

SOME FACTORS AFFECTING TWINNING RATE AND ITS EFFECTS ON POSTPARTUM REPRODUCTIVE PERFORMANCE OF FRIESIAN COWS

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SUMMARY

A total number of 1243 records of calving cases of 585 dairy Friesian cows during 8 consecutive years from 1997 to 2004 collected from Sakha Animal Production Research Station belonging to Animal Production Research Institute, Agriculture Research Center were used to study the effect of sire, live body weight (LBW) and age of dam and calving season on twinning rate and its consequent effects on postpartum reproductive performance of dairy Friesian cows.

Results indicated that, the average of twinning rate was 4.67% and freemartin rate was 0.64%. Sire, live body weight, age of dam and calving season had significant ($P<0.05$) effects on twinning rate. Twinning rate increased significantly ($P<0.05$) with increasing live body weight and age of dams. Winter season significantly showed the lowest ($P<0.05$) twinning rate (3.76%) and autumn season had the highest rate (6.20%).

Twins calving affected significantly ($P<0.05$) all the reproductive performance under consideration except the period from calving to the first service and gestation period. In this respect, the service period, days open and calving interval were longer, number of services per conception was higher, while conception rate was lower for twins compared with single calving. The percentages of retained placenta, dystocia, abortion and born death calf were significantly ($P<0.05$) higher with twins calving compared to single calving.

These results indicated that, several factors (genetic and environmental) affected on twinning rate in dairy Friesian cows. Calving interval for cows calved single or twins was in rate accepted, while retained placenta, dystocia, abortion and born death calf were nearly duplicate in cows calved twins compared to that of single calving.

Keywords: *Friesian, twins calving, reproductive performance*

INTRODUCTION

Twinning has many negative effects on some reproductive and productive aspects including increased dystocia, retained placenta, longer rebreeding intervals, higher mortality rates, frequent occurrence of freemartins (sterile females) (Beerepoot *et al.*, 1992; and Nielen *et al.*, 1989) and reduced and (or) delayed conception after twinning (Turman *et al.*, 1971; and Gregory *et al.*, 1990b). One would anticipate a preference for selection against twinning. However, individuals with high twinning rates still appear, especially in the Holstein breed, which ranged from 1.6 to 8.8% (Rutledge,

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1975). Day *et al.* (1995) reported that California Holstein cows gave 6.86% of birth twins. Eddy *et al.* (1991) observed twinning rate in British dairy cattle was 2.5% and increased with parity (0.9% for first parity up to 5% by sixth parity). Nielen *et al.* (1989) observed a 3.2% twinning rate in Dutch Friesians and Holsteins. Protection of recessive alleles may explain the repeated occurrence of high twinning individuals. However, Van Vleck and Gregory (1996) reported no dominance effects for ovulation rate, a trait closely related to twinning rate. Gregory *et al.* (1990a) concluded that twinning rate is a quantitative trait that has an underlying continuous expression involving many loci.

Although repeatability was not estimated, Nielen *et al.* (1989) noted a tendency of twinning cows to twins again from cows that had twinned once and twice, 9.3 and 12.5%, respectively. It should be noted that these values were higher than expected. Assuming that 6.4 and 3.3% from cows twinned once and twice would be expected to twins again. Ron *et al.* (1990) reported the twinning rate in Israel Holsteins to be 4.8 and 6.9% for second and third parity cows, respectively. The twinning rate of Israel Holsteins has increased from 4.5 to 5.6% during the last 20 year. In general, twinning reduced the reproductive performance of dams in their subsequent pregnancy and in the case of freemartins reduced the calves reproductive performance as well (Beerepoot *et al.*, 1992; and Eddy *et al.*, 1991).

The objective of this study was to evaluate the effect of sire, live body weight and age of dams and calving season on twinning rate and its effects on reproductive problems and postpartum reproductive performance of dairy Friesian cows.

