ESTIMATES OF HERITABILITY, REPEATABILITY AND BREEDING VALUE OF SOME PERFORMANCE TRAITS OF HOLSTEIN COWS IN EGYPT USING REPEATABILITY ANIMAL MODEL

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SUMMARY

Data collected from 1807 lactation records relevant to 735 Holstein cows, between 1995-2005 were utilized to estimate heritability, repeatability and breeding value of all lactation total milk yield (TMY), 305-day milk yield (305-DMY), peak yield (PY), lactation period (LP), first service period (FSP), days open (DO) and number of services per conception (NSC). Also, the effects of season and year of calving, age at first calving and parity on all lactation traits were studied. The least squares analysis indicated that the overall least squares means of TMY, 305-DMY, PY, LP, FSP, DO and NSC were 9537 kg, 8315 kg, 40.2 kg, 348.8 day, , 89.4 day, 113.1 day and 2.0 services, respectively. Season of calving had significant effect (P< 0.01) on PY, LP, DO and NSC and significant effect (P< 0.05) on 305-DMY, but had no significant effect on TMY and FSP. Year of calving had significant influence (P< 0.01) on all studied traits. Age at first calving had significant effect (P< 0.01) on TMY and 305-DMY and significant effect (P< 0.05) on PY and FSP, but had no significant effect on LP, DO and NSC. Parity had significant effect (P< 0.01) on TMY, 305-DMY, PY and LP and significant effect (P< 0.05) on DO, but had no significant effect on FSP and NSC.

Variance components, heritability, repeatability and breeding values for the studied traits were estimated using the Wombat programme fitting repeatability animal model. Estimates of the heritability were 0.065, 0.149, 0.159, 0.029, 0.089, 0.028 and 0.006 for TMY, 305-DMY, PY, LP, FSP, DO and NSC, respectively. The estimates of repeatability were 0.203, 0.189, 0.219, 0.114, 0.122, 0.028 and 0.018 for the same traits, respectively.

The breeding values for TMY, 305-DMY, PY, LP, FSP, DO and NSC of cows ranged between -2737 and 3285, -1698 and 1338 and -6.7 and 5.6 kg, between -45.0 and 71.1 day, -39.6 and 72.9, -37.9 and 64.8 days and between -0.14 and 0.19 service, respectively, the corresponding values for dams were between -2835 and 2979, -985 and 1875 and -7.3 and 6.0 kg, between -9.9 and 44.0, -38.4 and 86.9, -38.1 and 53.7 day and between -0.30 and 0.60 service, respectively. The breeding values for sires were between -1057 and 659, -737 and 613 and -1.3 and 2.4 kg, between -23.6 and 18.6, -15.6 and 32.7 and -11.2 and 13.5 day and between -0.76 and 1.16 service for the respective traits.

The results indicate that improvement of performance traits of Holstein cows could be obtained through improvement of management conditions.

Keywords: Heritability, repeatability, breeding value, milk traits, reproduction, Holstein cows, Egypt

INTRODUCTION

In Egypt, the population of cows is continuously increasing and was recently estimated to be about 4.95 million heads (FAO, 2015). This population produces about 3.17 and 0.48 million metric tons of milk and meat, which form 53.64 % of the total milk production (5.90 million metric tons) and 45.40 % of the total red meat production (1.04 million metric tons), respectively (FAO, 2015).

During the last three decades, the dairy industry in Egypt has been largely changed. Many private Holstein or Friesian dairy farms were established in the desert fringes of the delta governorates. Such large commercial dairy farms usually have stocks with herd size ranging from 200 to 500 lactating cows managed by experienced staff (Galal, 2007).

Though milk yield is the most economically important trait in dairy cows other traits such as reproduction and herd lifetime directly affect the profitability of the dairy farm (Ajili *et al.,* 2007, Tekerli and Kocak, 2009, Oltenacu and Broom, 2010, Sarakul *et al.,* 2011, Pritchard *et al*., 2012, Radwan *et al.,* 2015 and Rahbar *et al.,* 2016). Knowledge of variance components, genetic parameters and breeding values is necessary for the determination of an optimal breeding strategy seeking the genetic improvement of the dairy cows' performance traits (Javed *et al.,* 2007; Rahman *et al.,* 2007; Hayes and Goddard, 2008; Cilek and Sahin, 2009; Eghbalasaied, 2011; Shain *et al.,* 2012; Zink *et al.,* 2012; Tojhiani, 2013; Goshu *et al.,* 2014; Radwan *et al.,* 2015).

