NATIONAL GENETIC EVALUATIONS FOR SWINE IN CANADA

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SUMMARY

National genetic evaluations for swine in Canada are routinely computed for pig performance (backfat thickness and age at 100 kg) and sow productivity (total number of pigs born) using BLUP animal models. Approximate BLUP evaluations are also provided on-farm every time new data are collected. Current estimates for genetic change are reductions of about 0.35 mm and 1.5 days per year. These rates are about 50% faster for backfat and more than double for age than prior to the introduction of BLUP in 1985. Additional sow productivity traits are being studied and a national breeding plan is being developed for genetic improvement of carcass and meat quality.

INTRODUCTION

Canada has a long history of genetic improvement programs for swine, dating back to the early part of this century. The primary emphasis has been on reducing fat and increasing growth rate. In 1985, a BLUP animal model was applied on a regional basis to provide Estimated Breeding Values (EBVs) for backfat and age (Hudson and Kennedy, 1985). In 1987, a module was introduced which allowed for data entry, genetic evaluation, and reporting right on the farm using portable computers (Kennedy, 1988). In 1992, the regional evaluations were replaced by a single national evaluation for all of Canada. There is no direct selection for feed efficiency, but research has shown that selection for reduced backfat and increased growth rate results in a very effective correlated improvement in feed efficiency, without some of the negative effects that have been experienced with direct selection for this trait (Mrode and Kennedy, 1993).

More recently, a BLUP animal model was applied on a regional basis to provide EBVs for sow productivity (Mrode and Kennedy, 1991). A module is also being used on-farm to provide up to date EBVs each time new data is collected (Schaeffer et.al., 1993). This module is being integrated with the on-farm program for backfat and age mentioned above. In 1994, the regional evaluations have been replaced by a single national evaluation for sow productivity.

MATERIALS AND METHODS

Slaughter Pig Performance

Performance data for genetic evaluations are collected by federally accredited technicians during routine farm visits, usually every two or three weeks. These data are captured on a portable computer which computes EBVs for the new pigs using national EBVs of their parents and all new data collected in the herd since the last national evaluation. The approach is based on Henderson (1975). Technicians transfer data by diskette to a provincial office, which in turn provides the data to Agriculture and Agri-Food Canada every three months. National EBVs are updated four times per year, and the EBVs of potential parents are transferred back to the provincial offices for use in the on-farm module. A national publication of active parents (the "Sire and Dam Report") is produced after each quarterly evaluation, as well as individual herd reports (the "Herd Activity Monitor" report) which show breeders genetic and phenotypic trends for each of their own herds. In addition to the individual trait EBVs, a sire-line index is also provided which combines the backfat and age EBVs.

The historical data goes back to 1976 and currently there are about 1.5 million records. About 110,000 records on purebreds are added each year. Table 1 shows the distribution of records by breed.

Backfat and age are standardized to a 100 kg live weight basis and boar records are adjusted to a gilt equivalent. The animal model includes management group (defined as herd-year-season of

birth), genetic groups, litter, and animal. Evaluations are computed separately for each breed and trait.

Data from central test stations are also included in the national evaluations. In this case, average daily gain on test (converted to an age equivalent) is used in place of age at 100 kg, in order to remove pre-test variation caused by different farms. Also, the management group is defined as the group of pigs entering the station at the same time, rather than herd-year-season.

Sow Productivity

In some provinces, sow productivity data is also captured on portable computers, and updated EBVs are provided immediately with each herd visit (i.e. at the same time as for backfat and age described above). Other provinces are entering data directly into the provincial computer and mailing reports back to producers. Eventually, all provinces will likely move to on-farm data entry and reporting. As with production data, these data are transferred to Agriculture and Agri-Food Canada every three months. National EBVs are currently updated every six months, and transferred back to the provinces for use in the on-farm module. EBVs for total number of pigs born are being incorporated into the existing "Sire and Dam Report" for backfat and age. A dam-line index has been developed which includes EBVs for total number born, backfat, and age.

Historical data go back as far as 1980, depending on the province, and there are currently about 250,000 records, with about 30,000 new records collected per year. The numbers of records by breed are in table 1.

