TRADITIONAL SYSTEM OF GOAT MANAGEMENT: I. PRE-WEANING GROWTH PERFORMANCE OF THE SRD (NON-DESCRIPT) GOATS[1]

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ABSTRACT - The effects of season, sex and type of birth as well as all possible interactions were studied for birth weight (BW), weights at 41 (W_1), 69 (W_2), 97 (W_3), and 125 (W_4) days after birth and weight gains at intervals between the time of birth and 41 days of age (G_1), 41 and 69 days (G_2), 69 and 97 days (G_3), 97 and 125 days (G_4) of age after birth. Data were initialy recorded on 120 kids born in the years 1979 and 1980 and raised at the Centro Nacional de Pesquisa de Caprinos research farm, Sobral, State of Ceará, Brazil. The analysis of variance showed that season of birth had a highly significant ($P < 0.005$) effect on all weights analysed and on G_1 and G_4. The significant level was smaller ($P < 0.025$) for G_2 and G_3. Kids born in the rainy season were heavier and had higher weight gains than kids born in the dry season. Sex had a significant influence on BW, W_2, W_4 ($P < 0.05$), W_3 ($P < 0.025$), W_1 and G_1 ($P < 0.005$). Males were superior to females, except in G_4 where an inverse trend was observed. Type of birth was significant ($P < 0.005$) for all the weight variables studied, including G_1. Single born kids showed higher weight gains than did multiple born kids. With the exception of the season X type of birth interaction which was significant ($P < 0.025$) for BW, all other interactions analized were none significant for the variables studied.

Index terms: native breed, birth weight, weight gain, production.

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RESUMO - Foram estudados os efeitos da estação, sexo e tipo de nascimento, bem como os das interações possíveis, sobre os pesos ao nascimento (PN); aos 41 (P_1); aos 69 (P_2); aos 97 (P_3) e aos 125 (P_4) dias de idade e sobre os ganhos de peso do nascimento aos 41 (G_1); dos 41 aos 69 (G_2); dos 69 aos 97 (G_3) e dos 97 aos 125 (G_4) dias de idade. Foram utilizados 120 cabritos, criados na área experimental do Centro Nacional de Pesquisa de Caprinos, em Sobral, CE, nascidos entre os anos de 1979 e 1980. As análises de variância indicaram que a estação de nascimento influenciou de maneira significativa ($P < 0,005$) todos os pesos estudados, além das variáveis G_1 e G_4, e ao nível de $P < 0,025$, as variáveis G_2 e G_3. Os animais nascidos na estação chuvosa foram mais pesados e apresentaram maior ganho de peso, em relação aos nascidos na estação seca. O sexo influenciou o P_1 e G_1 ($P < 0,005$) e o PN, P_2 e P_4 ($P < 0,05$) e P_3 ($P < 0,025$), sendo que, nessas variáveis, os machos foram superiores às fêmeas, exceto em G_4, nas quais se observou tendência inversa. Houve influência do tipo de nascimento sobre todos os pesos estudados, inclusive sobre o G_1, ($P < 0,005$); os animais nascidos de partos simples mostraram maior ganho de peso que os nascidos de partos múltiplos. Com exceção da interação estação X tipo de nascimento, que influenciou de maneira significativa ($P < 0,025$) o PN, as demais interações não apresentaram efeito significativo sobre as variáveis estudadas.

Termos para indexação: raça nativa, peso ao nascimento, ganhos de peso, produção.

INTRODUCTION

Northeast Brazil is a hot semi-arid tropical region. Tropical breeds of cattle as well as hairy sheep and goats are raised in this area. While cattle receive the best possible management, sheep and goats are always relegated as secondary exploitations and thus in the majority of the farms they are not subject to any especial management and only in certain cases to the least possible investment (Primov 1982).

The objective of the present study was to evaluate goat production under the traditional system of management by imitating as much as possible the same conditions found at an average small farm.

MATERIAL AND METHODS

The Centro Nacional de Pesquisa de Caprinos (CNPC) - EMBRAPA is located in Sobral, Ceará. This area is

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characterized by high temperatures with an average maximum of 35°C and an average minimum of 22°C throughout the year with very little variations. Average annual rainfall is about 800 mm in a normal year and as little as 400 mm in a drought year. Rainfall occurs during the months of January through June, followed, on average, by six months of a dry period during which the availability of forage diminishes to levels lower than necessary to maintain the animal's, minimum daily nutritional requirements.