The objective of this investigation was to estimate heritability, repeatability and breeding value of all lactation traits namely, total milk yield, 305-days milk yield, peak yield, lactation period, age at first calving, first service period, days open and number of services per conception of Holstein cows raised in a commercial dairy herd in Egypt.

MATERIALS AND METHODS

Source of data:

Data used in this investigation were 1807 lactation records for 735 locally born Holstein cows belong to Elyoser private farm, 51 km south east of Alexandria. The records represented 73 sires and 565 dams and covered the period from 1995 to 2005. The all lactation traits were: total milk yield (TMY, kg), 305-day milk yield (305-DMY, kg), peak yield (PY, kg), lactation period (LP, day), age at first calving (AFC, month), first service period (FSP, day), days open (DO) and number of services per conception (NSC, service).

Herd management:

Animals were housed free in shaded open yards, grouped according to average daily milk yield and fed *ad libitum* on corn silage mixed with concentrate ration (TMR) all year round and supplemented with *Alfa alfa* if available. Feeding allowances were offered according to milk production and physiological status as recommended following NRC (1989). Water was also available ad libitum. Heifers were artificially inseminated for the first time when reaching 360 kgs of weight and pregnancy was detected by rectal palpation 60 days after service. The cows were machine milked thrice a day at 06 am, 13 pm and 18 pm.

Statistical procedures:

The GLM procedure of SAS (SAS, 2008) were utilized to test the significance of the fixed effects of season of calving (four seasons), year of calving (11 years), age at first calving (three classes) and parity (four classes) . Calvings were classified by season into autumn's between September and November, winter's between December and February, spring's between March and May and summer's between June and August. The statistical model fitted was:

$\mathbf{Y_{ijklm} = \mu + S_i + T_j + A_k + P_l + e_{ijklm}}$ where,

$\mathbf{Y_{ijkl}}$: either TMY, 305-DMY, PY, LP, FSP DO or NSC; $\boldsymbol{\mu}$: an underlying constant specific to each trait; $\mathbf{S_i}$: the fixed effect of i^{th} season of calving (i=1,2,3 and 4); $\mathbf{T_j}$: the fixed effect of j^{th} year of calving (j=1,2,3……11); $\mathbf{A_k}$: the fixed effect of k^{th} age at first calving (k=1, 2 and 3; 1 = AFC ≤ 26 , 2 = 26 < AFC ≤ 30 and 3 =AFC > 30); $\mathbf{P_l}$: the fixed effect of l^{th} parity (l=1,2,3 and 4) and $\mathbf{e_{ijklm}}$: random errors assumed to be independent normally, distributed and with zero mean and variance σ^2_e.

Variance components, heritability, repeatability and breeding values were estimated using the Wombat programme (Meyer 2006) fitting repeatability animal models. The assumed model was:

$\boldsymbol{y} = Xb + Za + Wpe + e$ where,

y: a vector of observations, ***b***: a vector of fixed effects with an incidence matrix ***X***, ***a***: a vector of random animal effects with incidence matrix ***Z***, ***pe***: a vector of random permanent environmental effects with incidence matrix ***W***, and ***e***: a vector of random residual effects with mean equals zero and variance $\boldsymbol{\sigma^2_e}$. The vector of additive (animal) effects ***(a)*** was assumed to be $\boldsymbol{N\sim(0, A\,\sigma^2_a)}$, where ***A*** is the numerator relationship matrix among animals in the pedigree file and $\boldsymbol{\sigma^2_a}$ is direct genetic variance. The vector of random permanent environmental effects ***(pe)*** was assumed to be $\boldsymbol{N\sim(0, I_c\,\sigma^2_{pe})}$, where $\boldsymbol{I_c}$ is identity matrix of order equal to the number of cows, and $\boldsymbol{\sigma^2_{pe}}$ is permanent environmental effects variance. The vector of residual (environmental) effects ***(e)*** was assumed to be $\boldsymbol{N\sim(0, I_n\,\sigma^2_e)}$, where $\boldsymbol{I_n}$ being the identity matrix of order equal to the number of records , and $\boldsymbol{\sigma^2_e}$ is the environmental variance.