MATERIALS AND METHODS

Experimental animals:

A total number of 1243 records of calving cases of 585 dairy Friesian cows during the consecutive 8 years from 1997 to 2004 collected from Sakha Animal Production Research Station belonging to Animal Production Research Institute, Agriculture Research Center, Ministry of Agriculture. All cows ranged between 350-650 kg live body weight, 3 -13 years of age and 1-8 parities.

Feeding and management:

Animal were housed in semi open sheds and fed traditional summer ration consisted of concentrate feed mixture, berseem hay, rice straw with or without corn silage and winter ration consisted of concentrate feed mixture, fresh berseem and rice straw. Cows were fed according to requirements of Animal Production Research Institute Recommendation (1997). They were fed in-group feeding assigned according to live body weight, age, milk yield and reproductive status. Concentrate feed mixture and rice straw were offered two times daily, while fresh berseem, berseem hay or corn silage were offered once daily. Water was available for animals all the day round. Cows were artificially inseminated using frozen semen within 14 hours after onset of the first spontaneously occurring estrus and number of service per conception were recorded.

Collected data:

The collected data included sires, live body weight and age of dams, season of calving, type of birth (single or twins) for the different years. Also, the periods from parturition to first service, concepts service, service period, days open, gestation

period, calving interval, number of services per conception, conception rate, incidence of retained placenta, dystocia, abortion and born death calf were recorded.

Statistical analysis:

The obtained data was statistically analyzed using general linear models procedure adapted by SPSS for windows (2004) for user's guide. Duncan test within program SPSS was done to determine the degree of significance between means. The model was as follows:

$$Y_{ijxL} = u + S_i + DW_j + DA_x + CS_L + e_{ijxL}$$

Where:

Y_{ijxL} = The observation $i jxL$ of the trait.

U = The overall mean.

S_i = Fixed effect of the i^{th} sire.

DW_j = Fixed effect of the j^{th} dam weight.

DA_x = Fixed effect of the x^{th} dam age.

CS_L = Fixed effect of the Lx^{th} calving season.

e_{ijxL} = The random error associated with individual record of the $ijxL$ observation.

RESULTS AND DISCUSSION

Some factors affecting twinning rate:

Sire:

The effects of sire on twinning rate in dairy Friesian cows are presented in Table (1). The heritability of twinning rate in Friesian cows was 0.028, which were within the values obtained by Gregory *et al.* (1990a) who found that heritability of twinning rate in cows was 0.02 ± 0.07 . Data collected over eight years showed that the average twinning rate in dairy Friesian cows was 4.67% and the percentage of freemartin from total number of cows and twin calving were 0.64 and 13.80%, respectively. Eddy *et al.* (1991) observed that twinning rate in British dairy cattle was 2.5%. But, Day *et al.* (1995) found it 6.86% in California Holstein cows.

The differences in twinning rate among the different sires were significant ($P < 0.01$), with ranged from 0.00 to 9.38%. The linear regression coefficient of twinning rate on sire was significant (0.061). While, Rutledge (1975) reported that twinning rate in the Holstein breed ranged from 1.6 to 8.8%. Differences among sire groups indicate some genetic change is occurring in the population. The increased incidence of twins in recent years could be an indication of a correlated response to selection for increased milk yield. Ron *et al.* (1990) reported that increased twinning rate was correlated with increased milk yield in Israeli Holsteins.

Live body weight of dams:

Data in Table (2) reveal that live body weight of dams had a significant ($P < 0.05$) effect on twinning rate in dairy Friesian cows. The highest twinning rate 6.67% was observed in cows having higher live body weight (LBW) between 600-650kg, while, the lowest rate 2.08% was found for cows having LBW between 350-400kg.

