

**COMPARISONS OF GENE EXPRESSION BETWEEN
HIGH AND LOW BIRTH WEIGHT PHENOTYPE IN
PIGS USING EMBRYOGENE MICROARRAY**

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OUTLINE

- Background
- Summary of Brazilian Research
- Project Proposal
- Implications



BACKGROUND

- In pig production, both litter size and litter quality (birth weight) are important economic traits (Foxcroft et al., 2007).
- Complex traits
- Genetic variability



SUMMARY OF BRAZILIAN RESEARCH

○ Reproductive Traits

	Commercial	Piau	<i>P</i> -value
OR	15.5 ± 1.96	11.1 ± 2.4	<0.05
TB	14.26 ± 3.7	9.33 ± 2.67	<0.05
BA	12.73 ± 3.12	7.91 ± 2.6	<0.05
ABWL (kg)	1.23 ± 0.56	0.990 ± 0.17	<0.05

University of Vicosa, Unpublished data, 2010



SUMMARY OF BRAZILIAN RESEARCH

		Days of estrous Cycle				(χ ²) P-value
Diameter	Breed	0	4	10	18	
Small	Piau	0.212	0.003	0.000	0.194	0.0391*
	Commercial	0.247	0.010	0.031	0.302	
Medium	Piau	0.027	0.053	0.229	0.088	0.700
	Commercial	0.051	0.098	0.333	0.122	
Large	Piau	0.015	0.124	0.264	0.048	0.0001**
	Commercial	0.021	0.140	0.519	0.181	



SUMMARY OF BRAZILIAN RESEARCH

○ Objective

Pattern of expression of candidate genes related with follicle/oocyte development and atresia during the estrous cycle in commercial line and Piau Brazilian native breed using the real-time polymerase chain reaction

Commercial line x Piau native breed

○ n=6/breed, days: 0, 4, 10 and 18

Follicle size classification

- (0-3 mm) small, (3-6 mm) medium, (>6 mm) large

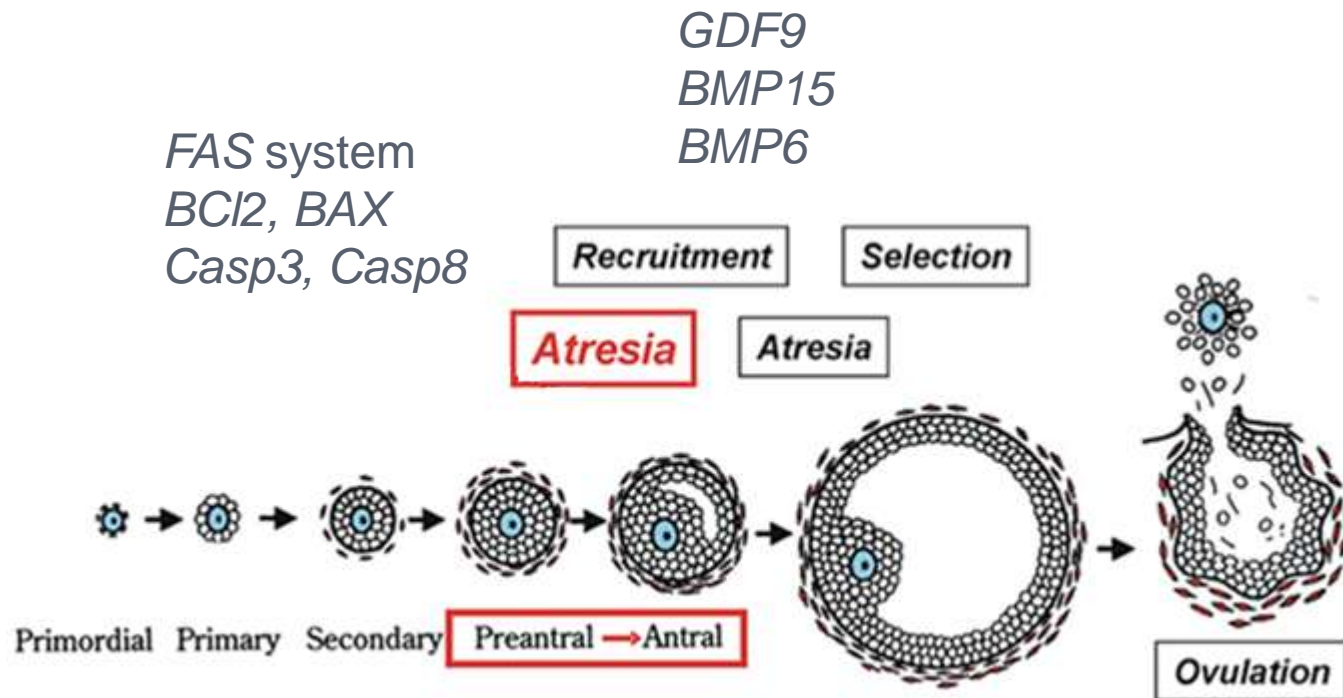
Health status (COCs)

