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Growth and performance of indigenous and crossbred goats

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Abstract

Indigenous goats in Uganda have not had any genetic improvement. Few studies on small ruminants, especially among the Mubende goat breed have been mainly based on nutrition. Relevant studies are lacking and there are no records on performance either under on-farm or on-station conditions to provide the necessary information for development of appropriate breeding plans and application of selection practices for genetic improvement. Three-year (1998-2000) performance evaluation data of 175 kids from the indigenous Mubende (M) and Teso (T) goats and their Boer (B) crossbred progeny managed at Serere Agricultural and Animal Production Research Institute (SAARI) were analysed for live body weights from birth to 24 weeks of age. The crossbred kids included F_1 (50% Boer) and F_2 (75% Boer blood) progeny born as a result of croosbreeding Boer bucks with both Mubende and Teso indigenous does. The pure indigenous Mubende and Teso breeds were used as controls. The birth weights of the F_1BxM, F_2BxM and Mubende were 1.91±0.06 kg, 2.06±0.08 kg and 1.98±0.05 kg, respectively, while those of F_1 BxT, F_2BxT and Teso were 2.01±0.05 kg, 1.74±0.11 kg and 1.54±0.07kg, respectively. Birth weight was significantly affected by breed (P>0.0001), kid sex (P>0.0002), type of birth (P>0.0001) and season (P>0.0063). The birth weights among the three categories of goats studied were almost the same except for the Teso (control) kids, which had significantly (P>0.001) the lowest weight.The weaning (age at 16 weeks) body weights for the F_1BxM, F_2BxM and Mubende were 8.94±0.30 kg, 7.16±0.43 kg and 8.27±0.28 kg, respectively, while those of F_1BxT, F_2 BxT and Teso were 9.47±0.43 kg, 10.72±0.52 kg and 6.99±0.37 kg, respectively. The body weights at weaning were significantly affected by breed (P>0.0001) and kid sex (P>0.00045). The F2 BxT weaners were significantly heavier in weaning body weight than the F_1BxM (P>0.01), F_2BxM (P>0.0001), F_1BxT ((P>0.05), Mubende (P>0.0001) and Teso ((P>0.0001) goats. The pre-weaning (0-16 weeks) growth rate for the F_1BxM, F_2BxM and Mubende were 62.77±2.74, 47.15±3.83, and 56.11±2.48 g/day, respectively, while those of F_1BxT, F_2BxT and Teso were 66.43±2.41, 79.49±4.69 and 49.38±3.28 g/day, respectively. Pre-weaning growth rate was significantly influenced by breed (P>0.0001), type of birth (P>0.0018) and breed xseason (P>0.0110) interaction. Again the F_2BxT kids were significantly heavier in pre-weaning growth rate than the F_1 BxM (P>0.01), F_2BxM (P>0.0001), F_1BxT ((P>0.01), Mubende ((P>0.0001) and Teso ((P>0.0001) kids. The results indicated that the Teso crossbred kids generally had higher body weights and growth rates than those of the Mubende goats. However, the birth weights of pure Teso were lower than those of Mubende pure kids. These findings do indicate that, generally, there was increased body weight and growth rate of the crossbred kids and that the Teso crossbred kids particularly performed better in growth characteristics possibly due to their being well adapted to the local environment as indicated by the significant interaction of season and breed.

Key words: Boer goat breeds, crossbreeding, kid weights, Uganda

Introduction

Goats are found over 50% of the households covering all regions of Uganda. They are mainly kept for meat, income and socio-cultural functions. The major indigenous goat breeds in Uganda include the Mubende, Kigezi and Small East African (SEA) (Mason and Maule, 1960). The SEA goat breed is the most predominant in the country particularly in Teso and Lango farming systems in semi-arid north-eastern parts of Uganda. The Mubende goats are found in the humid southern and central regions and particularly in Mubende district were the breed derives its name. The breed is, however, also said to be adapted to sub-humid and warm tropical Savannah climatic conditions found in other districts. The Kigezi goat breed is maily found in the highlands of Kabale in the extreme southern part of the country.

