

Genetic and Non-Genetic Analysis: Milk Yield and Reproductive Traits of Friesian Cows in Rami Farm

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Abstract

This study was conducted at the Rami farm cows' station for milk production located in Balnda north of Erbil Kurdistan Region- Iraq on one hundred Friesian cows, from Rami Farm between January 1, 2022, and July 20, 2023. to study the effect of age, parity, sex and calving year on Daily Milk Yield (DMY), Service per conception (SPC), Dry Period (DP) and Calving Interval (CI).and to estimate the heritability value (h²) of the studied traits. The results showed that the overall means of (DMY), (SPC), (DP) and (CI) were 29.87, 1.75, 49.20 and 365.00 respectively. The age of cow's had significant effect on (DMY) and (DP). Age (years) have significant ($P \leq 0.05$) effect on daily milk yield (DMY), which cows aged 3 years produced significantly higher daily milk yield (30.04 \pm 0.34) in comparison to cows aged 3 (29.76 \pm 0.23) and 4 (29.88 \pm 0.27) years respectively. Daily milk yield increased with the advance of parity and mostly reached its maximum value in the second parity being 30.10 \pm 0.12kg per day. The sex of Calves was had non-significant affected on daily milk yield. The result of the study showed the heritability value for TMP, LP, SPC and CL were 0.23, 0.08, 0.19 and 0.08 respectively. The result of the study showed the Best Linear Unbiased Prediction (BLUP) value for TMP, LP, SPC and CL were ranged between -2.986-3.291, -0.101-0.166, -4.218-5.021 and -0.535-0.545 respectively.

Keyword: Friesian cows, Genetic non-genetic correlation, heritability and BLUP

التحليل الوراثي وغير الوراثي: الإنتاج الحليب والصفات التناسلية للأبقار الفريزيان في مزرعة الرامي

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المستخلص

أجريت هذه الدراسة في محطة أبقار مزرعة رامي لإنتاج الحليب، الواقعة في بلدان شمال أربيل، إقليم كردستان العراق، على مئة بقرة فريزيان من مزرعة رامي، في الفترة من 1 يناير/كانون الثاني 2022 إلى 20 يوليو/تموز 2023. هدفت الدراسة إلى دراسة تأثير العمر، وعدد مرات الولادة، والجنس، وسنة الولادة على إنتاج الحليب اليومي (DMY)، وفترة الجفاف (SPC)، وفترة ما بين الولادتين (CI)، والتقدير قيمة المكافئ الوراثي (h²) للصفات المدروسة. أظهرت النتائج أن المتوسطات الكلية لـ (DMY)، و (SPC)، و (DP)، و (CI) كانت 29.87، و 1.75، و 49.20، و 365.00 على التوالي. كان لعمر الأبقار تأثير معنوي على (DMY) و (DP). العمر (بالسنوات) له تأثير معنوي ($P \leq 0.05$) على إنتاج الحليب اليومي (DMY)، حيث أنتجت الأبقار التي يبلغ عمرها 3 سنوات إنتاجاً يومياً أعلى بكثير (30.04 \pm 0.34) مقارنة بالأبقار التي يبلغ عمرها 3 (29.76 \pm 0.23) و 4 (29.88 \pm 0.27) سنوات على التوالي. زاد إنتاج الحليب اليومي مع تقدم الولادات ووصل في الغالب إلى أقصى قيمة له في الولادات الثانية وهو 30.10 \pm 0.12 كغم في اليوم. لم يكن لجنس العجول تأثير معنوي على إنتاج الحليب اليومي. أظهرت نتيجة الدراسة أن قيمة الوراثة لـ TMP و LP و SPC و CL كانت 0.23 و 0.08 و 0.19 و 0.08 على التوالي. وأظهرت نتائج الدراسة أن تقدير أفضل تنبؤ خطي غير منحاز (BLUP) لـ TMP و LP و SPC و CL تراوحت بين -2.986-3.291 و -0.101-0.166 و -4.218-5.021 و -0.535-0.545 على التوالي.