- Normal or atretic



SUMMARY OF BRAZILIAN RESEARCH

○ *Candidate genes*



SUMMARY OF BRAZILIAN RESEARCH

○ Corpus luteum

Gene	Day of estrous cycle	\hat{Y}	<i>P</i> -value
<i>BAX</i>	4	0.06	<0.05
<i>BAX</i>	18	0.07	<0.01
<i>FASL</i>	18	-4.81	<0.01
<i>CASP3</i>	0	-58.12	<0.05

\hat{Y} = Difference in expression (Commercial – Piau) as means of $2^{-\Delta\Delta C_t}$. Only significant contrasts are shown.



SUMMARY OF BRAZILIAN RESEARCH

○ Granulosa cells

Gene	Categories	Day of estrous cycle	\hat{Y}	<i>P</i> -value
<i>FAS</i>	L Atretic	0	-0.0019	<0.05
<i>BCL2</i>	M Normal	0	-0.0253	<0.01
<i>CASP8</i>	M Normal	18	-0.1856	<0.05
<i>CASP3</i>	M Atretic	4	0.0412	<0.05
<i>CASP3</i>	S Normal	4	0.0040	<0.05
<i>CASP8</i>	S Normal	4	-0.0458	<0.05

\hat{Y} = Difference in expression (Commercial – Piau) as lsmeans of $2^{-\Delta\Delta C_t}$. Only significant contrasts are shown.



SUMMARY OF BRAZILIAN RESEARCH

○ Oocyte

Gene	Categories	Day of estrous cycle	\hat{Y}	<i>P</i> -value
<i>GDF9</i>	L Normal	18	-0.9517	<0.05
<i>GDF9</i>	L Atretic	18	-0.7400	<0.05
<i>GDF9</i>	M Normal	10	-11.7542	<0.05
<i>BMP15</i>	M Normal	18	-8.5333	<0.05
<i>BMP6</i>	S Normal	10	-0.4250	<0.05
<i>BMP15</i>	S Atretic	18	-1.3000	<0.05

\hat{Y} = Difference in expression (Commercial – Piau) as lsmeans of $2^{-\Delta\Delta C_t}$. Only significant contrasts are shown.



CONCLUSION

- The factors analyzed may influence the important decision between proliferation or atresia in CL and granulosa cells from sows with different genetic backgrounds
- Apoptosis mediated by *FASL* and *CASP3* may be differently regulated in CL between breeds, reflecting a shorter estrous cycle length and faster luteal regression in the Piau breed
- Higher expression in Piau oocytes may play a role in inhibition of the luteinization process and potentially affect follicle development and ovulation rate among breeds