RESULTS AND DISCUSSION

The means, standard error (SE) and coefficient of variation (CV %) of the studied traits are presented in Table (1). Means for TMY, 305-DMY, PY, LP, FSP, DO and NSC were 9537.0 kg, 8315.3 kg, 40.2 kg, 348.8 day, 89.4 day, 113.1 day and 2.0 service, respectively. Means were lower than those of TMY and 305-DMY reported by Abou-Bakr *et al.* (2006) being 13172 and 10847 kg, respectively and those being 12054 and 9038 kg, respectively reported by Salem *et al.* (2006) on other commercial herds of Holstein cows in Egypt. The mean of LP (348.8 days) was shorter than that of 370 days obtained by Abou-Bakr *et al.* (2006) and that of 407 days obtained by Salem *et al.* (2006). Days open of 113.1 days obtained in this study was shorter than that of 154 days obtained by Abou-Bakr *et al.* (2006).

Table 1. Number of records, number of cows, number of sires, means, standard error (SE) and coefficient of variation (CV %) of the studied traits

Traits	No. records	No. cows	No. dams	No. sires	Mean ±SE	CV %
TMY	1631	698	318	73	9537±67.7	28.7
305- DMY	1807	735	330	73	8315±53.9	27.5
PY	1794	734	330	73	40.2±0.19	19.8
LP	1681	709	322	73	348.8±2.6	30.0
AFC	1807	735	330	73	27.2±0.06	8.7
FSP	1449	640	295	73	89. 4±1.0	43.4
DO	1001	493	245	73	113.1±1.4	39.9
NSC	1473	641	296	73	2.0±0.03	61.1

TMY: total milk yield (kg), 305-DMY: 305-day milk yield (kg), PY: peak yield (kg), LP: lactation period (day), AFC: age at first calving (month), FSP: first service period (day), DO: days open (day) and NSC: number of services per conception (services).

Environmental effects:

Season of calving had significant effect (P< 0.01) on PY, LP, DO and NSC and significant effect (P<0.05) on 305-DMY**,** but had nonsignificant effect on TMY and FSP (Table 2). Abou-Bakr *et al.* (2006) indicated that season of calving had significant effect (P<0.01) on 305-DMY**,** LP and DO, but had nonsignificant effect on TMY. Eid *et al.* (2012) found that season of calving had no significant effects on TMY, LP and NSC of Friesian cows in Sudan. Usman *et al.* (2012) indicated that season of calving had no significant effects on TMY but had significant effect (P<0.05) on LP of Holstein cows in Pakistan. In general, the effects of season of calving could be attributed to the changes in climatic conditions and feeding regimes during different seasons.

The influences of year of calving on all studied traits were significant (P<0.01) (Table 2). The influences depended mainly on the conditions of individual animals, feeding and management practices and year to year climatic changes. Similarly, Abou-Bakr *et al.* (2006) found that year of calving had significant effect (P< 0.01) on TMY, 305-DMY**,** LP and DO. Contrary, Eid *et al.* (2012) found that year of calving had no significant effects on TMY and LP, but had significant effect (P<0.05) on NSC of Friesian cows in Sudan. Usman *et al.* (2012) indicated that year of calving had no significant effects on TMY and LP of Holstein cows in Pakistan.

Age at first calving had significant effect (P<0.01) on TMY and 305-DMY and significant effect (P<0.05) on PY and FSP, but had no significant effect on LP, DO and NSC (Table 2). Abou-Bakr *et al.* (2006) reported significant effects (P< 0.01) of age at first calving on TMY, 305-DMY, LP and DO. Eid *et al.* (2012) found that age at first calving had significant effect (P<0.05) on TMY, but had no significant effect on LP and NSC of Friesian cows in Sudan. Lower age at first calving heifers should be offered higher levels of feeding and better management during their early stages of rearing and ought to be bred at the proper time of the estrus cycle to ensure conception. A reduction in the age at first calving will minimize the raising costs and shorten the generation interval and subsequently maximize the number of lactations per head

