Canadian Swine Improvement Program

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Canadian Centre for Swine Improvement

The Canadian Swine Improvement Program
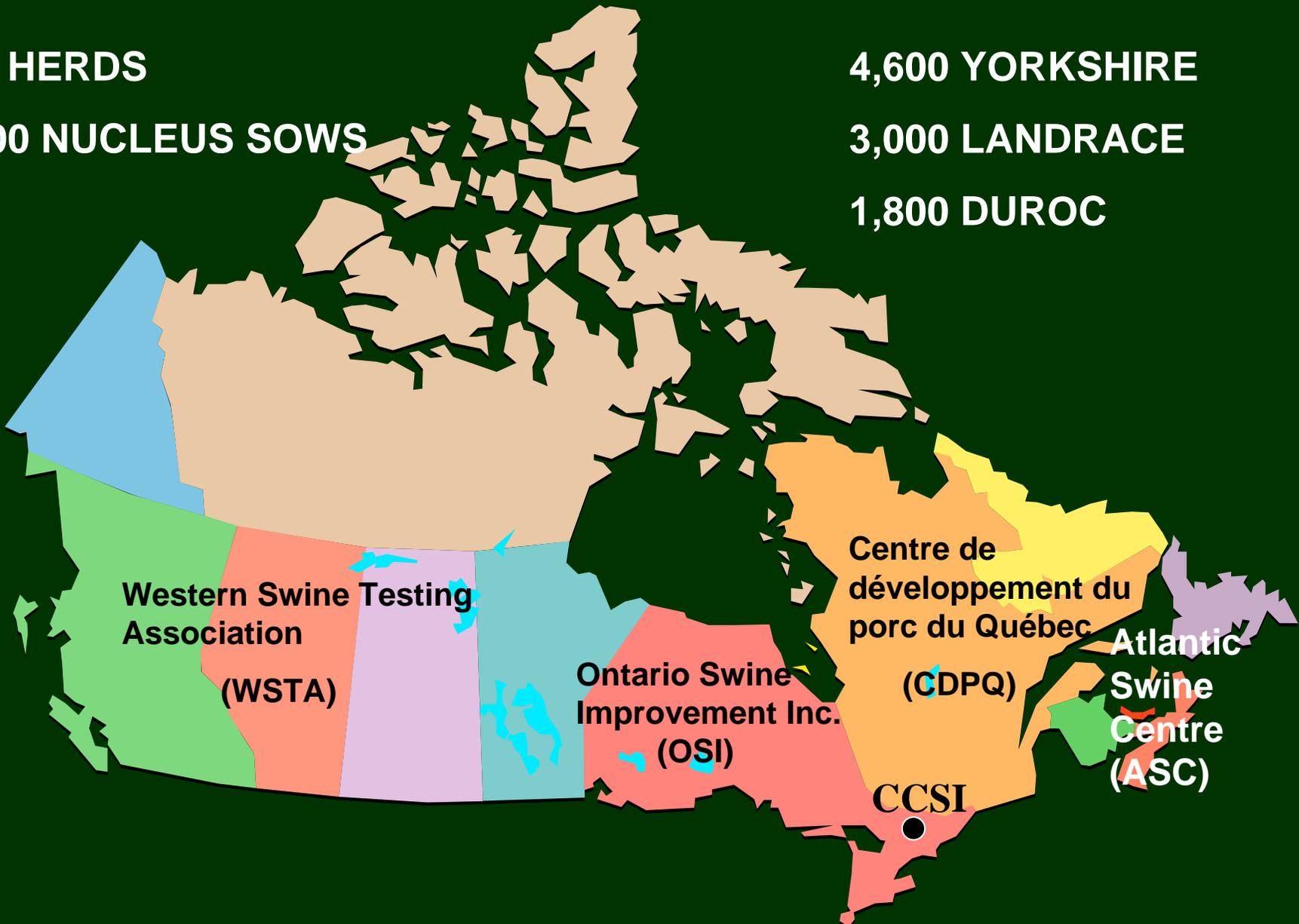
~ 125 HERDS

~ 9,400 NUCLEUS SOWS

4,600 YORKSHIRE

3,000 LANDRACE

1,800 DUROC

Western Swine Testing Association

(WSTA)

Ontario Swine Improvement Inc.