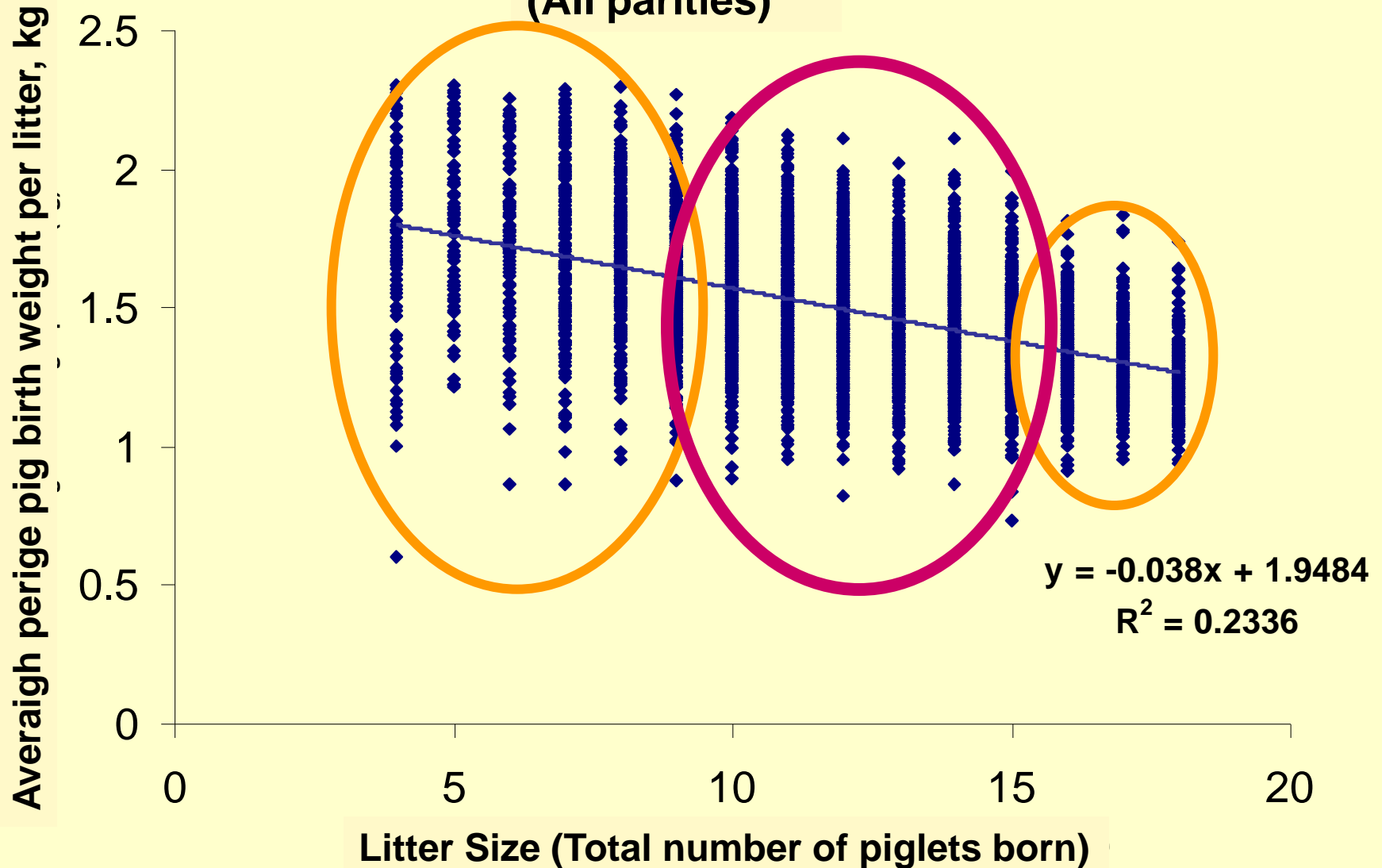


BACKGROUND – EMBRYOGENE STUDIES

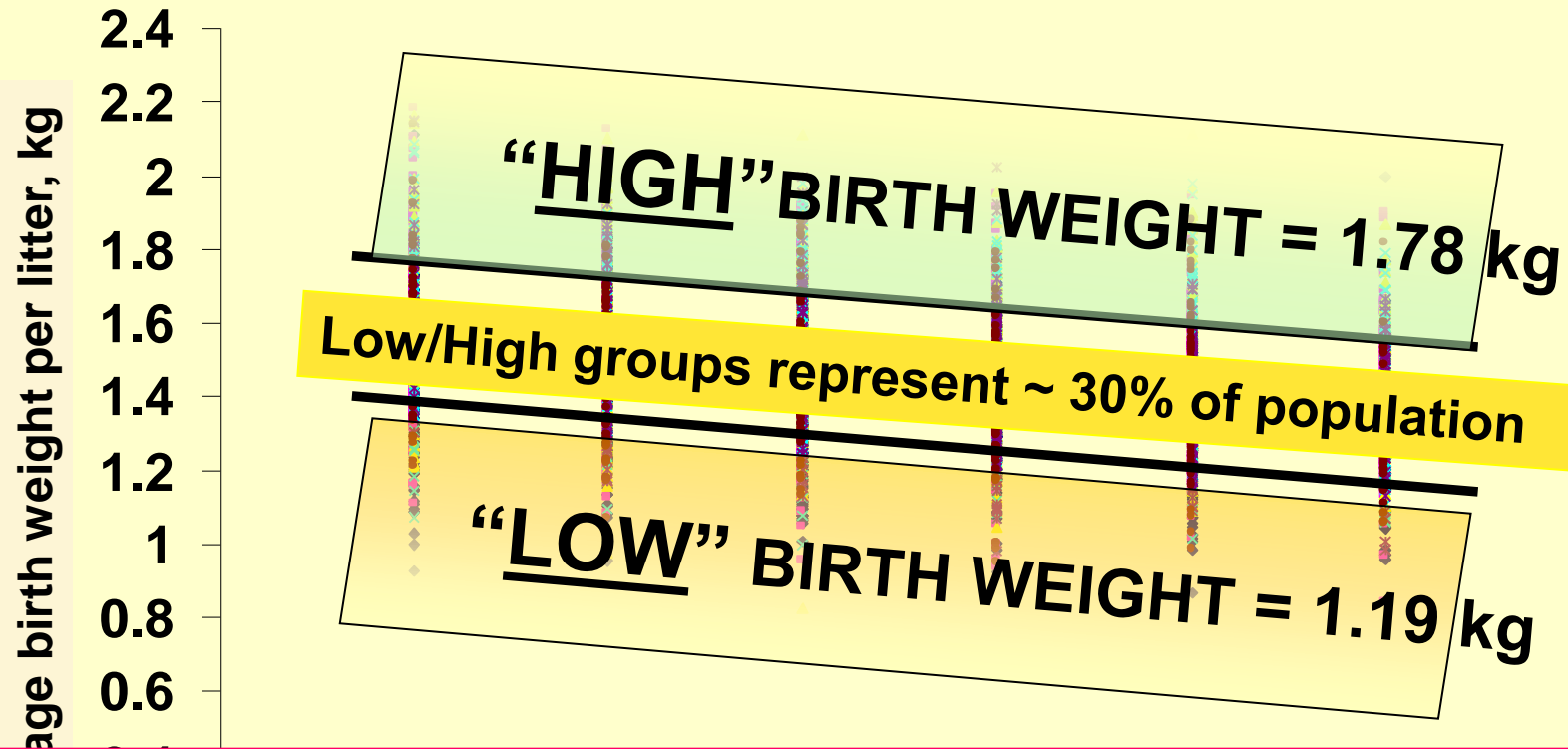
- Birth weight is an important factor for piglet survival and post natal growth potential
- Between-litter variation in birth weight is a problematic phenotypic trait in contemporary commercial sows
- The biological origins of low birth weight litters in mature sows has become a major research focus



