

Genetic Trends for Growth in a Selection Experiment Involving Purebred and Two-Breed Synthetic Beef Breed in a Tropical Environment

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Key words

Gudali cattle – Wakwa cattle – Meat animal – Genetic gain – Cameroon.

Summary

Data collected between 1968 and 1988 from a selection experiment involving the purebred Gudali and a two-breed synthetic, the Wakwa, at the Animal Production and Research Station of Wakwa in Ngaoundere, Cameroon, were analyzed using mixed model procedures. An assessment of genetic progress indicated positive and significant ($p < 0.01$) annual mean direct genetic trends for average preweaning daily gain (ADG), birth weight (BWT), weaning weight (WWT), yearling weight (YWT) and eighteen-month weight (EWT) in both breeds. Corresponding annual maternal trends, with the exception of the ADG trend in Gudali and EWT in Wakwa, were significant ($p < 0.05$) but negative. Differences between corresponding direct responses in Gudali and Wakwa were not significant. It was concluded that improvement through selection of growth traits was possible in both the synthetic and the indigenous breeds in a harsh tropical environment. The genetic antagonism between the direct and maternal genetic effects was of great concern and therefore requires further investigation.

■ INTRODUCTION

Cattle production in Cameroon is essentially under a traditional small-scale husbandry management system. The resultant effects are high inbreeding, low fertility, high mortalities of about 5-10% in adult cattle and 20% in calves (Tanya, unpublished results). In an effort to change the situation, the government has put in place a number of programs for cattle production improvement. In 1952 a program code-named “Wakwa” was launched (24). This program developed a two-breed synthetic beef cattle, the Wakwa, from mating the American Brahman to the local Gudali and continuing with the first filial generation (33). In 1969, another program, the

Gudali (Ngaoundere), was launched (22). This program was geared towards the systematic improvement of the indigenous Gudali through selection without crossbreeding. Much data on growth traits have accumulated over the years since the inception of the two programs. An evaluation of these data, in the form of an assessment of genetic progress attained, is imperative in an effort to identify problems to be expected for possible remedial actions.

Improvement in beef cattle through selective breeding presupposes the ability to recognize and mate animals with superior genotypes for economically important traits. Initial evaluation of bulls in the two programs had, however, simply been based on within-group comparisons. Research findings have shown that mass selection on own performance can lead to a bias (10, 17) resulting from the wrongly ranking of bulls and the non-adjustment of group averages for genetic changes that have taken place (35, 36). Tawah et al. (32), in an effort to improve on this methodological bias, used the best linear unbiased prediction (BLUP) approach developed by Henderson (11, 12) to estimate genetic trends for birth and weaning weights in Gudali and Wakwa breeds. No further attempts have been made to evaluate also genetic changes for postweaning weights in the two breeds.

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Henderson's mixed model methodology (MMM) (11, 12) is now the method of choice to evaluate BLUP for direct additive and maternal breeding values. This method can have many applications; among others, it enables maximum utilization of information from relatives (3, 29, 30, 34), leading to more precise inferences about genetic values and to the correction of biases due to ignoring many relationships (9), effectiveness in separating genetic effects from environmental effects (1, 3) and across-herd and across-year evaluations, provided there is genetic connectedness between herds and years (11, 13). Consequently, BLUP evaluation can substantially improve genetic progress in beef cattle since it results in higher accuracy, increased selection intensity and early identification of young animals of higher genetic merits as a result of comparing estimated breeding values (EBV) across herds and years. The objective of this study was to use the mixed model methodology to estimate comparative genetic trends for direct and maternal effects for preweaning and postweaning growth weights in Gudali and Wakwa breeds.

■ MATERIALS AND METHODS

The breeding animals were obtained from two selection experiments. One involved a recurrent selection of the local, purebred Gudali and the other a two-breed synthetic beef breed, the Wakwa. Data and various effects affecting the growth traits in the selection experiments have already been comprehensively

reported by Ebangi et al. (6). In addition, details on the experimental procedures have also been provided by Lhoste (21, 22), and Pamo and Yonkeu (28). However, the edited data structure on progeny records and covariates are presented in Tables I and II.

