SELECTION INDICES FOR IMPROVING BODY WEIGHT IN NEW ZEALAND WHITE BREED OF RABBIT MAINTAINED AT THE HILLY INDIAN STATE OF MEGHALAYA*

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ABSTRACT

Selection indices were constructed utilising the body weight records of 1042 male and female New Zealand White rabbits belonging to 76 sire families that were born and maintained at the Rabbit Research Farm, Indian Council of Agricultural Research Complex for North Eastern Hill Region, Umium, Barapani, Meghalaya, distributed over a period of 16 years from 1993 to 2008. Prior to genetic analysis, data were corrected for significant effects of parity, litter size at birth, sex of the animal, season of birth and period of birth by using least squares constants. Estimates of heritability and the genetic and phenotypic correlations were obtained from sire components of variances and covariances. Relative economic weights were estimated based on the feed cost, labour cost, medicine cost and the sale price of meat and hide. A total of eleven selection indices were constructed incorporationg body weights at 42 days (X_1), 90 days (X_2), 120 days (X_3) and 180 days (X_4). The expected genetic changes in each of the individual traits (ΔX), the expected changes in aggregate genetic worth (ΔH) and the heritabilities of respective indices were also obtained. On the basis of the relative efficiency (R_{IH}) the four best indices were found to be $I_9 = 0.8551X_2 + 0.7684X_3$ (R_{IH}=0.921), $I_2 = 0.1899X_1 + 0.9123X_2 + 0.7596X_3$ (R_{IH}=0.917), $I_6 = 0.2868X_1 + 0.7631X_2$ (R_{IH}=0.872) and $I_7 = 0.2143X_1 + 0.6823X_3$ (R_{IH}=0.853), respectively. The heritabilities of these four selection indices as noted above were also found to be high, being respectively 0.859, 0.844, 0.761 and 0.731. It is thought that these four indices that were identified as the best viz., I_9, I_2, I_6 and I_7 could be used effectively both by farmers and breeders for rapid genetic improvement of rabbit in terms of growth performance.

Key words : Selection index, Relative economic weight, New Zealand White rabbits, Rabbit

INTRODUCTION

Rabbit as an alternative source of meat has a good prospect in the north eastern region of India where the population is non-vegetarian in character. also, the hilly areas in this part of the country are suitable for rabbit rearing. experience indicates that New Zealand White breed of rabbit which was introduced way back in 1989 to the hilly state of Meghalaya at the initiative of Indian Council of Agricultural Research adapts well in the state. It is now felt that this breed of rabbit needs to be improved upon under the local environment through scientific selection and breeding. This is also necessary for preventing genetic degradation in live body

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weight. Among various methods of selection, selection index is considered to be the best method. The work under report pertains to construction of selection indices for improving growth performance in New Zealand White breed of rabbit incorporating body weights at different ages.

MATERIALS AND METHODS

The data utilized in the present study pertain to a total of 1042 male and female New Zealand White rabbits belonging to 76 sire families that were born and maintained at the Rabbit Research Farm, Indian Council of Agricultural Research Complex for North Eastern Hill Region, Umium, Barapani, Meghalaya, distributed over a period of 16 years from 1993 to 2008. The animals were maintained under uniform conditions of housing, feeding, health coverage and other managemental practices. Weaning was done at 42 days of age. Prior to genetic analysis, data were corrected for significant effects of parity, litter size at birth, sex of the animal, season of birth and period of birth by using least squares constants (Harvey, 1975). Estimates of heritability and the genetic and phenotypic correlations were obtained by half-sib analysis as per Becker (1975) using paternal components. Eleven selection indices incorporating the body weight at four different ages i.e. body weight at 42 days (X_1), 90 days (X_2), 120 days (X_3) and 180 days (X_4), without imposing restriction, were developed as per the method described by Hazel (1943) and Hogsett and Nordskog (1958). The heritability of each index was calculated as per the method described by Lin and Allaire (1977). In estimating the relative economic value, the cost of feed, labour and medicines were considered as input cost, while the sale price of the animals at different ages including the cost of the hides was considered as the total sale price of the animals at these ages. The difference between the total sale price and the total input cost was considered as the profit from the animal at that age. Since in rabbit 90 days body weight is normally considered as the market age when profit is expected to be the maximum, the relative economic value of the body weight at a particular age was calculated as a ratio of profit per animal at a particular age to the profit per animal at 90 days of age.

