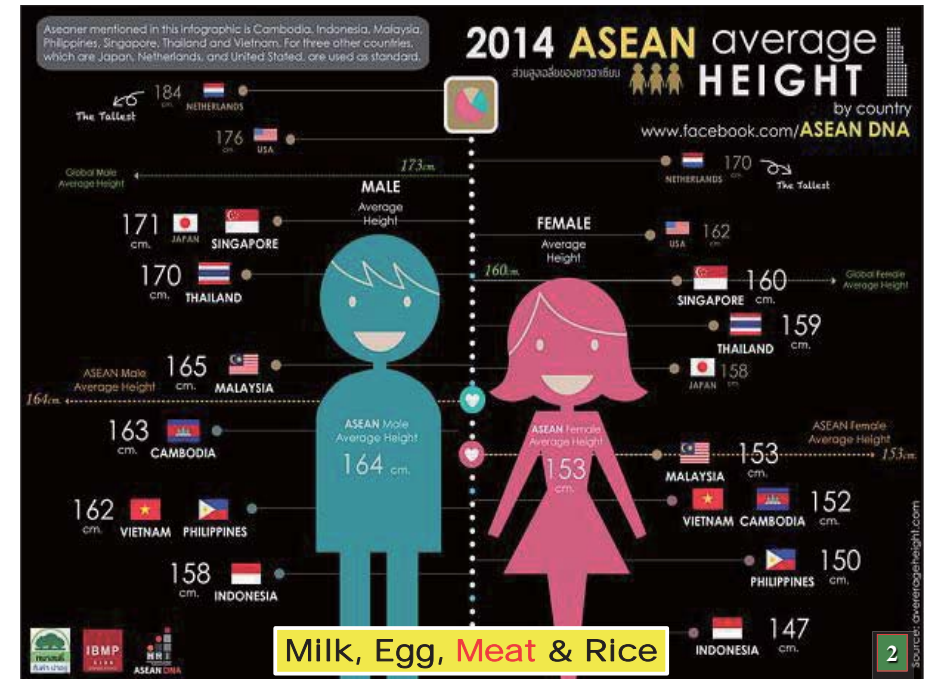


Web-based Operation for Boar Growth Performance Test Station in Taiwan

種用登錄 Genetic
全胎檢定 Reproduction
基因選種 Evaluation
市場拓展 Auction
創新加值 Taiwan-value

Mr. Ming-Che WU, Ph.D.
Division Chief of Breeding and Genetics
Taiwan Livestock Research Institute (TLRI)
mcwu@mail.tlri.gov.tw

Touch Your Heart



Ms. Dr. Ruth Miclat-Sonaco
Mr. Roberto Lumagbas Castro
Mr. Cristino E Balancio
Ms. Amy G Egula
2015年12月15日





Far-East Asia Networking of Dairy Technology Connected with ICAR Guidelnes for Young Farmers



Asterin J. Salles, Ph.D.
Director General
ATTI

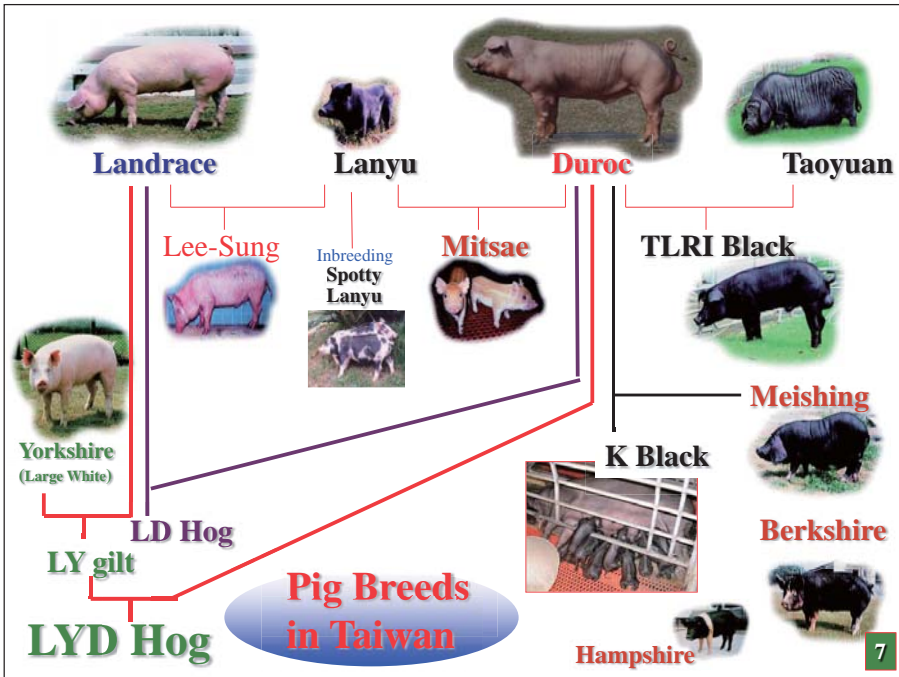
Yu Shin Cheng
Director General
TLRI

2016/05/24
Tainan, Taiwan

菲律賓農業部輔導署與行政院農業委員會畜產試驗所合作意願書簽署後團體照
Group photo after MOU signature of ATTI and TLRI on May 24, 2016
見證人：Dr. Kwang-Jin Han(Korea), Dr. Thaneek Pak-Uthai(Thailand), Dr. Jay Mattison(USA), Dr. Akio Takenaka(Japan), Dr. Nguyen Duc Trong(Vietnam), Dr. Daniel Abernethy(Australia)

