EFFECTIVENESS OF THE BEST LINEAR UNBIASED PREDICTION OF BEEF SIRE USING THE FIELD DATA COLLECTED FROM SMALL SCALE FARMS

YOSHIYUKI SASAKI
DEPARTMENT OF ANIMAL SCIENCE, KYOTO UNIVERSITY,
KYOTO CITY, 606, JAPAN

SUMMARY

Beef sire evaluation method was investigated under the field conditions with small scale farms. The 6,848 records on fattened steers of the Japanese Black Cattle were obtained from 1981 through 1987. The average head of steers in the subclass of market-year-farm was 5.2. Sires were evaluated using the best linear unbiased prediction (BLUP) method with maternal grandsires. The regression coefficient of the value realized in progeny on the expected value calculated using the BLUP nearly equaled one. It was demonstrated that the BLUP would be very effective, even using the field records collected from small scale farms.

INTRODUCTION

The best linear unbiased prediction (BLUP) seems to be theoretically the best known method for the genetic evaluation of animals (Henderson, 1973). The BLUP has been being utilized for sire and cow evaluation in many countries all over the world and for various animals.

In Japan, breeding population of beef cattle is divided into sub-populations which are equivalent to prefectures and the unit is small. Consequently, the progeny number per a sire varies considerably and is very small on the average. Furthermore, scales of farm and carcass market are also small.

The objective of this study was to investigate whether the BLUP could be effective for genetic evaluation of beef sire under the field conditions with small scale farms.

MATERIALS AND METHOD

The 10,431 records on fattened steers slaughtered from 1981 through 1987 were obtained from the Ohita Prefectural Record of Performance Program for the Japanese Black Cattle, so called WAGYU. They were edited to provide the data for this investigation. The editing procedure was to select the records on the basis of fulfilling the requirements that firstly each market-year subclass had at least 100 steers and secondly each farm had at least 20 steers. The number of the selected records in the final data set was 6,848, representing progeny of 93 sires. The distribution on the two way table by carcass market

Table Numbers of records used for the present research by year and by carcass market where the records were collected

Carcass market	Year 1981	1982	1983	1984	1985	1986	1987	Sum
Ohita	126	99	213					438
Oosaka	265	207	243	164	197	426	447	1,949
Matsubara	651	644	725	447	383	607	521	3,978
Tokyo	93	247	143					483
Sum	1,135	1,197	1,324	611	580	1,033	968	6,848

and year is shown in the Table. Since the number of the farms included in the data set was 62 and the number of market-year subclasses was 20, the average head of steers in the subclass of market-year-farm was 5.2.

At first, sires were evaluated using single-trait BLUP with maternal grandsires in the model (Everett et.al, 1979; Quaas et.al, 1979) as follows:

$$y_{ijklm} = MN_i + F_j + S_k + \frac{1}{2}S'_l + p(P_{ijklm}-\bar{P}) + a_1(A_{ijklm}-\bar{A}) + a_2(A_{ijklm}-\bar{A})^2 + e_{ijklm},$$

where, y_{ijklm}: a record on the average daily gain (kg/day), carcass weight (kg) or marbling score,

MN_i : the fixed effect of the ith market-year,

F_j : the fixed effect of the jth fattening farm,

S_k : the random effect representing one-half the breeding value of the kth bull,

S'_l : the random effect representing one-half the breeding value of the lth bull and this term is for maternal grandsire,

p : linear partial regression of the y_{ijklm} on fattening period of a particular steer,

P_{ijklm} and $\bar{P}$: continuous variable for the fattening period and its average, respectively,

a_1 and a_2 : linear and quadratic partial regression of the y_{ijklm} on slaughter age of a particular steer,

A_{ijklm} and $\bar{A}$: continuous variable for the slaughter age and its average, respectively,

e_{ijklm} : a random residual effect associated with a particular record.

A couple of the covariates were deleted according to trait, i.e., the quadratic regression on slaughter age in the case of carcass weight and in addition the linear regression on fattening period in the case of marbling score. The data used were from 1981 through 1985 (Data I). The sires with 10 or more progeny and the maternal grandsires with 50 or more grandsons were listed on the sire summary.

