AN EVALUATION OF WEANING CHARACTERISTICS OF TWO SIMMENTAL HERDS

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ABSTRACT

Weaning traits (205-day mass, pre-weaning gain, Kleiber ratio, cow mass at weaning and cow efficiency) over a period of 15 years in two Simmental Studs in Namibia were analysed to assess the effects influencing weaning mass and pre-weaning gain and to determine improvement of all traits in time. No contradictions to results in the literature were found as regards these effects. In the case of the Uitkomst herd, significant linear regressions (y=12.30x-644.0; P<0,05 and y=0.062x-3.436; P<0,05) could be applied respectively for the 205-day masses and the corresponding daily gains on year of birth for the period from 1969 to 1973 only. In the case of the Neudamm herd, linear regressions could be applied from 1975/76 to 1983/84 for 205-day masses (y=5.56x-228.6; P<0.05), their corresponding daily gains (y=0.025x-1.107; P<0.05) and cow efficiencies (y=0.037x-0.75; P<0.01 for heifers weaned and y=0.054x-1.96; P<0.01 for bulls weaned) on year of birth/weaning.

UITTREKSEL

Speeneienskappe (205-dae massa, voorspeense massatoename, Kleiberverhouding, koeimassa tydens speen en koeidoeltreffendheid) oor 'n periode van 15 jaar in twee Simmentaler Stoetkuddes in Namibië was geanaliseer om effekte wat speenmassa en voorspeense groei beïnvloed, te bepaal en om die verbetering van alle eienskappe oor jare vas te stel. Betreffende die effekte is geen teenstrydighede met resultate in die literatuur gevind nie. In die geval van die Uitkomst kudde kon betekenisvolle lineêre regressies (y=12.30x-644.0; P<0.05 en y=0.062x-3.436; P<0.05) onderskeidelik vir die 205-dae massas en ooreenstemmede daaglikse massatoenames op jaar van geboorte alleenlik vir die periode van 1969 tot 1973 gepas word. In die geval van die Neudamm kudde kon lineêre regressies van 1975/76 tot 1983/84 vir die 205-dae massas (y=5.56x-228.6; P<0.05), die ooreenstemmende daaglikse massatoe-names (y=0.025x-1.107; P<0.05) en koeidoeltreffendhede (y=0.037x-0.75; P<0.01 vir verse gespeen en y=0.054x-1.96; P<0.01 vir bulle gespeen) op jaar van geboorte/speen gepas word.

INTRODUCTION

Authorities in the former South West African Administration established two Simmental Studs during the nineteen-fifties, one at Neudamm Agricultural College and one at Uitkomst Research Station.

Since 1969, both herds have been subjected to performance testing by the National Beef Cattle Performance and Progeny Testing Scheme from the Republic of South Africa. At the end of 1984, the Neudamm Stud was transferred to Uitkomst to integrate both studs into one herd. Weaning characteristics (from 1969 to 1983) were chosen for evaluation due to the fact that they reflect herd profitability (Harwin, 1966; Lombard, 1971; Mostert, 1972; Venter, 1977). The purpose of the evaluation was to determine the improvement over time of the 205-day mass, mass gain from birth to the age of 205 days (average daily gain per day of age = ADA), growth efficiency in pursuance of the Kleiber (1936) ratio, cow mass and cow efficiency. Furthermore, the evaluation served to determine the effects contributing to the 205-day mass and the corresponding growth rate. Fertility parameters like calving and weaning percentages are probably more important but in this study it was not possible to ascertain factors such as culling procedures during the early years.

MATERIALS AND METHODS

The 205-day masses and ADA's were collected and summarized according to herd, sex and calving season. Cow masses at weaning were collected from available records. In the case of Uitkomst, records dated from 1975 and in the case

205-day masses as well as ADA's were additionally processed by the Proc. GLM-programme (S.A.S. User's Guide, 1979) according to the following fixed effect linear model:

$$Y_{ijkl} = M + A_i + B_j + C_k + D_l + BD_{jl}$$

where

Y_{ijkl} = individual corrected observation
M = general average
A_i = effect of sex (heifer or bull)
B_j = effect of month of calving (October, November or December)
C_k = effect of year (1969 to 1983)
D_l = effect of cow age at calving (4 classes: 1 = up to 36 months, 2 = 36 to 48 months, 3 = 48 to 72 months, 4 = above 72 months)
BD_{jl} = effect of interaction between month of calving and age of cow

of Neudamm, from 1976. Calves of both herds were born mainly from October to December with only a very small number of calves being born outside that period. All calves born within one season were regarded as contemporaries.

