DJAS., Vol. (4) (II): (81-90) (2025) DOI: 10.21608/djas.2025.428586

Damietta Journal of Agricultural Sciences
https://djas.journals.ekb.eg
ISSN: 2812-5347(Print)- 2812-5355 (Online)

Breeding Value Evaluation for Some Reproductive Traits in Egyptian buffalo

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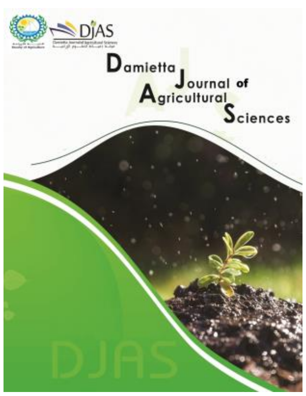

ABSTRACT:

This study aimed to determine the effects of some environmental factors on reproductive traits, as well as to estimate genetic parameters for age at first calving (AFC, months), number of Services per conception (NSC, count), Days open (DO, days), Gestation length (GL, days), and Calving interval (CI, days). Data were collected from 27 years and included 2,737 records of Egyptian buffaloes maintained at the Mahallet Mousa farms, affiliated to Animal Production Research Institute, Ministry of Agriculture, Egypt. Data were analyzed using General Linear Model (GLM) procedure in SAS (2002) to assess significant fixed effects, and an animal model was applied to estimate genetic parameters and breeding values. The mean values for AFC, NSC, DO, GL, and CI were 36.69 months, 1.92 services, 128.10 days, 317.90 days, and 446.01 days, respectively. The estimated heritability (h^2) for the aforementioned traits was 0.27, 0.15, 0.18, 0.09, and 0.16. Correspondingly, genetic correlations (rg) and phenotypic correlations (rp) among studied traits ranged from 0.07 to 0.96 and 0.08 to 0.68, respectively. The accuracy of predicted breeding values was ranged from 57% to 86% for sires, 63% to 97% for cows, and 62% to 92% for dams. These results indicate that genetic improvement of reproductive traits can be effectively achieved through selection based on buffalo cows, sires, or dams. This study highlights the necessity of ameliorating environmental conditions and management practices, along with implementing a structured genetic improvement strategy to boost reproductive efficiency, increase productivity, and achieve high profitability.

Key words: Buffalo, reproductive traits, genetic parameters, breeding values

INTRODUCTION

Egyptian buffalo play an essential role in the national agricultural economy due to their significant contribution to milk and meat production. The number of Egyptian buffaloes is approximately 3.4 million heads, contributing about 45% and 37% of the country's total milk and red meat production, respectively (FAOSTAT, 2019). Buffaloes play a crucial role in smallholder farming systems, often outperforming cattle due to their unique traits. One key advantage is their higher milk fat content and longer productive lifespan compared to cattle, making them more valuable for milk production and economic sustainability (FAO, 2017). Egyptian buffaloes also exhibit remarkable tolerance to tropical and subtropical climates, especially when compared to their hybridization with the Italian breed (Nasr, 2017). In general, buffaloes are known for their high ability to withstand harsh environmental and management conditions, their high feeding efficiency on dietary roughage, and their strong resistance to various infectious diseases (Abu El-Naser, 2014; El-Awady *et al.*, 2016; Guerrero-Legarreta *et al.*, 2020). These characteristics contribute to their extended productive lifespan compared to cattle under common environmental conditions (De Vries and Marcondes, 2020; El-Awady *et al.*, 2021). Abu El-Naser (2020) emphasized that enhancing efficiency through genetic improvement and environmental conditions can significantly reduce age at first calving (AFC), first days open (FDO), and first calving interval (FCI) in Egyptian buffaloes. Consequently, this leads to increased reproductive performance and actualization of high profitability. Gómez-Carpio *et al.* (2023) noted that genetic improvement of fertility traits is not easy due to their low heritability, and non-genetic factors play a major role in Italian Mediterranean buffaloes. Shafik *et al.* (2022) highlighted that the wide variations in reproductive and productive traits indicate great potential for improving the productive and reproductive traits of Egyptian buffalo and that improvement requires genetic selection programs and ameliorating management practices on farms.Previous research has reported low to moderate heritability estimates for reproductive traits in different buffalo breeds. The estimated heritability (h^2) for AFC ranged from 0.09 to 0.57 (Abu El-Naser, 2020; El-Awady *et al.*, 2021; Gómez-Carpio *et al.*, 2023 and Sharma *et al.*, 2023). For NSC, heritability varies between 0.04 and 0.11 (El-Awady *et al.*, 2021 and Sharma *et al.*, 2023). DO, estimates ranged also from 0.0001 to 0.20 (Mostafa *et al*., 2017; Helmy and Somida, 2021; El-Awady *et al.*, 2021 and Ahmed *et al*., 2024). Heritability values for GL, were range from 0.01 to 0.15 (Helmy and Somida, 2021; Ashour and El-Sharawy, 2021 and Sah *et al.*, 2024). Also, heritability estimates For CI range from 0.02 to 0.11 (Abu El-Naser, 2020; El-Awady *et al*., 2021; Helmy and Somida, 2021 and Kaplan and Tekerli, 2023).

