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FACTORS INFUENCING DAILY WEIGHT GAIN ON YOUNG ZEBU IN GAROUA DISTRICT, CAMEROON

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La croissance de jeunes zébus âgés a été étudiée dans 27 exploitations de la région du Nord Cameroun entre Janvier 1990 et Janvier 1996. Dans ces exploitations, des visites mensuelles ont permis de mesurer la croissance des veaux âgés entre 0 et 1 an. Au total, 310 veaux (141 mâles et 169 femelles) ont été mesurés au minimum deux fois au cours de la période d'étude. La croissance a été évaluée par le gain moyen quotidien obtenu à partir des mesures pondérales mensuelles. Les variables explicatives spécifiques aux individus étaient le sexe, la race, le poids de naissance, le rang de mise-bas et la saison de naissance. Les variables collectives étaient le type d'apports fourragers et le niveau de supplémentation en tourteau de coton, l'activité principale et l'âge de l'éleveur, l'effectif familial. La moyenne de ce gain était égale à 267 g / jour (avec des valeurs extrêmes de - 437 et 1 018 kg / j).

Les associations entre les variables explicatives et le gain de poids ont été testées en utilisant des modèles mixtes, adaptés aux données corrélées que constituent les enregistrements répétés du poids sur un même animal. Au cours de la période 0 à 120 jours, les gains de poids plus élevés ont été observés avec des animaux dont le poids de naissance est compris entre 25 et 32 kg, de race Arabe, Akou ou Goudali. Au delà de 120 jours, les meilleurs résultats proviennent de troupeaux avec des apports fourragers issus de la culture du mil ou de l'association mil-maïs, dont les propriétaires ont pour activité principale l'élevage ou l'agriculture. L'évolution du gain moyen quotidien en fonction de l'âge diffère pour les animaux nés en saison sèche ou en saison humide et il existe un phénomène de croissance compensatrice.

INTRODUCTION

Most of the studies conducted on farm animals in tropical countries investigate mortality or morbidity, and much more rarely growth rates. Slow rates of growth for young animals have negative effects on sale or on reproduction. Poor growth is linked to the farming system, to feeding as well as the preventive treatments (Gitau et al., 1994 ; Latif et al., 1995). The principle analytical difficulty of such results is the integration of the different hierarchical levels : several measurements on individuals in different farms. This paper presents an example of multilevel modelling used to analyse data from a longitudinal study on young zebu with unbalanced repeated measurements (Atwill, 1994 ; Diggle et al., 1995).

MATERIALS AND METHODS

The growth of young zebu was studied in 27 farms in the North Cameroon between January 1990 and January 1996. The farms were visited monthly and the growth rates of the calves aged between 0 to 1 year were measured. A total of 310 calves (141 males and 169 females) were studied at least twice during the period. Growth was estimated by the average daily gain obtained from the monthly weights. The factors thought to influence daily weight gain in calves were categorised in two classes. Calf-level class included age, sex, breed, birth weight, parity and season of birth. The farm variables were forage type (to feed the family or to sell), the level of supplementation with cottonseed meal during the last four months of the dry, the principle activity and age of the farmers (experience) and the size of his family.

Average daily weight gains by age were plotted as a scatter plot. A smoothed curve was fitted to the data points using a SAS procedure (f=60%) (PROC GPLOT ; Statistical Analysis Systems Institute Inc., Cary, NC).

There were three hierarchical levels in the models : each measurement (time variable - level 1) clustered by each cow (level 2) clustered by each herd (level 3). In order to estimate the proportion of variation, attributable to herd, calf and individual weight gain measurements within calves, variance components were estimated using the GLM procedure with random and repeated statements (PROC GLM ; SAS Institute). Multi-level models of fixed effects affecting the weight gain were adjusted for random effects and time-correlations by the MIXED procedure (PROC MIXED ; SAS Institute).

A stepwise selection procedure was used to select factors with significant correlation with daily weight gain ($P <$ 0.1) and included in an overall multivariate model. The models were established for two categories of age : 0 to 4 month and 4 month and greater.

RESULTS

The median daily weight gain was 267 g with a standard deviation of 286 g (extreme values were - 437 and 1 018 g). Average dairy weight gain appeared to increase with increasing age up to 4 months and thereafter decrease (Figure 1).

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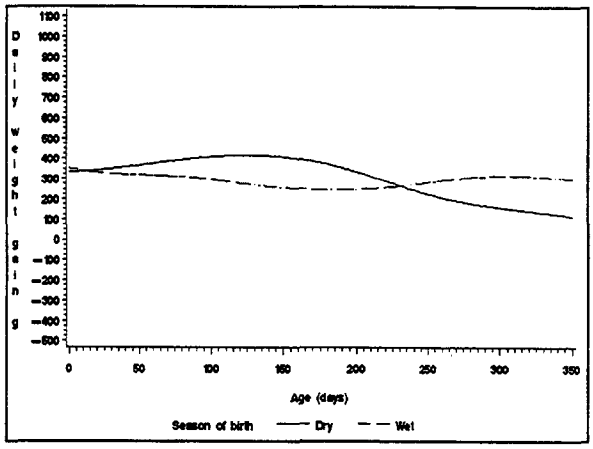
Figure 1
Daily weight gain (g) estimated at monthly intervals by age (in days) of 310 calves from 27 herds in Garoua District, Cameroon

Figure 2
Daily weight gain (g) estimated at monthly intervals by age (in days) and season of birth



Herd effect : There was a significant herd effect. This result justifies the inclusion of this parameter in multivariate models.

