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THE EFFECT OF GRADING UP ANKOLE CATTLE OF BURUNDI WITH SAHIWAL ON MILK PRODUCTION PERFORMANCE OF COWS

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ABSTRACT

Total of 510 lactation records, representing five successive parities, were collected on 102 cows (20 Ankole and 82 Sahiwal x Ankole crosses) to study the effect of grading up Ankole cattle of Burundi with Sahiwal breed on both total milk yield and lactation length.

Generally, the increase of Sahiwal blood in the Ankole cattle of Burundi by up-grading increased both total milk yield per lactation and lactation length.

Genotype had significant effect (P<0.001) on both milk yield and lactation length. However, parity only significantly affected (P<0.001) total milk yield per lactation. The 75, 87.5 and 93.75% Sahiwal cows yielded more milk per lactation than did 50% Sahiwal cows. However, for about the same length of lactation, the difference in total milk yield between 75 and 87.5% Sahiwal cows was not significant. The Ankole cows yielded, compared with the crossbred cows, less milk per lactation in shorter lactation.

For all crossbred cows, the percentage of improvement in total milk production attained its maximum at the 5th parity (ranged from 156.1 to 281.4%).

Keywords: Grading up, Ankole, Sahiwal, cattle, milk yield, lactation length.

INTRODUCTION

Crossbreeding has been approved as effective, rapid and economic mean for improving milk and meat production of indigenous breeds of cattle in many parts of the tropics (Jadhav *et al.,* 1991; Wang *et al.,* 1992; Rinz *et al.,* 1992; Fordyce *et al.,* 1993a and b; Chaudhry *et al.,* 1993; Sahota and Gill, 1994). The Sahiwal cattle, whose native home is in the Montgomery district of Pakistan, were first imported into Africa through Kenya mainly because of their higher milk yield than other Zebus and adaptation to tropical environments. The Sahiwal are also able to produce good beef (Fordyce *et al.,* 1993a and b). The excellent purebred and crossbred performance of the Sahiwal breed has been reported in a range of tropical production systems and environments (Trail and Gregory, 1981). This encouraged the government of Burundi to cross its local cattle breed, called "Ankole", with the Sahiwal breed through a grading up system initiated in 1978 by the "Institut des Sciences Agronomiques du Burundi" (ISABU) mainly to improve annual milk yield of the Ankole cows.

So, if we consider that the design of efficient mating systems with crossbreeding for improvement of annual milk yield of cows in the tropics requires a knowledge of breed differences, heterosis, and retention of heterosis under tropical conditions (Trail and Gregory, 1981). Although some reports provide information for first lactation performance, few studies investigated performance for later lactations (Cunningham and Syrstad, 1987;

Sharma and Pirchner, 1991). The present work documents milk yield over a 5-yr period (i.e. 5 successive parities) as well as the respective length of lactation of crosses of the Ankole cattle of Burundi up-graded by the Sahiwal breed and shows the superiority of various crosses over the Ankole purebred cows.

MATERIAL AND METHODS

Material:

A crossbreeding program started in 1978 at all the stations of the "Institut des Sciences Agronomiques du Burundi" (ISABU) included the up-grading the Ankole cows of Burundi with the semen of the imported Sahiwal sires.

Total of 510 lactation records representing 102 cows, of about the same age, having 5 successive lactations each, collected during the period from 1991 to 1995, were used in the present study. The cows were from two Government Stations: RUKOKO (i.e. Station I), situated in the natural region of the IMBO (north-west of the country) and MOSSO (i.e. Station II), situated in the depressions of the natural region of MOSSO (south-est of the country). Cows were grouped according to proportion of Sahiwal blood (from 0 to 100%) into 6 genotypes: Pure Ankole (0% Sahiwal), 50% Sahiwal, 75% Sahiwal, 87.50% Sahiwal, 93.75% Sahiwal and Pure Sahiwal (100% Sahiwal). Number of cows in each genotype was 20, 24, 19, 18, 8 and 13, respectively.

