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NON- GENETIC FACTORS AFFECTING GROWTH PERFORMANCE OF HOLSTEIN FRIESIAN CALVES RAISED UNDER EGYPTIAN CONDITIONS

S. El Kaschab, S. Omar, Elham M. Ghoneim and M. Omran
Animal Production, Dep. Fac. of Agric. Minufiya Univ. Egypt

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ABSTRACT: *Data on 2117 records collected during eleven years from 2002 to 2012 at the Experimental and Research Unit of Toukh Tanbesha belonging to Faculty of Agriculture, Menoufia University Egypt were used for the present investigation. The objectives of this study were to analyze non-genetic factors affecting growth performances of Holstein Friesian raised under Egyptian conditions. Least Squares mean ±SD of Birth weight (BW) was 34.55±5.50 kg. BW was found to be affected by year of calving and season of calving (P<0.001). Calves born during the period of 2002-2005 were significantly (P<0.05) heavier (34.38, 37.28, 36.30 and 36.71kg respectively) than those born during the period of 2006-2012 (33.24, 35.18, 33.28, 33.68, 32.99, 32.49, 29.98 kg respectively).Year 2003 had the highest value of BW (37.28 kg) while the lowest one (29.98 kg) was represented in year 2012. Calves born during the winter and autumn seasons had significantly heavier BW (35.68 and 34.45 kg respect.) than those born during the summer and spring seasons (33.67 and 34.31 kg respectively). On the other hand, parity had no significant effect on BW of calves but it seems to be a trend of increasing BW in the subsequent parity. Least squares mean±SD of weaning weight (WW), weaning age (WA) and pre weaning gain (PWG) were 94.54±4.00 kg, 93.35±15.84 days and 0.672±0.10 kg/day, respectively. Year of calving had highly significant effect on all traits (P<0.01), while the effect of season was significant (P<0.05) on (WA), however the effect of parities was not-significant on all traits. Least squares mean±SD for PWG was 0.672±0.10 kg/day and ranged between 0.5 to 1.280 kg. Results indicate that year of birth had highly significant effect (P<0.01) on PWG while season of calving and parities were non-significant. Furthermore, the analysis of variance show that the interaction between year of calving and effect of season of calving was significant (P<0.01) on all traits, whilst the parity was not-significant on all traits studied.*

***Key words**: Friesian calves, birth weight, weaning age, daily gain, non-genetic factors, rearing management, seasonal effect*

INTRODUCTION

While it is well understood that the dam and sire of a calf play a role in the genetically predicted birth weight of a calf, other factors do come into play. It is important to keep the other factors in mind that impact the birth weights of calves to help ensure a successful and prosperous calving season.

Growth performance is very determinant parameter for dairy and dual purpose cattle. It is primarily expressed and described by body weight and growth rate. Body weight changes of cattle are dependent on genetic and non-genetic factors. Mekonnen and Goshu (1996) reported that traits such as birth and weaning weight as well as growth and survival to weaning have important implications on herd productivity, management system, adaptability and breeding policy to be followed. The future of any dairy operation depends to a large extent, upon a successful programme of raising calves for replacement purposes. Calving difficulties account for a tremendous amount of economic loss in cattle. The highest correlated factor contributing to calving difficulties is the size and/or body weight of the calf (Kayln, 2013). Of all cases of calving difficulty, 60-90% of them can be attributed to the birth weight of the calf. In addition, birth weight of calves is of critical importance for herd management. Calves that are too small may lack vigour, tolerance to cold-stress, resistance to pathological agents, or the ability to overcome parturition stresses. On the other hand, calves that are too large may cause varying degrees of dystocia, leading to increased birth problems, metabolic and respiratory acidosis, depressed immunoglobulin absorption, and increased susceptibility to disease, (Whittier, 2007). Although factors affecting birth weight can be grouped into genetic and environmental causes, this is obviously an artificial division that might be misleading. The observed differences are often the result of an interaction between the environment and the genotype.

A number of authors studied growth performance in cattle, and in particular daily gain (Schwartzkopf Genswein *et al.*, 2003; Bruns *et al.*, 2005). In general, these researches are based on experimental plans, and only few considered on farm surveys. However, the present study aimed to investigate variability and sources of variation of growth performance in Holstein Friesian calves with an on farm approach.

