Session 22 “Innovation in pig genetics"

UNIVERSIDAD COMPLUTENSE MADRID

Impact of selection for birth weight uniformity in meat quality traits in SRC Iberian pigs

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INTRODUCTION

Pigs Breeding particularities

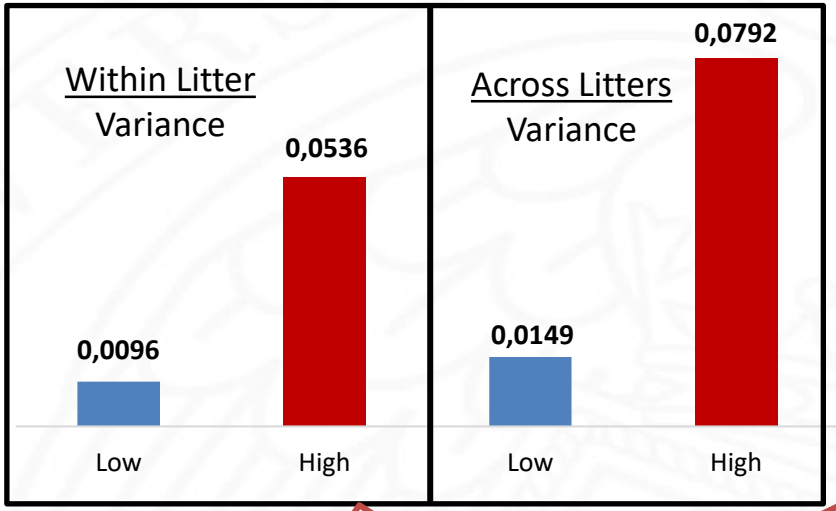
- Genetic selection has increased litter size, total number born (TNB).
- Increase in birth weight (BW) variability within litter.
- Within-litter variation of BW is of great importance in breeding practice for animal survival.

→ Animal Welfare

✓ Selecting to modify birth weight variability is feasible.

INTRODUCTION

Animal Models: Mice experiment



Formoso-Rafferty et al., 2016

INTRODUCTION

Animal Models: Mice experiment

- Low line presents advantages:
  - ✓ **Survival** at weaning, **litter size**, **total weaning weight.**
  - ✓ Higher **longevity** and **embryo survival**.
  - ✓ Uniformity of BW does not imply differences in **feed efficiency** on growth.
  - ✓ Productive and reproductively better under a **challenge.**

All traits measured suggested overall robustness and an increase in animal welfare in low line (Uniform line).

INTRODUCTION

Iberian Pig

- Slow growth, fat accumulation, and low prolific breed.
- Traditional outdoor production: *montanera.*
- "Sánchez Romero Carvajal-Jabugo Strain" is focused on product quality and maternal traits.


Photo: SRC

Andevalo system

- ✓ It uses a first parturition in sows, after that they are finished at *montanera* (slaughtered at 18-19 months).
- ✓ This allows discrete generations that fits with a selection experiment.

OBJECTIVE

The objective of this study was to analyse the correlated genetic response in carcass and meat traits in a selection experiment for BW variability in Iberian pigs (Sánchez Romero Carvajal population).

MATERIAL AND METHODS

Experimental Design

Generation 0

Initial Population

154 ♀ **x** 14♂ **maximizing the initial genetic variability**

Genetic Evaluation

2 replicates: 308 ♀ x 28 ♂

Only low (uniform) Line

Generation 1

14 ♀ best : 14 ♂

52 ♀ best: 154 ♀

154 ♀ x 14 ♂

(Optimized mating)

No sharing grandparents

N_e= 44

i=1.441 (18.5%)

Genetic Evaluation

Generation 2

14 ♀ best : 14 ♂

52 ♀ best : 154 ♀

Generation n

……

MATERIAL AND METHODS

Heteroscedastic Genetic model: BW

$$y_i = x_i\mathbf{b} + z_i\mathbf{u} + w_i\mathbf{c} + e^{\frac{1}{2}(x_i\mathbf{b}^* + z_i\mathbf{u}^* + w_i\mathbf{c}^*)}\varepsilon_i \qquad \varepsilon_i \sim N(0,1)$$