In beef cattle, selection experiments are usually based on what is regarded as important, namely the increased growth rate. In the Gudali and Wakwa selection experiment, a weight ratio (traditionally called an index) at weaning, 12, 24 and 36 months of age was used for individual selection. The ratio was calculated on a within age-sex-breed group basis. Individual animals were selected on a weight index calculated as a ratio of an individual's weight at weaning, yearling, 24 and 36 months to its corresponding age-sex-breed contemporary group average weight. The selection truncation point varied with numbers available, influenced by reproductive rate, deaths, sales, emergency slaughters and replacement requirements. According to Tawah et al. (32), conformation and physical or structural soundness were additional criteria used on sires and heifers that had already been subjected to individual weaning weight screening for final selection. The test bulls were then randomly mated to about 30 to 40 breeding females for progeny testing. The testing procedure has been described by Tawah et al. (32). Heifers were usually mated at three to four years or at 250 kg body weight and proportionately about 0.05 to 0.10 cows were regularly culled together with their progeny for poor calf weaning weight or poor individual

Table I

Summarized data structure on genetic trends

Breed	Trait	Rec	Mean	SD	CV	Sires	Dams	Dam/Sire	Rec/Sire	Rec/Dam
Gudali	BWT	2 886	24.09	2.73	11.34	93	1137	12.23	32.99	2.70
	ADG	2 732	0.52	0.12	23.14	93	1115	11.99	32.99	2.75
	WWT	2 899	149.79	28.49	9.15	93	1181	12.70	32.99	2.60
	YWT	2 098	159.12	28.04	17.64	82	1001	12.21	25.59	2.10
	EWT	1 957	197.77	36.50	18.45	79	931	12.08	24.80	2.10
Wakwa	BWT	1 793	24.90	3.14	12.62	60	656	10.93	32.68	2.99
	ADG	1 656	0.57	0.12	21.11	60	639	10.65	32.68	3.07
	WWT	1 838	161.65	29.54	18.27	60	710	11.83	32.68	2.76
	YWT	1 372	170.70	27.71	16.23	53	570	10.75	27.08	2.52
	EWT	1 328	213.65	37.38	17.50	53	579	11.13	25.17	2.30

Rec = number of records; SD = standard deviation; CV = coefficient of variation; BWT = birth weight (kg); ADG = preweaning average daily weight gain (kg/d); WWT = weaning weight (kg); YWT = yearling weight (kg); EWT = eighteen-month weight (kg)

Table II

Summarized data structure of covariates on genetic trends

Breed	Covariate	Minimum	Maximum	Mean	SD	CV
Gudali	WAGE	114	398	238.67	17.14	7.32
	YAGE	260	450	362.87	13.85	3.82
	EAGE	455	634	541.62	13.22	2.44
Wakwa	WAGE	151	319	239.28	14.84	6.20
	YAGE	252	400	361.69	11.50	3.18
	EAGE	458	592	541.18	12.29	2.27

SD = standard deviation; CV = coefficient of variation; WAGE = weaning age; YAGE = yearling age; EAGE = eighteen-month age

performance (age, conformation, agalactia, hardiness, disease resistance, maternal instinct and temperament) and failure to conceive after two successive matings (32).

BLUP for direct additive and maternal breeding values were obtained for each animal using a single-trait animal model. The model included a direct effect, maternal effect correlated to the direct effect, non-additive maternal permanent environmental effect, uncorrelated to direct and maternal effects and environmental effect, associated with the animal, fitted as random effects. Sex, season of calving, herd, calf birth year (CBY) and cow age group (CAG) were fitted as fixed effects. Ages at weaning (WAGE), yearling (YAGE) and eighteen months (EAGE) were fitted as linear covariates on weaning, yearling and eighteen-month weights, respectively, as described by Ebangi et al. (7). The estimated breeding value (EBV) for each animal was obtained with the MTDFREML program (2) together with estimates of variances and covariances for the different performance traits as described by Ebangi et al. (7). Annual genetic progress for direct and maternal effects were obtained as the mean of EBVs of a calving year. Direct and maternal genetic trends and standard errors, regression fit (R^2) and level of trend significance for each breed-trait combination were estimated by regressing BLUP-derived mean annual EBVs on year of calving using the general linear regression (31). The total direct and maternal trends were obtained by multiplying the annual trend for each breed-trait combination (regression coefficient) by the number of years encompassed in the data. The overall genetic trend for each breed-trait combination was obtained by adding corresponding direct and maternal genetic trends. Due to difficulties in obtaining true cumulative selection differentials, as proposed by James (15) for mixed model analyses, an approximation of the "realized heritability" (h^2_R) for each trait was calculated using the formula $h^2_R = R/i\sigma_p$ (8), where R was the overall genetic trend, i the unweighted means of selection intensities for males and females obtained from appendix A of Falconer and Mackay (8) and σ_p the phenotypic standard deviation calculated from phenotypic variances reported by Ebangi et al. (7). It was assumed that the selection intensity was the same in both breeds and that 70 and 90% of the bulls and heifers, respectively, were selected as reported by Tawah et al. (32).

