hay, maize meal, mavovo (distillers grain) and silages (maize, sorghum and grass). Artificial insemination is practised throughout the herd. As a result of this intensification cows and calves are kraaled at night and have to walk up to 7 kilometres per day to pasture which contributes to the considerable stress imposed by intensification.

8731 records of calves born on these farms during the period 1971 to 1974 were included in the investigation. These calves were born from February to October weaned at 210 days of age (± 45 days) and creepfed from 3 months of age.

There are numerous crossbred cow types in the herd as 12 breeds have been introduced previously. Thus, cow-types rather than cow-breeds are referred to. The Dual Purpose type includes Friesian and Brown Swiss types.

The Least squares method of fitting constants (Harvey, 1972) was used to estimate the effects of various independant variables on preweaning growth. The statistical model (Paterson, 1978) included the dependant variables of birth mass, average daily gain, actual weaning mass and adjusted 210 day weaning mass and the independant variables of breed of sire, type of dam, age and production status of cow, year of birth, season of birgh, sex and sire with their interactions as well as the regressions of the dependant variables on day of birth of the calf within the season.

Results and discussion

Breed of Sire

The effect of breed of sire on all preweaning traits was significant (P < 0,01) on both farms (Table 1). All the differences between sire breeds (Table 2) were significant (P < 0,05). The Charolais sired calves were heavier at birth and weaning than the Simmentalers which were heavier than the Herefords. These differences expressed as percentages (Table 3) show that under the slightly better nutritional regime on farm 2 (Paterson, 1978) the Simmentaler sired calves were closer to the Charolais weaning performance than on farm 1. The Simmentaler sired calves showed a more favourable birth to weaning mass ratio than the Charolais calves (Table 4) indicating that it may be possible to select sire-breeds to produce growthy calves with relatively small birth masses (Venter, 1977).

Type of Dam

The effect of type of dam on all preweaning traits was significant (P < 0,01) on both farms (Table 1). Calves from British type dams were significantly smaller (P < 0,05) at birth and the calves from Charolais type dams were significantly larger (P < 0,05) at birth than calves out of other dam-types (Table 5). At weaning the calves from British types were significantly smaller (P < 0,05) but not as consistently so as at birth. Calves from Simmentaler type dams were significantly heavier (P < 0,05) at weaning than calves out of most other dam-types while the calves out of Charolais type dams were superior to only a few dam-types.

These differences between cow-types are similar to those reported by Allen (1976) for crossbred British, Charolais and Dual Purpose types, but less than the differences between cow breeds reported by Preston & Willis (1974) and Mostert (1972) indicating a closer genetic similarity between these selected crossbred types than straightbreds.

Breed of Calf

The breed of sire with type of dam interaction effect on birth mass was not significant (Table 1), but it is apparent (Table 6) that the combination of Charolais sires with Charolais dams produced the largest calves on farm 1, and on farm 2 the conbination of Charolais sire with Dual Purpose dams produced the largest calves. The smallest calves on both farms were produced by Hereford bulls and British type cows. This interaction effect was not significant at weaning on farm 1. The greatest preweaning growth was made by calves from Charolais bulls and Simmentaler cows followed closely by calves from the reciprocal cross. The significant (P <0,01) interaction effect on Sire-breed x dam-type (Table 1) indicates that on farm 1 a certain amount of hybrid vigour probably influenced the results. This effect on farm 2 was not significant yet showed a similar tendency to the results on farm 1.

Sire within breed

The effect of the Simmentaler sires on all preweaning traits was significant (P <0,01) on both farms while the Hereford sire effect was only significant (P < 0,01) on farm 2 and the Charolais sire effect was not significant at all (Table 1). The presence of large variation amongst the sires of the Simmentaler breed and less variation amongst the Hereford and Charolais sires is obvious at birth and weaning. Selection of superior sires in terms of increased calf growth to weaning or reduced birth mass is possible, particularly amongst Simmentaler sires. Differences between sires within breeds for the ratio of birth mass to weaning mass (Table 7) do exist, but as these differences are small the improvement obtained from selecting for this trait would undoubtedly be very small particularly when the high positive genetic correlations (0,79 on farm 1 and 0,89 on farm 2) between these traits in this herd are considered (Harwin, 1970).