A negligible number of calves born either before October or after December were not included in the linear model. Other characteristics such as growth efficiency, cow mass and cow efficiency were not corrected by fixed effects because sexes were considered separately. Growth efficiency was calculated as the relation between the pre-weaning growth rate and the metabolic 205-day mass (Scholtz & Roux, 1988) and cow efficiency as the relation between the 205-day mass of a calf and the (cow mass)$^{0.73}$ (Bosman, 1986) at weaning.

Initially, it was tried to apply linear regressions over years to all the characteristics with the aid of the STATPAK-programme (NWA STATPAK, 1984). Year (1969 to 1983) was taken as the x-variable for the corresponding calving season (1969/70 to 1983/84). Because cow mass and hence cow efficiency was available only for the period from 1975/76 to 1983/84, both the 205-day mass and the pre-weaning growth rate were divided into corresponding intervals and linear regressions were then applied.

Differences between averages not included in the fixed effect linear model were tested for significance by means of the t-test (Haiger, 1978). All tests for significance were done at one- and five percent levels. Significant and highly significant contributions to the total variation as well as the significance of correlation coefficients (r) are indicated by * and ** respectively. Significant and highly significant differences between averages are indicated by single and double superscripts respectively.

RESULTS AND DISCUSSION

The results of the 205-day masses and corresponding mass gains are summarized in Tables 1 and 2. The statistical model declares by means of its coefficient of determination (R^2) 53.5 and 53.6% of the variation of the 205-day mass and ADA for the Neudamm herd and in case of the Uitkomst herd 43.6 and 43.7% respectively. The contribution of all effects to the total variation is highly significant except for month of calving in the case of the 205-day mass of Uitkomst, which was only significant. Year, followed by sex, made the greatest contribution to the total variation in all cases, while month of calving made the smallest contribution.

The average of the corrected averages differed highly significantly between the two herds. The averages of the sexes differed highly significantly in all cases. The bulls of the Neudamm herd were 7,4 percent and the bulls of Uitkomst herd 9,8 percent heavier than the heifers of the respective herds. This is in agreement with the findings of Heyns (1977) and Paterson (1978). A tendency was found that the earlier born calves, those born from October to December, were heavier and faster growing than those born later. Furthermore, as the cows became older, their calves became heavier and showed a higher ADA. The results obtained in this study regarding different effects influencing weaning traits correspond well with the results of other authors (Bosman & Harwin, 1967; Venter, 1977; Paterson, 1978; Van Zyl et al., 1987) although the effect of season might differ.

The corrected averages of the 205-day masses of both herds are graphically illustrated in Figure 1 and the daily mass gains of both herds in Figure 2. For the whole period no significant linear regressions could be fitted, but after dividing the period according to the recorded cow masses, significant linear regressions were found. In case of the Neudamm herd significant linear regressions were found from 1975 to 1983 for the corrected 205-day masses and ADA's where y=5.56x-228.6 (r=0.76*) and y=0.025x-1.107 (r=0.74*) respectively. In case of the Uitkomst herd, significant linear regressions were also found for the corrected 205-day masses and ADA's, but for the period from 1969 to 1973, where y=12.30x-644.0 (r=0.95*) and y=0.062x-3.436 (r =0.96*) for the mentioned traits respectively. The results indicating the increase over years did not meet the expectation that the 205-day mass and the ADA would significantly increase over the whole period. In comparison, Parnell et al. (1986) found an increase of 19 and 20 kg for heifers and bulls respectively over a ten-year period regarding the 200-day mass.

