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GENETIC AND SOME NON-GENETIC FACTORS AFFECTING PREWEANING BODY WEIGHT AND GROWTH RATE OF FRIESIAN CALVES IN EGYPT

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SUMMARY

Records of live body weight (LBW) at 3-week intervals from birth to weaning of 998 Friesian calves (514 males and 484 females) progeny of 45 sires collected during 10 years (from 1990 to 1999) from Sakha Farm, Animal Production Research Institute, Ministry of Agriculture located at Kafr El-Sheikh Governorate, Egypt were used in the present study. The effect of sire, year and month of calving, sex of calf, and weight of dam at calving (DWC) as covariate on LBW and average daily gain (ADG) during successive 3-wk periods from birth to 15 wk (weaning) of age were studied. Date were statistically analyzed utilizing the linear mixed model least squares and maximum likelihood (LSMLMW) computer program of Harvey (1990). Least squares means (LSM ±SE) of LBW at birth and at 3, 6, 9, 12 and 15 weeks of age were 31.2 ± 0.3, 38.2 ± 0.3, 47.1 ± 0.4, 59.0 ± 0.6, 74.0 ± 0.9 and 97.5 ± 0.7 kg, respectively. LSM±SE of ADG during the periods of 0 - 3, 4 - 6, 7 - 9, 10 - 12 and 13 - 15 wk of age were 331 ± 9, 422 ± 11, 569 ± 17, 713 ± 16 and 1118 ± 28 g/day, respectively. Least squares analysis of variance showed that sire had significant ($P<0.001$) effect on all LBWs and ADGs during the different ages except for ADG during the period from birth to 3 wk of age which was not significant. Year of birth showed highly significant ($P < 0.001$) effect on all traits studied. Month of calving had highly significant ($P < 0.01$ or 0.001) effect on all traits except for LBW at 15th wk of age, which was not significant. Differences between males and females in LBWs at different ages were highly significant ($P < 0.001$). Whereas, sex did not show any significant effect on ADG during the different ages except for ADG during the period from 6 – 9 wk which was significant ($P < 0.01$). Including DWC in the model yielded highly significant ($P < 0.001$) linear regression coefficients for all LBWs at the different ages (ranged from 0.021±0.002 to 0.028±0.005 kg/kg DWC). Regression of ADG on DWC was only significant ($P < 0.05$) at 4 - 6 wk of age.

***Keywords:* Friesian calves, preweaning body weight, growth performance, Egypt**

INTRODUCTION

Preweaning body weight and growth rates of calves are affected by several genetic and non-genetic factors. Several investigators showed that body weight is heritable and others studied the environmental factors affecting growth. Evaluation of the effects of these factors on both body weight and growth rate provides basic information for developing breeding programs for genetic improvement. However, a wide variation in the body weight and growth rates of calves between and within breeds has been observed (Abdel-Moez, 1996). Consequently, it is very necessary to the cattle breeder to know the various factors which causing the differences in weight of calf at different periods of age.

In Egypt, Friesian cattle were imported for milk and meat production. A lot number of Friesian male calves are slaughtered at different ages to fill the great gap in shortage of meat production, especially with the direction to use the imported tested and improved frozen semen in artificial insemination. Little information is available concerning preweaning growth in Friesian calves in Egypt. The present study aimed to investigate some factors affecting birth weight, body weight at 3, 6, 9, 12 and 15 weeks (weaning) of age and average daily weight gain during suckling period for Friesian calves. These factors are sire, year and month of calving, sex of calf, weight of dam at calving.

MATERIALS AND METHODS

Records on the live body weight at 3-weeks interval from birth to weaning of 998 Friesian calves (514 males and 484 females) from 45 sires collected during the period from January 1990 to March 1999 were used in the present investigation. The calves were maintained at Sakha Research Station, Kafr El-Sheikh Governorate belonging to Animal Production Research Institute, Ministry of Agriculture. The farm located at the northern middle part of the Delta (about 160 km from Cairo), Egypt. Dam of these calves were locally born Dutch Friesian cows produced from a nucleus herd imported into Egypt from Holland in 1960.

