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# Environmental factors affecting fertility traits of Thoroughbred and Halfbred horses reared in Turkey

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ABSTRACT

The aim of this study was to investigate environmental factors affecting fertility traits of Thoroughbred and Halfbred mares raised at a stud farm in Bursa between 1985 and 2000. The factor that showed the greatest influence over the fertility traits was the breeding month of mares. The effect of breeding month on first servicing period, service period and foaling interval was statistically significant. The effect of sex of foal on gestation length was statistically significant. The least square means of gestation length, first servicing period, and foaling interval were 337.6 days, 62.9 days, 81.7 days, 413 days for Thoroughbred; 333.4 days, 51.3 days, 70.3 days and 400 days for Halfbred, respectively. Ratios of pregnancy, sterility, parturition and abortion were 67.07, 31.14, 52.10 and 14.97% for Thoroughbred, 71.34, 27.07, 56.69 and 14.65% for Halfbred, respectively. It can be concluded that reproductive performance of Halfbred and Thoroughbred horses are low in this stud farm. Better performance levels can be obtained by culling old and infertile mares and better management.

**Key words**: Environmental factors, Fertility traits, Halfbred, Thoroughbred

The breeding season of horses in Turkey occurs from February to July, resulting in the same official age for all foals born the same season (Nagy *at al.* 2000). Fertility of mares can be affected by many factors, some genetic, others environmental. Environmental factors can be classified as factors with measurable effects (age, parity, foaling year, breeding season, etc.) and factors with un-measurable effects (infectious diseases, parasitic enfestations, etc.). The measurable effects can be determined, and these factors can be used in the management of the farm.

The gestation length was reported between 319 and 364 days for Thoroughbred mares (Hintz *et al.* 1992, Perez *et al.* 2003). Sevinga *et al.* (2004) reported that pregnancies were shorter when conception occurred in July, coinciding with maximum photoperiod oscillations. Gestation length was longer when mares gave birth to colts rather than fillies (Perez *et al.* 2003, Sevinga *et al.* 2004).

Older mares than 12 years of age are less likely to be in foal at the end of a breeding season compared to younger mares because of early pregnancy loss (Buiten *et al.* 2003). Zeller (2000) reported that service period was closely related to the mean environmental temperature in the postpartum period and to the average air moisture after birth.

Conception rate and foaling rate for Thoroughbred were reported from 83.3 to 90.9% and from 69.3 to 79.8%, respectively (Tischner 2002, Hemberg *et al.* 2004). It was stated that the ratio of abortion was between 11.0 and 13.6 for thoroughbred (Hemberg *et al.* 2004).

This study was conducted to investigate the environmental factors affecting fertility traits of Thoroughbred in Bursa.

## MATERIALS AND METHODS

The breeding records of 87 Thoroughbred mares and 178 Halbred mares raised at a stud farm in Bursa between 1985 and 2000 were collected. Twelve age groups were formed beginning from 4 years and ending at 15 years and older for foaling age; 6 groups for foaling month, and 16 groups for foaling year, between 1985 and 2000. Environmental factors which influenced first servicing period, service period, number of insemination per conception (NIPC), foaling interval and gestation length were investigated. The general Linear Model (GLM) was used for variance analyses of fertility traits. Duncan's multiple range test was used for multiple comparisons. On the basic of mares at mating, pregnancy, parturition and abortion ratios were calculated from breeding records of 167 Thoroughbred, 314 Halfbred mares.

## RESULTS AND DISCUSSION

Least square means for gestation length are presented in

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Table 1. The average gestation length was estimated as 334.4 days for Halfbred, 337.6 days for Thoroughbred. Effect of foal sex was significant (P<0.05). Colt foal pregnancies were longer than fillies. Gestation length was found the shortest in mares bred in July and the highest mares bred in February.