It means that the twinning rate increased significantly ($P < 0.05$) with increasing the dam weight. Cows weighed 550-600 kg expressed the highest freemartin rate being 2%. The linear regression coefficient of twinning rate on cows weight was significant (0.045). These results indicated that, increased LBW is associated with a good feeding level and may consequently increase ovulation rate that closely associated with

twinning rate. Van Vleck and Gregory (1996) reported that body weight of dams had dominance effects for ovulation rate, which closely related to twinning rate.

Table 1. Effect of sire on twinning and freemartin rates in dairy Friesian cows

Sire no.	No. of records	Twins calving		Freemartin	
		N	Rate %	N	Rate %
1	132	9	6.82 ^{ab}	0	0.00
2	62	4	6.45 ^b	1	1.61
3	32	3	9.38 ^a	0	0.00
4	75	6	8.00 ^{ab}	2	2.70
5	310	20	6.45 ^b	3	0.97
6	138	10	7.25 ^{ab}	2	1.45
7	77	6	7.79 ^{ab}	0	0.00
Others	417	0	0.00 ^c	0	0.00
Total	1243	58	4.67	8	0.64

a and b: Means in the same column with different superscripts differ significantly ($P < 0.05$).

Table 2. Effect of live body weight of dams on twinning and freemartin rates in dairy Friesian cows

Live body weight (kg)	No. of records	Twins calving		Freemartin	
		N	Rate %	N	Rate %
351-400	48	1	2.08 ^d	0	0.00
401-450	151	6	3.97 ^{cd}	0	0.00
451-500	426	18	4.23 ^{bc}	2	0.47
501-550	393	19	4.83 ^{bc}	2	0.51
551-600	150	9	6.00 ^{ab}	3	2.00
601-650	75	5	6.67 ^a	1	1.33
Total	1243	58	4.67	8	0.64

a, b, c and d: Means in the same column with different superscripts differ significantly ($P < 0.05$).

Age of dams:

The effect of age of dams on twinning rate of dairy Friesian cows is shown in Table (3). Twinning rate increased significantly ($P < 0.05$) with advancing age, which ranged from 3.97% for cows aged 3-5 years to 13.64% for cows aged 11-13 years. While cows aged 9-11 years showed significantly ($P < 0.05$) the highest freemartin rate being 5.55%. The linear regression coefficient of twinning rate on age of dams was significant (0.037). These results are in agreement with those obtained by Echternkamp and Gregory (1999), who found that twinning rate increased with the advance of dam's age.

Table 3. Effect of age of dams on twinning and freemartin rates in dairy Friesian cows

Age (Year)	No. of records	Twins calving		Freemartin	
		N	Rate %	N	Rate %
3-5	706	28	3.97 ^b	1	0.14 ^b
5-7	302	14	4.64 ^{ab}	3	0.99 ^b
7-9	177	10	5.65 ^{ab}	2	1.13 ^b
9-11	36	3	8.33 ^{ab}	2	5.55 ^a
11-13	22	3	13.64 ^a	0	0.00 ^b
Total	1243	58	4.67	8	0.64

a, b, c and d: Means in the same row with different superscripts differ significantly ($P < 0.05$).

Calving season:

The effects of calving season on twinning rate in dairy Friesian cows are shown in Table (4). The twinning rate differs significantly ($P < 0.05$) among the different seasons. In this regard, autumn season showed the highest rate (6.20%) and winter season had the lowest rate (3.76%). Twinning rate was 5.22%, during the summer season and 4.18% during season. The rate of freemartin tended to be higher in autumn season (1.55%) compared with the other calving seasons. This results is accordance with those reported by (Gregory *et al.*, 1990a), who found that the effects of season on twinning rate were different in beef cattle under seasonal breeding programs. It is noticeable that the percentage of twins from total twins calving in (winter and summer) was 27.6% and in (spring and autumn) was 22.4%. The incidence of freemartin rate in summer season was 1.55% being higher than that in other seasons.