الكلمات المفتاحية: الأبقار الفريزيان، الارتباط الوراثي، التحليل الوراثي وغير الوراثي، المكافئ الوراثي و BLUP

Introduction

For dairy producers, who typically make money from high-producing and fertile cows, the most crucial economic qualities as sources of income are milk output and reproductive traits, for some qualities, heritability is the primary genetic parameter that defines the potential for genetic advancement. (Mitra and Bhattacharya, 2006). Milk production and reproductive traits are the most important economic traits as sources of income for dairy farmers where high producing and fertile cows are usually profitable. Heritability is the key of genetic parameter which determines the amount of possible genetic progress for selected traits (Usman et al. 2012). In dairy breeding,

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selection for the milk yield has been mostly made on the basis of 305-days milk yield (Seyed Sharifi et al. 2008; Bilal & Khan 2009). Dry period is one of the important management strategies. Previous studies reported that to maximize milk yield in the next lactation in dairy cows, a 50 to 60 d dry period is necessary (Safa et al. 2013). The productive characteristics of Friesian cattle as well as native cows and their crosses, have been extensively studied, and genetic parameters for productive traits of imported cattle and their crosses with native cows have been estimated (Mostageer et al.,1999). It is well recognized that increasing the number of cattle and milking cows will improve the production of milk. A consistent and appropriate growth of the cow the population is required to increase the amount of milk produced while improving its quality. The age of the cows could impact the quantity of milk they produce. The character of age-related performance is capable of being modified. (Rensis et al.,2017; Mabrook et al.,2006). The reproductive function of cows is established according to their genetic factors and affected by the surrounding conditions. (Kozerski et al.,2017). This study aimed to evaluate genetic and non-genetic variables and genetic and phenotypic associations between the reproductive characteristics and milk productivity of Friesian cows under Iraq condition.

Materials and Methods

Location

Rami Farm project, is located in Balinda, Erbil Governorate -North of Iraq (latitude 37.009034, longitude 43.841098)

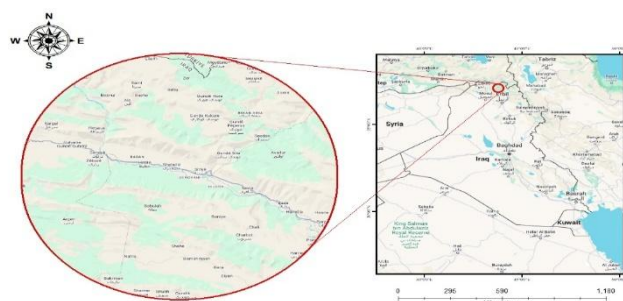


Figure 1. location of Rami Farm Balinda, Erbil Governorate -North of Iraq (latitude 37.009034, longitude 43.841098)

Management

This research was done on 100 Friesian cows from Rami Farm between January 1, 2022, and July 20, 2023. Program management has been done in accordance with management and nutrition. Cow housed in barns open dedicated to dairy cows and vary feeding from one year to another provide forage as feed animals to Base on the daily milk yield, alfalfa-based supply gives cows access to milk and usually offers a mean of 1 kg per 2.25-2.50 kg milk, and containing diet 15kg concentration, 0.5kg straw, 3kg alfalfa,25kg corn silage and water free and involve cows with a health program and preventative as follows system spraying periodically starting from the month of May as repeats every 30 days for a period of 3-5months and when temperatures drop .Cows are vaccinated against sporadic anthrax, and mastitis and anthrax are examined twice a day (morning and evening) after bathing and milking in order to eradicate external parasites towards the end of summer or fall.

Examining Analysis

The Statistical analysis system-SAS (2018) program was used to detect the effect of non-genetic factors in parameters study. Estimate of variance components to calculate of heritability and best unbiased prediction-BLUP according to REML-half sib procedure (Falconer and Mackay, 1996). The statistical analysis using the mathematical model that follows:

$$Y_{ijklmn} = \mu + A_i + P_j + S_k + R_l + I_m + e_{ijklmn}$$

Y_{ijklmn} : Observation value

μ : The overall mean

A_i : Effect of the age = i (3, 4, 5 year).

P_j : Effect of parity = j (first, second and third).

S_k : Effect of the sex = (male, female).

R_l : Effect of the calving year = (2022, 2023).

I_m : Effect of sire (4 sires).

eijklmn: is the error term associated with the observations.

The sire components of variance as well as covariance from multivariate analyses were used to estimate genetic variables using the given formula: $h^2 = 4 \delta^2 d / \delta^2 d + \delta^2 e$

Where:

$\delta^2 d$ is the sire component of variance

$\delta^2 e$ is the environmental component of variance.

