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PREDICTION OF GENETIC RESPONSE AT DIFFERENT RANGES OF SELECTION INTENSITY IN SAANEN GOATS BRED IN IRAQ

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Abstract:

The study was conducted at the private Rasan Agricultural Station for the breeding of Saanen goats in Shahid Halabja Governorate, located east of Sulaymaniyah Governorate in the Kurdistan Region of Iraq. The research included 265 records belonging to 74 does from the station records for the seasons 2021 and 2022, as the station was established in 2020 by importing 500 heads of the Saanen goats from the Netherlands, with the aim of estimating the direct and correlated genetic gain at different ranges of selection intensity (70 and 50%) depending on Phenotypic values of total milk yield and pre-weaning average daily gain and economic value resulting from them. The percentage of direct genetic gain for total milk yield was 3.79 and 5.83% and for the pre-weaning average daily gain 3.44 and 5.44% and for the economic value calculated from them 0.41 and 1.18% at the selection rate of 70 and 50%, respectively, the study showed that the lower the percentage of selected individuals, the greater the intensity of selection and the greater the selection differential, and thus the direct and correlated genetic gain of does increase

Keywords:

INTRODUCTION

The goat *(Capra hircus*) is a small ruminant animal that has the ability to adapt to different environmental conditions (Ekkeh et al., 2018; Baper and Hermiz, 2019; Kiura et al., 2020), and is raised primarily for milk and meat and in the second place for hair (Juma and Alkass, 2005; Abdel-Lattif, 2017; Jassim and Al-Azzawi, 2022). Goats are distinguished from farm animals by being simple in their feeding and management requirements, high feed conversion efficiency, early sexual maturity, long productive life, ability to exploit pastures, and their intake of fodder that they do not eat the rest of the animals and its price is cheap relative to sheep (Abdullah et al., 2013; Salim, 2016), as well as its high milk productivity compared to sheep and the birth of twins (Al-Azzawi et al., 2015; Fattal and Elnajjar, 2016; Al-Khazraji et al., 2020a) in addition to that it ate low-value fodder Food containing high levels of cellulose (Akdag et al., 2011; Al awiy et al., 2020).

Improving economic traits (productive) in goats can be established through improved management, feeding regimes as well as genetic improvement and selection of genetically superior animals (Hermiz et al., 2004). Genetic selection is a means of genetic improvement through which the breeder can change the herd average for a trait by increasing the frequency of desirable genes (changing the herd average) and reducing the frequency of undesirable genes (Falconer, 1990). The appropriate exclusion rate and continuous genetic selection are among the most important tools to improve economic traits in farm animals (Al Khazraji et al., 2020b). Breeders aim to improve their animals genetically to increase the economic gain, This can be achieved by organizing pedigree records and examining the performance of animals (phenotypic value) (Kinghorn, 1997). The efficiency of genetic improvement depends largely on the genetic equivalent (heritability) of the trait to be improved and its genetic relationship with important economic traits (Hermiz and Baper, 2019). The genetic gain is defined as the average phenotypic value between the offspring of the elected parents and the average value of the generation of the parents before the selection, it is based on the fact that the average value of the elected parents is higher than the general average for all the parents which is called the selection differential, the breeder aims to increase the selection differential to increase the genetic gain and this is achieved by increasing the intensity of selection (Al-Anbari, 2005). Goats did not receive support and care from scientific and research institutions in Iraq, except for some simple attempts and in spaced periods. Therefore,

this study aims to estimate the direct and correlated genetic gain at different ranges of selection intensity (70 and 50%) depending on the phenotypic values of total milk yield and pre-weaning average daily gain and economic value the resulting from them.

MATERIALS AND METHODS

The study was conducted at the private Rasan Agricultural Station for the breeding of Saanen goats in Halabja Governorate, located east of Sulaymaniyah Governorate in the Kurdistan Region of Iraq. The research included 268 records belonging to 74 does from the station's records for the seasons 2021 and 2022, as the station was established in 2020 by importing 500 heads of the Saanen goats from the Netherlands.