Secondly, the records of steers shipped in 1986 and 1987 (Data II) were adjusted using the best linear unbiased estimates for non-genetic fixed effects obtained from the whole data.

Finally, a certain number of sires were selected based on the expected progeny difference (EPD) from the bulls included in the sire summary and used as the sire in Data II so that the selection rates equaled 100, 50, 30, 20 or 10%. On the other hand, a certain number of maternal grandsires were also selected as well as sires, so that the rates equaled 100, 90, 80, 70, 60, 50, 40, 30 or 20%. Then, steers which had both the selected sire as his father and the selected maternal grandsire as his maternal grandfather were chosen from the Data II. If the number of steers chosen was assumed to be n, expected value was calculated as follows:

$$\sum_{k=1}^{n} (EPD_k + \frac{1}{2}EPD'_k)/ n,$$

where, EPD_k : EPD of the father of the kth steer, EPD'_k : EPD of the maternal grandfather of the kth steer. On the other hand, the value realized in progeny was calculated as an average of adjusted measurements of the steers.

RESULT AND DISCUSSION

Scatter diagrams of the average daily gain, carcass weight and marbling score of the realized-to-expected value pairs are as shown in the Figure. The realized value increased in all three traits as the expected value increased. The linear regression of the realized value on the expected value was significant ($p<.01$) in all traits.

The regression equation for the traits are as shown in the Figure. None of the regression coefficients are significantly different from one. Furthermore, the simple correlation coefficients between the realized value and the expected value were 0.951, 0.985 and 0.907 for daily gain, carcass weight and marbling score, respectively.

Theoretically, if the EPD is accurate and unbiased, and n is large, both the linear regression coefficient and the correlation coefficient between the realized value and the expected value will be near to one infinitely. As shown in the Figure, the derived coefficients equal virtually one when n is large.

The result has demonstrated that the EPD predicted by the BLUP using field records is very effective, even when field records are collected at the very small scale farms which ship approximately 5 steers on the average per year to a market.

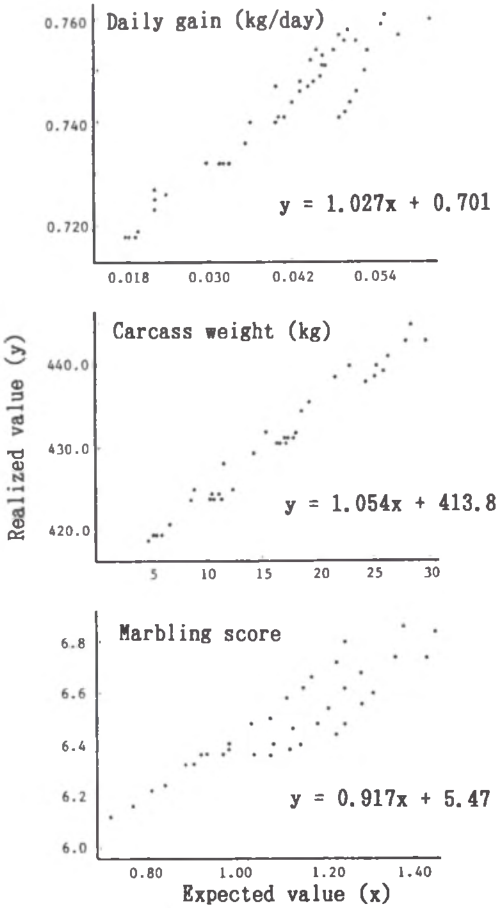

Fig. Scatter diagrams of the average daily gain, carcass weight and marbling score of the realized-to-expected value pairs in the mean of progeny group produced between sires selected, based on their expected progeny difference, and daughters of maternal grandsires selected as well as sire

REFERENCES

EVERETT, R.W., QUAAS R.L. and MCCLINTOCK, A.E. 1979. J.Dairy Sci. 62:1304-1313.

HENDERSON, C.R. 1973. Proc. of the Anim. Breed. and Genet. Symp. in Honor of J.L.Lush. p.10-41. ASAS and ADSA. Campaign. IL.

QUAAS, R.L., EVERETT, R.W. and MCCLINTOCK, A.C. 1979. J.Dairy Sci. 62:1648-1654.