Management:

Calving season started in late January. First calving occurred between 30 and 36 months of age. Breeding cows and weaned heifer calves were fed on natural pastures from November to mid-June (the rainy season), whereas during the dry season they fed, beside grass, on legume silage (*ad libitum*). Lactating cows received supplementary feed of about 0.5 kg concentrated ration for every litre of milk produced . Calves were fed twice daily on whole milk by suckling their dams until weaning at 20 weeks of age. The quantity of milk consumed by each calf was calculated by the difference between its weight before and after suckling. Milking was by hand twice daily and milk yield was recorded at each milking. Quantity of milk consumed by each calf plus quantity of milk given by each cow represented her daily milk yield in litres. In each lactation, total milk yield for each cow was given by summing up daily milk yields. Cows were dried off about 2 months before the expected date of calving if they were not already dry.

The traits considered in the present study are total milk yield (in litres) per lactation for each one of the five successive lactations (i.e. parities) and lactation length (in days).

Statistical methods:

Data were analyzed by the General Linear Models Procedure of SAS (1987) according to the following model:

$$Yijk = \mu + G_i + Pj + (G*P)ij + Eijk ,$$

where: Yijk is total milk yield in litres or lactation period length in days for each cow:

μ is the population mean of the trait;
G_i is the fixed effect of the i $\underline{th}$ genotype (i = 1, …, 6);
Pj is the fixed effect of the j $\underline{th}$ parity (j = 1, ..., 5);
(G*P)ij is the effect of interaction between genotype and parity;
Eijk is the random effect of the experimental error.

As Station effect was not significant (P>0.10) in a preliminary statistical analysis, therefore, it was ignored in the above-mentioned model.

RESULTS AND DISCUSSION

Milk production performance of cows:

Lactation performance of cows of the six genetic groups over the five successive parities is shown in Table 1 for annual milk yield and in Table 2 for the length of lactation period.

Generally, the increase of Sahiwal blood in the Ankole breed of Burundi by up-grading increased significantly total milk yield per lactation (Table 1). Also, for most of genotypes considered, total milk yield was greater in the later parities and smaller in the early ones, which confirmed the results reported previously by many authors (Keown *et al.,* 1986; Schutz *et al.,* 1990). Milk yield attained its maximum at the 3rd lactation in Sahiwal cows, at the 4th lactation in both Ankole and 75% Sahiwal cows, and at the 5th lactation in both 50, 87.5 and 93.75% Sahiwal cows. The present findings are similar to those of Reddy and Nagarcenkar, 1988 in the Sahiwal breed.

The results presented in Table 1 also show that the crossbred groups (i.e. 50, 75, 87.5 and 93.75% Sahiwal) performed better than Ankole cattle all over the five successive parities in their milk production. This approves the usfulness of using crossbreeding to improve total milk production of the Ankole cattle.

It appeared from Table 2 that, with the exception of the 1st lactation, the increase of Sahiwal blood in the Ankole breed, generally, increased lactation length all over the five successive lactations, but there was a clear variability in this trait among genetic groups. It also appeared from Table 2 that lactation period length attained its maximum at the 1st lactation in Ankole cows and decline gradually there after until reached the 5th lactation, however, in the case of crossbred cows there was, generally, an increase in lactation period length with the increase of parity, especially in the case of both 50 and 87.5% Sahiwal cows. In Sahiwal cows, lactation length was higher in second lactation and up to fourth one and decline there after. This contrasts with the findings of Reddy and Nagarcenkar, 1988 who observed a tendency for lactation period to decrease as the parity order advanced.

Results of analysis of variance (Table 3) show that genotype had significant effect (P<0.001) on both total milk yield and lactation period length. However, parity only significantly affected (P<0.001) total milk yield. The interaction between genotype and parity was statistically significant (P<0.001) only in the case of lactation period length.

For the effect of genotype, results showed that 75, 87.5 and 93.75% Sahiwal cows yielded more milk per lactation (181.0 litres or +16.53%, 277.3

litres or +25.32% and 594.4 litres or +54.27%, respectively) than did 50% Sahiwal cows in a 14.0 days (+5.69%), 21.3 days (+8.66%) and 28.3 days (+11.51%) longer laction, respectively. For about the same length of lactation, the difference in total milk yield between 75 and 87.5% Sahiwal cows was not significant (only 96.3 litres).

