Consequences of Post-grazing Residues Control and Birth Season on the Body Traits, Reproductive Performance and Offspring's Growth of Suckling Goats and Ewes Reared at Pasture in Guadeloupe (FWI)*

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ABSTRACT : In Guadeloupe small ruminants (SR) are reared for meat production under pasture conditions. Intensive rotational grazing systems (irrigated, fertilised and high stocked) allow reasonable levels of production but generate high post-grazing residues. Experiments were designed to control them. A system in which residuals were mown (RM) was tested in comparison to the control system (Residuals Remained, RR). The same design was carried out for two years with Creole goat (G) and Martinik sheep (S). An accelerated reproductive rate (3 parturitions over 2 years) was carried out. Systems were compared at three parturition seasons per year (dry, intermediate and rainy seasons). Each group was composed of 20 goats (36.0±2.5 kg) or 20 ewes (46.8±2.4 kg). The female body traits did not vary according to pasture management and seasons. The stocking rate averaged 1,400 kg LW/ha. The mean fertility rate for does varied significantly ($p<0.05$) within the kidding season, from 80.4±0.5% to 93.7±2.9% while the mean litter size was 2.30±0.07 total kids born. No effect of pasture system was observed. Corresponding values for ewes were 83.2±12.8% vs. 75.6±12.5% ($p<0.05$) and 2.43±0.24 vs. 2.03±0.29 ($p<0.01$) total lambs born for SRM and SRR ewes, respectively. A seasonal effect was observed upon ewe performances. The preweaning mortality of kids and lambs averaged 16.3% and 14.4%, respectively. It was 7 and 9 percentage points more ($p<0.01$) for RR than for RM kids and lambs, respectively. For both species, weaning took place at an average age of 81.4±3.6 days. In Creole kids, live weight at birth and at weaning were 1.9±0.2 kg and 8.9±0.8 kg, respectively. In the Martinik sheep, the traits averaged 2.9±0.2 kg and 18.9±0.9 kg. For both traits in both species, significant ($p<0.05$) group×season interactions were recorded. The consequences of elimination of post-grazing residues varied according to the SR species, the environmental conditions and the animal physiological status. The forage characteristics were not limiting factors since forage availability in the RM systems (2,300 and 2,600 kg DM/ha, respectively) and chemical composition were at satisfactory levels (CP content averaged 12 and 10%). It is recommended to develop new grazing system which would allow the use of post-grazing residues instead of mowing the refusals. ***(Asian-Aust. J. Anim. Sci. 2003. Vol 16, No. 8 : 1108-1117)***

Key Words : Creole Goat, Martinik Ewe, Reproductive Parameters, Growth Traits, Pasture Management, Season of Breeding

INTRODUCTION

In the West Indies, small ruminants (SR) are mainly raised under the suckling system for meat production and sometimes for milk production (Devendra and Mc Leroy, 1982; Rastogi et al., 1993; Knights and Garcia, 1997). The efficiency of SR weaner production can be improved by increasing the number of offspring weaned per dam joined and by increasing birth frequency. The potential exists for increasing SR production in this region due to their high reproductive rate and/or reproductive performance (Devendra and McLeroy, 1982; Gonzalez-Stagnaro, 1983; Chemineau et al., 1991) and smaller body size and more efficient use of feed than dairy and beef cattle (in particular goats, Knights and Garcia, 1997). However animal husbandry practices need to be improved.

The most widespread animal production system is grazing and systems are slightly intensified (Devendra and Mc Leroy, 1982; CIAT, 1985; Osuji, 1987). The SR production systems are based on natural savannas, leading to poor animal performances. With regard to tropical forages the following facts have been well documented (Humphreys, 1991): tropical pastures are productive but season-dependent, their high content of structural elements, that are poorly digestible, lead to low or medium nutritive values (Aumont et al., 1995). However, adequate management of tropical pastures at the right stage of maturity may lead to a better nutritive value. The intensive utilization of forages is one way of increasing the production of ruminants in tropical areas using semi-intensive management systems which may increase production from pastures where land and energy-dense feeds are limited [CIAT (1985) and Osuji (1987) for Latin-American regions and Kochapakdee et al. (1994), Humphreys (1991) and Corbett (2001) for Asian-Australasian regions].

