# EFFECT OF MC4R GENOTYPE ON GROWTH, FAT DEPOSITION, APPETITE AND FEED EFFICIENCY IN CANADIAN PIGS

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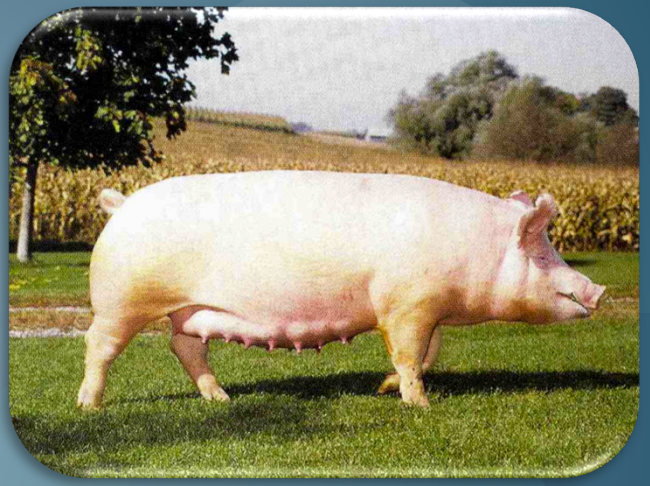
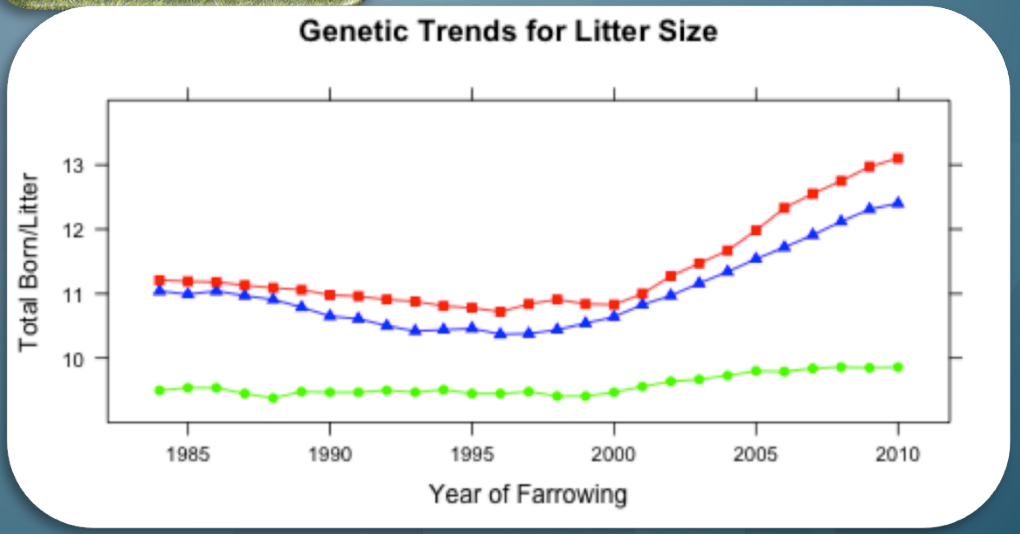
# Classical selection





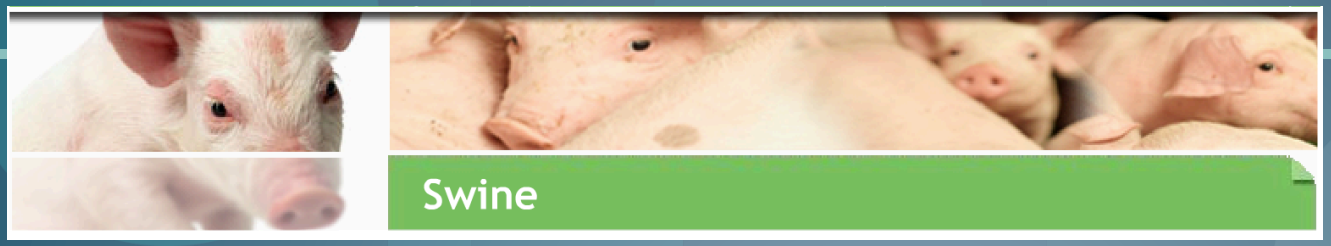
# Swine Genomics Project


- **Developing new genomic tools to**
  - **Improve meat quality traits**
  - Enhance product differentiation through meat quality and Improve production efficiency
- **Specific objectives:**
  - Build a large database with phenotypic and genotypic data collected in different swine breeds
  - Study relationships between genetic markers, performances and meat quality in pigs from different breeds
  - Develop new methods to include genomic information into swine genetic evaluations
  - Develop guidelines and recommendations on the use of genomic data in swine breeding programs