HERD MANAGEMENT

Animals are raised in intensive and closed barns dedicated to housing goats, and the herd is managed automatically according to a program that includes feeding, preparation for the copulation season, preparation for pregnancy and parturition, in addition to health and veterinary care. The quantity and quality of feed varies according to sex and age. The does are provided with concentrated fodder and coarse fodder depending on the reproduction season, pregnancy, lactation and milking. The amount of concentrated fodder and coarse fodder increases at the end of pregnancy and lactation. As for feeding the newborns, they are left with their mothers to breastfeed, and at the age of two weeks they begin to eat green fodder and concentrated fodder at a rate of 110 g/day. After weaning, up to 9 months, they are given concentrated and coarse fodder freely. The copulation season at the station began in mid-February and ended in mid-April in the year 2021 and from mid-October and ended in mid-December in the year 2022. The placement program is used and records the date of copulation, the number of the does, and the number of the copulated buck. The herd is divided into groups and the buck is entered into each group, then the buck is isolated with the does that have copulated it in boxes for 24 hours. At the end of the copulation season, a buck is used to make sure that all the does are copulated, after which the pregnant does are isolated in the barns of the pregnant does until the end of pregnancy.

Studied Data

The records of does and their kids were used for the seasons 2021 and 2022 for the characteristics of total milk yield and pre-weaning average daily gain. The economic value Iraqi dinars resulting from these two characteristics was calculated according to the following equation :

Economic value = (total milk yield x 1400 dinars) + (pre-weaning average daily gain /gm x 5.5 dinars)

Based on the adoption of the price of one liter of milk 1400 Iraqi dinars and the price of a kilogram of pre-weaning average daily gain at a price of 5500 Iraqi dinars.

Statistical Analysis

The general linear model (GLM) method was used within the statistical program SAS (2012) in analyzing the data and adjusting for the fixed factors (sex of kids, type of birth, month of birth, year of birth) and the variance components of the random effects were estimated using the Restricted Maximum Likelihood method (REML) and through it Genetic equivalent (heritability) was estimated using the half-sibling method.

Selection Criteria

(The first criterion) : the phenotypic value for total milk yield (PVTMY) and for the following selection options :

A- Electing 70% of the does to study the direct effect on PVTMY and the correlated effect on the phenotypic value for pre-weaning average daily gain (PVWADG) and for the phenotypic economic value calculated from total milk yield and pre-weaning average daily gain (PEV).

B- Electing 50% of the does to study the direct effect on PVTMY and the correlated effect on PVWADG and PEV.

(The second criterion) : the phenotypic value of pre-weaning average daily gain (PVWADG) and for the following selection options :

A- Electing 70% of the does to study the direct effect on PVWADG and the correlated effect on PVTMY and PEV.

B- Electing 50% of the does to study the direct effect on PVWADG and the correlated effect on PVTMY and PEV.

(The third criterion) : the economic value (PEV) of total milk yield and pre-weaning average daily gain, and for the following selection options :

A- Electing 70% of the does to study the direct effect on PEV and the correlated effect on PVTMY and PVWADG.

B- Electing 50% of the does to study the direct effect on PEV and the correlated effect on PVTMY and PVWADG.

Genetic Gain Estimation

The genetic gain or the expected response from selection was estimated for selection rates (70% and 50%) according to each of the aforementioned selection methods using the following equations :

Direct Genetic Gain Estimation

Genetic gain = the selection differential of the trait x the genetic equivalent (heritability) of the trait

The selection differential = the average value of the trait after the election - the average value of the trait before the election

Estimating Correlated Genetic Gain

The Correlated Genetic Gain was calculated using the following equation :

$CRy = i\ h_x\ h_y\ rG_{xy}\ \sigma p_y$

i : intensity of selection.

h_x : the square root of the genetic equivalent of the trait x that is directly targeted by selection.

h_y : the square root of the genetic equivalent of the trait y.

rG_{xy} : genetic correlation between traits x and y.

σp_y : is the phenotypic standard deviation of the associated trait y.

Direct and Correlated Genetic Gain Ratio

The percentage of direct and correlated genetic gain = $\frac{\text{The genetic gain of the trait at each selection ratio}}{\text{The overall mean}}$

RESULTS AND DISCUSSION

Selection Criteria

The estimates of genetic equivalent of total milk yield, pre-weaning average daily gain and economic value calculated between them were 0.52, 0.51 and 0.50, respectively. The general average of total milk yield, pre-weaning average daily gain and economic value were 361.95 kg, 163.67 gm and 507630.446 dinars, respectively.

Phenotypic values of total milk yield (The first criterion)

Total milk yield rates were 389.413 kg at 70% selection and 404.208 kg at 50% selection of the main herd, which indicates a high direct and correlated genetic gain with a low selection rate (Table 1). These values represent the expected total milk yield of the herd during the next season, since selection will allow only the superior does in the total milk yield to remain in the herd, as it will depend on them to be the mothers of the next generation.