Reproductive efficiency is a important factor affecting milk production, as it is relation to calving performance. As a result, genetic improvement of fertility traits has become a major breeding goal for buffalo and cattle in Egypt (El-Awady *et al.*, 2016; El-Awady and Abu El-Naser, 2017; Abu El-Naser, 2020; Abu El-Naser et al., 2020; El-Awady *et al.*, 2021 and Ghazy *et al.*, 2024). Genetic evaluation of Egyptian buffaloes should primarily focus on reproductive traits, as female fertility significantly impacts milk production efficiency, which is essential for the profitability of dairy farms. The primary objective of this study was to assess the impact of environmental factors on key reproductive traits in Egyptian buffaloes. These traits include age at first calving (AFC, months), number of services per conception (NSC, services), days open (DO, days), gestation length (GL, days), and calving interval (CI, days). In addition to estimate genetic parameters and breeding values for these reproductive traits.

3. MATERIALS AND METHODS:

Data and Management:

This study utilized reproductive trait data from lactating Egyptian buffalo herds maintained at the Mahallet Mousa Experimental Stations, which include Mahallet Mousa (MM), El-Nattafe El-Gidid (NG), and El-Nattafe El-Kadim (NK), all managed by the Animal Production Research Institute (APRI), Ministry of Agriculture. Egypt. Data were collected over a period of 27 years (1998–2024) and included 2737 records from 598 dams and 182 sires. The reproductive traits studied were age at first calving (AFC, months), number of services per conception (NSC, count), days open (DO, days), gestation length (GL, days), and calving interval (CI, days). The buffaloes were housed under semi-open sheds and managed under almost uniform feeding and husbandry practices across farms. During December to May, the animals were primarily grazed on Egyptian clover (*Trifolium alexandrinum*) with a concentrate mixture and rice straw. From June to November, animal were fed on concentrate mixture, rice straw, and a limited amount of clover hay. The feeding regimen was adjusted based on live weight, milk production, and pregnancy status. Buffaloes had access to water three times daily via water troughs, and multi-mineral licking blocks were provided in the stalls. Buffalo cows were inseminated during estrus after 60 days postpartum for, while heifers were inseminated upon reaching 350 kg of live weight or 18–24 months of age. Pregnancy was detected via rectal palpation rectal palpation 60 days after the last mating.

Statistical Analysis:

The collected data were statistically analyzed using the General Linear Model (GLM) procedure in SAS (2002) to evaluate the effects of environmental factors on reproductive traits. The statistical models applied were as follows:

Model 1

$Yijklm= \mu + Si + PCj + F_K +P_l + eijklm$

Where:

Yijklm = the individual observation of studied traits (NSC, DO, GL and CI).

M = the overall mean.

Si =Fixed effect of season of calving (i = 4: winter, spring, summer, and autumn).

PCj =the Fixed effect of Period of calving years (j = 1^{st}, 2nd, 3^{rd}, 4^{th}, and $5^{th)}$; where:

1^{st} period extended from 1998–2002.

2^{nd} period extended from 2003–2007.

3^{rd} period extended from 2008–2012.

4^{th} period extended from 2013–2017.