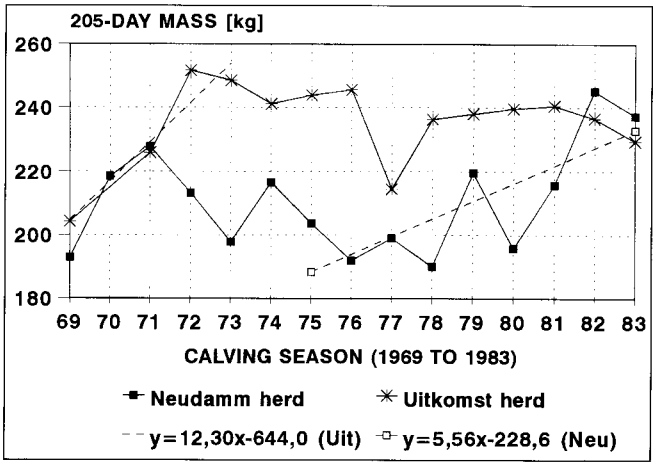

Figure 1. General linear model (GLM)-corrected 205-day masses (Neu = Neudamm herd; Uit = Uitkomst herd).

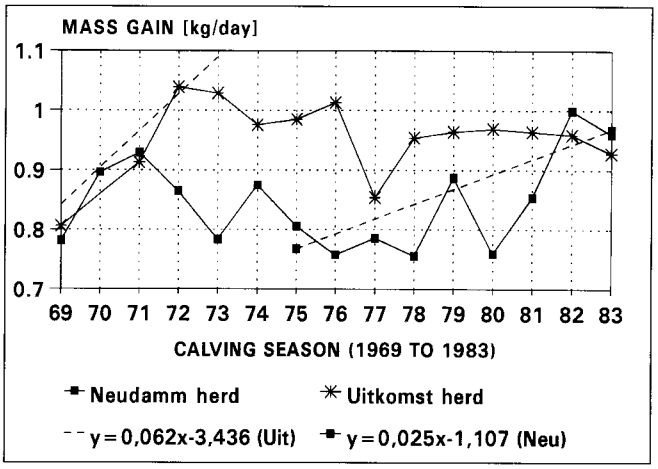

Figure 2. General linear model (GLM)-corrected mass gains from birth to 205 days of age (Neu = Neudamm herd; Uit = Uitkomst herd).

Table 1. Average 205-day masses (kg)

Calving season	NEUDAMM					UITKOMST				
	Heifers		Bulls			Heifers		Bulls		
	n	x SD	n	x SD	ca	n	x SD	n	x SD	ca
1969/70	18	188.8 ±21.2	16	196.9 ±23.7	192.9	19	201.8 ±16.0	14	215.0 ±21.2	204.2
1970/71	15	206.9 ±12.3	14	230.9 ±20.9	218.4	-	-	-	-	-
1971/72	17	222.4 ±20.6	12	243.6 ±22.9	227.8	18	217.5 ±20.6	12	247.5 ±25.7	225.9
1972/73	22	215.1 ±14.1	10	213.8 ±25.6	213.3	19	241.2 ±17.2	15	275.7 ±17.2	251.6
1973/74	29	192.3 ±19.4	16	204.6 ±22.6	197.9	15	246.7 ±25.4	14	264.7 ±30.8	248.5
1974/75	20	208.6 ±24.0	21	226.9 ±20.1	216.7	24	233.2 ±16.1	16	256.4 ±35.4	241.2
1975/76	32	191.3 ±27.0	28	204.3 ±31.6	203.7	27	236.1 ±23.9	25	263.1 ±24.2	243.9
1976/77	35	184.8 ±23.4	31	202.2 ±23.0	192.0	23	238.4 ±20.1	24	269.8 ±24.4	245.6
1977/78	45	198.8 ±15.4	42	203.2 ±23.3	199.0	30	215.1 ±28.6	22	227.4 ±32.8	214.5
1978/79	39	185.8 ±26.9	40	199.6 ±21.9	190.0	25	224.4 ±29.7	16	259.3 ±24.2	236.3
1979/80	22	216.0 ±16.1	21	231.3 ±25.0	219.6	27	231.2 ±25.8	17	247.9 ±27.3	238.0
1980/81	25	197.3 ±12.7	17	201.1 ±17.4	195.8	17	231.7 ±26.5	21	249.4 ±35.4	239.6
1981/82	24	210.8 ±18.2	19	231.8 ±13.8	215.8	22	236.5 ±16.0	19	262.5 ±24.5	240.5
1982/83	25	238.8 ±17.8	25	258.8 ±19.2	245.2	8	232.5 ±21.4	28	254.6 ±19.2	236.6
1983/84	24	224.0 ±18.7	26	253.9 ±19.2	237.4	21	234.4 ±16.0	28	236.5 ±20.4	229.5
Total	392		338			295		271		
Average		205.4		220.2	211.0^{aa}		230.1		252.1	235.4^{aa}
Heifers					203.5^{bb}					224.4^{jj}
Bulls					218.5^{bb}					246.4^{jj}
October					214.3^{cc}					239.6^{k}
November					213.8^{dd}					236.5
December					205.0^{ccdd}					230.1^{k}
Cow age 1					198.4^{eeffgg}					218.4^{llmmnn}
Cow age 2					209.8^{eehhii}					233.4^{lloopp}
Cow age 3					216.8^{ffhh}					242.9^{mmoo}
Cow age 4					219.1^{ggii}					247.1^{nnpp}
Fixed effect linear model (R^2) (%)					53.5**					43.6**
Sex (R^2) (%)					6.8**					13.3**
Month of calving (R^2) (%)					1.4**					0.8*
Year (R^2) (%)					34.5**					17.1**
Cow age (R^2) (%)					4.3**					6.0**
Month x cow age (R^2) (%)					0.6					0.6

