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EFFECT OF SELECTION INTENSITY ON THE ESTIMATION OF CORRELATED AND DIRECT GENETIC RESPONSE DEPENDING ON MILK PRODUCTION IN HOLSTEIN FRIESIAN COWS

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Abstract

The study was conducted in Iraq during the period from 2017-2019 to investigate the effect of selection intensity on the estimation of correlated and direct genetic response depending on milk production in Holstein Friesian cows. 90 Holstein – Frisian cows with the same age were used and selection program was done with three selection intensity rates; 90, 80 and 70%. Economical response was calculated. 3 criterions were dependent. Total milk yield (TMY), lactation period (LP) and economic value (EV) to determine the genetic response. Results showed the phenotypic total milk production (PVTMP) were 2273.36, 2413.65 and 1558.59 kg in case of selection 90, 80 and 70% from herd respectively, the PVLP increased from 181.04 day (in origin herd) to 198.25 day in 70% of selection while the economic value increased from 1058641.56 ID to 1279293.65 ID when depending criterion TMY. When depending the criterion LP, the PVTMP raised from 2117.28 kg in origin herd to reach 2477.91 kg in 70% of selection rate, the PVLP increased from 181.04 day (in origin herd) to 202.82 day in 70% of selection while the economic value increased from 1058641.56 ID to 1238956.35 ID when depending criterion TMY. According the EV criterion. The mean of PVTMP increased from 2117.28 kg in the origin herd to 2558.59 kg in 70% 0f selection rate and the PVLP increased from 181.04 day to 198.25 day while the economic value increased from 1058641.67 ID to 1279293.65 ID in the same direction.

Key words: Holstein Friesian, Genetic response, Milk traits, Economic values.

Introduction

Holstein-Frisian is one of the best daily cattle breeds around the world originated in Netherlands and widespread in the most of continents. In Iraq, the breed comprise a high proportion of the exotic dairy animals and its well adapted through crossing it with the native dairy cattle breed to be more resist against diseases and undertake the high temperature degrees or harsh pastures (AL-Khuzai *et al*., 2018). Many factors helps the breed to be the first dairy breed globally such as the high ability of adoption (Arave *et al*., 2012) and the high milk production of cross-breeds resulted from crossing this breed with the native breeds (Coffey *et al*., 2015). Because of the great success of this breed many studies interest with the farm economic data and milk pricing information to be a good tools or indicators to detect the net profits and evaluation the economical outcomes (Banga *et al*., 2009).

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The suitable culling rate and continuous genetic selection are the most important tools to improve dairy cattle performance and increases the milk yield continuously taking into consideration the deterioration that occurs in negative - correlated traits such as resistance (Oltenacu and Algers, 2005). The major aim of this study is to document the relationship of selection intensity or culling rate of individuals with the direct or correlated response of milk yield and lactation period of Holstein-Frisian cows reared in Iraq to choose the best selection intensity that actualize the highest economical benefit under farming conditions.

Materials and Methods

The current study was conducted by using data available from private ruminant's farm in the middle of Iraq, the data belong to 90 Holstein-Frisian cows. Economical response was calculated as:

E.R = TMY × 500 ID

Where :

ER: economical response

TMY: total milk yield

ID: Iraqi Dinar

General Linear Model (GLM) with SAS, (2012) computer program was used for data analyzing and adjusting to the fixed factors such as parity and month calving and estimating of variance components for random effects of traits that studded. Restricted maximum likelihood (REML) method was used to estimate heritability for every phenotypic traits correlated with economical response:

$$Y_{ijkl} = \mu + P_i + B_j + R_K + e_{ijkl}$$

μ: overall mean

P_i : effect of parity (1st and 2nd)

B_j :effect of calving month (January, February and March)

R_K : effect of sire

e_{ijkl} : is a random error.

The herd arranged according to every trait and the selection done as:

1. Selection according to the Phenotypic value of total milk production (PVTMP: selection of 90% from cows to study the direct effect on PVTMP which correlated with phenotypic value of lactation period (PVLP) and Economic value (EV) and selection 80% and 70% to study the direct effect of PVTMP correlated with PVLP and EV.

2. Selection according to the Phenotypic value of PVLP to the direct and correlated effect mentioned above.

3. Selection according to the Phenotypic value of EV to the direct and correlated effect mentioned above.

Table 1: Least square Mean to PVTMY (kg), PVLP (day) and EV (dinar) by adopting an selection criterion for TMY.