5^{th} period extended from 2018–2024).
F_K = the Fixed effect of farm (k = 3; Mahallet Mousa (MM), El-Nattafe El-Gidid (NG), and El-Nattafe El-Kadim (NK).
Pl =the fixed effect of parity (l = P1 to ≤P10).
eijklm=random error assumed to be NID (0, σ2e).

Model 2 was used to analyze the effect of season and period of calving and farm on age at first calving (AFC).

$Y_{ijkl} = \mu + Si + PCj + F_K + eijkl$

Where: all components of this model are as defined for model 1.

Genetic and phenotypic parameters for reproductive traits were estimated using the derivative-free restricted maximum likelihood (REML) method. The MTDFREML program, as described by Boldman *et al*. (1995), was used to analyze the data under a multi-trait animal model**:** $Y = X\beta + Za + e$

Where: Y, β, a, and e are vectors of the observations, fixed effects included that factors with a significant on traits, genetic effects, and residual effects, respectively. Whereas X and Z are incidence matrices that are related to records of fixed and genetic effects, respectively. The predicted breeding values (PBVs) were calculated using the MTDFREML program to obtain the best linear unbiased predictions (BLUP) for all animals included in the pedigree file under the multi-trait analysis framework.

RESULT AND DISCUSSION

A- Descriptive Statistics*:*

The least squares means and standard errors for reproductive traits in Egyptian buffaloes are given in Table 1. The mean of age at first calving (AFC) was 36.69 ± 6.32 months. The present estimate is almost similar to the findings in Egyptian buffaloes of Shafik *et al.* (2017) (36.44 m), Abu El-Naser (2020) (37.9 m), Easa *et al.* (2022) (36.61 m), and Abd-elrahman *et al.* (2024) (36.75 m). AFC indicates a heifer's ability to conceive and calve. Age at first calving at an optimal age is desirable for early returns, as it increases lifetime productivity and reduces the generation interval. Furthermore, a shorter generation interval helps in the early evaluation of sires, resulting in faster genetic gains. However, decreasing the age at first calving below the optimal level may result in weak calves, difficult calving, and reduced milk production during the first lactation (Kumar *et al.*, 2017). mean number of services per conception (NSC) was 1.92 ± 1.01 services. The present estimate was higher than the mean obtained by Bashir *et al.* (2015) in Nili-Ravi buffaloes (1.56), Budiarto *et al*. (2019) in swamp buffaloes (1.4), and Nastiti *et al.* (2023) in swamp buffaloes (1.25). On the other hand, the present result is lower than the estimate reported by Sharma *et al.* (2023) in Murrah buffaloes (2.01). However, the current mean of NSC was come within the range (1.36 to 2.24, services) who estimated by El-Awady *et al.* (2021) in Egyptian buffaloes. The mean number of services per conception (NSC) was 1.92 ± 1.01 services. The present estimate was higher than the mean obtained by Bashir *et al.* (2015) in Nili-Ravi buffaloes (1.56), Budiarto *et al*. (2019) in swamp buffaloes (1.4), and Nastiti *et al.* (2023) in swamp buffaloes (1.25). On the other hand, the present result is lower than the estimate reported by Sharma *et al.* (2023) in Murrah buffaloes (2.01). However, the current mean of NSC was come within the range (1.36 to 2.24, services) who estimated by El-Awady *et al.* (2021) in Egyptian buffaloes. The means of days open (DO) and calving interval (CI) were 128.10 days and 446.01 days, respectively. The current results closely match the estimates reported by Abu El-Naser (2020) for both DO and CI in Egyptian buffaloes. Along the same lines, the calving interval was obtained by Pawar *et al*. (2018) in Surti Buffaloes (447.92 ± 9.52) and Koçak *et al.* 2019 (450.35± 2.98) in Anatolian buffaloes. The estimation of the mean gestation length (GL) was 317.90 days. This mean is slightly higher than those reported by Ayad *et al.* (2022) in Egyptian buffaloes (314.06 days), Bashir *et al*. (2015) (308 days) in Nili-Ravi buffaloes, Bhave *et al.* (2018) in Murrah buffaloes (308.68 days), Deka *et al*. (2018) in swamp buffaloes (304.18 days). The differences in estimates from previous studies and the current study may be due to breed, differences in data size, management, farm location, and country.Calving interval (CI) depends mainly on days open (DO) or the number of services per conception (NSC). Improvement in the service period (i.e., a decrease in DO) leads to a decrease in CI, which improves overall reproductive efficiency. The present estimated coefficients of variation (CV%) for the studied traits ranged from 2.74% to 62.26%, with the highest CV% value observed for DO (62.26%), indicating a huge variation among individual buffaloes (Table 1). The present results were in agreement with those obtained by El-Awady and Abu El-Naser (2017) and Abu El-Naser (2020).