When Ankole cows compared with the Sahiwal-Ankole crosses cows, the former yielded less milk per laction (501.9 litres or –84.58%, 682.9 litres or –115.08%, 779.2 litres or –131.31% and 1096.3 litres or –184.75%, respectively for 50, 75, 87.5 and 93.75% Sahiwal) in a 31.6 days (14.75%), 45.6 days (21.28%), 52.9 days (24.69%) and 59.9 days (27.95%) shorter lactation than did crossbred cows. Generally, the increase of Sahiwal blood in the Ankole cattle of Burundi by up-grading increased significantly both total milk yield per lactation and length of lactation period. However, their performance was less than expected from the additive contribution of Sahiwal genes.

Table 3: Least squares means (LSM), standard errors (±S.E.) and tests of significance+ for lactation performance traits of cows

Traits	Total milk yield (litres)			Lactation length (days)		
Factors	**LSM**	**±S.E.**	**Significance of difference**	**LSM**	**±S.E.**	**Significance of difference**
Genotype (G):						
Ankole	593.4^{e}	40.18		214.3^{c}	4.68	
50% Sahiwal	1095.3^{d}	35.55		245.9^{b}	4.14	
75% Sahiwal	1276.3^{c}	39.83	***	259.9^{ab}	4.64	*
87.50% Sahiwal	1372.6c	40.94		267.2a	4.76	
93.75% Sahiwal	1689.7b	61.05		274.2a	7.10	
Pure Sahiwal	2135.7a	47.89		274.9a	5.57	
Parity (P):						
First lactation	1205.3^{c}	40.79		257.3	4.75	
Second lactation	1311.8^{bc}	41.01		254.5	4.77	
Third lactation	1383.0^{ab}	41.38	***	251.4	4.82	NS
Fourth lactation	1415.8^{ab}	41.42		257.2	4.82	
Fifth lactation	1486.5^{a}	40.88		260.0	4.75	
Interaction:						
G*P	-	-	N.S	-	-	***

+ Means in the same column with different superscripts differ significantly (P<0.05).
NS, not significant at P>0.05; *, significant at P<0.001.**

Table 3 also showed that, for all genotypes considered in the study, total milk yield was greater in the later parities and smaller in the early ones, which confirmed the results reported previously in the precedent paragraph. The significant interaction between genotype and parity in the case of laction period length showed that the ranking of genotypes varied from one laction to another, may be due to seasonal variation in feed supply especially during the dray season (starting in June).

Superiority of crossbred cows:

Considering milk production performance of the Pure Ankole cows raised in Station II (i.e. MOSSO) as representitive of the expected milk production performance of the breed in Burundi, the superiority of each one of the four crossbred groups over the mean of the Ankole cattle can be investigated for total milk yield. The results presented in Table 4 show that for all crossbred

cows the percentage of improving in total milk production attained its maximum at the 5th parity (ranged from 156.1 to 281.4%). On the other hand, the increase of Sahiwal blood in the Ankole breed of Burundi by up-grading increased significantly the percentage of improving in total milk yield per lactation, which confirms the results reported previously in the precedent paragraph. These findings in general confirm the report of earler workers (Pozy and Kagarama, 1980) who concluded that crossbreeding local Ankole cattle of Burundi with Sahiwal increased milk yield in 1st lactation 26% from 943 to 1194 kg and in subsequent lactation 57% from 821 to 1296 kg.

Table 4: Percentage of improvement+ in total milk yield (in litres) of Sahiwal-Ankole crosses cows per parity compared to Ankole cows

Parity / Genotype	First lactation	Second lactation	Third lactation	Fourth lactation	Fifth lactation
50% Sahiwal	51.7	78.3	75.8	67.1	159.7
75% Sahiwal	80.8	124.8	112.8	106.1	156.1
87.50% Sahiwal	116.2	122.2	123.9	115.9	185.7
93.75% Sahiwal	142.6	172.8	165.8	172.7	281.4

+Percentage of improvement = $(X_{Crossbred} - X_{Ankole})/X_{Ankole}*100$

Results also showed that the ranking of crosses varied slightly from one lactation to another (2nd and 5th lactations), may be due to the significant interaction between genotype and parity in the case of the length of lactation period as explained previously.

CONCLUSION

From all these results it can be concluded that introducing the Sahiwal to the Ankole cattle in Burundi would improve their milk production performance by using up-grading. Additionaly, considering the high costs of rearing dairy cows, the above results suggested that, for the Burundian Ankole breeders, the optimal blood percentage in a synthetic breed would be 75% Sahiwal.

