Productivity of Bahama native, Florida native and Barbados Blackbelly sheep under improved grazing management in the Bahamas[1] /

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Compendio

La productividad de ovejas y carneros indígenas se investigó durante tres años (1975-1978) en un sistema mejorado de forrajes con manejo intensivo en la Isla de Andros, las Bahamas. En el estudio, se utilizaron ovejas indígenas de las Bahamas y carneros indígenas de Florida (EUA), Barbados (Blackbelly) y de las Bahamas. El efecto de la raza de carneros sobre el peso de corderos al destete (ajustados a 90 días de edad) fue mayor ($P < 0.05$) en las progenies de los carneros de las Bahamas y de Florida que en las de Barbados. Bajo un régimen de monta continua, las ovejas indígenas de las Bahamas tuvieron un promedio de 227.8 días entre partos. Las ovejas que parieron durante la temporada lluviosa tuvieron un intervalo menor ($P < 0.01$) entre el parto y la monta que las que parieron en la temporada seca. El peso total promedio de corderos al destete/oveja/parto fue 35.2 kg. El peso total de corderos destetados por parto fue mayor ($P < 0.01$) en las ovejas que criaron corderos gemelos (vs. las que criaron uno solo); y en las ovejas que fueron servidas por carneros de Florida y de las Bahamas (vs. las servidas por Blackbelly). Bajo estas condiciones, se estima que con ovejas indígenas de las Bahamas se podría obtener 1.6 partos por año y destetar un total de 56.3 kg de cordero a los 90 días de edad.

Introduction

Breeds of sheep vary in their productive ability, and therefore, information regarding breed performance is necessary for their effective utilization in production systems. Studies documenting the performance of purebreds and their crosses serve as preliminary predictions of specific breed usefulness and adaptability in particular management systems, market preferences and geographic regions (4, 5, 6). Although numerous investigators have documented the comparative productivity of various breeds throughout the temperate regions of the world, a scarcity of data exists on the productivity of adapted strains under tropical conditions (7, 20).

Development of viable sheep production schemes in tropical environments is dependent upon the propagation and selection of locally adapted breeds and strains under improved husbandry practices (2, 3, 20). The objectives of this study were to evaluate the productivity of indigenous (native) and introduced tropical strains of sheep under an improved, all-forage management system on Andros Island, Bahamas.

Materials and methods

Location, climate and soils

The Commonwealth of the Bahamas consists of approximately 700 islands, located southeast of Florida, U.S. Andros Island is the largest (6 176 km^2) in the chain, but is regarded as the most underdeveloped. The island is unique in that it contains the only two fresh-water streams in the Bahamas

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and an abundant supply of fresh water is located close to the soil surface Andros is situated just north of the Tropic of Cancer and has a climate of the tropical savanna type. Seasonal precipitation means and temperature ranges collected on northeast Andros are presented in Table 1.

The investigations were conducted on oolithic limestone sediment soils believed to have been formed during the Pliestocene Era (10). Soil analyses prior to pasture establishment indicated a pH value of 7.8, low phosphorus levels, low to medium potassium levels, medium magnesium and high calcium levels. Initially, the soils were essentially devoid of organic matter and very low in nitrogen (1).

maturity, while rams typically weigh from 65 to 90 kg. They are a fine-boned, poorly-muscled type, but display adequate skeletal frame. Most representatives lack wool, but possess a coarse haircoat ranging from white to dark brown in color.

The Florida native is a strain of mixed breeding that has developed through natural and limited productive-trait selection under Florida range conditions and over a span of several centuries. These sheep are adapted to the heat and humidity of the southeast and display a genetically-based resistance to *Haemonchus contortus* (9, 11). The Florida native rams used in these investigations were obtained from the University of Florida, Gainesville, Florida.

Table 1: Meteorological data from the Bahamas agricultural research, training and development station, North Andros[1].