In the French West Indies intensive grazing systems (artificial pastures, high level of fertilisation and irrigation)

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Table 1. Composition of groups, mating and birth period and live weight traits of Creole goats and Martinik ewes according to pasture management system (RM, refusals mown vs. RR refusals remained) and to reproduction season (dry, intermediate and rainy seasons)

Species	Martinik sheep		Creole goat	
pasture management	SRM	SRR	GRM	GRR
Dry season/year 1	Mating period: 21/09/99-15/10/99			
Number	12	13	9	9
Date of lambing/kidding	26/02/00±6 d	25/02/00±8 d	26/02/00±8 d	27/02/00±7 d
Liveweight (kg)	44.4±1.9	42.8±3.2	33.1±1.5	33.4±2.0
Interm. season/year 1	Mating period: 21/01/00-15/02/00			
Number	12	12	13	13
Date of lambing/kidding	24/06/00±6 d	24/06/00±4 d	23/06/00±5 d	18/06/00±4 d
Liveweight (kg)	46.5±1.8	46.0±0.8	36.7±1.1	37.1±1.2
Rainy season/year 1	Mating period: 17/05/00-14/06/00			
Number	12	12	12	12
Date of lambing/kidding	25/10/00±7 d	28/10/00±5 d	16/10/00±1 d	17/10/00±5 d
Liveweight (kg)	48.3±2.2	47.1±1.4	37.8±1.4	36.0±1.2
Dry season/year 2	Mating period: 21/09/00-19/10/00			
Number	12	12	12	12
Date of lambing/kidding	20/02/01±6 d	24/02/01±4 d	21/02/01±5 d	21/02/01±2 d
Liveweight (kg)	48.4±0.7	49.3±2.2	37.8±1.1	38.7±1.4
Interm. Season/year 2	Mating period: 17/01/01-14/02/01			
Number	11	10	11	12
Date of lambing/kidding	24/06/01±5 d	19/06/01±6 d	18/06/01±4 d	19/06/01±3 d
Liveweight (kg)	46.6±2.6	44.0±2.2	36.0±1.9	37.1±2.2
Rainy season/year 2	Mating period: 16/05/01-11/06/01			
Number	12	11	12	12
Date of lambing/kidding	28/10/01±7 d	24/10/01±6 d	15/10/01±3 d	16/10/01±4 d
Liveweight (kg)	46.8±0.8	44.8±1.0	36.2±1.0	34.7±1.1

were investigated to improve SR meat production. Such an intensive system produced high animal output per unit area (up to 1,385 kg live weight (LW) weaned kids per ha each year (Alexandre et al., 1997) and 1,250 kg LW weaned lambs (Mahieu et al., 1997). This approach is to cope with reduced land availability and to increase the amount of local meat for consumers. However, some long-term disadvantages are noted. These are excesses of available herbage leading to bad management of the pastures and consequently to reduced pastoral value. In addition, higher levels of parasitic infestation have been observed (Aumont et al., 1997) leading to increases in the farmer's costs. The challenge then is to maintain a high level of productivity from these systems, while improving their profitability. As intensive grazing systems generate high post-grazing residues (Alexandre et al., 1997; Mahieu et al., 1997; Corsi et al., 2001), experiments aimed at the management of such residues were designed. In a first phase mowing to eliminate post-grazing residues was tested against the control system. The following experiments were conducted in both goats and sheep. The objectives were to investigate systems of SR production by varying pasture management (elimination of residuals) and birth season. The evaluations were based on reproductive performances and body traits of the dam and on the viability and growth rate of their progeny.

MATERIALS AND METHODS

This study was carried out at the Animal Production Unit at the INRA Research Centre in Guadeloupe, which is a humid tropical island of the Caribbean (16.1° N; 61.6° W). The experimental farm of the INRA- Animal Production Unit is located in the dry zone. Annual rainfall averages 1,280 mm, with a marked dry season from January to July (less than 70 mm per month) is experienced. Maximum air temperature varies from 27°C (January) to 32°C (August) and the minimum from 21°C to 25°C, respectively. The relative humidity is usually above 70% and the day length ranges from 11 h to 13 h.

Experimental design

There were two concurrent experiments, one experiment was with the Creole goat (G) and the other was with Martinik sheep (S). For both species, two plots of a pasture based on tropical grasses were compared on the basis of the sward management. Year round grazing was done and pastures were grazed on a 28 day cycle. The treatment was pasture management. In the first treatment or system of pasture management, when the animals were moved out of the paddock, the sward was mown in order to remove the post-grazing residues. This system was called "residuals

mown" (RM). It was compared to the control system where residuals were not mown and remained on the paddock (RR). The treatments were defined as GRM vs. GRR and SRM vs. SRR, respectively. Each plot was grazed by 20 females (half of them were lactating and half were pregnant). The two pasture management methods were compared at three parturition seasons per year (Table 1). The experiment lasted for two years.

