GENETIC TRENDS IN JAPANESE PROGENY-TESTED CATTLE FOR CARCASS TRAITS UNDER STATION vs. FIELD SYSTEM

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INTRODUCTION

As beef cattle breeds, we have Japanese Black, Japanese Brown-Kumamoto and Kouchi, Japanese Shorthorn, Japanese Polled, Aberdeen Angus, Hereford and so on. The first five breeds are indigenous of Japan and called WAGYU, which is noted to produce high marbled meat, but with thin fat layer beneath the skin and surrounding the internal organs.

Judging had been adopted as a means for improvement of the WAGYU cattle until recently. However, performance and progeny testing programs for meat productivity were established and put to use as station system in 1968, which seems to be the same as that in France (Fouilloux, *et al*., 1999). The testing station was centralized only within prefecture.

A recording system to collect data on carcass traits of the fattened steers shipped from fattening farms was investigated and tried in some prefectures (Sasaki *et al*., 1986 ; Sasaki and Sasae, 1988). It was confirmed that BLUP method (Henderson, 1973 ; 1984) is very effective in predicting breeding values of sires, even using field records collected from small-scale conditions in Japan (Sasaki, 1992). Based on these results, the breeding scheme with the field recording system for beef cattle started recently all over Japan.

The purpose of this study was to estimate genetic changes for carcass traits in the Japanese Brown-Kumamoto population which is one breed of WAGYU. Additionally, the impact of systematic changes in progeny test on the genetic change was investigated. Especially, a comparison between station and field system for progeny test was made.

MATERIAL AND METHODS

Progeny test has been conducting as a station system since 1968. Ten progeny which were produced at cow-calf operations by mating with young candidate bulls are gathered and tested at the testing station. The testing period is 364 days with the preparatory period of 20 days. The field recording system for carcass records of the Japanese Brown-Kumamoto cattle has been established in 1987 (Matsumoto, 1994). After that, on-farm progeny test was introduced. Field records for performance of Japanese Brown-Kumamoto collected from 1988 to 1998 have been accumulated. The records that the frequency per a level of market-year was less than 100 or the frequency per a level of farm was less than 10 were excluded. Finally edited records were 31,989. Traits considered were beef marbling standard number (BMS, 1 to 12), carcass weight (CWT, kg), rib-eye area (REA, cm^2), back fat thickness (BFT, mm), daily gain for fattening period (DG, g/day) and rib thickness (RT, mm). In the mathematical model for predicting the breeding value, market-year, farm, sex, fattening period and slaughter age were included as the fixed effects which affected on the carcass traits significantly. The pedigree was traced back to the grandparents of the fattened steer.

The genetic trends for carcass traits and DG were estimated from the average predicted breeding value of cows by year of birth. Blair and Pollak (1984) indicated that the average yearly predicted breeding values could be used to estimate genetic trend from such field data.

RESULTS

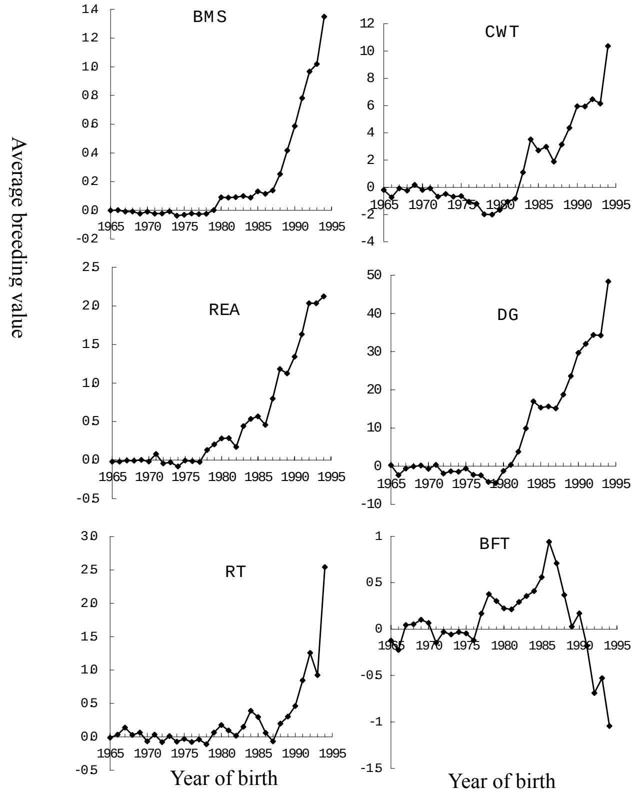

Figure 1. Estimated genetic trends for the average predicted breeding value for carcass traits

After the progeny test started in 1968, the genetic trends for BMS and REA were positive slightly, while that of BFT was negative. Since the on-farm progeny test was adopted in 1987, however, the genetic trends for all carcass traits and DG were changed to be positive dramatically as shown in the Figure 1. Then, the annual genetic change was calculated as the regression coefficient of the breeding values of cows on the year of birth (Table 1). The annual genetic changes during the recent period (1988-1994) after the on-farm progeny test has been adopted were significantly higher than those in 1968 - 1987(P<0.01).

