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Research Article

# Some Productive Characteristics of $F_1$, $B_1$ and $F_1xB_1$ Crossbreeds from Simmental x SAR Crossbreeding

Mehmet N. ORMAN
Department of Biostatistics, Faculty of Veterinary Medicine, Ankara University, Dışkapı, 06110 Ankara - TURKEY
Okan ERTUĞRUL
Department of Genetics, Faculty of Veterinary Medicine, Ankara University, Dışkapı, 06110 Ankara - TURKEY
Orhan ALPAN
Department of Biostatistics, Faculty of Veterinary Medicine, Ankara University, Dışkapı, 06110 Ankara - TURKEY

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**Abstract:** South Anatolian Red (SAR) cattle are well adapted to the arid, hot and harsh conditions of the region and have the highest milk yield among the local breeds in Turkey. The purpose of this study was to determine the main productive characteristics, such as viability, reproduction and milk production, of $F_1$, $B_1$ and $F_1xB_1$ crossbred genotype groups from Simmental x SAR crossbreeding.

A t test was used for 2 group comparisons. In cases of insufficient numbers of variants in the groups Kruskal-Wallis and Mann-Whitney U tests were used where appropriate.

There was no difficulty during birth in any of the crossbred groups. Viability rates for males were 100% in the $B_1$ and 97.3% in the $F_1xB_1$ crossbred groups and 92.3% in the $B_1$ and 94.6% in the $F_1xB_1$ groups for females.

The average milk yields of the $F_1$ and $B_1$ genotype groups were similar to those of SAR. However, there were sizeable variations in the genotype groups for milk production, indicating that selection for milk yield is highly promising. In conclusion the crossbreeding programme would be beneficial for viability and possibly for milk production.

**Key Words:** Cattle, Simmental, South Anatolian Red, crossing, reproduction, milk production

## Simental X GAK $F_1$, $G_1$ ve $F_1xG_1$ Melezlerinin Bazı Verim Özellikleri

**Özet:** Güney Anadolu Kırmızısı (GAK) sığır ırkı Güney Doğu ve Akdeniz bölgesinin iklim koşullarına uymuş, Türkiye yerli sığır ırkları arasında en yüksek süt verimine sahip bir ırktır. Bu çalışmanın amacı GAK ırkının çevre şartlarına uyum yeteneği ile, Simental ırkının et ve süt verim yeteneklerini bir arada toplayan yeni bir sığır genotipi meydana getirmektir.

İstatistik analizlerde t-test kullanılmıştır. Denek sayısının yetersiz olduğu durumlarda, grup sayısı 3 ve daha fazla olduğunda parametrik olmayan testlerden Kruskal-Wallis test ve grup sayısı 2 olduğunda Mann-Whitney U test kullanılmıştır.

$G_1$ ve $F_1xG_1$ melezlerinde herhangi bir doğum güçlüğüne rastlanılmamıştır. Yaşama gücü değerleri erkek buzağılar için $G_1$ genotipinde %100, $F_1xG_1$ genotipinde ise % 97,3, dişi buzağılarda ise $G_1$ genotipinde % 92,3; $F_1xG_1$ genotipinde ise %94,6 olarak hesaplanmıştır.

Süt verimi yönünden $F_1$ ve $G_1$'ler, GAK ırkının süt verimi değerine yakın değerler göstermişlerdir. Süt veriminde büyük bir varyasyon oluşması bu özelliğe ait gelişmenin sağlanabileceğini göstermektedir.

**Anahtar Sözcükler:** Sığır, Simental, Güney Anadolu Kırmızısı, melezleme, dölverimi, süt verimi

## Introduction

The South Anatolian Red (SAR) is the highest milk producing breed among the local Anatolian cattle populations. The milk and beef production capacity of SAR cattle is lower than that of dairy and dual-purpose cattle breeds in Europe. However, it is well adapted to the hot, arid conditions and other subtropical hardships, such as tick-borne diseases, in the southern regions of Turkey.

