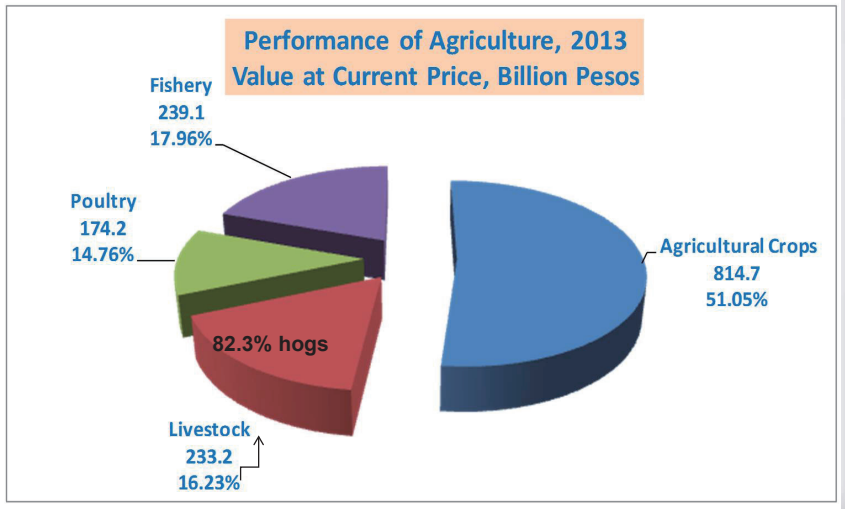
Pig Genetic Networking – Philippines & Taiwan
Swine Genomics R&D in the Philippines

Genomic Screening Technology for Pig Herd Performance Improvement

Ester B. Flores
Project Development Officer IV
Philippine Carabao Center National Headquarters
Muñoz, Nueva Ecija Philippines

Introduction



Common Commercial breeds

Landrace X Large White

Philippine native pig

F1 X

Duroc

Pietrain

Market hogs

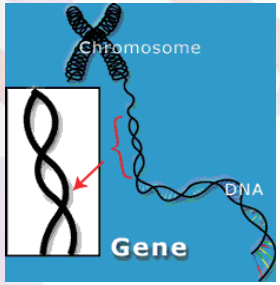
Utilization of DNA marker Selection in Breeder and Commercial Farms: Project Objectives

- ✓ Promote the adoption of molecular methods of selection by local swine raisers to improve prolificacy and production efficiency thru the establishment of a private-sector operated swine genomics service laboratory
- ✓ Validate and estimate the effect of favorable genotype on different traits both at the level of nucleus (purebred GGP, GP) and commercial herds for positive traits
- ✓ Provide assistance in the use of genomic information in the breeding program for individual herds

Strategy...

Marker-Assisted-Selection (MAS) is the process of using DNA evaluation results to assists in the selection of individuals that would be parents of the next generation.

7 gene markers for screening of genetic defects and disease resistance:
PSS, RN, BAX, MX1, FUT1, BPI, NRAMP1



10 gene markers for screening of fertility, growth and meat quality traits:
ESR, PRLR, LIF, RBP4, MYOG, MC4R, HFABP, CAST, LEPR, IGF2

Gene Markers

A. Genetic Defects

Gene	Genetic Defect
Halothane (HAL)	Porcine Stress Syndrome
Rendement Napole (RN)	Acid Meat Condition
BCL-2 associated X protein (BAX)	Scrotal Hernia

B. Disease Resistance

Gene	Associated with
Fucosyltransferase 1 (FUT1) gene	Resistance to *E. coli* F18
Myxovirus resistance protein 1 (MX1)	Resistance against influenza virus
Bactericidal/permeability-increasing protein (BPI) gene	Resistance against *Salmonella*
Natural Resistance-associated Macrophage Protein 1 Encoding (NRAMP1) gene	Immune function and production performance

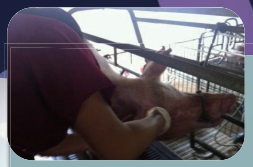
Gene Markers

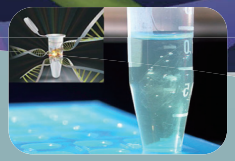
A. Fertility traits

Gene	Associated with
Estrogen receptor (ESR), Prolactin receptor (PRLR), Leukocyte Inhibitory factor (LIF)	Litter size
Retinol binding protein 4(RBP4)	Litter size, Sperm quality

B. Growth and meat quality traits

Gene	Associated with
Myogenin (MYOG)	Average Daily Gain and muscle mass
Heart-fatty acid binding protein (HFABP)	Intramuscular fat (IMF)
Insulin-like growth factor 2 (IGF2)	Leanness
Leptin receptor (LEPR), Melanocortin-4 receptor (MC4R)	Body composition and fat


Blood Collection

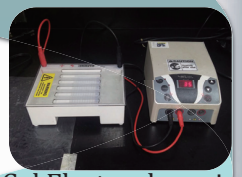

DNA Extraction


PCR Amplification

Methodology

Data analysis

- **Genotypic and allelic frequencies**
  - **1,272 samples - Landrace, Large White, Duroc**
- **Estimation of marker effect on fertility traits**

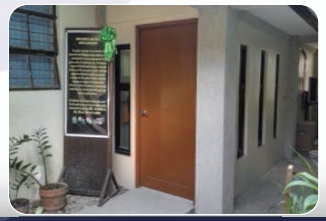

Gel Electrophoresis


UV Transillumination

Swine Genetic Analytical Service Laboratory (SGASL)