(OSI)

Centre de développement du porc du Québec

(CDPQ)

Atlantic Swine Centre

(ASC)

CCSI

Some key factors in the program

- National database
- National standard testing system
- Genetic evaluation methods
- Web-based tools for genetic improvement
- Delivery structure
- R & D activities

National database

- 30 years of historical data
- Detailed performance records on 3 million pigs
- Pedigree records traces an animal's genetic background for generations. Purebred registration system dates back to 1889
- Web-based tools for different purposes, e.g. data transfer, EBV report, selection decision, mating planning etc.

National standards and accreditation

- About 90,000 pigs tested each year and added to database

- National standards guarantee the comparability of the swine genetic merits across herds

- Accredited technicians, trained regularly, guarantee the data quality

Genetic evaluation program

- Best Linear Unbiased Prediction (BLUP) for genetic evaluation

- Animal model

- One of the most advanced programs in the world

- Integrates information on each animal and all its relatives

- Generates EBV that can be compared across herds

Genetic Evaluations

Routine evaluations

- Current traits:
  - Age to market wt.
  - Backfat thickness at market wt.
  - Lean yield
  - Loin eye area
  - Loin muscle depth
  - Feed conversion
  - Litter size
    - Age at first farrowing
    - Farrowing interval
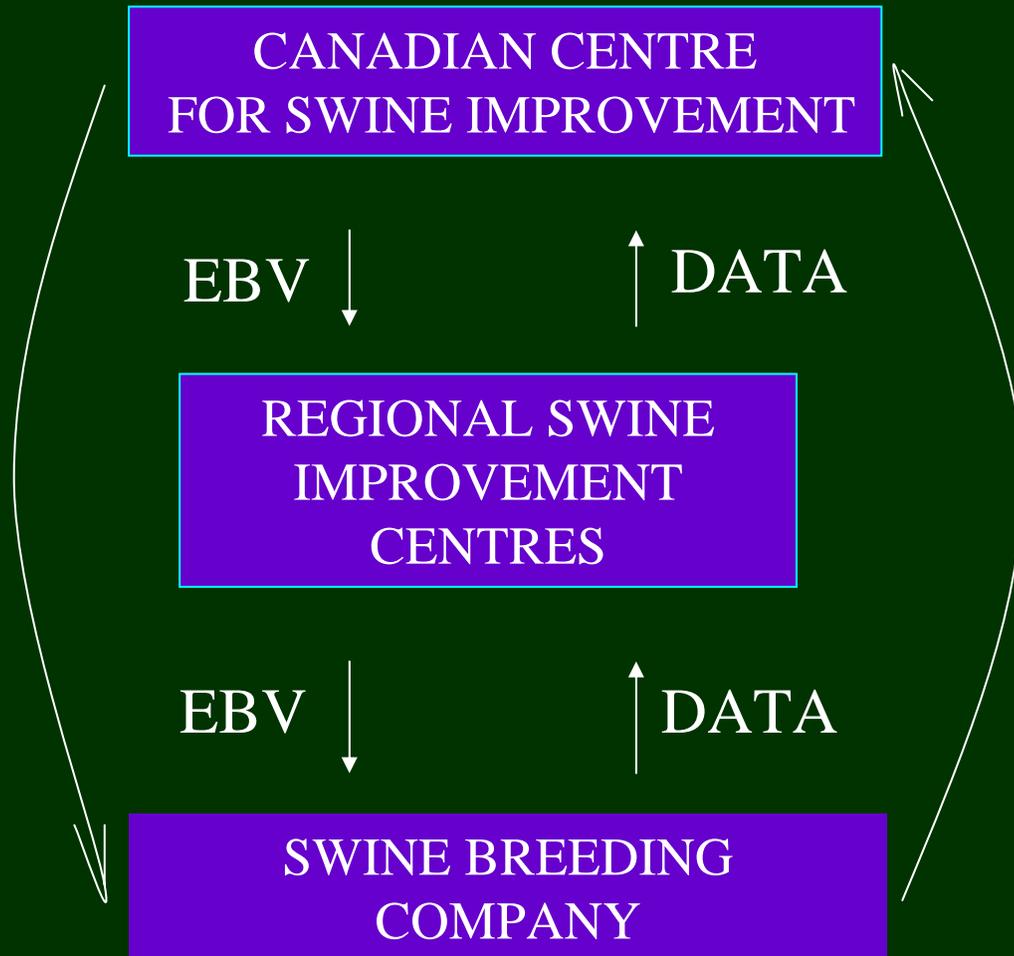   - Weaning weight