- ✓ y_i is the individual birth weigth
- ✓ Systematic effects (**b**): sex, litter size, replicate*generation and sow age (covariate)
- ✓ Random effects: maternal genetic effect (**u**) and litter effect (**c**)
- ✓ x_i and z_i : and w_i : incidence vectors for **b**, **u,** and **c** respectively

*: effects associated to environmental variance

ρ_{uu^*}

Software: GSEVM v2.0 (Ibáñez-Escriche *et al.,* 2010)

MATERIAL AND METHODS

Data

Generation 0	Sows	Litters	Individual BW (born alive)
Generation 0 - Replicate 1	156	104	665
Generation 0 - Replicate 2	158	139	880
Generation 1 - Replicate 1	157	132	882
Generation 1 - Replicate 2	169	127	797
Generation 2 - Replicate 1	188	139	931
Total	**828**	**641**	**4155**

Pedigree: 3631 individuals.

Other traits:

- ✓ Survival (at birth and at 21 days in Total and in %).

MATERIAL AND METHODS

Data

34 Traits

187 Records

Growth Traits:
Montanera Entrance Body Weight
Slaughter Weight
Montanera Gained Weight
Montanera Average Daily Gain

Carcass Traits:
Carcass Weight
Carcass Yield
Ham Weight 1
Ham Weight 2
Total Hams Weight
Ham Yield
Shoulder Weight 1
Shoulder Weight 2
Total Shoulders Weight
Shoulder Yield
Loin Weight

Carcass Composition Traits:
Intramuscular Fat Content (IFC)
% Proteine
% Humidity
Total (IFC + %Prot + % Humidity)

Fatty Acids:
Lauric
MYristic
Palmitic
Palmitoleic
Margaric
Margaroleic
Stearic
Oleic
Linoleic
A-Linoleic
Arachidic
Gadoleic
% Oleic +Linoleic
Unsaturated Fatty Acid
Saturated Fatty Acid

RESULTS AND DISCUSSION

Genetic Parameters

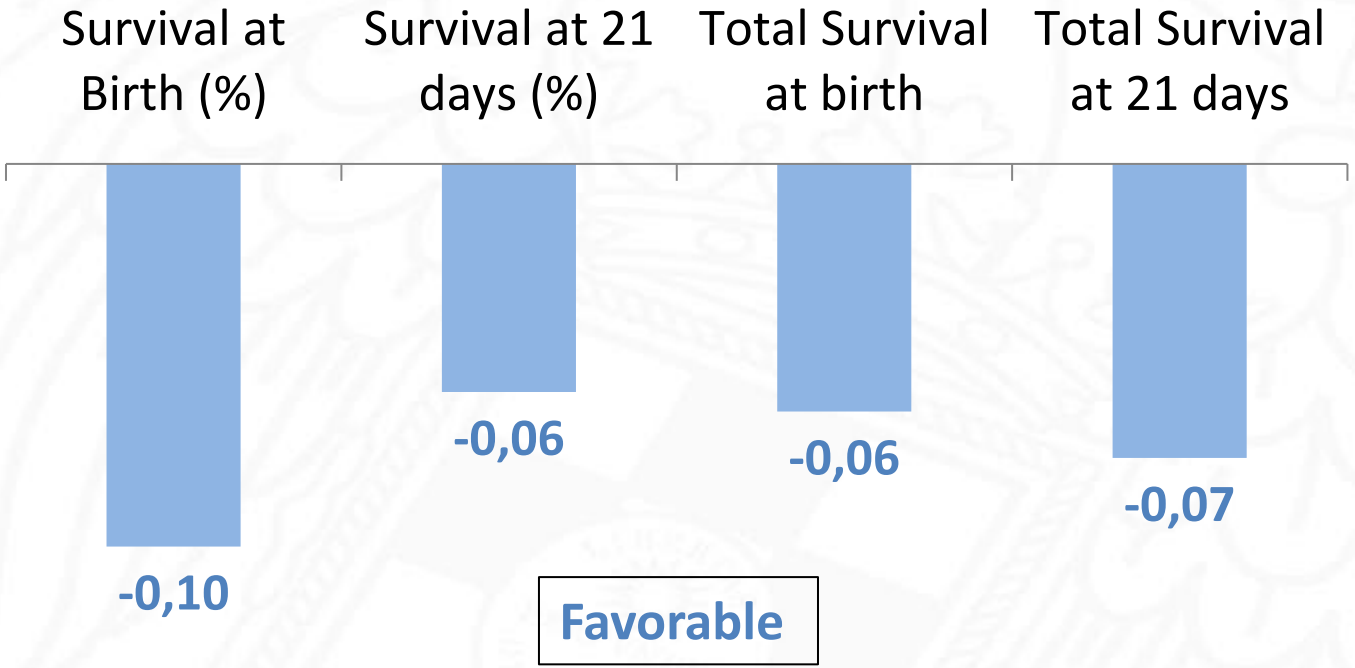
σ^2_u	σ^2_{u*}	GCV	ρ_{uu*}	σ^2_c	σ^2_{c*}
0.0051 (0.0017)	0.2238 (0.0739)	0.4661 (0.0791)	-0.3711 (0.1540)	0.0085 (0.0013)	0.1296 (0.0522)