B- Effect of season, period of calving years, farm, and parity on studied traits:

1. Effect of season of calving:

Season of calving had a non-significant effect on NSC and GL but showed a highly significant ($P \leq 0.001$) effect on DO and CI, and a significant ($P \leq 0.05$) effect on AFC. Buffalo cows that calved in the autumn season had the significantly lowest means for DO (122.42 days), GL (317.57 days), and CI (440 days), contrarily their mean of AFC was the significantly highest mean (37.43 months).The significantly lowest mean of AFC was observed in spring (36.33 m), whereas the significantly lowest mean of NSC was found in summer (1.85 services). Thus, the results indicate optimal reproductive performance of buffaloes in winter. The variations in reproductive traits across different seasons may be attributed to environmental conditions, progesterone levels, and ovarian function, feed quality and quantity. These findings agree with Ayad *et al*. (2022), who found a highly significant effect of the season of calving on DO and CI, vice versa for NSC and GL, in Egyptian buffaloes. While, they were found that the buffalo cows calved in spring season have the lowest DO (69.69 ±2.71 days), CI (382.93±2.82 days), NSC (1.49 ±0.0_4days) and GL (313.24 ±0.26). Likewise, Eldawy *et al.* (2021) noted that season of calving was a significant effect on calving interval (CI) and days open (DO) in Egyptian buffalo. In the same way, Ramadan (2018) showed that the season of calving had significant in CI in Egyptian buffalo, wherefrom, buffalo cows calved at winter have the shortest CI period (13.61 months) than those calved in the other seasons. Norman *et al.* (2009) noted that the gestation length was shorter (2.0 d) for October conceptions compared to January and February conceptions for Holstein cows. Abu El- Naser In Friesian cows, Naser *et al.* (2019) noticed that the month of calving had no significant effect on DO and CI. Sharma *et al*. (2023) in Murrah buffaloes the season of calving had significant effects on NSC and CI.

2.Effect of period of calving year:

The period of calving year had a highly significant effect on AFC, NSC, DO, GL, and CI. Buffalo cows calved during the first period (1998-2002) had the significantly lowest means for NSC (1.81), GL (317.57 days), and CI (440 days). Meanwhile, the significantly lowest mean of AFC (36.72 months) was recorded during the second period (2003-2007), and the significantly shortest mean of GL (315.64 days) was observed during the fourth period (2013-2017) table 1. These variations may be due to changes in management practices, environmental conditions, feed availability, culling strategies, and disease prevalence over time. The current results for CI agree with those reported by Wakachaure *et al*. (2008) while disagree with those reported by Jakhar *et al.* (2016) in Murrah buffaloes. And also, Sharma *et al.* (2023) agreed with present results for AFC, while the opposite was true for CI and NSC in Murrah buffaloes

3.Effect of farm*:*

The farm had a highly significant effect on all studied traits (AFC, NSC, DO, and CI), except GL, which was not affected by farm location. The best farm in terms of reproductive traits expected AFC and GL was El-Nattafe El-Gidid. Which, the significantly lowest means for NSC, DO, and CI were 1.85±0.02, 124.06±2.18, and 441.60±2.19, respectively compared to buffalo that living in the other farms (table 1). These findings align with those reported by Dass and Sadana (2000) in a study of Murrah buffaloes and Alkoyak *et al*. (2024) in a study of Anatolian buffaloes, for farm effect on calving interval. Similarly, that was indicated by Abu El-Naser et al. (2019) for calving interval and days open.

4.Effect of parity:

Parity had a highly significant effect on NSC, DO, and CI and a significant effect on GL. Buffalo cows in the 5^{th} parity had the best NSC (1.72), while buffalo in the 9^{th} parity had the best DO (110.58 days), GL (316.70 days) and CI (427.29 days). Which, buffalo in 9^{th} parity the lowest significant means of DO, GL and CI compared to buffalo in the other parities table 1.