n = number; x = average; SD = standard deviation; ca = corrected average by linear model; $^{a,b...}$ = significant difference (P<0.05); $^{aa,bb...}$ = highly significant difference (P<0.01); R^2 = coefficient of determination; * = significant (P<0.05) contribution to total variation; ** = highly significant (P<0.01) contribution to total variation

Table 2. Average daily mass gains from birth to 205 days (kg per day)

Calving season	NEUDAMM					UITKOMST				
	Heifers		Bulls			Heifers		Bulls		
	n	x SD	n	x SD	ca	n	x SD	n	x SD	ca
1969/70	18	0.819 ±0.241	16	0.782 ±0.105	0.798	19	0.803 ±0.077	14	0.852 ±0.105	0.806
1970/71	15	0.850 ±0.055	14	0.947 ±0.100	0.896	-	-	-	-	-
1971/72	17	0.915 ±0.095	12	0.992 ±0.110	0.929	18	0.883 ±0.100	12	1.000 ±0.126	0.913
1972/73	22	0.879 ±0.055	10	0.858 ±0.105	0.865	19	0.996 ±0.071	15	1.146 ±0.077	1.039
1973/74	29	0.765 ±0.089	16	0.806 ±0.089	0.784	15	1.021 ±0.114	14	1.140 ±0.130	1.029
1974/75	20	0.839 ±0.105	21	0.911 ±0.089	0.875	24	0.947 ±0.071	16	1.004 ±0.158	0.976
1975/76	32	0.757 ±0.122	28	0.796 ±0.141	0.806	27	0.949 ±0.110	25	1.071 ±0.110	0.985
1976/77	35	0.725 ±0.105	31	0.803 ±0.095	0.758	23	0.991 ±0.089	24	1.110 ±0.095	1.013
1977/78	45	0.791 ±0.071	42	0.801 ±0.105	0.786	30	0.856 ±0.164	22	0.917 ±0.141	0.854
1978/79	39	0.741 ±0.118	40	0.796 ±0.100	0.756	25	0.910 ±0.130	16	1.050 ±0.105	0.954
1979/80	22	0.878 ±0.071	21	0.930 ±0.114	0.887	27	0.934 ±0.114	17	1.012 ±0.126	0.964
1980/81	25	0.773 ±0.055	17	0.775 ±0.084	0.760	17	0.936 ±0.118	21	1.007 ±0.155	0.969
1981/82	24	0.835 ±0.084	19	0.924 ±0.055	0.854	22	0.952 ±0.077	19	1.062 ±0.110	0.964
1982/83	25	0.976 ±0.071	25	1.054 ±0.084	0.999	8	0.936 ±0.095	28	1.040 ±0.089	0.959
1983/84	24	0.903 ±0.084	26	1.030 ±0.084	0.960	21	0.961 ±0.071	28	0.953 ±0.095	0.928
Total	392		338			295		271		
Average		0.830		0.881	0.846^{aa}		0.934		1.023	0.954^{aa}
Heifers					0.818^{bb}					0.907^{jj}
Bulls					0.875^{bb}					1.000^{jj}
October					0.867^{cc}					0.977^{kll}
November					0.860^{dd}					0.954^{k}
December					$0,812^{ccdd}$					0.931^{ll}
Cow age 1					0.784^{eeffgg}					0.875^{mmnnoo}
Cow age 2					0.843^{eehhii}					0.941^{mmppqq}
Cow age 3					0.871^{ffhh}					0.988^{nnpp}
Cow age 4					0.887^{ggii}					1.011^{ooqq}
Fixed effect linear model (R^2) (%)					53.6^{**}					43.7^{**}
Sex (R^2) (%)					5.0^{**}					11.2^{**}
Month of calving (R^2) (%)					2.2^{**}					1.0^{**}
Year (R^2) (%)					35.7^{**}					18.7^{**}
Cow age (R^2) (%)					4.9^{**}					6.4^{**}
Month x cow age (R^2) (%)					0.7					0.5