Outline

1. Breed Resources
2. Pedigree on the Web
3. Growth Performance Test
4. Gene-marker Application
5. Meat Quality Improvement
6. Total Sperm Count Selection
7. Conclusion



http://www.angrin.tlri.gov.tw/pig_all.htm

Pig Web

03575

- Breed
- Bear Semen Net
- Pedigree Reg. of D, L & Y
- Number of Teats
- Litter Size at Birth
- Award Movie
- Growth Performance
- Test/Class
- Body Weight at 70 Day Old
- Body Weight at 150 Day Old
- Growth Trait Data
- Selection Index since 1975
- Chr 6 Stress Gene Hal-1843
- Chr 1 Reproduction ESR
- Chr 16 Reproduction PRLR
- Chr XY Line Marker
- Chr 6 Meat Quality HFABP
- Chr 2 Meat Quality IGF2in3
- Chr 2 Meat Quality IGF2in7
- Pig Photo and Video
- Top Records

種豬產業發展里程

1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 2014 種豬品質提升年

http://www.angrin.tlri.gov.tw/english/index_pig.htm

9

Regulation for Genomic Breeding of Farm Animals in Taiwan

Animal Industry Act Article 17

The competent authority may dispatch inspector to examine or test **the breeding flock**, breeding stock, facilities, pedigree registry and related records of breeders, and the breeders shall not evade, interfere with or object to such **examination** or **testing**.

Breeding flock or breeding stock found to have contracted notified disease or have **hereditary disease** during the aforesaid examination or testing shall be **banned from breeding**. The aforesaid inspectors shall present their identification when carrying out their duty.

9

Technology Chain for Breeding Pig Industry

Birth Recording	Trait Performance Test	Pedigree Registration	Auction
Mating date of female (NS/AI)	Pigs born (male/female) Teat number (left/right)	Basic Pedigree Growth Performance (GP)	Test Station (7.5 months old)– Duroc
Birth weight	Birth weight	Reproductive Performance (RP)	Landrace
Farrowing date of sows (F/AF)	3-week body weight	Superb GP	Yorkshire
Birth pedigree: Sire Dam Sire of Sire Dam of Sire Sire of Dam Dam of Dam	5-month body weight	Superb RP	FFASI (8~10 months old) – Duroc
	Day of age at 110(100) kg BW (male/female)	Plum Blossom Award	Landrace
	Back fat thickness at 110(100) kg BW (M/F)	Genotype – Hal-1843(CRC)	Yorkshire
	40~110 (100) kg body weight (male/female) – Average daily gain	ESR	Berkshire
	Feed efficiency (FE)	HFABP	Black
	Body conformation evaluation	IGF2in7	
	Conformation trait (length, width, height, depth)	IGF2in3	
	Semen quality (Total sperm counts , normality)	PRLR	
	Day age to be sire or dam (Age at first litter)	XY-markers	

Pedigree Registration: NAIF

Performance Test Station: Hsinhua (Farm should have at least 30 registered sows of one breed.)

Genotyping: TLRI, NPTU (Prof. HL Chang), NAIF

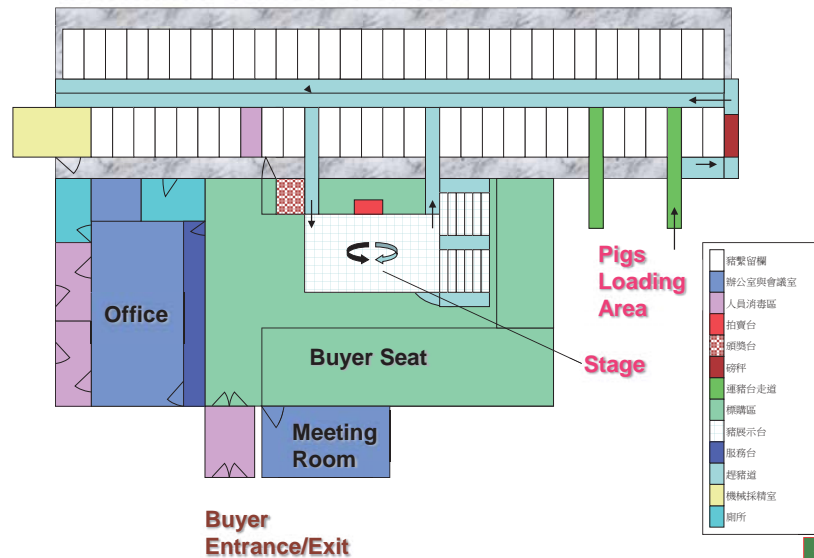
Conformation Evaluation: YY Sung, LC Hsia, RC Weng, YY Lai, PH Wang

Hoof Evaluation: TLRI (NT Yen, KC Liu, KY Lin)

Selection Index: TLRI (MC Wu and YC Huang)

10

Facility Layout for Breeding Pig Auction at Hsinhua Station of Taiwan



11

Hygiene Control

Buyer

Car & Pigs



Sanitation



12

Application of Selection Index for Landrace, Yorkshire and Duroc Breeds of Pig

(66% : 18% : 16%)