Month	Precipitation (mm)	Temperatures (C°)	
		Maximum	Minimum
January	63.5	27.8	8.1
February	96.5	29.4	9.7
March	20.1	30.6	9.2
April	32.3	31.1	10.8
May	130.1	32.2	14.8
June	246.4	31.8	17.0
July	103.6	32.6	19.8
August	114.8	32.9	18.7
September	157.0	32.4	19.2
October	153.9	31.4	15.0
November	112.8	30.3	11.1
December	38.1	28.9	7.2
Total	1 268.7	Mean 30.9	Mean 13.4

1/ Data are 3-year means (1974, 1975, 1976).

Sheep populations

Bahama native ewes and rams and Barbados Blackbelly and Florida native rams were utilized for these investigations. The Bahama native sheep were assembled from five flocks located on New Providence and Eleuthera Islands and were representative of the native type found in the country. The origin of these sheep is not clear and is complicated by the introduction of various temperate breeds and strains (i.e., Wiltshire Horn and Cadzow Meat Improver) from the British Isles. Nonetheless, they are a hardy strain that through natural selection has developed into a type capable of reproduction under the climatic and husbandry stresses of typical Bahamaian agriculture. Bahama native ewes average 50 kg at

The Barbados Blackbelly is a haired sheep of unknown ancestry originating in Barbados and other islands in the West Indies (12). The Barbados Blackbelly rams utilized in these studies were obtained from the Mississippi State University, at State College, Mississippi.

Animal-forage management and data collection

All sheep were maintained exclusively on grass, legume and legume-grass pastures. Pasture stands included such species as transvala digitgrass (*Digitaria decumbens*), guineagrass (*Panicum maximum*), green panicgrass (*Panicum maximum var. trichoglume*), buffelgrass (*Cenchrus ciliarus*), siratro (*Macroptilium atropurpureum*), glycine (*Glycine wightii*), green leaf desmodium (*Desmodium aparines*) and alfalfa (*Medicago sativa*). The pastures were rotationally grazed and stocked and fertilized for high productivity. Monosodium phosphate, a salt-trace mineral mix (Table 2) and water were provided free-choice.

All ewes, rams and lambs were subjected to regular worming and disease immunization schedules. Worming was at 8-week intervals, using various commercially-available anthelmintics that were rotated to maximize control of parasites. Mature sheep were given annual booster doses of *Clostridium perfringens* Types C and D toxoid and were vaccinated against tetanus, blackleg, malignant edema and black disease. Lambs were vaccinated between 1 and 2 months of age against enterotoxemia, tetanus, blackleg, malignant edema and black disease and with the combined *Leptospira* bacterins against *Leptospira canicola*, *L. icterohaemorrhagia*, *L. grippotyphosa*, *L. hardjo* and *L. pomoma*. Lamb vaccinations were repeated 2 to 3 weeks following the initial series.

Breeding was on a continuous basis and lambing occurred through-out all months of the year. The ewes lambed on pasture without assistance. At birth, lambs were weighed, eartagged and docked. The lambs were weaned at approximately 3 to 4 months of age. Weaning weights were adjusted to 90 days of age (13). Lambs were not creep fed either grain or pasture.

Table 2: Composition of trace-mineral salt mixture.

Ingredient	Amount
Plain Salt	90.7 kg
Magnesium	1 362.0 g
Zinc	317.8 g
Manganese	254.2 g
Iron	90.8 g
Copper	9.1 g
Cobalt	7.3 g
Iodine	6.3 g
Selenium	1.2 g
Vitamine A	15 000 000 IU

Statistical procedures

Statistical analysis of lambing intervals and lamb weights were by least squares analysis of variance (8). The mathematical models, with resulting mean squares, are presented in Tables 3, 4 and 5. Mean separation was by Duncan's Multiple Range Test (21).

Results and discussion

Birth and weaning weights

The birth and weaning weight averages per lamb, by years, seasons, sire breeds, sexes, birth and rearing types (number of lambs) and dam ages are presented in Table 6. Also included in Table 6 are the means of total lamb weaning weight produced per ewe and averaged by the same factors.