■ RESULTS AND DISCUSSION

Direct genetic trends, maternal genetic trends, total genetic trend, regression fit (R^2), realized heritability (h^2_R), standard errors and level of significance for the traits are presented in Tables III and IV, respectively.

The annual direct genetic trends in Gudali were positive and significantly ($p < 0.05$ or $p < 0.01$) different from zero. The lowest direct trend was obtained for the average daily gain (1.0 g/day) and the highest obtained for yearling weight (0.33 kg/year). Corresponding annual maternal trends, though negative, were also significantly ($p < 0.05$ or $p < 0.01$) different from zero but for average preweaning daily gain. Annual maternal trends showed a decline from average preweaning daily gain (-0.1 g/day) to yearling weight (-0.15 kg/year). In Wakwa, annual direct genetic trends were also positive and significantly ($p < 0.05$ or $p < 0.01$) different from zero. They exhibited an upward trend from average preweaning daily gain (1.0 g/day) to eighteen-month weight (0.24 kg/year). Maternal trends in the Wakwa breed were also negative and significantly ($p < 0.05$ or $p < 0.01$) different from zero but for the eighteen-month weight trend. They also experienced a decline from average preweaning daily gain (-0.03 g/day) to weaning weight (-0.06 kg/year). A positive maternal trend was however noticeable from yearling (-0.001 kg/year) to eighteen months

(0.04 kg/year). But for direct annual trends for birth weight and average daily gain, direct trends in Gudali were higher than corresponding trends in Wakwa. Conversely, maternal trends in Wakwa were negatively higher than corresponding trends in Gudali but for WWT and YWT trends. Regression fits (R^2) ranged from 18 to 65% and from -3 to 60% in Gudali, and from 16 to 61% and 12 to 53% in Wakwa, for direct and maternal trends, respectively. The estimates for realized heritability ranged from 0.23 to 0.39 in Gudali and from 0.03 to 0.50 in Wakwa.

Total genetic trends, a reflection of the overall genetic changes in the population as a result of selection for both direct and maternal effects, estimated as the sum of total direct trends and total maternal trends (TMT), were generally lower than total direct trends. This was because positive trends in direct genetic effects were offset by negative trends of maternal effects. Total genetic trends were 0.29 and 0.20 kg, 0.01 and 0.01 kg, 2.39 and 2.90 kg, 3.08 and 4.03 kg, and 3.94 and 4.88 kg, at birth, average preweaning daily gain, weaning, yearling and eighteen months, in Gudali and Wakwa, respectively.

Estimated annual breeding values for the direct and maternal genetic effects are illustrated in Figures 1 to 10. With the exception of EBVs for direct genetic effect for birth weight (Figure 1) in Gudali, two trend patterns appear clearly in all other figures: an earlier downward trend in EBVs followed by an upward trend. The birth weight in Gudali experienced an upward trend from 1968 (-0.19 kg) to 1972 (0.16 kg) and then dropped in 1973 (-0.13 kg). It experienced thereafter an upward trend and attained a maximum annual trend of 0.37 kg in 1985. In Wakwa, the direct genetic trend for birth weight followed a downward trend from 1968 (0.01 kg) to 1973 (-0.71 kg), followed thereafter by an upward trend and attained an annual maximum genetic response of 0.44 kg in 1985.