MATERIALS AND METHODS

Data source and management:

Data used for this study collected from 2117 records during eleven years from 2002 to 2012 at the Experimental and Research Unit of Toukh Tanbesha belonging to Faculty of Agriculture, Menoufia University Egypt. Data were extracted and compiled from records kept for each individual animal record and field books. Born calves were registered, tagged and weighed on the day of birth and housed individually in semi open pens. The identification number of calves, sires and dams, sex, were recorded in the field record book.

Calves allowed to get colostrums immediately after birth for three days then they suckled whole milk artificially until weaning. Calves were fed whole milk and calf's starter with berseem hay according their body weight. Through suckling period, calves were given the amount of whole milk in plastic buckets three times daily at 4.00 a.m., 12.00 p.m. and 18.00 p.m. Calf's starter was provided once daily at 8.00 a.m., while berseem hay was introduced once at 9.00 a.m. as shown in Table (1). Water was available ad lib in plastic buckets. Calves were weighed weekly to nearest kg before morning suckling and feeding. In normal cases, weaning was occurred at ≥ 90 kg body weight.

Statistical analysis:

Data were statistically analyzed using general linear model procedure by SPSS (Statistical Package for Social Science) program version 10, (1999**)**, according to the following model:

$Y_{ijkm} = \mu + C_j + S_i + L_k + e_{ijkm}$

Where,

Y_{ijkm} = Observed trait at calving year i, season of calving j, and lactation number k,.

μ = Population mean for each trait.

C_i= Effect of calving year (i = years 2002, 2003, 2004, …. 2012);

S_j = Seasonal effects (j = spring, summer, autumn, and winter);

L_k = Effects of lactation number (k = 1, 2, 3, 4, ≥ 5);

e_{ijkm} = Random sampling error.

Table (1): Calves suckling and feeding regime .

Calves Body weight (kg)	Whole milk (kg)	Calf's starter (kg)	Berseem hay (kg)
First three days of age suckling their dams colostrums			
≤40kg	4	0.000	0.400
40-50kg	5	0.100	0.600
51-60kg	6	0.200	0.800
61-70kg	7	0.400	1.000
71-80kg	8	0.800	1.200
81-90kg	5	1.500	1.500

RESULTS AND DISCUSSION

Birth weight (BW) :

In the present study Least Squares means ± SD of BW of 2117 calves was 34.55±5.50 kg (Table, 2). Analysis of variance show that year of calving had a highly significant effect on BW (P<0.01). Furthermore there was specific trend for the effect of year of calving on BW Fig.(1).

In general, born calves during the first four years (2002-2005) were significantly (P<0.05) heavier (34.38, 37.28, 36.30 and 36.71kg respectively) than those born during the last seven years studied from year 2006 to year 2012 (33.24, 35.18, 33.28, 33.68, 32.99, 32.49, 29.98 kg, respectively). On the other hand, born calves of year 2003 had the heaviest BW (37.28 kg) and the lowest one (29.98 kg) was represented in year 2012 (Fig., 1).

Table (2): Least Squares means ± SD for Calf's birth weights

Birth weights (kg)		
Factor	№ of animals	LSM±SD
Overall mean	2117	34.55± 5.50
Year of birth : sig.		**
2002	281	34.38±5.73 [bc]
2003	265	37.28 ±5.33 [a]
2004	194	36.30±4.88 [a]
2005	255	36.71±3.38 [a]
2006	201	33.24 ± 5.58 [de]
2007	192	35.18± 5.88 [b]
2008	165	33.28 ± 5.29 [de]
2009	142	33.68 ± 5.10 [b]
2010	136	32.99± 5.65 [de]
2011	150	32.49± 5.43 [e]
2012	119	29.98± 3.51 [f]
Sex of birth : sig.		**
Male	1070	35.23± 5.653 [a]
Female	1047	33.86± 5.262 [b]
Season of birth : sig.		**
Spring	379	34.31± 5.52 [b]
Summer	540	33.67± 5.82 [c]
Autumn	637	34.45± 5.53 [b]
Winter	561	35.68± 4.93 [a]
Parities: sig.		NS
1	840	34.04± 5.62
2	522	34.89± 5.57
3	334	34.96± 5.38
4	205	34.99± 4.91
≥5	216	34.67± 5.46

Interaction between:

Year of birth x Season of birth	**
Year of birth x Parties	*
Year of birth x Sex of Calf	NS
Season of birth x parties	NS
Season of birth x sex of Calf	NS
Parties x Sex of Calf	NS
Year x Season of Birth x Parties	**
Year x Season of Birth x Sex of Calf	NS
Year of Birth x Parties x Sex of Calf	NS
Season of Birth x Parties x Sex of Calf	NS
Year of Birth x Season of Birth x Parties x sex of calf	NS

Means within the same column with different superscript are significantly different.
NS = Non significant ** = highly significant $p < 0.01$ *= significant $p < 0.05$

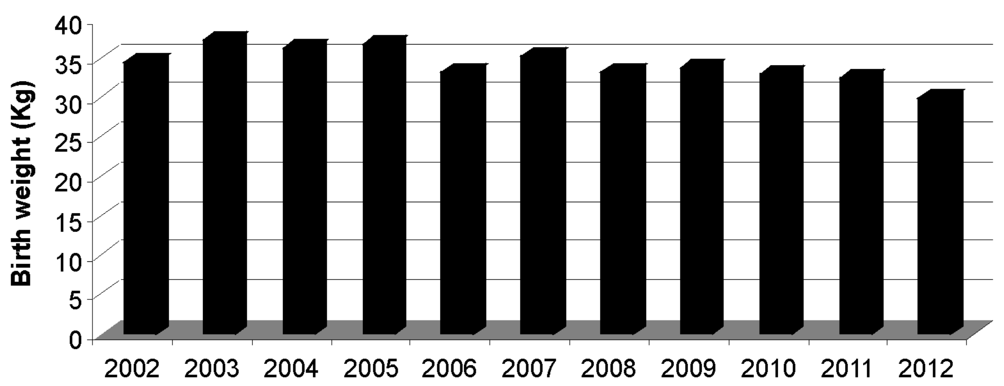

Fig. (1): Development of birth weight during eleven years.

34.45 kg, respectively) than those born during the summer and spring season (33.67 and 34.31 kg respectively). This might be because dams calved in winter and autumn season would have better nutrition during the second period of parturition, therefore be in a better body condition during calving.

Therefore the highest calving rate was occurred during autumn season (29.4%), followed by winter (26.4%), summer (25.6%) and spring (Table, 3). This result is in agreement with that reported by Heins *et al.,* (2007) who showed that the BW was comparatively higher in cows calved in winter season, followed by BW of cows calved in spring and summer season, respectively.

These results are in agreement with those reported by Addisu (1999), Giday (2001), and Shahzad *et al.,* (2010) showed that the BW was significantly affected by year ($P<0.05$), they added that the variation of body weight of calves over the years might also be related to the nutritional status of their dams as affected by rainfall pattern and thus with the feed availability as reported by Asheber (1992), Mekonnen *et al* (1996) and Addisu (1999). In general variability in birth weight across years implies inconsistency of management level of the farm and variability of natural pasture between years.

Least squares analysis show that calves born during the winter and autumn season had significantly heavier BW (35.68 and

Table (3): Calving frequencies during Seasons studied.

Season	Number	% Percent
Autumn	668	29.4
winter	600	26.4
spring	424	18.6
summer	583	25.6
Total	2275	% 100.0

reaction could be resulting in decreased birth weights when environmental temperatures are increased during gestation. In contrast, cold temperatures will result in increased birth weights, as blood flow is directed to the core of the body.

Male calves were significantly ($p<0.01$) heavier at birth by 1.37 Kg ($p<0.01$) than females. BW of calves male (n=1070) and female (n=1047) calves was 35.23±0,17 kg and 33.86±0,16 kg, respectively, (Table, 2). This result is in agreement with the findings of Nix *et al.* (1998) and Bakir *et al.* (2004). These differences could be attributed to the longer gestation period of male calves and/or higher androgen concentration in male fetuses (Elkaschab *et al*, 1975). Spencer (1982) and Taj (2001) explained these differences due to breed, environmental and managerial practices that had impact on BW.