Management

The calves were allowed to suckle their dam's colostrum for the first three days after birth. Thereafter they were artificially reared on natural milk twice daily on the age basis till weaning at the age of 15 wk. An amount of 437.5 kg of natural milk was available for each calf during the suckling period (15 weeks). Beside milk, green fodders were given to the calves *ad libitum* according to the schedule applied under the feeding and management system of Animal Production Research Institute (APRI), Egypt. Green fodder in winter was Berseem (*Trifolium alexandrinum*) and green maize or elephant grass were offered in summer. The concentrates (calf meal) and hay were offered to calves from the beginning of the third or fourth week of age according to their age. About 113, 91, and 17 kg of calf meal, hay and yellow maize, respectively were available for each calf during the suckling period (15 weeks). The calf meal consisted of 48% yellow maize, 17% cotton-seed cake, 10% wheat bran, 10% rice starch residue, 10% linseed meal, 2% molasses 1% limestone, 1% bone meal and 1% salt.

The calves were loosely housed while they were housed indoors in individual pens bedded with rice straw at the time of suckling and also overnight. After morning suckling the calves were grouped according to their ages in shades stables with open yards. Birth weight of calves was recorded to the nearest kg within 24 hours from birth. Then, the calves were weighed at 3-weeks interval till weaning (at the end of the 15th week of age). Body weight of cows at calving was recorded within 1 – 3 days from calving.

Statistical analysis

Date were statistically analyzed utilizing the linear mixed model least squares and maximum likelihood (LSMLMW) computer program of Harvey (1990). The following linear mixed model was used:

$$Y_{ijklm} = \mu + S_i + Y_j + M_k + Se_l + b(x - \bar{x}) + e_{ijklm}$$

where :

Y_{ijklm} = the individual observation;

μ = the overall mean;

S_i = the random effect of the <u>ith</u> sire, i = 1, 2, 3, ... 45;

Y_j = the fixed effect of the <u>jth</u> year of birth, j = 1, 2, 3, ..., 10 (from 1990 to 1999);

M_k = the fixed effect of the <u>kth</u> month of calving, k = 1, 2, 3, ..., 12 (Jan. to Dec.);

Se_l = the fixed effect of the <u>lth</u> sex of calf, l = 1 and 2 (male and female, respectively);

b = partial linear regression of the live body weight (kg) or average daily gain (g/d) on dam weight at calving (kg);

$(x - \bar{x})$= x is the dam weight at calving and $\bar{x}$ is the average of dam weight at calving of the herd, and

eijlkm = the random error.

RESULTS AND DISCUSSIONS

Actual means and variations

Actual means, standard deviations (SD) and coefficient of variations (CV%) of live body weights (kg) and averages daily gain (g/d) at 3-week intervals from birth to weaning (15th wk of age) of 998 Friesian male and female calves are presented in Table 1. The present means of LBWs generally fall within the range of those estimates reported in most studies carried out on the Friesian calves under Egyptian conditions. Birth weigth ranged between 25.9 to 37.3 kg as reported by many authors (Ragab and Abdel-Aziz, 1961 (32.5 kg); Afifi and Soliman, 1971 (30.9 kg); Afifi *et al.*, 1975 (31.5 kg); Alim and Taher, 1979 (25.9 Kg); Omar, 1984 (30.4 kg) and Abdel-Moes, 1996 (37.3 kg)). Weight at weaning or at 15-week of age ranged between 76.2 to 98.0 kg (Ragab and Abdel-Aziz, 1961 (98.0 kg); Alim and Taher, 1979 (96.9 Kg); Afifi *et al.*, 1975 (93.0 kg) and El-Gaffarawy, 1979 (76.2 kg)).