The downward trend in EBVs for ADG and WWT, and YWT and EWT direct genetic effects in Gudali was from 1968 to 1972 and 1968 to 1970, respectively. It was followed thereafter by an upward trend, attaining annual maximum genetic responses of 20.0 g/day, 6.3, 6.3 and 4.0 kg/year for ADG, WWT, YWT and EWT, respectively, in 1982 (Figures 3, 5, 7, 9). The pattern of EBVs for maternal genetic effects was the reverse of that for direct trends for all traits but for EWT, where it was virtually zero. On the other hand, the downward trend for EBVs for direct genetic effects for ADG, WWT, YWT and EWT in Wakwa occurred between 1968 and 1969. It was followed by an upward trend, attaining maximum annual genetic responses of 10.0 g/day, 4.2, 3.8 and 5.4 kg/year in 1983 for ADG, WWT, YWT and EWT, respectively (Figures 4, 6, 8, 10). As was the case in Gudali, the direction of maternal trends was the opposite of that of direct trends but for the EWT trend.

Considerable fluctuations in EBVs for direct and maternal genetic effects occurred and are illustrated in Figures 1 to 10 as reflected by predominant peaks. This is probably an indication that estimates of annual genetic trends tended to hide substantial variations across years and herds. With the exception of the EWT trend in Wakwa, the general tendency was that, as EBVs for direct effects increased, corresponding maternal EBVs decreased. This observation is in agreement with findings by Johnson et al. (16) for birth weight, preweaning gain and 205-day weight traits in Angus and birth weight in Herefords. The initial downward trends can be attributed to the limited number of animals in the population during the earlier phase of the experiments, which resulted in a reduction in genetic variability and selection intensity. Culling of animals at this stage was therefore relaxed and, consequently, genetically inferior animals were allowed to reproduce in order to increase the size of the population. The upward trend can be

Table III

Direct and maternal genetic trends (standard error) for preweaning and postweaning traits in Gudali cattle from 1968 to 1988

Trait	DTD	TDT	R ²	MTD	TMT	R ²	TTD	h ² _R
BWT	0.022** (0.004)	0.418	0.60	-0.007** (0.001)	-0.133	0.60	0.285	0.33
ADG	0.0005* (0.0001)	0.0095	0.18	-0.0001 ^{ns} (0.0001)	-0.0019	-0.03	0.008	0.23
WWT	0.228** (0.053)	4.351	0.49	-0.103* (0.030)	-1.957	0.24	2.394	0.29
YWT	0.326** (0.06)	5.542	0.65	-0.145** (0.03)	-2.465	0.58	3.077	0.39
EWT	0.245** (0.06)	4.165	0.47	-0.013* (0.006)	-0.221	0.21	3.944	0.37

DTD = direct trend (kg/year); TDT = total direct trend; R² = regression fit for genetic trend; MTD = maternal trend (kg/year); TMT = total maternal trend; TTD = total genetic trend (TDT + TMT); h²_R = realized heritability

BWT = birth weight (kg); ADG = preweaning average daily weight gain (kg/d); WWT = weaning weight (kg); YWT = yearling weight (kg); EWT = eighteen-month weight (kg)

* p < 0.05; ** p < 0.01; ^{ns} not significant

Table IV

Direct and maternal genetic trends (standard error) preweaning and postweaning traits in Wakwa cattle from 1968 to 1988

Trait	DTD	TDT	R ²	MTD	TMT	R ²	TTD	h ² _R
BWT	0.027* (0.01)	0.540	0.16	-0.017* (0.007)	-0.340	0.20	0.200	0.21
ADG	0.0008* (0.0003)	0.016	0.23	-0.0003* (0.0001)	-0.006	0.20	0.010	0.03
WWT	0.199* (0.08)	3.983	0.28	-0.064* (0.03)	-1.088	0.15	2.895	0.32
YWT	0.238** (0.06)	4.046	0.53	-0.001** (0.0002)	-0.017	0.53	4.029	0.50
EWT	0.243** (0.036)	4.131	0.61	0.044 ^{ns} (0.02)	0.748	0.12	4.879	0.46

DTD = direct trend (kg/year); TDT = total direct trend; R² = regression fit for genetic trend; MTD = maternal trend (kg/year); TMT = total maternal trend; TTD = total genetic trend (TDT + TMT); h²_R = realized heritability

BWT = birth weight (kg); ADG = preweaning average daily weight gain (kg/d); WWT = weaning weight (kg); YWT = yearling weight (kg); EWT = eighteen-month weight (kg)