On the other hand, Results showed that parity had no significant effect on BW of calves but there seems to be a trend of increasing BW in the subsequent parity, (Table, 2). This might be due to ability of maternal body condition being carried large fetus developed in the subsequent calving. Acharya *et al.* (1977) reported that BW of claves increased from first to third calving when it reached the maximum value and then showed a gradual decline. Shahzad *et al.,* (2010) found that calves born during early lactations were lighter in weight than those born during late lactations and the cows during early lactations were not fully grown and thus continued to grow till attaining adult size. This appeared to influence the BW of calves born later**.** Also Swali *et al.*, (2006) and Johanson and

On the other hand, restricting maternal nutrition to decrease birth weights is not a sound management practice. Extreme reductions in feed, such as feeding less than 70% of the cow's nutrient requirements, will result in decreased birth weights (Kayln, 2013). However, it often results in an increase in calving difficulties because the cows are weak and undernourished. Slightly restricting the nutrient requirements of the cow will result in decreases in energy reserves (body fat) of the cow before limiting the nutrient flow to the fetus. In partitioning of nutrients, the cow puts her pregnancy at the top of the list, right below keeping herself alive; therefore, her body will work overtime to metabolize stored nutrients to allow the fetus to grow. This is why restricting feed, unless in an extreme case, has little impact on birth weight (Kayln, 2013).

Furthermore, some authors reported that the influence of season of calving on BW could be attributed to the seasonal variation in feeding and temperature among years. Acharya *et al*., (1977) reported that the influence of season of calving on BW may be the result of differential availability of pastures to pregnant dams due to variable weather conditions during different months and the direct effect of the latter on comfort of the animal. Interestingly, one factor that contributes to the birth weight of calves is the weather. It is well established that as the environmental temperature increases, the cow will direct a greater portion of her blood flow to her extremities for cooling. Therefore there is less blood flow to the core of the cow, which results in a decrease in the amount of nutrients being carried to the fetus through the maternal blood. This significant effect (P<0.01) on WW and WA (Table, 4). Furthermore, there was specific trend for the effect of year of Birth on WW and WA Fig.(2) and Fig (3), which might be due to environmental and managerial practices particularly combinations of nutrition and quality of feed given to animals during the lactation period. The effect of year of Birth is consistent with that reported by (Asheber 1992; Addisu 1999; Giday 2001).

It is interesting to find out that the highest value of WW was recorded in the year 2006 (99.67±0.57 kg) and the lowest value was happened in the year 2007(93.31±2.93 kg). This variation might be due to the difference of overall management, especially as differences in feeding availability.

Also the analysis of variance showed that the effect of season of birth was significant (P<0.05) on WA only (Table, 4). Calves born during the summer and autumn had significantly longer WA (94.71 and 94.50 days, respectively) than those born during spring season (89.95 days).

On the other hand, parities had no significant effect on WW and WA (Table, 4). The effect of interaction between year of calving and season of calving was highly significant (P<0.01) for WA and significant (P<0.05) for WW. This might be due to differences in genotype and /or herd management. It is noted that the age of weaning increases in the summer and autumn season of the year, this may be due to heat stress burden and the reality of animals which will delay its growth rate over the age of weaning.

Pre weaning daily gain (PWG):

As shown in Table (4) Least Squares mean±SD for PWG was 0.672 ± 0.10 kg/day and ranged between 0.5 to 1.280 kg.

Akpa *et al.,* (2007) in Nigeria reported that the least-squares mean ± SD for PWG was 0.39±0.020kg/day ranged between 0.39 and 0.43 kg and the effect of Birth season was highly significant, and reported also that the environmental factors (season and year of birth) were the key elements responsible for variations in average daily gain.

Berger (2003) reported that the calves born in early parities were lighter in weight than those born to late-parity dams.

As shown in Table (2) the effect of the interactions year x season of birth and year x season of birth x parties were highly significant (p<0.01) where the interaction year of birth x parties was significant (p<0.05). It is expected that years effects on birth weight are dependent on parities and seasons of birth.

Weaning weight (WW) and weaning age (WA) for female calves :

Growth traits especially for female calves are essential for an sustainable herd structure and replacement strategies. Weaning weight is important for cow produced calf because it monitors their primary product. In addition, the WW expresses calf rearing ability of cow, so the changes of WW are important factors at selection. Therefore, it is an important requirement to estimate the breeding value based on weaning results exactly (Roberson *et al.,* 1986). With other words, heifers rearing are one of the most important elements of dairy herd replacement for a successful dairy operation.

Table (4) show that the least-squares means±SD of WW of female calves (n=755) was 94.54±4.003 kg, the overall mean ranging between 90 to 110 kg, while the weaning age (WA) of those calves was 93.35±15.84 days and ranging between 53 to 157 days.