Table 2. Effects of season and year of calving and age at first calving on the studied traits

	Traits							
Factors	TMY	305-DMY	PY	LP	AFC	FSP	DO	NSC
Season of calving	**NS**	*	**	**	**	**NS**	**	**
Year of calving	**	**	**	**	**	**	**	**
Age at first calving	**	**	*	**NS**	-	*	**NS**	**NS**
Parity	**	**	**	**	-	**NS**	*	**NS**

TMY: total milk yield (kg), 305-DMY: 305-day milk yield (kg), PY: peak yield (kg), LP: lactation period, (day), AFC: age at first calving (month), FSP: first service period (day), DO: days open (day) and NSC: number of services per conception (services).
NS: Not significant (P>0.05); *: significant (P< 0.01);**: Highly significant (P< 0.01)

Parity had significant effect (P<0.01) on TMY, 305-DMY, PY and LP and significant effect (P<0.05) on DO, but had no significant effect on FSP and NSC (Table 2). This is mainly due to the increase in age accompanied with the increase in body weight and to the full development of the udder secretory tissues and due to the changes in managerial systems and environmental conditions among parities. Significant effects (P<0.01) of parity on TMY, 305-DMY, LP and DO were reported by Abou-Bakr *et al.* (2006). Also, significant effect (P<0.01) of parity on TMY, LP and DO of Friesian cows in Sudan were indicated by Abdel Gader *et al.* (2007). Usman *et al.* (2012) reported that parity had significant effect (P<0.05) on TMY but had no significant effect on LP of Holstein cows in Pakistan. Contradictory, Eid *et al.* (2012) found that parity had non-significant effects on TMY and LP, but had significant effect (P<0.05) on NSC of Friesian cows in Sudan.

Heritability (h^2):

Estimates of variance components and heritability (h^2) for all lactations studied traits are presented in Table (3). Low heritability estimates for lactation traits in this study indicated low genetic to environmental variance ratios and reflected differences in their response to the existing environmental conditions. Low heritability estimates were found for FSP and DO and that of NSC was close to zero. In general, selection for traits with low heritability is worthwhile. Similarly, low heritability estimates of 0.059, 0.130, 0.030 and 0.014 for TMY, 305-DMY, LP and DO, respectively were reported by Abou-Bakr *et al.* (2006). Salem *et al.* (2006) depicted heritability estimates of 0.22, 0.27, and 0.07 for TMY, 305-DMY, and LP, respectively. Abdel Gader *et al.* (2007) indicated heritability estimates of 0.130, 0.172, and 0.510 for TMY, LP, and DO, respectively. In Iran, Pozveh *et al.* (2009) reported low heritability estimates of 0.04 and 0.06 for FSP and DO of Holstein cows. In Pakistan, Usman *et al.* (2012) depicted heritability estimates of 0.255 and 0.184 for TMY and LP of Holstein cows. El-Bayoumi *et al.* (2015) reported heritability estimates of 0.34, 0.32, 0.10 and 0.07 for TMY, 305-DMY, LP and DO of Holstein cows in Egypt. Radwan *et al.* (2015) depicted heritability estimates of 0.29, 0.31, 0.16, 0.10, 0.10 and 0.21 for all lactation TMY, 305-DMY, PY, LP, DO and NSC of Holstein cows in Egypt.

Repeatability (r):

Estimates of repeatability (r) for all studied traits are presented in Table (3). The low estimates of repeatability for all studied traits indicated low genetic and permanent environmental variances to temporary environmental variance ratios for all studied traits and reflected differences in their response to the existing environmental conditions. This indicated that selection on the basis of first record is not advisable. In general, the present estimates of repeatability for TMY, 305-DMY and LP were lower than those depicted by Abou-Bakr *et al.* (2006) which were 0.48, 0.79 and 0.62 for TMY, 305-DMY and LP, respectively and those depicted by Salem *et al.* (2006) which were 0.50, 0.61 and 0.31 for the same traits, respectively. However, Pozveh *et al.* (2009) reported low repeatability estimates of 0.06 and

0.10 for FSP and DO of Holstein cows in Iran. Usman *et al.* (2012) depicted repeatability estimates of 0.261 and 0.194 for TMY and LP of Holstein cows in Pakistan. Repeatability estimates of 0.39 and 0.05 for 305-DMY and DO of Holstein cows in Egypt were reported by Rushdi (2015).

