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Selection index for Deccani sheep

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Abstrat: *Selection indices (11) were constructed using different combinations of body weights at three, six and twelve months age and greasy fleece yield of first clip at six months age. The index I_6 = [1.991 W3 + (- 0.546) W6] was rated as most useful index for its high reliability (r_{IH} = 0.656) and expected aggregate genetic gain (ΔH = 2.99). The response per generation in W3, W6, W12 and GFY1 were expected to be 0.906 kg, 1.034 kg, 1.152 kg and 26.01 g, respectively.*

Key words: *Selection index, Deccani sheep*

INTRODUCTION

Mutton and wool production of sheep has to be increased by increasing genetic potential and managemental tools, to meet out ever increasing animal protein and wool products requirement of human population. Deccani sheep is known for its mutton production and coarse wool. Selection was, therefore, aimed at overall improvement in growth and production performance through the use of selection index which is the most efficient method for bringing about overall improvement in the flock for maximum net economic returns (Hazel and Lush, 1942). The index selection procedure combines the economically important traits into a net score, giving the component traits relative weightage as per their relative economic importance, heritabilities and correlations. Thus, it best discriminates the individuals on the basis of their aggregate genetic worth.

MATERIALS AND METHODS

The data on Deccani sheep evolved at Network Project on Sheep Improvement, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra spread over a period of five years (1995-99) were used. The population has been undergoing selection since 1992. The records on 524 individuals, sired by 34 rams, were analysed. The data were corrected for significant year, season and sex effects by fitting least squares constants. The rams having less than five progenies were not included in the analysis. The genetic and phenotypic variance and covariance components were estimated using LSMLW Programme PC-2 version (Harvey, 1990). Eleven selection indices were constructed using three months body weight (W3), six months body weight (W6), twelve months body weight (W12) and greasy fleece yield of first clip at six months age (GFY1) in different combinations.

The economic weight of a character is the change in net return per unit change in the character. Using this approach, the method suggested by Hogsett and Nordskog (1958) was used for calculating economic weights.

The selection indices were computed (Cunnigham,1969). Per cent reduction in the rate of genetic gain in the aggregate genotype when the variate is dropped from the index was calculated as follows.

Per cent reduction in the genetic gain in the i^{th} trait (genetic cost of restriction).

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$$100 - \sqrt{\frac{\left(b'pb - bi^2/Wii \right)}{b'pb}} \times 100$$

Where,

bi is the weighing factor for the particular trait;

Wii is the corresponding diagonal element of P inverse, and

b′pb is the variance of index

The relative efficiency of index was calculated as per Hogsett and Nordskog (1958).

$$\text{Relative efficiency} = \frac{\Delta H(I_l)}{\Delta H(I_m)}$$

Where,

I_1 is i^{th} index whose relative efficiency is estimated, and

I_m is standard index with maximum aggregate genetic – economic gain.

RESULTS AND DISCUSSION

Selection indices (11) were constructed by incorporating three months weight (W3), six months weight (W6), twelve months weight (W12) and greasy fleece yield of first clip at six months age (GFY1) in different combinations. Phenotypic and genetic variances and covariances including the relative economic values used in the construction of selection indices are given in Table 1. The weighing factors (b_{is}) and accuracy (r_{IH}) of the indices are shown in Table 2. The direct and correlated responses of the traits (ΔG_i) and aggregate genetic economic values (ΔH) are depicted in Table 3. Some

Table 1
Variances, covariances and relative economic values of different traits used in construction of selection indices

Traits	*W3*	*W6*	*W12*	*GFY1*	a_i
W3	0.2540102.45890	0.278766	0.3127628	7.105008	1.0
W6	2.97783	0.29282094.37927	0.3342910	7.703333	0.70
W12	3.22881	4.58740	0.38476615.56065	9.225897	0.40
GFY1	81.7385	116.633	138.199	208.92115286.06	0.03

Above diagonal are phenotypic covariances, below diagonal are genetic covariances, on diagonal are phenotypic and genetic variances

Table 2
Index weighing factors (b_{is}) and accuracy (r_{IH}) of the indices

Index	*Traits included*	*b values*				
		W3	*W6*	*W12*	*GFY1*	r_{IH}
I_1	(1,2,3,4)	1.940094	-0.709492	0.30772	-0.004653	0.66155
I_2	(1, 2, 3)	1.938894	-0.729372	0.209176	-	0.658712
I_3	(1, 2, 4)	2.00544	-0.489884	-	-0.002464	0.657377
I_4	(1, 3, 4)	1.560287	-	-0.039694	-0.005352	0.6462
I_5	(2, 3, 4)	-	0.314697	0.586485	-0.004539	0.538168
I_6	(1, 2)	1.991645	-0.546125	-	-	0.656436
I_7	(1, 3)	1.54661	-	-0.164757	-	0.642338
I_8	(1, 4)	1.524019	-	-	-0.005829	0.646091
I_9	(2, 3)	-	0.294684	0.49018	-	0.534846
I_{10}	(2, 4)	-	0.814239	-	-0.000228	0.518656
I_{11}	(3, 4)	-	-	0.835025	-0.004094	0.533029