Animals and their management

Creole goats (Chemineau et al., 1984) and Martinik ewes (Leimbacher, 1996) were used in the experiment. The mean live weights (LW, Table 1) over the two years were, goats 35.5±1.8 kg vs. 36.6±2.9 kg for the GRM and GRR groups respectively, ewes 47.4±2.9 kg and 46.2±2.4 kg for the SRM and SRR groups respectively. The goat flock composition was similar over the two years and the average kidding number was 4.2±2.5 and 4.1±2.4 for GRM and GRR groups, respectively. The mean lambing numbers for the ewe flocks were 3.8±2.1 and 4.0±2.5 for SRM and SRR groups, respectively. The animals were subjected to 3 parturitions within 2 years mating system. The male effect was used for insuring ovulatory and oestrus activities (Chemineau et al., 1991). The birth periods (Table 1) occurred during the dry season (DS: mid-January to mid-February), the intermediate season (IS: mid-May to mid-April) and the rainy season (RS: mid-September to mid-October). The offspring were weaned between 10 and 12 weeks of age. Regular drenchings were carried out in order to avoid any nematode infestation (intramuscular moxidectin injection), every two weeks for youngs and dams from birth to weaning and every month for adults during the mating and gestating periods. External parasites were controlled every two weeks for youngs and adults (spray of flumethrin acaricides).

Pasture management

Prior to the experiment, pastures were mown to 3-5 cm above ground, divided into the two plots and then each plot was grazed under their respective management during a two month-period that was defined as a transition period prior to experimental measures.

Year round grazing was done and pastures were rotated at 28 days age of regrowth. For both pasture management, each plot was equally divided into 5 paddocks and the animals grazed the forage within each paddock for seven days (one week into each specific paddock, and 4 weeks outside the same paddock). The goat plot spread over 4,100 m^2 per system and the sheep plot over a total area of 6,250 m^2 per system. The pastures were irrigated and fertilised with 150 kg nitrogen/ha/annum. When the animals were moved out of the paddock, each paddock received an application of a 30-12-18 N-P-K fertiliser. In the RM system, all the post-grazing residues were mown with a lawnmower fitted with a grass collector.

Forage sampling procedures

The swards botanical composition were evaluated at the beginning and at the end of the experiment method adapted from Daget and Poissonet (1971), species identification using Fournet (1978). Biomass and chemical composition of the herbage on offer were determined before the animals were let into the paddock The forage regrowth period lasting 4 weeks, measures on biomass on offer were determined at least twice during the suckling period (that lasted between 10 to 12 weeks) once at the beginning and at the end of the suckling period. No measures were done during the mating period. During year 2000, measures occurred on March 17, April 21, May 26, June 30, August 04, September 08, October 13, November 11 and December 22. During year 2001, dates of determination were March 01, April 06, May 11, June 15, July 20, August 24, September 28, November 02 and December 07. Herbage mass was estimated by cutting 10×0.09 m^2 quadrats with hand-held electric clippers. Samples were weighed fresh and a subsample of 300 g was kept to determine dry matter (drying at constant weight at 60°C in a forced draught oven over 48 h). The chemical composition of the samples were determined according to the method of Van Soest et al. (1991) for fibres Acid Detergent Fiber (ADF), Neutral Detergent Fiber (NDF) and by the Kjeldhal method for crude protein (CP).

Data and statistical analyses

A complete recording system was applied in which all individual reproductive and growth rate data were collected. At birth all offspring were identified and the pedigree of all animals were known. Rank of parturition has been defined as the parity of the dam. Fertility rate (FR) has been calculated, for each mating season, as the ratio of the number of females giving birth to offspring (born dead or alive) to the number of exposed females. The litter size (LS) was defined as number of total born offspring reported on total females which gave birth. Mortality rates (MR) were calculated at birth (MRb), from birth to 7 days (MRb-7) and from birth to weaning (MRb-w) as a proportion of the number of total offspring that died during the given period to the total number of offspring present at the beginning of the period.

Kids and lambs were weighed at birth, then every week and at weaning. Individual live weights were used to estimate weight at fixed ages: 10 days (LW10), 30 days (LW30) and 70 days (LW70). The average daily gain between LW10 and LW30 (ADG10-30); between LW30

Table 2. Botanical composition of the sward grazed by Creole goat and Martinik sheep under different pasture management systems (refusals mown RM vs. refusals remained RR) over the two-year-experiment

Small ruminant	Goats				Sheep			
Pasture management	GRM (%)		GRR (%)		SRM (%)		SRR (%)	
Year	2000	2002	2000	2002	2000	2002	2000	2002
B. mutica	13	4	40	33	5	0	11	1
C. dactylon	4	7	3	10	4	7	3	10
Dichantium sp.	6	8	18	12	37	38	43	43
D. decumbens	24	21	12	17	28	29	37	38
P. maximum	51	64	21	35	21	19	0	0
Miscellanous	2	1	6	<1	5	7	6	8