RESULTS AND DISCUSSION

Relative economic weight age:

Literature suggests that the efficiency of index method does not suffer very much if the economic weights are not accurate (Pease *et al*., 1967). According to Kotaiah and Ranganathan (1980) the direction of the change is more important than the actual value of economic weight for each trait. Considering this, rough estimates of relative economic weights were obtained from major cost components influencing the relative economic value the most. The results pertaining to the computation of relative economic weightage is given in Table 1.

Construction of Selection Indices:

Selection indices were constructed incorporating the body weights of New Zealand White rabbits at four different ages i.e. body weight at 42 days (X_1), 90 days (X_2), 120 days (X_3) and 180 days (X_4). The genetic parameters namely the heritability estimates of these four growth traits, the phenotypic standard deviations as well as the phenotypic and genetic correlations amongst them in all possible combinations, which were used in the construction of indices, are presented in Table 2.

Table 1: The total input cost as per major cost components for body weight at different ages(day)

Body weight at	Total feed intake/animal(g)	Feed cost per animal(Rs)	Medicine cost per animal(Rs)	Labour cost per animal(Rs)	Total input cost(Rs)
42	126	1.76	0	22.68	**24.44**
90	1326	18.56	0.72	48.6	**67.88**
120	3576	50.06	1.17	64.8	**116.03**
180	10776	150.86	2.02	97.2	**250.08**

Estimates of relative economic value(R_W)

Age, d	A	B	C	D	E
42	42.64		42.64	18.20	**0.38**
90	101.34	15	116.34	48.46	**1.00**
120	145.15	15	160.15	44.12	**0.91**
180	165.75	15	180.75	-69.33	**-1.43**

A=Sale price (Rs) based on dressed meat **B**=Price of hide (Rs)/animal at sale **C**=Total sale price Rs) **D**=Profit in Rs **E**=R_W

Table 2. Parameters used in the construction of selection indices using body weight at different ages in New Zealand White breed of rabbit

Traits(body weight)	Heritability	Phenotypic standard deviation
Body weight at 42 days (X_1)	0.6087±0.1438	0.2523
Body weight at 90 days (X_2)	0.7444±0.1583	0.2766
Body weight at 120 days (X_3)	0.7453±0.1584	0.3162
Body weight at 180days (X_4)	0.5616±0.1552	0.3066
Correlation coefficients between	Phenotypic	Genetic
X_1 X_2	0.3986±0.0303	0.5271±0.1145
X_1 X_3	0.1521±0.0352	0.1472±0.1550
X_1 X_4	0.0941±0.0415	0.3058±0.1572
X_2 X_3	0.3165±0.0324	0.5017±0.1125
X_2 X_4	0.2094±0.0400	0.5654±0.1110
X_3 X_4	0.5564±0.0289	0.8297±0.0544

A total of 11 indices were developed incorporating all the four traits, every three of the four traits, as well as every two of the four traits. The constructed selection indices are presented in Table 3.

The aggregate genetic changes in each of the traits, the aggregate genetic worth and the heritabilities of the individual indices are presented in Table 4.

Table 3: Constructed selection indices using body weight at different ages showing the weight age (b) for each trait and the efficiency of the index (R_{IH}) for New Zealand White rabbit

Index no.	Values of b	R_{IH}
I_1	$0.1459065X_1 + 0.5890982X_2 + 0.18771X_3 - 0.1439061X_4$	0.709
I_2	$0.1899286X_1 + 0.9122562X_2 + 0.7595562X_3$	0.917
I_3	$0.2260974X_1 + 0.3207166X_2 - 0.4954722X_4$	0.601
I_4	$0.04531077X_1 + 0.1328221X_3 - 0.323135X_4$	0.481
I_5	$0.5184492X_2 + 0.2225778X_3 - 0.1951783X_4$	0.662
I_6	$0.2868235X_1 + 0.7630996X_2$	0.872
I_7	$0.2143229X_1 + 0.682274X_3$	0.853
I_8	$0.00609988X_1 - 0.7476515X_4$	0.729
I_9	$0.8551432X_2 + 0.7683572X_3$	0.921
I_{10}	$0.2873901X_2 - 0.5275776X_4$	0.596
I_{11}	$0.1381921X_3 - 0.3786169X_4$	0.533