Animals and management - Fifty adult SRD (non-descript) does (Shelton & Figueiredo 1981) were selected at random from the population of goats of the CNPC and maintained on native "caatinga" pastures at the stocking rate of 1 to 1.5 ha/head/year. Animals were released from the corral to the fields about 7:00 A.M. and returned about 4:30 P.M. daily Sodium chloride was provided *ad libitum*. Two bucks were used in natural matings throughout the year. Matings were identified by marking the bucks on the chest with a mixture of grease and powdered color ink, changing color every fifteen days. Kids born were identified with eartags and weighed immediately after birth. Umbilical cords were not treated with iodine. Kids remained in the corral until they could jump an obstacle of about 0.50 m which was set at the entrance gate. During the dry season, green leaves from juazeiro (*Zizyphus joazeiro*) tree were cut and fed to the animals. Water was only available at the corral. Animals were dewormed three times per year, without any previous scheme. Rewarming was performed according to the general animal health condition. Foot and mouth disease vaccine was given to animals every four months. Castration was not done, nor were kids separated by sex. Thus, some matings occurred at a young age. Weaning was allowed to occur naturally.

Data and statistical methods - Weights of 120 kids were recorded at birth (BW) and every 28 days thereafter (W_1, W_2, W_3 and W_4). The latter were recorded on a fixed day, thus there exists a variation in the exact age in days at the moment data was recorded. The first 28 days weighment was ignored and analysis of data started at the second 28-day recording (W_1) with a mean age of 41 days. Weight gains were also calculated from time of birth until first weight (G_1 = 41 days interval), from first weight to second (G_2 = 28 days interval), from second to third (G_3 = 28 days interval) and from third to fourth (G_4 = = 28 days interval).

The pattern of kidding throughout the year was not analysed due to small number of observations within a month period, thus kiddings were divided in two seasons. Variation between months and animals within seasons is included in the error term of the analysis of variance.

The exact number of days between day of birth and W_1 was used as a covariable in the statistical analysis. Does' weight at parturition was also recorded and was used as a covariable in the analysis. The general linear models procedure of least squares analysis was applied for the analysis of data (Barr et al. 1979). The effect of year of birth was not included in the model due to small number of observations recorded in one of the years of the experiment which was characterized by high mortality. The effects due to season of birth (dry and rainy), sex of kids, and type of birth (singles and multiples) were included and considered fixed in the models.

RESULTS

Results presented in this paper were obtained from kids surviving from birth until weaning. Therefore, number of total observations diminished at every time interval due to mortality.

Weaning time, as it is considered in this paper, does not conform to the definition of the term, since weaning was allowed to occur naturally. Under improved management conditions, weaning is accomplished at an average of 112 days (Sistema de produção de ovinos e caprinos 1980). So, for this paper weaning was assumed to occur at around the fourth weighment (W_4), recorded with a mean age of 125 days. We believe that this arbitrary way of defining weaning time could be considered a good cut-off point since kids by this time are much more dependent on forage than on mother's milk.

Results of the analysis of variance for birth weight (BW) and weighments one through four (W_1 to W_4) are presented in Table 1 and the corresponding least squares means are presented in Table 2. An analysis of variance and least squares means of weight gains are presented in Tables 3 and 4 respectively.

Main effects and interactions - The season of birth was highly significant for all the variables analysed. Animals born in the rainy season showed significantly higher birth weights than animals born during the dry season ($P < 0.005$); this trend was maintained throughout the time period analysed. Sex of kid had a significant effect on BW, W_2 W_4 ($P < 0.05$), W_3 ($P < 0.025$) and W_1 ($P < 0.005$). Male kids were heavier than females from birth to 125 days of age.

The effect of type of birth was also important and significant ($P < 0.005$) for all variables studied. Kids born as singles showed higher weights at birth and throughout the period analysed than did kids born as twins or triplets. Interactions of main

TABLE 1. Analysis of variance of body weights (kg) of SRD goats.