σ^2_u - Additive genetic variance of Birth Weight
σ^2_{u*} - Additive genetic variance of the Birth Weight variability
GCV - Genetic coefficient of variation for the residual variance
ρ_{uu*} - Genetic correlation between the trait and its variability.
σ^2_c – Litter variance of Birth Weight
σ^2_{c*} - Litter variance of the Birth Weight variability

(Standard deviation of marginal posterior distributions in brackets)

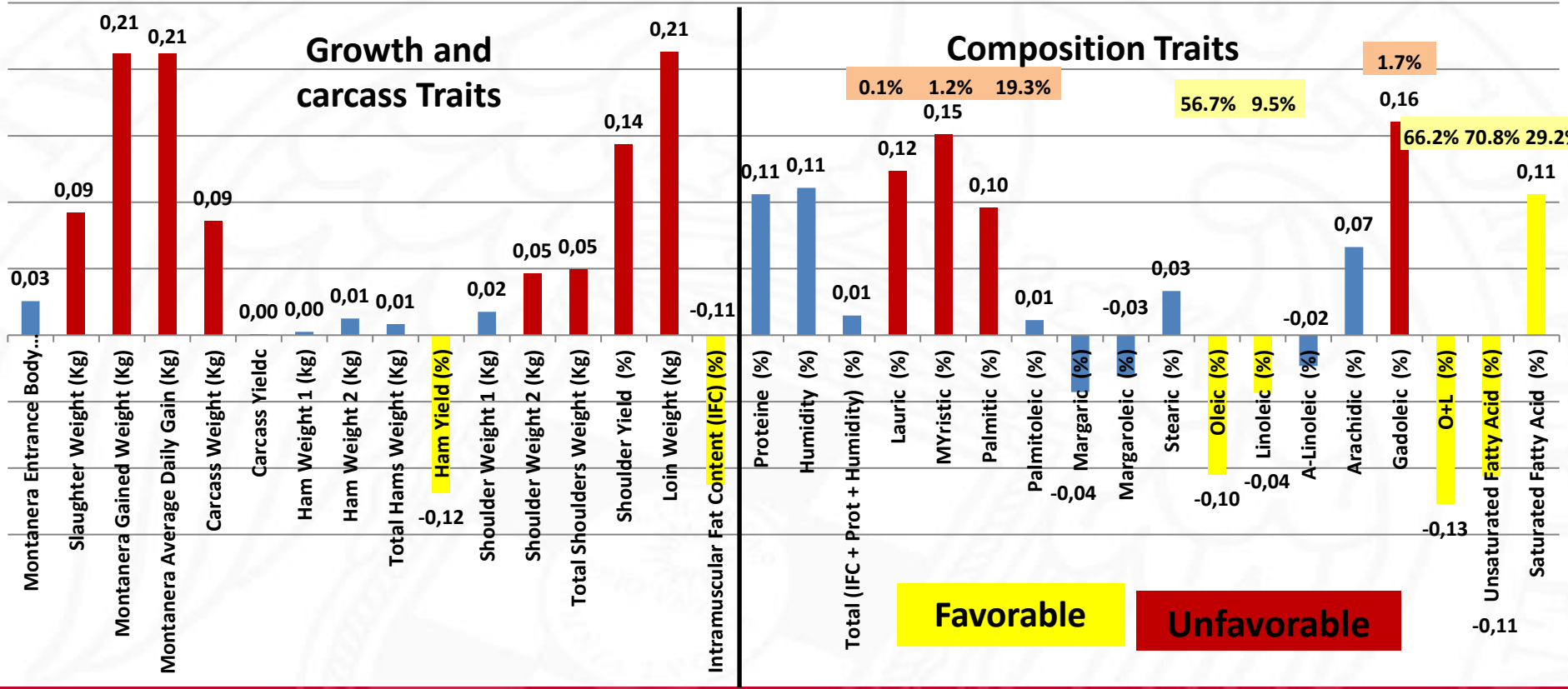
RESULTS AND DISCUSSION

Correlations between $\hat{u}^*_{BW}$ and Survival phenotypic values



RESULTS AND DISCUSSION

Correlations between $\hat{u}^*_{BW}$ and carcass traits