- New evaluations:
  - Piglet survival
  - Meat quality
    - Colour
    - Marbling
    - pH(24)
    - Drip loss
  - Conformation
    - Feet and legs
    - Number of teats

Web tools for genetic improvement

- Breeding for Profit, which allows breeders to estimate their own economic values and define customized selection criterion.
- Computer Dating, which helps breeders make mating plans and selection decisions
- Tools to monitor genetic progress at herd, regional and national levels
- Tools to evaluate connectedness of nucleus herds
- Electronic Data Interchange (EDI)
- Web-based approach instantly at finger-tips

Delivery Structure

CANADIAN CENTRE
FOR SWINE IMPROVEMENT

EBV ↓   ↑ DATA

REGIONAL SWINE
IMPROVEMENT
CENTRES

EBV ↓   ↑ DATA

SWINE BREEDING
COMPANY

- National Standards
- National EBV

- Data capture by technicians from regional centres

- On-farm EBV

Genetic Improvement for Commercial Producers

	Yearly average 1999-2003	2004
Age to 100 kg (days)	-1.12	-1.4
Lean yield (%)	+0.09	+ 0.18
Loin eye area (cm^2)	+0.16	+0.40
Feed Conversion (kg/kg)	-0.016	-0.022
Backfat (mm)	-0.20	-0.30
Loin muscle depth (mm)	+0.10	+0.2
Litter size at birth	+0.17	+0.35

Estimated improvement for Yorkshire X Landrace sows crossed to Duroc sires

Canadian Breeding Stock

- World wide reputation for carcass and meat quality as well as productivity

- Canadian breeding stock exported to 50 countries

  - Example: A recent contract of this year: 16,000 breeding pigs will be exported to Cuba. The first shipment of 3,500 pigs left in July