Correlation between birth weight and litter size (All parities)



Correlation between birth weight and litter size
(all parities)



Hypothesis: Low average birth weight litters are a consequence of high ovulation rates, linked to crowding of embryos *in utero* in early gestation and detrimental effects on placental development

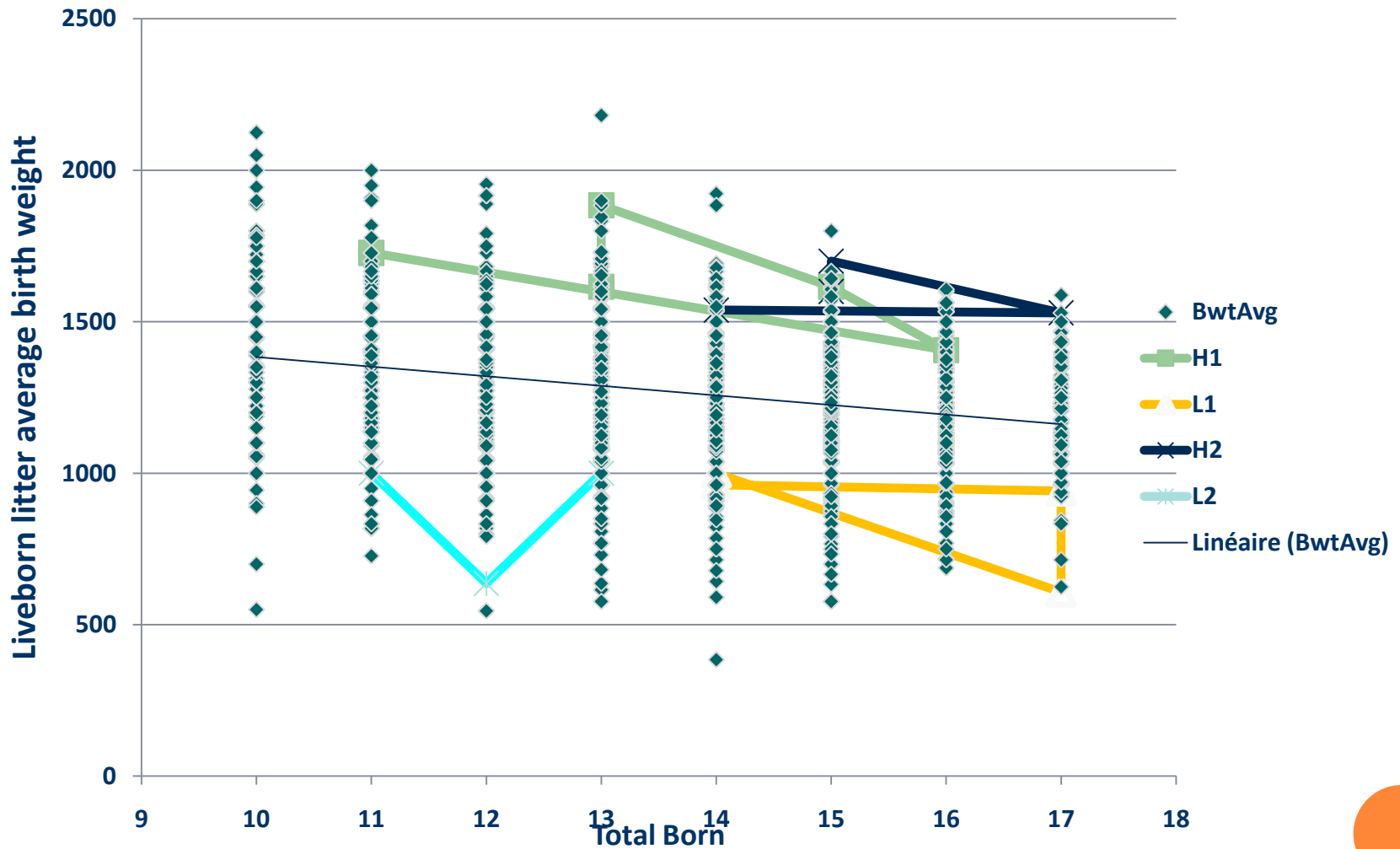
PROJECT PROPOSAL

	Indiana Exp		Commercial	Piau	<i>P</i> -value
