Indian Journal of Animal Sciences **78** (12): 1380–1383, December 2008

Environmental factors affecting reproductive performance of mares

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Received: 6 August 2007; Accepted: 27 July 2008

Key words: Environmental factors, Haflinger, Horse, Performance, Reproductive

The horses are seasonal polyestreous species with onset of the breeding season occuring in spring, associated with increase in daylight, temperature and availability of food. The breeding season in Turkey occurs from February to July, resulting in the same official age for all foals born in the same season (Nagy *et al.* 2000). Horses are considered to have relatively poor reproductive efficiency compared with sheep and cattle (Yang and Cho 2007). However, ratio of difficult birth is less than other species. Several factors are considered to be of importance for breeding efficiency such as, stallion, age and reproductive status of mares (maiden, barren, lactating), and month of breeding.

The age of the mares had a significant influence on the live foal rate, being lower for older mares than 12 years of age because of early pregnancy loss (Staun *et al.* 1982, Buiten *et al.* 2003, Hemberg *et al.* 2004).

Conception rate and foaling rate often expressed on a seasonal basis as a measurement of reproductive efficiency. The ratio of conception was reported between 67 and 76.81% for Haflinger mares (Demirtel 1975, Yurdaydýn and Sevinç 1983, Küçük 1990). It was stated that the ratios of abortion was between 3.2 and 7.1% for Haflinger mares (Demirtel 1975, Meragalli and Valzania 1985, Küçük 1990). Marsalek (2000) reported percentage of born foals of Hafflinger as 59.25.

The gestation length was reported between 331 and 342 days for Haflinger mares (Meragalli and Valzania 1985, Küçük 1990).

The present study was conducted to investigate the environmental factors affecting fertility traits of Haflinger mares raised at a stud farm in Bursa.

Fertility records of 64 Haflinger mares raised at a stud farm in Bursa between 1985 and 2000 were collected. Twelve age groups were formed beginning from 4 years and finishing 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 were effective on gestation length, first servicing period, service period, foaling interval and number of insemination for per conception (NIPC) 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 127 Haflinger mares.

Least square means for gestation length are presented in Table 1. The average gestation length was estimated as 333.8 days. The effect of foal sex on gestation length was significant ($P<0.05$). Pregnancy was longer when mares gave birth to colts rather than fillies. Gestation length was the lowest in mares bred in July (later in the reproductive season).

The least square means of first servicing period, service period, foaling interval and NIPC are presented in Table 2.

The effects of foaling month on the first servicing period, service period and foaling interval was significant ($P<0.001$–$P<0.01$). Average first servicing period, service period and foaling interval were 68.26, 95.11 and 422.1 respectively. Service period was lowest in April as 42.48 days, and highest in June as 218.76 days. NIPC was more higher in older mares than 12 years of age than young mares.

Pregnancy, parturition and abortion rates are presented in Table 3. Average pregnancy ratio and avarage abortion ratio were 59% and 11.81% respectively.

Avarage gestation length were found 333.8 days and between limits of previous researches (Meragalli and Valzania 1985, Küçük 1990). Although Demirci (1988) reported that gestation length decrease with age, effect of foaling age on gestation length was statistically non-significant in this study. As reported previously (Akkayan and Demirtel 1973, Kutluca 1995), gestation length was longer when mares gave birth to colts rather than fillies.

As informed by Perez *et al.* (2003), gestation length was the lowest in mares bred in July, when photoperiod was maximum. This natural adaptative mechanism allows the newborn foal access to the best nutritive and environmental resources.