This may be attributed to the fact that the buffalo kept at the stations until these parities were selected buffaloes. The variations across different parities may be attributed to differences in body weight, body condition score, degree of sexual maturity, and overall reproductive efficiency. Previous studies by Sanker *et al.* (2014), Charlini and Sinniah (2015), Nava-Trujillo *et al*. (2018), Fakruzzaman *et al.* (2020), and Alkoyak *et al*. (2024) confirmed the significant effect of parity on CI in buffaloes. Likewise, Ayad *et al*. (2022) clarified that parity had highly significant on SNC, Do, GL and CI and El-Qaliouby *et al.* (2024) demonstrated that parity significantly affects DO and CI in Egyptian buffaloes.

C- Genetic parameters:

The heritability estimate (h^2) for AFC was moderate (0.27), while it was slightly lower for NSC, DO, and CI (0.15, 0.18, and 0.16, respectively), and the heritability for GL was weak (0.09) as illustrated in Table 2. A lower heritability value indicates that better management and feeding procedures could be more efficient than selective breeding for the studied traits in Egyptian buffaloes. Fertility traits were influenced by the environment and exhibited low heritability, suggesting potential for improvement through selective breeding, modification of management practices, and better nutrient intake (Sharma *et al*., 2023). In general, the moderate h² estimate for AFC and low estimates for DO and CI were 0.25, 0.12, and 0.12, respectively, in Egyptian buffaloes was reported by Abu El-Naser (2020). Similarly, Shalaby *et al*. (2016) estimated weak heritability for DO and CI in the first lactation of Egyptian buffaloes was (0.07 and 0.08, respectively). Easa *et al*. (2022) indicated that the heritability estimate for AFC and CI was 0.35 and 0.09, respectively, in Egyptian buffaloes. El-Awady *et al.* (2021) revealed that the h² estimate for AFC, NSC, and CI was 0.56, 0.11, and 0.15, respectively, in Egyptian buffaloes. The present estimated heritabilities were lower than those obtained in buffaloes by Verma *et al*. (2019); Tamboli *et al*. (2021) and Sharma *et al*. (2023), where AFC heritability was 0.28±0.03, 0.362±0.086, and 0.36±0.21, respectively. Conversely, the h² estimates by Helmy and Somid (2021) for AFC, GL, DO, and CI were low and being 0.12 (0.04), 0.01 (0.02), 0.0001 (0.01), and 0.002 (0.02), respectively in Egyptian buffaloes. Genetic correlations (r_g) among the studied traits ranged from (0.07 to 0.96). The highest genetic correlation was observed between AFC and CI, while the lowest was found between AFC and NSC, as shown in Table 2. The present results are consistent with those obtained by Abu El-Naser (2020) in Egyptian buffaloes, where genetic correlations among AFC, DO, and CI were positive, ranging from 0.03 to 0.24. Likewise, El-Awady *et al.* (2021) stated that the genetic correlations between AFC and both NSC and CI were positive (0.31 and 0.53, respectively). Also, Helmy and Somid (2021) indicated that the genetic correlation between AFC and GL was positive (0.15), and the genetic correlations between DO and both AFC and GL were 0.37 and 0.04, respectively. Similarly, the genetic correlations between CI and AFC, GL, and DO were 0.38, 0.05, and 0.99, respectively. Easa *et al*. (2022) also found that the genetic correlation between AFC and CI was positive (0.61) in Egyptian buffaloes.

The phenotypic correlations (r_p) among the studied traits were positive and ranged from 0.08 to 0.68. The current results were inagreement with estimates in Egyptian buffaloes reported by Abu El-Naser (2020), who found that the phenotypic correlation between DO and CI was 0.19. Similarly, El-Awady *et al*. (2021) estimated the genetic correlations between AFC and both NSC and CI to be 0.075 and 0.042, respectively.