	High	Low			
OR	27.6	30.0	15.5 ± 1.96	11.1 ± 2.4	<0.05
T Born	-	-	14.26 ± 3.7	9.33 ± 2.67	<0.05
B Alive	-	-	12.73 ± 3.12	7.91 ± 2.6	<0.05
ABWL (kg)	1.7	1.2	1.23 ± 0.56	0.990 ± 0.17	<0.05
E Number	22.1	20.3	-	-	0.18
E Surv	80.9	67.6	-	-	0.21

Q: Are these traits repeatable within sows?

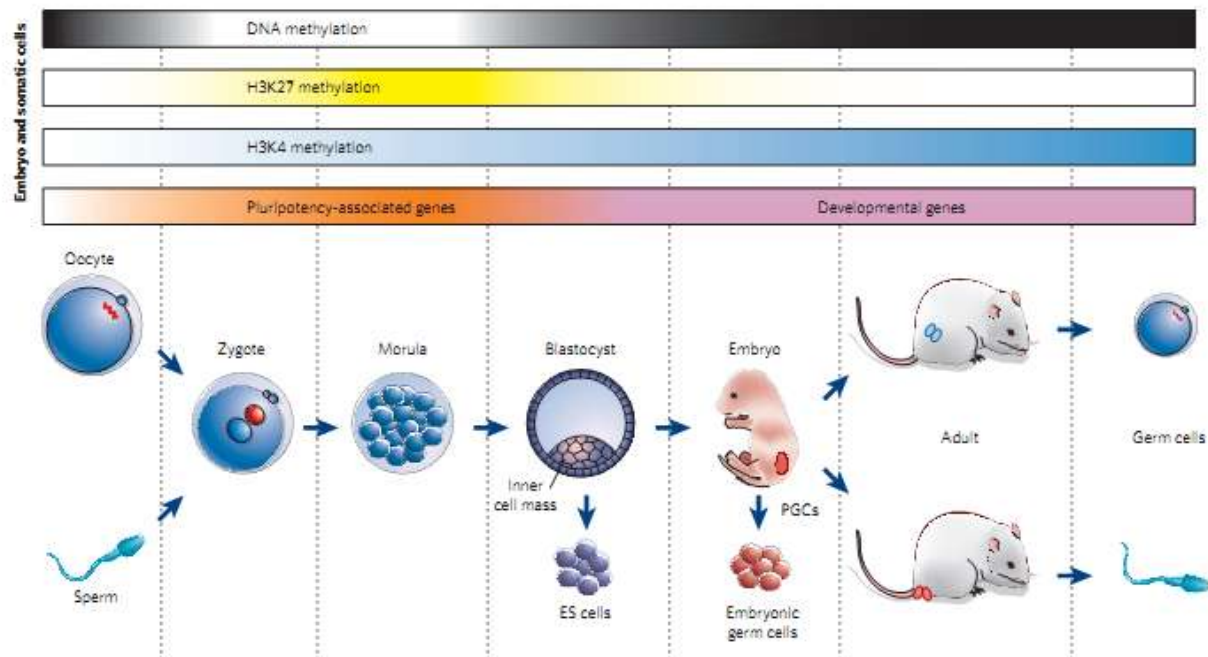


USASK / UoFA / C-P:IG STUDY, 2010, PRELIMINARY DATA



BACKGROUND

How to improve growth performance after birth?

