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Research Paper

Selection Indices for Improvement in Body Weights in Sirohi Goats Under Field Conditions of Southern Rajasthan

Veterinary Science

KEYWORDS : Body weights, Selection Indices, Sirohi kids, Southern Rajasthan.

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ABSTRACT

In the present investigation, body weights at birth, 3, 6, 9 and 12 months of age, of 3465 kids of Sirohi breed born from 1447 does and 59 bucks spreading over a period of seven years (2006-2012) andmaintained under AICRP on goatsin Nathdwara, Railmagra and Devegarh clusters of Rajasamand district, Bhadsoda cluster of Chittorgarh district and Vallabhnagar cluster of Udaipur district of Rajasthan wereanalyzed to estimate genetic and phenotypic parameters required for the development of selection indices.A total of 26 selection indices were constructed by incorporating different traits in different combinations to know which and how many traits combines best in an index based on reliability, genetic gain in aggregate genotype and maximum genetic gain in 12 months body weight.The index0.3532 (BWT) + 0.2112 (3WT) + 0.1374 (6WT) + 0.1892 (12WT) was adjudged to be the most useful due to its highest reliability (rIH= 0.4927)and maximum genetic gain in 12 months body weight.

INTRODUCTION

The aim of the present day livestock breeders is to raise animals on commercial lines which are based on the principle of maximum gain from minimum input. Animals which will bring maximum economic returns are kept while the rest unwanted low profitable stock culled at anearliest to reduce pressure on space and resources and also to increase efficiency of management. For this selection and culling, a kind of yard stick is needed to discriminate the animals likely to bring maximum economic returns from those less profitable. To develop this type of discriminating yardstick, all economically important traits are taken into account and combined according to their relative weights into a net economic score for each animal to construct selection index. The relative weight of a trait depends upon its heritability, relative economic value and association with other traits. The animals which rank best on these scales are retained and others culled for maximum returns from a livestock enterprise. Among different methods of selectionviz. index selection, tandem selection and independent culling level, index selection is the most

efficient for bringing overall improvement in the flock for maximum net economic returns (Hazel and Lush, 1942). Sirohi goat derived its name from Sirohi district of Rajasthan and is the one of the best dual-purpose goat breed of Rajasthan. Growth is an early expressed trait and has a direct bearing on the age at maturity, which is correlated with lifetime production and reproduction. In present study selection indices were constructed for improvement in body weights of Sirohi goats.

MATERIALS AND METHODS

Information source for present investigation was the Sirohi farmer's flocks maintained under ICAR sponsored All India Coordinated Research Project (AICRP) on Sirohi goats, Livestock Research Station, Udaipur (Rajasthan). The project area comprised of Nathdwara, Railmagra and Devegarh clusters of Rajasamand district, Bhadsoda cluster of Chittorgarh district and Vallabhnagar cluster of Udaipur district. The data was collected from 3465 Sirohi kids born from 1447 does and 59 bucks, over a period of seven years (2006-2012) on body weights at birth, 3, 6, 9 and 12 months of age. Since the subclass numbers were unequal and disproportionate, Least squares analysis (Harvey, 1990) was carried out to estimate the genetic and phenotypic parameters. Relative economic value (a) was estimated by simple regression method. Twelve months body weight was taken as dependent variable and change in 12 months body weight by unit change in birth, 3, 6 and 9 months body weight was worked out. Relative economic values for body weights at birth, 3, 6, 9 and 12 months of age were estimated as 0.2248, 0.4601, 0.658, 0.8271 and 1, respectively.

Selection index were constructed as per Hazel`s (1943) procedure. The aggregate genetic value (H) of an individual defined as follows: $H = a_1G_1 + a_2 G_2 +.....+ a_nG_n$

In matrix notation $H = a' G$

Where,

H= Aggregate genetic or breeding value,

a'= Row vector of economic values of traits,

G= Column vector of additive genetic values of traits included in the aggregate genotype.

Since H is not directly observable characteristic hence improvement in H is then brought about by selection on an index:

I = b' X Where,
I = Net score of an individual,
b' = Row vector of unknown regression coefficients (weighing factor) maximizing the correlation between index and aggregate breeding value,
X = Column vector of phenotypic values for traits included in the index.