* p < 0.05; ** p < 0.01; ^{ns} Not significant

attributed to an increase in selection intensity because of improved methodology, and an increase in the population size resulting in greater genetic variability. In the later part of the selection program, most of the calves born in the herds had become proven sires and dams. The positive and negative swings in EBVs might be attributed to fluctuations in selection differentials, possibly because of alterations in selection objectives and management policies. Replenishment of stock, especially Gudali, by later introductions could equally have contributed to fluctuations in EBVs. The early increase in EBVs in the Wakwa breed might be attributed to the fact that the selection program in the breed started during the early stage of breed formation when there were greater variations in the growth traits. Consequently, there was a higher response of the traits to selection in Wakwa than in Gudali, which

was gradually constituted during the selection period. Tawah et al. (32) also predicted a decline in trends in Wakwa due to a reduction in herd size because of continuous distribution of animals to farmers, high mortalities due to dermatophilosis, and lack of a clear breed selection policy. Consequently, while selection differentials were on the rise in Gudali because of an increase in population size and genetic variability, it was the opposite in Wakwa.

It is also most likely that the low genetic overall responses might be attributed to the genetic antagonism found between direct and maternal genetic effects as a result of reported high negative genetic correlations between direct and maternal effects in both breeds (7). As a result of this genetic antagonism, the estimates of overall genetic trends were lower because the positive estimated

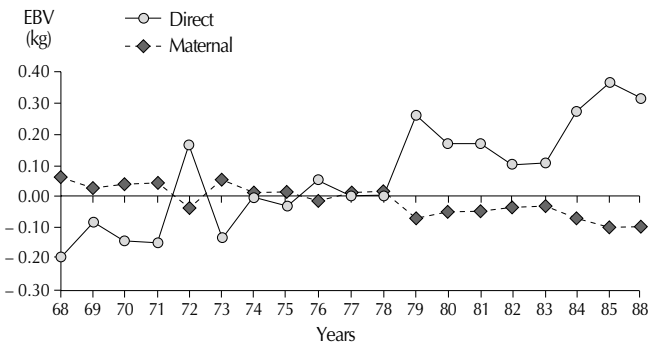


Figure 1: Direct and maternal genetic trends for birth weight in Gudali beef cattle. EBV = estimated breeding value.

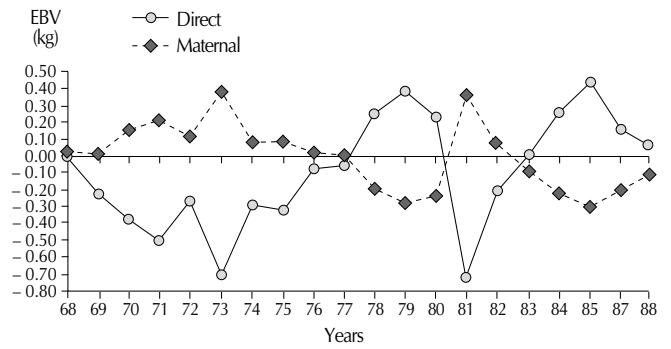


Figure 2: Direct and maternal genetic trends for birth weight in Wakwa beef cattle. EBV = estimated breeding value.

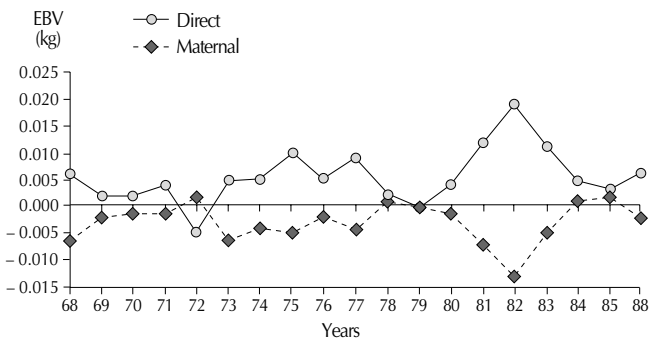


Figure 3: Direct and maternal genetic trends for preweaning average daily weight gain in Gudali beef cattle. EBV = estimated breeding value.