The indigenous goat breeds generally have low productivity for meat due to their poor genetic potential for growth. Limited breed evaluation work conducted on the Mubende goat found it most promising for its meat and fine skin characteristics (Gall, 1981; Devendra and Burns, 1983). The Mubende goat has also good reproductive and growth characteristics having a twinning rate reaching 30% and able to attain adult male and female live weights of 40 kg and 30 kg respectively (Sacker and Trail, 1966) with some males reaching 50 kg (Okello, 1994). Under station experimental conditions, fecundity rates of up to 1.5 young per litter with kidding intervals of 300 days have been reported (Mason and Maule, 1960).

The SEA goats are said to comprise the Karamoja, Sebei, Teso and other types identified more by location and farming system since they are not well defined into distinct breeds (NARO-ILRI-SRNET, 1995). The Small East African (SEA) goats are the smallest in body size with average adult body weights of 25 - 30 kg. They are slow in growth, attaining sexual maturity at about the age of 7 months with live body weights of 14-15 kg when put under good management (Wilson, 1957; Kakusya, 1976; Katongole and Gombe, 1985). Twinning constitutes 5 - 15 % of births with an average gestation period of 146.5 days while breeding is all year round with an average of 2.3 services per year (NARO-ILRI-SRNET, 1995).

All indigenous goats owned by communities in developing countries are regarded as meat goats because they are not purposely selected in any specific direction and vary tremendously in size and other physical characteristics but are renown as major providers of meat, skins and some times fiber to their owners (Gall, 1981). The South African Boer goat is, however, one breed that has been specifically selected for high meat production and quality (Devendra and Burns, 1983; Jindal, 1984). Introduction of exotic breeds and their use for upgrading indigenous breeds has been widely adopted by the farmer communities and organizations as an alternative way of improving the low output of meat and milk among the indigenous goats. However, information on the performance of crossbred progeny arising from crossbreeding indigenous breeds with exotic goats under different agro-ecological conditions and farming systems in Uganda, either under on-station experimentation or on-farm conditions is generally lacking. Performance evaluation of crossbred progeny under specific production environments is necessary to determine better performing breeds and breed combinations.

This paper, therefore, presents results of crossbreeding the boer goat breed with the indigenous Mubende and Teso goats under on-station conditions at Serere Agricultural and Animal Production Research Institute (SAARI) in the North-eastern region of Uganda.

Materials and methods

Experimental site

The study was conducted at SAARI located in Soroti district in North-eastern region of Uganda, located in Serere county, 27 km to the south west of Soroti town, Soroti district. It is found at an altitude of 1140 m above sea level and at latitude 33 40E and longitude 01 50N. The mean temperatures ranges from 22 to30^{0}C. Average annual rainfall is 1350 mm ranging from 1000 to1500 mm. Soil types are mainly sandy and sandy loam. These climatic and soil conditions produce two wet and two dry seasons. The long wet season occurs between April and June (3 months) and the short wet season between October and November (2 months), while the long dry season occurs between December and March (4 months) and short dry season between July and September (3 months). The long dry season (December- March) greatly reduces availability of good quality natural pastures and browse. This affects the feed intake and quality of forages and eventual growth performance and productivity of goats.

The institute is involved in crop and livestock research activities. The land use is planned according to the cropping calendar for crop rotation. Livestock graze on natural pastures and on fields after crop harvest. The natural vegetation is characteristic of scattered tree grassland savannah with a mixture of grass, trees and various shrub species. The predominant natural pastures include *Imperata cylindrical*, H*ypparrhenia spp*., C*ynodon spp.,Panicum spp. and Cymbopogon afronodus*.

The institute also has planted improved pasture legumes and grasses. The legumes include Lablab (*L. pupureus cv. rongai*), Siratro (*M. atropurpureum*), Stylo (*S. guyanensis*) and grasses include elephant grass (*Pennisetum purpureum*), star grass (*Panicum maximum*) and Guatemala grass (*Tripsacum laxum*). These are being tested for adaptation to the conditions in the region and also used for feeding institute livestock, as training, demonstration and multiplication materials and source of pasture seeds for farmers.

Selection of goat breeds

Three breeds of goats were involved in this study, which included two indigenous goat breeds; Mubende and Teso (SEA) and the exotic meat Boer goats. Two pure Boer bucks were purchased from Makerere University Farm at Buyana located in the central region in Mpigi district.

