Comparative analysis of milk yield and reproductive traits of Holstein-Friesian cows born in Turkey or imported from Italy and kept on farms under the Turkish-ANAFI project

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ABSTRACT

This research investigated the milk yield, reproductive traits and productive life of Holstein-Friesian cows born in Turkey or imported from Italy and raised on farms involved in the Turkish-ANAFI Project. A total of 2600 records for age at first calving, 4733 completed lactation records from 2080 cows, and 1130 productive life (from first calving to disposal) records from 50 farms in the provinces of İzmir, Manisa and Aydın under the Turkish-ANAFI Project were evaluated. Least squares means for age at first calving, 305-day milk yield, lactation milk yield, lactation duration, days open, days dry, and productive life were 28.2 months, 6232 kg, 6829 kg, 336.0 days, 138.0 days, 78.3 days, and 28.9 months, respectively. Corresponding least squares means for cows born in Turkey and imported from Italy were 28.8 and 27.6 months (P<0.01), 6182 and 6281 kg (P>0.05), 6761 and 6897 kg (P<0.05), 333.9 and 338.1 days (P<0.05), 132.7 and 143.4 days (P<0.01), 79.2 and 77.3 days (P>0.10), and 21.6 and 36.1 months (P<0.01), respectively. The level of milk yield of Holstein-Friesian cows in herd-book herds under the project in the Aegean Region was satisfactory. However, there were reproductive problems as shown by the length of days open. Shorter productive life of cows born in Turkey compared to cows from Italy suggested that breeders tended to cull locally born cows at a younger age but that they tended to keep imported cows in the herd for a longer period unless serious problems occurred.

Key words: Holstein-Friesian, Country of origin, Milk yield, Reproductive traits, Productive life

RIASSUNTO

ANALISI COMPARATIVA DELLA PRODUZIONE DI LATTE E DEI CARATTERI RIPRODUTTIVI DI VACCHE DI RAZZA FRISONA NATE IN TURCHIA O IMPORTATE DALL’ITALIA E MANTENUTE IN ALLEVAMENTI DEL PROGETTO ANAFI-TURCHIA

Obiettivo della ricerca è stato valutare la produzione di latte, le caratteristiche riproduttive e la durata della vita produttiva di vacche di razza Frisona nate in Turchia o importate dall’Italia ed allevate in strutture coinvolte nel progetto ANAFI-Turchia. Per le analisi sono state utilizzate 2600 osservazioni per l’età al primo parto, 4733 lattazioni di 2080 vacche e 1130 osservazioni per la vita produttiva (intervallo dal primo parto all’eliminazione) raccolte in da 50 aziende delle province di Izmir, Manisa, e Aydın che hanno partecipato al progetto ANAFI-Turchia. Le medie stimate per l’età al primo parto, la produzione di latte a 305 giorni, la produzione effettiva, la durata di lattazione, l’intervallo parto concepimento, la durata del periodo di asciutta e della vita produttiva sono risultate 28.2 mesi, 6232 kg, 6829 kg, 336.0 giorni, 138.0 giorni, 78.3 giorni, e 28.9 mesi rispettivamente. Le medie stimate per gli stessi caratteri per le vacche nate in Turchia e per quelle importate dall’Italia sono risultate 28.8 e 27.6 mesi (P<0.01), 6182 e 6281 kg (P>0.05), 6761 e 6897 kg (P<0.05), 333.9 e 338.1 giorni (P<0.05), 132.7 e 143.4 giorni (P<0.01), 79.2 e 77.3 giorni (P>0.10), e 21.6 e 36.1
Introduction

The Aegean Region is one of the regions of Turkey where intensive production of dairy cattle is most prevalent. Therefore, the proportion of high-yielding European dairy breeds in the total cattle population in the region has increased rapidly. Among the dairy breeds that have been raised in the Aegean Region, Holstein-Friesians become more prevalent day by day, as is generally the case in most of the countries of the world, due to their high milk and meat production and good adaptation to different climates under good management (Grothe, 1995).