Other Main Effects

The effects of age of dam, year, and sex significantly (P <0,01) – influenced all preweaning traits except for the effect of season (Table 1). Birth mass increased with age of dam up to 6 years old on farm 1 and 5 years old on farm 2, while for average daily gain and adjusted 210 day mass calf growth increased to 3 years of age on farm 1 and 5 years of age on farm 2. Rainfall of the previous year was related to the year-effect on preweaning growth even though the pastures were irrigated. The regressions of these preweaning traits on day of birth were significant (P < 0,01) and are in agreement with these reported by Lombard (1971). On farms 1 and 2 birth mass increased by 0,022 kg and 0,037 kg per day respectively for each day the calf was born later in the season. Average daily

Table 1

Analysis of variance of factors affecting birth mass (B.M.), average daily gain (A.D.G.), actual weaning mass (A.W.M.) and adjusted 210 day mass (ADJ. M.) on 2 farms

	Farm 1					Farm 2				
Source of variation:	D.F.	Mean Squares				D.F.	Mean Squares			
		B.M.	A.D.G.	A.W.M.	ADJ M		B.M.	A.D.G.	A.W.M.	ADJ. M.
Total	3768	632,16**				4963				
Total Reduction	79	643,16**	0,24**	15 429,90**	15 159,10**	80	693,55**	0,26**	20 501,07**	16 472,53**
Mean	1	71,39	0,01	7,89	29,03	1	31,57	0,00	896,88	1 194,12
Sire Breed	2	1 696,12**	0,69**	39 807,52**	43 551,75**	2	1 169,86**	0,28**	9 986,29**	21 005,44**
Dam Type	4	280,21**	0,07**	4 610,86**	4 823,30**	4	441,21**	0,24**	10 206,03**	14 976,71**
Dam Age	14	178,30**	0,18**	6 878,18**	10 198,78**	15	418,34**	0,38**	10 883,93**	22 236,45**
Year	3	302,30**	0,35**	25 293,12**	11 673,97**	3	116,03**	0,15**	20 360,73**	6 465,62**
Season	1	1 624,67	+0,60**	1 246,32	+41 388,02**	1	+692,38**	0,04	308,65	179,76
Sex	1	2 767,52**	2,93**	160 611,73**	169 990,44**	1	2 223,12**	1,22**	77 819,26**	77 859,39**
Sire Charolais	4	8,53	0,01	905,42	602,54	4	48,88	0,02	961,87	717,60
Sire Hereford	4	52,25	0,02	1 329,64	1 251,18	4	138,39**	0,04**	1 474,72	2 702,51**
Sire Simmentaler	8	331,67**	0,04**	3 221,46**	2 675,35**	8	455,43**	0,05**	3 534,61**	3 896,58**
Sire Breed x Dam Type	8	18,61	0,04**	1 952,58**	1 988,44**	8	37,87	0,02	441,24	981,72
Sire Breed x Sex	2	60,57	0,01	396,64	147,14	2	115,44	0,00	526,92	113,94
Dam Type x Sex	4	10,06	0,01	446,17	347,42	4	33,75	0,02	635,97	777,58
Sire Breed x Year	6	35,62	0,03*	2 598,81**	1 434,55**	6	50,70*	0,03*	1 693,43*	1 534,70*
Dam Type x Year	12	50,43	0,02	808,94	797,00	12	53,40	0,02	1 374,00	857,42
Sire Breed x Season	2	0,55	0,01	3 866,45**	285,35	2	34,55	0,02	2 887,53*	970,96
Birthday B Linear	1	259,29**	0,35**	42 149,41**	19 665,98*	1	808,16**	0,18**	169 090,01**	13 723,95**
Birthday B Quadratic	1	28,18	0,03	114 928,41**	1 642,73	1	246,87**	0,32**	4 477,27**	17 958,46**
Birthday B Cubic	1	0,00	0,00	111 632,10	27,90	1	89,22	0,29	47 163,96	15 237,19
Error	3689	23,05	0,01	693,40	596,77	4883	23,44	0,01	655,85	610,13