Based on some of the studies and characteristics of goats in Uganda (Mason and Maulse 1960; Kakusya, 1979; NARO-ILRI-SRNET, 1995; Oluka, 1999), field observations and information from farmers regarding the characteristics of the breeds, the indigenous Mubende and Teso local goats were identified, selected and purchased for the study. The Mubende goats were selected from Mpigi and Mubende districts in the humid southern and central region, and the Teso local goats from the semi-arid districts of Soroti and Kumi in Teso region in North eastern Uganda.

On-station goat management

All animals under the study were raised under uniform management throughout the study period from 1998 to 2000. The goats were released for free grazing on natural vegetation and pastures within the institute paddocks each day from 10.00 O'clock in the morning to 5.00 O'clock in the evening. Supplementary feeds were not provided but elephant grass and lab lab legume fodder were occasionally provided as browse. Water was provided on a daily basis and mineral salt was given regularly. Antihelmintics were given once every month and spraying against ticks done using acaricides was twice every month. Standard housing in roofed houses and concrete floors was provided as night shelters.

All bucks, dams and kids were ear tagged for identification. The goats were herded separately according to the breeding plan. No flock mixing was allowed between the breeding flocks at any time. This was to ensure certainty of the breed of offspring produced.

Experimental design

The study started with 2 Boer bucks (No. 01, 02), 2 Mubende bucks (Nos. 03, 04) 2 Teso bucks (Nos. 05, 06), 20 SEA (Teso type) and 20 Mubende does. Boer buck No. 01 was randomly mated to 10 Mubende does and Boer buck No.02 mated to 10 Teso does to produce F_1 BxM and F_1 BxT crossbred kids, respectively. The 2 Mubende bucks (Nos. 03 and 04) were randomly mated to the remaining 10 Mubende does and the 2 Teso bucks (Nos. 05 and 06) were similarly randomly mated to the remaining 10 Teso does to produce their respective purebred F_1 kids. Later on, after a maturity period of 1 year, the crossbred F_1 (50%) female kids were backcrossed to the Boer bucks to produce F_2 (75%) crossbred kids. To avoid inbreeding, the Boer bucks were exchanged by mating the ones used on Mubede does on Teso crossbred does and vice versa to produce F_2 BxM and F_2 BxT crossbred goats. Controlled mating was effected throughout the breeding period by having flocks herded separately according to the mating plan at a particular time. Oestrus was attained naturally. A total of 175 F_1 and F_2 kids were produced and evaluated during the three year period.

Data collection and measurement of kid body weights

The data collection was mainly on kid body weights. Kidding dates, sex of kid, type of birth and birth weights were taken within 24 hours of kidding. Indigenous Mubende and Teso breeds were used as controls. The kidding dates were used to establish the season of birth by months and year of kidding. Body weights were recorded at weekly intervals from birth to 24 weeks of age.

Kid weights were taken using a polythene bag, which was then suspended on a spring balance graded in 200 gm divisions. The spring balance was adjustable to exclude the weight of the polythene bag before weighing the kids. The kid weights were taken early in the morning before they had suckled and those of weaners were recorded before they would be released for grazing.

Data analysis

The analysis of variance was carried out to determine the effect of fixed effects on body weight of kids with time. The fixed effects considered were breed of kid, kid sex, type of birth, year and season of birth. The General Linear Model (GLM) procedures were used in the analysis of live body weights and growth rate of kids with least square means (LSM) to test the differences between means (SAS, 2000). The residual mean square was used as an error term to test the significance of all differences evaluated among classes.

The analysis model used was:

$$Y_{ijklmn} = \mu? + B_i + X_j + T_k + Y_l + S_m + BS_{ij} + e_{ijklmn}$$

Where:

Y_{ijklmn} = the live weight or growth rate of the n^{th} kid of the i^{th} breed, j^{th} kid sex, k^{th} kid type, l^{th} year of birth and m^{th} birth season.

? = the general mean

B_i = the fixed effect of breed of kid (i = 1, 2, 3, 4, 5, 6)

X_j = the fixed effect of sex of kid (j = 1, 2)

T_k = the fixed effect of type of kid (k = 1, 2, 3)

Y_l = the fixed effect of year of birth (l = 1, 2, 3)

S_m = the fixed effect of season of birth (m =1, 2)

BS_{ij} = the interaction between B_i and S_m

e_{ijklmn} = the random residual effect

Results and discussion

Analysis of variance

Analysis of variance for fixed effects and interactions on kid body weight is shown in Table 2.