D- Breeding values :

The predicted breeding values (EBVs) for buffalo sires, buffalo cows, and buffalo dams for AFC, NSC, DO, GL, and CI are presented in Table 3. The breeding values for AFC, NSC, DO, GL, and CI of buffalo sires were ranged from -7.60 to 9.78 m, -1.17 to 1.07 s, -13.93 to 15.99 d, -18.20 to 16.83 d, and -26.94 to 21.12 d, respectively. The corresponding breeding values for buffalo cows were ranged from -9.99 to 12.29 m, -1.45 to 1.47 s, -17.79 to 16.74 d, -13.87 to 13.60 d, and -20.64 to 22.68 d, respectively. In addition to the above for traits, the predicted breeding values for buffalo dams were ranged from -8.56 to 8.82 m, -1.45 to 1.69 s, -12.46 to 15.61 d, -17.25 to 13.49 d, and -21.37 to 23.28 d, respectively. The ranges of breeding values for buffalo cows and dams were higher than those of sires for AFC, NSC, and DO, but the highest value for GL was observed in sires. The accuracy of predicted breeding values was ranged from 57 to 86% for sires, 63 to 97% for buffalo cows, and 62 to 92% for dams, as shown in **Table 3**.These results indicate that the genetic improvement could be achieved through buffalo cows, sires, or dams. High accuracy levels of breeding values help breeders and those interested in genetic improvement to select for desirable traits in their buffaloes, ultimately enhancing genetic progress in buffalo herds. The current results are consistent with those reported by El-Awady and Abu El-Naser (2017) in dairy cattle and Abu El-Naser (2020) in Egyptian buffaloes, who indicated that the accuracy of sires' breeding values for AFC, DO, and CI ranged from 70-81%, 70-81%, and 69-79%, respectively. Additionally, the accuracy of the same traits for buffalo cows' breeding values varied between 90-94%, 38-53%, and 37-39%, respectively, while for dams, they varied between 49-50%, 70-71%, and 72-73%, respectively.

Table 1. Least square means (± SE, CV%) of studied traits under the effect of season of calving, Period of calving years, farm and parity.

Variable	No.	Traits				
		AFC, m	**NSC, S**	**DO, d**	**GL, d**	**CI, d**
Least square means and standard deviation and coefficients of variations						
Means		36.69	1.92	128.10	317.90	446.01
SD	2737	6.32	1.01	79.78	8.72	80.26
CV%		17.10	52.72	62.26	2.74	17.99
Independed factors		**Mean±SE**	**Mean±SE**	**Mean±SE**	**Mean±SE**	**Mean±SE**
Season of Calving		*	ns	**	ns	**
Winter	547	36.75^{ab}± 0.26	1.91^{b} ± 0.04	129.84^{b}±3.38	318.74^{a} ±0.40	448.58^{b}±3.41
Spring	427	36.33^{b}±0.28	2.03^{a}±0.05	141.51^{a}± 4.01	318.03^{ab} ±0.44	459.54^{a} ±4.03
Summer	892	36.95^{ab}±0.21	1.85^{b} ±0.03	126.16^{b} ± 2.67	317.66^{b}± 0.28	443.82^{b} ±2.67
Autumn	871	37.43^{a}±0.23	1.93^{ab}±0.03	122.42^{b}± 2.67	317.57^{b}±0.28	440.00^{b} ±2.67
Period of calving		**	**	**	**	**
1st	392	37.51^{AB}±0.29	1.81^{c}±0.04	122.95^{b}± 3.72	318.10^{a}±0.45	441.05^{b}±3.71
2nd	447	36.72^{bc}±0.27	2.00^{a}±0.04	141.45^{a}±4.48	318.30^{a}±0.46	459.76^{a}± 4.48
3rd	590	37.67^{a}±0.28	1.85^{bc}±0.03	123.49^{b}±3.20	317.99^{a}±0.40	441.48^{b}± 3.21
4th	475	36.76^{bc}±0.29	1.98^{ab}±0.04	123.97^{b}±3.43	315.64^{b}±0.26	439.61^{b}± 3.42
5th	833	36.45^{c}±0.21	1.93^{Ab}±0.03	128.98^{b}±2.66	318.83^{b}±0.28	447.82^{b}±2.72
Farm		**	**	**	ns	**
(MM)	840	36.45b± 0.23	1.97^{a}±0.03	141.20^{a}±3.16	318.50^{a}±0.32	459.70^{a}±3.16
(NG)	618	37.18^{a}± 0.18	1.89^{ab}±0.03	118.66^{b}±2.47	317.85^{ab}±0.31	436.51^{b}±2.51
(NK)	1279	37.12^{a}± 0.18	1.85^{b}±0.02	124.06^{b}±2.18	317.54^{b}±0.23	441.60^{b}±2.19
Parity		-	**	**	*	**
P1	480	-	2.07^{ab}±0.03	117.13^{b}±2.85	317.93^{bc}±0.39	435.07^{bc}±2.82
P2	427	-	2.23^{a}±0.05	164.19^{a}±4.77	317.21^{bc}±0.36	481.40^{bc}±4.81
P3	396	-	1.94^{bc}±0.05	126.86^{b}±3.86	318.14^{abc}±0.41	445.00^{b}±3.91
P4	316	-	1.81^{cd}±0.05	122.42^{b}±4.45	318.44^{abc}±0.50	440.87^{bc}±4.50
P5	276	-	1.72^{d}±0.06	124.25^{b}±4.52	317.08^{bc}±0.52	441.34^{bc}±4.55
P6	226	-	1.77^{cd}±0.06	126.61^{b}±5.22	318.65^{ab}±0.62	445.26^{b}±5.31
P7	181	-	1.75^{cd}±0.07	116.08^{b}±5.41	317.44^{bc}±0.67	433.52^{bc}±5.42
P8	145	-	1.82^{cd}±0.08	115.53^{b}±5.56	319.83^{a}±0.82	435.37^{bc}±5.55
P9	106	-	1.75^{cd}±0.08	110.58^{b}±6.67	316.70^{c}±0.79	427.29^{c}±6.82
≤P10	184	-	1.74^{cd}±0.07	124.79^{b}±6.23	317.97^{bc}±0.69	442.77^{bc}±6.29