The breeding of registered dairy-cattle in Turkey was done on state farms until only recently. However, state farms were unable to meet the increasing demand for breeding cattle. A project known as the Turkish-ANAFI Project was implemented in the Aegean Region from 1989 through 1994 to meet the increasing demand for Holstein-Friesian breeding heifers and cows. The goal of this project was to provide Turkey with a breeding system similar to those in developed countries.

Programs used for the improvement of dairy cattle populations in developed countries have been implemented for over 100 years by associations established by breeders as herd-book and cow testing organizations (Voelker, 1981; Grothe, 1995). These associations have carried out milk-recording schemes and kept herd-book records for approximately 50% of the dairy cattle population in their respective countries.

The aim of the Turkish-ANAFI Project was to establish a herd-book organization similar to ANAFI (Associazione Nazionale Allevatori della Razza Frisona Italiana “National Association of Breeders of Italian Friesian Cattle”).

In Turkey, several studies have examined milk yield and reproductive traits of Holstein-Friesian cattle raised for many years on state farms in which milk recording and herd-book registration have been carried out (Kumuk, 1989; Kumlu et al., 1991; Akbulut et al., 1992; Bakır et al., 1994; Özcan and Altınel, 1995; Kaya, 1996). However, it was the Turkish-ANAFI project that first offered the possibility to investigate the performance of Holstein-Friesian cattle under field conditions.

In developed countries, performance of cows under field conditions for traits that have economic value have continuously been measured and published by extensive organizations for herd-book and milk recording. These performance data have been effectively used in both genetic and environmental improvement programs (Wiggans, 1994).

The purpose of this study was to make comparative analyses of milk yield, reproductive traits, and productive life of imported (from Italy) or locally born Holstein-Friesian cows raised on the farms in the project, using herd-book and milk records. Thus, both the performance of locally born Holstein-Friesian cows under field conditions and the performance of cows imported from Italy to form a base population for a herd-book program under the conditions of Aegean Region would be determined.

Material and methods

Under the Turkish-ANAFI-project, a total of 2800 pregnant Holstein-Friesian heifers donated by the Italian Government were distributed to 217 private farms in nine provinces of the Aegean Region in order to create a base breeding population (Anonymous, 1996). In the İzmir, Manisa, and Aydın provinces, which were considered the main provinces of the project, a total of 1301 pregnant heifers were distributed to 94 farms. In addition,
210 elite pregnant heifers were given to four state farms (Beydere and Söke Vocational Schools of Agriculture, Agricultural Faculty Farm of Aegean University, and Aegean Agricultural Research Institute) in three provinces (Table 1). The provinces of İzmir, Manisa and Aydın are in the western part of the Aegean Region, and the climate in this area is Mediterranean climate.

Herd-book, milk recording, and reproduction data collected from 1990 through 1996 from 50 farms in the provinces of İzmir, Manisa and Aydın under the Turkish-ANAFI project were the material of the study. Records were collected by supervisors of the project through monthly visits to farms and were entered into a central computer using special software for storing and processing the data (FCS, 1989). The type of records used was the owner-sampled record, i.e. all the recordings are undertaken by the farmer (ICAR Method B). A total of 8470 calving/lactation records from 2862 cows in 50 herds were examined and the following records were excluded: (1) all records of a cow with missing birth date, (2) records of cows with missing calving date, (3) records of cows born before 1987 or after 1995, (4) records of cows with age at first calving <18 months, (5) records of lactations initiated before 1990 or after 1996, (6) lactation records <150 days in length, (7) lactation records with days open <15 days, and (8) lactation records with 305-day milk yield <2000 kg. Data editing left a total of 2600 records for age at first calving, a total of 4698 to 4733 completed lactation records (Table 2) from 2074 to 2080 cows for milk yield, lactation duration, days open or days dry, and a total of 1130 records for productive life.

In this study, age at first calving, 305-day milk yield, lactation milk yield, lactation duration, days open, days dry, and productive life were examined.