- Breeding stock export increases over years

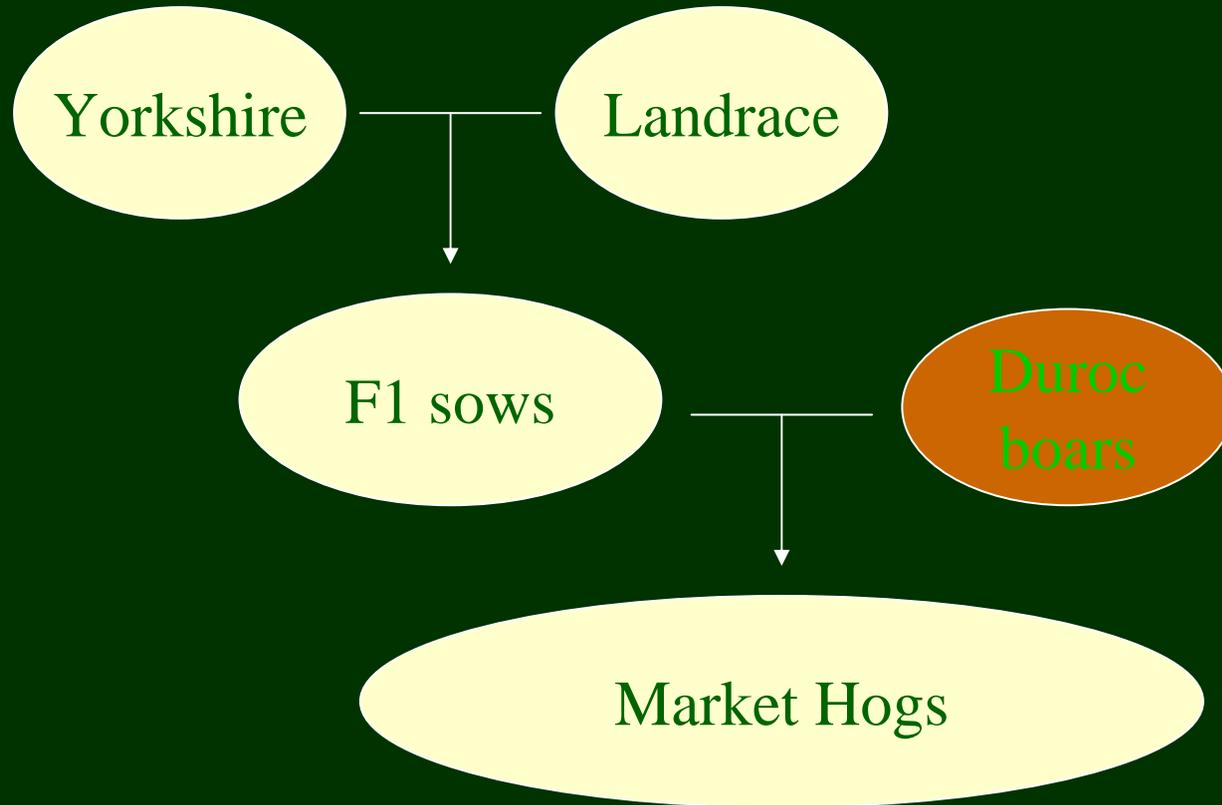# Breeding Stock Exports in Dollar Value
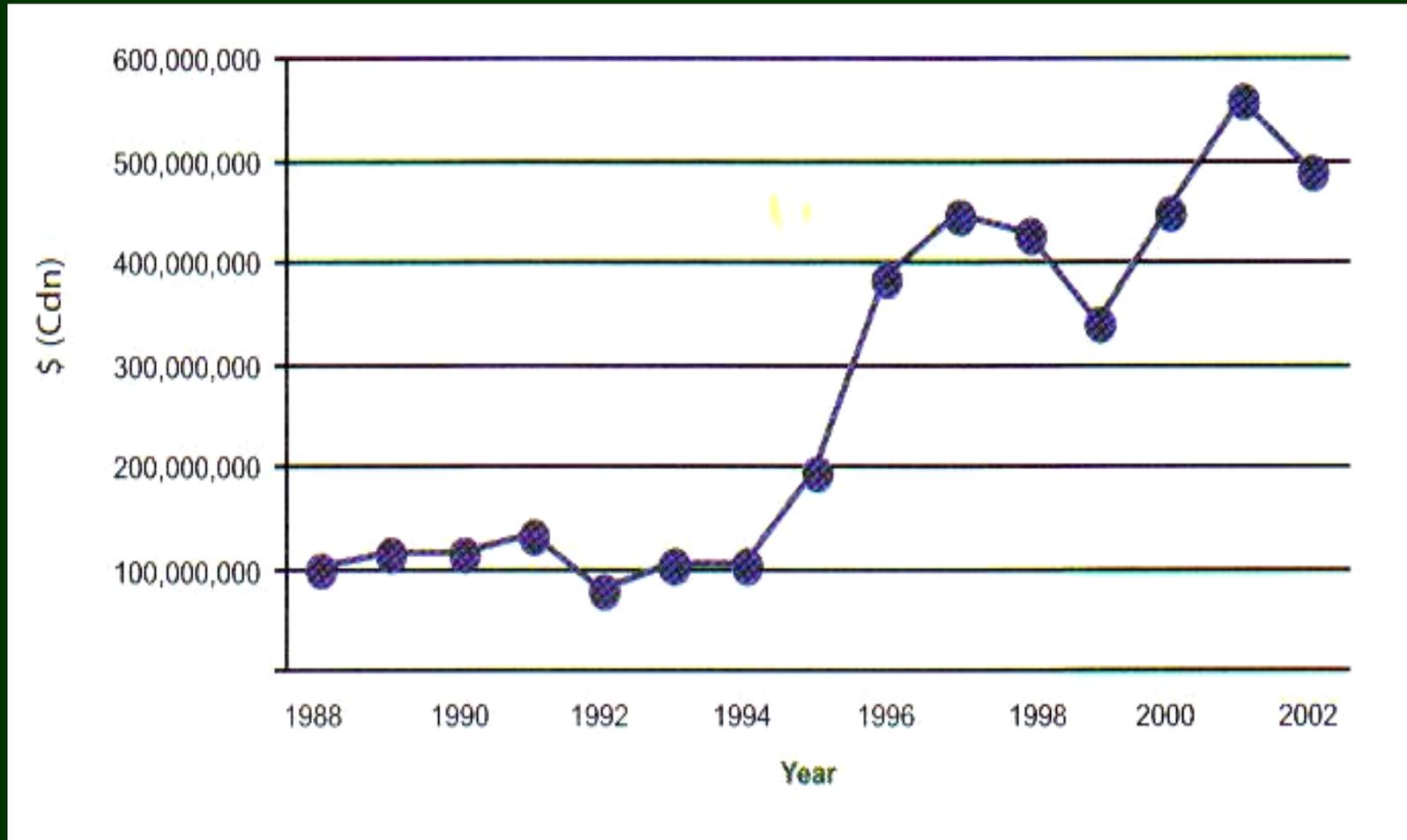
Major Swine Breeds In Canada*

