

## GENETIC EVALUATION OF BEEF CATTLE IN CANADA

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### SUMMARY

The Canadian beef cattle genetic evaluation program is described. Methods for national and within-herd evaluations are discussed. National evaluations are used by the beef industry primarily to identify superior beef sires, while within-herd evaluations provide individual breeders with timely information on the genetic ranking of all animals, the amount and direction of genetic change, and the genetic performance of the herd in comparison to the national average. The future direction of beef genetic evaluations in Canada is also discussed.

### INTRODUCTION

As early as 1976, Canadian beef sires were evaluated for their genetic merit based on the Best Linear Unbiased Prediction method (BLUP), using a sire model (Schaeffer and Wilton, 1975). In 1988, the model was expanded to a multi-trait individual animal model (IAM), whereby all animals including sires, cows and calves were evaluated for calving ease, maternal calving ease, weaning gain, maternal weaning gain (milk) and yearling gain. The model accounts for breed of dam and heterosis effects, and therefore can be applied to both purebred and crossbred records. At the same time, a within-herd evaluation module based on the same model was developed and made available to regional offices. This module operates on a standard micro-computer to permit the timely processing of performance data for within-herd selection. Since 1990, multiple trait evaluation was expanded from 5 to 7 traits to include birth weight and maternal birth weight. This was done first at the national level, then for the within-herd module.

### NATIONAL DATA BASE

Performance records are collected at the farm through several programs: the national R.O.P. program, provincial programs, and the programs run by various breed associations. The five major breeds of beef cattle used in Canada are Angus, Charolais, Hereford, Limousin and Simmental. Together, these breeds contribute close to 140,000 records annually to the national data base. Although this varies from breed to breed, about 50% of calves are purebred and the rest are crossbred. These records are sent to Agriculture Canada twice a year. Currently, the national data base contains over 2,200,000 performance records.

Selection of records for evaluation Before inclusion in the data base, records are subjected to various edits, including connectedness to the main sire group and minimum size of breed of dam, age of dam, sex, or contemporary group subclasses.

Multiple identification Since there are two systems for identifying beef animals in Canada (tattoos and registration numbers), extensive editing is required to ensure that there are no conflicts between the two systems. Editing procedures include verification of pedigrees against herd-book files and against cross-reference files for sires registered outside of Canada.

Pedigree data from herd books In addition to editing, pedigree files are used to genetically link groups of animals that otherwise might be disconnected, and to trace back animal ancestry beyond the scope of the performance data base.

## NATIONAL EVALUATION

Statistical model The fixed effects in the Individual Animal Model are breed of dam by age of dam by sex of calf (MAS), and contemporary groups within herd. There are 20 different classes of breed of dam, each corresponding to a particular category of genotype. Breed of dam effects account for both the genetic effect of the breed of dam and the heterosis resulting from crossbreeding to the breed of sire being evaluated. For purebred calves, the breed of dam group is the same as the breed of sire. Random effects are animal effects, permanent environmental effects and error terms associated with each record. The inverse of the relationship matrix is formed for all animals and their parents.

Currently evaluations are computed separately for each sire breed. Each breed must have a minimum of 2000 performance tested animals including both purebreds and crossbreds. EPDs are calculated for calving ease, birth weight, weaning gain, yearling gain, maternal calving ease, maternal birth weight, and maternal contribution to weaning gain (milk).

Base adjustment The average EPDs of calves born during the most recent 3 years is calculated and the EPDs of all animals are expressed in relation to this base group. Using a moving, recent base means that EPDs are generally smaller, in absolute value, than those calculated in countries where fixed, older bases are the norm. However, this choice of genetic base makes it easier for Canadian breeders to distinguish between animals that are better than average for the breed and those that are not.

Genetic trends Genetic trends for five of the major breeds evaluated in Canada are shown in Table 1. The trends correspond to the change in the average genetic value of calves over the last 5 years and are expressed in terms of EBVs for calving ease (CE), birth weight (BW), weaning gain from birth to 200 days of age (WG), yearling gain from 200 to 365 days of age (YG), maternal calving ease (MCE), maternal birth weight (MBW) and maternal weaning gain (MWG). Evaluation for weights and gains are expressed in pounds. Calving ease evaluations are expressed in Snell score units (unassisted = 100, slight assistance = 50, hard pull = 30, surgical = 0).

Table 1. Genetic change in the Canadian beef cattle population from 1988 to 1993.

Breed	genetic change (calf EBV's)						
	CE	BW	WG	YG	MCE	MBW	MWG
Angus	-0.2	1.0	7.8	14.4	0.0	-0.2	0.4
Charolais	0.0	-0.2	11.0	19.8	0.8	-2.6	-7.4
Hereford	-1.0	2.6	13.0	26.0	0.2	0.0	4.0
Limousin	-0.4	0.8	6.0	10.8	0.0	0.0	2.2
Simmental	-0.6	1.0	10.2	18.4	0.2	-0.2	2.2

### WITHIN HERD EVALUATION

Use of within herd evaluations Although national evaluations provide accurate genetic information for sires, dams and calves, they are not produced frequently enough to help individual breeders with all their selection decisions. In many instances, breeders must select individual animals immediately after their performance or that of their progeny has been measured. In practice, this means evaluations must be computed on a micro-computer, either at the farm or at a nearby processing centre.

Module The within-herd module developed to meet this need uses the same model as the national evaluations, i.e. it is based on a multi-trait individual animal model for the seven traits under consideration. Within-herd performance records are preadjusted for the effects of breed of dam, age and dam and sex. The diagonal and right hand sides of the equations are then modified, using the procedure described by Chesnais and Song (1988), to account for the national EPDs of the parents. The micro-computer module is written in FORTRAN and runs under DOS. It was developed to use extended memory, ranging from a minimum of 4 Mbytes to a maximum of 16 Mbytes.

### FUTURE DIRECTION OF BEEF EVALUATIONS IN CANADA

The Canadian beef cattle industry is making a concerted effort to further increase the use and impact of its beef improvement program. A Centre for Beef Improvement (CBI) is being developed to ensure the standardization of all animal identification and to provide more and more effective service to all users of genetic evaluation information. Future developments in the field of genetic evaluation per se include the development of EPDs for other economically important traits such as carcass traits and reproductive performance, and the joint use of farm and test station data in national evaluations.

## REFERENCES

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