The aim of the project was to develop a new genotype of cattle that would utilise the prospective feed resources in the area, after the completion of the extensive irrigation project in South-eastern Turkey. The new

genotype was expected to possess the high beef and milk production traits of Simmentals, and the heat tolerance and disease resistance abilities of the SAR breed. The first phase of the project was completed in the mid 1990s and performance characteristics of the Simmental x SAR crossbred ($F_1$) generation were reported (1).

In the second phase of the project, $B_1$ and $F_1$ x $B_1$ genotypes were produced and the purpose of this study was to evaluate the parameters of some productive traits in these genotype groups.

It was suggested by Alpan and Arpacık (2) that improvement of the productive characteristics of SAR through selection requires a long time and has some limitations. For this reason it would be more feasible to improve the breed by crossing it with prominent European breeds.

SAR is a variety of Damascus cattle. Its average milk production ranges from 1500 to 3000 kg and length of lactation from 190 to 300 days, with some individual cows producing around 5000 kg of milk (3). Because of its prominent merits, the Damascus cow was preferred by early immigrants to Israel and upgrading crossings with sires was performed to produce Israeli Holsteins.

Yarkın et al. (4) reported that the average values for the first breeding age of SAR cows on Ceylanpınar State Farm was 26 months, service period 136 days, lactation length 276 days and lactation milk yield 3054 kg. Twenty-two years later Ertuğrul (5) studied the records of SAR cattle at the same station from 1978 to 1992 and reported that the first breeding age was 25.6 months, first calving age was 34.9 months, pregnancy period was 282.7 days, calving interval was 381.6 days and dry period was 176.1 days. In the same study the actual milk yield was 1772.9 kg, age corrected milk yield was 2545.9 kg and the length of lactation was 215 days. The mortality rate of the calves in the first 3 months was 6.9%.

Another crossbreeding project using SAR as the dam side and Holstein as the bull side was carried out at 2 state farms in the Mediterranean region of Turkey. In one study the focus was on the health status in the genotype groups. The morbidity rates were 42.0%, 16.2%, 13.3% and 16.1% and the mortality rates were 13.1, 7.0, 1.3 and 4.6 in the genotype groups of Holstein, SAR, $F_1$ and $B_1$, respectively (6). In the other study the productive characteristics in the genotype groups for first calving age were 33.7, 35.0, 37.4 and 33.7 months; for length of lactation were 292, 220, 292 and 279 days; and for actual milk yields were 2804, 1792, 2514 and 3231 kg, in the above genotype order (7).

The origin of the Simmental breed is Switzerland and it was reported that the breed averages of Simmentals in this country were 2.6 years for first calving age and 5825 kg for lactation milk yield (8). In Austria, where the Simmental is a prominent breed the milk yield was 5156, calving rate was 88.2% and calving interval was 385 days (9).

The Simmental breed is relatively new in Turkey and some productive characteristics of Simmental cattle in Turkey have been reported by various researchers. The average milk yields ranged from 2300 to 3300, with a calving interval of 439 days, and mortality rates of the calves to 6 months of age ranged from 1.2% to 6.4% (10-13).

## Materials and Methods

The animal material of this study consisted of 37 $F_1$, 30 $B_1$ and 4 $F_1$ x $B_1$ crossbred cows obtained from Simmental x SAR crossbreeding. Beside these cows, 1 $F_1$, 1 $B_1$ and 3 $F_1$ x $B_1$ bulls were present on the farm during the project period. Additionally 98 males and 44 females from different genotype groups were sold to the farmers in the area. The feed materials of roughages and concentrates used for feeding the cattle were produced on the farm except for supplemental minerals and vitamins.

$F_1$ cows and heifers were artificially inseminated using Simmental sperm. In the following generation $F_1$ females were bred with the $B_1$ bull and $B_1$ females were bred with the $F_1$ bull so that $F_1$ x $B_1$ and $B_1$ x $F_1$ reciprocal crossbred calves were obtained. Number of inseminations per pregnancy, length of pregnancy, abortions, calving difficulties, stillbirths, milk production, length of lactation, milk production in the months of lactation and dry period were recorded. The cows and calves were raised in semi-open housing facilities.