Table 3
Direct and correlated responses (DGi) in individual traits

Index	ΔGi				ΔH	Relative efficiency %
	W3	W6	W12	GFY1		
I_1	0.9117	1.0386	1.1554	26.4419	3.02	100
I_2	0.9062	1.0346	1.1551	(26.2984)	3.00	99
I_3	0.9093	1.0361	(1.1513)	26.0202	3.00	99
I_4	0.9042	(1.0111)	1.1251	25.5173	2.95	97
I_5	(0.7623)	0.8081	0.9221	21.9762	2.45	81
I_6	0.9064	1.0341	(1.1520)	(26.0144)	2.99	99
I_7	0.8976	(1.0054)	1.1237	(25.3153)	2.93	97
I_8	0.9042	(1.0099)	(1.1240)	25.5452	2.94	97
I_9	(0.7560)	0.8032	0.9219	(21.8099)	2.44	80
I_{10}	(0.7462)	0.7836	(0.8943)	20.6109	2.36	78
I_{11}	(0.7477)	(0.7977)	0.9134	22.0654	2.43	80

Within parentheses are the correlated responses

Table 4
Some useful indices containing different number of trait combinations

No.of traits	Index No.	Genetic gain in component traits				ΔH	Relative Efficiency%
		W3	W6	W12	GFY1		
4	I_1	0.9117	1.0386	1.1554	26.4419	3.02	100
3	I_2	0.9062	1.0346	1.551	-	3.00	99
3	I_3	0.9093	1.036	-	26.0202	3.00	99
2	I_6	0.9064	1.0341	-	-	2.99	99

useful indices containing different number of trait combinations are given in Table 4. Genetic cost of restriction of the traits in the index is presented in Table 5.

The partial regression coefficients of different traits ("b" values) in an index are a function of their relative economic values, heritabilities and correlations with other traits. W3 received maximum weightage followed by W12, W6 and GFY1. The chief measure of the accuracy of an index is its correlation with the aggregate breeding value, r_{IH}. The genetic response to selection is proportional to this correlation. On comparing the relative measures of accuracy of all the indices, index I_1, [1.940 W3 + (- 0.709) W6 + 0.307 W12 + (- 0.004) GFY1], was observed to be the most accurate (r_{IH} = 0.66). The indices I_2, I_3 and I_6 are also observed to be the most accurate (r_{IH} = 0.65). Indices I_4, I_8 and I_7 were equal in accuracy (r_{IH} = 0.64). Others indices (r_{IH} > 55 %) in the descending order of their accuracy were I_5, I_9, I_{11} and I_{10}.

Number of traits included in the index has a bearing on its accuracy (r_{IH}) and aggregate genetic gain (ΔH). The general trend was an increase in r_{IH} value and ΔH with an increase in the number of traits included in the index. The usefulness of an index is based on its correlation with aggregate genotype (r_{IH}), the expected gain in aggregate breeding value (ΔH) and the number of traits included in the index. Indices I_1, I_2, I_3 and I_6 were superior to other indices when compared on the basis of r_{HI} and ΔH values. Index I_1, though expected to bring about maximum gain in

Table 5
Genetic cost of restriction of the traits in the indices

Index	*W3*	*W6*	*W12*	*GFY1*
I_1	18.65	2.32	0.63	0.42
I_2	18.80	2.48	0.34	-
I_3	21.10	1.71	-	0.14
I_4	17.51	-	0.01	0.59
I_5	-	0.95	3.62	0.61
I_6	20.99	2.54	-	-
I_7	17.44	-	0.40	-
I_8	38.78	-	-	0.98
I_9	-	0.85	3.02	-
I_{10}	-	23.74	-	0.00
I_{11}	-	-	25.80	0.51

aggregate breeding value (3.02) and is also reliable (r_{IH} = 0.66), is less useful because it is based on all the 4 traits, which lowers the selection intensity for each trait. Drastic reduction in r_{TI} and ΔH values was observed when W3 was dropped from the index followed by W6, W12 and GFY1. On making a comparison between the number of traits, aggregate genetic gain and reliability of the index, index I_6, [1.991 W3 + (- 0.546) W6] was adjudged to be the most useful index for its high reliability (r_{IH} = 0.656) and expected gain in aggregate breeding value (ΔH = 2.99). Using this index the response in each trait per generation was expected to be 0.906 kg for W3, 1.034 kg for W6, 1.152 kg for W12 and 26.01 g for GFY1. This observation was further confirmed from the inspection of the traits in the index (genetic cost of restriction) where W3 was the most important followed by W6 (Table 5). The genetic change in each trait associated with 1.4 standard deviation of selection was almost similar in the 4 indices, viz., I_1, I_2, I_3 and I_6. Hence, for early selection of rams, index I_6 incorporating W3 and W6 may be the best selection criteria for enhancing the overall productivity of the Deccani sheep.

Singh and Kushwaha (1995) in Bharat Merino, Kushwaha *et al*. (1996) in Chokla and Arora and Kushwaha (1998) in Malpura also reported that index combining three months body weight, six months body weight and greasy fleece yield of first clip was the best criterion of selection.

CONCLUSION

The index I_6 = [1.991 W3 + (- 0.546) W6] was rated as most useful index for its high reliability (r_{IH} = 0.656) and expected aggregate genetic gain (D H = 2.99). The response per generation in W3, W6, W12 and GFY1 were expected to be 0.906 kg, 1.034 kg, 1.152 kg and 26.01 g, respectively.

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