# Genomics Project Team

- **Canadian Centre for Swine Improvement (CCSI)**
  - Brian Sullivan, Laurence Maignel, Stefanie Wyss, Jim Groves and Mohsen Jafarikia
- **Agriculture and Agri-Food Canada**
  - Marie-France Palin, Dairy and Swine R & D Centre
  - Claude Gariépy, Food Research and Development Centre
  - Nicolas Devillers, Swine welfare and behaviour
- **Centre de développement du porc du Québec (CDPQ)**
  - Frédéric Fortin
- **Canadian Swine Breeders**
- **Laval University**
  - Claude Robert, Département des Sciences animales
- **University of Guelph**
  - Flavio Schenkel, Centre for Genetic Improvement of Livestock (CGIL)

# 60K SNP panel & Candidate Genes




DNA LandMarks

- **Growth, feed efficiency, carcass and meat quality**
  - **MC4R**, HMGA1, PRKAG3, CAST, CCKAR, HAL
- **Litter size and sow longevity**
  - ESR, IGFBP1, CCR7, CPT1A

Agriculture and Agri-Food Canada
www.agr.gc.ca

- **Sow productivity**
  - Adiponectin and receptor genes
    - ADIPOR1, ADIPOR2, ADIPOQ

# MC4R- overview

- MelanoCortin-4 Receptor: **MC4R**
- Plays a vital role in energy homeostasis
- A missense mutation in amino acid Asp298Asn
  - Affect growth rate and fat deposition
  - Significant effects on feed intake and lean meat percentage
  - Differences in feed efficiency varied and were often not significant.
- In comparison to G allele, pigs with A:
  - 170 g/day more feed intake
  - Were fatter by 1 to 2 mm
  - 4 to 5 days faster to a set market weight

**(Kim *et al*. 2000, 2004)**

# Objectives

- Estimate the frequency of this mutation in major Canadian pig breeds
- Investigate the effect on:
  - Average Daily Gain (ADG)
  - BackFat Thickness (BFT)
  - Average Daily Feed Intake (ADFI)
  - Feed Conversion Ratio (FCR)
- Provide guidelines for application to the Canadian swine industry

# Materials & Methods

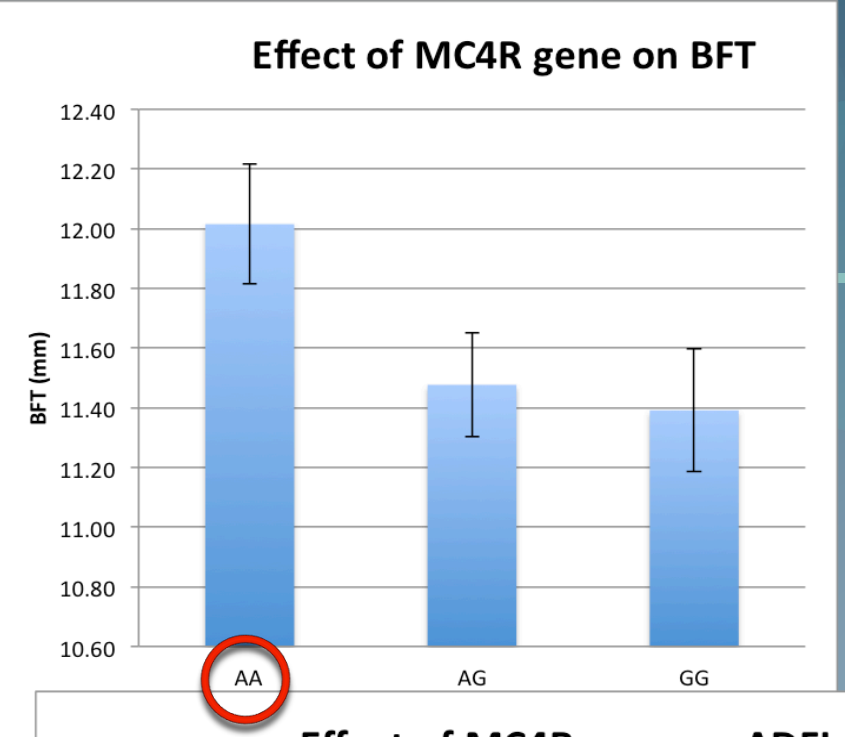
- Deschambault test station in Quebec over four trials in 2004 & 2010
- Animals genotyped for MC4R
  - 722 barrows, 162 females and 138 males
  - 277 Duroc, 304 Landrace and 441 Yorkshire
  - Entered the nursery at:
    - Average age of 17.9±4.5 days
    - Average weight of 5.3±1.4 kg
  - Transferred to finishing pens at:
    - An average age of 69.2±7.0 days
    - Average on-test weight of 29.4±7.1 kg
  - On average, animals spent 92.5±15.0 days on test
  - Had an average off-test weight of 118.0±8.7 kg