The present means of ADG (g/d) (Table 1) generally fall also within the range of those estimates reported in most studies carried out on the Friesian calves under Egyptian conditions. Ragab and Abdel-Aziz (1961) working on 218 Friesian calves found that the overall mean of ADG for the period from birth to 4 months of age was o.55 kg/d. The differences between our findings and other investigators may be due to the differences in the genotype, management, number of animals, years of study and/or methods of analysis.

Coefficients of variation (CV%) of LBW at different ages studied ranged between 9.22 – 11.7%. Meanwhile, coefficients of variation of ADG declined with advancing of age and ranged from 27.1 to 47.7%, which may be due to the increase in the overall mean of ADGs with the advancing in age. The relatively lower CV% reported in the present study for LBW may be related to the good management, sufficient feeding system and the accuracy of recording applied in the farm.

Table 1. Unadjusted means, standard deviations (SD) and coefficients of variation (CV%) of live body weights (kg) and averages daily gain (g/d) at 3-week intervals from birth to weaning

Trait	Abbreviation	Mean	SD	CV %
Birth weight	BW	31.5	4.11	11.9
Body weight at 3 weeks of age	W3	38.6	4.67	11.0
Body weight at 6 weeks of age	W6	47.2	5.75	11.2
Body weight at 9 weeks of age	W9	58.9	7.52	11.7
Body weight at 12 weeks of age	W12	73.7	9.14	11.4
Body weight at 15 weeks of age	W15	96.9	9.46	9.22
Average daily gain from 0 - 3 wk of age	ADG1	340	167	47.7
Average daily gain from 4 - 6 wk of age	ADG2	410	166	38.2
Average daily gain from 7 - 9 wk of age	ADG3	555	197	33.1
Average daily gain from 9 – 12 wk of age	ADG4	702	209	28.5
Average daily gain from 13 – 15 wk of age	ADG5	1107	313	27.1

* Coefficient of variation computed as the percentage of the square root of the residual mean squares divided by the overall least squares means of a given trait according to Harvey (1990).

Factors affecting live body weight

The least square means and mean squares of live body weight at birth, 3, 6, 9, 12 and 15 weeks (weaning) of age are presented in Tables 2 and 3 respectively.

Effect of sire

Sire of the calf had highly significant ($P < 0.01$ or 0.001) effects on live body weights of calves at the different ages studied (Table 3). Several studies agreed upon the presence of significant effect for sire of calf on live body weight (Afifi and Soliman, 1971; Al-Amin, 1979; Maarof *et al.* (1988); Kabuga and Agyemang, 1984; Duc *et al.* (1993); Choi *et al.* (1996); Abdel-Meaz (1996) and Colborn *et al.* (1997). The present results indicate the possibility of genetic improvement in live body weights of calves through sire selection.

Effect of year of birth

Least squares analysis of variance (Table 3) showed highly significant ($P < 0.001$) effect for year of birth on live body weights at different ages studied. The highest birth weight was obtained year 1998 (32.9 kg) and the lowest in 1991 (29.3 kg) (Table 2). The differences in LBW among years might be due to differences in management and agro-climatic condition. The same significant effect of year of birth on birth weight or on weaning weight was reported also by several studies (Ledic and Luz-ledic, 1983; Kabuga and Agyemang, 1984; Ahunu and Makarechian, 1986; Singh *et al.*, 1989; Reyes *et al,* 1992 and Duc *et al.*, 1993).