Although the means of the first two years were not significantly different, average birth ($P < 0.05$) and weaning weight ($P < 0.01$) increased 35% in the third year. Average lamb weaning weight produced per ewe also increased markedly (additional 35%) during the third year. Although the year comparisons are affected by many different factors such as pasture availability, mean rainfall and temperature, ewe replacement probably accounted for a major proportion of the year-to-year changes in production level. There was no culling on the basis of production during the 3-year period. Pasture quality and quantity increased over the years because of the full establishment of introduced legumes and grasses on the native soils. A similar increase in animal performance was also observed on the same experimental site with goats (22). During the first year, the pastures were in an establishment phase and the legumes particularly had not reached an optimal state of production. Although the pastures eventually became legume dominant, the legumes tended to be slower to establish than were the grasses (1). Although birth and weaning weights were not significantly affected by season of birth, there was a 1.2 kg advantage for lambs born during the wet season.

Breed of sire

Sire breed differences were non-significant for birth weight, averaging 3.2 kg (Table 6). However, mean weaning weight of Barbados Blackbelly-sired lambs was significantly less ($P < 0.05$) than either Bahama native– or Florida native– sired lambs. Mean weaning weight produced per ewe per lambing followed the same trend as mean per lamb weaning weight which should be anticipated, and averaged 36.6, 32.5 and 36.1 kg for Bahama native, Barbados Blackbelly and Florida native, respectively. Although no previous studies have determined the performance of the Bahama native strain, it has been observed that the performance of Florida natives and Rambouillet were similar (11), and that birth weights and gains of Barbados Blackbelly purebreds and crosses were less than other meat-type breeds (12).

Lamb sex significantly ($P < 0.01$) affected birth and weaning weights. Ewe, ram and wether lambs

Table 3: Mean squares for birth and weaning weight of lambs from Bahama native ewes.

Source	df	Birth wt., kg	Weaning wt., kg[a]
Year (Y)	2	1.372*	1 109.605**
Season (S)	1	0.001	24.966
Sire breed (SB)	2	0.712	83.949*
Sex birth (B)	1	4.430**	–
Sex weaning (W)	2	–	171.832**
Birth type (BT)	1	1.115	–
Rearing type (RT)	1	–	127.904*
Dam age (D)	2	0.839	14.010
Y X BT	2	0.398	–
Y X RT	2	–	65.305*
S X SB	2	0.036	3.328
S X B	1	0.213	–
S X RT	1	–	88.132*
S X BT	1	0.764	–
S X W	2	–	21.584
SB X B	2	1.113	–
SB X RT	2	–	28.640
SB X BT	2	0.269	–
SB X W	4	–	8.300
B X BT	1	0.260	–
W X RT	2	–	4.000
D X S	2	0.020	17.121
D X BT	2	0.093	–
D X RT	2	–	9.495
Residual	–	0.309	20.569
Residual df for each trait	–	268	244

a Adjusted to 90 days of age.
* $P < 0.05$.
** $P < 0.01$.

Table 4: Mean squares for lambing interval of Bahama native ewes.

Source	df	Lambing interval, days
Year (Y)	1	1 162.2
Season (S)	1	25 344.0*
Ewe age	2	6 551.0
Rearing type (R)	1	7 618.6
Y X R	1	2 110.2
S X R	1	5 568.7
Residual	105	2 332.0

* $P < 0.01$.

averaged 22.6, 27.2 and 23.6 kg, respectively, which are similar to previous reports except that the differences between ewe and wether lambs in this study were less (6, 14).

Although birth type (number of lambs born per ewe) did not influence birth weight, rearing type significantly ($P < 0.05$) affected mean weaning weight per lamb and per ewe. Ewes raising twins produced 75% more lamb at weaning than did ewes raising singles, which is in agreement with previous reports (14, 16). The means presented in Table 6 are on a per lambing basis; means for annual production per year were 41.0 and 71.7 kg for ewes raising single and twin lambs, respectively, assuming an average of 1.6 lambings per year (Table 7).

Table 5: Mean squares for total weight of lamb from Bahama native ewes.