The weighting factors (b) in index was obtained by solving the equation

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[P] b = [G] a

$b = [P]^{-1} [G] a$

Where,

[P] = Phenotypic variance-covariance matrix of the traits included in the index,

[G] = Genotypic variance-covariance matrix for traits on which information is used for the index,

a = Vector of relative economic values of traits.

Reliability of the index

The reliability of the index was measured by multiple correlation between the index and aggregate genotype:

rHI = Cov(HI) / (σH x σI)

where,

σ 2I = b' [P] b = Variance of the index,
σ2H = a' [G] a = Variance of the aggregate genotype,
σH I = b' [G] a = Covariance of the index and aggregate genotype.

Expected genetic gain

The aggregate gain achieved through use of index (es) constructed was computed as follows:

$$\Delta H = b_{HI} (IS - I\mu)$$
$$= b_{HI}.i .\sigma I$$
$$= r_{HI} .i .\sigma H$$

Where,

ΔH = Genetic gain in aggregate breeding value,
bHI = Regression of I on H

$(IS - I\mu)$ = Selection differential computed as difference between mean index values of the selected individuals and the population,

i =Selection intensity computed as z / p where p is the proportion of individuals selected and z is the height of the ordinate at the point of truncation,

σH, σI= Standard deviation of the aggregate breeding value and index value

respectively.

Genetic gain in the component traits of index were calculated as follow:

$$\partial = [G] b (i / \sigma I)$$

Where,

∂= Column vector of genetic gain corresponding to each trait of the index,
[G] = Genetic variance-covariance matrix,
b = Vector of weighting factors.

RESULTS AND DISCUSSION

A total of 26 selection indices were constructed by combining birth, 3, 6, 9 and 12 months body weights in different combinations. There were 10 indices with two traits, 10 indices with three traits and 5 indices with four traits besides one index which had all the five traits. Genotypic and phenotypic variances and covariances utilized for the construction of selection indices are presented in Appendix I and AppendixII,respectively.

Appendix I - Estimates of Genetic variance and covariance among body weight at different ages in Sirohi goats

Trait*	BWT	3 WT	6 WT	9 WT	12 WT
BWT	0.0166	0.0354	0.0554	0.0567	0.0885
3 WT		0.5602	0.6618	0.6840	0.785
6 WT			1.0265	1.0966	1.1012
9 WT				1.3539	1.3141
12 WT					1.5927

*BWT, 3WT, 6WT, 9WT and 12 WT are the body weight at birth, 3, 6, 9 and 12 months of ages, respectively

Appendix II- Estimates of phenotypic variance and covariance among body weight at different ages in Sirohi goats

Trait*	BWT	3 WT	6 WT	9 WT	12 WT
BWT	0.1164				
3 WT	0.1719	3.0578			
6 WT	0.1840	2.6210	5.3780		
9 WT	0.1938	2.4090	4.5677	7.5378	
12 WT	0.2234	2.2170	3.8899	6.1856	8.5448

*Same as Appendix I

On comparing of the variance of different indices ($\sigma^2 I$), it is revealed that index constructed by incorporating all 5 traits had maximum variance (2.2937), while it was minimum (0.0233) for index constructed by using birth weight and 3 months body weight. It is inferred that the variance of index increases with increase in number of traits. Secondly, the indices with traits expressed at early ages had lower index variance than those composed of late expressed traits. Similar trend was observed in the genetic variances(σ2H) of the indices.

The measure of the accuracy of a selection index is its correlation with the aggregate breeding value (rIH). The genetic response to selection is in proportion to this correlation (rIH). The correlation between H and I ranged from 0.4288 (I3) to 0.4927 (I22). On the basis of correlation between H and I, index I7 (rIH= 0.4807) based on 3 and 12 months body weights among two traits selection indices; index I18 (rIH=0.4901) based on 3, 6 and 12 months body weights among three traits selection indices and index I22 (rIH= 0.4927) based on birth, 3, 6 and 12 months body weights among all indices observed as most accurate. A careful appraisal of table 1 revealed that the addition of nine months weight in indices, while keeping number of other traits constant, resulted in low accuracy. Secondly the indices incorporating 12 months body weight were more accurate in comparison to others indices having same numbers of traits.