n = number; x = average; SD = standard deviation; ca = corrected average by linear model; $^{a,b...}$ = significant difference (P<0.05); $^{aa,bb...}$ = highly significant difference (P<0.01); R^2 = coefficient of determination; * = significant (P<0.05) contribution to total variation; ** = highly significant (P<0.01) contribution to total variation

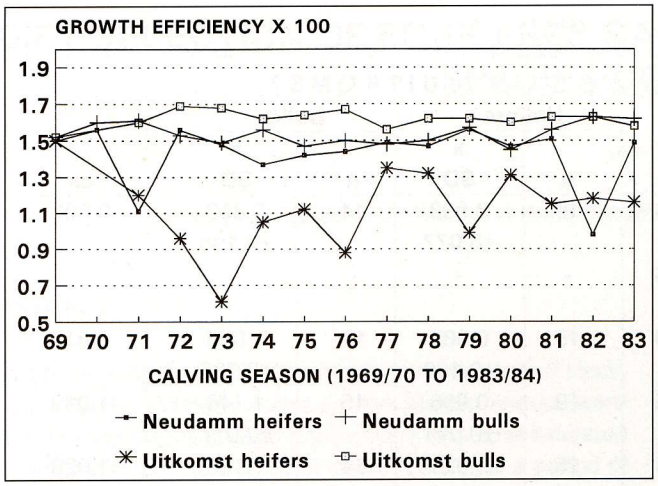

Figure 3. Average pre-weaning growth efficiency.

Pre-weaning growth efficiency or the Kleiber ratio according to Scholtz & Roux (1984, 1988) is a useful measurement for feed conversion (Table 3 and Figure 3). No significant regression over years could be applied although the averages between heifers and bulls, within and between herds, differed highly significantly. The vast differences between the relation of Uitkomst bulls to Uitkomst heifers and that of Neudamm bulls to Neudamm heifers (1.43 and 1.08) as well as the great fluctuations from year to year and the definitely lower efficiency of the Uitkomst heifers in comparison to the others, is striking. According to Scholtz & Roux (1984), the Kleiber ratio might hold the possibility to select for sexual dimorphism (large bulls and small cows within the same herd). This feature could possibly show up in this case.

Cow masses at weaning are listed in Table 4 and are illustrated graphically in Figure 4. The Uitkomst cows were found to be

Table 3. Average pre-weaning growth efficiency [(ADA 205)/(205-day mass)$^{0.75}$]