Records are adjusted for parity, season of farrowing, number of services during the heat period of conception, A.I. or natural mating, breed of sire of the litter, and age at farrowing. The animal model includes management group (defined as herd-year of farrowing), genetic groups, litter, animal, and permanent environment. Evaluations are computed separately for each breed.

Table 1. Numbers of records available for genetic evaluation.

	Performance Records		Sow productivity Records	
	Since 1976	1993 only	Since 1980	1992 only
Yorkshire	574,754	47,140	105,632	13,327
Landrace	446,534	37,104	120,811	14,909
Lacombe	41,365	1,180	2,211	120
Hampshire	85,581	5,963	9,939	1,211
Duroc	163,543	20,002	18,104	2,984
Total	1,311,777	111,389	256,697	32,551

RESULTS

Performance

EBVs for about 200,000 potential parents are provided each quarter to the provinces for use in the on-farm module. The "Sire and Dam Report" lists EBVs for about 3,000 active boars and about 15,000 active sows. The report includes separate sections for top 10% lists and A.I. boars, as well as top young animals. Estimated genetic trends are presented in table 2. The current rates of change average about 0.35 mm and 1.5 days per year.

Table 2. Genetic change in backfat and age (per year) for pigs born 1980 to 1985, 1985 to 1990, and 1990 to 1992.

	1980-1985		1985-1990		1990-1992	
	backfat (mm/yr)	age at 100 kg (days/yr)	backfat (mm/yr)	age at 100 kg (days/yr)	backfat (mm/yr)	age at 100 kg (days/yr)
Yorkshire	-0.20	-0.6	-0.21	-0.9	-0.30	-1.5
Landrace	-0.33	-0.8	-0.25	-1.3	-0.43	-1.4
Lacombe	-0.18	-0.8	-0.15	-1.2	-0.32	-1.6
Hampshire	-0.08	-0.6	-0.07	-0.9	-0.20	-1.3
Duroc	-0.18	-0.9	-0.18	-1.3	-0.34	-1.5

National sow productivity EBVs have so far been published on a regional basis, but they will appear as part of the existing national "Sire and Dam Report" starting in the Fall of 1994. EBVs of potential parents are also transferred to provincial computers for use in the on-farm module. There has been no significant national genetic trend found for these traits so far, but as the program gains momentum, selection of prolific lines should result in significant genetic progress based on theoretical results.

DISCUSSION

Since the introduction of BLUP in 1985 and on-farm data entry, evaluation and reporting in 1987, rates of genetic improvement have increased by about 50% for backfat and by 100 to 200 % for age. The benefits of BLUP based selection over previous evaluation methods are largest for traits with lower heritability. This could explain some of the greater improvement rates observed for age. There is also a resistance by breeders to selecting for further reductions in backfat due to the feeling by some that Canadian pigs are already approaching an optimum level of fatness. Whether or not this is true has been the subject of debate for many years, although the genetic trend has continued.

Based on a recent economic analysis by Kennedy (1993), current genetic improvement rates for backfat (0.35 mm/year) and age (1.5 days/year) translate into a net economic value of about $1.30 Cdn per slaughter pig per year, which is of course cumulative (eg. 2 years = $2.60 per pig). To illustrate the significance of this, with 15 million slaughter pigs produced annually in Canada, the net economic value of genetic improvement to the swine industry in the first year is close to $20 million. In the fifth year it is close to $100 million, and growing. Eventually, some optimal limit will be reached for one or both of these traits. However, this kind of improvement has been taking place for many years. In the future, we will see more selection for other traits, specifically, sow productivity traits as well as carcass and meat quality traits. Improvements in these traits will likely more than make up for any reduced genetic trends in performance traits.

The sow productivity improvement program is not as well developed as the performance improvement program. Over the next few years, this gap will be closing. EBVs for additional traits, such as age at first farrowing, farrowing interval, and litter weight at weaning, may be added pending results of on-going research. The potential for economic returns from improved sow productivity are also very large.

The industry is currently developing a plan, with the assistance of researchers and government, for a carcass and meat quality improvement program. This program will likely be based on slaughter results of sibs, and could include some measures of lean distribution, tenderness, water-holding-capacity, and intramuscular fat. The plan is being developed with participation from all segments of the industry, with particular emphasis on the meat packing sector where improvements can be detected and some form of incentive program adopted.

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