Table 1. Least square means of gestation length (day)

| | Thoughbred | | Halfbred | |
|---|---|---|---|---|
| Factors | n | Mean+ SEM | n | Mean+SEM |
| Breeding age | ns | | | ns |
| 4 | 10 | 332.6±3.18 | 20 | 332.6±1.89 |
| 5 | 7 | 337.7±3.46 | 13 | 331.2±2.29 |
| 6 | 9 | 337.8±3.20 | 16 | 334.0±2.07 |
| 7 | 6 | 339.1±4.06 | 13 | 331.0±2.26 |
| 8 | 5 | 331.7±4.21 | 13 | 330.2±2.26 |
| 9 | 6 | 332.8±3.74 | 14 | 335.9±2.21 |
| 10 | 10 | 340.3±3.32 | 14 | 334.7±2.18 |
| 11 | 9 | 338.8±2.98 | 9 | 334.8±2.79 |
| 12 | 6 | 338.9±402 | 14 | 333.2±2.17 |
| 13 | 6 | 340.3±3.86 | 14 | 335.6±2.21 |
| 14 | 4 | 340.4±4.55 | 9 | 333.9±2.71 |
| 15 and older | 9 | 340.3±3.20 | 29 | 333.0±1.54 |
| Breeding month | | ns | | ns |
| 2 (February) | 6 | 341.3±4.04 | 15 | 2334.3±2.25 |
| 3 (March) | 19 | 338.5±2.22 | 39 | 333.8±1.36 |
| 4 (April) | 15 | 336.8±2.79 | 42 | 333.6±1.25 |
| 5 (May) | 22 | 336.9±2.03 | 48 | 333.4±1.21 |
| 6 (June) | 18 | 336.5±2.27 | 21 | 333.3±1.83 |
| 7 (July) | 7 | 335.6±3.84 | 12 | 331.6±2.34 |
| Breeding year | | ns | | ns |
| 1985 | 4 | 336.2±4.81 | 8 | 333.6±2.88 |
| 1986 | 4 | 333.1±4.76 | 8 | 332.3±1.36 |
| 1987 | 6 | 334.0±3.78 | 10 | 333.7±3.11 |
| 1988 | 5 | 343.3±4.20 | 7 | 334.9±2.79 |
| 1989 | 7 | 342.5±3.48 | 9 | 334.0±2.26 |
| 1990 | 7 | 3312.2±3.49 | 13 | 332.8±2.66 |
| 1991 | 7 | 337.6±3.56 | 9 | 332.7±2.90 |
| 1992 | 4 | 335.2±4.57 | 8 | 332.3±2.64 |
| 1993 | 6 | 335.5±3.91 | 10 | 329.8±2.57 |
| 1994 | 4 | 335.5±4.90 | 10 | 327.7±2.00 |
| 1995 | 6 | 339.3±3.99 | 18 | 333.5±2.33 |
| 1996 | 5 | 337.8±3.99 | 12 | 336.4±1.84 |
| 1997 | 5 | 341.3±4.15 | 18 | 333.3±2.47 |
| 1998 | 8 | 335.1±3.39 | 11 | 336.1±2.31 |
| 1999 | 5 | 348.4±4.36 | 12 | 339.7±2.10 |
| 2000 | 4 | 335.1±4.90 | 15 | 331.4±2.90 |
| Sex of foal | | * | | * |
| Filly | 39 | 335.4±1.45$^{b}$ | 85 | 332.1±0.97$^{b}$ |
| Colt | 48 | 337.6±1.53$^{a}$ | 93 | 334.6±0.91$^{a}$ |
| Overall mean | 87 | 337.6±1.10 | 178 | 333.4±0.72 |

In Table, *:P<0.05; ***: P<0.001; ns: nonsignificant; SEM: standard error of the mean, a,b,c: Means without a common superscript within each variable and each factor differ (P<0.05).