CONCLUSIONS

- ✓ Increasing uniformity in Birth Wight could be achieved without a negative change in the Birth Wight.
- ✓ There is no expected negative response in important meat quality traits analysed, but this needs to be monitored.

Thank you

Photo: SRC

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We are grateful to the staff at Coto Gomeles: Manolache Vasile and Francisco Calvente.
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MATERIAL AND METHODS

Homoscedastic Genetic model: Total number born (TNB)

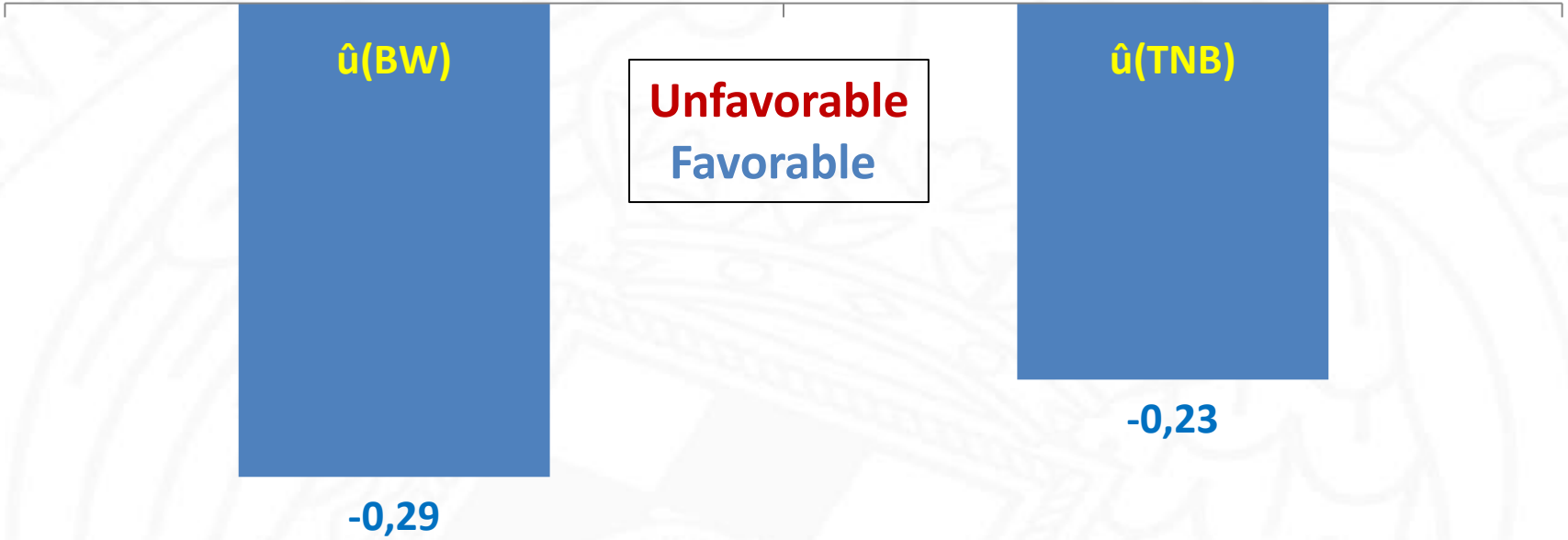
$$y_i = \mathbf{x_i b} + \mathbf{z_i} \boldsymbol{u} + e_i$$