Genetic response	C.V	Mean ±S.D	No.	Trait	Selection rate
-	50.98	1079.57± 2117.28	90	PVTMP	Origin herd (100%)
	27.08	181.04 ± 49.03		PVLP	
	50.98	1058641.67 ± 539786.01		EV	
37.46	44.91	2273.36 ± 1020.87	81	PVTMP	90
0.42	25.25	187.07 ± 47.23		PVLP	
12486.47	44.91	1136682.10 ± 510433.95		EV	
71.13	41.31	2413.65 ± 997.17	72	PVTMP	80
0.83	23.93	192.89 ± 46.17		PVLP	
23709.56	41.31	1206826.39 ± 498586.47		EV	
105.91	38.44	2558.59 ± 983.50	63	PVTMP	70
1.20	23.48	198.25 ± 46.55		PVLP	
35304.32	38.44	1279293.65 ± 491750.14		EV	

Table 2: Percentage of direct genetic yield (numbers in diagonal) and correlated (values outside diagonal) at different percentages of selection depending on the phenotypic value.

EV	LP	TMP	Selection rate	Traits
1.17	0.23	**1.76**	90	TMP
2.23	0.45	**3.35**	80	
3.33	0.66	**5.00**	70	
0.86	**0.29**	1.29	90	LP
1.82	**0.58**	2.73	80	
2.72	**0.83**	4.08	70	
1.17	0.23	1.76	90	EV
2.23	0.45	3.35	80	
3.33	0.23	1.76	70	

The genetic response was estimated of the three criteria of selection for TMY, LP and EV and the percentage used for each criterion (70, 80 and 90%) were estimated using the following equation:

Genetic response = (trait value mean of post selection - trait value mean of pre selection) × heritability of trait. (Al-Anbari, 2005).

The ratio of direct and indirect (correlated) genetic response was calculated according to the following equation (Al-Anbari, 2005).

$$\text{Percentage of direct and correlated genetic response} = \frac{\text{The genetic response of trait at each selection}}{\text{Overall mean}} \times 100$$

Results

Phenotypic values of total milk production - TMY (criterion 1), results represented in table 1, showed that the PVTMP were 2273.36, 2413.65 and 1558.59 kg in case of selection 90, 80 and 70% from herd respectively. The results proved increase of genetic response with increase of selection intensity. The mean of PVLP increased by decreasing selection percentage, it's about 198.25 day in case of select 70% of herd compared with 181.04 day in origin herd (no selection). Economic value (EV) increased as the selection rate decreased, the lowest value was noticed in origin herd (1058641.67 ID) while the highest value was in herd with 70% of selection rate (1279293.65 ID).

Results represented in table 2, showed that the direct genetic yield for the traits that studded increased from 1.76 to 5.00 in TMP, 0.29 to 0.83 in LP and 1.17 to 3.33 in EV (the values in diagonal). The values outside the diagonal represented to the correlated genetic response which varied from

Table 3: Least square Mean to PVTMY (kg) , PVLP (day) and EV (dinar) by adopting an selection criterion for LP.

Genetic response	C.V	Mean ±S.D	No.	Trait	Selection rate
-	50.98	2117.28 ± 1079.57	90	PVTMP	Origin herd (100%)
	27.08	181.04 ± 49.03		PVLP	
	50.98	1058641.67 ± 539786.01		EV	
27.40	48.08	2231.44 ± 1073.05	81	PVTMP	90
0.54	24.02	188.82 ± 45.36		PVLP	
9132.40	48.08	1115719.14 ± 536525.50		EV	
57.89	45.30	2358.49 ± 1068.42	72	PVTMP	80
1.06	21.77	196.13 ± 42.70		PVLP	
19276.77	45.30	1179246.53 ± 534212.43		EV	
86.55	43.32	2477.91 ± 1073.43	63	PVTMP	70
1.52	20.46	202.82 ± 41.50		PVLP	
28850.35	43.31	1238956.35 ± 536712.89		EV	

1.29 to 4.08 in TMP, 0.23 to 0.66 in LP and 1.17 to 3.33 in EV.

The means of PVTMP, PVLP and EV depending on LP criterion with different of selection intensities were differed positively as an indicator for a positive genetic response for selection (Table 3). The mean of PVTMP raised from 2117.28 kg in origin herd to reach 2477.91 kg in 70% of selection rate. The PLVP raised in the same direction from 181.04 day in origin herd to 202.82 day in 70% of selection rate. Economic value increased as the selection intensity increased, its became 1238956.35 ID in 70% of selection rate compared with 1058641.67 ID in the origin herd.