The LSM are presented in Table 3. Growth pattern of kids by breed are shown in Figs. 1 and 2.

Birth weights of kids

Birth weight of offspring was influenced by breed of kid ($P<0.0001$), type of birth ($P<0.0001$), kid sex ($P<0.0002$), season of birth ($P<0.05$) and interaction between breed and season ($P<0.0099$). There was no significant effect of year of birth on birth weight ($P>0.05$ (Table 2). These findings are supported by similar studies conducted on goats (Ruvuna *et al*. 1987; Das *et al*. 1994; Katongole *et al.* 1994). The birth weight of F_2 BxM crossbred kids was the highest (2.06±0.08 kg) and not significantly different from that of F_1 BxT, F_1 BxM and Mubende kids ($P<0.005$). Teso kids had significantly ($P<0.001$) the lowest birth weights compared to the rest of the F_1 BxM, F_2 BxM and Mubende kids breeds except F_2 BxT kids ($P>0.05$). This finding indicates that the Mubende kids (50%Boer) benefited more from heterosis than their Teso counterparts. This could have some bearing on better combining ability of the adaptation genes from the Mubende breed and the meat producing ability from the Boer breed. It could also indicate that Mubende breed was better by virtue of its bigger size over the Teso breed. On the other hand, the pure Teso kids showed inferior growth performance when compared to F_1 BxM, F_2 BxM and Mubende kids. The Teso type of goat is characteristically similar to that of the SEA breed which is the smallest breed in the country with lower birth and adult body weight (Ruvuna *et al*. 1987). It was not very surprising that the F_2 BxT had similar birth weights to pure Teso kids because, it has been noted that there is usually a depression in F_2 generation.

Pre-weaning body weight of kids

The pre-weaning body weights of kids (birth-16 weeks) for the various breeds is given in Table 3. Throughout this period, there was significant influence of breed ($P<0.0001$) (Table 3). Pre-weaning weight at 16 weeks of Blended goats in Tanzania which was found to be 8.7±0.29 kg and influenced by sex of birth (Das *et al*., 1989) is similar to that of the F_1 BxM (8.94±0.30 kg) and F_1 BxT (9.47±0.27kg) crossbred kids in this study. The most distinct feature is, however, the observation that the F2BxT kids (75%Boer, 25% Teso) were generally consistently heavier than the rest of the kid breeds (Table 3, Figs. 3 and 4) after weaning. The depression experienced at birth gets reversed with time and these kids had better growth. This may be due to a combination of adaptation and the selection of herbage by the Teso breed in its natural environment when the goats were weaned and depended solely on vegetation and pasture.

Recent studies on the performance of the Galla and Small East African goats in Kenya and their crosses with exotic Toggenburg and Anglo-Nubian breeds (Ruvuna *et al.*, 1987; Okeyo, 1985; Ahuya, 1987 and Okeyo *et al.*, 1991), found that the Galla goat provides better maternal environment than the Small East African (SEA). However, when these (SEA) were crossed with Toggenburg and Nubian and used as F_1 dams, the maternal heterosis of the F1s dams was superior. The SEA goat, which had superior fitness for Western Kenya, thus exhibited better combining ability (non-additive) effects with the exotic and thus, overcoming its lower production (additive genetic) effects (Ahuya, 1987).