- ✓ y_i is the TNB
- ✓ Systematic effects (**b**): replicate*generation and sow age (covariate)
- ✓ Random effects: genetic effect (**u**)
- ✓ $\mathbf{x_i}$, $\mathbf{z_i}$: incidence vectors for **b** and **u**

Software: TM (Legarra *et al*., 2008)

RESULTS AND DISCUSSION

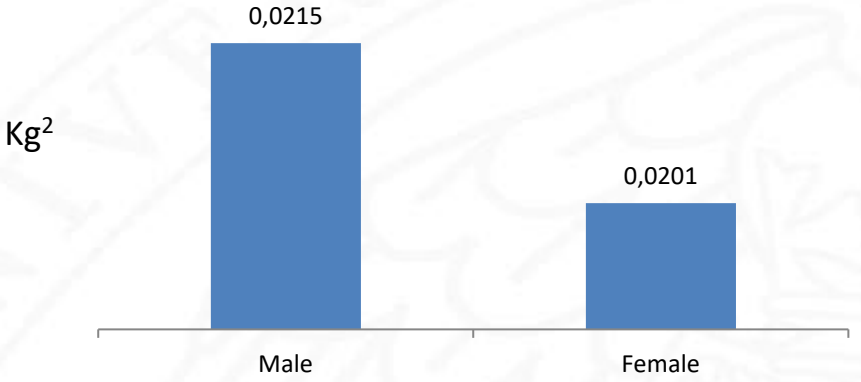
Correlations between û*(BW) and other predicted breeding values