1975~1980 I = 250 + 110 ADG - 50 FE - 19.7 BF

1981~1991 I = 100 + 60 ADG - 40 FE - 45 BF
33% : 40% : 27%

1992~2004 (L, Y) I = 100 + 130 ADG - 40 FE - 40 BF
66% : 18% : 16%

2005~2015 L, Y I = 100 + 140 ADG - 60 FE - 30 BF
42% : 43% : 15%
D I = 100 + 120 ADG - 55 FE - 50 BF
40% : 40% : 20%

Trait measurement is the deviation from the class mean

13

Application of Selection Index for Landrace, Yorkshire and Duroc Breeds of Pig

2016 (limit of ADG >=1.0 Kg; FE <=2.20; BF110Kg <=1.45cm)

L, Y I = 100 + 140x(ADG-1.0) - 60x(FE-2.2) - 30x(BF-1.45)
42% : 43% : 15%

D I = 100 + 120x(ADG-1.0) - 55x(FE-2.2) - 50x(BF-1.45)
40% : 40% : 20%

2017~ (limit of genetic gain varied in breeds)

L, Y I = 100 + 140x(ADG-1.020) - 60x(FE-2.120) - 30x(BF-1.397)

D I = 100 + 120x(ADG-1.018) - 55x(FE-2.122) - 50x(BF-1.388)

14

Pig Breeding Database of Taiwan

www.angrin.tlri.gov.tw

AID-COA
TLRI
NAIF
FFASI
NPTU
ATIT

Goal:

Feed efficiency (Feed/Gain) of growing boars from 40 to 110 kg of body weight

FE=3.17 in 1975 and upgraded to FE=2.08 in 2005, projected to FE=1.80 in 2025

Major breed: Duroc

Hsinhua Station
D gilt, The Best



Fortune D0634-11
(FE=1.95) 2005/3/13

Hsinhua Station
D boar, The Best



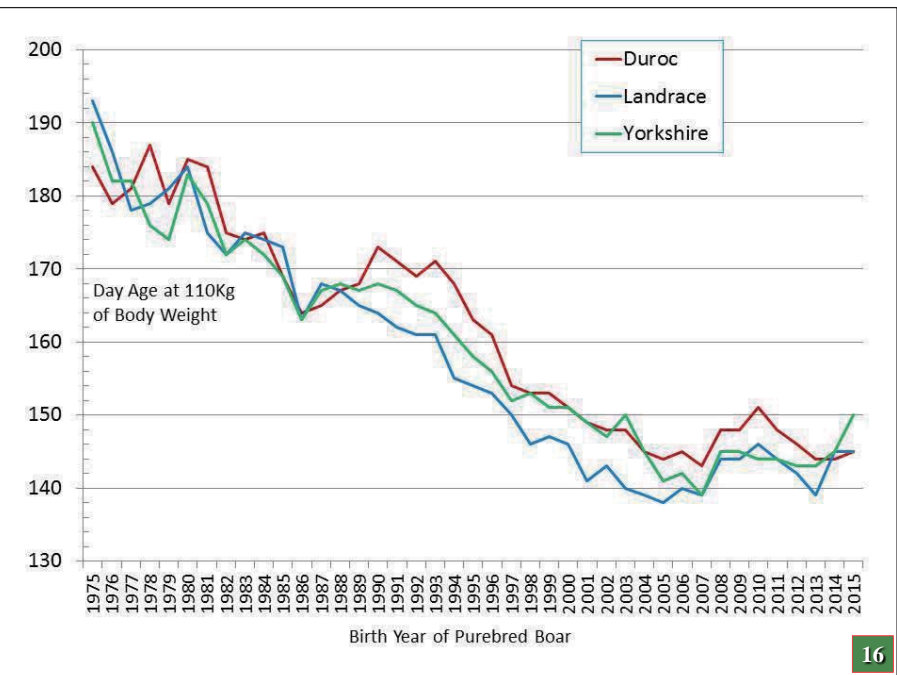
Hwei Huang D0329-05
(FE=1.90) 2003/8/26

Zhunan Station
D boar, The Best

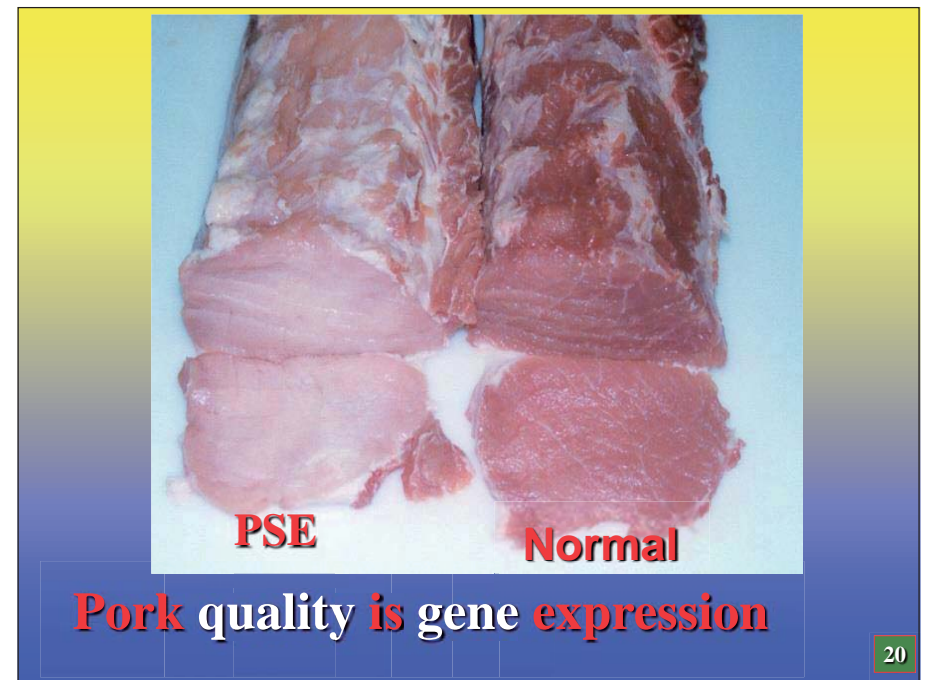
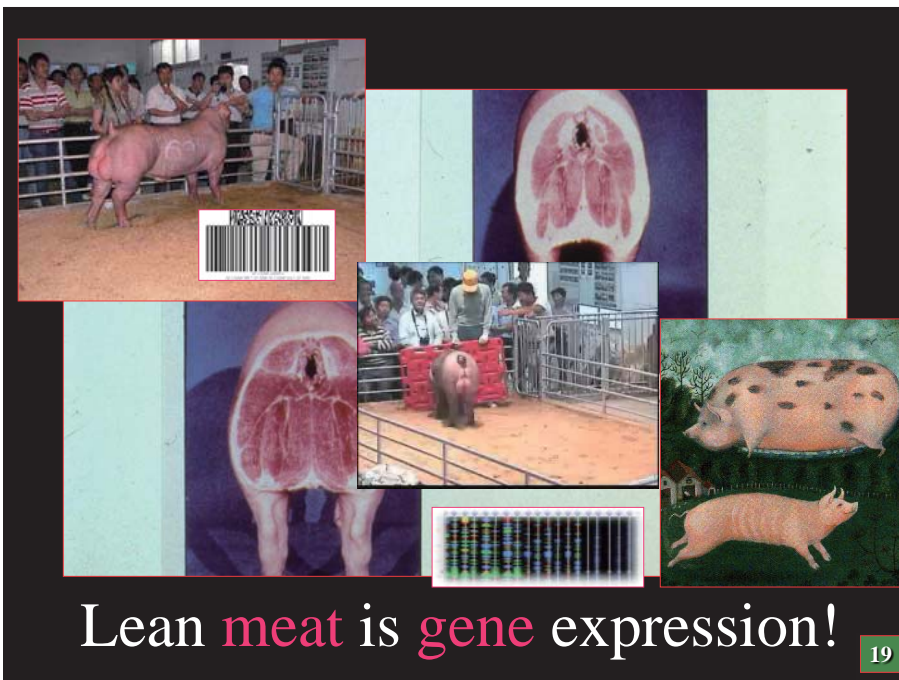
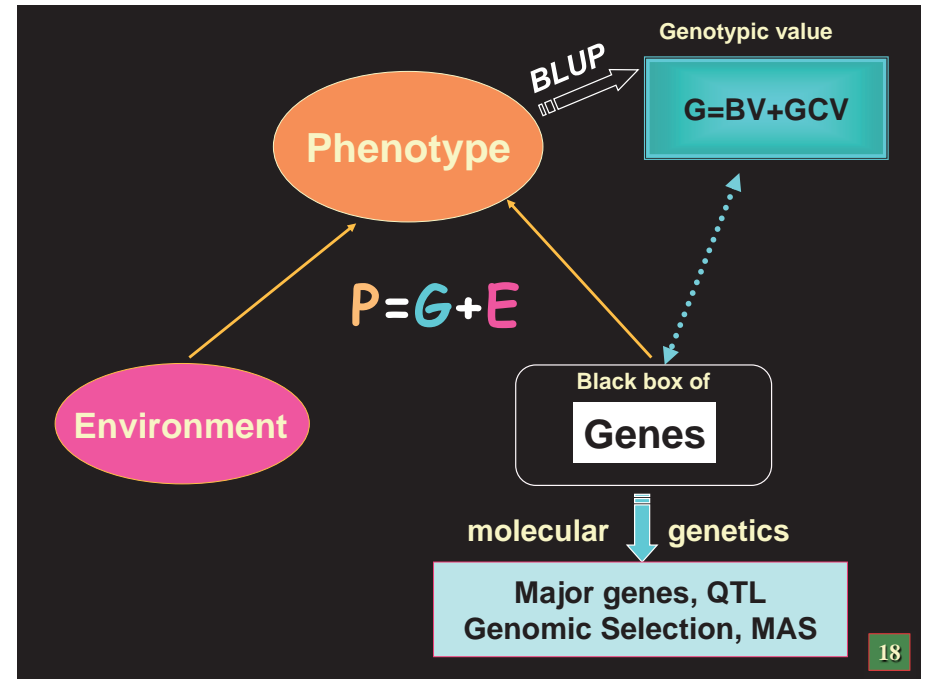
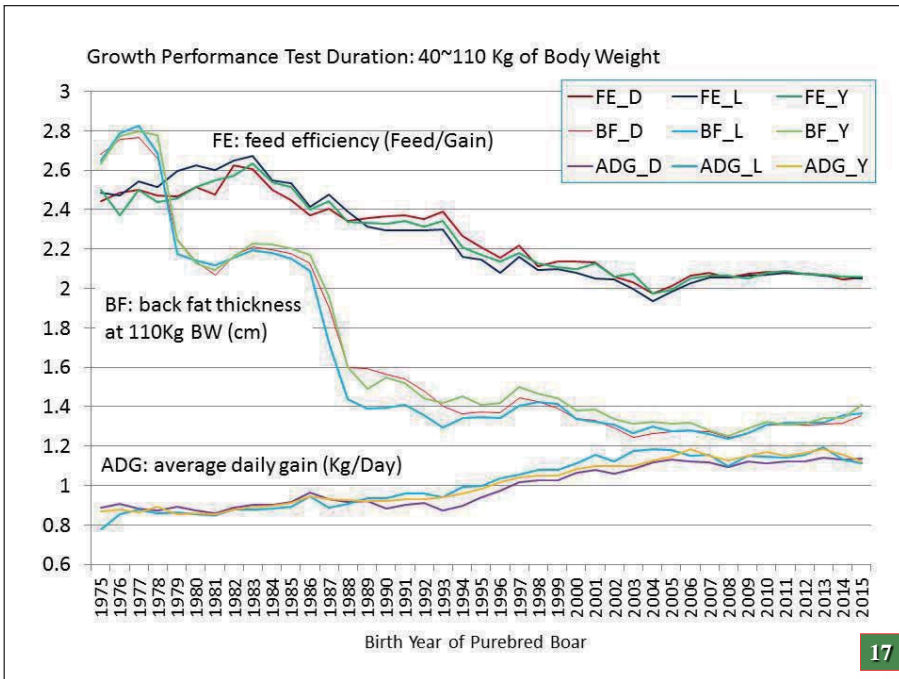