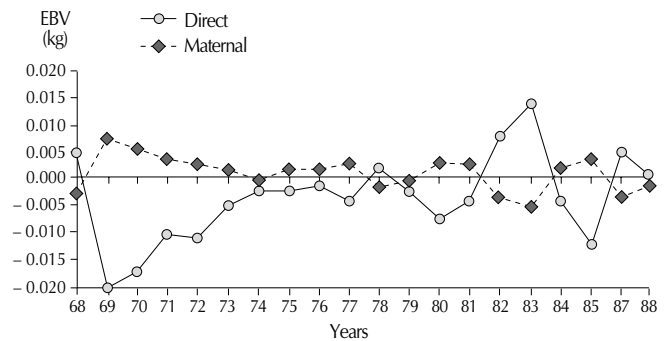


Figure 4: Direct and maternal genetic trends for preweaning average daily weight gain in Wakwa beef cattle. EBV = estimated breeding value.

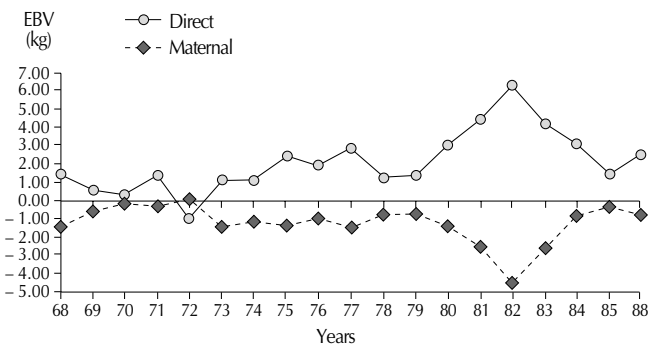


Figure 5: Direct and maternal genetic trends for weaning weight in Gudali beef cattle. EBV = estimated breeding value.

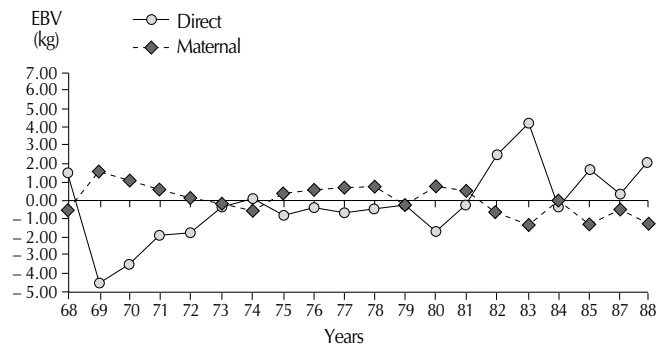


Figure 6: Direct and maternal genetic trends for weaning weight in Wakwa beef cattle. EBV = estimated breeding value.

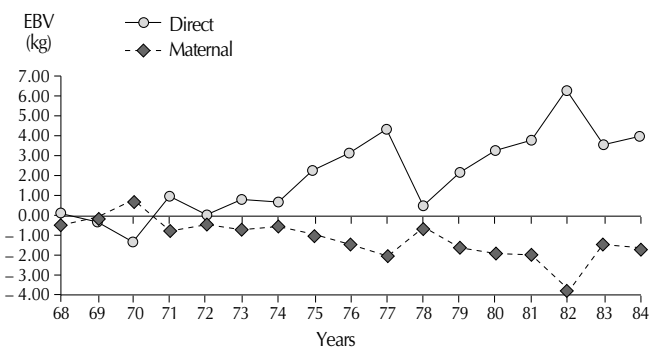


Figure 7: Direct and maternal genetic trends for yearling weight in Gudali beef cattle. EBV = estimated breeding value.

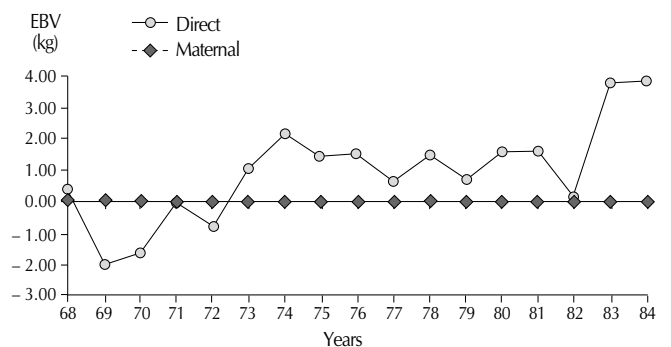


Figure 8: Direct and maternal genetic trends for yearling weight in Wakwa beef cattle. EBV = estimated breeding value.