Effect of month of calving

Month of birth had highly significant ($P < 0.001$) effect on live body weights at different ages studied except for weaning weight (Table 3). The highest birth weight was obtained in May (32.8 kg) and the lowest in November (29.9 kg) (Table 2). Most of the studied carried out on the effect of month or season of birth on birth weight confirmed the presence of such significant effect, e.g. Afifi and Soliman (1971) in Egypt, who reported irregular variation in birth weight from one month of birth to another. They added that the highest born obtained in April and May and the lowest in November and December. These results were in close agreement with those reported in the present study. They attributed the seasonal fluctuations in birth weight to the differences in condition of the cows during gestation period. The differences in system of feeding and management, which are practiced at different seasons, are logical sources of variation in pregnant cow's conditions. The same significant effect of month (or season) of birth on birth weight was reported also by several studies (Al-Amin, 1979; Morsey et al., 1984 Badran and El-Barbary, 1986).

Table 2. Least squares means of live body weights at birth, 3, 6, 9, 12, and 15 weeks (weaning weight) of age

Classification	No.	Least squares means (± SE) of live body weight (kg) at:					
		Birth	3 wk	6 wk	9 wk	12 wk	15 wk
Overall mean	998	31.2±0.3	38.2±0.3	47.1±0.4	59.0±0.6	74.0±0.9	97.5 ± 0.7
Year of birth :							
1990	83	29.9±1.0	33.6±1.1	42.5±1.3	56.6±1.8	69.8±2.2	97.9±2.3
1991	97	29.3±0.8	35.0±0.9	45.1±1.2	58.8±1.6	72.3±1.9	97.1±2.0
1992	105	31.2±0.8	37.8±0.8	47.5±1.1	61.3±1.4	75.2±1.8	98.7±1.8
1993	98	32.4±0.7	40.3±0.8	48.7±1.0	61.0±1.4	76.3±1.7	101.7±1.7
1994	131	31.9±0.8	40.2±0.9	48.0±1.1	61.5±1.5	77.7±1.9	99.8±1.9
1995	121	31.8±0.6	37.7±0.6	45.0±0.8	55.5±1.1	68.9±1.4	92.9±1.4
1996	62	30.4±0.8	39.3±0.9	48.8±1.2	61.4±1.6	77.1±1.9	96.6±2.0
1997	138	31.2±0.8	40.1±0.9	48.7±1.1	57.5±1.5	72.6±1.9	95.7±2.0
1998	136	32.9±0.8	39.3±0.9	46.6±1.2	54.6±1.6	69.4±2.0	91.4±2.0
1999	27	31.3±1.1	38.7±1.2	49.5±1.5	61.9±2.0	80.5±2.4	103.3±2.5
Month of calving:							
January	108	30.5±0.5	37.4±0.5	46.8±0.7	58.2±0.9	73.1±1.2	97.6±1.1
February	88	30.1±0.5	37.9±0.5	46.7±0.7	59.3±1.0	75.6±1.3	97.4±1.2
March	132	32.2±0.4	39.3±0.5	49.2±0.6	62.2±0.9	76.1±1.1	98.1±1.0
April	104	32.3±0.5	40.6±0.5	49.6±0.7	62.0±0.9	77.0±1.2	98.4±1.1
May	96	32.8±0.5	39.4±0.5	47.6±0.7	59.2±1.0	74.4±1.2	97.1±1.2
June	96	31.9±0.5	38.9±0.5	46.6±0.7	57.4±1.0	73.8±1.2	96.8±1.2
July	79	31.9±0.6	38.8±0.6	47.8±0.7	60.7±1.0	75.9±1.3	97.9±1.3
August	49	30.8±0.6	37.0±0.7	45.2±0.9	56.9±1.2	70.7±1.5	96.2±1.5
September	41	30.8±0.7	36.4±0.8	45.3±1.0	57.3±1.4	71.2±1.7	96.5±1.7
October	45	31.3±0.7	37.5±0.7	46.9±0.9	58.7±1.2	74.5±1.6	97.7±1.5
November	83	29.9±0.6	37.7±0.6	46.3±0.7	57.3±1.0	71.5±1.3	96.6±1.3
December	77	30.1±0.6	37.4±0.6	46.5±0.8	58.8±1.0	73.9±1.3	99.2±1.3
Sex :							
Male	514	31.9±0.4	39.0±0.3	47.9±0.4	60.1±0.7	75.4±0.9	99.1±0.8
Female	484	30.6±0.4	37.4±0.3	46.2±0.4	57.9±0.7	72.6±0.9	95.8±0.8
Regression of live body weights on:							
Dam weight at calving		0.021± 0.002	0.022 ± 0.003	0.026 ± 0.003	0.026 ± 0.004	0.025 ± 0.005	0.028 ± 0.005