Shun An D0785-01
(FE=1.51) 2004/6/29

15



16



	Color	Firmness/Wetness	Marbling (IMF)	
PSE (Hal-1843 Test) AA				1 (HFABP genotyping)
AB				2
RSE				3
RFN				4
DFD				5
				LL0 LL1 LL2 HL3 HL4 HL5 HH6

Pork marbling is gene expression!

Pork belly is popular in Asian cuisine!

Belly

豬肉部位分切圖 Wholesale cuts of pork

行政院農業委員會 中央畜產會

Genomic Breeding 基因選種

行政院農業委員會畜產試驗所
Livestock Research Institute
Council of Agriculture, Executive Yuan

Elite Animal 優質豬

Marker Genotype Screened by Pig Industry in Taiwan

Favorable genotype	Chr.	Start year
Hal-1843 AA	6	1996
ESR MM + MN	1	2001
HFABP HH6 + HL5	6	2002
IGF27 FF	2	2005
IGF23 QQ	2	2005
PRLR PP+LP	16	2008
XY-marker Sw1325	XY	2012

25



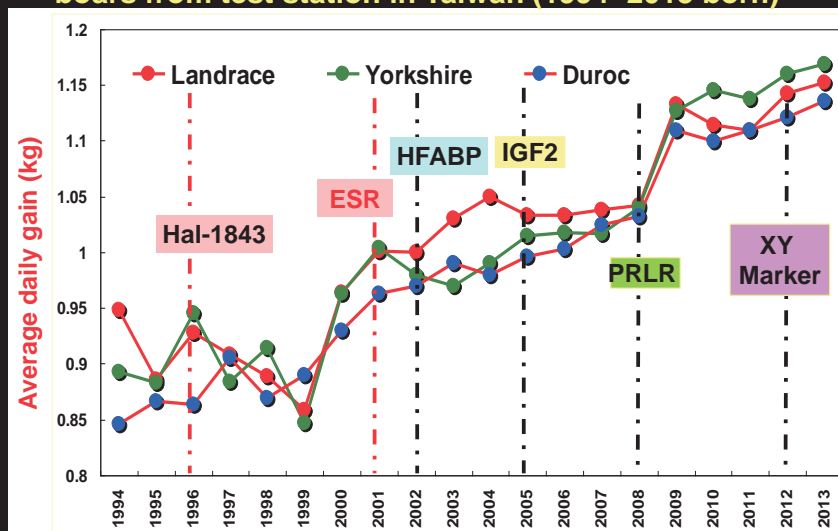
- Meat quality (intramuscular fat or marbling) of pork is related to meat eating quality.
- Fat marbling is designed as the percentage of intramuscular fat.

- H, a and d allele from three loci of heart fatty acid-binding protein (HFABP) gene are favorable alleles to fat marbling.
- Marker group of LL, HL or HH is based upon favorable allele counts:
 0-2 for lower quality (LL)
 3-5 for average quality (HL)
 6 for higher quality (HH)

	aa	Aa	AA	
HH	HH6	HL5	HL4	dd
	HL5	HL4	HL3	Dd
	HL4	HL3	LL2	DD
Hh	HL5	HL4	HL3	dd
	HL4	HL3	LL2	Dd
	HL3	LL2	LL1	DD
hh	HL4	HL3	LL2	dd
	HL3	LL2	LL1	Dd
	LL2	LL1	LL0	DD