Table 4: Expected genetic change in each trait (ΔX) and the aggregate genetic worth (ΔH) along with the heritability (H^2_I) for indices constructed without restriction using body weights at different ages in New Zealand White

Index no.	ΔX_1	ΔX_2	ΔX_3	ΔX_4	ΔH	h^2_I
I_1	0.100	0.197	0.136	0.114	0.196	0.712
I_2	0.085	0.194	0.210	-	0.418	0.844
I_3	0.055	0.048	-	-0.074	0.175	0.369
I_4	-0.019	-	-0.078	00.113	0.083	0.303
I_5	-	0.186	0.141	0.105	0.164	0.652
I_6	0.120	0.203	-	-	0.248	0.761
I_7	0.059	-	0.288	-	0.230	0.731
I_8	-0.044	-	-	-0.171	0.229	0.559
I_9	-	0.189	0.219	-	0.389	0.849
I_{10}	-	0.0001	-	-0.115	0.164	0.368
I_{11}	-	-	-0.095	-0.129	0.098	0.363

On the basis of relative efficiency of the indices, the following four indices were recommended for use to maximize response.

$I_9 = 0.8551X_2 + 0.7684X_3$ (R_{IH}=0.921)

$I_2 = 0.1899X_1 + 0.9123X_2 + 0.7596X_3$ (R_{IH}=0.917)

$I_6 = 0.2868X_1 + 0.7631X_2$ (R_{IH}=0.872)

$I_7 = 0.2143X_1 + 0.6823X_3$ (R_{IH}=0.853)

It can be seen from Table 4 that the expected genetic changes in the individual traits varied a lot from index to index. Even, in some of the indices the expected genetic changes in individual traits were found negative. However, in the above mentioned four best indices it was found that the expected genetic changes in individual traits were all positive. Also, the expected change in aggregate genetic worth and heritability values of these indices were found high. The heritability values for indices I_9, I_2, I_6 and I_7 were, respectively 0.859, 0.844, 0.761 and 0.731. Going by these estimates, it may be opined that all these four indices could

effectively be used for obtaining satisfactory response to selection in regards to body weight at different ages in New Zealand White breed of rabbit.

Perusal of all the 11 indices constructed in the present work reveals that incorporation of X_4 i.e. body weight at 180 days reduced the efficiency of index to a great extent. This is because the relative economic value of X_4 was obtained high and negative. Out of the four best indices as noted above I_9 is obviously the best and the simplest as it incorporates only two traits namely body weight at marketing (X_2) and body weight at 120 days (X_3) having highest relative efficiency. Furthermore and for the commercial purpose, I_6 is obviously the best and the simplest as it incorporates only two early traits namely body weight at weaning (at 42 days; X_1) and body weight at marketing (X_2) having a high relative efficiency (R_{IH}=0.872). However, all the four indices can be used effectively in the selection programme aimed at improvement of body weight of New Zealand White breed of rabbit.

The selection indices as developed in the present study, and the indices incorporating various traits as constructed by some workers (Mc Reynolds,1975, Vrillon *et al.*,1979, Garreau *et al*., 2004) indicate that selection indices developed by judicious incorporation of traits of economic importance would help in bringing about rapid genetic advance in rabbit populations enhancing its productivity and profitability. Results as obtained in the present study show that the four indices identified as the best viz., I_9, I_2, I_6 and I_7 could be used effectively both by farmers and breeders for rapid genetic improment of rabbit in terms of growth performance.

CONCLUSION

It is thought that the four indices identified in the present study as the bests will help in locally bringing about genetic improvement of rabbit in organized farms. For the commercial purpose, I_6 is obviously the best and the simplest as it incorporates only two early traits namely body weight at weaning (at 42 days; X_1) and body weight at marketing (X_2) having a high relative efficiency (R_{IH}=0.872).

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