Source	Total birth weight, kg		Total weaning weight, kg	
	df	MS	df	MS
Year (Y)	2	2.910**	2	2 085.034**
Season (S)	1	0.234	1	148.652
Sire breed	4	1.332	4	152.218**
Ewe age (A)	2	1.684	2	3.766
Birth type (B)	1	199.341**	–	–
Rearing type (R)	–	–	1	9 855.372**
Y X B	2	0.255	–	–
Y X R	–	–	2	343.301**
S X A	2	0.050	2	17.978
S X B	1	0.272	–	–
S X R	–	–	1	194.993*
Residual	221	0.675	211	41.285

* $P < 0.05$
** $P < 0.01$

Table 6: Average birth and weaning weights per lamb and total weaning weight per ewe from Bahama native ewes.

Item	Birth		Weaning			
	No. lambs	Wt., kg.	No. lambs	Wt., kg.	No. lambings	Wt., kg.
Year						
1975	31	3.1 ± 0.12^b	30	21.2 ± 1.08^d	25	31.1 ± 1.63^b
1976	140	3.2 ± 0.07^b	135	22.6 ± 0.69^d	119	31.8 ± 1.18^b
1977	122	3.4 ± 0.08^c	109	29.6 ± 0.69^e	83	42.6 ± 1.09^c
Season						
Wet (May–Oct.)	129	3.2 ± 0.09	109	25.1 ± 0.95	100	36.6 ± 1.32
Dry (Nov.–Apr.)	164	3.2 ± 0.07	165	23.9 ± 0.59	127	33.8 ± 1.04
Sire Breed						
Bahama Native	92	3.3 ± 0.08	85	25.1 ± 0.78^b	68	36.0 ± 1.11^b
Barbados Blackbelly	130	3.1 ± 0.07	125	23.1 ± 0.76^c	95	32.5 ± 0.98^c
Florida Native	71	3.2 ± 0.09	64	25.3 ± 0.83^b	46	36.1 ± 1.20^b
Sex						
Ewe	143	3.1 ± 0.07^d	136	22.6 ± 0.66^d	–	–
Ram	150	3.3 ± 0.06^e	37	27.2 ± 1.11^e	–	–
Wether	–	–	101	23.6 ± 0.62^d	–	–
Birth Type						
Single	137	3.3 ± 0.09	–	–	–	–
Twin	156	3.1 ± 0.08	–	–	–	–
Rearing Type						
Single	–	–	145	25.9 ± 0.78^b	158	25.6 ± 0.93^d
Twin	–	–	129	23.1 ± 0.83^c	69	44.8 ± 1.28^e
Dan Age						
1 yr.	24	3.1 ± 0.13	21	23.8 ± 1.23	18	34.9 ± 1.73
2 yrs. or 6 yrs.	59	3.2 ± 0.08	60	25.2 ± 0.70	49	35.2 ± 1.16
3 to 6 yrs.	210	3.3 ± 0.05	193	24.5 ± 0.54	160	35.5 ± 0.74

a Adjusted to 90 days of age.
bc de Means within trait and subclass with different superscripts were different ($P < 0.05$ and $P < 0.01$, respectively).

Table 7: Lambing interval of Bahama native ewes.

Item	No. intervals	Lambing interval, days
Year		
1975	25	221.4 ± 13.8
1976	88	234.2 ± 9.6
Season		
Wet (May-Oct.)	62	199.7 ± 12.8[a]
Dry (Nov.-Apr.)	51	255.9 ± 9.9[b]
Ewe age		
1 yr	11	228.9 ± 15.2
2 yrs or > 6 yrs	22	213.3 ± 11.1
3 to 6 yrs	80	241.4 ± 7.6
Rearing type		
Single	92	215.6 ± 8.1
Twin	21	240.0 ± 12.0
Overall	113	227.8 ± 7.7

ab Means within subclasses with different superscripts were different ($P < 0.01$).

Age of dam differences were non-significant for birth and weaning weight per lamb or per ewe. These results are in disagreement with previous studies (5, 14, 18) in which maximum production was attained between 4 and 6 years of age and the least production observed with first-lamb yearlings or 2-year-olds.