These results agree nearly with the results reported by many researchers. Ouda (2001) reported WW at 15 week of age (ranged from 76.20 to 98.0 days) with the average weight of 96.60 kg in calves in a herd of HF cattle in Egypt. Also Hulya *et al.,* (2006) in Egypt studied weaning weight and found an average of 97.27±10.25 kg. The reduced weaning weight value of this study from the previous works of the same breed might be due to inconsistency farm management.

In the present study analysis of variance shows that the year of Birth had a highly

Table (4): Least- Squares means ± SD of Weaning weight, Weaning age and Pre weaning gain of female calves.

Factor	№ of animals	Weaning weight (kg)	Weaning age (days)	Pre weaning daily gain (kg/day)
		LSM±SD	LSM±SD	LSM±SD
Overall mean :	755	94.54±4.003	93.35±15.84	0.672±0.10
Year of birth : Sig.		**	**	**
2002	53	96.08±4.47 ^{b}	90.21±13.76 ^{cde}	0.719 ±0.12 ^{abc}
2003	134	94.35±3.80 ^{ab}	86.20 ±14.01 ^{de}	0.694 ±0.10 ^{bcd}
2004	97	94.49±3.83 ^{ab}	92.86 ±14.86 ^{bcde}	0.649±0.08 ^{d}
2005	95	94.91±3.97 ^{ab}	91.56 ±11.64 ^{bcde}	0.658 ±0.08 ^{cd}
2006	30	99.67±0.57 ^{a}	94.67 ±12.22 ^{abcde}	0.726±0.11 ^{ab}
2007	70	93.31±2.93 ^{c}	95.67 ±10.86 ^{abcd}	0.637 ±0.09 ^{d}
2008	77	94.45±5.00 ^{ab}	96.49±16.33 ^{abc}	0.660 ±0.09 ^{cd}
2009	63	93.92±3.49 ^{ab}	100.9±17.030 ^{ab}	0.639±0.06 ^{d}
2010	51	95.35±3.47 ^{ab}	103.86±16.58 ^{a}	0.639±0.11 ^{d}
2011	59	94.32±4.64 ^{ab}	95.40 ±22.01 ^{abcd}	0.716±0.13 ^{abc}
2012	26	94.62±3.47 ^{ab}	90.21 ±12.58 ^{e}	0.762 ±0.88 ^{a}
Season of birth Sig.		NS	*	NS
Spring	155	95.48±4.58	89.95±15.20 ^{b}	0.714 ±0.10
Summer	182	94.42±3.91	94.71±17.51 ^{a}	0.677±0.10
Autumn	250	94.12±3.59	94.50±14.46 ^{a}	0.651±0.10
Winter	168	94.59±4.11	92.78±16.11 ^{ab}	0.666 ±0.05
Parities: Sig.		Ns	NS	NS
1	304	94.47±4.05	93.64±15.09	0.674±0.11
2	184	94.36±3.72	92.03±16.28	0.671±0.09
3	95	95.11±4.45	94.33±16.58	0.671±0.09
4	99	94.93±3.97	92.92±14.43	0.661±0.08
≥5	73	94.19±3.86	94.66±16.93	0.680±0.10

Interaction between

Sig	WW	WA	PWG
Year x Season	*	**	**
Year x parities	NS	NS	NS
Season x parities	NS	NS	NS
Year x Season x parities	NS	NS	NS

Means within the same column with different superscript are significantly different
NS = Non significant ** = highly significant p< 0.01 *= significant p< 0.05