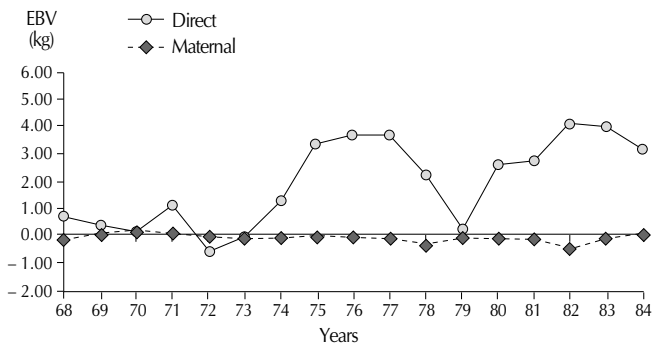


Figure 9: Direct and maternal genetic trends for eighteen-month weight in Gudali beef cattle. EBV = estimated breeding value.

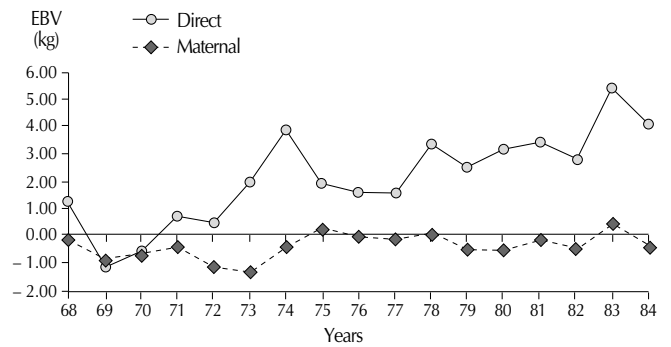


Figure 10: Direct and maternal genetic trends for eighteen-month weight in Wakwa beef cattle. EBV = estimated breeding value.

breeding values obtained for direct genetic effects were offset by the corresponding negative contributions from maternal genetic effects. It could be further explained by the fact that maternal contribution measures one half of the trend for direct effects plus the full trend in the maternal environment due to genetic and non-genetic effects. Accordingly, a negative trend in maternal genetic effects and (or) non-genetic effects such as heifer rearing practices would certainly bring about the lower (negative) maternal trend as was reported by Deese and Roger (4), and Hohenboken and Brinks (14). On the other hand, the present trends obtained are merely results from retrospective analyses over a period when the contemporary group comparison method was used in ranking bulls. As stated earlier, contemporary comparison has been shown to produce bias results (10, 17) and not to adjust for group averages in situations where genetic changes have taken place (35, 36). Consequently, it is possible that inferior bulls were maintained in the herds. In addition, selection for single traits in Gudali and Wakwa beef cattle were seldom practiced. Apart from selecting for growth, selection usually involved, among others, functional and structural soundness of udders, feet, legs, eyes and fertility, viability and disposition. Other factors likely to lower the genetic trends include interactions of genotype and environment, direct maternal effects, high mortality rates (23) for less than two-year-old calves, low parturition rates (35), prolonged mating of heifers as a result of poor growth, long generation intervals (7.1 years in Gudali and 8.7 years in Wakwa; 32), preference placed on certain sires leading to their being maintained for an extended period of time in the herds, and use of dubious young bulls.

The observed trends in the present study were lower than theoretical attainable trends. Tawah et al. (33) reported higher sire estimated transmitting ability (ETA) and dam estimated breeding values for birth and weaning weights in Gudali. The authors also reported higher dam EBV and sire ETA for birth and weaning weights, respectively, in Wakwa. Sire ETA and dam EBV reported for birth and weaning weights in Wakwa were, however, lower than reported estimates in this study. It is most likely that the differences in the trends are due to differences in models and analytical procedures used and sample size. Direct trends for weaning weight in Gudali were higher than direct trends reported by Khombe et al. for the weaning weight of Mashona cattle breed of Zimbabwe (18). The overall genetic trends reported in the present study were also higher than trends of 0.003, -0.013, 0.097 and 0.097 kg/year in the Gobra breed reported by Diop and Van Vleck (5) for birth, weaning, yearling and final weights, respectively. However, present estimates were low compared to those obtained for temperate beef cattle breeds (3, 19, 20, 25, 26, 27, 34).