The direct effect of the selection criterion

The results of the study showed that the direct genetic gain for the characteristic of total milk yield resulting from the selection of does, depending on the phenotypic value of the characteristic of total milk yield, increases with a decrease in the proportion of selected animals, as the direct genetic gain for the characteristic of total milk yield reached 13.73 and 21.12 kg at a selection rate of 70 and 50% on respectively from the base herd (Table 1). It appears from (Table 4) that the percentage of direct genetic gain to total milk yield increased with the increase in the percentage of excluded does 3.79 and 5.83% at the selection rates of 70 and 50%, respectively. The proportion of the selected individuals is inversely proportional to the value of the selection differential, and this means that the lower the percentage of the selected individuals, the greater the intensity of the selection and the greater the selection differential, thus increasing the genetic gain (Al-Anbari, 2005; Al-Azzawi, 2018; AL Khazraji, 2020).

The correlated effect of the selection criterion

The results of the study showed that the correlated genetic gain for the characteristic of total milk yield resulting from the selection of does, depending on the phenotypic value of the characteristic of total milk yield, increases with a decrease in the percentage of selected animals, as the correlated genetic gain for the characteristic of pre-weaning average daily gain reached 5.47 and 8.28 g at a selection rate of 70 and 50%, respectively, from the base herd, and the correlated genetic gain for the characteristic of the economic value of total milk yield and pre-weaning average daily gain reached 18554.13 and 28925.69 dinars at a selection rate of 70 and 50%, respectively, of the base herd (Table 1). This means that the lower the percentage of selected individuals, the greater the intensity of selection and the greater the selection differential, Thus the genetic gain increased (Al-Anbari, 2005; Al-Azzawi, 2018; AL Khazraji, 2020). It is inferred from these results that the selection of does depending on the phenotypic value of the characteristic of total milk yield will lead to an increase in the selection differential and thus a genetic improvement of the characteristic of pre-weaning average daily gain and economic values, as the correlated genetic gain ratios for the characteristic of pre-weaning average daily gain and economic values reached at a selection rates of 70 and 50% (3.34, 3.65, 5.06, and 5.69%) on respectively (Table 4).

Phenotypic values of pre-weaning average daily gain (The second criterion)

The pre-weaning average daily gain rates were 174.72 and 181.151 gm at the selection rates of 70 and 50%, respectively, of the base herd. We conclude from (Table 2) the high direct and correlated genetic gain with the low selection rate. These values represent the expected pre-weaning average daily gain of the herd during the next season, since selection will allow only the superior does in their birth weights to remain in the herd, as it will depend on them to be the mothers of the next generation.

The direct effect of the selection criterion

The results of the study showed that the direct genetic gain for the characteristic of pre-weaning average daily gain resulting from the selection of does, depending on the phenotypic value of the characteristic of pre-weaning average daily gain, increases with a decrease in the percentage of selected animals, as the direct genetic gain for the characteristic of pre-weaning average daily gain reached 5.63 and 8.91 gm at a selection rate of 70 and 50% on

respectively from the baseline herd (Table 2). It appears from (Table 4) that the percentage of direct genetic gain for pre-weaning average daily gain increased with an increase in the percentage of excluded does, 3.44 and 5.44% at the selection rates of 70 and 50%, respectively.

The correlated effect of the selection criterion

The results of the study showed that the correlated genetic gain for the characteristic of pre-weaning average daily gain resulting from the selection of does, depending on the phenotypic value of the characteristic of pre-weaning average daily gain, increases with a decrease in the percentage of selected animals, as the correlated genetic gain for the characteristic of total milk yield reached 11.65 and 17.87 kg at a selection rate of 70 and 50% on respectively from the base herd, and the correlated genetic gain for the characteristic of the economic value of total milk yield and pre-weaning average daily gain was 17041.35 and 25771.80 dinars at a selection rate of 70 and 50%, respectively, of the base herd (Table 2). These results indicate the selection of does depending on the phenotypic value of the trait of pre-weaning average daily gain will lead to an increase in the selection differential and thus a genetic improvement of the characteristic of total milk yield and economic values, as the correlated genetic gain ratios for the characteristic of pre-weaning average daily gain and economic values reached at a selection rates of 70 and 50% (3.21, 3.35, 4.93 and 5.07%) on respectively (Table 4).

The economic value of total milk yield and pre-weaning average daily gain (the third criterion)

The rates of economic values for total milk yield and pre-weaning average daily gain amounted to 511867.085 dinars at a selection rate of 70% and 519611.239 dinars at a selection rate of 50% of the main herd. We conclude from (Table 3) the high direct and correlated genetic gain with a decrease in the selection rate.