The genetic gain in aggregate genotype (ΔH) ranged from 0.2138 (I1) to 2.1203 (I26). Table 1 revealed that the index constructed using late expressed traits resulted in higher genetic gain in comparison to those incorporating early expressed traits. The index I10 (ΔH= 1.3429) constructed by incorporating 9 and 12 months body weights among two traits selection indices; index

I20 (ΔH=1.8369) constructed by incorporating 6, 9 and 12 months body weights among three traits selection indices, I25 (ΔH= 2.1029) constructed by incorporating 3, 6, 9 and 12 months body weights among four traits selection indices and I26 (ΔH= 2.1203) constructed by incorporating all body weight traits under study among all the indices observed as most efficient in terms of genetic gain in aggregate genotype.

Table 1: Regression coefficient (b values), index variance ($\sigma^2 I$), aggregate genetic variance ($\sigma^2 H$), correlation between H and I (r_{IH}) and genetic gain in aggregate genotype (ΔH)

Index no.	b value					σ^2_I	σ^2_H	r_{IH}	ΔH
	BWT	3WT	6WT	9WT	12WT				
1	0.0476	0.0842	-	-	-	0.0233	0.1268	0.4290	0.2138
2	0.1512	-	0.1227	-	-	0.0905	0.4617	0.4428	0.4212
3	0.1931	-	-	0.1453	-	0.1743	0.9481	0.4288	0.5845
4	0.4529	-	-	-	0.1769	0.3270	1.6333	0.4474	0.8006
5	-	0.1211	0.1232	-	-	0.2047	0.9637	0.4608	0.6334
6	-	0.1595	-	0.1393	-	0.3312	1.5654	0.4600	0.8058
7	-	0.2158	-	-	0.1727	0.5624	2.4336	0.4807	1.0499
8	-	-	0.1788	0.1360	-	0.5332	2.5642	0.4560	1.0223
9	-	-	0.2000	-	0.1801	0.7728	3.4863	0.4708	1.2308
10	-	-	-	0.1615	0.1967	0.9201	4.6927	0.4428	1.3429
11	0.1173	0.1168	0.1236	-	-	0.2112	0.9883	0.4622	0.6433
12	0.1128	0.1558	-	0.1393	-	0.3387	1.5946	0.4609	0.8148
13	0.3057	0.2029	-	-	0.1703	0.5826	2.4816	0.4845	1.0686
14	0.2496	-	0.1742	0.1340	-	0.5480	2.6026	0.4589	1.0364
15	0.4696	-	0.1903	-	0.1746	0.8090	3.5433	0.4778	1.2592
16	0.5751	-	-	0.1549	0.1887	0.9685	4.7544	0.4513	1.3778
17	-	0.1760	0.1441	0.1425	-	0.8006	3.6041	0.4713	1.2527
18	-	0.2259	0.1380	-	0.1920	1.1355	4.7280	0.4901	1.4918
19	-	0.2975	-	0.1007	0.2058	1.3810	6.0542	0.4776	1.6452
20	-	-	0.2835	0.0636	0.2233	1.7216	7.7799	0.4704	1.8369
21	0.1741	0.1691	0.1445	0.1416	-	0.8139	3.6498	0.4722	1.2630
22	0.3532	0.2112	0.1374	-	0.1892	1.1633	4.7923	0.4927	1.5100
23	0.3621	0.2821	-	0.1004	0.2028	1.4104	6.1233	0.4799	1.6626
24	0.5578	-	0.2714	0.0640	0.2162	1.7730	7.8580	0.4750	1.8642
25	-	0.2818	0.2010	0.0542	0.2368	2.2563	9.5422	0.4863	2.1029
26	0.4026	0.2649	0.2002	0.0543	0.2333	2.2937	9.6276	0.4881	2.1203

Note- BWT, 3WT, 6 WT, 9WT, 12 WT are the body weights at birth, 3, 6, 9 and 12 months of age, respectively.

The number of traits included in the index has a bearing on its accuracy and aggregate genetic gain. The general trend was an increase in rIHvalue and ΔH with an increase in the number of traits included in the index. This is in conformity with the reports of Sinha and Biswas (1979), Ganai (1992) and Sharma (1995). However, the increase in these values was not linear because it is the underlying genetic and phenotypic parameters of traits which determines the accuracy and efficiency of an index.