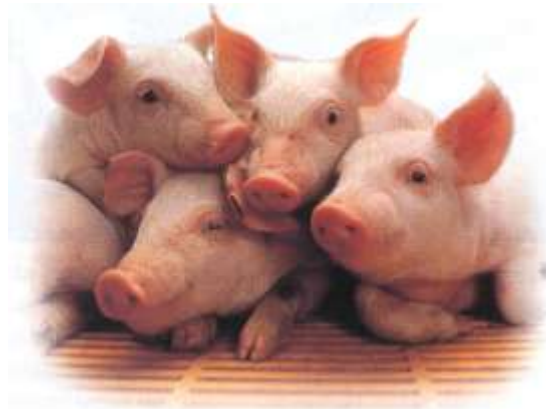


- Gene imprinting
- Metabolism, Maternal nutrition status and Methylation state

PROJECT PROPOSAL

- Hypothesis

There is differential gene expression profile between HIGH and LOW birth weight litters phenotype



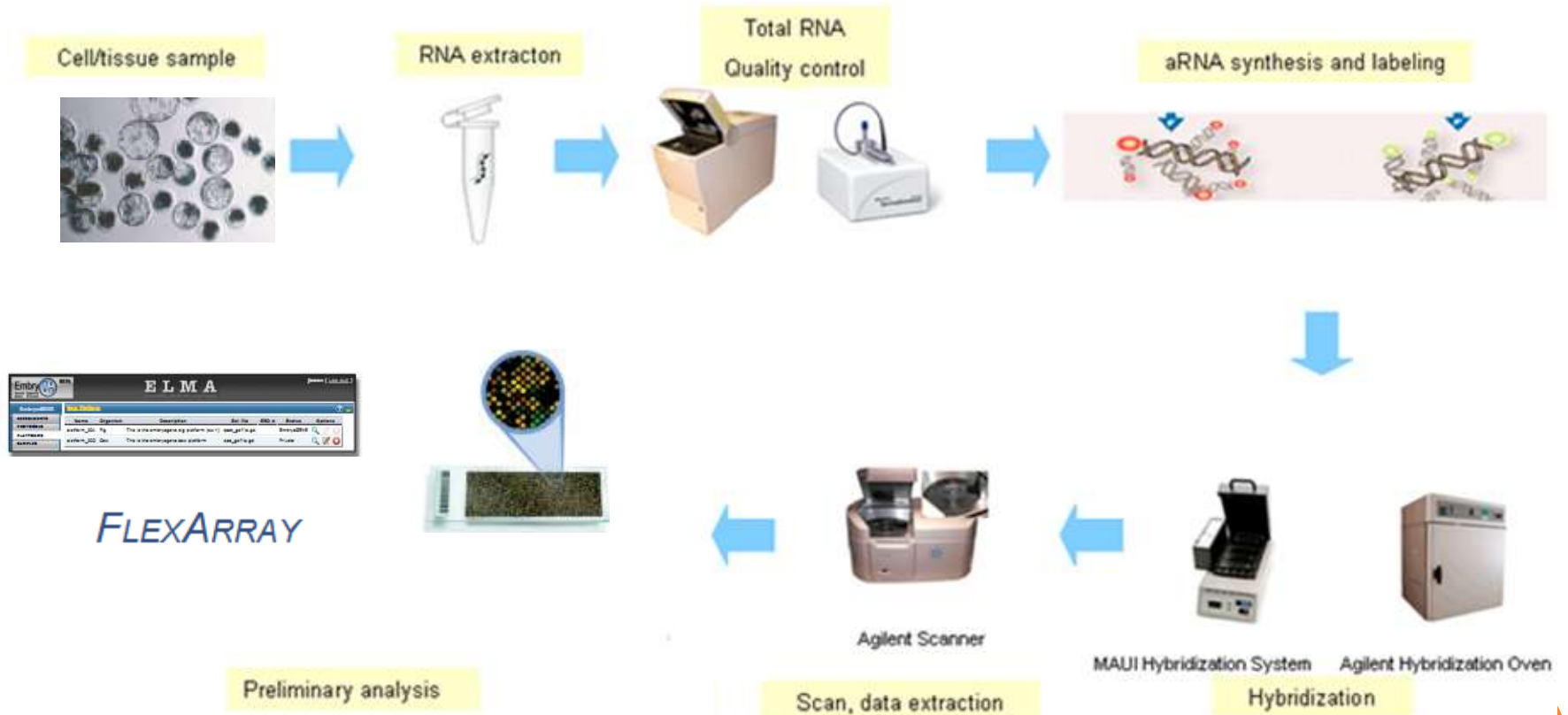
PROJECT PROPOSAL

- Objective

To elucidate differences between low and high average birth weight sows on day 5 of gestation, with respect to ovarian follicular development, luteal function and early embryonic development

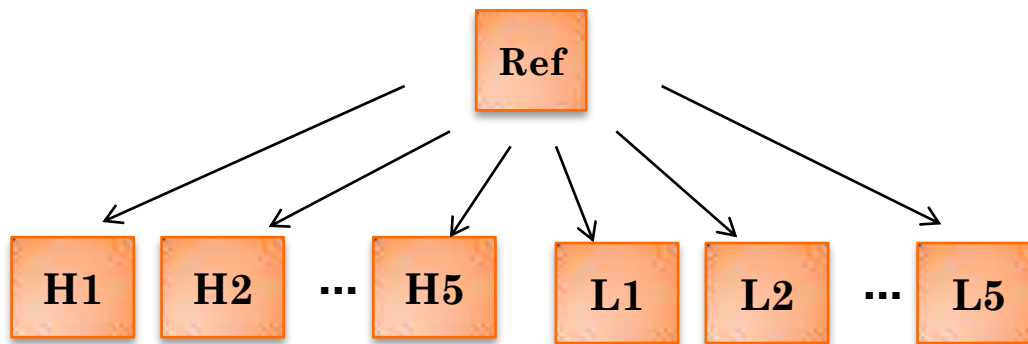


METHODOLOGY



METHODOLOGY

- Reference design



Experimental design using a reference RNA sample. Boxes represent RNA samples, and arrows represent microarrays.



IMPLICATIONS

- Understanding alterations in transcript abundance in the early embryo development
 - Identification of tissue-specific and novel genes and genetic pathways involved in embryo development
 - Identify markers for predicting embryo developmental competence as a way to identify embryos with low or high potential