* ($P < 0.05$); ** ($P < 0.01$) and ns (non-significant); Age at first calving by month (AFC, m), Number of services per conception (NSC, S), Days open by day (DO, d), Gestation length by day (GL, d) and Calving interval by day (CI, d); Season of calving: Winter (December to February), Spring (March to May), Summer (June to August), and autumn (September to November); Period of calving (PC) (1st, 2nd, 3rd, 4th and 5th), where, 1st: 1998-2002, 2nd: 2003-2007, 3rd: 2008-2012, 4th : 2013 to 2017 and 5th: 2018 to 2024 ; Mahallet Musa (MM), El-Nattafe El-Gidid (NG) and El-Nattafe El-Kadim (NK)); and Parity (Number of sequence lactation)= (P1 to ≤P10).

Table 2. Heritability estimates (on the diagonal), genetic correlations (r_g) (below the diagonal), and phenotypic correlations (r_p) (above the diagonal) of the studied traits.

Items	AFC	NSC	DO	GL	CI
AFC	**0.27**	0.67	0.63	0.08	0.77
NSC	0.65	**0.15**	0.23	0.45	0.66
DO	0.30	0.91	**0.18**	0.44	0.68
GL	0.07	0.16	0.13	**0.09**	0.11
CI	0.96	0.56	0.39	0.25	**0.16**

Table 3. Estimated breeding values for studied traits in Egyptian buffaloes.

	Breeding Values (BV's)		
Traits	**Min±SE**	**Max±SE**	**Accuracy**
	Estimate sires breeding value (EBV's)		
AFC, m	-7.60±2.56	9.782± 2.73	0.68-0.72
NSC, S	-1.17 ±0.47	1.07± 0.47	0.57- 0.86
DO, d	-13.93±3.78	15.99 ±3.22	0.58- 0.84
GL, d	-18.20 ±3.54	16.83 ±3.71	0.73- 083
CI, d	-26.94±3.92	21.12 ±3.59	0.63 0.74
	Estimate of buffalo cows breeding value (EBV'c)		
AFC, m	-9.99 ±2.09	12.29 ± 2.73	0.94-0.97
NSC, S	-1.45± 0.28	1.47±0.39	0.93-0.90
DO, d	-17.97±3.21	16.74±3.21	0.90-0.92
GL, d	-13.871±3.43	13.6±3.19	0.74-0.79
CI, d	-20.64±3.97	22.68 ±3.63	0.63-0.69
	Estimate of dams breeding value (EBV'd)		
AFC, m	-8.56 ±2.29	8.82 ±2.60	0.83-0.92
NSC, S	-1.43±0.57	1.69±0.49	0.81-0.90
DO, d	-12.46± 3.09	15.61±3.76	0.76-0.92
GL, d	-17.25±3.47	13.49±3.96	0.62-0.67
CI, d	-21.37±3.04	23.28±3.51	0.68-0.76