Breeding values:

Estimates of breeding values (BV) for all studied traits are presented in Table (4). Breeding value defined as the total genetic ability of an animal for a given trait. Therefore, breeding value refers to the value of an animal in a breeding program for a particular trait. In practice, breeders want to know the level of performance that can be expected from progeny of certain individuals.

The present breeding values for TMY, 305-DMY, PY, LP, FSP, DO and NSC of cows ranged between -2736.6 & 3284.5, -1698.0 & 1337.8, -6.7 & 5.6 kg, -45.0 & 71.1 days, , -39.6 & 72.9, -37.9 & 64.8 days and between -0.14 & 0.19 service, respectively, the corresponding values for dams were between -2835.0 & 2979.1, -985.2 & 1875.1, -7.3 & 6.0 kg, -9.9 & 44.0 days, -38.4 & 86.9, -38.1 & 53.7 days, and between -0.30 & 0.60 service, respectively. The breeding values for sires were between -1056.8 & 659.1, -737.1 & 621.9, -1.3 & 2.4 kg, -23.6 & 18.6 days, -15.6 & 32.7, -11.2 & 13.5 days, and-0.76 & 1.16 services for the respective traits. El-Bayoumi *et al.* (2015) reported breeding values for TMY, 305-DMY, LP and DO of Holstein cows ranged between -2096.0 and 2117.0, -372.9 and 315.9 kg, between -75.9 and 78.2 and between -50.1 and 144.3 days, respectively, the corresponding values for dams were between -1372.0 and 2113.0, -396.2 and 226.8 kg, between -77.4 and 53.2 and between -37.6 and 170.5 days, respectively. The breeding values for sires were between -1095.0 and 1186.0, -245.9 and 171.9 kg, between -34.7 and 40.6 and between -24.4 and 66.3 days for the respective traits. Radwan *et al.* (2015) reported breeding values of all animals ranged between -4917.4 & 4731.3, -3863.1 & 3076.4, -8.3 and 11.7 kg, -76.5 & 75.6 days, -64.0 & 98.1 days, and -1.46 & 8.37 service, for TMY, 305-DMY, PY, LP, DO and NSC, respectively. The high ranges of breeding values for milk production traits may be logic because of utilization of high producing cows for formation of the above herds. But unfortunately, this approach may face the barrier of the tendency of the high producing cows to be less sound for fertility.

Table 3. Variance components, heritability (h^2) , repeatability (r), standard error (SE) for the studied traits.

Traits	No of records	σ^2_a	σ^2_{Pe}	σ^2_e	σ^2_P	h^2 (SE)	r (SE)
TMY	1631	4611. 6	9798.4	56417.0	70827.0	0.065 (0.041)	0.203 (0.032)
305-DMY	1807	7275.0	1936.0	39545.0	48757.0	0.149 (0.045)	0.189 (0.030)
PY	1794	8.06	3.07	39.62	50.75	0.159 (0.047)	0.219 (0.031)
LP	1681	298.3	700.5	9283.2	10282.0	0.029 (0.028)	0.114 (0.030)
FSP	1449	127.5	47.6	1257.5	1432.4	0.089 (0.042)	0.122 (0.033)
DO	1001	52.74	0.004	1842.72	1895.46	0.028 (0.034)	0.028 (0.038)
NSC	1473	0.008	0.016	1.332	1.356	0.006 (0.022)	0.018 (0.028)

TMY: total milk yield (kg), 305-DMY: 305-day milk yield (kg), PY: peak yield (kg), LP: lactation period, (day), AFC: age at first calving (month), FSP: first service period (day), DO: days open (day) and NSC: number of services per conception (services).