Conclusions

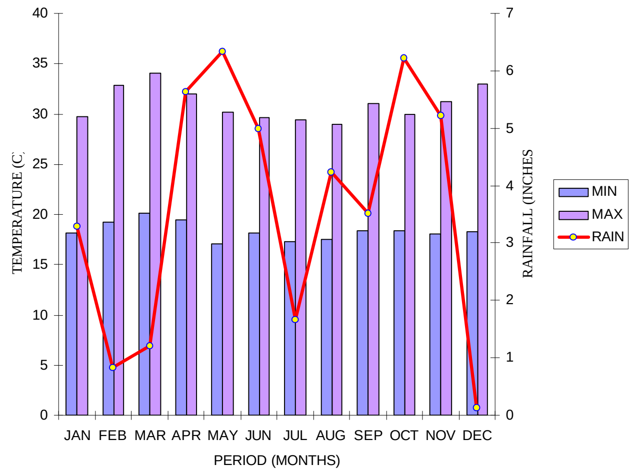

Figure1. Mean monthly rainfall and temperature at SAARI, 1998

Table 1. Mating groups by breed of goat

Parents		Offspring	Percentage (%) of blood		
Buck	Doe	Kid	% Boer	% Mubende	% Teso
Boer (No. 01)	Mubende	F_1 (F_1 BxM)	50	50	-
Boer (No. 02)	Teso	F_1 (F_1 BxT)	50	-	50
Boer (No. 02)	F_1Mubende	F_2 (F_2 BxM)	75	25	-
Boer (No. 01)	F_1Teso	F_2 (F_2 BxT)	75	-	25
Mubende (Nos. 03,04)	Mubende	F_1 (MxM)	-	100	
Teso (Nos. 05, 06)	Teso	F_1 (TxT)	-	-	100