Age at first Calving (AFC), Number of Services per Conception (NSC), Days Open (DO), Gestation Length (GL) and Calving Interval (CI)

CONCLUSION

The results demonstrated the potential for increasing the reproductive efficiency of the studied traits if Egyptian buffalo breeders implement appropriate care, improve environmental conditions, and adopt better management practices. Furthermore, increasing the accuracy and range of predicted breeding values for the studied reproductive traits indicates greater genetic differences among individuals, enhancing the potential for improvement. Therefore, genetic progress can be achieved by reducing the duration of these studied traits, reducing the cost of raising buffalo cows, maximizing their lifetime production, and ultimately increasing profitability.

FUNDING

This research did not receive any funding

CONFLICTS OF INTEREST

The authors declare no conflict of interest associated with the paper. The authors alone are responsible for the content and writing of this article.

AUTHORS CONTRIBUTION

Mustafa M.El-Maghazy: Designed the study and drafted the manuscript. Mohamed M. Hegazy: Supervised data collection and provided critical reviews of the manuscript. Samah N. Alzend: Collected a data, performed statistical analysis, and assisted in manuscript preparation and formatting. Abdullah A. Ghazy and Ibrahim A. Abu El-Naser: Contributed to methodology design, data analysis, and interpretation of results, provided expert review, and played a role in writing the manuscript.

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الملخص العربي

تقدير القيم التربوية لبعض الصفات التناسلية فى الجاموس المصرى

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4مركز التميز البحثي فى العلوم الزراعية المتقدمه -كلية الزراعة- جامعة دمياط

تهدف هذه الدراسة إلى تقدير تأثير بعض العوامل البيئية على الصفات التناسلية، وكذلك تقدير المعالم الوراثية للعمر عند أول ولادة وعدد مرات التلقيح اللازمة للإخصاب وعدد الأيام المفتوحة وطول فترة الحمل والفترة بين ولادتين. جمعت بيانات هذه الدراسة خلال 27 عامًا على التوالي لعدد 2737 سجل للجاموس المصري، الموجود في ثلاث محطات تابعة لمعهد بحوث الإنتاج الحيواني- وزارة الزراعة- مصر. تم تحليل بيانات هذه الدراسة باستخدام General Linear Model (GLM)- برنامج ال SAS (2002) وذلك لتقدير تأثير العوامل البيئية على الصفات المدروسة واستخدام نموذج الحيوان لتقدير المعالم الوراثية والقيم التربوية لها وكان متوسط كل من العمر عند أول ولادة (AFC 36.69 شهرًا وعدد مرات التلقيح اللازمة الإ خصاب(NSC) 1.92 تلقيحه وعدد الأيام المفتوحة (DO) 128.10 يومًا وطول فترة الحمل (GL) 317.90 يومًا والفترة بين ولادتين (CI) 446.01 يومًا. تم تقدير المكافئ الوراثي للصفات المدروسة المذكورة آنفًا وكانت 0.27، 0.15، 0.18، 0.09 و0.16 على التوالى. وتراوحت الارتباطات الوراثية والمظهرية الصفات المدروسة بين 0.07 إلى 0.96 و 0.57 إلى 0.68 على التوالى. وتراوحت دقة التنبؤ للقيمة التربوية بين 57 إلى 86% للطلائق، 63 إلى 97% للجاموس و62 إلى 92% للأمهات. تشيرالنتائج الحالية إلى إمكانية تحقيق التحسين الوراثي بفاعلية في الصفات التناسلية فى الجاموس من خلال الانتخاب عن طريق الطلائق أو الجاموس أو الامهات. وخلصت الدراسة إلى ضرورة تحسين الظروف البيئية وممارسات الإدارة، مع وضع استراتيجية للتحسين الوراثي لتعزيز الكفاءة التناسلية وزيادة الإنتاجية وتحقيق الربحية العالية.

الكلمات الافتتاحية: الجاموس ، الصفات التناسلية ، المعالم الوراثية، القيم التربوية