Actual lactation milk yield of a cow is calculated using a monthly milk test. However, if a cow is dried off in less than 305 days, her milk yield was regarded as 305-day lactation milk production. Therefore no correction factor was applied. If lactation length was longer than 305 days,

the milk yield after 305 days was not included in the calculations and 305-day milk yield was considered to be 2 x 305-day corrected milk production (14).

Statistical tests were performed for each trait between and among the subgroups. Student's t-test was used for comparisons between $F_1$ and $B_1$ and also $F_1$ and $F_1$ x $B_1$ generations. In cases where sample sizes were small, a non-parametric Mann-Whitney U test or Kruskal-Wallis test was used.

## Results

This study started in 1998 and lasted for 3.5 years. During this period 37 $F_1$ x $B_1$ and 12 $B_1$ male calves, and 37 $F_1$ x $B_1$ and 13 $B_1$ female calves were born. There were 2 abortions in $B_1$, 3 twins in $F_1$ x $B_1$ crossbreds and 3 stillbirths among $B_1$ calves. Mortality by 6 months of age occurred in one female in the $B_1$ group.

The numbers of inseminations per pregnancy in the genotype groups are given in Table 1.

The average numbers of inseminations per pregnancy were 1.40 ± 0.051 in $F_1$, 1.40 ± 0.103 in $B_1$ and 1.25 ± 0.250 in $F_1$ x $B_1$ genotypes. The differences among the groups were not significant.

The lactation milk yields of $F_1$ and $B_1$ cows are given in Table 2. The $F_1$ genotype had higher milk yields for the first and second lactations than the $B_1$ genotype. The difference between $F_1$ and $B_1$ for the first lactation corrected milk yield was highly significant ($P < 0.01$).

The results of the lactation length, calving interval and dry period in the genotypes are given in Table 3.

The average lactations were all relatively short. The differences between the genotypes and among the lactation numbers within the genotypes were all non-significant. Overall calving intervals in both genotypes were longer than 1 year. The general dry periods averaged 158.19 and 183.90 days with relatively high errors of the means. The differences between the genotypes and among the lactation numbers were non-significant.

The means of first breeding and first calving ages for the genotypes are given in Table 4. The averages for the first breeding and accordingly the first calving ages were relatively high and the differences among the genotypes were not significant.

## Discussion

During the study period of 3.5 years 99 crossbred calves (49 male and 50 female) in different genotype groups were obtained. There were 3 stillbirths (in $B_1$) and 2 abortions (in $B_1$). One calf in the $B_1$ and 3 calves in the $F_1$ x $B_1$ genotype died by 6 months of age. Survival rates were 96.0% in $B_1$ and 97.3% in $F_1$ x $B_1$ crossbreds. For the male and female calves the respective survival rates were 92.3% and 94.6%. These findings were higher than those in the report by Comerford, et al. (15) on the Simmental breed. The survival rates were also higher than the reported values on Simmentals by Deliömeroğlu (12) at Kazova State Farm and by Alpan et al. (10) at

Table 1. Number of inseminations per pregnancy in genotypes.

| Lactation Number | $F_1$ | | | $B_1$ | | | $F_1$x $B_1$ | | | P |
|---|---|---|---|---|---|---|---|---|---|---|
| | N | X | Sx | N | X | Sx. | N | X | Sx. | |
| 1 | 37 | 1.41 | 0.106 | 30 | 1.37 | 0.122 | 4 | 1.25 | 0.250 | N.S. |
| 2 | 31 | 1.29 | 0.095 | 15 | 1.47 | 0.236 | - | - | - | N.S. |
| 3 | 25 | 1.40 | 0.115 | 3 | 1.33 | 0.333 | - | - | - | |
| 4 | 21 | 1.43 | 0.130 | 2 | 1.50 | 0.500 | - | - | - | |
| 5 | 12 | 1.58 | 0.149 | - | - | - | - | - | - | |
| 6 | 3 | 1.33 | 0.333 | - | - | - | - | - | - | |
| Σ | 129 | 1.40 | 0.051 | 50 | 1.40 | 0.103 | 4 | 1.25 | 0.250 | N.S. |

N.S.: non-significant

Table 2. Actual and corrected milk yields in the $F_1$ and $B_1$ genotypes.