- Yorkshire   51%
- Landrace   29%
- Duroc   19%
- Others   0.5%

*Per cent of total registrations in 2004

Why use purebred parents for crossbreeding

- The purebred parents are from large populations where maximum selection progress can take place without risk of high inbreeding rate

- The purebred parents are from distinct breeds, therefore benefit from maximum hybrid vigor (heterosis)

- Results of crossbreeding from these breeds are predictable, i.e. "you know what you are getting".

Canadian Pork Export in Dollars
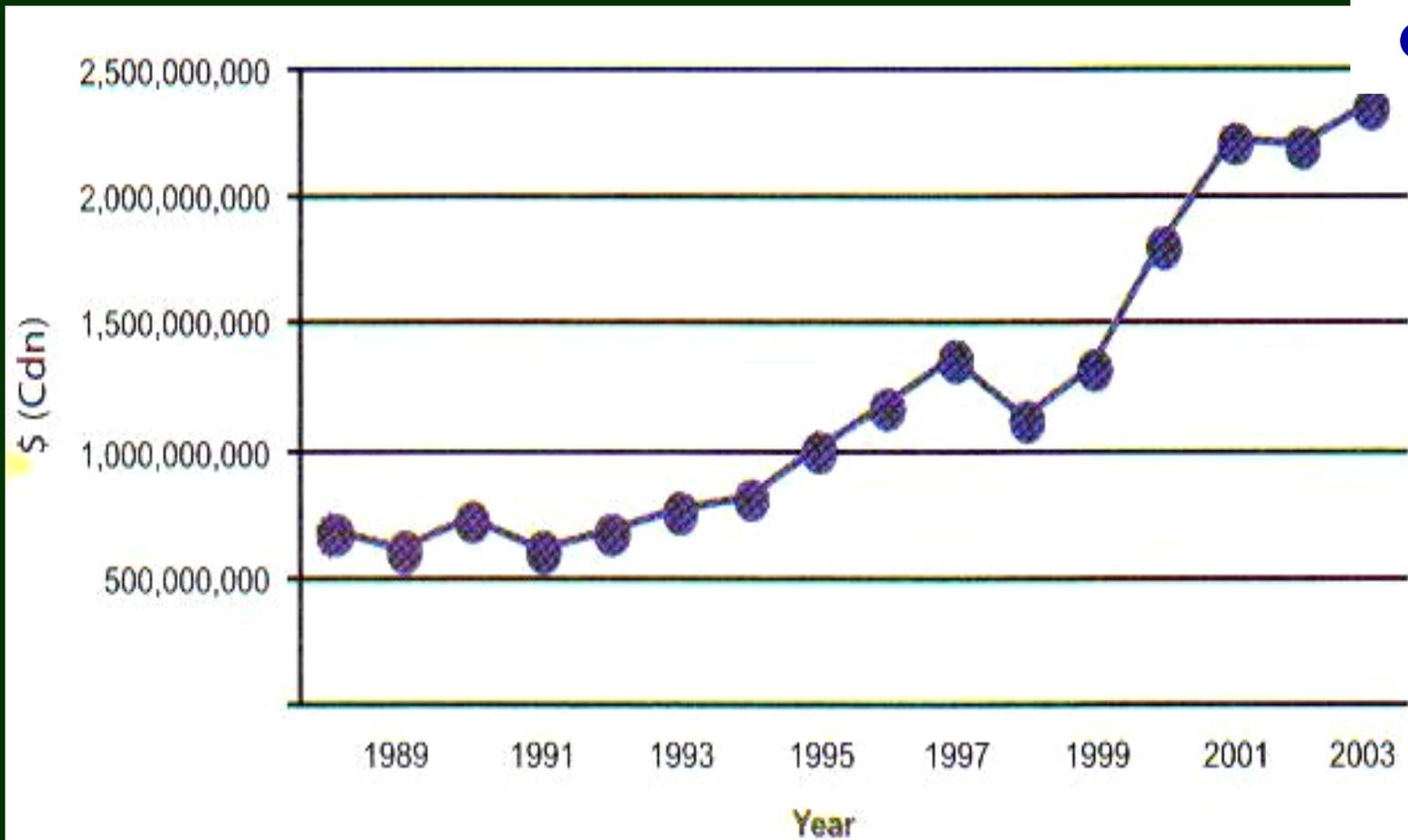
$2.65 Billion in 2004