The least square means of first servicing period, service period, foaling interval and NIPC were presented in Table 2 for Thoroughbred and in Table 3 for Halfbred. The effects of foaling month on the first servicing period, service period and foaling interval were significant (P<0.001 – P<0.01). Service period was the shortest in April as days 37.02 for halfbred, 34.51 days for thoroughbred. Average first servicing period, service period and foaling interval were 51.3 days, 70.30 days, and 400 days for halfbred; 62.86, 81.69, 412.95 days for Thoroughbred, respectively.

Pregnancy, parturition and abortion rates are presented in Table 4 for Thoroughbred, in Table 5 for Halfbred mares. Average pregnancy ratios were 67.07% for Thoroughbred, 71.34% for Halfbred mares. Average abortion ratios were 14.97% for Thoroughbred, 14.65% for Halfbred mares.

Average gestation length was 333.4 days for Halfbred, 337.6 days of Thoroughbred, respectively. Similar findings were reported by Perez *et al.* (2003). As reported by Perez *et al.* (2003) and Sevinga *et al.* (2004), gestation length was longer when mares gave birth to colts rather than fillies. This may be ascribed to differences due to sex chromosome linked effects. Although Demirci (1988) reported that age of mares significantly influenced gestation length, effect of foaling age on gestation length was statistically nonsignificant in this study.

Effect of breeding month on gestation length was statistically nonsignificant. However, as reported by Perez *et al.* (2003) and Sevinga *et al.* (2004) gestation length was the shortest in mares bred in July (later in the reproductive season), when photoperiod was maximum. This natural adaptative mechanism allows the newborn foal access to the best nutritive and environmental resources.

Effect of year on gestation length was statistically nonsignificant (P>0.05). However, gestation duration for Thoroughbred and Halfbred mares was the longest in 1999. This may have influenced the nutrition quality of rations, which might have become deficient and irregular, leading to later end of gestation as a mechanism for adjusting to adverse climatic and nutrition conditions in that year.

Shorter service period and first servicing period in mares foaling in April may result from effect of temperature, humidity and availability of green fodder during the spring, which might be favourable for the physiological functioning of different systems.

Although Allen *et al.* (2007) reported that increasing mare age was the biggest limiting factor to a high rate of fertility of Thoroughbreds, the important factor was the month of foaling in this study. The longest service period and foaling interval were in mares foaling in June, in agreement with Zeller (2000). Mares foaling in June could not have a chance for gestation in later in the reproductive season. As these mares will be mated in next breeding season, service period will be longer. Mares foaling early in the year may have both more chance for gestation in reproductive season and an age

Table 2. The least square means of first servicing period, service period, foaling interval and NIPC of thoroughbred mares