** Highly Significant P < 0,01

* Significant P < 0,05

D.F. = Degrees of freedom

Table 2

Least squares means for birht mass (B.M.), average daily gain (A.D.G.) actual weaning mass (A.W.M.) and adjusted 210 day mass by sire breed on 2 farms

Sire breed:	Farm 1					Farm 2				
	N	Least squares means (kg)				N	Least squares means (kg)			
		B.M.	A.D.G.	A.W.M.	ADJ. M		B.M.	A.D.G.	A.W.M.	ADJ. M.
Mean	3768	34,27	0,791	190,2	200,5	4963	36,31	0,803	199,6	204,9
Charolais	923	36,72	0,826	199,5	210,1	1143	39,00	0,839	205,0	215,1
Hereford	828	31,99	0,734	176,5	186,2	940	33,78	0,759	191,3	193,2
Simmentaler	2017	34,11	0,814	194,9	205,1	2880	36,15	0,811	202,6	206,4

Table 3

The percentage superiority in birth mass (B.M.), average daily gain (A.D.G.), actual weaning mass (A.W.M.) and adjusted 210 day mass (ADJ. M) shown by the Charolais sired calves over the Hereford and Simmentaler sired calves

Breed of sire	Farm 1				Farm 2			
	B.M.	A.D.G.	A.W.M.	ADJ. M.	B.M	A.D.G.	A.W.M.	ADJ. M.
Hereford	15	9	7	11	15	11	12	12
Simmentaler	8	3	4	4	8	1	2	2

Table 4

Birth mass (B.M.) as a percentage of adjusted 210 day mass (ADJ. M) by breed of sire

Sire breed	Farm 1			Farm 2		
	B.M.	ADJ. M.	Percentage	B.M.	ADJ. M.	Percentage
Charolais	36,71	210,11	17,5	39,0	215,11	18,1
Hereford	31,99	186,17	17,2	33,78	193,17	17,5
Simmentaler	34,11	205,10	16,6	36,15	206,39	17,5

Table 6

Least squares means (kg) for birth mass (B.M.), average daily gain (A.D.G.), actual weaning mass (A.W.M.) and adjusted 210 day mass (ADJ. M) for all combinations of sire breed and dam types on 2 farms

Sire breed	Type of Dam									
	British		Bos Indicus		Charolais		Simmentaler		Dual Purpose	
	Farm 1	Farm 2	Farm 1	Farm 2	Farm 1	Farm 2	Farm 1	Farm 2	Farm 1	Farm 2
(B.M.)										
Charolais	35,44	37,18	36,37	38,79	37,96	39,86	37,19	38,44	36,63	40,70
Hereford	30,52	32,15	31,67	32,89	33,65	35,55	32,06	34,42	32,05	33,90
Simmentaler	33,03	34,89	33,56	35,71	35,62	37,60	33,65	36,03	34,71	36,51
(A.D.G.)										
Charolais	0,816	0,846	0,820	0,836	0,811	0,815	0,868	0,864	0,814	0,834
Hereford	0,710	0,752	0,746	0,773	0,835	0,750	0,748	0,756	0,732	0,764
Simmentaler	0,798	0,811	0,801	0,800	0,856	0,844	0,810	0,789	0,807	0,811
(A.W.M.)										
Charolais	197	204	197	205	198	203	208	207	197	206
Hereford	169	190	177	189	182	195	179	190	174	192
Simmentaler	191	204	191	205	205	201	194	202	194	202
(ADJ. M.)										
Charolais	207	214	209	214	208	214	219	216	207	218
Hereford	180	192	188	192	188	195	189	195	186	192
Simmentaler	201	209	202	208	215	206	204	204	204	205

