Effect of Different Ranges of Selection Intensity to Compare the Expected Response According to Different Selection Methods in Saanen Goats

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ABSTRACT

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. The station was established in 2020 by importing 500 heads of the Saanen goats from the Netherlands, with the aim of estimating the direct genetic gain and the response associated with selection at different ranges of selection intensity (70 and 50%) and comparing them according to Different selection methods depending on the phenotypic values of total milk yield, birth weight and the economic value resulting from them, as well as the total milk yield and pre-weaning average daily gain and the economic value calculated from them. The direct genetic gain ratios for does and bucks were 3.79, 5.83 and 4.75, 6.68%, depending on total milk yield, 2.86, 4.71 and 3.48, 5.34% depending on birth weight, 3.65, 5.69 and 4.61, 6.54% depending on economic value calculated from them at a selection rate of 70 and 50%, respectively. The direct genetic gain ratios for does and bucks were 3.44, 5.44 and 3.68, 6.43% depending on the pre-weaning average daily gain 0.41, 1.1 8 and 0.97, 1.80% depending on Total milk yield and pre-weaning average daily gain at a selection rate of 70 and 50%, respectively, The values of family selection efficiency for total milk yield, birth weight and pre-weaning average daily gain were 0.204, 0.190 and 0.201, respectively. The study showed the superiority of bucks over does by the direct genetic gain and the response associated with selection, the resultant depending on the phenotypic value of the characteristic of total milk yield, birth weight and the economic value resulting from them, as well as the phenotypic value of the characteristic of total milk yield, the pre-weaning average daily gain and the economic value resulting from them, in addition to that individual selection (does) is better of familial selection (bucks) in this study.

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 genetic gain and the response associated with selection at different ranges of selection intensity (70 and 50%) and compare them according to different selection methods depending on the phenotypic values of total milk yield, birth weight, economic value resulting from total milk yield and birth weight, pre-weaning average daily gain and economic value resulting from total milk yield and pre-weaning average daily gain.

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 birth weight. The economic gain was calculated in Iraqi dinars resulting from these two characteristics according to the following equation :

Economic gain = (total milk yield x 1400 dinars) + (birth weight x 0.00)

The economic gain was also calculated between total milk yield and pre-weaning average daily gain from the following equation :

Economic gain = (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 kilogram of milk 1400 Iraqi dinars and the price of a kilogram of weight gain at the price of 5500 Iraqi dinars.

Selection methods

1-Individual Selection (election of does)

The number of individuals (does) reached (74) individuals, as selection rates of 70 and 50% were adopted to calculate the direct genetic gain and the response associated with selection, based on the performance or averages of the productive performance of the individuals according to the following selection criteria :

Specific selection criteria for does (individual selection) to study the direct genetic gain of total milk yield and the response associated with selection to birth weight trait.

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

A- Electing 70% of the does to study the direct effect on PVTMY and the response associated with selection for the traits PVBWT, EVTMYBWT.

B- Electing 50% of the does to study the direct effect on PVTMY and the response associated with selection for the traits PVBWT, EVTMYBWT.

(The second criterion) : the phenotypic value for birth weight and for the following selection options :

A- Electing 70% of the does to study the direct effect on PVBWT and the response associated with selection for the traits PVTMY, EVTMYBWT.

B- Electing 50% of the does to study the direct effect on PVBWT and the response associated with selection for the traits PVTMY, EVTMYBWT.

(The third criterion) : the economic value resulting from total milk yield and birth weight and for the following selection options :

A- Electing 70% of the does to study the direct effect on EVTMYBWT and the response associated with selection for the traits PVTMY, PVBWT.

B- Electing 50% of the does to study the direct effect on EVTMYBWT and the response associated with selection for the traits PVTMY, PVBWT.

Specific selection criteria for does (individual selection) to study the direct genetic gain of total milk yield and the response associated with selection to pre-weaning average daily gain trait.

(The first criterion) : the phenotypic value for total milk yield and for the following selection options
A- Electing 70% of the does to study the direct effect on :
PVTMY and the response associated with selection for the traits PVWADG, EVTMYWADG.
B- Electing 50% of the does to study the direct effect on PVTMY and the response associated with selection for the traits PVWADG, EVTMYWADG.
(The second criterion) : the phenotypic value for pre-weaning average daily gain and for the following selection options :
A- Electing 70% of the does to study the direct effect on PVWADG and the response associated with selection for the traits PVTMY, EVTMYWADG.
B- Electing 50% of the does to study the direct effect on PVWADG and the response associated with selection for the traits PVTMY, EVTMYWADG.
(The third criterion) : the economic value resulting from 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 EVTMYWADG and the response associated with selection for the traits PVTMY, PVWADG.
B- Electing 50% of the does to study the direct effect on EVTMYWADG and the response associated with selection for the traits PVTMY, PVWADG.