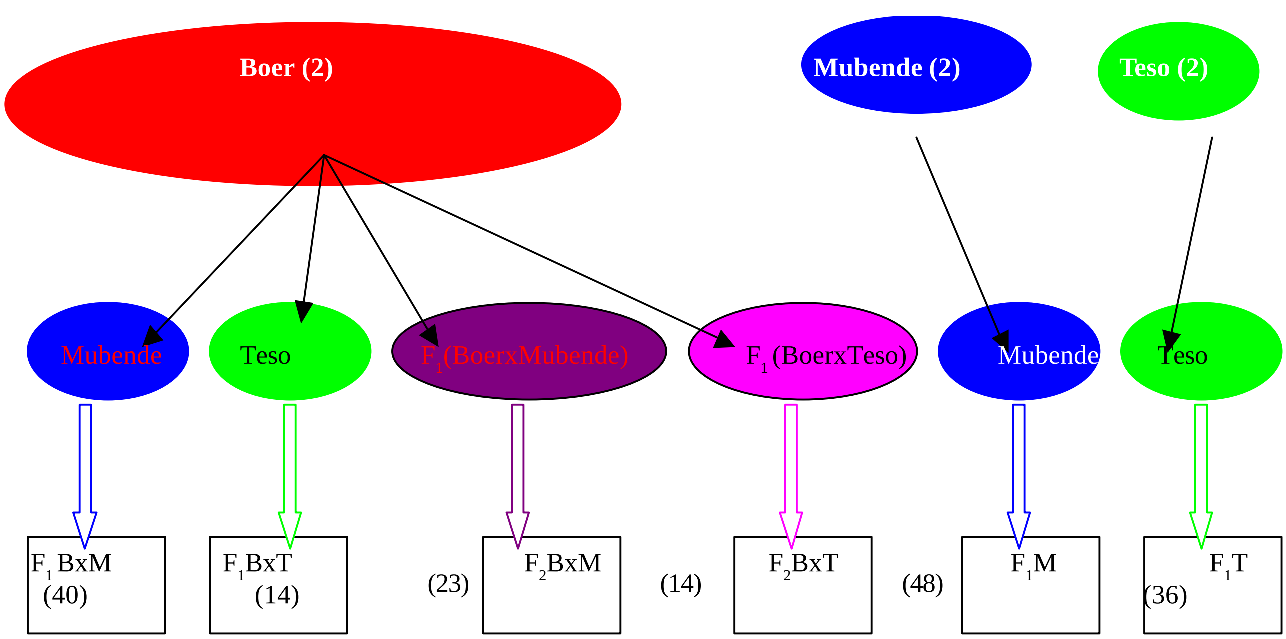

Figure 2. Mating arrangement of breeding bucks and does

Table 2. Analysis of variance of kid weights

Source	Body weight (kg)												Growth rate (g/day)		
	Birth			Week 8			Week 16			Week 24			Week 0-16		
	df	*MS*	*P>F*	*df*	*MS*	*P>F*	*df*	*MS*	*P>F*	*df*	*MS*	*P>F*	*df*	*MS*	*P>F*
Breed	5	5.85	0.0001	5	74.98	1.0001	5	34.1	0.0001	5	33.8	0.0001	5	74.98	0.001
Sex	1	1.9	0.0002	1	0.003	0.9717	1	9.80	0.0045	1	0.92	0.5535	1	0.003	0.977
Type	2	7.07	0.0001	1	24.13	0.0018	1	1.58	0.2478	1	33.86	0.0004	1	24.13	0.008
YOB	2	0.25	0.1390	2	1.61	0.5115	2	3.69	0.0463	2	1.49	0.5658	2	1.61	0.515
Season	1	0.99	0.0063	1	2.64	1.0001	1	0.48	0.5229	1	2.96	0.2882	1	2.64	0.291
BrdxSs	5	0.40	0.0099	5	1.85	0.1719	5	3.33	0.2762	5	7.39	0.0110	5	7.39	0.010
Resid.	199	0.13		170	1.18		148	2.61		148	2.39		148	2.39	

YOB = Year of birth; Brd x Ss – Breed x Season interaction

Table 3. Comparison of body weight and growth rate of indigenous and crossbred goats

Effect	Body weights (kg)				Growth rate (g/day)
	Birth	8 weeks	16 weeks	24 weeks	0-16 weeks
Boerx Mubende					
F_1 BxM	1.91±0.06[a]	5.88±0.19[a]	8.94±0.30[b]	13.65±0.30[a]	62.77±2.74[b]
F_2 BxM	2.06±0.08[a]	4.69±0.27[b]	7.16±0.43[c]	12.61±0.40[ab]	47.15±3.83[c]
Mubende	1.98±0.05[a]	5.21±0.19[b]	8.27±0.28[b]	11.21±0.27[b]	56.11±2.48[bc]
Boer x Teso					
F_1 BxT	2.01±0.05[a]	7.24±0.17[a]	9.47±0.27[b]	13.16±0.26[a]	66.43±2.41[b]
F_2 BxT	1.74±0.11[ab]	6.55±0.35[a]	10.72±0.52[a]	14.85±0.50[a]	79.49±4.64[a]
Teso	1.54±0.07[b]	4.72±0.21[b]	6.99±0.37[c]	9.25±0.36[c]	47.15±3.28[c]

B= Boer goat breed, M= Mubende goat breed, T=Teso goat breed

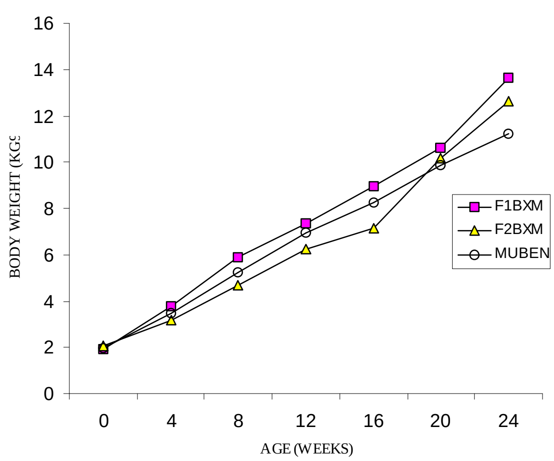

Figure 3. Least square mean kid body weights of Boer and Mubende crossbred goats

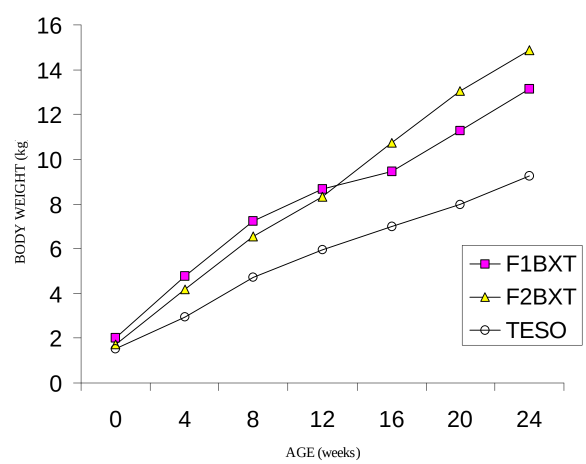

Figure 4. Least square mean kid body weight of Teso and Boer crossbred goats

Generally the crossbreds had better growth rates and body weights than the indigenous Mubende and Teso goats, underscoring the importance of crossbreeding. The Teso crossbred weaners performed better than the Mubende weaners possibly because they were well adapted to the local environment since there was significant interaction of season and breed.

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