The longest service period and foaling interval were in

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

Factors	Haflinger	
	n	Mean±SEM
Breeding Age		ns
4	8	334.9±3.32
5	8	332.7±3.84
6	6	335.0±5.00
7	5	336.3±4.59
8	7	327.6±4.48
9	8	333.2±3.23
10	5	335.4±4.41
11	3	330.0±5.47
12	3	332.9±6.28
13	3	332.4±5.49
14	5	341.2±4.34
15 and older	3	334.1±5.31
Breeding month		ns
2 (February)	13	335.2±2.60
3 (March)	10	334.9±2.87
4 (April)	11	334.9±2.97
5 (May)	9	333.0±3.37
6 (June)	14	332.9±2.72
7 (July)	7	332.0±3.80
Breeding year		ns
1985	5	334.1±4.69
1986	5	330.4±4.20
1987	3	334.3±5.34
1988	3	328.8±5.70
1989	4	336.1±4.16
1990	5	334.6±3.83
1991	6	329.2±4.04
1992	5	336.5±4.58
1993	3	331.4±5.71
1994	2	337.5±6.32
1995	2	333.6±6.15
1996	4	334.4±4.35
1997	4	335.9±5.15
1998	4	329.1±5.86
1999	4	338.6±4.35
2000	5	336.7±4.72
Sex of foal		*
Filly	35	330.9 1.75 b
Colt	29	336.7 1.78 a
Overall mean	64	333.8 1.21

*: P<0.05; **: P<0.01; ***: 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).

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

Although Kutluca (1995) reported that service period was lowest in mares foaling in May, the lowest service period was in mares foaling in April in this study. Shorter service 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.

Effect of age of mares on NIPC was statistically significant. NIPC was longer in the older mares (12 >) and younger mares (6<). As it was reported (Staun *et al.* 1982, Buiten *et al.* 2003), it could be said that service period was the longer in the older mares than 12 years except for 9 years old mares. Increasing mare age may be associated with degenerative endometrial changes, incidence of acute endometrial and abnormal oocyte. Longer service period in 5 years of age mares may be associated with that reproductive organs of these mares is not completely mature.

Average NIPC was 6.03 and higher than previous study (Yurdaydýn and Sevinç 1983, Küçük 1990, Morris and Allen 2002). In this farm, oestrus detection and artificial insemination should be performed at the right time and in an appropriate way. Control of ovulation and gestation 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 with a subsequent covering to have her conceive, thus avoiding the loss of a full breeding year.

In this study, ratio of pregnancy was 59% for Haflinger, which is the more lower than other studies (Demirtel 1975, Yurdaydýn and Sevinç 1983, Küçük 1990). This rate may be increased with better management based on use of the ultrasound scanner to monitor follicular development to diagnose and treat uterine problems. Ratio of abortion for haflinger mares was higher than other studies (Demirtel 1975, Meragalli and Valzania 1985, Küçük 1990). Luteal insufficience is one of the important causes of embryonic deaths especially in initial five month of gestation. Carioðlu (1999) informed that in prevention of luteal insufficient, 100 mg of medroxyprogesterone acetate applications at intervals of 4 days could be recommended.

As the factor have the greatest influence over the fertility traits was the breeding month of mares, mares should be mated before April in breeding season for a profitable horse breeding. Proportions of sterility and abortion should be

Table 2. Least square means of first servicing period, service period, foaling interval and NIPC of Haflinger mares