Table 1. Number of farms involved in the project and number of imported pregnant heifers distributed to the farms.

| Provinces | Private farms | State farms | To private farms | To state farms |
|-----------|---------------|-------------|-----------------|----------------|
| İzmir     | 45            | 2           | 561             | 76             |
| Manisa    | 30            | 1           | 469             | 74             |
| Aydın     | 19            | 1           | 271             | 60             |
| Total     | 94            | 4           | 1301            | 210            |

Table 2. Distribution of the final data according to provinces and country of origin of cows.

| Provinces | N. of farms | N. of cows | N. of completed lactation records |
|-----------|-------------|------------|----------------------------------|
|           | Born in Turkey | Imported from Italy | From cows born in Turkey | From imported cows |
| İzmir     | 25          | 823        | 427                              | 1223             | 1029             |
| Manisa    | 15          | 444        | 324                              | 682              | 768              |
| Aydın     | 10          | 366        | 216                              | 520              | 511              |
| Total     | 50          | 1633       | 967                              | 2425             | 2308             |

Total 2600 4733
Lactation milk yield and 305-day milk yield were calculated by the special software prepared for the project (FCS, 1989) using the Test Interval method. Lactation milk yield was the milk production during the whole lactation period. The 305-day milk yield was the milk production during the first 305 days after calving. In case a cow produced milk for more than 305 days, the production during the first 305 days was calculated. If a cow produced milk for less than 305 days, the production during her lactation period was considered as 305-day milk yield, i.e. lactation yield was not projected to a 305-day basis. Age at first calving, lactation duration, days open, days dry, and productive life were calculated by a computer program written in FORTRAN (Uzmay and Kaya, 1994). Productive life was calculated by subtracting the date of first calving from the date of disposal except for sale for dairy purposes.

The data were analyzed using Least-Squares Method as applied in the LSMLMW program by Harvey (1987).

The following model was used to analyze 305-day milk yield, lactation milk yield, lactation duration, and days dry:

\[
Y_{ijklmno} = \mu + c_i + h_j + y_{ck} + s_{cl} + m_o + p_n + b_{d_{ijklmno}} + e_{ijklmno} \quad (1)
\]

where

- \(Y_{ijklmno}\) = record for 305-day milk yield, lactation milk yield, lactation duration or days dry,
- \(\mu\) = least-squares mean,
- \(c_i\) = random effect of the \(i\)th cow (absorbed),
- \(h_j\) = fixed effect of the \(j\)th herd (\(j = 1, 50\)),
- \(y_{ck}\) = fixed effect of the \(k\)th year of calving (\(k = 1, 7\)),
- \(s_{cl}\) = fixed effect of the \(l\)th season of calving (\(l = 1, 4\)),
- \(m_o\) = fixed effect of the \(o\)th country of origin (\(m = 1, 2\)),
- \(p_n\) = fixed effect of the \(n\)th parity (\(n = 1, 5\)),
- \(b\) = linear regression coefficient of the trait considered on days open,
- \(d_{ijklmno}\) = days open,
- \(e\) = random residual (~N; 0, \(\sigma^2_e\)).

Since the effect of cows was nested within herd and country of origin, dependency was found in the inverse matrix. Therefore, the random effect of cows was absorbed into the equations. Years of calving covered the period from 1990 to 1996. Four seasons of calving were defined as winter (December through February), spring (March through May), summer (June through August) and autumn (September through November). Countries of origin were Turkey and Italy. Parity was defined as 1st, 2nd, 3rd, 4th, and 5th and later parities.

For days open, the model was:

\[
Y_{d_{ijklmno}} = \mu + c_i + h_j + y_{ck} + s_{cl} + m_o + p_n + b_{d_{ijklmno}} + e_{ijklmno} \quad (2)
\]

where

- \(Y_{d_{ijklmno}}\) = record for days open,
- \(m_o\) = fixed effect of the \(o\)th class of 305-day milk yield (\(o = 1, 6\)). Other terms in the model were as described in model (1).