Table 3. Mean squares (MS) of factors affecting live body weight at birth, 3, 6, 9, 12, and 15 weeks (weaning weight) of age

Source of variation	d.f	MS and significant					
		BW	W3	W6	W9	W12	W15
Sire	44	30.7***	27.4 **	49.3**	106.3***	187.3***	147.0***
Year	9	56.0***	126.4***	162.2***	376.6***	701.5***	575.8***
Month	11	68.2***	92.2***	128.6***	256.0***	256.1***	46.3 N.S
Sex	1	382.4***	584.5***	609.8***	1217.9***	1775.7***	2500.0***
Regression of live body weight on:							
Dam weight	1	1196.2***	1358.0***	1948.0***	1964.1***	1778.2***	2169.8***
Remainder	931	13.9	17.6	28.0	47.8	71.6	80.8

The insignificant effect for month of birth on weaning weight reported in the present study was confirmed also by Afifi and Soliman (1971) on Friesian cattle in Egypt.

Effect of sex

Table 3 showed highly significant ($P < 0.001$) effect for sex of calf on live body weights at different ages studied. The male calves were heavier than females by 1.3 and 3.3 kg at birth and weaning weights, respectively. Many studies showed the same results (Ragab and Abdel-Aziz, 1962; Afifi and Soliman, 1971; Kabuga and Agyemang, 1984 and Omar 1984).

Effect of weight of dam at calving

The effect of dam weight at calving on live body weights of the calf was highly significant (P<0.001) at different ages studied (Table 3). Birth weight increased by 0.021kg/kg increase in dam weight at calving, whereas weaning weight increased by 0.028 kg/kg increase in dam weight at calving. The present results were nearly the same of that obtained by Afifi and Soliman (1971) in Egypt who found that regression coefficient of birth weight on dam's weight at calving was 0.01 kg and weaning weight was 0.016 kg. Alim and Taher (1979) working on Dutch and Danish Friesian calves reported that the differences in weaning weight due to dam's weight at calving was significant. On the other hand, Omar (1984) found that body weight of dam , irrespective of her age, had a significant (P < 0.01) effect on birth weight of her calves.

Factors affecting Average daily gain

Least squares means and mean squares of averages daily gain as affected random effect (sire), fixed effects and covariates are presented in Tables 4 and 5, respectively.

Table 4. Least squares means of averages daily gain (g/d) at 3-week intervals from birth to weaning