Table 4. Effect of calving season on twinning and freemartin rates in Friesian cows

Age (Year)	No. of records	Twins calving		Freemartin	
		N	Rate %	N	Rate %
Winter	425	16	3.76 ^c	2	0.47
Spring	311	13	4.18 ^{bc}	1	0.32
Summer	249	13	5.22 ^{ab}	1	0.40
Autumn	258	16	6.20 ^a	4	1.55
Total	1243	58	4.67	8	0.64

a, b and c: Means in the same column with different superscripts differ significantly ($P < 0.05$).

Effect of twinning on postpartum reproductive performance:

Reproductive periods:

The effects of twinning on reproductive performance in dairy Friesian cows are shown in Table (5). The service period, days open and calving intervals were significantly ($P < 0.05$) longer after twins calving compared to single calving. The periods from parturition to first service, service period, days open and calving interval after twins calving increased by 3.54, 14.32, 17.86 and 17.78 day than single calving, respectively. The linear regression coefficients of the period from parturition to first service, service period, days open, gestation period and calving interval on twins calving were 0.100, 0.087, 0.071, 0.003 and 0.071, respectively. A longer interval from parturition to first ovulation or conception in dams of twins vs. singles is well documented (Turman *et al.*, 1971; Cady and Van Vleck, 1978; Wheeler *et al.*, 1982;

and Guerra-Martinez *et al.*, 1990). Such delays may result from longer uterine involution period after twins calving. Additional suckling and lactation stress were also suggested by Bellows *et al.* (1974). In this concept weaning the calves soon after birth removed such negative effect of twins calving on postpartum estrus (Bellows *et al.*, 1974). Turman *et al.* (1971) demonstrated that early weaning enhanced conception.

Table 5. Effect of twinning on reproductive performance and milk yield of dairy Friesian cows

Traits	Single calving	Twins calving	SEM
Reproductive periods:			
• First service (day)	45.87	49.41	0.51
• Service period (day)	67.62 ^b	81.94 ^a	2.62
• Days open (day)	113.49 ^b	131.35 ^a	2.56
• Gestation period (day)	277.41	277.3	0.22
• Calving interval (day)	390.87 ^b	408.65 ^a	2.56
Conception rates %:			
• Entire first 90 day of lactation	35.78 ^a	22.41 ^b	1.35
• Entire first 120 day of lactation	46.50 ^a	34.48 ^b	1.41
• Entire first 150 day of lactation	54.77 ^a	41.38 ^b	1.41
• Entire lactation	72.83 ^a	62.07 ^b	1.27
No. of service per conception	2.70 ^b	3.18 ^a	0.06
Reproductive problems:			
• Retained placenta %	24.22 ^b	37.93 ^a	1.23
• Dystocia %	6.50 ^b	15.52 ^a	0.72
• Abortion %	2.87 ^b	5.17 ^a	0.28
• Born death calf %	0.93 ^b	1.72 ^a	0.01

a and b: Means in the same row with different superscripts differ significantly ($P < 0.05$).

Conception rates and number of service per conception:

The conception rates entire the first 90, 120, 150 day and lactation were significantly ($P < 0.05$) higher, and the number of service per conception was significantly ($P < 0.05$) lower for single compared with twins calving (35.78, 46.50, 54.77 and 72.83, Vs. 22.41, 34.48, 41.38 and 62.07%, respectively) as shown in Table (5). The linear regression coefficients of conception rates entire the first 90, 120, 150 and lactation and number of service per conception on twinning calving were 0.060, 0.048, 0.048, 0.051 and 0.051, respectively. The reduction in fertility occurred primarily in dams of twins. Twins has many negative effects on reproduction, which reduced and (or) delayed conception after twinning calving (Turman *et al.*, 1971; and Gregory *et al.*, 1990b).