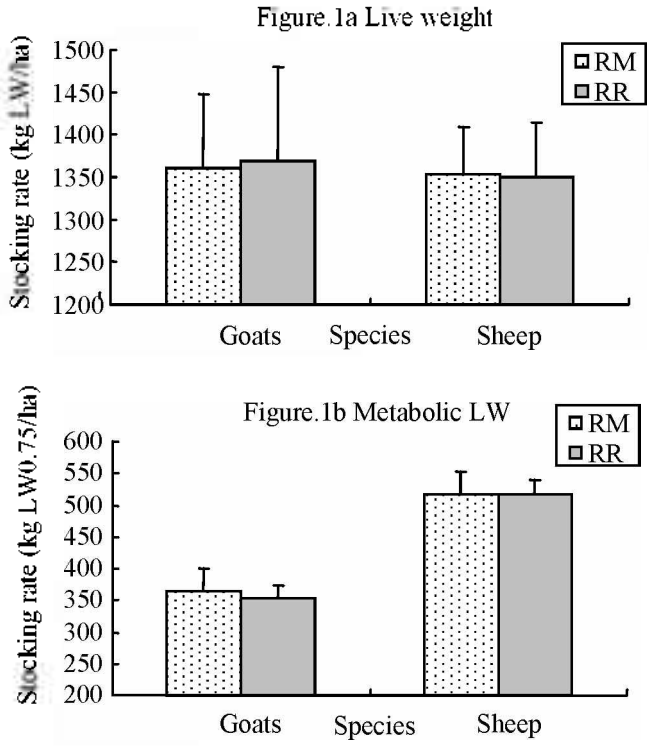

Figure 1. Average stocking rate during the 2 year-experiment in goats and sheep plots according to pasture management. Residuals Mown (RM, dotted) vs. Residuals Remained (RR full). Figure 1a, stocking rate expressed as live weight; Figure 1b, stocking rate as metabolic LW.

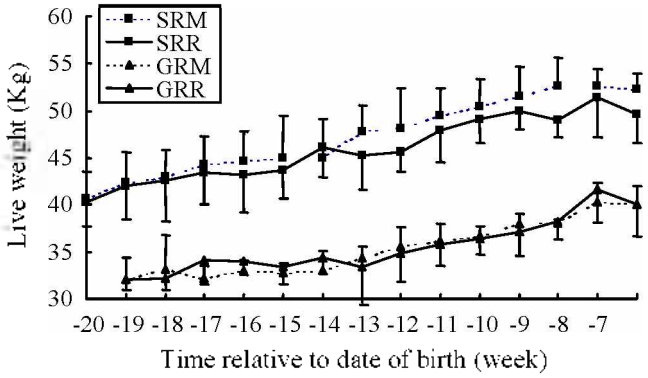

Figure. 2 Mean live weight (kg) of Creole goats (G groups, triangle) and Martinik ewes (S groups, square) during gestation according to pasture management. post-grazing Residues Mown (RM, dotted lines) vs. Residuals Remained (RR full lines).

and LW70 (ADG30-70) and between birth and weaning weights (ADGb-w) were calculated. Does and ewes were weighed every week. While being weighed, a body condition score (BCS), assessed by two scorers, was attributed to each female according to the method described for the goats by Aumont et al. (1994) and to the method of Russel et al. (1969) for the ewes.

Herbage data were analysed using SAS general linear model (SAS, 1988), by species. The model contains effects due to pasture management, birth season (dry season, DS: mid-January to mid-February; intermediate season, IS: mid-May to mid-April and rainy season, RS: mid-September to mid-October), year and pasture management x birth season interaction. The model was as followed:

$$Y_{ijk} = m + PM_i + S_j + Y_k + (PMS)_{ij} + e_{ijk} \quad \text{(model 1)}$$

Where m is the mean;

PM_i is the pasture management effect (i=1, 2);

S_j is the season effect (j=1, 2, 3);

PMS_{ij} is the pasture management * birth season interaction and

e_{ij} is the residual term.

The LW and BCS of reproductive female were analysed according to model 1, with in addition the effect of the female's lactation number.

The offspring's LW and ADG at fixed age were analysed according to model 1 with in addition the effect of the sex and birth weight of the kid as a covariable.

The fertility and mortality rates that are not continuous variables have been analysed using the Xi square procedure.

RESULTS

The average annual stocking rates for the different

Table 3. Pasture characteristics according to animal (Creole goat and Martinik sheep), season (dry DS, intermediate IS and rainy RS) and pasture management groups (refusals mown RM vs. refusals remained RR)

Season	DS		IS		RS	
pasture management	RM	RR	RM	RR	RM	RR
	Creole goat plot					
Biomass (Kg DM/ha)	2,939.5[a]	4,363.7[b]	2,437.9[a]	3,804.8[b]	2,652.0[a]	3,295.4[b]
Crude protein (% DM)	13.2	11.9	10.7	10.3	14.3	12.6
Neutral detergent fibre (% DM)	69.3	71.6	70.9	72.4	71.5	72.7
Acid detergent fibre (% DM)	33.6	35.3	33.9	35.3	35.9	36.9
Lignin (% DM)	6.1	5.2	4.5	4.9	6.3	6.3
	Martinik sheep plot					
Biomass (Kg DM/ha)	2,438.7[a]	3,198.1[b]	1,669.4[a]	2,444.1[b]	2,869.2[a]	3741.4[b]
Crude protein (% DM)	10.3	9.2	10.8	9.3	12.4	9.4
Neutral detergent fibre (% DM)	69.6	70.4	70.7	71.1	73.0	73.7
Acid detergent fibre (% DM)	33.7	34.3	32.3	33.7	35.6	36.8
Lignin (% DM)	5.2	5.2	4.5	5.2	6.2	6.8

