The 100th Anniversary Workshop
of Canadian Livestock Records Corporation

Friday April 1, 2005

Yuefu Liu, CCSI

CLRC held a workshop in Lord Elgin Hotel, Ottawa, on Friday, April 1, 2005, for celebrating 100 years of service to the Canadian Livestock industry. The workshop included a morning session and an afternoon session. About 35 people attended the workshop. The CLRC director from CSBA, Don Dietrich presented in the workshop.

Morning session

There are two speakers in the morning session.

(1) David Trus, Animal Registration officer of Agriculture and Agri-Food Canada, first gave a presentation on "The federal government role in and support of registry activities through the years, and a look at the trends in registration activities during those years". He reviewed the changes in the livestock industries over times since 100 years ago, including changes of livestock breeds and numbers of registered animals in each breeds, advancement of science and technology in livestock production, and significant events in the history of livestock productions related to livestock legislations and amendments. He also described the current trends, emerging issues and future challenges.

(2) Eric Lawlor from Ontario Ministry of Agriculture and Agri-Food, delivered a talk on "The place of small breeds in the livestock industry". He talked about the minor breeds Dexter cattle and its origin, and described different ways for marketing the minor breeds.

Afternoon session

The afternoon session was a panel discussion of geneticists on the topics of genetic improvement and genetic diversity, and their use as marketing tools. Davis Trus moderated the discussions. The panel includes Jacques Chesnais from the Semex Alliance, Yuefu Liu from Canadian Centre for Swine Improvement, Bill desBarres from Equine Canada and Eric Lawlor from Ontario Ministry of Agriculture and Food. The discussions began with short presentations by each panel members.

Jacques Chesnais talked about the genetic progress and genetic diversity of dairy cattle during the past 40 years. In 1960's, milk yield was 4,600 on average while it is 9,700 kg nowadays. However, the genetic resources narrowed down considerably at the same time. The average inbreeding coefficient nowadays is 5.19% for Holstein, 4.83% for Jersey and 7.75% for Canadianne. 90% of nowadays cows are originated from a bull named Johnanna Rag Apple Rabst that was born in 1921.

Yuefu Liu talked about the role of molecular genetics in swine genetic improvement and keeping genetic diversity. He explained why molecular genetics are useful for livestock genetic improvement in comparison with quantitative genetics that has been used so far in swine breeding. He used IGF2 and HFABP gene as examples. He pointed out the importance to maintain the genetic diversity at these genes with example for the utilization of the genes.

Bill desBarres talked about the horse breeding. His talk mainly concentrated on the importance of using molecular genetics to horse improvement. He expressed the strong wish to get research fund from federal government or a foundation to conduct molecular genetic research for horse, especially the research on horse color genes.

Eric Lawlor raised the issue of minor breeds as a discussion topic.

During the panel discussion, Jacques Chesnais mentioned the fast progress of molecular genetics studies. Following the completion of genome sequence for human and some model animals, the international Bovine Genome Sequencing project deposited the first draft of the bovine genome sequence into freely available public databases for use by biomedical and agricultural researchers around the world. He expected that the next will be swine and other livestock.

Jacques Chesnais pointed out that marker information is mainly used in dairy cattle improvement when many genes have been mapped in swine He questioned whether there are many genes with large effects like IGF2 and HFABP genes in swine. Yuefu Liu answered that number of genes with such large effects like IGF2 and HFABP could be very limited for the traits that have been selected. Genes with large effects usually become fixed very soon. HFABP gene is still polymorphic because intramuscular fat or marbling has not been selected yet and it is not a gene for backfat. IGF2 is still polymorphic because of the imprinting mechanism that allows this gene got away from selection. The IGF2 gene is silent and therefore unselected every other generation on average. These polymorphic major genes are very valuable and useful. We need to keep the genetic diversity at these gene loci.

In discussion of gene patents, Davis Trus emphasize that gene alone is not patentable. What can be patented is the DNA tests. Yuefu Liu provided the examples of patented genes of swine for explaining Trus's point and the gene patent is always related to a specific testing position within gene.

Davis Trus invited the discussion on strategy and downfall in using molecular information. Yuefu Liu mentioned that CCSI adopted a step-wise priority strategy in using gene information. CCSI uses molecular information selectively and begin with those which are well studied, reliably mapped, and directly useful for solving the extent or emerging issues in the swine industry.

The General manager of Semex pointed out a problem that there is a large distance between the fast progress of molecular genetics and the public and breeder's acceptance.