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تأثير تدريج ماشية الأنكول البوروندية بالساهيوال على أداء إنتاج اللبن فى الأبقار

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أستخدم أجمالى ٥١٠ سجل إنتاج لبن جمعت من ١٠٢ بقرة مكونة من ٢٠ بقرة من سلالة الأنكول ، ٨٢ بقرة من خلطان الساهيوال x الأنكول لكل منها ٥ مواسم متتالية و ذلك لدراسة تأثير تدريج ماشية الأنكول البوروندية بسلالة الساهيوال على كل من محصول اللبن السنوى (الكلى) و طول موسم الحليب.

عموماً فقد أدت زيادة دم الساهيوال فى ماشية الأنكول البوروندية نتيجة لعملية التدريج إلى زيادة كل من محصول اللبن الكلى لكل موسم حليب و طول موسم الحليب. وقد أظهر التركيب الوراثى تأثيراً معنوياً (عند مستوى معنوية ٠,٠٠١) على كل من محصول اللبن الكلى و طول الموسم. فى حين لم يكن لترتيب موسم الحليب تأثير إلا على محصول اللبن الكلى (عند مستوى معنوية ٠,٠٠١).

وقد أظهرت الأبقار الخليطة التى تحتوى على ٧٥ ، ٨٧,٥ ، ٩٣,٧٥ % من دم الساهيوال إنتاجاً أعلى من اللبن لكل موسم حليب مقارنة بالأبقار الخليطة التى تحتوى على ٥٠ % من دم الساهيوال. بينما عند نفس طول موسم حليب فإن الاختلافات فى محصول اللبن الكلى بين الأبقار الخليطة التى تحتوى على ٧٥ % من دم الساهيوال و تلك التى تحتوى على ٨٧,٥ % منه لم تكن معنوية.

وقد أعطت الأبقار الأنكول محصولاً من اللبن أقل لكل موسم حليب و طولاً أقصر لموسم الحليب مقارنة بالأبقار الخليطة. و بالنسبة لجميع الأبقار الخليطة فإن نسبة التحسين فى محصول اللبن الكلى نتيجة لعملية التدريج وصلت إلى أقصى قيمة لها عند موسم الحليب الخامس (تراوحت ما بين ١٥٦,١ إلى ٢٨١,٤ %).

Table 1: Means (X) and standard errors (S.E.) for total milk yield (in litres) of cows of the six genetic groups for the five successive lactations

Parity		First lactation		Second Lactation		Third lactation		Fourth lactation		Fifth lactation	
Genotype	No. of Cows	X	S.E.	X	S.E.	X	S.E.	X	S.E.	X	S.E.
Ankole	20	582	26.17	581	47.18	619	84.74	660	50.02	526	33.76
50 % Sahiwal	24	883	70.45	1036	63.16	1088	68.71	1103	55.18	1366	86.35
75% Sahiwal	19	1052	79.43	1306	100.48	1317	85.41	1360	83.56	1347	80.73
87.5% Sahiwal	18	1258	80.57	1291	74.22	1386	85.92	1425	86.98	1503	120.21
93.75% Sahiwal	8	1412	267.56	1585	205.41	1645	225.27	1800	224.28	2006	249.19
Pure Sahiwal	13	2045	126.76	2072	135.37	2243	148.28	2147	92.91	2171	93.21

Table 2: Means (X) and standard errors (S.E.) for lactation period length (days) of cows of the six genetic groups for the five successive lactations

Parity		1st lactation		2nd lactation		3rd lactation		4th lactation		5th lactation	
Genotype	No. of Cows	X	S.E.	X	S.E.	X	S.E.	X	S.E.	X	S.E.
Ankole	20	265	7.58	229	13.51	175	15.91	213	16.26	190	15.39
50% Sahiwal	24	230	12.73	235	11.06	248	8.63	250	7.96	266	10.16
75% Sahiwal	19	250	10.28	267	6.44	264	4.66	260	6.93	258	6.81
87.5% Sahiwal	18	257	8.47	260	7.81	271	5.85	272	5.00	276	10.47
93.75% Sahiwal	8	271	31.77	255	17.35	273	17.00	267	12.40	304	11.59
Pure Sahiwal	13	271	5.68	281	4.10	276	5.71	282	10.53	265	5.43