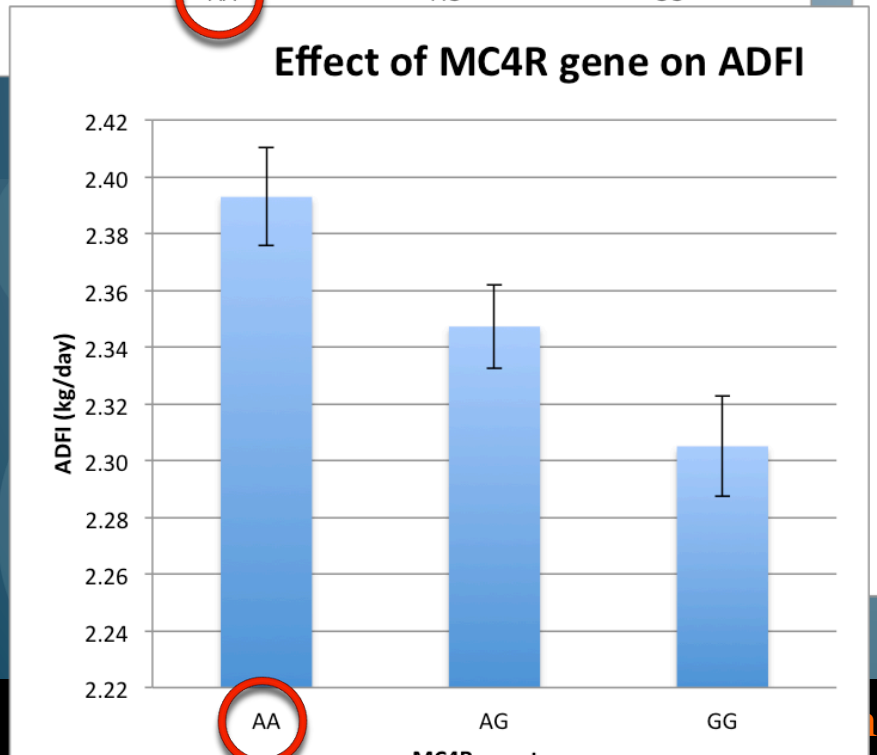
# Statistical Model

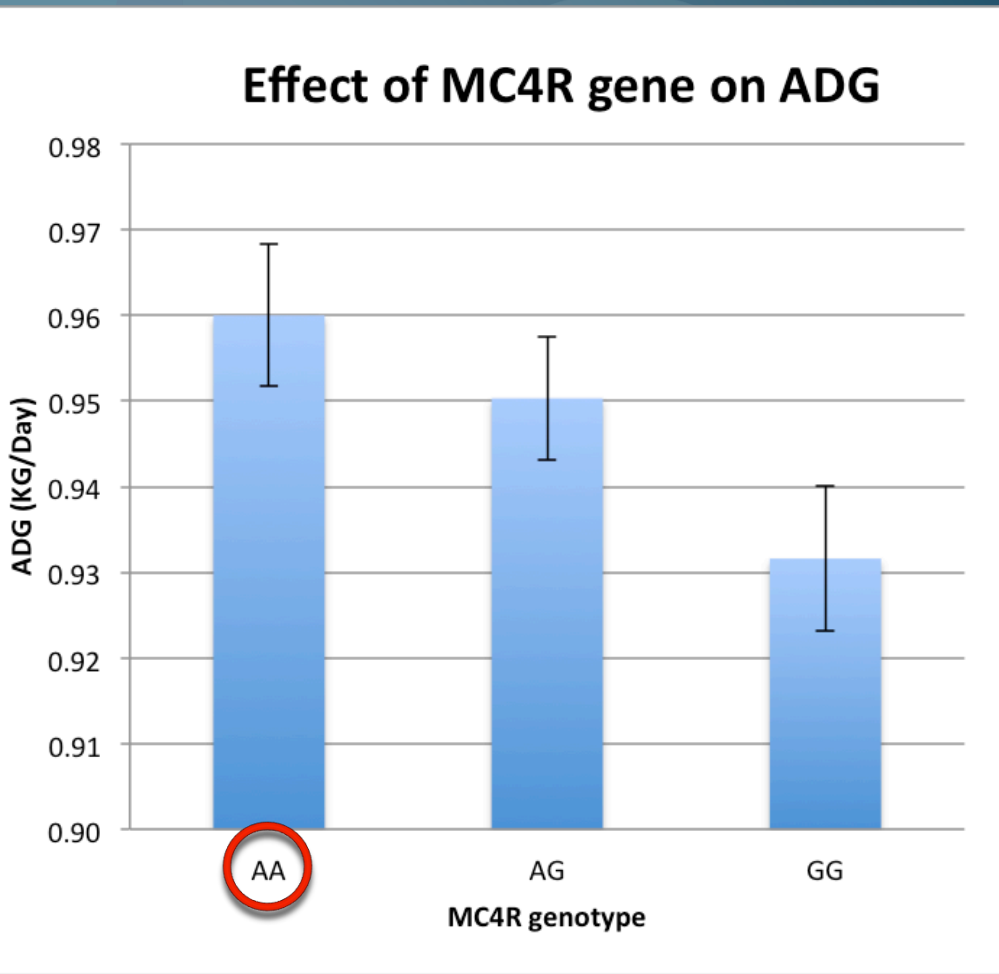
- Fixed effects
  - MC4R genotype
  - Interaction of sex, breed and trial
  - On-test age and weight as covariates
- Random effects
  - Pen within trial
  - Farm of origin within trial
  - Birth litter

# Results

- Frequency of MC4R (G allele):
  - 0.33 Duroc
  - 0.77 Landrace
  - 0.48 Yorkshire
- Significant effect on:
  - ADG, BFT and ADFI ($p<0.01$)
- Not a significant effect on FCR
- In comparison to GG, AA pigs had:
  - 30±1 g/day greater average daily gain
  - 0.6±0.2 mm thicker backfat
  - 90±2 g/day more feed consumption


Effect of MC4R gene on BFT
BFT (mm)
12.40
12.20
12.00
11.80
11.60
11.40
11.20
11.00
10.80
10.60
AA
AG
GG


Effect of MC4R gene on ADFI
ADFI (kg/day)
2.42
2.40
2.38
2.36
2.34
2.32
2.30
2.28
2.26
2.24
2.22
AA
AG
GG


Effect of MC4R gene on ADG
ADG (KG/Day)
0.98
0.97
0.96
0.95
0.94
0.93
0.92
0.91
0.90
AA
AG
GG
MC4R genotype

# Implication of MC4R

- Including MC4R in BLUP evaluation
  - Increase EBV accuracy
    - Increase genetic progress
      - ADG, ADFI, BFT
- Increasing appetite
- Higher fat without adversely affecting feed efficiency
  - Fertility problems in lean dams

# Acknowledgements

- **Breeders on the Canadian Swine Improvement Program**
- **CCSI's regional centers**
  - Atlantic Swine Centre
  - Centre de développement du porc du Québec
  - Ontario Swine Improvement
  - Western Swine Testing Association
- **Financial support**
  - Agriculture and Agri-Food Canada
  - Conseil pour le developpement de l'agriculture du Quebec, New Brunswick, Nova Scotia, Manitoba, Ontario
  - Ministere de l'Agriculture, des Pêcheries et de l'Alimentation du Québec
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# Our success depends on Technology and Open collaboration

Thank You !