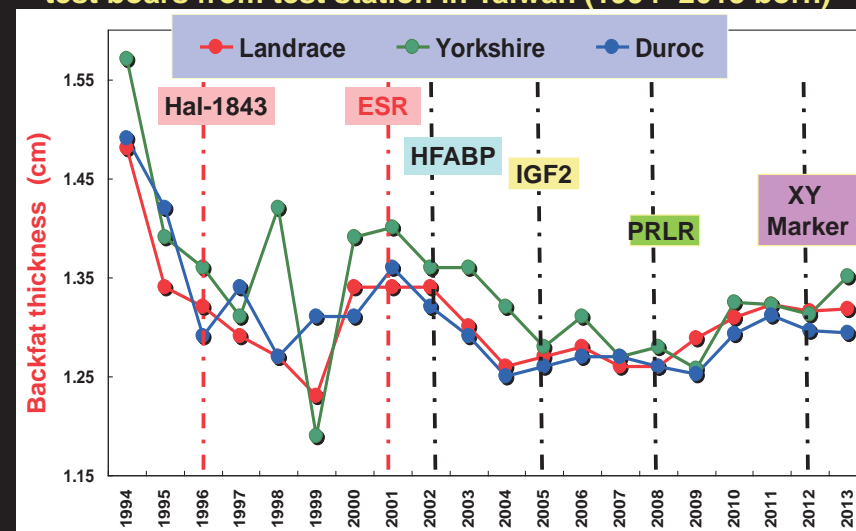
26

Phenotypic trends of average daily gain for off-test boars from test station in Taiwan (1994~2013 born)



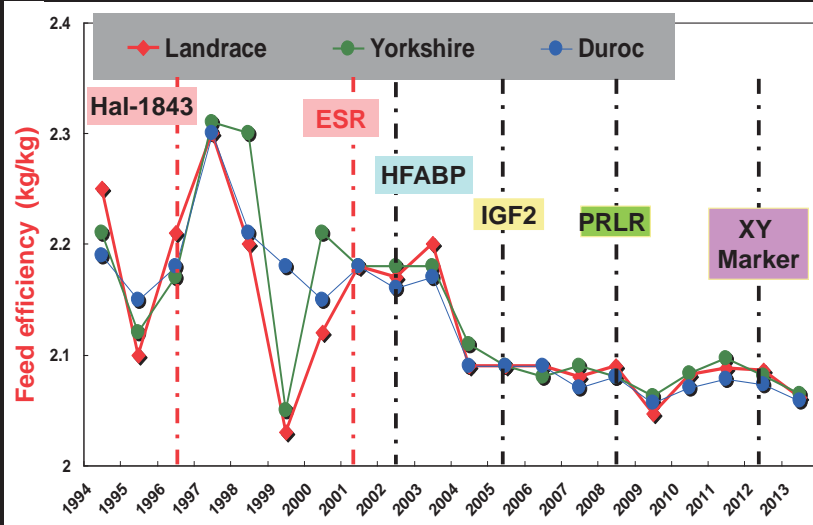
27

Phenotypic trends of backfat thickness at 110 kg for off-test boars from test station in Taiwan (1994~2013 born)



28

Phenotypic trends of feed efficiency (feed/gain) for off-test boars from test station in Taiwan (1994~2013 born)



29

Remarks for Genomic Breeding (MAS)

DNA information can help pig industry to fix a specific desirable major mutation, such as the normal **Halothane** or **PSS** allele.

Molecular information can increase **phenotypic** selection accuracy and response.

The successful breeding program via genomic information mainly depends on the fragment size of **DNA information**, accurate and reliable **pedigree** recording system of breeding stocks, and the integrating efficiency among them.

New genomic information is expanding and become more promising for further **application**.

30

Global meat production is associated with human population

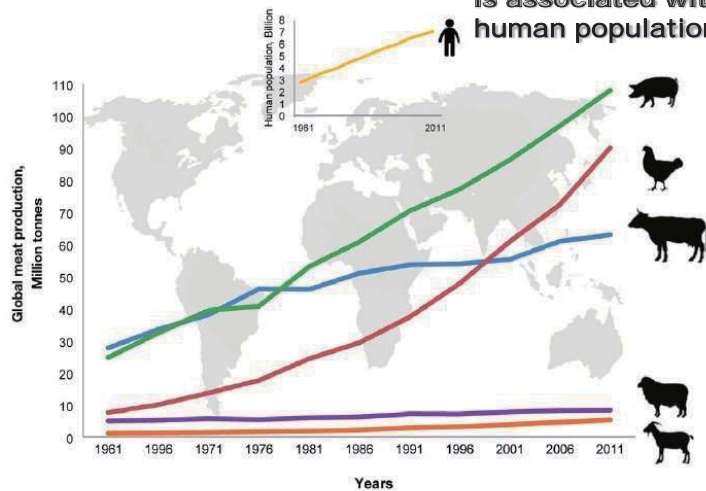


Figure 2. The quantity of meat produced globally from pigs, chickens, cattle, sheep, and goats between 1961 and 2011 (FAOSTAT, 2014), superimposed with the human population growth (UNDESA, 2013) over the same time period.