| Lactation Number | $F_1$ | | | $B_1$ | | | P |
|---|---|---|---|---|---|---|---|
| | N | X | Sx | N | X | Sx. | |
| Actual Milk Yield | | | | | | | |
| 1 | 33 | 2041.94 | 209.275 | 17 | 1434.12 | 247.835 | N.S. |
| 2 | 25 | 1945.64 | 234.162 | 8 | 1837.25 | 328.602 | N.S. |
| 3 | 24 | 2078.67 | 232.600 | 2 | 2535.00 | 1177.000 | - |
| 4 | 16 | 1816.31 | 231.582 | - | - | - | - |
| 5 | 10 | 1557.50 | 253.325 | - | - | - | - |
| 6 | 3 | 2263.00 | 585.102 | - | - | - | - |
| Σ | 111 | 1958.00 | 104.173 | 27 | 1586.43 | 199.040 | N.S. |
| 2x 305 ME Milk Yield | | | | | | | |
| 1 | 34 | 1872.03 | 175.187 | 23 | 1090.13 | 218.583 | * |
| 2 | 28 | 1736.32 | 224.181 | 10 | 1497.60 | 344.583 | N.S. |
| 3 | 24 | 2029.38 | 226.074 | 2 | 2247.00 | 1093.000 | - |
| 4 | 16 | 1794.94 | 229.483 | - | - | - | - |
| 5 | 10 | 1547.60 | 254.175 | - | - | - | - |
| 6 | 3 | 2060.00 | 554.386 | - | - | - | |
| Σ | 115 | 1837.79 | 96.928 | 35 | 1244.86 | 181.266 | * |

*: $P < 0.01$
N.S.: non-significant

Karacabey State Farm. The results reported by Akcan et al. (6) on Holstein (H), SAR and H x SAR crossbreeds of $F_1$ and $B_1$ were in agreement with the results obtained in this study. Higher surviving abilities of the crossbred generations both in H x SAR and S x SAR crossings were attributed to the contributions of SAR to the crossbred generations. If the environmental conditions at the farm are improved it is thought that the viability of the crossbred animals would be further increased.

Crossbred genotypes are, in general, well adapted to harsh environmental conditions and have higher liveability than European breeds. Improvements in housing and hygienic conditions would further increase their liveability.

The mean numbers of inseminations per pregnancy were 1.40 ± 0.051, 1.40 ± 0.103 and 1.25 ± 0.250 for $F_1$, $B_1$ and $F_1$ x $B_1$ crossbreeds, respectively. These values were smaller than the findings given by Alpan et al. (10) and Deliömeroğlu et al. (13) for Simmentals.

The averages of first breeding age in the genotypes were 525.51, 531.11 and 520.00 days and first calving ages were 843, 845 and 808 days in the above order. These values are mainly related to the body development of the animal and the management practices on the farms. Heifers are bred at about 18 months of age at Ceylanpınar State Farm. These findings were lower than the values for pure-bred Simmentals reported by İlarslan et al. (11) and Deliömeroğlu et al. (13). Furthermore the findings on first breeding and calving ages were lower than those of the respective crossbreeds of Holsteins with SAR at Boztepe State Farm (7).

The means for calving interval were 390 days in the $F_1$ and 370 days in the $B_1$ genotypes. The ideal practice of cattle management is to obtain one calf from a cow each year. The average for $B_1$ is in agreement with accepted range of the ideal calving interval. This trait is again determined by the genotype of the animal and the environment, mainly management practices and especially

Table 3. Lactation lengths. calving interval and dry periods in the genotypes.