Source of variation	d.f.	Mean squares				
		BW	W_1	W_2	W_3	W_4
Season	1	2.597****	24.105****	38.223****	61.314****	117.021****
Sex	1	0.422*	5.555****	8.184*	10.069**	8.909*
Type of birth	1	3.195****	16.124****	27.454****	33.883****	22.889****
Season x Sex	1	0.004^{NS}	0.333^{NS}	2.689^{NS}	0.102^{NS}	0.490^{NS}
Season x Type	1	0.584**	0.039^{NS}	0.456^{NS}	1.411^{NS}	0.281^{NS}
Sex x Type	1	0.012^{NS}	1.225^{NS}	1.654^{NS}	3.589^{NS}	4.567^{NS}
Season x Sex x Type	1	0.021^{NS}	0.191^{NS}	0.479^{NS}	1.374^{NS}	3.109^{NS}
Regression on mothers' weight	1	2.491****	3.749****	2.049^{NS}	4.341^{NS}	4.902^{NS}
Regression on exact age	1	-	8.839****	12.019***	3.772^{NS}	1.790^{NS}
Regression on birth weight	1	-	5.667****	6.575^{a}	2.397^{NS}	2.436^{NS}
Residue	§	0.0902(109)	0.4120(78)	1.6734(61)	1.8047(51)	2.1922(48)

BW = Birth weight
W_1 = Body weight at an average 41 days of age
W_2 = Body weight at an average 69 days of age
W_3 = Body weight at an average 97 days of age
W_4 = Body weight at an average 125 days of age
NS = Non significant
§ = Residue degrees of freedom within parenthesis within each column.

*$(0.025 < P < 0.050)$
**$(0.010 < P < 0.025)$
***$(0.005 < P < 0.010)$
****$(P < 0.005)$
a = P = 0.052

TABLE 2. Least squares means of body weights (kg) of SRD goats.

Main effects	Classes	BW	W_1	W_2	W_3	W_4
μ		1.853	4.476	6.313	7.752	9.466
Season	Rainy	$2.07(0.047)^{a}$	$5.21(0.115)^{a}$	$7.19(0.241)^{a}$	$8.62(0.250)^{a}$	$10.61(0.273)^{a}$
	Dry	$1.75(0.036)^{b}$	$3.91(0.106)^{b}$	$5.35(0.260)^{b}$	$6.17(0.307)^{b}$	$7.41(0.358)^{b}$
Sex	Male	$1.97(0.039)^{c}$	$4.83(0.103)^{c}$	$6.64(0.222)^{c}$	$7.84(0.235)^{c}$	$9.31(0.268)^{c}$
	Female	$1.84(0.044)^{d}$	$4.28(0.104)^{d}$	$5.90(0.241)^{d}$	$6.95(0.289)^{d}$	$8.44(0.333)^{d}$
Type of birth	Simple	$2.10(0.046)^{e}$	$5.14(0.124)^{e}$	$7.11(0.265)^{e}$	$8.41(0.274)^{e}$	$9.74(0.316)^{e}$
	Multiple	$1.71(0.042)^{f}$	$3.97(0.110)^{f}$	$5.42(0.262)^{f}$	$6.38(0.320)^{f}$	$8.01(0.366)^{f}$

Note: Figures within parenthesis indicate one standard error of the means.
Comparisons are made within columns and within main effects.

effects were generally non-significant except the season X type of birth interaction, which showed to be significant ($P < 0.025$) for birth weight.

The analysis of variance for weight gains demonstrated a significant season effect for G_2, G_3 ($P < 0.025$), G_1 and G_4 ($P < 0.005$). Weight gains within every interval of time analysed were higher for kids born in the rainy season than for kids born in the dry season. The effects of sex and type of birth were only significant ($P < 0.005$) for G_1, not showing any effect on the other variables. Males and kids born as singles always gained more weight within every interval studied than did females and kids born as multiples up to G_3, but, at G_4 females showed some advantage over males for both main effects. Interactions of main effects were not significant for any of the weight gain variables analysed.

Covariables - For the analysis of BW and the subsequent body weighments as well as weight gains, the does' body weight at parturition was used as a covariable and it showed to be significant up

TABLE 3. Analysis of variance of weight gains (kg) of SRD goats.