Calving season	NEUDAMM				UITKOMST			
	Heifers		Bulls		Heifers		Bulls	
	n	x SD	n	x SD	n	x SD	n	x SD
1969/70	18	0.0150 ±0.0008	16	0.0152 ±0.0007	19	0.0150 ±0.0008	14	0.0152 ±0.0008
1970/71	15	0.0156 ±0.0005	14	0.0160 ±0.0007	-	-	-	-
1971/72	17	0.0111 ±0.0072	12	0.0161 ±0.0007	18	0.0120 ±0.0065	12	0.0160 ±0.0009
1972/73	22	0.0157 ±0.0004	10	0.0153 ±0.0007	19	0.0096 ±0.0077	15	0.0169 ±0.0004
1973/74	29	0.0148 ±0.0008	16	0.0149 ±0.0006	15	0.0061 ±0.0070	14	0.0168 ±0.0007
1974/75	20	0.0137 ±0.0045	21	0.0156 ±0.0006	24	0.0105 ±0.0073	16	0.0162 ±0.0009
1975/76	32	0.0142 ±0.0027	28	0.0147 ±0.0015	27	0.0112 ±0.0067	25	0.0164 ±0.0007
1976/77	35	0.0144 ±0.0009	31	0.0150 ±0.0006	23	0.0088 ±0.0076	24	0.0167 ±0.0004
1977/78	45	0.0149 ±0.0006	42	0.0148 ±0.0008	30	0.0135 ±0.0049	22	0.0156 ±0.0008
1978/79	39	0.0147 ±0.0010	40	0.0150 ±0.0008	25	0.0132 ±0.0054	16	0.0162 ±0.0007
1979/80	22	0.0156 ±0.0006	21	0.0157 ±0.0007	27	0.0099 ±0.0072	17	0.0162 ±0.0008
1980/81	25	0.0147 ±0.0005	17	0.0145 ±0.0008	17	0.0131 ±0.0054	21	0.0160 ±0.0009
1981/82	24	0.0151 ±0.0006	19	0.0156 ±0.0004	22	0.0115 ±0.0068	19	0.0163 ±0.0006
1982/83	25	0.0098 ±0.0075	25	0.0163 ±0.0005	8	0.0118 ±0.0070	28	0.0163 ±0.0006
1983/84	24	0.0149 ±0.0030	26	0.0162 ±0.0005	21	0.0116 ±0.0070	28	0.0158 ±0.0007
Total	392		338		295		271	
Average		0.0143^{aa}		0.0154^{aa}		0.0113^{aa}		0.0162^{aa}

ADA 205 = average daily gain from birth to the age of 205 days; n = number; x = average; SD = standard deviation; ^{aa} = highly significant difference ($P<0.01$)

Table 4. Average cow masses at weaning (kg)

Weaning season	NEUDAMM			UITKOMST		
	n	x	SD	n	x	SD
1975	-	-	-	36	566.1	±54.0
1976	59	469.7	±62.2	50	556.4	±48.2
1977	65	479.5	±50.3	41	595.0	±47.7
1978	87	484.1	±45.0	42	544.7	±66.2
1979	70	479.3	±54.9	33	554.2	±78.8
1980	42	531.1	±60.1	43	549.0	±75.0
1981	42	481.0	±37.2	37	499.5	±63.5
1982	41	507.6	±41.2	41	554.2	±44.4
1983	50	535.2	±33.2	41	553.0	±46.7
1984	49	508.7	±30.2	49	544.4	±43.9
Total	505			413		
Average		497.4^{aa}			551.7^{aa}	

n = number; x = average; SD = standard deviation; ^{aa} = highly significant difference (P<0.01)

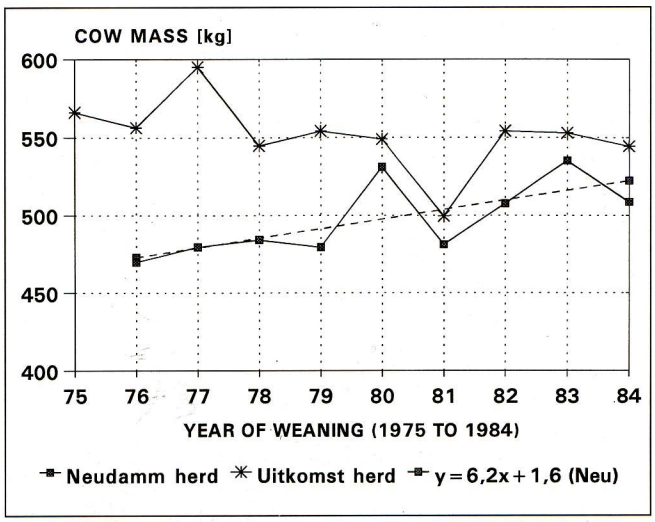

Figure 4. Average cow masses at weaning (kg) (Neu = Neudamm cows).