2-Family Selection (election of bucks)

The number of families reached (8) and the size of these families ranged from 11 to 20 as selection rates of 70 and 50% were adopted to calculate the direct genetic gain and the response associated with selection, based on the performance or averages of the family's productive performance according to the following selection criteria :

Specific selection criteria for bucks (family selection) to study the direct genetic gain of total milk yield and the response associated with selection to birth weight trait.

(The first criterion) : the phenotypic value for total milk yield and for the following selection options :
A- Electing 70% of the bucks to study the direct effect on PVTMY and the response associated with selection for the traits PVBWT, EVTMYBWT.
B- Electing 50% of the bucks to study the direct effect on PVTMY and the response associated with selection for the traits PVBWT, EVTMYBWT.
(The second criterion) : the phenotypic value for birth weight and for the following selection options :
A- Electing 70% of the bucks to study the direct effect on PVBWT and the response associated with selection for the traits PVTMY, EVTMYBWT.
B- Electing 50% of the bucks to study the direct effect on PVBWT and the response associated with selection for the traits PVTMY, EVTMYBWT.
(The third criterion) : the economic value resulting from total milk yield and birth weight and for the following selection options :
A- Electing 70% of the bucks to study the direct effect on EVTMYBWT and the response associated with selection for the traits PVTMY, PVBWT.
B- Electing 50% of the bucks to study the direct effect on EVTMYBWT and the response associated with selection for the traits PVTMY, PVBWT.

Specific selection criteria for bucks (family selection) to study the direct genetic gain of total milk yield and the response associated with selection to pre-weaning average daily gain trait.

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

A- Electing 70% of bucks to study the direct effect on PVTMY and the response associated with selection for the traits PVWADG, EVTMYWADG.

B- Electing 50% of bucks to study the direct effect on PVTMY and the response associated with selection for the traits PVWADG, EVTMYWADG.

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

A- Electing 70% of bucks to study the direct effect on PVWADG and the response associated with selection for the traits PVTMY, EVTMYWADG.

B- Electing 50% of bucks to study the direct effect on PVWADG and the response associated with selection for the traits PVTMY, EVTMYWADG.

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

A- Electing 70% of bucks to study the direct effect on EVTMYWADG and the response associated with selection for the traits PVTMY, PVWADG.

B- Electing 50% of bucks to study the direct effect on EVTMYWADG and the response associated with selection for the traits PVTMY, 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 :

Estimation expected genetic gain / direct

The expected genetic yield was calculated using the following equation :

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 the response associated with the selection

The response associated with selection 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.

The proportion of direct genetic gain and the response associated with selection

The direct genetic gain and the response associated with selection were calculated using the following equation :

Direct genetic gain ratio and associated response to selection

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

Calculating the Efficiency of Family Selection Compared to Individual (Phenotypic) Selection

It is calculated according to the following equation:

$$= 1+(n-1)\times rG\ /\sqrt{(n[1+(n-1)\times t]}$$

Where t represents the following :

$t = rG \times h^2 + c$

n : family size.

rG : the degree of kinship between family members.

t : internal correlation coefficient.

r : the relationship between family members.

h^2 : the genetic equivalent (heritability) of the trait.

c : Zero environmental impacts of animals being raised in one environment.

Results and Discussion

Comparison Between Family Selection and Individual Selection Based on Total Milk yield and Birth Weight

The results of the study showed (Table 1) the superiority of family selection over individual selection by the direct genetic gain to total milk yield and the response associated with selection for the trait of birth weight and the result is based on the phenotypic value and genetic merit of the trait of total milk yield, birth weight and the economic value resulting from total milk yield and birth weight, as it reached The rates of direct genetic gain for the total milk yield trait are 4.75 and 6.68% for family selection and for individual selection 3.79 and 5.83% at a selection rate of 70 and 50%, respectively, and so on for the trait of birth weight and the economic value resulting from total milk yield and birth weight, it is noted that the direct genetic gain rates of family selection are higher compared to individual selection. In family selection, we need fewer male fathers than females in individual selection, This means that the intensity of selection in family selection for males is higher than the intensity of selection for females in individual selection, and therefore the selection differential is higher, and thus the genetic gain increases.