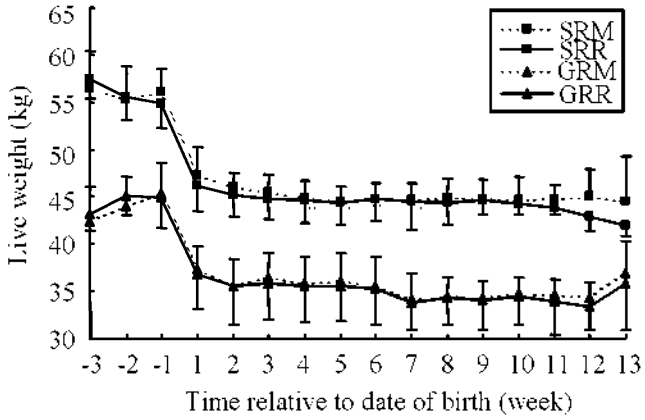

Figure 3. Mean live weight (kg) of Creole goats (G groups, triangle) and Martinik ewes (S groups, square) during lactation according to pasture management: post-grazing Residues Mown (RM, dotted lines) vs. Residuals Remained (RR full lines).

groups. for each species and at the different seasons did not vary greatly and averaged 1,400 kg LW/ha (Figure 1a). It was around 355 and 515 kg metabolic LW/ha for goat and sheep respectively (Figure 1b).

Pasture characteristics

The main sward components (Table 2) were species with good pastoral value: Digitaria decumbens. Panicum maximum. Brachiaria mutica. Dichantium sp., representing 95% of the whole sward for the goat plots and 90% for the ewe plots. Species of low pastoral value. Cynodon dactylon. Abilgaardia sp.. Eleusine indica, miscellanous Cyperaceae represented 5 to 10%.

The herbage mass (Table 3) varied from 2.676 to 3.821 kg DM/ha and from 2.325 to 3.127 kg DM/ha according to the pasture management within the goat and sheep plots, respectively. Significantly ($p<0.05$) lower values were obtained during the intermediate season for both species and groups. The CP, NDF and ADF (Table 3) averaged 12.

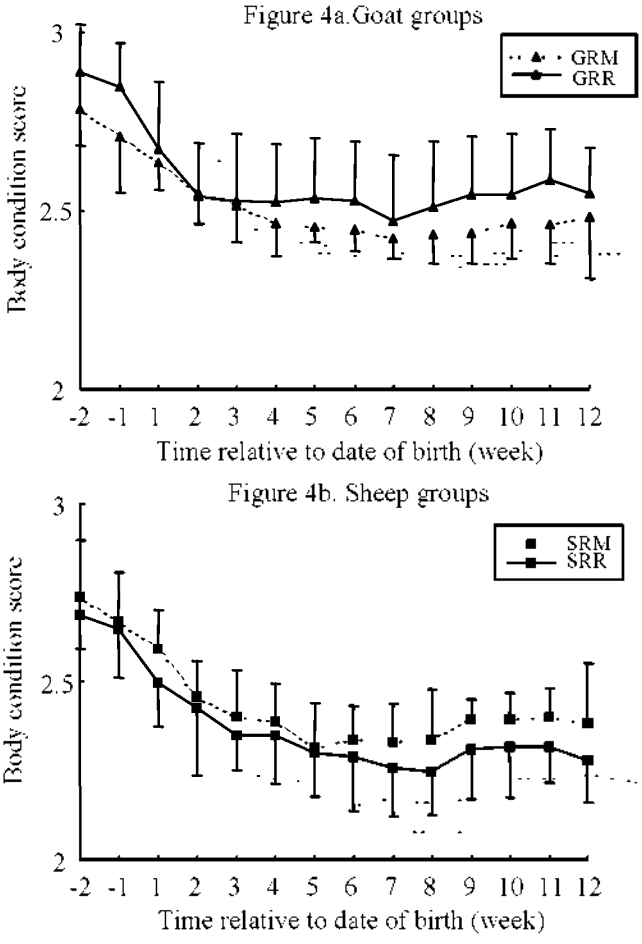

Figure 4. a. Average body condition score of Creole goats (G groups, triangle) and Fig. 4b Martinik ewes (S, groups, square) during lactation according to pasture management: Residuals Mown (RM, dotted lines) vs. Residuals Remained (RR full lines).