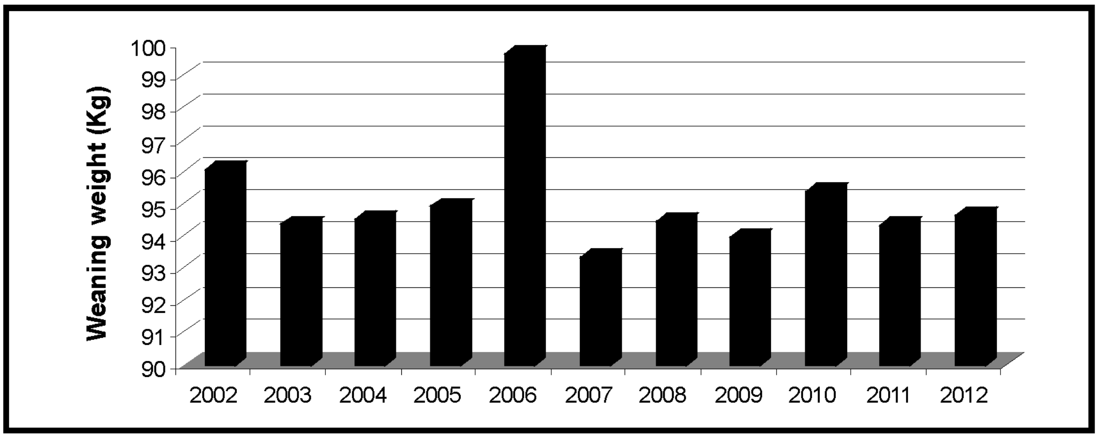

Figure (2): Development of weaning weight during eleven years.

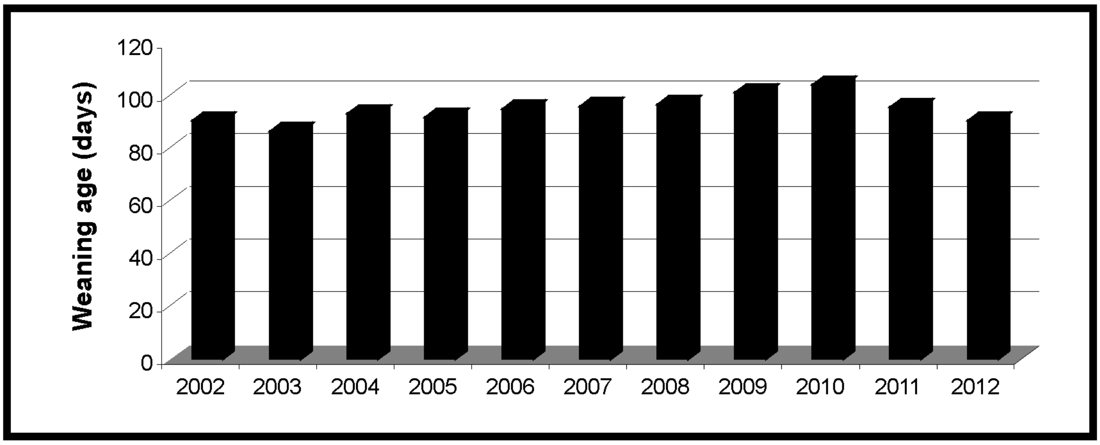

Figure (3): Development of weaning age during nine years.

traits studied. These results are in agreement with those reported by Akpa *et al.,* (2007) who reported that the effect of year of birth was highly significant ($p<0.01$) on ADG at all ages, and the effect of Birth season on PWG at 3, 6, 9 and 12 month was highly significant. They added that the environmental factors (season and year of birth) were the key elements responsible for variations in PWG. It is notable from Table (4) that year 2006 and 2012 had a largest estimated values of PWG which could be due to the small numbers of calves reared in these years.

The present results indicate that year of Birth only had highly significant effect ($P<0.01$) on PWG while season of Birth and parities were non-significant. There was specific trend for the effect of year of Birth on PWG Fig.(4). These differences might be due to difference in genotype, herd, environmental and managerial practices, especially the quality of nutrition provided to the animals which had impact on PWG.

Furthermore, the analysis of variance (Table 4) show that the interaction between year of Birth and season of Birth was significant ($P<0.01$) on all traits, whilst the effect of parity was not-significant on all