Comparison Between Family Selection and Individual Selection Based on Total Milk yield and pre-weaning average daily gain

The results of the study showed (Table 2) the superiority of family selection over individual selection by the direct genetic gain to total milk yield and the response associated with selection for the trait of pre-weaning average daily gain and the result is based on the phenotypic value and genetic merit of the trait of total milk yield and pre-weaning average daily gain and the economic value resulting from total milk yield and pre-weaning average daily gain, as it reached The direct genetic gain rates for the total milk yield trait reached 4.75 and 6.68% for family selection and for individual selection, 3.79 and 5.83% at a selection rate of 70 and 50%, respectively, and so on for the pre-weaning average daily gain trait and the economic value resulting from total milk yield and pre-weaning average daily gain, It is noted that the rates of direct genetic gain for family selection are higher compared to individual selection. In family selection, we need fewer male fathers than females in individual selection, This means that the intensity of selection in family selection for males is higher than the intensity of selection for females in individual selection, and therefore the selection differential is higher, Thus Genetic gain increases.

Efficiency of Family Selection Compared to Individual Selection

It is clear from (Table 3) the results of the values of the efficiency of family selection compared to individual selection, as it reached 0.204, 0.190, 0.201 for total milk yield, birth weight and pre-weaning average daily gain, respectively, the efficiency of familial selection is lower compared to individual or phenotypic selection due to the high estimate of the genetic equivalent of 0.50-0.52, so phenotypic selection is recommended in this study.

We conclude from the study that family selection is superior to individual selection with direct genetic gain and the response associated with selection and the result is based on the phenotypic value and genetic merit for the trait of total milk yield and birth weight and the economic value resulting from them, as well as the phenotypic value and genetic merit for the trait of total milk yield and pre-weaning average daily gain and the economic value resulting from them, in addition to Individual or phenotypic selection (bucks) is better than family selection (does).

Table (1) Percentages of the direct genetic gain (on-axis values) and the response associated with selection (off-axis values) for individual selection and family selection at selection based on phenotypic values for total milk yield, birth weight and economic value resulting from them.

Types of selection		Individual Selection	Family Selection	Individual Selection	Family Selection	Individual Selection	Family Selection
Trait	Election percentage	PVTMY	PVTMY	PVBWT	PVBWT	EVTMYBWT	EVTMYBWT
PVTMY	70	**3.79**	**4.75**	3.48	4.4	3.65	4.61
	50	**5.83**	**6.68**	5.46	6.29	5.69	6.54
PVBWT	70	2.87	3.51	**2.86**	**3.48**	3	3.65
	50	4.74	5.44	**4.71**	**5.34**	4.87	5.58
EVTMYBWT	70	3.79	4.75	3.48	4.4	**3.65**	**4.61**
	50	5.83	6.68	5.46	6.29	**5.69**	**6.54**

Table (2) Percentages of the direct genetic gain (values on the axis) and the response associated with selection (values off the axis) for individual selection and family selection at selection based on phenotypic values for total milk yield, pre-weaning average daily gain and economic value resulting from them.

Types of selection		Individual Selection	Family Selection	Individual Selection	Family Selection	Individual Selection	Family Selection
Trait	Election percentage	PVTMY	PVTMY	PVWADG	PVWADG	EVTMYWADG	EVTMYWADG
PVTMY	70	**3.79**	**4.75**	3.34	4.21	3.65	4.61
	50	**5.83**	**6.68**	5.06	5.74	5.69	6.54
PVWADG	70	3.21	3.53	**3.44**	**3.68**	3.35	3.67
	50	4.93	5.67	**5.44**	**6.43**	5.07	5.95
EVTMYWADG	70	0.55	1.11	0.35	0.96	**0.41**	**0.97**
	50	1.31	1.94	1.14	1.65	**1.18**	**1.8**

Table (3) Efficiency of family selection

Trait	Relationship between family members	Genetic equivalent	Internal correlation coefficient	Efficiency of family selection
Total milk yield	0.5	0.50	0.250	0.204
Birth weight	0.5	0.52	0.260	0.190
pre-weaning average daily gain	0.5	0.51	0.255	0.201

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