Table 1. Period regression of the predicted breeding values for carcass traits and daily gain on year of birth

Progeny test	BMS[a]	Carcass weight (kg)	Rib-eye area (cm^2)	Daily gain (g/day)	Rib thickness (mm)	Back fat thickness (mm)
Station system (1968-1987)	0.01±0.001[b]	0.23±0.01	0.05±0.002	1.3±0.04	0.01±0.002	0.05±0.004
Field system (1988-1994)	0.17±0.01	0.88±0.11	0.18±0.02	4.0±0.3	0.25±0.02	-0.20±0.03

a : The marbling is classified into twelve grades based on the Beef Marbling Standards (BMS) with the number of 1 to 12.

b : Regression coefficient of the predicted breeding value on the year of birth and its standard error.

DISCUSSION

The progeny testing program was established and put to use in each prefecture in 1968. It was station system. At that time, the most important choice was to decide which would be the better testing scheme, station system or field system. In 1965, only 4.6 % of slaughtered cattle were evaluated on the carcass and the carcass records could not be collected. Then, it was concluded that the field recording system could not be adopted in those days.

The number of progeny-tested bulls was enough sizable as the total number at all stations, but the stations were so much dispersed all over the nation not to have enough animals for keeping high selection intensity within each prefecture. This might be the most serious cause of the very low genetic response during 1968 to 1987 (Figure 1 and Table 1).

Then, we had investigated field system for progeny testing on carcass traits of beef cattle. More than 40% of steers slaughtered at abattoirs became to be graded around 1980. The carcass graded records were available to be collected and used for evaluating the beef bulls. Furthermore, such carcass records could be used for evaluating the sires and cows which are parents of the fattened steers, because the heritability estimates of carcass traits were 0.2 to 0.4 (Sasaki *et al*., 1986).

The fattened steers shipped from farms are raised on different farms, slaughtered at different ages, not produced from random mating, that is, affected by selection. Furthermore, livestock population shows a positive genetic trend usually. In these conditions, we can get BLUP of animal's breeding values by solving the mixed model equations (Henderson, 1973,1984). Then the most appropriate model for sire evaluation was chosen in terms of residual variance by the least squares analysis of variance and predicted error variance by BLUP procedures (Sasaki and Sasae, 1988).

The BLUP method seems to be theoretically a best known method for the genetic evaluation of animals. In Japan, however, cattle numbers are small in general, within prefectures, herd size also is small, and the carcass markets are not large. Usually prefectures conduct a sire evaluation program in which progeny number per sire is small. It was confirmed that the BLUP method (Henderson, 1973; 1984) could overcome the difficulties caused by our small scale conditions, comparing predictions based on the expected progeny differences of sire and

maternal grandsires with realized values of the progeny (Sasaki, 1992).
Estimates of genetic trends for carcass traits of beef cattle are rare and also positive response for the traits has not been reported (MacNeil, *et al*., 1999 ; Wheeler, *et al*., 1996). Since the on-farm progeny test with field recording system started, dramatic responses are about to appear in some prefectures. The responses found in the Japanese Brown- Kumamoto in Kumamoto prefecture was changed to be very positive as shown in Figure 1 and Table 1.

CONCLUSION

These results clearly indicate that the on-farm progeny test is effective for evaluating and selecting beef cattle for carcass traits.

REFERENCES

Blair, H.T. and Pollak, E.J. (1984) *J. Anim. Sci.* **58** : 878-886.
Fouilloux, M.N., Renand, G., Gaillard, J. and Menissier, F. (1999) *Genet. Sel. Evol.* **31** : 465-489.
Henderson, C.R. (1973) *Proc. of the Anim. Breeding and Genetics Sym. in Honor of Dr. J. L. Lush* : 10-41.
Henderson, C.R.(1984) *Application of Linear Models in Animal Breeding,* Univ. Guelph Press. Guelph. Ont. Canada.
MacNeil, M.D., Short, R.E. and Urick, J.J. (1999) *J. Anim. Sci.* **77** : 2345-2351.
Matsumoto, M. (1994) *Animal Husbandry* **48** : 139-143.
Sasaki, Y.(1992) *J. Anim. Sci.* **70** : 3317-3321.
Sasaki, Y and Sasae, Y.(1988) *Jpn. J. Zootech. Sci.* **59(1)** : 23-30.
Sasaki, Y., Sasae, Y., Uchiyama, S., Hayashida, M., Iwaisaki, H., Itoh, Y., Gannichida, T., Itoh, M. and Takasaki, M. (1986) *Bulletin Beef Cattle Sci*. **41** : 21-27.
Wheeler, T.L., Cundiff, L.V., Koch, R.M. and Crouse, J.D. (1996) *J.Anim. Sci.,* **74** : 1023-1035.