71 and 35% DM respectively. In the ewe plots the corresponding values were 10. 71 and 34% DM. No significant variations were noted.

Table 4. Fertility rate (%), litter size at birth (number of kids per doe) preweaning mortality rates (MR, %), liveweight (LW; kg) at birth and at weaning, average daily gain (ADG; g) of suckling Creole Goat reared in intensive grazing systems in Guadeloupe (F.W.I.) according to birth season and pasture management (RM, refusals mowed vs. R refusals remained)

Variable	Dry Season		Interm* Season		Rainy Season		Seasonal
groups	GRM	GRR	GRM	GRR	GRM	GRR	effect
Fertility rate (%)	95.8[a]	91.7[b]	80.1	80.8	87.5	87.5	p<0.05
SD	5.9	11.8	15.3	27.2	5.9	5.9	
Litter size (n/female)	2.31	2.47	2.31	2.31	2.20	2.40	NS
SE	0.28	0.19	0.13	0.08	0.03	0.05	
Mortality rate ** (%)							
MR at birth	12.6[a]	3.8[b]	4.6[a]	14.5[t]	6.3	8.9	p<0.01
SD	0.2	0.1	0.1	0.2	0.1	0.1	
MRb-w	15.5[a]	7.7[b]	6.7[a]	30.0[b]	16.7	20.0	p<0.01
SD	0.3	0.1	0.1	0.5	0.1	0.2	
Liveweight (kg)							
At birth	1.65[a]	2.12[b]	1.71[a]	2.11[b]	1.79	2.00	NS
SE	0.15	0.18	0.18	0.20	0.18	0.19	
At weaning	9.45	9.69	9.65	9.74	7.72[a]	7.01[t]	p<0.01
SE	0.76	0.81	0.82	0.82	0.84	0.85	
Age at weaning (d)	75.7	76.9	82.5	84.8	83.2	83.8	p<0.05
SE	1.3	1.4	1.6	1.7	1.7	1.7	
Average daily gain***							
ADG 10-30 (g)	107.2	111.0	92.6[a]	101.9[t]	81.1	77.6	p<0.05
SE	8.9	9.7	11.1	11.3	11.4	11.7	
ADG 30-70 (g)	74.9	67.7	93.2	91.3	65.1	67.9	p<0.01
SE	7.9	9.0	9.3	9.5	10.6	11.3	

* Interm, intermediate season; ** Mortality rate (MRb-w) from birth to weaning; *** Average daily gain (ADG) at different periods: data adjusted to birth weight; SE standard error associated to lsmeans; [a, b]: values with different superscripts within the same subcolumn differ significatively (p<0.01).

Body weight, body condition score and reproductive performances of the dams

The LW increase during pregnancy (Figure 2) represented about 21 and 27% of average LW for GRM and GRR groups, respectively. Corresponding values for SRM and SRR groups were 23 and 18%. Values were not significantly different. At birth the loss of LW (Figure 3) reached 7.5 and 8.8 kg LW for goats and ewes, respectively (i.e. 17 and 15% relative loss). Whatever the animal, the mean BCS decreased very slightly during lactation. It averaged 2.5 from the beginning to the end of lactation (Figure 4). For both traits, a significant interaction effect pasture management×season was recorded.

The mean fertility rate (Table 4) for does varied significantly (p<0.05) within the kidding season, from 80.4±0.5% to 93.7±2.9% while the mean litter size was 2.30±0.07 total kids born. LS of GRR does tended to be higher than GRM in D and R seasons. Corresponding values for ewes were 83.2±12.8% vs. 75.6±12.5% (p<0.05) and 2.43±0.24 vs. 2.03±0.29 (p<0.01) total lambs born for SRM and SRR ewes, respectively (Table 5). A seasonal effect was observed upon ewe fertility rate regardless of the pasture management system, with the rainy season having lower values. In contrast LS of ewes lambing during the RS was higher than the 2 other seasons.

Kids' preweaning mortality (Table 4) averaged 16.3%. It was 7 percentage points more (p<0.01) for GRR than for GRM kids. Lambs' preweaning mortality (Table 5) ranged from 9.9% to 18.1% for SRR and SRM (p<0.01). Whatever the species or the pasture management, 90% of the mortality rate occurred from birth to 7 days post-partum.

Growth rates of offspring

Growth traits are presented in Table 4 for the kids and in Table 5 for the lambs. Significant differences (p<0.01) occurred for all these traits according to litter size and sex. For both species, weaning took place at an average age of 81.4±3.6 days. In Creole kids, live weight at birth (BW) and at weaning (WW) were 1.9±0.2 kg and 8.9±0.8 kg, respectively. The ADG 10-30 and ADG 30-70 were 95.4±10.8 g and 76.5±9.0 g, respectively. In the Martinik sheep, BW and WW averaged 2.9±0.2 and 18.9±0.9. The ADG 10-30 and ADG 30-70 were 177.5±12.6 g and 205.8±11.7 g, respectively. For both traits in both species, significant (p<0.05) group×season interactions were recorded. Pre-weaning average daily gains (ADGb-w), adjusted for birthweight was significantly lower (p<0.05) in group RR than in RM only during the rainy season for the kids (Table 4) and during the dry season for the lambs (Table 5).