Six classes of 305-day milk yield were defined as ≤4000 kg, 4001 to 5000 kg, 5001 to 6000 kg, 6001 to 7000 kg, 7001 to 8000 kg, and >8000 kg.

For age at first calving, the model was:

\[
Y_{jklmn} = \mu + h_j + y_{bk} + s_{bl} + m_o + e_{jklmn} \quad (3)
\]

where

- \(Y_{jklmn}\) = record for age at first calving,
- \(y_{bk}\) = fixed effect of the \(k\)th year of birth (\(k = 1, 9\)),
- \(s_{bl}\) = fixed effect of the \(l\)th season of birth (\(l = 1, 4\)).

Other terms in the model were as described in model (1).

Years of birth covered the period from 1987 to 1995. Four seasons of birth were defined as described in seasons of calving in model (1).

The model for productive life was:

\[
Y_{jmn} = \mu + h_j + m_o + e_{jmn} \quad (4)
\]

where

- \(Y_{jmn}\) = record for productive life.
- \(m_o\) = fixed effect of the \(o\)th year of birth (\(o = 1, 9\)).

Other terms in the model were as described in model (1).

Duncan’s multiple range test was used to compare means within each factor.

Results and discussion

Least squares means for age at first calving and days open are given in Table 3. Least squares mean for age at first calving was found to be 28.2 months. Although this age is more than 24 months, which was reported by Wattiaux (1996) as
optimal value for average age at first calving, it takes place within the acceptable range (24 to 30 months). However, it can be reduced to 24 months of age by better feeding and management. Age at first calving for imported heifers was 1.2 months shorter than those born in Turkey (P<0.01), suggesting that heifers born in Italy were raised under better feeding and management conditions.

Table 3. Least squares means and standard errors for age at first calving and days open.

| Factors               | Age at first calving (months) | Days open |
|-----------------------|------------------------------|-----------|
|                       | n.  | X    | SE | n.  | X    | SE |
| Herd¹ (n.=50)         |     |      |    |     |      |    |
| Min.                  | 25  | 24.5 | 0.8 | 78  | 77.9| 11.8|
| Max.                  | 12  | 32.0 | 1.0 | 12  | 256.9| 26.9|
| Year²                 |     |      |    |     |      |    |
| 1987                  | 250 | 31.3 | 0.3 | -   | -   | -  |
| 1988                  | 403 | 29.5 | 0.2 | -   | -   | -  |
| 1989                  | 377 | 29.1 | 0.2 | -   | -   | -  |
| 1990                  | 367 | 27.6 | 0.2 | 470 | 154.0| 5.5 |
| 1991                  | 349 | 27.0 | 0.2 | 633 | 136.7| 4.6 |
| 1992                  | 398 | 27.7 | 0.2 | 876 | 129.8| 3.8 |
| 1993                  | 294 | 27.7 | 0.3 | 872 | 139.4| 3.5 |
| 1994                  | 130 | 26.8 | 0.4 | 872 | 145.4| 3.4 |
| 1995                  | 32  | 27.2 | 0.7 | 659 | 137.1| 3.8 |
| 1996                  | -   | -    | -  | 330 | 123.9| 5.2 |
| Season³               |     |      |    |     |      |    |
| Winter                | 710 | 28.0 | 0.2 | 1088| 137.3| 3.5 |
| Spring                | 726 | 28.6 | 0.2 | 1408| 143.7| 3.3 |
| Summer                | 578 | 28.6 | 0.2 | 1139| 137.4| 3.4 |
| Autumn                | 586 | 27.7 | 0.2 | 1077| 133.8| 3.5 |
| Country of origin     |     |      |    |     |      |    |
| Turkey                | 1633| 28.8 | 0.2 | 2405| 132.7| 3.7 |
| Italy                 | 967 | 27.6 | 0.2 | 2307| 143.4| 2.8 |
| Class of 305-day milk yield (kg) |      |      |    |     |      |    |
| ≤4000                 | -   | -    | -  | 290 | 115.3| 5.9 |
| 4001-5000             | -   | -    | -  | 849 | 116.5| 3.9 |
| 5001-6000             | -   | -    | -  | 1247| 131.3| 3.3 |
| 6001-7000             | -   | -    | -  | 1142| 145.4| 3.3 |
| 7001-8000             | -   | -    | -  | 729 | 148.3| 3.9 |
| >8000                 | -   | -    | -  | 455 | 171.4| 4.8 |
| Parity                |     |      |    |     |      |    |
| 1                     | -   | -    | -  | 1855| 143.9| 2.7 |
| 2                     | -   | -    | -  | 1254| 135.2| 3.0 |
| 3                     | -   | -    | -  | 813 | 134.0| 3.6 |
| 4                     | -   | -    | -  | 475 | 133.1| 4.5 |
| ≥5                    | -   | -    | -  | 315 | 144.0| 5.7 |
| Overall               | 2600| 28.2 | 0.1| 4712| 138.0| 2.6 |