Appendixes:

(1) Swine Registration Trends, presented by David Trus during the workshop

(2) The PowerPoint presentation by Yuefu Liu at CLRC Workshop

SWINE REGISTRATION TRENDS

Year	Berkshire	Ch. White	Duroc	Hampshire	Lacombe	Landrace	Lg. Black	Pietrain	PInd China	Spotted	Tamworth	B. Saddleback	Yorkshire	TOTAL
1915	2535	1555	1337	117					595		675		3147	9961
1920	2670	1596	2098	213			43		735		487		4761	12603
1925	1196	566	358	169			99		209		812		7571	10980
1930	1074	455	487	113			87		277		682		6454	9629
1935	484	137	59	13					5		530		6633	7861
1940	623	69	132	5					31		697		11199	12756
1945	835	84	160	10					5		1097		15701	17892
1950	640	100	141	41					3		1225		15935	18085
1955	474	26	106	9							1327		19370	21312
1960	108	0	8	0	1630	3632	508				528	247	11735	18396
1965	95	10	18	30	1694	2320	117				246		13116	17646
1970	26	112	1027	3554	1728	3410	421		90	10	97	52	12443	22970
1975	89	89	1553	974	1305	3486	56			27	47	26	8055	15707
1980	142	12	3203	2144	1312	11139	50		0	165	66	15	12673	30921
1985	14	17	1804	1317		7068				141	39	3	9536	19939
1990	30	2	3521	1867	471	8450	28	0	2	17	30	0	10973	25391
1995	7	0	2952	519	205	7425		538		10	12		8579	20247
2000	1368	0	9493	288	254	17119	19	4	0	17	10	0	23056	51628

The role of molecular genetics
in genetic improvement

Yuefu Liu
CCSI

Why Molecular Genetics

- **Performance = genes + environment**
  - Genetic improvement is to select animals with better genes
  - Selection should be conducted on genes, not on performance
  - A method needed to separate gene from environmental effects
- **Quantitative genetics**:
  - Infers gene effect based on performance information
  - BLUP
  - EBV is not equal to gene effects
- **Molecular genetics**:
  - A science that study the genes and their functions directly at a molecular level
  - Provides a direct measure of genes and genotypes
  - Accurate selection and allow faster genetic improvement.

Why not widely utilized yet ?

- Swine: 2,700,000,000 nucleotide pairs.
- 95% of DNA are not genes:
  - location ?
  - function ?
  - size of the effects ?
- Use of molecular info depends on the progress of molecular genetics studies

Status of Swine Gene Mapping

- So far, 3000 loci: over 900 genes; 2000 markers.
- Some genes well studied: e.g. Halothane, RN, IGF2 gene, ...; some need more research.
- Some companies began to utilize molecular information quite intensively:
  - Monsanto: 78 genes and 26 QTLs since 2002
  - Sygen: 12 genes and 40 QTLs
- CCSI's strategy: Selectively use, begin with those
  - which are well studied
  - which are directly useful for the industry

Example 1: IGF2 gene
Insulin-like growth factor 2 gene

Quebec market reference:
- 19% of carcasses have less backfat than 13.6 mm (lower limit).
- 20% of carcasses have lean yield higher than 62.9% (upper threshold of the grid).
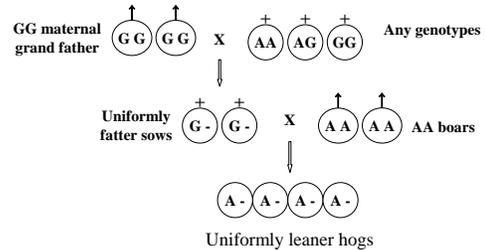- Some extreme lean pork was discounted in Western Canada.

Example 1: IGF2 gene

Are Canadian hog carcasses really too lean?
- The average lean 60%
- desired range in most payment grids is between 61% and 63% with an average of 62% (e.g. new "OlyWest Contract").
- Increasing lean yield from 60% to 62% means $ 4.25 more income from each hog (Sullivan, 2004).
- The problem is actually:
  - low uniformity of the carcass leanness
  - not the average leanness.

Example 1: IGF2 gene

- The swine industry needs carcasses that are more uniform to be within the desired range and 2% leaner
- Molecular genetics solution: IGF2 gene:
  - Increases lean yield by 2% and uniformity by 25%
  - Can be used for leaner hogs from fat sows

IGF2: Used for leaner hogs from fat sows

GG maternal grand father (G G) (G G) X (A A) (A G) (G G) Any genotypes

Uniformly fatter sows (G -) (G -) X (A A) (A A) AA boars

(A -) (A -) (A -) (A -)

Uniformly leaner hogs

Example 2: HFABP gene
Heart fatty acid binding protein gene

- Some pork loins is too lean, which influences the eating quality.
- Asian markets need even more intramuscular fat (IMF).
- Method to measure IMF is still in developing
- Molecular genetics solution: HFABP gene
  - Increases IMF by 0.4%
  - IMF can be improved by selecting HFABP, independently from backfat thickness

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For genetic improvement, Especially Useful:

- Traits not measurable on living animals
- Traits of low heritability
- Sex-limited traits
- Disease resistance
- Early stage selection

Future prospects

- Molecular genetics studies progress rapidly
- High throughput, high efficiency and low cost techniques have come into use, e.g. Microarray technique, SNP genotyping
- Molecular genetics will be more and more useful for genetic improvement of livestock

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Thank You