DISCUSSIONS

The pasture conditions were not totally similar for the

Table 5. Fertility rate (%), litter size at birth (number of lambs per ewe) preweaning mortality rates (MR, %), liveweight (LW, kg) at birth and at weaning, average daily gain (ADG, g) of suckling Martinik sheep reared in intensive grazing systems in Guadeloupe (F.W.I.) according to birth season and pasture management (RM, refusals mowed vs. RR refusals remained)

Variable	Dry season		Interm* season		Rainy season		Seasonal
groups	SRM	SRR	SRM	SRR	SRM	SRR	effect
Fertility rate (%)	87.5[a]	80.1[b]	87.1	85.8	75.0[a]	60.9[b]	p<0.01
SD	5.9	4.5	5.4	8.2	23.6	3.7	
Litter size (n/female)	2.48[a]	1.89[b]	2.24	2.10	2.56[a]	2.09[b]	NS
SE	0.03	0.27	0.08	0.28	0.41	0.48	
Mortality rate ** (%)							
MR at birth	7.7[a]	3.0[b]	4.3	4.8	16.5	15.3	p<0.01
SD	0.1	0.1	0.1	0.1	0.2	0.2	
MRb-w	11.4[a]	3.0[b]	14.9[a]	4.8[b]	28.0[a]	21.8[b]	p<0.01
SD	0.2	0.1	0.3	0.1	0.4	0.5	
Liveweight (kg)							
At birth	2.95	2.73	2.90	2.89	3.19[a]	2.73[b]	p<0.05
SE	0.17	0.17	0.17	0.18	0.18	0.18	
At weaning	18.00	17.00	20.64	20.85	18.33	18.84	p<0.01
SE	0.92	0.91	0.88	0.90	0.90	0.95	
Age at weaning (d)	82.3	79.9	84.9	86.4	78.8	78.5	p<0.05
SE	1.6	1.7	1.7	1.7	1.7	1.8	
Average daily gain***							
ADG 10-30 (g)	169.0[a]	188.2[b]	170.5	195.1	167.9	174.4	p<0.05
SE	12.3	12.7	12.5	12.0	14.0	13.9	
ADG 30-70 (g)	2,004.1	207.1	224.9	226.8	175.4[a]	199.4[b]	p<0.01
SE	10.5	10.5	10.9	11.2	11.3	11.7	

* Interm: intermediate season; ** Mortality rate, MRb-w, from birth to weaning; *** Average Daily Gain (ADG) at different periods: data adjusted to birth weight; SE standard error associated to lsmeans; a, b: values with different superscripts within the same subcolumn differ significatively (p<0.01).

two SR plots. P. maximum and B. mutica together represented 65-70% of the sward composition for the goat plots, when D. decumbens and Dichantium sp. represented 65-80% for the ewe plots. The sward composition remained stable during the experiment, except an increase for P. maximum and a decrease for B. mutica, in relation to a very severe drought during the last year, when irrigation was impossible for many weeks. For these reasons the two SR performances could not be statistically compared, although previous results on digestibility trials have shown that nutritive value of tropical forage was less affected by the species than by the age of re-growth (Aumont et al., 1995).

Grazing system effects

The consequences of the elimination of post-grazing residues in intensive grazing systems with small ruminants vary according to the SR species, the environmental conditions, the paddock physical environment and the animal physiological status. The lack of high differences in grazing systems may be due to the fact that the forage allowance and composition were not the limiting factors. Firstly, the biomass reached an average 2,500 kg DM/ha even in the RM system (and 40% more in the RR system) thus ensuring sufficient forage on offer to animals. Minson (1990) explained that, where the yield of forage exceeds 2,000 kg DM/ha and grazing is unrestricted, ruminants have no difficulty satisfying their appetite. Moreover, the herbage composition was quite satisfactory thus ensuring high performance levels as the CP contents were up to 10% as recorded for other tropical forages utilized under adequate conditions within the Caribbean region (Aumont et al., 1995). However, although the stocking rate was high the animals maintained their LW and BCS.

In goats, discrepancy from expectation in post-grazing residues elimination may be due to many factors. Among them, as goats are browsers, the sward height may have been less advantageous in the system with residuals mown than in the RR system, in order to allow a selective feeding behaviour ("browsing"). Moreover, the lower nitrogenous fertiliser input in the present study compared to previous experiments (150 vs. 300 kg N/ha/year) may have lead to a better sward structure in the RR system than in the ones described by Alexandre et al. (1997). Cruz and Boval (2000) suggested that with these tropical stoloniferous pastures, exploited at a similar stage of maturity, high N fertiliser can result in excessively high proportion of stems. In addition, according to studies of Aumont et al. (1997) the anthelmintic treatments carried out every 2 weeks may have reduced the negative impact of gastro-intestinal parasistism in the RR systems in general, thus inducing better conditions for animal performances.