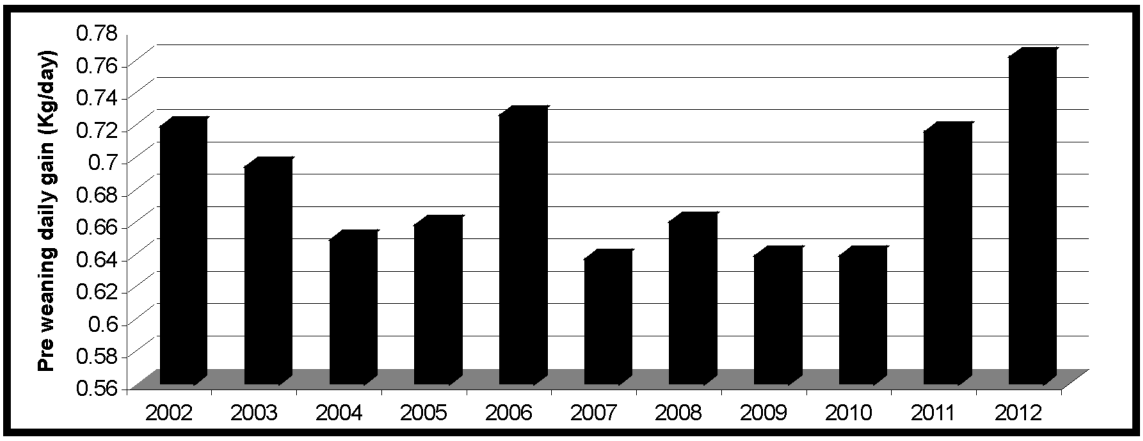

Figure (4): Development of pre weaning daily gain (PWG) during eleven years.

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Conclusion:

The present investigation revealed that Toukh Tanbisha farm had fluctuated levels on calves growth performance recorded through eleven years studied which may reflect the deviation from the achie-vement of the initial objective of the farm. The fact that the farm tracking management system of government in terms of buying and selling each production requirements was dramatic. Therefore, the major basic animal husbandry practices are well below expected standards. The probability of successfully implementing and controlling most of the factors identified in this study is much higher than attempting to control other factors, which cannot be totally controlled by the management team. This study would provide a guideline for further breeding policy and keeping standards of such exotic breeds in the country.

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العوامل الغير وراثية المؤثرة علي أداء النمو في عجول الفريزيان هولشتين المرباة تحت الظروف المصرية

سمير الخشاب ، سعيد عمر ، الهام محمد غنيم ، محمد عمران

قسم الإنتاج الحيواني . كلية الزراعة . جامعة المنوفية . مصر

الملخص العربى:

تم تجميع عدد 2117 سجل ولادات خلال مدة زمنية بلغت أحد عشر عاما في الفترة من 2002 إلي 2012م في وحدة تجارب وبحوث الإنتاج الحيواني التابعة لكلية الزراعة . جامعة المنوفية مصر . وذلك لهدف تحليل العوامل الغير وراثية المؤثرة علي أداء النمو في العجول الصغيرة المرباة تحت الظروف المصرية .

وأظهرت نتائج التحليل أن المتوسط العام ± معامل الاختلاف لوزن الميلاد 34,55±5,5 كجم . ووجد أن تأثير السنة وفصل الولادة عالي المعنوية علي وزن الميلاد . العجول المولودة خلال الفترة من 2002 –2005 (34,38 ، 37,28 ، 36,30 ، 36,71 كجم علي التوالي) كانت أكبر وزنا من المولودة خلال الفترة من 2006 إلي 2012 (33,24 ، 35,18 ، 33,28 ، 33,68 ، 32,99 ، 32,49 ، 29,98 كجم علي التوالي) سجلت سنة 2003 أكبر قيمة لوزن الميلاد (37,28 كجم) بينما كانت سنة 2012 أقل السنوات في وزن الميلاد (29,98 كجم).

بدراسة تأثير الموسم لوحظ أن العجول المولودة في الشتاء والخريف كانت أكبر وزنا (35.68 ، 34.45 كجم علي التوالي) من العجول المولودة في الصيف والربيع (33.67 ، 34.31 كجم) .

علي الجانب الآخر كان تأثير موسم الولادة غير معنويا إلا أنه هناك اتجاه لزيادة وزن الميلاد بتقدم موسم الأم، وكانت نتائج تحليل التباين لوزن الفطام وعمر الفطام ومعدل النمو حتى الفطام علي النحو التالي 94,54± 4,00 كجم ، 93,35± 15,84 يوم، 0,672± 0,10 كجم/يوم وكان تأثير السنة عالي المعنوية علي كل هذه الصفات بينما كان تأثير فصل الولادة معنويا فقط علي عمر الفطام ، وجاء تأثير الموسم الولادة للأم غير معنويا علي كل الصفات . إضافة لذلك جاء تأثير التداخل بين السنة وفصل الولادة عالي المعنوية علي كل الصفات في حين التداخل مع موسم الولادة كان غير معنويا .