σ^2_a : Additive variance, σ^2_{Pe} : permanent environmental variance, σ^2_e : residual variance, and σ^2_P :phenotypic variance

Table 4. Breeding values for the studied traits

Trait	Cow breeding values		Dam breeding values		Sire breeding values	
	Min. ± S.E	Max. ± SE	Min. ± S.E	Max. ± SE	Min. ± SE	Max. ± SE
TMY	-2737 ± 1283	3285 ± 1201	-2835 ± 1054	2979 ± 1120	-1057 ± 535.2	659 ± 392
305-DMY	-1698 ± 6967	1338 ± 614	-985 ± 757	1875 ± 639	-737 ± 337	613 ± 243
PY	-6.7 ± 2.1	5.6 ± 2.4	-7.3 ± 2.1	6.0 ± 2.0	-1.3 ±1.0	2.4 ± 0.8
LP	-45.0 ± 34.7	71.1 ± 34.7	-9.9 ± 26.7	44.0 ± 27.3	-23.6 ± 16.0	18.6 ± 14.1
FSP	-39.6 ± 24.1	72.9 ± 26.6	-38.4 ± 25.2	86.9 ± 28.7	-15.6 ± 11.0	32.7 ± 13.1
DO	-37.9 ± 3 0.5	64.8 ± 33.4	-38.1 ± 27.4	53.7 ± 30.78	-11.2 ± 10.9	13.5 ± 11.8
NSC	-0.14 ± 0.26	0.19 ± 0.26	-0.30 ± 0.34	0.60 ± 0.34	-0.76 ± 0.40	1.19 ± 0.44

TMY: total milk yield (kg), 305-DMY: 305-day milk yield (kg), PY: peak yield (kg), LP: lactation period, (day), AFC: age at first calving (month), FSP: first service period (day), DO: days open (day) and NSC: number of services per conception (services).

CONCLUSIONS

Low heritability and repeatability estimates for the studied traits indicated that the differences in the performance traits of Holstein cows were mainly due to different nutritional, climatic conditions and management practices prevalent over different times. Therefore, the interacting relationship between the genetic and environmental factors may also contribute to inflating the phenotypic variation in the traits under investigation. Consequently, improvement of managerial systems and environmental conditions would have positive effects on performance traits of Holstein cows in this herd.

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تقديرات المكافئ الوراثي، المعامل التكراري والقيم التربوية لبعض صفات الأداء لأبقار الهولشتين فريزيان في مصر باستخدام نموذج الحيوان التكراري

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أجرى هذا البحث على بيانات قطيع أبقار الهولشتين بمزرعة اليسر الخاصة الموجودة بالكيلو ٥١ طريق إسكندرية ـ القاهرة الصحراوي. وقد شمل البحث بيانات ١٨٠٧ سجل حليب لعدد 735 بقرة خلال الفترة من ١٩٩٥ وحتى ٢٠٠٥. واستهدف البحث تقديرات المكافئ الوراثي، المعامل التكراري والقيم التربوية لبعض صفات الأداء لأبقار الهولشتين في قطيع تجاري تحت ظروف البيئة المصرية. وأيضاً دراسة تأثير كل من موسم الولادة، سنة الولادة، العمر عند أول ولادة وترتيب موسم الحليب علي الصفات موضع الدراسة.

تم تحليل البيانات إحصائياً بطريقة الحد الأدنى للمربعات باستخدام برنامج الـ SAS، وأوضحت النتائج أن المتوسط العام بلغ ٩٥٣٧ كجم لإنتاج اللبن الكلي، ٨٣١٥ كجم لإنتاج اللبن في ٣٠٥ يوم، ٤٠.٢ كجم لأقصي إنتاج لبن يومي، ٣٤٨.٨ يوم لطول موسم الحليب، ٨٩.٤ يوم لفترة التلقيح الأولي، ١١٣.١ يوم لفترة الأيام المفتوحة و٢.٠ تلقيحة لعدد التلقيحات اللازمة للاخصاب. كان لموسم الولادة تأثير عالي المعنوية (P< 0.01) علي كل من أقصي إنتاج لبن يومي، طول موسم الحليب، فترة الأيام المفتوحة وعدد التلقيحات اللازمة للاخصاب وتأثير معنوي (P< 0.05)علي إنتاج اللبن في ٣٠٥ يوم بينما لم يكن له تأثيراً معنوياً علي كل من إنتاج اللبن الكلي وفترة التلقيح الأولي. كان لسنة الولادة تأثيراً معنوياً جداً (P< 0.01) علي كل الصفات موضع الدراسة. كان للعمر عند أول ولادة تأثير عالي المعنوية (P< 0.01) علي كل من إنتاج اللبن الكلي وإنتاج اللبن في ٣٠٥ يوم وتأثير معنوي (P< 0.05) علي أقصي إنتاج لبن يومي وفترة التلقيح الأولي بينما لم يكن له تأثيراً معنوياً علي كل من طول موسم الحليب، فترة الأيام المفتوحة وعدد التلقيحات اللازمة للاخصاب. وكان لترتيب موسم الحليب تأثير عالي المعنوية (P< 0.01) كل من إنتاج اللبن الكلي وإنتاج اللبن في ٣٠٥ يوم، أقصي إنتاج لبن يومي وطول موسم الحليب وتأثير معنوي (P< 0.0 5) علي فترة الأيام المفتوحة بينما لم يكن له تأثيراً معنوياً علي كل من فترة التلقيح الأولي وعدد التلقيحات اللازمة للاخصاب.