Lambing interval

The lambing interval of Bahama native ewes under a continuous breeding regime is summarized in Table 7. Overall, the ewes averaged 227.8 days (7.6 months) between lambings, and therefore are adapted to a three times per two years accelerated lambing program under improved pasture conditions. Although the means of the two years in which data were available differed by 13 days, year effects were non-significant.

Lambing season influenced ($P < 0.01$) the length of the subsequent lambing interval. Ewes lambing during the wet season (May through October) averaged 199.7 days (6.7 months) to their next lambing. In contrast, ewes lambing during the dry season (November through April) delayed their next lambing for 255.9 days (8.5 months). The longer interval observed for ewes lambing during the dry season is undoubtedly related to the quality and quantity of forage available to the ewes during the critical lambing to rebreeding period. These results emphasize the importance of optimum nutrition for maximum reproductive performance in extensive, all-forage, tropical production systems.

With regard to general productivity, the results indicate that the Bahama native ewes, maintained under an improved tropical pasture system, can yield acceptable levels of total lamb production. As in breed evaluation studies in temperate areas (5, 6, 15, 17, 18, 19), different component traits (i.e., ewe fertility, prolificacy, lamb livability, milk production, growth rate) are quite important in defining productive efficiency. An additional important inference of these results is that breeds or strains indigenous to a geographical area, although not selected for performance traits, can be of acceptable to high production when maintained under improved management and nutritional conditions.

Summary

The productivity of indigenous (native) ewes and rams was studied over a period of three years (1975-1978) under an improved, intensive all-forage management system on Andros Island, Bahamas. The study focused on Bahama native ewes and rams, and Barbados Blackbelly and Florida (USA) native rams. The effect of the breed of the ram on the weaning weight of lambs (adjusted to 90 days of age) was greater ($P < 0.05$) in the progeny of Bahama and Florida rams than in Barbados rams. The lambing interval of Bahama native ewes under a continuous breeding regime averaged 227.8 days between lambings. Ewes lambing during the wet season had a shorter interval ($P < 0.01$) between lambing and breeding times than those that lambed during the dry season. The average lamb weaning weight produced per ewe per lambing was 35.2 kg. The total lamb weaning weight per lambing was greater ($P < 0.01$) for ewes raising twin lambs (vs. those raising single lambs); and for ewes sired by Florida and Bahama rams (vs. those sired by Blackbelly rams). Under these conditions, it is expected that Bahama native ewes can produce 1.6 lambings per year, and a total of 56.3 kg of 90 day-old weaned lamb.

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Unidades básicas del SI*

Especie	Unidad	Símbolo	Especie	Unidad	Símbolo
Longitud	metro	m			
Masa	kilogramo	kg	Temperatura	kelvin	K
Tiempo	segundo	s	Intensidad luminosa	candela	cd
Corriente eléctrica	ampere	A	Cantidad de sustancia	mole	mol

Unidades suplementarias

Angulo plano	radián	rad	Angulo sólido	steradián	sr

Unidades derivadas que tienen nombres y símbolos aprobados por el SI:

Especie	Unidad	Símbolo	Fórmula	Especie	Unidad	Símbolo	Fórmula
Frecuencia	hertz	Hz	1/S	Conductancia eléctrica	siemens	S	A/V
Fuerza	newton	N	$Kg.m/s^2$	Flujo magnético	weber	Wb	V.s
Presión	pascal	Pa	N/m^2	Densidad de flujo	tesla	T	Wb/m^2
Trabajo	joule	J	N.m	Inductancia	henri	H	Wb/A
Potencia	watt	W	J/s	Flujo luminoso	lumen	lm	cd/sr
Cantidad electricidad	coulomb	C	A.s	Iluminación	lux	lx	$1m/m^2$
Potencial eléctrico	volt	V	W/A	Radiactividad	bequeral	Bq	1/s
Capacidad eléctrica	farad	F	C/V	Dosis absorbida	gray	Gy	J6kg
Resistencia eléctrica	ohm	W	V/A				

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