31

POTENTIAL, OPPORTUNITIES & CHALLENGES



32

Total sperm count per collection in boars within 300 days of age

Male Traits

- Mounting libido
- Penis length
- Corkscrew tip

TSC (Billion) (10E9)	Breed (Collection Date: 2011/1/3-2015/12/9)(N=1566)					TSC (Billion) (10E9)	Breed (Collection Date: 2016/1/4-2017/6/3)(N=406)				
	Head	Duroc	Landrace	Yorkshire	Black		Head	Duroc	Landrace	Yorkshire	Black
230-239	1		1			230-239					
160-169	1		1			160-169					
150-159	3	2	1			150-159					
140-149	4	2	2			140-149					
130-139	3	1	2			130-139	1	1			
120-129	12	9	3			120-129	7	5			
110-119	35	24	8	3		110-119	18	17			
100-109	52	38	11	2	1	100-109	37	26	10	1	
90-99	116	86	21	5	4	90-99	56	44	12		
80-89	210	140	47	17	6	80-89	82	65	17		
70-79	283	207	53	15	8	70-79	80	55	20	4	
60-69	330	231	64	27	8	60-69	63	48	10	3	
50-59	260	192	46	10	12	50-59	42	34	6	2	
40-49	144	95	31	13	5	40-49	17	14	2	1	
30-39	87	66	10	6	5	30-39	1	1			
20-29	20	13	2	3	2	20-29	1	1			
10-19	5	4	1			10-19	1	1			

Elite Boar



New sperm parameter

DNA breakage

Sperm Chromatin Structure Assay

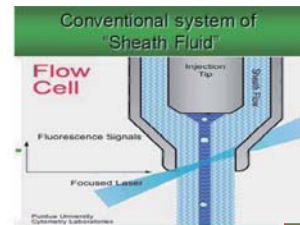
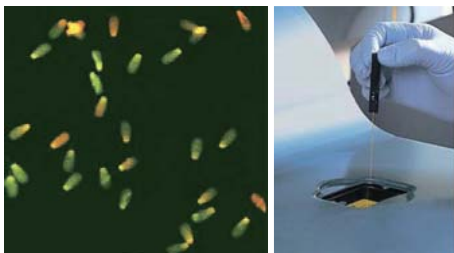


Sperm Chromosome DNA Screening

- D, L, Y breeding boars at 300 days of age from breeding farms
- Colored native chicken at 180 days of age from GGP farms
- Black, native, mini breeds of conserved livestock and poultry farms

SCSA Analyzed by Flow Cytometer

Definition : Estimate the structure stability of the sperm nucleus chromatin after an acide attack. The acridine orange (AO) has the capacity to change from red fluorescence when it is linked to fragmented DNA green fluorescence to green when it is linked to intact DNA.



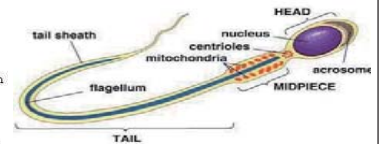
Boar Trait Sheet

Sperm Quality Sheet of Boar at 9 Month Old (Query Date : 2015/1/7)

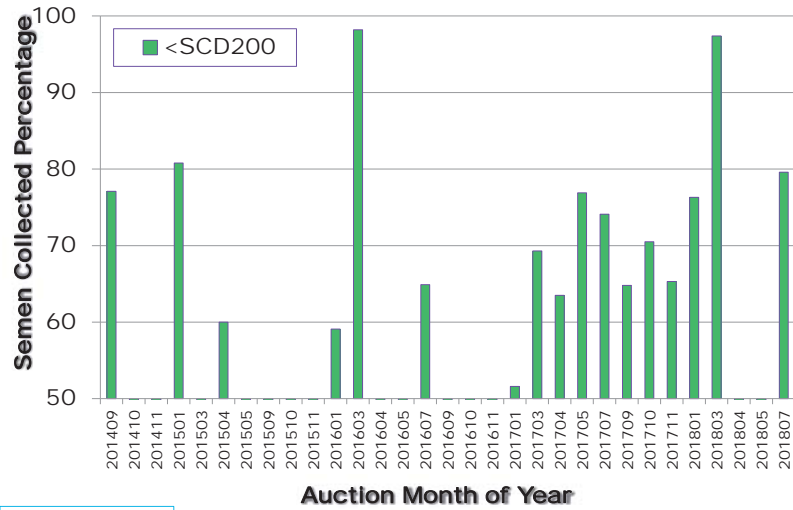
Breed	Ear_No	Birth Date	Breeding Pig Farm
D0745-02		2014/2/7	Shui Po
PSS Genotype	AA	ESR Genotype	NN
Meat Quality Genotype	HH6(HHstd)	IGF27-FR3 Genotype	FF
Collection Date	2014/1/5	Collection Age, Days	271
Mounting Desire	High	Penis Appearance	IE%
Semen Volume (mL)	150	Penis Length(cm)	25
		Semen Color	Milk White
		Sperm Activity	90+++
		Sperm Conc. Level	+++
V75G	A40G	M30B	C500B
(-74)	(-39)	(-31)	(-501)
91	52	18	351
			69
			98
			2
			0.42

- Sperm Quality Assay:** Measuring key physiological functions for insights in the fertilisation potential of semen and/or its genitor
1. V75G **Viability** - Indicator of the sperm membrane integrity as percentage of viable spermatozoa
 2. A40G **Viability & Acrosome integrity** - Indicator of the acrosome integrity and it is essential for fertilization
 3. M30B **MitoPotential** - Indicator of the mitochondrial status to show the integrity of the mitochondria
 4. &5. C500B & CH90B **Calcium level** - Indicator of the level of Ca in the sperm head. - One of the signs of capacitation of sperm
 6. SC95G **DNA fragmentation & DNA TUNEL assay** - Indicator of the condensation of the DNA structure
 7. OX90B **Oxidation level** - Indicator of intracellular level of reactive oxygen species needed for sperm function but that are harmful at a high level
 8. B0 **Bacterial count** - Total bacterial count