* a, b, c, d Within each factor, means in the same column with unlike superscripts differ significantly (P<0.05).
1 In order to give an idea about the variation among herds, values for herds that had minimum or maximum mean value with respect to traits examined were given.
2 Year of birth for age at first calving; calving year for days open
3 Season of birth for age at first calving; calving season for days open.

Winter (Dec. to Feb.), Spring (Mar. to May), Summer (Jun. to Aug.), Autumn (Sep. to Nov.)
Conversely, Afifi et al. (1992) found no significant differences between local and imported Friesian cows with respect to age at first calving in Egypt. The effects of herd, year of birth, and season of birth on age at first calving were also significant (P<0.01).

Least squares mean for days open was 138.0 days. This is higher than the optimal value of 85 to 110 days reported by Wattiaux (1996), indicating that there might have been considerable reproductive problems in breeding farms in the Aegean Region. However, to obtain an optimal days open is difficult. Days open for Holsteins were 143 days in Mexico (McDowell et al., 1976a), 120 days in Israel (ICBA, 1997), and 132 to 136 days in the first three lactations in North Carolina, in the United States (Makuza and McDaniel, 1996). Least squares mean for days open for cows from Italy was 143.4 days, 10.7 days longer than that of cows born in Turkey (P<0.01). Similarly, Lafi et al. (1995) reported that imported Holstein-Friesian first-calf heifers had significantly more days open than local Holstein-Friesian first-calf heifers in Jordan. There was a relationship between milk yield and

**Table 4.** Least squares means and standard errors for 305-day milk yield and lactation milk yield.

| Factors               | 305-day milk yield (kg) | Lactation milk yield (kg) |
|-----------------------|-------------------------|---------------------------|
|                       | n. | X     | SE | n. | X     | SE |
| Herd1 (n.=50)         |    |       |    |    |       |    |
| Min.                  | 45 | 4269a | 218| 12 | 4597a | 424|
| Max.                  | 30 | 7614a | 230| 30 | 8742a | 280|
| Calving year          |    |       |    |    |       |    |
| 1990                  | 459| 5830a | 71 | 469| 6385a | 86 |
| 1991                  | 632| 6109a | 58 | 632| 6656a | 71 |
| 1992                  | 876| 6376a | 48 | 876| 6947a | 57 |
| 1993                  | 868| 6301a | 45 | 867| 6865a | 55 |
| 1994                  | 869| 6317a | 43 | 870| 6936a | 53 |
| 1995                  | 657| 6457a | 48 | 655| 7135a | 59 |
| 1996                  | 329| 6231a | 67 | 329| 6877a | 82 |
| Calving season2       |    |       |    |    |       |    |
| Winter                | 1087| 6308a | 45 | 1087| 6899a | 55 |
| Spring                | 1403| 6303a | 42 | 1402| 6902a | 51 |
| Summer                | 1137| 6092a | 43 | 1136| 6707a | 52 |
| Autumn                | 1073| 6223a | 45 | 1073| 6807a | 55 |
| Country of origin     |    |       |    |    |       |    |
| Turkey                | 2400| 6182  | 46 | 2398| 6761b | 56 |
| Italy                 | 2300| 6281  | 35 | 2300| 6897b | 42 |
| Parity                |    |       |    |    |       |    |
| 1                     | 1851| 5553a | 33 | 1850| 6223a | 40 |
| 2                     | 1251| 6225a | 37 | 1250| 6831a | 46 |
| 3                     | 811 | 6527a | 45 | 811 | 7121a | 56 |
| 4                     | 474 | 6494a | 58 | 474 | 7038a | 71 |
| ≥5                    | 313 | 6360a | 74 | 313 | 6931a | 90 |
| Days open3            |    |       |    |    |       |    |
| 4700                  | 2.0 | 0.2   |    | 4698| 10.9  | 0.2 |
| Overall               | 4700| 6232  | 32 | 4698| 6829  | 38 |