- All samples tested at the SGASL
- Inaugurated on March 2016






RESULTS

Genotypic and allelic frequency for markers of genes associated with fertility

GENE	Distribution of genotypes (%)			Allele frequencies	
	AA	AB	BB	A	B
ESR	39.92	57.9	**2.20****	68.87	31.15
PRLR	**18.77****	47.19	34.04	42.37	57.63
RBP4	**37.90****	54.4	7.8	65.10	35.00
LIF	25.42	40.62	**33.95****	45.73	54.26

Note: percentages in blue fonts are of desired genotypes

RESULTS

Genotypic and allelic frequency of genes for growth and meat quality

GENE	Distribution of genotypes (%)			Allele frequencies	
	AA	AB	BB	A	B
MYOG	**99.2****	0.80	-	99.6	0.40
LEPR	16.93	38.69	**44.37****	36.28	63.72
IGF2	**44.56****	43.54	11.90	66.33	33.67
H-FABP GENE RFLP					
HaeIII	39.57	43.25	**17.1****	61.20	**38.80**
MspI	**3.06****	15.38	81.56	**10.75**	89.25
HinfI	**3.14**	33.43	63.43	**19.9**	80.14

Note: percentages in blue fonts are of desired genotypes

RESULTS

Genotypic frequency for *Hal, BAX* and *RN* gene in the pig population

Gene	Genetic defect	No. of samples	Genotype Frequency		
			Normal	Carrier	Mutant
Hal	Porcine Stress Syndrome	1463	**93.51**	5.04	1.45
RN	Acid Meat	1457	**91.07**	5.33	3.61
BAX	Scrotal Hernia	1256	**96.29**	2.21	1.50

Note: percentages in blue fonts are of desired genotypes

RESULTS

Genotypic frequency for the screening of disease resistance in the pig population

Gene	Associated with	No. of samples	Genotype Frequency		
			Resistant	Heterozygous	Susceptible
FUT1	Resistance to *E. coli* F18	1312	3.96	34.68*	61.36*
MX1	Resistance against influenza virus	1348	79.90	18.25	1.85
BPI	Resistance against Salmonella	1397	98.93	0.86	0.21
NRAMP1	Immune function and production performance	1251	43.25	48.92	7.83

**For FUT1 gene, the heterozygous and susceptible genotype are considered as Sensitive to E. coli F18*

Average number of piglets born alive per litter of sows carrying favorable alleles of genes for fertility

GENE	GENOTYPE					
	AA		AB		BB	
	Mean	SE	Mean	SE	Mean	SE
ESR	9.8	0.49	10.2	0.54	**10.6***	0.71
PRLR	**9.8***	0.68	9.5	0.58	10.2	0.47
LIF	10.0	0.69	10.0	0.51	**9.6***	0.64

***Desirable genotype**

Average marker effect for ESR gene on no. of piglets born live per parity

Parity No.	GENOTYPE						Overall Average	N
	AA		AB		BB			
	Mean	N	Mean	N	Mean	N		
1	10.6	9	12.4	19	11.7	15	11.7	43
2	9.7	9	10.9	19	11.2	15	10.6	43
3	12.6	9	12.2	14	13.5	10	12.7	33
Average/ genotype	11.4	37	11.5	70	11.7	56	11.5	163

Results shown is data from a single herd only

Average farrowing interval of sows carrying favorable alleles of genes for fertility traits

GENE	GENOTYPE					
	AA		AB		BB	
	Mean, dd	SE	Mean, dd	SE	Mean, dd	SE
ESR	158.2	3.4	156.7	3.8	**154.2****	5.3
PRLR	**160.5****	6.0	158.0	5.2	157.2	4.0
LIF	162.6	5.7	156.76	3.8	**155.8****	4.9

****Desirable genotype**

RESULTS

Gene marker effect on fertility from analysis of data of a single herd with purebred Landrace and Large white sows

Trait	Breed		ESR		PRLR			LIF		
	L	LW	AA	AB**	AA**	AB	BB	AA	AB	BB**
FI, 1st parity	**193**	**184**	197	**180**	**166**	197.5	202	230	172.2	**164**
LS, 1st parity	**7**	**8.6**	7.3	**8.3**	**9**	6.8	7.6	7.2	7.7	**8.6**
BW, kg	**1.4**	**1.4**	1.3	**1.5**	**1.5**	1.4	1.4	1.5	1.2	**1.4**
WW, kg	**7.9**	**8**	8	**7.9**	**7.7**	8.2	8	8.3	7.8	**7.8**

***Favorable genotype, L-Landrace, LW-Large White, FI – farrowing interval, LS – Litter size, BW – birth weight, WW – weaning weight*

Genotype frequencies of selected markers in a local native pig herd

Marbling (HFAB)		ESR		FUT1	
Haplotype group code	Freq (%)	Genotype	Freq (%)	Genotype	Freq (%)
HL5	18.2	AA	86.4	AA	50.0
HL4	50.0	AB	13.6	AG	40.9
HL3	27.3			GG	9.1
LL2	4.5				

Summary

- Sows carrying the favorable genotype for ESR gene has, on the average, more piglets born alive
- Sows carrying the favorable genotype for LIF gene has, on the average, shorter farrowing interval
- Native pigs appears to have a higher percentage of favorable alleles of markers for marbling gene than commercial pigs

Acknowledgement

PCAARRD

DEPARTMENT OF AGRICULTURE 1898

DEPARTMENT OF AGRICULTURE BUREAU OF ANIMAL INDUSTRY DA

ACCREDITED SWINE Breeders Association of the Philippines