| Factors | n | First servicing period (day) Mean± SEM | Service period (day) Mean±SEM | Foaling interval (day) Mean±SEM | NIPC |
|---|---|---|---|---|---|
| Age | ns | ns | ns | ns | ns |
| 5 | 8 | 94.61±2.66 | 101.21±3.01 | 429.±78±3.04 | 5.07±0.15 |
| 6 | 6 | 80.53±3.12 | 75.79±3.53 | 388.83±3.56 | 3.75±0.17 |
| 7 | 7 | 96.41±2.75 | 132,16±3.12 | 465.61±3.15 | 4.95±0.15 |
| 8 | 5 | 57.79±3.77 | 72.02±4.27 | 389.10±4.31 | 4.96±0.21 |
| 9 | 5 | 30.63±3.52 | 60.01±3.98 | 387.22±4.02 | 4.39±0.19 |
| 10 | 7 | 39.89±2.84 | 69.31±3.21 | 396.07±3.24 | 4.96±0.16 |
| 11 | 5 | 72.15±3.66 | 70.11±4.14 | 425.47±4.18 | 2.64±0.20 |
| 12 | 6 | 39.03±3.09 | 47.34±3.50 | 387.11±3.54 | 5.04±0.17 |
| 13 | 6 | 71.50±3.61 | 78.26±4.08 | 404.32±4.12 | 5.84±0.20 |
| 14 | 5 | 48.36±3.33 | 81.51±3.76 | 415.56±3.80 | 8.15±0.18 |
| 15 and older | 7 | 50.70±2.99 | 93.24±3.38 | 440.64±3.41 | 5.74±0.16 |
| Month | | ** | ** | ** | ns |
| 1 (January) | 8 | 35.14±2.77 b | 70.51±3.14 b | 408.97±3.17 b | 5.69±0.15 |
| 2 (February) | 12 | 34.57±2.56 b | 62.29± 2.89 b | 400.22±2.92 b | 5.40±0.14 |
| 3 (March | 13 | 34.16±2.11 b | 46.75±2.39 b | 375.94±2.41 b | 4.61±0.12 |
| 4 (April) | 10 | 16.81±2.63 b | 34.51±2.98 b | 277.90±3.01 b | 4.18±0.14 |
| 5 (May) | 17 | 29.47±209 b | 37.66±2.36 b | 376.51±2.39 b | 4.45±0.11 |
| 6 (June) | 7 | 221.62±3.15 a | 228.81±3.57 a | 531.22±3.60 a | 5.94±0.17 |
| Year | | ns | ns | ns | ns |
| 1985 | 4 | 66.55±3.85 | 87.10±4.36 | 416.26±4.40 | 4.19±0.47 |
| 1986 | 4 | 46.97±4.05 | 71.21±4.58 | 395.19±4.62 | 6.17±0.49 |
| 1987 | 4 | 45.11±3.87 | 59.88±4.38 | 385.00±4.42 | 5.73±0.47 |
| 1988 | 3 | 104.06±4.41 | 102.27±4.99 | 433.60±5.04 | 4.31±0.54 |
| 1989 | 3 | 83.61±4.22 | 103.29±4.77 | 442.27±4.82 | 7.03±0.52 |
| 1990 | 5 | 74.17±3.57 | 79.48±4.04 | 396.42±4.08 | 4.23±0.44 |
| 1991 | 4 | 64.60±4.17 | 93.61±4.71 | 4.27.06±4.76 | 5.93±0.51 |
| 1992 | 8 | 21.16±2.82 | 45.81±3.19 | 371.44±3.22 | 5.34±0.34 |
| 1993 | 4 | 72.03±3.66 | 118.12±4.14 | 471.59±4.18 | 7.70±0.45 |
| 1994 | 6 | 46.36±3.14 | 73.06±3.55 | 411.04±3.59 | 7.22±0.38 |
| 1995 | 5 | 82.83±3.31 | 71.19±3.74 | 403.24±3.78 | 2.29±0.40 |
| 1996 | 5 | 54.34±3.45 | 113.38±3.91 | 400.47±3.95 | 7.61±0.42 |
| 1997 | 4 | 15.01±3.86 | 29.39±4.36 | 385.85±4.41 | 3.53±0.47 |
| 1998 | 4 | 50.43±3.80 | 62.31±4.29 | 406.89±3.34 | 2.00±0.46 |
| 1999 | 4 | 102.18±3.55 | 91.23±4.01 | 430.55±4.05 | 2.36±0.43 |
| Overall mean | 67 | 102.18±3.55 | 81.69±1.15 | 412.95±1.16 | 5.04±0.13 |

advantage over foals born the same season. Therefore, a profitable horse breeding could be possible by foaling before April. Artificial photoperiod, simulating long days, can be used to advance the time of the first ovulation of the year in mares in this farm.

As Staun *et al.* (1982) reported, it could be said that service period was longer in mares older than 12 years expect for 7-year-old Thoroughbred. Increasing mare age may be associated with degenerative endometrial changes, incidence of acute endometrial and abnormal oocyte. Longer service period in 5-year-old mares may be associated with that reproductive organs of these mares is not completely mature.