*Within each factor, means in the same column with unlike superscripts differ significantly (P<0.05).

1 In order to give an idea about the variation among herds, values for herds that had minimum or maximum mean value with respect to traits examined were given.

2 Winter (Dec. to Feb.), Spring (Mar. to May), Summer (Jun. to Aug.), Autumn (Sep. to Nov.)

3 Covariate
days open. As shown in Table 3, days open increased as 305-day milk yield increased (P<0.01). Higher yield is associated with reduced reproductive performance in lactating cows (Nebel and McGilliard, 1993; Bagnato and Oltenacu, 1994). Reproductive performance has largely been influenced by feeding and management. One of the most common causes of low fertility in dairy cows is negative energy balance in early lactation (Wattiaux, 1996). High yielding cows are more susceptible to reproductive problems because they have a longer period with negative energy balance in early lactation, and therefore, they require better feeding and management. Longer days open for imported cows (Table 3), which also had higher milk yield, suggested that feeding and management were not at the desired level.

The effects of herd, calving year, and parity (P<0.01) on days open were significant. Although the effect of calving season on days open was not significant (P>0.05), the P-value (0.057) was near to the critical P-value (0.05). Days open was highest in cows calving in spring. Days open decreased until fourth parity, suggesting that cows with reproductive problems have been culled at early ages. After fourth parity, days open began to increase.

Least squares means for 305-day milk yield and lactation milk yield are in Table 4. Average 305-day milk yield was 6232 kg. This level of yield was generally higher than those reported before 1996 for Holstein-Friesian cows raised at state farms in Turkey (Kumuk, 1989; Kumlu et al., 1991; Akbolut et al., 1992; Anonymous, 1992; Özcan and Altunel, 1995; Kaya, 1996). It was also higher than 305-day milk yields reported in studies carried out in Egypt to evaluate performance of the imported Friesian cattle (Afifi et al., 1992; Sadek et al., 1994). Least squares mean for lactation milk yield was 6829 kg. This value was higher than those reported for Holsteins imported from different countries to Iran (Kashan and Salehi, 1994). Milk yield level found in this study is quite satisfactory for breeding farms under the conditions of Turkey.

Least squares mean for 305-day milk yield for cows imported from Italy was 6281 kg. This was higher than that of cows born in Turkey, which was 6182 kg. Although the difference between these 305-day milk yields was not significant (P>0.05), the P-value (0.057) was near to the critical P-value (0.05). Least squares means for lactation milk yield were 6897 kg and 6761 kg (P<0.05) for cows from Italy and those born in Turkey, respectively. Studies in Mexico (McDowell et al., 1976b), Jordan (Lafi et al., 1995), Egypt (Farghaly et al., 1997), and the Czech Republic (Stadnik and Louda, 1999) also showed that imported Holstein-Friesians produced more milk than local Holstein-Friesians. Milk yield for cows from Italy was lower than that for Holstein-Friesian cows in Italy in 1993, which was 7421 kg (ANAFI, 2002), but it was higher than that for Holsteins in Sicily, which was 5799 kg (Licitra et al., 1998), where the environmental conditions are more similar to those in the western part of the Aegean Region. Higher milk yield of imported cows compared to cows born in Turkey can be explained by the fact that genetic potential for milk yield in Italian cows was higher, and/or feeding and management of Italian cows were better.