Realized heritability essentially describes selection response and might not provide valid information on real heritability (8). The estimates obtained in the present study were moderate to high but for the estimate for average preweaning daily gain in Wakwa. These moderate to high estimates might therefore be indicators of higher responses to selection when management and husbandry practices are improved with selection intensity remaining constant.

CONCLUSION

Significant positive direct trends reported for preweaning daily gain, weaning and yearling weights traits in both Gudali and Wakwa indicated that selection for improvement was effective. Significant positive trends reported for birth and eighteen-month weights also indicated that direct selection for weaning and yearling weights could bring about positive correlated responses in these traits. Direct genetic trends were generally higher than corresponding maternal components, indicating that the emphasis placed on direct performance was not successful in increasing maternal performance. Consequently, selecting mainly for direct performance could result in maternal breeding values contributing very little or even negatively to the overall genetic gain. While the direct genetic trend contributes positively to the overall genetic gain, the corresponding maternal component contributes negatively to it. Intense selection for individual growth, when the antagonism between direct and maternal genetic effects is pronounced, could therefore result in a substantial loss in maternal performance. This aspect appears paradoxical and will have to be further investigated.

Acknowledgments

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Résumé

Ebangi A.L., Erasmus G.J., Tawah C.L., Mbah D.A. Progrès génétiques pour la croissance dans une expérience de sélection portant sur deux races bovines bouchères, pure et synthétique, dans un environnement tropical

Des données recueillies entre 1968 et 1988 sur les bovins de la Station zootechnique et de recherche de Wakwa, à Ngaoundéré au Cameroun, au cours d'une expérience de sélection portant sur une race pure (Goudali) et une race synthétique (Wakwa) ont été analysées avec des procédures statistiques de modèles mixtes. L'estimation du progrès génétique a montré que les tendances moyennes annuelles génétiques directes étaient positives et significatives ($p < 0,01$) pour le gain de poids moyen quotidien avant sevrage, le poids à la naissance, le poids au sevrage, le poids à un an et le poids à dix-huit mois chez les deux races. Les tendances annuelles des effets maternels correspondant à ces caractères, à l'exception du gain de poids moyen quotidien avant sevrage chez les Goudali et du poids à dix-huit mois chez les Wakwa, étaient significatives ($p < 0,05$) mais négatives. La différence entre les réponses directes correspondantes chez les Goudali et les Wakwa n'était pas significative. En conclusion, l'amélioration génétique par sélection des caractères de croissance est possible dans un environnement tropical difficile, aussi bien chez la race synthétique que chez la race locale. L'antagonisme génétique entre les effets génétiques directs et maternels est troublant et nécessite des études plus approfondies.

Mots-clés: Bovin Goudali – Bovin Wakwa – Animal à viande – Gain génétique – Cameroun.

Resumen

Ebangi A.L., Erasmus G.J., Tawah C.L., Mbah D.A. Tendencias genéticas para el crecimiento en un experimento de selección, involucrando una raza de carne pura y una raza de carne sintética a partir de dos razas en un medio tropical

Los datos recogidos entre 1968 y 1988 durante un experimento de selección, involucrando ganado puro Gudali y Wakwa, este último sintético a partir de dos razas, en la Estación de Investigación y Producción Animal de Wakwa en Ngaoundere, Camerún, fueron analizados mediante procedimientos de modelos mixtos. Una asesoría del progreso genético indicó promedios anuales positivos y significativos ($p < 0,01$) de las tendencias genéticas directas para la ganancia de peso promedio pre destete (ADG), peso al nacimiento (BWT), peso al destete (WWT), peso al año (YWT) y a los dieciocho meses (EWT) en ambas razas. Las tendencias maternas anuales correspondientes, con excepción de ADG en Gudali y EWT en Wakwa, fueron significativas ($p < 0,05$) pero negativas. Las diferencias entre las respuestas directas correspondientes en Gudali y Wakwa no fueron significativas. Se concluyó que el mejoramiento a través de la selección de los caracteres de crecimiento fue posible tanto en las razas sintéticas como las autóctonas en un medio tropical rudo. El antagonismo genético entre los efectos genéticos maternos y directos representó una preocupación mayor y por lo tanto requiere una investigación ulterior.

Palabras clave: Gudali ganado bovino – Wakwa ganado bovino – Animal de carne – Mejora genética – Camerún.