Classification	No.	LSM of averages daily weight gain at the age from:				
		0–3 wk	4–6 wk	7–9 wk	10–12 wk	13 –15 wk
Overall mean	998	331 ± 9	422 ± 11	569 ± 17	713 ± 16	1118 ± 28
Year of birth :						
1990	83	174 ± 40	426 ± 41	670 ± 49	631 ± 52	1335 ± 79
1991	97	270 ± 34	482 ± 35	651 ± 42	643 ± 45	1182 ± 68
1992	105	315 ± 31	460 ± 32	656 ± 39	664 ± 42	1117 ± 63
1993	98	379 ± 29	400 ± 30	585 ± 37	730 ± 39	1186 ± 60
1994	131	394 ± 32	375 ± 33	644 ± 40	771 ± 43	1050 ± 65
1995	121	282 ± 23	347 ± 24	498 ± 31	639 ± 32	1145 ± 50
1996	62	425 ± 34	452 ± 35	597 ± 43	750 ± 45	926 ± 69
1997	138	423 ± 33	412 ± 34	419 ±42	717 ± 45	1103 ± 68
1998	136	303 ± 34	347 ± 35	382 ± 43	702 ± 46	1049 ± 69
1999	27	349 ± 44	514 ± 45	589 ± 54	888 ± 57	1085 ± 86
Month of calving :						
January	108	327 ± 18	448 ± 19	540 ± 25	714 ± 26	1164 ± 41
February	88	370 ± 19	418 ± 20	602 ± 26	775 ± 27	1036 ± 43
March	132	337 ± 17	473 ± 18	620 ± 24	662 ± 24	1046 ± 39
April	104	393 ± 18	431 ± 19	588 ± 25	716 ± 26	1019 ± 41
May	96	312 ± 19	392 ± 20	553 ± 26	720 ± 27	1083 ± 43
June	96	336 ± 19	365 ± 20	513 ± 26	783 ± 27	1093 ± 43
July	79	329 ± 21	429 ± 22	611 ± 28	723 ± 29	1050 ± 45
August	49	292 ± 25	393 ± 26	558 ± 32	659 ± 34	1214 ± 52
September	41	268 ± 29	421 ± 30	571 ± 37	662 ± 39	1209 ± 60
October	45	293 ± 26	448 ± 27	562 ± 34	752 ± 35	1103 ± 54
November	83	373 ± 21	407 ± 22	523 ± 28	678 ± 29	1195 ± 45
December	77	348 ± 21	434 ± 22	585 ± 28	717 ± 30	1204 ± 46
Sex :						
Male	514	339±10	422±12	585±18	724±18	1130±30
Female	484	324±10	421±12	553±18	702±18	1106±30
Regression of ADG on :						
Dam weight at calving		0.064±0.1	0.207±0.1	0.005±0.1	0.056±0.1	0.122±0.2

Table 5. Mean squares (MS) of average daily gain at 3-week intervals from birth to weaning

Source of variation	d.f	MS and significant				
		0 – 3 wk	4 – 6 wk	7 – 9 wk	10-12 wk	13-15 wk
Sire	44	33025 NS	39185*	77595***	794745***	208889***
Year	9	236180***	137803***	275811***	164023***	302109***
Month	11	72436***	64361**	96940**	122491**	350747***
Sex	1	48368 NS	628 NS	236006**	119083 NS	140111 NS
Regression of ADG on:						
DWC	1	11594 NS	120543*	73.1 NS	9324 NS	41844 NS
Remainder	931	25055	25965	35559	41310	91803

Effect of sire

Sire of the calf had highly significant ($P < 0.05$ or 0.001) effects on ADG of calves at the different studied periods except for the ADG in the first period from birth to 3 wk of age (Table 5). The significant effect of sire on preweaning ADG was reported by Fahmy (1972) on buffalo calves. On the other hand, Pahnish (1964) reported insignificant effect for sire on ADG from birth to weaning.

Effect of year of birth

Least squares analysis of variance (Table 5) showed highly significant ($P < 0.001$) effect of year of birth on ADG at different ages studied. The present study showed wide variations in ADGs from year to another for the different studied periods (Table 4). The highest ADG was observed in year 1996 (425 g/d), meanwhile the lowest ADG was observed in year 1990 (174 g/d). The differences in ADG among years might be due to differences in management and agro-climatic condition. Similar results were found by Kabuga and Agyemang (1984) who working on 97 Friesian calves in Ghana. The authors stated that year of birth influenced significantly weaning weight and daily gain. Kassa-Meshra and Arnason (1986) in Ethiopia found that growth from birth to weaning was significantly affect by year of birth. DeNise *et al.* (1988) on Herford calves stated that year of birth was a significant source of variation in all environments for all preweaning daily gain traits. Reyes *et al*(1992) came to the same conclusion.