Sperm Quality Assay

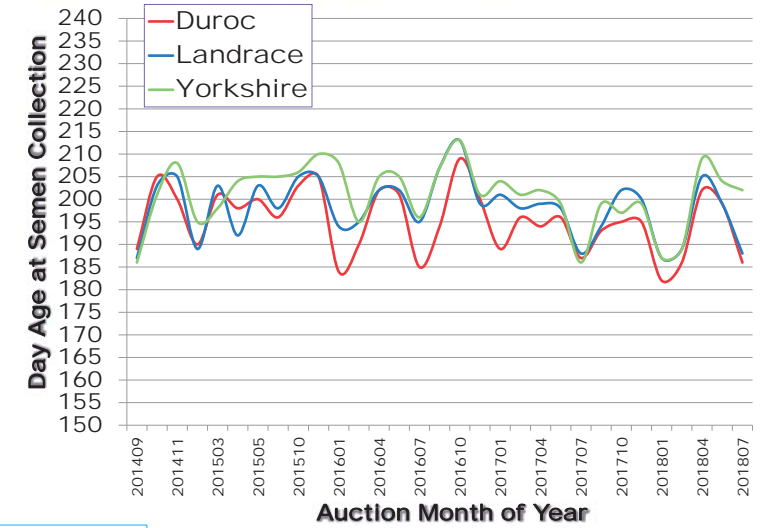


Trends on Semen Collected Percentage of Pre-Auction Boars within 200 Days of Age at Growth Performance Test Station in Taiwan



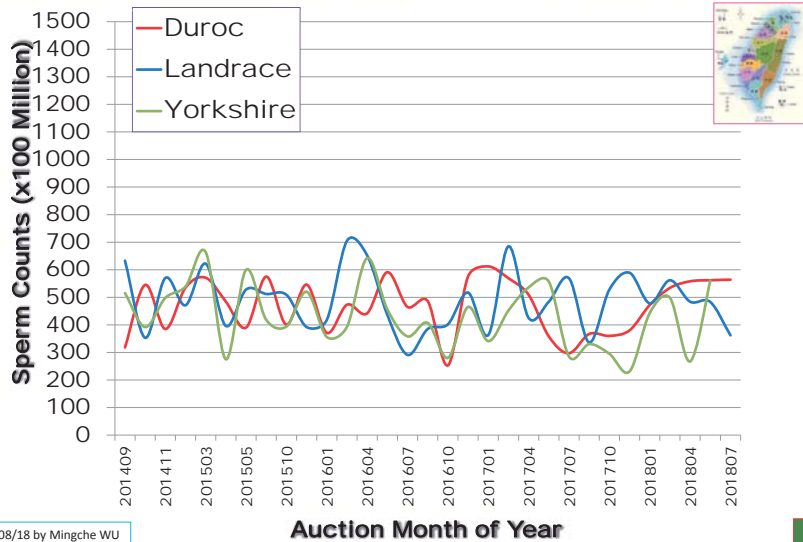
2018/08/18 by Mingche WU

Trends on Age at Semen Collection of Pre-Auction Boars with Growth Performance Index Rank 1 to 4th at Test Station in Taiwan



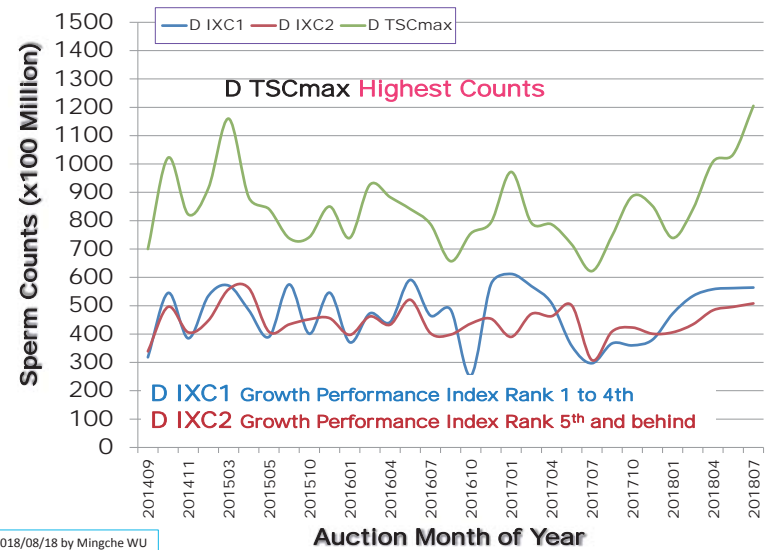
2018/08/18 by Mingche WU

Trends on Total Sperm Count per Collection of Pre-Auction Boars with Growth Performance Index Rank 1 to 4th at Test Station in Taiwan



2018/08/18 by Mingche WU

Trends on Total Sperm Count per Collection of Pre-Auction Duroc Boars at Test Station in Taiwan



2018/08/18 by Mingche WU