In sheep the stocking rate of ewes with lambs was probably at it's maximum, specifically for the RM system. de Villiers et al. (1995) have indicated that for the South

African Mutton Merino the optimum stocking rate was less than 36 ewes/ha on italian ryegrass, to obtain a good level of weaning mass and to ensure good post-weaning performances. In our experiment it was at a very high level: 64 ewes/ha.

Variations according to birth season

Creole goats and Martinik sheep, similar to other tropical breeds, are characterised by an ability to breed year round (Chemineau et al., 1991). However, climatic and herbage conditions may affect their reproductive performance. Mellado and Meza-Herrera (2002) studying the effect of the climatic factors with milch does in a hot-arid environment of Mexico reported that the breeding efficiency was depressed when rainfall was present at mating (although there was no detrimental effect of high ambient temperatures). Similar conclusions were reported by Galina et al. (1996) in Colima Mexico, studying the reproductive performances of Black Belly and Pelibuey ewes grazing tropical grasses and supplemented during the dry season. Rainfall had a significant correlation with fertility but temperature and photoperiod did not.

What is interesting about intensive systems of production with small ruminants?

The two SR exhibit very high production capabilities under such intensive grazing systems, without supplementation. Their LW and BCS were not markedly reduced at the end of lactation thus enabling them to start a new reproduction cycle in good condition.

In goats, the fertility rate was higher than 82% as reported only for the best tropical breeds such as the Thai goat reared under intensive feeding (Kochapakdee et al., 1994) or the Nubian in Northern Mexico (Mellado et al., 1991). The prolificacy rate (up to 2.35 kids/kidding) was higher than that of other native or tropical breeds reared in Latin America (Gonzalez-Stagnaro, 1983; Mellado et al., 1991) or that of crossbred Black Bengal in Bangladesh (Hoque et al., 2002). In Martinik sheep high reproductive performances were obtained comparative to values reported in the tropical literature. Peron et al. (1991) have reported for the Pelibuey of Cuba a fertility rate of 78.5 to 92.1% and a LS that ranged between 1.17 and 1.48 under adequate conditions. Nawak et al. (1999) have reported lower LS for Kajli and Lohli ewes of Pakistan (about 1.33) than for Martinik ewes. The mortality rate of the kids observed was low as compared to the frequent high level recorded for small ruminants in adverse environments. The data reviewed varied from 27 to 38% (Akusu and Egbunike, 1990; Awemu et al., 1999). Same conclusions were underlined for lambs of other hair sheep breeds by Galina et al. (1996) in Mexico (15.5%) and Rastogi et al. (1993) in the Caribbean (13.6%).

The kid's growing performances were similar to or higher than the other small-sized tropical breeds. Rossanigo et al. (1995) reported the ADGb-w was 76.8 to 91.3 g/d (depending on the conditions). A review by Alexandre (unpublished data) of 25 papers dealing with hair sheep bred under improved conditions pooling a total of 38 experiments, indicates the following: the average (and range) birth weight, weaning weight and ADG from birth to weaning were 2.8 kg (1.5 to 5.0), 11.1 kg (8.5 to 16.1) and 91 g/d (78 to 111) respectively. The Martinik lambs reared under intensive grazing conditions in this study have shown very high performances compared to the literature values.

Sheep defined by numerous authors as good grazers, are very efficient in transforming roughages and forages in proteins and this trait appears to be high in the present study. In contrast, goats well-known as browsers rather than as grazers, performed well in these grazing systems although their productivity was lower than those of sheep. There exists a scope of enhancing animal production from pasture as recommended by Corbett (2001).

CONCLUSIONS

The consequences of elimination of post-grazing residues in intensive grazing systems with small ruminants varied according to the SR species, the environmental conditions, the paddock physical environment and the animal physiological status. The grazing system did not limit the animal performance and weaner growth rate, probably because the forage was not limiting in availability or chemical composition. On the other hand, one of the challenges has been successfully achieved that is by reducing the input (fertiliser by 50% and no supplements) while maintaining high animal output. On the contrary, the veterinary input was still at a high level: the severe prophylaxy carried out in this present study was totally experimental in order to avoid strong interactions between pasture management, feeding level and parasitism. Further studies are required to take into account this component. The elimination of post-grazing residues by mowing them at every pasture cycle was totally experimental and is not practical and recommended. Finally, as eliminating the residues did not negatively affect the animal results, it is recommended to develop new grazing systems which would allow their use with associated herbivores thus obtaining two types of animal production.

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