The effects of herd, calving year, calving season, and parity on 305-day milk yield and lactation milk yield were significant (P<0.01). Cows calving in winter and spring produced more milk than those calving in summer and autumn. This finding is similar to that of Licitra et al. (1998). Milk yield increased until third lactation and then slightly decreased. Both 305-day milk yield and lactation milk yield were influenced by length of days open (P<0.01). Milk yield increased as conception delayed. This increase was more apparent for lactation milk yield (b=10.9 kg) compared to 305-day milk yield (b=2.0 kg).

Least squares mean for lactation duration and days dry are in Table 5. Least squares mean for lactation duration was 336.0 days. Lactation duration (338.1 days) for cows imported from Italy was longer (P<0.05) than that of cows born in Turkey (333.9 days), possibly as a result of longer days open for imported cows. The effect of herd on lactation duration was significant (P<0.01), while the effects of calving season and calving year were not significant (P>0.05).

Least squares mean for days dry was 78.3 days. This was quite higher than 50 to 60 days,
which was accepted as optimal value for days dry (Wattiaux, 1996). There was no significant difference (P>0.10) in days dry between imported cows and those born in Turkey. Length of dry period was significantly influenced by herd (P<0.01). The effects of calving year and calving season on days dry were not significant (P>0.10).

Lactation duration shortened (P<0.01) as parity advanced. However, days dry increased (P<0.01) as parity advanced. Both lactation duration (b=0.72 days) and days dry increased (b=0.26 days) as days open increased (P<0.01).

Least squares means for productive life of cows are given in Table 6. Least squares mean for productive life was found to be 28.9 months. This value was lower than that of Holstein cows in the United States, which was 38.4 months, (Nieuwhof et al., 1989) and was higher than that of Holstein cows in Quebec, Canada, which was 23.2 months (Chauan et al., 1993). Mean productive life for imported cows (36.1 months) was higher (P<0.01) than for cows born in Turkey (21.6 months). Mangurkar et al. (1986) reported that length of productive life for Holstein-Friesians imported to India from Canada was 40.20 months. The effect of herd on productive life was also significant.

Table 5. Least squares means and standard errors for lactation duration and days dry.

| Factors                     | Lactation duration (days) | Days dry |
|-----------------------------|---------------------------|----------|
|                             | n. | X    | SE  | n. | X    | SE  |
| Herd1 (n.=50)               |    |      |     |    |      |     |
| Min.                        | 427| 298.5| 2.2 | 54 | 58.4 | 6.1 |
| Max.                        | 54 | 354.5| 6.1 | 427| 114.4| 2.3 |
| Calving year                |    |      |     |    |      |     |
| 1990                        | 469| 335.3| 2.3 | 477| 80.1 | 2.4 |
| 1991                        | 632| 334.3| 1.9 | 648| 78.6 | 2.0 |
| 1992                        | 876| 334.7| 1.6 | 879| 79.4 | 1.6 |
| 1993                        | 867| 333.7| 1.5 | 870| 81.4 | 1.5 |
| 1994                        | 870| 336.0| 1.4 | 868| 77.8 | 1.5 |
| 1995                        | 655| 338.5| 1.6 | 659| 76.2 | 1.7 |
| 1996                        | 329| 339.4| 2.2 | 332| 74.3 | 2.3 |
| Calving season2             |    |      |     |    |      |     |
| Winter                      | 1087| 337.1| 1.5 | 1094| 77.9 | 1.5 |
| Spring                      | 1402| 337.9| 1.4 | 1416| 76.7 | 1.4 |
| Summer                      | 1136| 334.8| 1.4 | 1142| 79.3 | 1.4 |
| Autumn                      | 1073| 334.3| 1.5 | 1081| 79.0 | 1.5 |
| Country of origin           |    |      |     |    |      |     |
| Turkey                      | 2398| 333.9| 1.5 | 2425| 79.2 | 1.5 |
| Italy                       | 2300| 338.1| 1.1 | 2308| 77.3 | 1.1 |
| Parity                      |    |      |     |    |      |     |
| 1                           | 1850| 343.9| 1.1 | 1865| 70.2 | 1.1 |
| 2                           | 1250| 335.1| 1.2 | 1258| 79.1 | 1.3 |
| 3                           | 811 | 334.7| 1.5 | 816 | 80.0 | 1.6 |
| 4                           | 474 | 333.6| 1.9 | 477 | 79.5 | 2.0 |
| ≥5                          | 313 | 332.7| 2.5 | 317 | 82.4 | 2.5 |
| Days open3                  |    |      |     |    |      |     |
| 4698                        | 0.72| 0.01 | 4733| 0.26| 0.01 |
| Overall                     | 4698| 336.0| 1.0 | 4733| 78.3 | 1.0 |