The direct effect of the selection criterion

The direct genetic gain for the economic value of total milk yield and pre-weaning average daily gain reached 2118.31 and 5990.39 dinars at a selection rate of 70 and 50%, respectively, of the base herd (Table 3). It appears from (Table 4) that the percentage of direct genetic gain to the economic value of total milk yield and pre-weaning average daily gain increased with an increase in the percentage of excluded does by 0.41 and 1.18% at selection rates of 70 and 50%, respectively.

The correlated effect of the selection criterion

The results of the study showed that the correlated genetic gain for the characteristic of the economic value of total milk yield and pre-weaning average daily gain resulting from the selection of does, depending on the phenotypic value of the characteristic of the economic value of total milk yield and pre-weaning average daily gain increased with a decrease in the percentage of selected animals. 70 and 50%, respectively, of the base herd (Table 3). These results indicate that the selection of does based on the phenotypic value of the characteristic of the economic value of total milk yield and pre-weaning average daily gain will lead to an increase in the selection differential and thus a genetic improvement of the characteristic of total milk yield and pre-weaning average daily gain (Table 4). We conclude from the study, the lower the proportion of selected individuals, the greater the intensity of selection and the greater the selection differential, and thus the greater the direct and correlated genetic gain for the does, The high genetic correlations of does between total milk yield and pre-weaning average daily gain means that selection for any of these traits leads to an increase in the direct and correlated genetic gain of other traits.

Table (1) averages of total milk yield (PVTMY), pre-weaning average daily gain (PVWADG), economic value of total milk yield and pre-weaning average daily gain (PEV) by adopting an election criterion for total milk yield.

Selected (%) percentage	Trait	No. of does	Mean ± SD	Genetic gain
%100	**PVTMY**	74	**361.95 ± 56.654**	
	PVWADG		163.679 ± 33.996	
	PEV		507630.446 ± 79437.931	
%70	**PVTMY**	52	**389.413 ± 30.547**	**13.73**
	PVWADG		174.408 ± 14.988	5.47
	PEV		544738.714 ± 42827.122	18554.13
50%	**PVTMY**	37	**404.208 ± 22.449**	**21.12**
	PVWADG		179.93 ± 13.747	8.28
	PEV		565481.842 ± 31470.177	28925.69

Table (2) averages of total milk yield (PVTMY), pre-weaning average daily gain (PVWADG), the economic value of total milk yield and pre-weaning average daily gain (PEV) by adopting an election criterion for pre-weaning average daily gain.

Selected (%) percentage	Trait	No. of does	Mean ± SD	Genetic gain
%100	PVTMY	74	361.95 ± 56.654	

	PVWADG		**163.679 ± 33.996**	
	PEV		507630.446 ± 79437.931	
%70	PVTMY	52	385.251 ± 32.903	11.65
	PVWADG		**174.72 ± 14.558**	**5.63**
	PEV		541713.152 ± 46126.472	17041.4
50%	PVTMY	37	397.698 ± 25.453	17.87
	PVWADG		**181.151 ± 12.210**	**8.91**
	PEV		559174.051 ± 35682.883	25771.8

Table (3) averages of total milk yield (PVTMY), pre-weaning average daily gain (PVWADG), economic value of total milk yield and pre-weaning average daily gain (PEV) by adopting an election criterion for the economic value of total milk yield and pre-weaning average daily gain.

Selected (%) percentage	Trait	No. of does	Mean ± SD	Genetic gain
%100	PVTMY	74	361.95 ± 56.654	
	PVWADG		163.679 ± 33.996	
	PEV		**507630.446 ± 79437.931**	
%70	PVTMY	52	365.971 ± 48.152	2.01
	PVWADG		164.821 ± 19.646	0.58
	PEV		**511867.085 ± 67511.871**	**2118.31**
50%	PVTMY	37	371.493 ± 41.798	4.77
	PVWADG		167.346 ± 18.290	1.87
	PEV		**519611.239 ± 58605.283**	**5990.39**

Table (4) Percentages of direct genetic gain (values on the axis) and correlated (values outside the axis) of does at selection based on phenotypic values of total milk yield, pre-weaning average daily gain, economic value of total milk yield and pre-weaning.

Trait	Selected percentage (%)	PVTMY	PVWADG	PEV
PVTMY	70	**3.79**	3.34	3.65
	50	**5.83**	5.06	5.69
PVWADG	70	3.21	**3.44**	3.35
	50	4.93	**5.44**	5.07
PEV	70	0.55	0.35	**0.41**
	50	1.31	1.14	**1.18**

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