Table 5. Average cow efficiency at weaning [(205-day mass)/(cow mass)$^{0.73}$]

Weaning Season	NEUDAMM				UITKOMST			
	Heifers		Bulls		Heifers		Bulls	
	n	x SD	n	x SD	n	x SD	n	x SD
1975	-	-	-	-	21	2.286 ±0.185	15	2.515 ±0.284
1976	32	2.158 ±0.225	27	2.280 ±0.308	25	2.403 ±0.248	25	2.595 ±0.235
1977	34	2.051 ±0.225	31	2.223 ±0.233	17	2.266 ±0.172	24	2.533 ±0.229
1978	45	2.149 ±0.157	42	2.270 ±0.197	27	2.133 ±0.233	15	2.306 ±0.347
1979	34	2.117 ±0.215	36	2.218 ±0.233	19	2.350 ±0.150	14	2.600 ±0.198
1980	22	2.242 ±0.205	20	2.373 ±0.282	27	2.343 ±0.192	16	2.427 ±0.247
1981	25	2.160 ±0.158	17	2.240 ±0.159	16	2.445 ±0.285	21	2.696 ±0.285
1982	24	2.269 ±0.212	17	2.428 ±0.225	22	2.346 ±0.173	19	2.627 ±0.244
1983	25	2.409 ±0.145	25	2.670 ±0.207	10	1.877 ±1.003	25	2.670 ±0.207
1984	24	2.375 ±0.190	25	2.674 ±0.189	21	2.344 ±0.243	28	2.408 ±0.231
Total Average	265	2.214^{abb}	240	2.375^{ac}	205	2.279^{dd}	202	2.538^{bbcdd}

n = number; x = average; SD = standard deviation; $^{a,c...}$ = significant difference (P<0.05); ^{bb,dd} = highly significant difference (P<0.01)

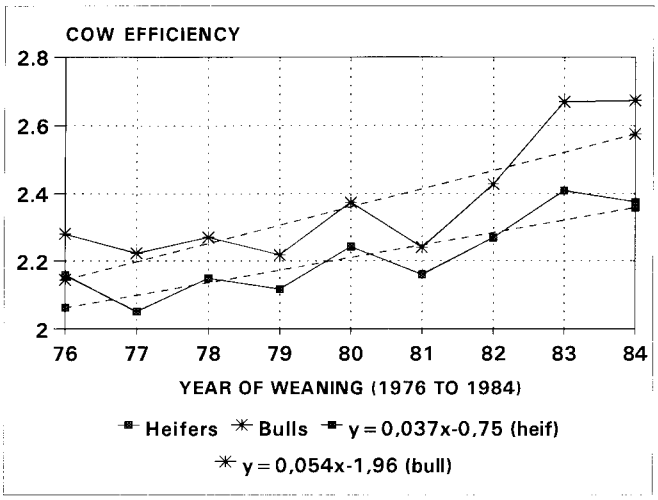

Figure 5. Average cow efficiency, Neudamm herd (heif = heifer calves; bull = bull calves).

highly significantly heavier than the Neudamm cows, but the latter group showed an increase described by the following significant regression: y=6.2x+1.6 (r=0.70*).

Cow efficiency is summarized in Table 5. Uitkomst cows with bull calves were the most efficient, followed by Neudamm cows with bull calves and then Uitkomst and Neudamm cows with heifer calves. Some averages differed significantly and others even highly significantly.

Only in the case of the Neudamm herd were highly significant positive regressions found for cow efficiency (Figure 5), namely y=0.037x-0.75 (r=0.85**) for cows with heifer calves and y=0.054x-1.96 (r=0.82**) for cows with bull calves. The results indicate that the 205-day mass increased at a higher rate than the cow mass.

CONCLUSION

The results concerning the different effects influencing weaning mass and pre-weaning gain do not contradict other results found in the literature, which means that no abnormalities were detected. Regarding weaning mass, pre-weaning gain and cow mass, the Uitkomst herd was superior to the Neudamm herd. In case of growth efficiency, Uitkomst bulls were the most efficient and Uitkomst heifers the least efficient. A definite reason for this finding cannot be given. Significant positive linear regressions were found in the case of the Uitkomst herd for weaning mass and pre-weaning gain from 1969 to 1973. In the case of the Neudamm herd, positive linear regressions were found for the period of 1975/76 to 1983/84 for weaning mass, pre-weaning gain, cow mass and cow efficiency. Hence, improvement did occur in both herds over time. It is recommended that a further increase in cow mass should be avoided in future and that more emphasis should be placed on efficiency traits.

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