تم تحليل البيانات المتاحة بواسطة نموذج الحيوان Univariate Repeatability Animal Model بإستخدام برنامج Wombat. كانت تقديرات المكافئ الوراثي لصفة إنتاج اللبن الكلي ٠.٠٦٥، لإنتاج اللبن في ٣٠٥ يوم ٠.١٤٩، لأقصي إنتاج لبن يومي ٠.١٥٩، لطول موسم الحليب ٠.٠٢٩، لفترة التلقيح الأولي ٠.٠٨٩، لفترة الأيام المفتوحة ٠.٠٢٨ ولعدد التلقيحات اللازمة للاخصاب ٠.٠٠٦ وكانت تقديرات المعامل التكراري لصفة إنتاج اللبن الكلي ٠.٢٠٣، لإنتاج اللبن في ٣٠٥ يوم ٠.١٨٩، لأقصي إنتاج لبن يومي ٠.٢١٩، لطول موسم الحليب ٠.١١٤، لفترة التلقيح الأولي ٠.١٢٢، لفترة الأيام المفتوحة ٠.٠٢٨ ولعدد التلقيحات اللازمة للاخصاب ٠.٠١٨.

تراوحت تقديرات القيم التربوية للأبقار بين -٢٧٣٧ و ٣٢٨٥ كجم ، بين -١٦٩٨ و ١٣٣٨ كجم وبين -٦.٧ و ٥.٦ كجم وبين -٤٥.٠ و ٧١.١ يوم، بين -٣٩.٦ و ٧٢.٩ يوم وبين -٣٧.٩ و ٦٤.٨ يوم وبين -٠.١٤ و ٠.١٩ تلقيحة بالنسبة لإنتاج اللبن الكلي، لإنتاج اللبن في ٣٠٥ يوم، لأقصي إنتاج لبن يومي، لطول موسم الحليب، لفترة التلقيح الأولي، لفترة الأيام المفتوحة ولعدد التلقيحات اللازمة للاخصاب.علي التوالي. أما تقديرات القيم التربوية للأمهات فتراوحت بين -٢٨٣٥ و ٢٩٧٩ كجم، بين -٩٨٥ و ١٨٧٥ كجم وبين -٧.٣ و ٦.٠ كجم وبين -٩.٩ و ٤٤.٠ يوم، بين -٣٨.٤ و ٨٦.٩ يوم وبين -٣٨.١ و ٥٣.٧ يوم وبين -٠.٣٠ و ٠.٦٠ تلقيحة بالنسبة للصفات السابقة علي التوالي. أما تقديرات القيم التربوية للطلائق فتراوحت بين -١٠٥٧ و ٦٥٩ كجم، بين -٧٣٧ و ٦١٣ كجم وبين -١.٣ و ٢.٤ كجم وبين -٢٣.٦ و ١٨.٦ يوم، بين -١٥.٦ و ٣٢.٧ يوم وبين -١١.٢ و ١٣.٥ يوم وبين -٠.٧٦ و ١.١٦ تلقيحة بالنسبة للصفات السابقة علي التوالي. توضح نتائج هذا البحث أن لنظم الرعاية المناسبة والظروف البيئية الملائمة أثراً كبيراً علي الأداء الإنتاجي والتناسلي لأبقار الهولشتين في مصر.