Effect of month of calving

Results given in Table 5 show highly significant ($P < 0.01$ or 0.001) effect of month of birth on ADG at different periods. The present study showed wide variations in ADG from month to another (Table 4). The highest ADG was recorded in April (393 g/d), meanwhile the lowest ADG1 was recorded in September (268 g/d). Many studied confirmed the significant effect of month (or season) of birth on ADG in calves (e.g. Ragab and Abdel-Aziz, 1961; Lee, 1986 and Sadek et al., 1993). Such significant effect for month of birth on ADG may be due to variations in atmosphere and feedstuffs available at different months of the year.

Effect of sex

No significant differences were obtained between male and female calves in ADG during the different periods of age except for the ADG during the period from 7 – 9 weeks of age (Table 5). These results partially in close agreement with the results of Ragab and Abdel-Aziz (1962) and Al-Amin (1979) who reported that sex of calf did not affect ADG of Friesian calves during suckling period.

Effect of weight of dam at calving

Least squares analysis of variance (Table 5) showed that dam weight at calving did not affect significantly on ADG during different periods except for the ADG during the period from 4 - 6 weeks of age. Such insignificant effect of dam weight at calving on ADG may be due to that all heifers were inseminated at nearly similar weight (350 kg) for the first time. The present results are in close agreement with that obtained by Kohli *et al.* (1951) on Milking Shorthorn.

CONCLUSION

From this study it could be concluded that:

1. Adjusting the individual records of cows for the environmental effects will remove large portions of the non-genetic variations in growth performance.
2. The high genetic differences among sires for the different traits studied indicate the high genetic potential for rapid genetic improvement in LBW and ADG traits of Friesian calves.
3. The economic importance must be given to these traits in breeding programs, taken into consideration more priority for milk production of the dam.

REFERENCES

Abdel-Moes, K.A., 1996. Studies on growth performance of Holstein-Friesian calves in a commercial herd. M.Sc. Thesis, Fac. Of. Agric., Cairo Univ.

Afifi, Y.A. and A.M. Soliman, 1971. Sources of variation on birth and weaning weights of Friesian calves. Agric., Rec. Rev., 49 (4): 1.

Afifi, Y.A.; E.A. Helali, and L.S. Korit, 1975. The effect of early weaning on performance of Friesian calves. Agric. Res. Rev., U.A.R., 53: 49.

Ahunu, B. and M. Makarechian, 1986. Influence of birth date, sex of calf, breed group and age of dam on preweaning performance of range beef calves. Canadian J. Anim. Sci., 66, (2): 381-388.

Al-Amin, s. k (1979). A genetic study on growth and carcass characteristics in Friesian cattle. Ph.D. Thesis, Fac. Of Agric., Cairo Univ., Egypt.

Alim, K.A. and A. Taher (1979). The performance of Friesian and buffaloes calves. World Rev. of Anim. Prod., 15: 71. (ABA, 1981, 49: 1172.

Badran, A.E. and A.S.A. El-Barbary, 1986. Sources of variation in the birth weight of Friesian calves in Egypt. Alexandria J. Agric. Res., 31: 3, 41 (Abst.).

Choi, S.H.D.; D.H. Daik; W.J. Shin; J.Y. Song and C.S.N.A., 1996. Effects of pregnancy phase and other factors on body weight in Korean native cows. Korean J. of Anim. Sci., 38 (1): 23-30. (ABA, 64, 7).

Colborn, D.J.; G.H. Deutscher; M.K. Nielson and D.C. Adams, 1997. Effects of sire, dam traits, calf traits and environment on dystocia and subsequent reproduction of two years old heifers. J. Anim. Sci., 75: 1452-1460.

Duc, N.V.; R.P. Verma; C.X. Thin and N.Q. Tien, 1993. Factors influencing the birth weight of Murrah calves in Vietnam. Ind. J. Dairy Sci., 46, 11.