*a, b Within each factor, means in the same column with unlike superscripts differ significantly (P<0.05).

1 In order to give an idea about the variation among herds, values for herds that had minimum or maximum mean value with respect to traits examined were given.

2 Winter (Dec. to Feb.), Spring (Mar. to May), Summer (Jun. to Aug.), Autumn (Sep. to Nov.)

3 Covariate
and implement an extension program to improve reproductive performance for economical milk production.

The data provided by the Coordination Board of the Turkish-ANAFI Project is gratefully appreciated.

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Conclusions

The level of milk yield of Holstein-Friesian cows in herd-book herds under the project in the Aegean Region was satisfactory. Milk yield of imported cows was higher than that of locally born Holsteins. Higher milk yield in imported cows was most probably due to the fact that they came from a population where an intensive selection program has been carried out. The imported cows had a positive influence on the Holstein production in the region. The Italian cows were readily accepted by the breeders in the region as shown by their longer productive life. The results also indicated good adaptation of Holsteins to warmer climates. However, reduced reproductive performance, especially for imported cows, indicated that feeding and reproductive management were not at the desired level. It would be beneficial for breeders' associations and research institutions to develop and implement an extension program to improve reproductive performance for economical milk production.

Table 6. Least squares means and standard errors for productive life of cows.

| Factors                  | n. X SE | n. | X  | SE  |
|--------------------------|---------|----|----|-----|
| **Herd**<sup>1</sup>   |         |    |    |     |
| (n=50)                   |         |    |    |     |
| Herd<sup>1</sup>         |         |    |    |     |
| Min.                     | 11      | 17.0<sup>b</sup> | 6.1 |
| Max.                     | 20      | 52.6<sup>a</sup> | 4.6 |
| **Country of origin**   |         |    |    |     |
| Turkey                   | 592     | 21.6<sup>a</sup> | 1.4 |
| Italy                    | 538     | 36.1<sup>a</sup> | 1.2 |
| **Overall**              | 1130    | 28.9 | 1.1 |

<sup>a, b</sup> Within each factor, means in the same column with unlike superscripts differ significantly (P<0.05).

<sup>1</sup> In order to give an idea about the variation among herds, values for herds that had minimum or maximum mean value with respect to traits examined were given.

(P<0.01). Shorter productive life of cows born in Turkey compared to cows from Italy suggested that breeders tended to cull locally born cows at a younger age, but they tended to keep imported cows in the herd for a longer period unless serious problems occurred. On the other hand, it is not possible to make a reliable interpretation of the productive life found in this study, since the data used come from a recently established herd-book organization.

The data provided by the Coordination Board of the Turkish-ANAFI Project is gratefully appreciated.

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