Factors	n	First servicing period (day) Mean±SEM	Service Period (day) Mean±SEM	Foaling interval (day) Mean±SEM	NIPC Mean±SEM
Age		ns	ns	ns	*
5	6	62.93±4.14	96.37±4.99	425.8±4.81	6.31±0.22 ab
6	6	78.31±3.44	94.16±4.14	438.3±4.00	6.27±0.18 ab
7	6	22.94±3.76	62.71±4.53	352.7±4.37	5.86±0.20 ab
8	5	56.98±3.81	77.32±4.59	394.2±4.43	4.74±0.20 ab
9	7	84.17±3.67	106.18±4.42	413.5±4.26	3.97±0.19 ab
10	7	33.62±3.35	46.60±4.03	374.7±3.89	2.49±0.18 b
11	4	81.08±4.72	75.83±5.69	412.8±5.49	2.72±0.25 b
12	3	99.65±5.56	109.77±6.70	449.1±6.46	5.72±0.29 ab
13	3	104.42±5.22	133.53±6.28	469.7±6.06	8.62±0.28 ab
14	3	32.09±5.65	130.60±6.81	451.6±2.59	11.34±0.30 a
15 and older	7	94.65±3.34	113.14±4.02	460.0±3.88	8.24±0.18 ab
Month		***	**	**	ns
1(January)	16	72.64±2.55 b	103.02±3.08 b	428.6±2.97 b	5.98±0.13
2 (February)	10	45.98±2.98 bc	92.18±3.59 b	405.6±3.46 b	7.09±0.16
3 (March)	6	10.32±4.19 c	57.13±5.05 b	400.4±4.87 b	7.15±0.22
4 (April)	7	27.73±3.32 bc	42.48±4.00 b	365.4±3.86 b	5.15±0.18
5 (May)	11	39.04±2.79 bc	57.11±3.37 b	390.8±3.25 b	5.20±0.15
6 (June)	7	213.85±3.67 a	218.76±4.43 a	541.5±4.27 a	5.59±0.19
Year		ns	ns	ns	ns
1985	5	60.76±4.19	87.00±5.05	425.1±4.87	8.72±0.22
1986	4	36.36±4.24	72.69±5.11	377.3±4.93	7.20±0.22
1987	3	84.02±5.50	108.27±6.62	433.5±6.39	4.64±0.29
1988	3	24.13±5.18	80.77±6.24	402.4±6.02	10.06±0.27
1989	3	60.12±5.23	65.78±6.30	388.0±6.08	4.14±0.28
1990	5	70.25±3.82	89.19±4.60	423.8±4.44	8.12±0.20
1991	5	8.84±3.73	69.63±4.49	380.3±4.33	9.88±0.20
1992	5	20.78±4.07	58.78±4.90	381.5±4.73	5.12±0.21
1993	3	53.33±4.93	72.60±5.94	403.8±5.73	5.60±0.26
1994	2	89.16±5.86	112.63±7.06	436.7±6.81	5.55±0.31
1995	2	114.14±6.09	134.20±7.34	452.4±7.08	4.80±0.32
1996	4	60.65±4.87	105.21±5.86	438.6±5.65	7.15±0.26
1997	4	62.31±4.24	63.92±5.11	395.3±4.93	2.44±0.22
1998	4	122.77±4.96	151.71±5.97	494.5±5.76	3.25±0.26
1999	5	156.26±3.81	154.28±4.58	497.6±4.42	3.74±0.20
Overall mean	57	68.26±1.19	95.11±1.43	422.1±1.38	6.03±0.06

Table 3. Ratios of oestrus, pregnancy, sterility, parturition, and abortion of Haflinger mares

	Mares at mating	Oestrus		Pregnancy		Sterility		Parturition		Abortion	
Year	n	n	%	n	%	n	%	n	%	n	%
1985	11	11	100	7	63.64	4	36.36	5	45.45	2	18.18
1986	10	10	100	5	50.00	4	40.00	5	50.00	1	10.00
1987	7	7	100	4	57.14	3	42.86	3	42.86	1	14.29
1988	7	7	100	2	28.57	5	71.43	3	42.86	1	14.29
1989	7	7	100	4	57.14	3	42.86	4	57.14	0	0.00
1990	11	11	100	6	54.55	5	45.45	5	45.45	1	9.09
1991	11	11	100	6	54.55	5	45.45	6	54.55	0	0.00
1992	14	14	100	7	50.00	7	50.00	5	35.71	2	14.29
1993	10	10	100	6	60.00	4	40.00	3	30.00	3	30.00
1994	3	3	100	3	100.0	1	33.33	2	66.67	0	0.00
1995	4	4	100	0	0.00	2	50.00	2	50.00	0	0.00
1996	8	8	100	6	75.00	2	25.00	4	50.00	2	25.00
1997	6	6	100	4	66.67	2	33.33	4	66.67	0	0.00
1998	7	7	100	5	71.43	2	28.57	4	57.14	1	14.29
1999	5	5	100	4	80.00	1	20.00	4	80.00	0	0.00
2000	6	6	100	6	100.0	0	0.00	5	83.33	1	16.67
Total	127	127	100	75	59.0	50	39.37	64	50.39	15	11.81

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.

SUMMARY

The present study was conducted to investigate the environmental factors affecting fertility traits of Haflinger mares raised at a stud farm. Gestation length was the lowest in mares bred in July. The effect of foaling month on servicing period, service period and foaling period was significant. The longest service period and foaling intervals were in mares foaling in June. Breeding month of mares affect the fertility traits the most.

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