Reproductive problems:

Results in Table (5) showed that the average percentages of retained placenta, dystocia, abortion and born death calf in twins birth cows were significantly ($P < 0.05$) higher than those birth single (37.93, 15.5, 5.17 and 1.72 vs. 24.22, 6.50, 2.87 and 0.93 respectively). The linear regression coefficients of the percentages of retained placenta, dystocia, portion and born death calf on twinning calving were 0.067, 0.075,

0.029 and 0.017, respectively. These results agreed with those obtained by Echterkamp and Gregory (1999) who found that the majority of the retained placenta was associated with twins births. Previous findings by Chew *et al.* (1977) suggested that the retained placenta resulted from physiological immaturity of the placenta (i.e., decreased estradiol-17 β and increased progesterone synthesis) at parturition, which presumably would be more prevalent in twins births with the shorter gestation length. Similarly, twins calves are smaller and physiologically less mature at birth (Gregory *et al.*, 1990b, & 1996). Dystocia with single births in cattle is generally associated with larger physical size and (or) birth weight and (or) with small or young dams (Bellows *et al.*, 1971; and Gregory *et al.*, 1990b, & 1996). Dystocia with twins resulted primarily (i.e., 78.9% of the dystocia) from abnormal presentation of head and (or) legs for one or both twins fetuses at parturition. The increased incidence of fetal membrane presentation with twins may result from the higher circulating concentrations of progesterone and estradiol found in cows gestating multiple fetuses (Echterkamp, 1992).

CONCLUSION

In conclusion, sire, body weight and age of dams and season of calving showed significant effect on twinning rate, which had adverse effect on reproductive performance of Friesian cows.

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بعض العوامل المؤثرة على معدل التوائم وتأثيره على الأداء التناسلي بعد الولادة في الأبقار الفريزيان

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استخدم في هذه الدراسة 1243 سجل ولادة لعدد 585 بقرة فريزيان خلال 8 سنوات متتالية من عام 1997 وحتى عام 2004 لدراسة تأثير كل من الأب، وزن وعمر الأم، عدد مرات الولادة، فصل الولادة على معدل التوائم وتأثيره على الأداء التناسلي بعد الولادة والمشاكل التناسلية (احتباس المشيمة، عسر الولادة، الإجهاض، ولادة جنين نافق) في الأبقار الفريزيان.

توضح النتائج أن معدل التوائم في الأبقار الفريزيان في مصر 4.67% منها 0.64% توائم مختلفة الجنس. أظهر كل من الأب، وزن الأم، عمر الأم، رقم الولادة، فصل الولادة تأثيراً معنوياً على معدل التوائم. زيادة معدل التوائم مع زيادة وزن الأم وعمرها ورقم الولادة حتى الولادة السادسة ثم يقل بعد ذلك. انخفاض معدل التوائم في ولادات فصل الشتاء (3.76%) بينما ارتفع في ولادات فصل الخريف (6.20%) وكذلك انخفض معدل التوائم معنوياً مع التغذية الشتوية بالمقارنة بالتغذية الصيفية.

تأثرت كل الصفات التناسلية للأبقار بعد الولادة ما عدا الفترة من الولادة حتى التلقيح الأولى وفترة الحمل تأثيراً معنوياً بولادة التوائم. زيادة فترة التلقيح وفترة التلقيح المخصب (Days open) والفترة بين ولادتين معنوياً في الأبقار الفريزيان مع ولادة التوائم عنه مع الولادة الفردية. ارتفاع عدد التلقيحات اللازمة لحدوث الإخصاب، بينما انخفض معدل الخصوبة معنوياً مع ولادة التوائم بالمقارنة بالولادة الفردية. بالإضافة إلى ذلك ارتفعت نسبة احتباس المشيمة وعسر الولادة والإجهاض وولادة جنين نافق معنوياً مع ولادة التوائم بالمقارنة بالولادة الفردية.

نستخلص من هذه الدراسة أن الأب، وزن وعمر الأم وموسم الولادة لها تأثير معنوي على معدل التوائم الذي له تأثير سلبي على الأداء التناسلي للأبقار الفريزيان.