Results and Discussion

Non-Genetic Factors

Non-genetic factors impact on Milk yield and reproductive traits of Friesian cows in Rami farm summarized at (Table .1). The overall means of Daily milk yield (DMY), Service per conception (SPC), Dry period and Calving interval-CI were $(29.87 \pm 0.15, 1.75 \pm 0.08, 49.20 \pm 0.66$ and $365.00 \pm 2.71)$ respectively.

Table (2). shows that Age (years) have significant ($P \leq 0.05$) effect on daily milk yield (DMY), which cows aged 3 years produced significantly higher daily milk yield (30.04 ± 0.34) in comparison to cows aged 3(29.76 ± 0.23) and 4(29.88 ± 0.27) years. present results in line with (Mabrook et al., 2006; Macmillan et al., 2017) who observed that dairy productivity is growing together with the animal age, then stabilizes at a maximum level and is decreasing with aging. Cows age also, affected significantly on dry period which recorded significantly higher (51.91 ± 1.45) for cows aged 3 years than ones aged 4 or 5 years. CI was not statistically significant. (Table.2). The period of the service time and the length of the pregnancy determine the calving interval, an integrated reproduction indicator. A calving duration of not more than 365 days is optimal. This index's increase is simultaneously commercially inefficient and physiologically unreasonable. It is related to the fact that, in order to make the cooperative's milk production successful, it is suggested that it have one calf for every cow through the year. (Holodova et al.,2019).

The research indicates that the Productive Cooperative's calving interval of Friesian cows in Rami farm was optimal and amounted to (365.00 ± 2.71) days. Present results (Table .2). showed the significant ($P \leq 0.05$) effect of parity on daily milk yield; total milk production was greater (30.10 ± 0.12) in multiparous cows (second parity) than primiparous cows (first and third parity) cows. Present outcome in line with (Adrien et al. 2012) who found that multiparous cows produced greater quantities of milk generally at 60 DIM than a primiparous cows. (Siewert et al.,2019) also, discovered that the daily milk produced by multiparous cows significantly greater than that of a primiparous cows. Parity effect was non-significant on service per conception (SPC). current findings with regard to those reported by (Khan et al.,1990) who found that parity has a significantly major impact on service per conception. It is important to point that age of cow, skill of technician, age of semen, interval from calving to insemination and the breeding value of the sire are the important factors of the conception rate. (Visser et al., 1988). effect of parity was non-significant on dry period and calving interval-CI.

Impact of calf gender was non-significant on daily milk yield (Table. 2) and calving interval-CI, while Cows that calved male calves reported significantly ($P \leq 0.05$) greater (1.96 ± 0.16) service per conception (SPC) and longer dry period (51.25 ± 1.52), than cows that calved female calves which reported (1.68 ± 0.09) service per conception (SPC) and shorter dry period (48.55 ± 0.72) respectively. One of the most important indicators of a cow's capacity for reproduction is the conception frequency. The number of pregnant cows divided by the total number of inseminations provides the conception rate. Calving year not affected all studied parameters.

Table 1. ANOVA-Analysis of variance for non-genetic factors affecting in parameters study

S.O. V	Degree of freedom-D.F.	Mean Square			
		Daily milk yield-DMY	Service per conception-SPC	Dry period	Calving interval-CI
Age	2	5.221 *	0.413 NS	152.91 *	219.81 NS
Parity	3	4.398 *	1.045 NS	101.04 *	103.76 NS
Calf gender	1	3.267 NS	1.747 *	91.452 NS	2.195 NS
Calving year	1	0.222 NS	0.511 NS	7.768 NS	0.975 NS
experimental error	92	2.331	0.693	41.457	49.327

* ($P \leq 0.05$), ** ($P \leq 0.01$), NS: Non-Significant.

Table 2. Least squares (Mean \pm SE) of non-genetic factors impact on Milk yield and reproductive traits of Friesian cows in Rami farm