Time effect : The modelling of daily weight gain requires both a simple and quadratic term for the age effect. In addition there was a first order auto-regressive process between two successive measurements of daily weight gain ($p<0.023$). The estimate of AR(1) process is - 0.078 (s.e. : 0.035).

Multi-levels models of the fixed effects :
From the multi-level model (Table I) of the fixed effects on the daily weight gain in the first period of growth (0-4 months), it can be seen that only specific factors for individuals were included (no herd effects). The fixed effects race and weight at birth had significant effects on weight gain. Crossbred animals and M'Bororo had the lowest weight gains. The Arabe, Akou and Goudali races had on average weight gains which were much higher than those of the crossbred animals (142 and 117 g / d above crossbred animals, respectively). The weight at birth had an effect on daily weight gain. The lightest (<25 kg) and the heaviest calves (> 32 kg) had the lowest growth rates. The calves with a birth weight between 25 and 32 kg had on average a supplementary daily weight gain of 128 g compared to animals in the low birth weight group.
The growth curve can be modelled for calves older than 4 months using herd factors. The only individual factor to be closely linked to growth is the season of birth but there is an interaction between season of birth and age (Figure 2) which makes interpretation delicate. The type of crop farmed to feed family also has an effect on growth. The reference class is that of sorghum. The best results were obtained with millet or millet-maize (respectively, + 180 et + 161 g compared to sorghum). Next came maize-groundnut, mouskouari and lastly maize-manioc (resp. +116, +111 and +90 g compared to sorghum). The herds where the main activity of the owner was animal husbandry or farming had better results than herds owned by animals dealers (respectively +259 and +256 g). Animals in state farms had intermediate results. The least factor included in the model was the number of family members.

DISCUSSION

The greatest proportion of the variability was explained, firstly because of month to month variation for each calf and secondly because of farm-to-farm variation. The analysis of the time effect indicates that there was compensatory growth between 0-1 yr. The auto-regression coefficient between two successive measurements of weight gain was negative, this means that if an animal experienced a reduction in growth rate during a period it can have an accelerated growth rate. This phenomenom is explained by the fact that the animals which have experienced a restriction will have a greater appetite and their maintenance requirements will be lower than animals fed correctly. The farm to farm variation in weight gain are likely to be indicative of variations in calf management and nutrition between farms.
The average daily weight gain was not very high when it is considered that most herds received a supplement of cottonseed meal of 0 to 1 kg /animal/d during the last four months of the dry season. This can be explained by the fact that the zebu breeds studied are not amongst with the best growth capacities and that the majority of the herds are reared traditionally. In the traditional system of rearing, the calves normally receive nearly all the milk produced by the dam up to 4 month of age and thereafter part of the milk is used to feed the family of the farmer. Therefore, up to four months growth rate is rapid but afterwards growth slower in addition the latter period coincides with the dry season. The husbandry practices could explain the fluctuations in weight gain depending on the age of the animals.

Between 0 and 4 months, the only factors which are significantly linked to weight gain are breed and birth weight. Ever if the animals produced by crossing are hardy, they have poorer growth rates than pure breed animals (except Bororo breed). There was no significant association between calf sex and weight gain. It would be expected for males to have higher growth rates than females. However, since heifers have higher economic value, it is possible that the farmers treat preferentially the heifers during rearing. Parity of the dam does not appear to have a negative effect on calf growth rate, even if milk production is lower for first and second lactations.

It was expected that during the second period of growth feeding and husbandry practices became important. The residual foodstuffs from the millet or maize crops used to feed the family appear to be adapted for feeding the dams and the weaned animals. The level of supplementation with meal should have appeared in the model. It is probable that the supplementation plan was not followed in the farms where the supplements were low. The experience of the farms (age factor) appear to have an effect on weight gain when considering the entire period 0-1 yr. However, in this study, calves of more-experienced farmers had lower daily weight gains. One interesting farm-level variable associated with calf daily weight gain was the main activity of the animals owner. It has been argued that animal's dealers were better calf managers. It was not confirmed by our results : it seems that when the principle activity of the farmers was the fattening and selling of young animals (animal dealer category) growth rates were lower than for animal breeders or tradition farmers.

Table I

Multi-level models of the fixed effects affecting the daily weight gain (g) of young zebus

		Model 0-4 month		Model 4-12 month	
Variable		Estimate	*P*-value	Estimate	*P*-value
Age		0.5	0.7420	- 4	0.0001
Age^2		-0.001	0.9143	0.005	0.0001
Race	*M'bororo vs Cross*	11	0.0083		
	Goudali vs Cross	117			
	Arabe,Akou vs Cross	142			
Weight at birth	*25-32 kg vs <25 kg*	128	0.01		
	>32 kg vs <25 kg	19			
Season of birth					0.007
Forage type					0.001
	Maize-Manioc vs Sorghum			90	
	Mouskouari vs Sorghum			111	
	Maize-groundnut vs Sorghum			116	
	Maize-Millet vs Sorghum			161	
	Millet vs Sorghum			180	0.0001
Main Activity	*Civil servant vs dealer*			85	
	Farmer vs dealer			256	
	Breeder vs dealer			259	0.1
Family size				3	

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