Average NIPC was higher than previous study (Morries and Allen 2002, Hemberg *et al.* 2004). In this farm, oestrus detection and artificial insemination should be performed at the right time and in an appropriate way. An appropriate teasing technique should be used to decide whether a mare is properly in heat. Control of ovulation and gestation examination between days 15 and 35 after ovulation by using ultrasonography in particularly should be given much attention. If the fact that mares are not pregnant has been diagnosed early enough in the season, it may be possible

Table 3. Least square means of first servicing period, service period, foaling interval and NIPC of halfbred mares

| Factors | n | First servicing period (day) Mean±SEM | Service Period (day) Mean±SEM | Foaling interval (day) Mean±SEM | NIPC |
|---|---|---|---|---|---|
| Age | ns | ns | ns | ns | ns |
| 5 | 9 | 60.27±1.36 | 81.76±1.55 | 403.9±1.54 | 5.45±0.16 |
| 6 | 9 | 22.25±1.32 | 43.63±1.50 | 375.8±1.57 | 4.56±0.16 |
| 7 | 10 | 41.34±1.25 | 55.62±1.42 | 394.8±1.42 | 4.37±0.15 |
| 8 | 9 | 47.22±1.34 | 61.50±1.52 | 379.4±1.50 | 3.76±0.16 |
| 9 | 6 | 61.72±1.67 | 72.39±1.90 | 405.6±1.91 | 4.68±0.20 |
| 10 | 6 | 41.05±1.70 | 77.97±1.93 | 418.0±1.92 | 5.80±0.20 |
| 11 | 6 | 34.35±1.68 | 40.58±1.91 | 373.1±1.91 | 4.61±0.20 |
| 12 | 5 | 71.59±1.92 | 93.42±2.18 | 420.9±2.30 | 6.24±0.24 |
| 13 | 7 | 66.22±1.59 | 83.22±1.81 | 410.6±1.81 | 6.32±0.19 |
| 14 | 6 | 54.46±1.65 | 81.91±1.88 | 410.5±1.87 | 8.57±0.20 |
| 15 and older | 16 | 63.79±1.05 | 81.21±1.19 | 407.3±1.20 | 5.70±0.13 |
| Month | | *** | *** | *** | *** |
| 1 | 15 | 53.21±1.12 b | 73.82±1.27 b | 402.5±1.26 b | 5.96±0.13 |
| 2 | 18 | 49.51±1.00 b | 62.51±1.14 bc | 388.9±1.13 bc | 5.36±0.12 |
| 3 | 27 | 28.08±0.84 bc | 58.59±0.95 bc | 380.0±0.96 bc | 5.62±0.10 |
| 4 | 18 | 15.14±1.03 c | 37.02±1.17 c | 371.4±1.20 c | 4.79±0.13 |
| 5 | 5 | 22.43±1.75 c | 39.48±1.99 c | 369.8±1.97 c | 5.38 ±0.21 |
| 6 | 6 | 139.41±1.72 a | 150.43±1.94a | 487.2±1.95 a | 5.64±0.20 |
| Year | | ns | ns | ns | |
| 1985 | 4 | 72.28±1.98 | 72.82±2.21 | 368.0±2.62 | 3.48±0.27 |
| 1986 | 6 | 44.24±1.67 | 45.47±1.90 | 385.6±1.87 | 4.56±0.20 |
| 1987 | 4 | 32.68±2.07 | 99.81±2.36 | 370.5±2.34 | 3.44±0.24 |
| 1988 | 6 | 51.07±1.73 | 90.63±1.97 | 39.9±1.96 | 3.61±0.20 |
| 1989 | 8 | 48.78±1.47 | 77.49±1.67 | 421.09±1.67 | 7.94±0.17 |
| 1990 | 4 | 34.68±1.99 | 390.33±2.26 | 373.4±2.24 | 4.91±0.23 |
| 1991 | 4 | 25.80±1.94 | 35.01±2.21 | 408.8±2.63 | 4.33±0.28 |
| 1992 | 6 | 41.70±1.71 | 47.73±1.95 | 372.5±1.78 | 6.19±0.19 |
| 1993 | 5 | 55.32±1.66 | 70.60±1.99 | 417.9±1.97 | 9.46±0.21 |
| 1994 | 6 | 52.96±1.53 | 67.49±1.73 | 396.1±1.72 | 5.73±0.18 |
| 1995 | 9 | 31.60±1.36 | 61.96±1.54 | 393.9±1.53 | 6.71±0.16 |
| 1996 | 7 | 67.93±1.51 | 107.53±1.71 | 436.8±1.70 | 7.56±0.18 |
| 1998 | 9 | 41.64±1.34 | 53.73±1.52 | 393.5±1.51 | 4.38±0.16 |
| 1998 | 5 | 86.28±1.82 | 97.88±2.07 | 424.3±2.05 | 3.19±021 |
| 1999 | 6 | 82.49±1.64 | 85.88±1.86 | 445.0±1.85 | 6.41±0.19 |
| Overall mean | 89 | 51.30±0.50 | 70.30±0.57 | 400.0±0.58 | 5.46±0.06 |