| Lactation Number | $F_1$ | | | $B_1$ | | | P |
|---|---|---|---|---|---|---|---|
| | N | X | Sx | N | X | Sx. | |
| Lactation Length | | | | | | | |
| 1 | 31 | 249.48 | 14.894 | 14 | 233.71 | 13.145 | N.S. |
| 2 | 24 | 239.04 | 13.940 | 8 | 234.00 | 22.066 | N.S. |
| 3 | 24 | 255.75 | 14.029 | 2 | 347.00 | 1.000 | - |
| 4 | 16 | 234.50 | 16.929 | - | - | - | - |
| 5 | 10 | 224.30 | 23.472 | - | - | - | - |
| 6 | 3 | 310.00 | 50.362 | - | - | - | - |
| Σ | 108 | 245.69 | 7.077 | 27 | 203.37 | 12.203 | N.S. |
| Calving Interval | | | | | | | |
| 1 | 32 | 377.47 | 13.327 | 15 | 362.27 | 15.875 | N.S. |
| 2 | 25 | 409.52 | 19.191 | 3 | 360.00 | 15.535 | - |
| 3 | 21 | 375.38 | 9.587 | 2 | 445.00 | 8.000 | - |
| 4 | 12 | 413.67 | 23.788 | - | - | - | - |
| 5 | 3 | 357.33 | 21.759 | - | - | - | - |
| Σ | 91 | 389.63 | 7.961 | 20 | 370.20 | 13.273 | N.S. |
| Dry Period | | | | | | | |
| 1 | 32 | 158.34 | 21.273 | 15 | 205.47 | 36.810 | N.S. |
| 2 | 24 | 204.08 | 31.619 | 3 | 133.33 | 34.090 | - |
| 3 | 21 | 114.71 | 15.877 | 2 | 98.00 | 9.000 | - |
| 4 | 11 | 160.18 | 35.372 | - | - | - | - |
| 5 | 3 | 86.33 | 23.730 | - | - | - | - |
| Σ | 91 | 158.19 | 12.855 | 20 | 183.90 | 29.068 | N.S. |

N.S.: non-significant

Table 4. First breeding age and first calving age in the genotypes.

| Genotype | First breeding age | | | First calving ages | | |
|---|---|---|---|---|---|---|
| | N | X | Sx | N | X | Sx |
| $F_1$ | 37 | 525.57 | 11.282 | 37 | 843.00 | 19.005 |
| $B_1$ | 30 | 531.77 | 11.179 | 30 | 845.37 | 15.300 |
| $F_1xB_1$ | 4 | 520.00 | 12.430 | 4 | 808.00 | 16.119 |
| P | N.S. | | | N.S. | | |

N.S.: non-significant

reproduction management. The above means are similar to those reported for Simmentals by Deliömeroğlu et al. (13) and for SAR by Ertuğrul (5), and shorter than those in the reports by İlarslan et al. (11) and Yarkın et al. (4) in Turkey.

An optimum dry period of 2 months is needed for the cow to replenish her body reserves, to raise her fetus and to prepare the animal for the next lactation. However, extension of the dry period decreases the economy of the enterprise. The average dry periods for the $F_1$ and $B_1$ genotypes were 158 and 184 days, respectively. Both averages were longer than the economic optimum and the difference between the genotypes was not significant. It is thought that the dry periods of both genotypes could be shortened by management practices on the farm. These values were also longer than those in the reports on Simmentals (11) and SAR (5).

The mean lengths of lactation were 246 days for the $F_1$ and 243 days for the $B_1$ groups. There was no significant difference between the genotypes and both averages were shorter than the standard lactation period of 305 days. These values were similar to those of SAR (2) and shorter than the reports on Simmentals by Deliömeroğlu et al. (13) and on Holstein x SAR crossbreeds of $F_1$ and $B_2$ genotypes (7). The short lactation length in SAR is thought to be partly due to genetic background and partly due to high environmental temperatures in the region. The SAR breed transmits this undesirable trait to its crossbred generations of $F_1$ and $B_1$ accordingly.

The standard errors of the milk yield means were rather large, indicating considerable genetic variations. This also shows that selection would be effective for increasing milk production in the following generations. On the other hand, the small numbers of individuals in the genotype groups restricted the application of effective selection in the study. The main purpose of the crossbreeding programme was to develop an animal with high beef production capacity. That is why the Simmental breed was chosen as the sire line of the crossing. However, it was also desired that female crossbreeds would give a satisfactory level of milk to justify the crossbreeding. The Simmental breed is known to produce 4000 kg and SAR about 2000 kg of milk. It is thought that the milk productions of crossbreeds could be markedly raised by improving environmental factors and applying more effective selection methods in the genotype groups.

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