Canada: The Second Largest Pork Exporting Country

Country	Total amount (tons)	Share in world pork exports
Canada	970,000	~22%
USA	~1,000,000	~23%
EU	1,400,000	~32%

Source: Foreign Agricultural Service, USDA, 2004

Research and Development

- The success in pork production depends on many factors. Genetic improvement is one of the most important ones.

- To keep Canadian swine genetics fast progress, CSIP has committed to remain at the leading edge of technological advances through R & D activities

Research and Development

Research collaborations

- Breeders, breeding companies and packing industry

- Federal government research laboratories

- Canadian universities

- Regional Centres (ASC, OSI, CDPQ, WSTA)

Research and Development

1. Selection strategies	**2. Quantitative methods**
3. Molecular genetics	**4. Optimum use of genetics**

Heavier carcass weights

- The project supported by government and swine industry
- "Heavier carcass weights and pork quality : performance testing of purebred pigs from the Canadian Swine Improvement Program"
- Packers demand heavier hogs.
- What would happen to carcass and meat quality if carcass weight is increased ?
- The project is to investigate this influence .
- Compare the hogs slaughtered in two groups: Current (107 kg) and heavier (125 kg)

Use of molecular information

- Projects supported by government and swine industry.
- "Uses of molecular information for addressing current and emerging issues for the quality of Canadian pork".
- To test specific genes useful for swine improvement, such as IGF2 gene and HFABP gene, under Canadian conditions.
- Develop the strategic plan and guideline for use of molecular information in the Canadian swine industry

Halothane gene

- Negative effect on meat quality.

- HAL-1843 test discovered by University of Toronto in Canada

- Halothane gene are screened among AI sires and also among purebred dams

- Halothane gene is practically eradicated so far in nucleus populations of three major breeds.

RN Gene

- Normal (rn+) vs. Carriers (RN-)

- Higher drip loss, Lower pH, Red, soft, exudative pork (RSE)

- Economic Loss: $14/carrier pig

Canadian RN Gene Study

Breed	rn+/rn+ (free)	RN - /rn+ (single carrier)	RN - /RN - (double carrier)
Duroc	116	0	0
Yorkshire	110	0	0
Landrace	79	0	0

Source: FRDC, CCSI, INRA, June 2001

IGF2 gene

- Location: The distal end of SSC2p
- Highly polymorphic: e.g. LW, P, B, Y and W
- Imprinting gene, only paternal gene expressed
- Phenotypic effect: Major gene for Lean growth

  A (G-A) SNP in IGF2: add 3-4% more lean meat

Uses of IGF2 gene

- **Leaner hogs**
- **Leanness uniformity**
  - Maternal genes at the locus not expressed
  - A homozygous sire, especially AI sire, can produce a large number of progeny that have equal effect at the locus
  - IGF2 gene has a very large effect

- **The imprinting could be used for producing hogs with desired leanness from fatter dams**

- **AI sires have been tested in Canada. The strategies for using this gene is in development**

HFABP gene

Effect on Intramuscular fat	Source
.40 %	Gerben et al. (1999)
.36 %	Gerben et al. (2000)
.30 % (with AFABP)	Meadus (2001)

- 25% of pork loins are under consumers' acceptance threshold of IMF

- HFABP can be used to increase intramuscular fat.

Molecular genetics: New Opportunities

- Swine gene mapping study has advanced rapidly: Over 900 genes and 2000 markers discovered.
- New genomic technologies, such as microarray, SNP genotyping, are in development for use in swine improvement.
- Swine Genome Sequence Program is under way
- Molecular genetics makes it possible to do genotypic selection and accelerate swine improvement.
- R & D activities of swine industries are important to monitor the development of the new techniques, in order to catch the opportunities provided by the new technologies in time.
- Currently, molecular genetics is a major R & D activity.

Thank you

For more information,
visit CCSI web site at:
www.ccsi.ca