Source of variation	d.f.	Mean squares			
		G_1	G_2	G_3	G_4
Season	1	24.105****	5.469**	6.322**	17.073****
Sex	1	5.555****	0.836^{NS}	1.689^{NS}	0.014^{NS}
Type of birth	1	16.124****	2.594^{NS}	1.004^{NS}	1.403^{NS}
Season x Sex	1	0.333^{NS}	0.426^{NS}	0.559^{NS}	0.680^{NS}
Season x Type	1	0.039^{NS}	0.103^{NS}	0.669^{NS}	0.903^{NS}
Sex x Type	1	1.225^{NS}	0.193^{NS}	0.014^{NS}	0.449^{NS}
Season x Sex x Type	1	0.191^{NS}	0.005^{NS}	0.106^{NS}	0.087^{NS}
Regression on mothers' weight	1	3.748****	0.005^{NS}	0.375^{NS}	0.032^{NS}
Regression on exact age	1	8.839****	0.014^{NS}	1.960^{NS}	0.086^{NS}
Regression on birth weight	1	0.036^{NS}	0.034^{NS}	0.079^{NS}	0.549^{NS}
Residue	§	0.4120(78)	0.8443(61)	0.9297(51)	0.5241(48)

G_1 = W_1 - BW; 41 day interval
G_2 = W_2 - W_1; 28 day interval
G_3 = W_3 - W_2; 28 day interval
G_4 = W_4 - W_3; 28 day interval
§ = Residue degrees of freedom within parenthesis within each column.

NS = Non significant
* = $(0.025 < P < 0.050)$
** = $(0.010 < P < 0.025)$
*** = $(0.005 < P < 0.010)$
**** = $(P < 0.005)$

TABLE 4. Least squares means of weight gains (kg) of SRD goats.

Main effects	Classes	G_1	G_2	G_3	G_4
μ	-	2.539	1.586	1.174	1.529
Season	Rainy	3.26(0.115)^a	1.92(0.171)^a	1.41(0.179)^a	1.97(0.134)^a
	Dry	1.97(0.106)^b	1.22(0.185)^b	0.62(0.220)^b	0.64(0.175)^b
Sex	Male	2.89(0.103)^c	1.69(0.158)^c	1.19(0.169)^c	1.29(0.131)^c
	Female	2.34(0.104)^d	1.45(0.171)^c	0.83(0.207)^c	1.33(0.163)^c
Type of birth	Simple	3.20(0.124)^e	1.83(0.188)^d	1.19(0.197)^d	1.09(0.154)^d
	Multiple	2.04(0.110)^f	1.31(0.186)^d	0.84(0.229)^d	1.52(0.179)^d

Note: Figures within parenthesis indicate one standard error of the means.
Comparisons are made within columns and within main effects.

to 41 days of average age of the kids, remaining non-significant for the rest of dependent variables studied. Two other variables such as the exact age of kids expressed in days at the time of weighment and birth weight were used in the analysis of body weights and weight gains data. The covariable of exact age of kids was significant for W_1, G_1, ($P < 0.005$) and W_2 ($P < 0.01$).

The birth weight covariable was significant ($P < 0.005$) and approaching significance ($P = 0.052$) for body weights at 41 and 69 days of age respectively, remaining non-significant for all other dependent variables.

DISCUSSION

In Northeast Brazil, goat husbandry is relegated to last place when compared with cattle and sheep husbandry. The most abundant type of goat is the so called SRD-goat (non descript) which has been described elsewhere (Shelton & Figueiredo 1981). This local goats are very well adapted to the ecological conditions of the region. It appears that their adaptability strategy is based on high fertility and prolificacy and not on other productive characteristics such as meat and milk production. Survival of the animals during the long dry season

periods and recurrent droughts makes it an interesting breed for small producers, since it is linked to their own survival. In essence, it is a species in general and a breed specifically which does not need major investments to insure at least, however low, a level of productivity which appears to be enough to support a small-holder and his family. This being the case it was necessary to evaluate the level of productivity of this breed under conditions similar to the ones imposed by an average small-holder. Eventhough this was the purpose of the present study, it could not be accomplished in all extent, since animals were foraging for about 9.5 hours daily while small-holders' animals usually spent 12 or more hours daily on the fields. Also, during dry lean months of dry season, the animals of producers may have traveled long distances as the producers' farms were not fenced, whereas the experimental animals of the Center were maintained within fenced areas.

In the former case the animals had access to a better diet and could be more selective than animals restricted to a pre-fixed area. During the dry season field foraging is sometimes complemented with cut branches from evergreen trees like "juazeiro" (*Zizyphus joazeiro*), and "jucazeiro" (*Caesalpinia ferrea*), to supplement the diet of the animals and to insure survivability. We believe this to be a major difference with the management applied to the animals studied at the CNPC, since the consistency of this feeding pattern was not carried out as often and in quantities similar to which is practised at the small farm level.