Thereis decrease in selection intensity as the number of traits under selection increases, which is detrimental to genetic progress. Progress for a single trait using index selection with n traits, based on aggregate economic value is only √n times as large as progress under exclusive selection for that trait.

Keeping these points in view, an index is needed, which is reliable (rIH), efficient (ΔH), expected to results in more response (genetic gain) in 12 months body weight(Table 2.) and at the same time based on few numbers of traits of higher economic value. The index I22 based on body weights at birth, 3, 6 and 12 months of age was adjudged as best selection index due to its maximum accuracy(rIH= 0.4927) and highest genetic gain in 12 months body weight (0.8433 kg).

Table 2: Direct and correlated response in different traits and relative genetic gain in 12 months body weight

Index no.	Response in traits (Genetic gain)					Relative genetic gain in 12 WT
	BWT	3 WT	6 WT	9 WT	12 WT	
1	0.0346	0.4479	0.5350*	0.5527*	0.6446*	76.88%
2	0.0433	0.4029*	0.6253	0.6662*	0.6912*	82.44%
3	0.0384	0.3561*	0.5701*	0.6963	0.6975*	83.19%
4	0.0567	0.3792*	0.5383*	0.6319*	0.7878	93.96%
5	0.0344*	0.4622	0.6393	0.6744*	0.7140*	85.16%
6	0.0330*	0.4492	0.6285*	0.7243	0.7500	89.46%
7	0.0428*	0.4787	0.6216*	0.6992*	0.8297	98.96%
8	0.0338*	0.4051*	0.6377	0.7287	0.7199*	85.87%
9	0.0430*	0.4360*	0.6429	0.7263*	0.8077	96.34%
10	0.0388*	0.3866*	0.5746*	0.6964	0.7670	91.48%
11	0.0394	0.4612	0.6418	0.6766*	0.7256*	86.55%
12	0.0368	0.4488	0.6306*	0.7255	0.7586*	90.48%
13	0.0501	0.4736	0.6214*	0.6970*	0.8394	100.12%
14	0.0405	0.4081*	0.6422	0.7311	0.7376*	87.98%
15	0.0526	0.4353*	0.6438	0.7234*	0.8237	98.25%
16	0.0498	0.3905*	0.5827*	0.6976	0.7896	94.18%
17	0.0349*	0.4559	0.6581	0.7374	0.7573*	90.32%
18	0.0429*	0.4843	0.6604	0.7334*	0.8345	99.53%
19	0.0410*	0.4730	0.6361*	0.7270	0.8263	98.56%
20	0.0417*	0.4336*	0.6473	0.7367	0.8017	95.62%
21	0.0387	0.4553	0.6599	0.7383	0.7657*	91.31%
22	0.0489	0.4806	0.6604	0.7318*	0.8433	**100.58%**
23	0.0467	0.4701	0.6369*	0.7262	0.8352	99.61%
24	0.0495	0.4341*	0.6496	0.7361	0.8167	97.41%
25	0.0420*	0.4789	0.6645	0.7435	0.8304	99.04%
26	0.0470	0.4764	0.6652	0.7429	0.8384	100%

Note: * =Represents the correlated response in traits not included in the index;

BWT, 3WT, 6 WT, 9WT, 12 WT are the body weights at birth, 3, 6, 9 and 12 months of age, respectively.

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REFERENCE

Ganai N A. 1992. Selection indices for genetic improvement of Marwari sheep.M.V.Sc. Thesis, R.A.U., Bikaner. | Harvey WR. 1990. User's guide for LSMLMW PC-1 Version mixed model Least Squares and MaximumLiklihood computer programme. Ohio State University, Colombus, U.S.A. | Hazel L N. 1943. The genetic basis for constructing selection indices.Genetics28: 476-490. | Hazel L N and Lush J L. 1942.The efficiency of three methods of selection.Journal of Heredity33: 393-399. | Sharma P R. 1995. Selection indices for genetic improvement of Nali sheep.M.V.Sc. Thesis, R.A.U., Bikaner. | Sinha R and Biswas D K. 1979. Selection indices for egg type chicken. The Indian Journal of Animal Genetics and Breeding1: 102-106. |