Table 7

Calf birth mass (B.M.) as a Percentage of adjusted 210 day mass (ADJ. M.) (kg) by sire

Breed:	Sire:	Farm 1			Farm 2		
		B.M.	ADJ. M	$\frac{B.M.}{ADJ.M.} \times 100$	B.M.	ADJ. M.	$\frac{B.M.}{ADJ\ M.} \times 100$
Charolais	CH 02	36,9	210	17,6	39,9	219	18,2
	CH 03	36,7	206	17,8	39,6	215	18,4
	CH 04	36,6	209	17,5	39,0	212	18,4
	CH 05	36,4	212	17,2	38,4	215	17,9
	CH 06	36,9	213	17,3	38,1	214	17,8
	Average	36,7	210	17,5	39,0	215	18,1
Hereford	HF 02	31,7	189	16,8	32,6	190	17,2
	HF 29	31,3	183	17,1	32,7	187	17,5
	HF 34	32,4	190	17,1	34,2	194	17,6
	HF 36	31,8	185	17,2	34,2	198	17,3
	HF 91	32,8	185	17,7	35,2	198	17,8
	Average	32,0	186	17,2	33,8	193	17,5
Simmentaler	SM 04	33,8	204	16,6	35,3	204	17,3
	SM 05	32,2	203	15,9	34,3	201	17,1
	SM 06	33,5	196	17,1	35,6	201	17,7
	SM 07	35,9	206	17,4	37,0	204	18,1
	SM 08	33,0	204	16,2	35,1	207	17,0
	SM 09	32,8	204	16,1	34,7	204	17,0
	SM 10	33,9	205	16,5	36,9	212	17,4
	SM 11	35,3	212	16,7	37,4	212	17,6
	SM 12	36,7	211	17,4	39,0	215	18,1
	Average	34,1	205	16,6	36,2	206	17,5

gain increased by 0,0008 kg and 0,0006 kg on farms 1 and 2 respectively. According to expectations, actual weaning mass decreased by 0,389 kg and 0,444 kg per day since calves born later were younger and adjusted 210 day mass increased by 0,188 kg and 0,187 kg per day.

Interaction Effects

The interaction effects were unimportant relative to the other effects, but significant effects on birth mass were found for the interactions sire-breed by sex, sire-breed by year and dam-type by year and on growth to weaning. The significant interactions were sire-breed by dam-type, sire-breed by year, sire-breed by season and dam-type by year. The breed by year and breed by season interactions indicate that the faster growing breeds, in particular the Charolais and often the Simmentaler, respond well to good seasons and the Charolais is particularly affected negatively by poor seasons.

Acknowledgements

With kind permission of the City Engineer the data used in this investigation was extracted from the records of the Johannesburg City Council cattle farms.The authors are grateful to Messrs. S. Hurwitz and W. Avis and Mrs D. Steyn for their assistance in the collation of this data and to the Department of Agricultural Technical Services and the department of Statistics, Pretoria University, for assistance with the analyses.

References

ALLEN, D.M., 1976. The future – milk versus beef or milk and beef. In *Principles of Cattle production.* Eds. H. Swan & W.H. Broster, London, Butterworths

BONSMA, J.C. & SKINNER, J.D., 1969. Factors influencing birth date, birth weight and preweaning growth rate of Afrikaner, Bonsmara and Hereford cattle in the subtropics. *Proc. S. Afr. Soc. Anim. Prod.* 8, 161.

BOSMAN, D.J. & HARWIN, G.O., 1967. Variation between herds in respect of the influence of year, sex, season and age of cow on weaning weight of beef calves. *Proc. S. Afr. Soc. Anim. Prod.* 6, 213.