El-Gaafrawy, A.A. (1979). Genetical and some environmental influences affecgting growth rate of Friesian calves and crosses up till maturity. M.Sc. Thesis, Fac. of Agric., Al-Azhar Univ, Cairo, Egypt.

Fahmy, S.K., 1972. Genetic and environmental relationship among some traits of Egyptian buffaloes. Ind. J. Dairy Sci., 25:80.

Harvey, W.R., 1990. User's Guide for LSMLMW, Mixed Model Least Squares and Maximum Likelihood Computer Program. PC-2 Version. Ohio State Univ., Columbus (Mimeograph), USA.

Kabuga JD, Agyemang K, 1984. Performance of Canadian Holstein-Friesian cattle in the humid forest zone of Ghana. II. Preweaning performance. Trop. Anim. Health Prod., 16(3):174 – 80.

Kassa-Meshra, H. and T. Arnason, 1986. Non-genetic factors affecting growth of Ethiopian Boran cattle. World Rev. Anim. Prod., 22(2): 45 – 55.

Kohli, M.L.; A.C. Cook and M.M. Dowson, 1951. Relation between some body measurements and certain performance characters in Milking Shorthorn steers. J. Anim. Sci., 10: 352.

Ledic, I.L. and I. Luz-ledic, 1983. Environmental and genetic effects on preweaning growth in Tabapua calves. Thesis, Escola Veterinaria de Univ. Fedral de Minas Gerais, Brazil. (ABA, 53, 5678).

Lee, C.F., 1986. The growth performance of Holstein aged 0 – 3 months in Northern Taiwan. J. Taiwan-Livestock-Res., 19:1, 51 Abst. (cited by Nutr. Abst. And Rev., 1987. 50-05247).

Maarof, N.N.; S.A. Magid,; A.M.S. Al-Ani, 1988. Studies of body weight of Friesian cattle. 2. Some phenotypic and genetic parameters. J. Agric. and water Res. Anim Prod, 7: 1, 35 – 40. (ABA,57: 123).

Morsey, M.A.; A.A. Nigm; A. Mostageer and F. Pirchner, 1984. Some economic characteristics of the Egyptian Baladi cattle. Egypt. J. Anim. Prod., 24: 273.

Omar, E.A., 1984. Effect of genetic and environmental factors on the growth of male and female calves. M.Sc. Thesis. Fac. Of Agric., Kafr El-Sheikh, Tanta Univ., Egypt.

Pahnish, O.F.; R.L. Roberson; J.S. Tylor; R.T. Brinks and C.B. Roubicek, 1964. Genetic analysis of economic traits measured in range raised Herfords at pre-weaning and weaning ages. J. Anim. Sci., 23: 562.

Ragab, M.T. and A.S. Abdel-Aziz, 1961. The effect of some environmental factors on body weight and relative growth rate in Friesian calves in Tahreer Province. Egypt. J. Anim. Prod., 2: 107.

Ragab, M.T. and A.S. Abdel-Aziz, 1962. Inter-relations between body weigh body measurements and relative growth rate in Friesian calves in Tahreer Provinice. Egypt. J. Anim. Prod., 2: 95.

Reyes, A.; Los, D.E.; Menendez; A. Buxander, 1992. Non-genetic factors affecting preweaning growth in Zebu cattle. Revist Cubana de Rep. Anim., 1992, 17-18. (C.F. Anim. Husb. General, J. article).

Sadek, R.R.; M.A. Morsey; A.A. Nigm; M.A.M. Ibrahim and A.M. Sabry, 1993. The effect of grading up Baladi cattle with Friesian on meat performance. Egypt. J. Anim. Prod., 30(2): 143.

Singh, R.V.; N. Tewari; C.V. Singh and Y.P. Singh, 1989. Genetic and non-genetic factors affecting economic traits of first lactation in F1 crossbred cows. Livestock-adviser,1989, 14(12): 13-18.