Genetic response increased as a result from selection for the three traits and became 86.55, 1.52 and 28850.35 in 70% of selection rate compared with 27.40, 0.54 and 9132.40 respectively in the origin herd.

Least square means of PVTMY, PVLP and EV which summarized in table 4, showed a considered increase in these traits values with the increase of selection intensity when the criterion is economic value. The mean of PVTMP increased from 2117.28 kg in the origin herd to 2558.59 kg in 70% 0f selection rate and the PVLP increased from 181.04 day to 198.25 day while the economic value increased from 1058641.67 ID to 1279293.65 ID in the same direction.

The genetic response increased positively as the selection rate decrease and became 105.91, 1.20 and 35304.32 for the three traits respectively in 70% of selection rate. The estimates of heritability for TMY, LP and EV were 0.24, 0.07 and 0.16 (heritability of the EV derived from the rate heritability of TMY and LP), respectively.

Table 4: Least square Mean of PVTMY (kg) , PVLP (day) and EV (dinar) by adopting an selection criterion for EV.

Genetic response	C.V	Mean ±S.D	No.	Trait	Selection rate
-	50.98	2117.28 ± 1079.57	90	PVTMP	Origin herd (100%)
	27.08	181.04 ± 49.03		PVLP	
	50.98	1058641.67 ± 539786.01		EV	
37.46	44.91	2273.36 ± 1020.87	81	PVTMP	90
0.42	25.25	187.07 ± 47.23		PVLP	
12486.47	44.91	1136682.10 ± 510433.95		EV	
71.13	41.31	2413.65 ± 997.17	72	PVTMP	80
0.83	23.93	192.89 ± 46.17		PVLP	
23709.56	41.31	1206826.39 ± 498586.47		EV	
105.91	38.44	2558.59 ± 983.50	63	PVTMP	70
1.20	23.48	198.25 ± 46.55		PVLP	
35304.32	38.44	1279293.65 ± 491750.14		EV	

Discussion

The results of current study are accordance with the results of AL-Anbari, (2005) who revealed that the increase of selection intensity in Holstein cows for milk yield traits lead to increase the genetic response. Earlier studies revealed that the genetic selection is an effective tool for increasing population mean through increasing the allele frequency for desired genes through generations (Falconer, 1990). In many cases when we intend to improve one traits by select the good genotype, another trait will improved too because of positive correlation therefore we must interest of the relationship among traits which are not independent. The real problem which hamper the genetic improvement by increasing selection intensity is the size of herd or imitations of annual culling rate (Weigel and Lin, 2000) and many studies reported that the fixing of the number of selected animals is incorrect legislation in breeding programs and usually lead to reduce the genetic progress in quantitative traits (Meuwissen and Woolliams, 1994).

Selection intensity is correlated strongly with the genetic progress therefore, the choosing of animals group with the desirable traits will be drive genetic progress, the results of current study are harmonic with the assumptions of Beilharz *et al*., (1993), Fogarty *et al*., (1994) and Sakul *et al*., (1994) who reported that the genetic response of economic traits increased by increasing the intensity of selection and increase the economic response. Results revealed a positive correlation between economic value and total milk yield and also a positive genetic response dependant on direct selection, similar with those of AL-Azzawi, (2018).

Genetic correlation among the traits involved in selection program must be taken in to consideration because the estimations of economic values without taking these correlations in to account, the breeding value will often biased (Henderson, 1975; Schaeffer *et al*., 1998; Lassen *et al*., 2007). Many studies referred that the most common problems of genetic selection in dairy cattle is related to the intensive of selection for many generations therefore, the suitable rate that achieve the highest genetic response can be considered as the foundation stone of successful genetic improving (Daetwyler *et al*., 2007; Hayes and Goddard, 2010; Koster *et al*., 2013).

Kiplagat *et al*., (2011) reported that the phenotype expression of milk traits is controlled by multiple genes and the frequency of these genes are altered by selection rate therefore, the difference of values resulted from presence or absence of limited alleles.

Conclusion

In conclusion, the selection intensity is one of many important factors such as selection accuracy, generation interval and genetic variance which affected on genetic response and the well knowing about these factors is very important to develop the selection strategies and progress correctly and confidently in breeding programs to reach to the best results in optimal time.

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