BOSMAN, D.J. & HARWIN, G.O., 1966. Genetic and environmental factors affecting preweaning traits in beef cattle under extensive ranching conditions. *Proc. S. Afr. Soc. Anim. Prod.* 5, 153.

CUNNINGHAM, E.P., 1974. Breeding goals for beef cattle. *Ann. Genet. Sel. Anim.* 6, 219.

DICKERSON, G., 1969. Efficiency of animal production – moulding the biological components. *J. Anim. Sci.* 30, 849.

HARTZENBERG, F., 1971. 'n Statistiese analise van faktore wat die vroeë groei by vleisbeeste beïnvloed. D.Sc (Agric)-proefskrif, Univ. Pretoria.

HARVEY, W.R., 1972. Instructions for the use of LSMLMM (Least squares and maximum likelihood general purpose program 252K Mixed Model version). Mimeograph report.

HARWIN, G.O., 1970. Estimation of genetic parameters for preweaning traits in beef cattle in two environments. Paper presented at the S.A. Genetic Society Annual Congress. 1970.

HARWIN, G.O., FOURIE, P.C. & LOMBARD, J.H., 1966. Factors influencing efficiency and gross return under intensive beef production systems. *Proc. S. Afr. Soc. Anim. Prod.* 5, 147.

HARWIN, G.O., & LOMBARD, J.H., 1974. Intensification of the beef cow herd. *S. Afr. J. Anim. Sci.* 4, 247.

HARWIN, G.O. & VENTER, H.A.W., 1970. An investigation of the creep-feeding of beef calves in the mixed bushveld. *Proc. S. Afr. Soc. Anim. Prod.* 9, 161.

HEYNS, H., 1960. The growth of the Afrikaner calf in relation to the production and composition of the milk of its dam. II. The milk production of the dam and growth of the calf. *S. Afr. J. Agr. Sci.* 3, 517.

HEYNS, H., 1974. Genetiese en omgewingsparameters van 'n Afrikanerbeeskudde. D.Sc (Agric)-Thesis, Univ. of Pretoria.

KOGER, M., 1976. Effect of restricted feed grain: Changes in beef cattle breeding. *J. Anim. Sci.* 42, 787.

LINDHOLM, H.B., & STONAKER, H.H., 1957. Economic importance of traits and selection indexes for beef cattle. *J. Anim. Sci.* 16, 998.

LOMBARD, J.H., 1963. An investigation of environmental and genetic causes of variation in beef cattle traits. M.Sc (Agric)-Thesis, Univ. of Pretoria.

LOMBARD, J.H., 1971. Genetic and environmental factors affecting production of beef cattle in the highland sourveld areas. D. Sc (Agric)-Thesis, University of Pretoria.

MOSTERT, L., 1972. A comparative study of beef breeds and dual purpose breeds with regard to their beef production potentialities under ranching conditions in South West Africa. D.Sc (Agric)-Thesis, U.O.F.S., Bloemfontein.

PATERSON, A.G., 1978. Statistical analyses of factors affecting preweaning growth of beef cattle under intensive pasture conditions. M.Sc (Agric)-Thesis, Univ. of Pretoria.

PRESTON, T.R. & WILLIS, M.B., 1974. *Intensive beef production.* Oxford, Pergamon Press.

SWIGER, L.A., GREGORY, K.E., SUMPTION, L.J., BREIDENSTEIN, B.C. & ARTHAUD, V.H., 1965. Selection indexes for efficiency of beef production. *J. Anim. Sci.* 24, 418.

VENTER, H.A.W., 1977. Die doeltreffendheid van voorspeense groei by sekere vleis-, dubbeldoel- en kruisrasse in die Noord-Transvaalse soetbosveld. D. Sc (Agric)-Tesis, Univ. van Pretoria.

VORSTER, T.H., 1954. The influence of certain environmental factors and breed differences on cattle production. *Rhod. Agric. J.* 51, 428.