Factors	No.	Least squares Mean \pm SE			
		Daily milk yield-DMY	Service per conception-SPC	Dry period	Calving interval-CI
Overall mean	100	29.87 \pm 0.15	1.75 \pm 0.08	49.20 \pm 0.66	365.00 \pm 2.71
Age (year)					
3	22	30.04 \pm 0.34 a	1.82 \pm 0.20	51.91 \pm 1.45 a	362.72 \pm 1.73
4	43	29.76 \pm 0.23 b	1.74 \pm 0.12	48.83 \pm 0.95 ab	365.69 \pm 0.96
5	35	29.88 \pm 0.27 ab	1.71 \pm 0.13	47.57 \pm 1.17 b	365.57 \pm 1.22
Parity					
First	13	29.54 \pm 0.46 b	2.07 \pm 0.26	48.46 \pm 1.91	365.77 \pm 2.39
Second	50	30.10 \pm 0.12 a	1.68 \pm 0.12	49.40 \pm 0.92	364.60 \pm 0.98
Third	37	29.69 \pm 0.26 ab	1.75 \pm 0.13	49.44 \pm 1.12	365.28 \pm 1.16
Calf gender					
Male	24	29.58 \pm 0.30	1.96 \pm 0.16 a	51.25 \pm 1.52 a	365.00 \pm 1.47
Female	76	29.96 \pm 0.18	1.68 \pm 0.09 b	48.55 \pm 0.72 b	365.00 \pm 0.82
Calving year					
2022	42	30.00 \pm 0.24	1.81 \pm 0.14	49.04 \pm 1.12	364.76 \pm 1.16
2023	58	29.78 \pm 0.19	1.71 \pm 0.09	49.31 \pm 0.81	365.17 \pm 0.90
* (P \leq 0.05), ** (P \leq 0.01), NS: Non-significant.					

Genetic and Phenotypic Correlation Coefficient

Heritability (h^2) values show the genetic variability of the variables under study, and measuring them is crucial for determining the selection method and calculating the breeding value of animals. Estimates of heritability (h^2), genetic correlations (r_G), and phenotypic correlations (r_P) between various milk production and reproductive variables are displayed in (Table 3).

Heritability (h^2) estimates for Daily milk yield (DMY), Service per conception (SPC), Dry period (DP) and Calving interval (CI) were 0.23, 0.08, 0.19 and 0.08 respectively. These estimations were in line with most of previous investigators and varied from low to moderate, as reported by (Meyer et al., 1985; Dadpasand et al. 2013; Kaygisiz et al., 2013) and (El-Arian et al., 2003) for dry period. Higher heritability (h^2) estimation for milk yield (0.33) recorded by (Boujenane., 2002). According to certain investigations, heritability estimates of milk yield and composition could increase in parallel with herds' higher milk production level. (Hill et al. (1983).

Table. (3) shows those genetic correlation coefficients between Daily milk yield (DMY) positively correlated with Dry period (DP). Similar results mentioned by Ojango and Pollott. (2001) and (Hammoud et al., 2013), respectively. Genetic correlation between Daily milk yield (DMY) with Calving interval (CI), and Service per conception (SPC) negatively correlated (0.02, 0.67) respectively, while correlated positively (0.04) Dry period (DP). Furthermore, service per conception (SPC) correlated positively with Calving interval (CI) following Dry period (DP). This suggests that the phenotypic expression fertility traits are more influenced by management and environmental factors than genetic factors.

Table 3. Heritability (h²) estimates, as well as the genetic and phenotypic correlation between the parameters.

Parameters	Daily milk yield-DMY	Service per conception-SPC	Dry period-DP	Calving interval-CI
Daily milk yield-DMY	0.23	-0.67 **	0.04 NS	-0.02 NS
Service per conception-SPC	-0.73 **	0.08	0.08 NS	0.02 NS
Dry period-DP	0.12 NS	-0.07 NS	0.19	-0.08 NS
Calving interval-CI	0.09 NS	0.02 NS	-0.13 NS	0.08

** (P≤0.01), NS: Non-Significant. No of Sir =4.
The value on diameter: Heritability-h², the value up of diameter: rG: Genetic correlation, the value down of diameter: rP: Phenotypic correlation.

Conclusion

The current study's findings indicate that when parity improved, daily milk production increased, virtually approaching its highest level in the second parity. Cows' age significantly affected overall dry period (DP) and daily milk yield (DMY). The Best Linear Unbiased Prediction (BLUP) value for TMP, LP, SPC and CL were ranged between -2.986-3.291, -0.101-0.166.-4.218-5.021 and-0.535-0.545 respectively.

The present investigation demonstrated that, under suitable circumstances, at Rami Farm, Friesian cows can produce considerable amounts of milk and have favorable reproductive traits. The majority of the traits under study showed positive genetic correlation and moderate heritability estimates, suggesting that multi-trait selection will be used to genetically enhance these qualities.

Conflict of Interest

Researchers agree that the objectives of other people are not hampered by this effort.

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