Another major difference is the health care of the doe and kid at birth, whose deficiency is believed to be one of the major causes contributing to kid mortality after birth[4].

Having in mind all this intrinsic differences between the conditions in this study and what in reality occurs at the small farm level, we could, although with some limitations, state that findings encountered and presented in this report could be regarded as being between the low and medium range when compared to the productivity level of animals at the small farm level, since diets appear to be better at the latter while general health care was better in the former.

Results presented take into account surviving kids only. Kid mortality which was high during 1980 is reported elsewhere (Simplício et al. 1982).

The season effect was significant; this finding is in agreement with Oliveira et al. (1982). Season is an effect which has been demonstrated to be significant for other tropical regions as well (International Livestock Center for Africa 1979, Ali et al. 1975). Rains occur during a 5 to 6-month period with as much as about one half of it concentrating within a month or so for some years, or spread throughout the rainy season for others; thus its distribution pattern is not uniform, so some variation is expected to occur between months within season, and between years. Birth weights and weight gains (G_1, G_2, G_3 and G_4) were significantly higher for kids born during the rainy season as compared to kids born during the dry season. Birth weights have been shown to depend on maternal environment, does' weight, age effects and genotype of the kid (Hunter 1956, Labban 1971, Shin et al. 1975). Higher birth weights have significant effect on later growth (Datta et al. 1963) and improve survivability of the kids (Shelton 1964, Malik & Acharya 1972). In the present study, where genotype of the mothers and kids was assumed to be the same, the differences found between kids born in the rainy season versus kids born in the dry season may have depended heavily on their mothers' weight, which in turn depends on the availability of forage during the gestation period or at least during the last third of it. The effect of mothers' weight appears to be effective up to an average 41 days of age of the kids.

In general, sex and type of birth effects were found to be significant. Male and single born kids were heavier than females and multiple born kids. The trend was similar for the weight gain variables analysed, being significant only for G_1 and showing a reversal of the trend for G_4. It seems that, although body weights and weight gains were higher for male and single born kids during the period analysed, a compensatory effect started after 41 days of age in the other two opposite classes.

[4] Hansen, D.E. Personnal communication, 1982.

The season X type of birth interaction was only significant for birth weight, which was expected since single born animals had heavier birth weights in general, independent of the season of birth, but are expected to have a significantly lower birth weight when born during the dry season than when born in the rainy season. The same is true for multiple birth kids. Thus, for instance, mortality rates among multiple birth kids born during the dry season are the highest (Riera et al. 1980, Simplício et al. 1982).

Recognizing that a comparison between values reported in this study with those reported in other papers is difficult to make, we will refer to some of them for the purpose of placing the SRD breed and the type of management studied at some level among other relatively smaller breeds reported in the literature. In general, birth weight, weighings taken every 28 days and weight gains reported in this study are low when compared to breeds native to temperature areas and raised under sub-tropical regions (Epstein & Herz 1963). Values reported for goats raised in the humid tropics (International Livestock Center For Africa 1979) and South India for the Malabari breed, which shows a mean birth weight of 1.7 kg (Nair 1982), appear to be lower than SRD, the breed effect most probably being important as well. However, the Sirohi breed raised under range management conditions in the Northwestern semi-arid region of India presents higher birth weights (2.8 kg) and weaning weights (13.6 kg) than SRD goats (Mishra et al. 1982). Ranatunga (1971) reports birth weights evaluated during a 5-year period at two state farms in Ceylon as being 2.03 and 1.53 kg respectively. The mean birth weight reported in this study will lie between these two figures. Other reports on the Black Bengal goats (Ali et al. 1973) and the Assam local goat breed (Sarma et al. 1981) suggest that the SRD native Northeast Brazilian goat breed although being small in general, is not the smallest of the goat breeds.

The stablishment of an improved breeding management system in Fiji Islands (Laor 1982) which was based on intense culling levels and optimum management resulted in an increase of flock productivity. Although intense culling levels can not be carried out on our conditions and kidding has to be limited to the rainy season due to restrictions imposed by the environment, the procedure suggested by Laor (1982) can be used as a guideline to obtain improved productivity of goats in Northeast Brazil.

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