ACKNOWLEDGMENTS

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Industry





INDIANA EXPERIMENT

Mean (SEM)	High	Low	P-value
ABWL (kg)	1.7 ± 0.02	1.2 ± 0.02	0.0001
No. Alocated	10.0	10.0	
No. Bred	8.0	10.0	
No. Pregnant	5.0	9.0	0.52
Percent in heat/bred	62.5	90.0	0.40
OR	27.6 ± 2.0	31.0 ± 1.6	0.33
Embryo number*	22.1 ± 2.0	20.3 ± 1.7	0.18
Embryo Survival*	80.9 ± 8.2	67.6 ± 6.7	0.21
CL weight*	11.3 ± 1.0	10.8 ± 0.8	0.42

*Gestation day used as covariate. University of Alberta



USASK / UOFA / C-P:IG STUDY, 2010, PRELIMINARY DATA

	Total born Average	BWT Average (kg)	Means_TBA	Means_BWTA (kg)
H1	15.3	1.428	13.2 ± 1.12	1.57 ± 0.1
H2	12.8	1.599		
H3	12.0	1.684		
H4	12.5	1.645		
H5	13.3	1.478		
L1	13.6	1.040	12.8 ± 0.94	1.05 ± 0.1
L2	14.0	1.019		
L3	11.4	1.223		
L4	12.7	1.026		
L5	12.2	0.931		



“IMPACTS OF PRENATAL PROGRAMMING FOR EFFICIENCY OF PORK PRODUCTION SYSTEMS”

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ABRAVES

UBERLANDIA, BRASIL, 2009