with a subsequent covering to have her conceive, thus avoiding the loss of a full breeding year.

Ratios of pregnancy for Thoroughbred and Halfbred mares were respectively 67.07 and 71.34%, which, is lower than other studies (Tischner 2002, Hemberg *et al.* 2004).

In this study, rations of abortion for thoroughbred and halfbred were respectively 14.97 and 14.65%, which is similar to that of Hemberg *et al.* (2004). Most of the foals were aborted before reaching 5 months of age (Tischner 2002). Abortion can be caused by luteal insufficiency, embryonic defects, endometritis, twinning, equine viral rhinopneumonitis etc. Luteal insufficiency is one of the important causes of embryonic deaths. Yang and Cho (2007) reported high early embryonic death rate of 12.2% within 45 days after ovulation. Carioglu (1999) informed that in prevention of luteal insufficiency, 100 mg of medroxyprogesterone acetate applications at intervals of 4 days could be recommended. These applications keep the serum progesterone level high during days 16-48, which are the most critical days of pregnancy.

Profitable horse breeding depends on mare's having a live foal in the every year. Mares should be mated in early

Table 4. Ratios of oestrus, pregnancy, sterility, parturition, and abortion of Thoroughbred

| | Mares at mating | Oestrus | | Pregnancy | | Sterility | | Parturition | | Abortion | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | n | n | % | n | % | n | % | n | % | n | % |
| 1985 | 9 | 9 | 100 | 7 | 77.78 | 2 | 22.22 | 4 | 44.44 | 3 | 33.33 |
| 1986 | 7 | 7 | 100 | 4 | 57.14 | 3 | 42.86 | 4 | 57.14 | 0 | 0.00 |
| 1987 | 11 | 11 | 100 | 7 | 63.64 | 4 | 36.36 | 6 | 54.55 | 1 | 9.90 |
| 1988 | 7 | 7 | 100 | 6 | 85.71 | 1 | 14.29 | 5 | 71.43 | 1 | 14.28 |
| 1989 | 11 | 11 | 100 | 8 | 72.73 | 3 | 27.27 | 7 | 63.64 | 1 | 9.09 |
| 1990 | 11 | 11 | 100 | 9 | 81.82 | 2 | 18.18 | 7 | 63.64 | 2 | 18.18 |
| 1991 | 21 | 19 | 90.5 | 10 | 47.62 | 9 | 42.86 | 7 | 33.33 | 3 | 14.29 |
| 1992 | 13 | 13 | 100 | 6 | 46.15 | 7 | 53.85 | 4 | 30.77 | 2 | 15.38 |
| 1993 | 15 | 14 | 93.3 | 8 | 53.33 | 6 | 40.00 | 6 | 40.00 | 2 | 13.33 |
| 1994 | 9 | 9 | 100 | 6 | 66.67 | 3 | 33.33 | 4 | 44.44 | 2 | 22.22 |
| 1995 | 12 | 12 | 100 | 7 | 58.33 | 5 | 41.67 | 6 | 50.00 | 1 | 8.33 |
| 1996 | 14 | 14 | 100 | 9 | 64.29 | 5 | 35.71 | 5 | 35.71 | 4 | 28.57 |
| 1997 | 5 | 5 | 100 | 5 | 100.0 | 0 | 0.00 | 5 | 100.0 | 0 | 0.00 |
| 1988 | 10 | 10 | 100 | 10 | 100.0 | 0 | 0.00 | 8 | 80.00 | 2 | 20.00 |
| 1999 | 7 | 7 | 100 | 6 | 85.71 | 1 | 14.29 | 5 | 71.43 | 1 | 14.29 |
| 2000 | 5 | 5 | 100 | 4 | 80.00 | 1 | 20.00 | 4 | 80.00 | 0 | 0.00 |
| Total | 167 | 164 | 98.2 | 112 | 67.07 | 52 | 31.14 | 87 | 52.10 | 25 | 14.97 |

Table 5. Ratios of oestrus, pregnancy, sterility, parturition, and abortion of halfbred mares

| | Mares at mating | Oestrus | | Pregnancy | | Sterility | | Parturition | | Abortion | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | n | n | % | n | % | n | % | n | % | n | % |
| 1985 | 13 | 13 | 100 | 10 | 76.92 | 3 | 23.08 | 8 | 61.54 | 2 | 15.38 |
| 1996 | 13 | 13 | 100 | 10 | 76.92 | 3 | 23.08 | 8 | 61.54 | 2 | 15.38 |
| 1987 | 15 | 15 | 100 | 11 | 73.33 | 4 | 6.67 | 10 | 66.67 | 1 | 6.67 |
| 1988 | 13 | 13 | 100 | 8 | 61.54 | 5 | 38.46 | 7 | 53.85 | 1 | 7.69 |
| 1989 | 16 | 16 | 100 | 11 | 68.75 | 5 | 31.25 | 9 | 56.25 | 2 | 12.50 |
| 1990 | 27 | 27 | 100 | 17 | 62.96 | 10 | 37.04 | 13 | 48.15 | 4 | 14.81 |
| 1991 | 26 | 26 | 100 | 12 | 46.15 | 14 | 53.85 | 9 | 34.62 | 3 | 11.54 |
| 1992 | 20 | 20 | 100 | 12 | 60.00 | 8 | 40.00 | 8 | 40.00 | 4 | 20.00 |
| 1993 | 27 | 22 | 81.5 | 12 | 44.44 | 10 | 37.04 | 10 | 37.04 | 2 | 7.41 |
| 1994 | 20 | 20 | 100 | 13 | 65.00 | 7 | 35.00 | 10 | 50.00 | 3 | 15.00 |
| 1995 | 29 | 29 | 100 | 21 | 72.41 | 8 | 27.59 | 18 | 62.07 | 3 | 10.00 |
| 1996 | 23 | 23 | 100 | 17 | 73.91 | 6 | 26.09 | 12 | 52.70 | 5 | 21.74 |
| 1997 | 20 | 20 | 100 | 20 | 100.0 | 0 | 0.00 | 18 | 90.00 | 2 | 10.00 |
| 1998 | 17 | 17 | 100 | 17 | 100.0 | 0 | 0.00 | 11 | 64.71 | 6 | 35.29 |
| 1999 | 16 | 16 | 100 | 16 | 100.0 | 0 | 0.00 | 12 | 75.00 | 4 | 25.00 |
| 2000 | 19 | 19 | 100 | 17 | 89.47 | 2 | 10.53 | 15 | 78.95 | 2 | 10.53 |
| Total | 314 | 309 | 98.41 | 224 | 71.34 | 85 | 27.07 | 178 | 56.69 | 46 | 14.65 |

breeding season. Proportions of sterility and abortion should be decreased. These ratios can be reduced with better management and culling of barren and old mares. Oestrus detection and artificial insemination should be performed at the right time and in an appropriate way. An appropriate teasing technique should be adopted in deciding whether a mare is properly in heat or not.

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