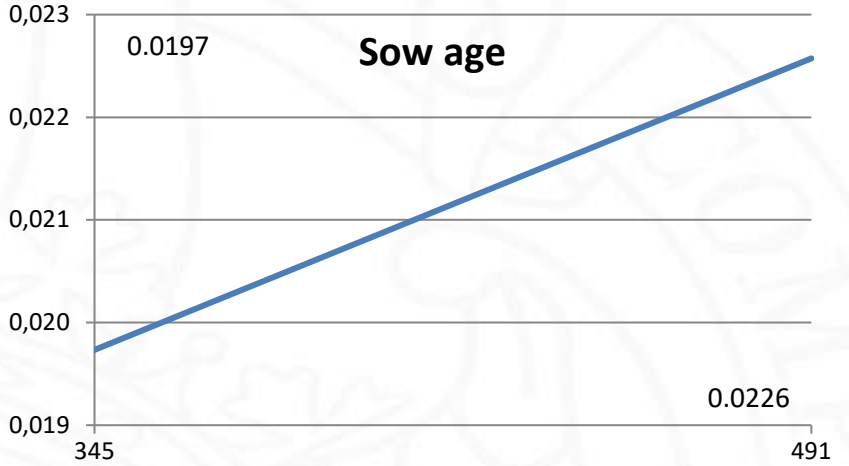


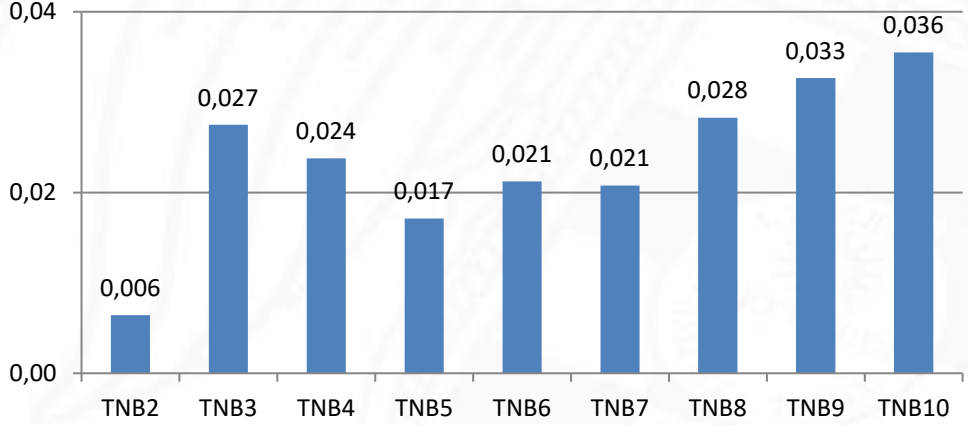
BW: Birth Weight
TNB: Total number born
*: traits associated to environmental variance

RESULTS AND DISCUSSION

Systematic effects BW residual variance



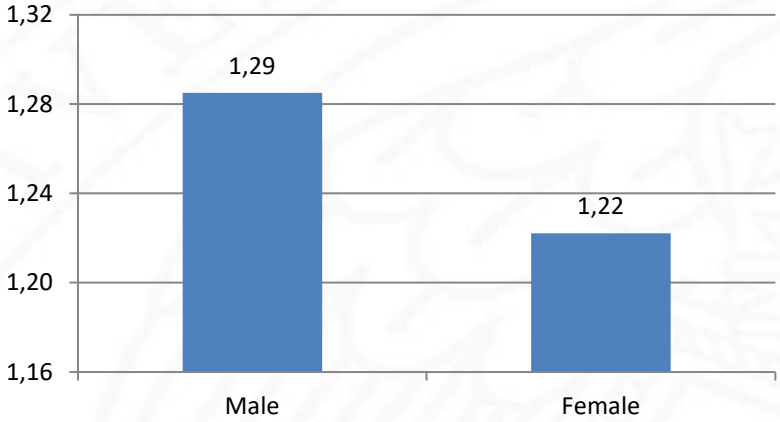




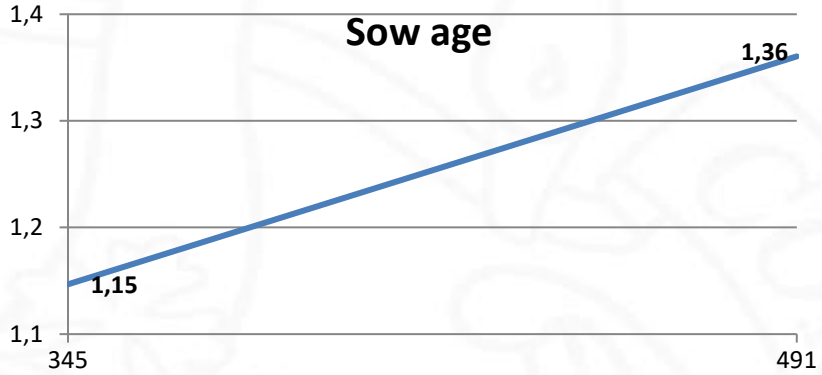
Average Expected residual variance:
0.0208

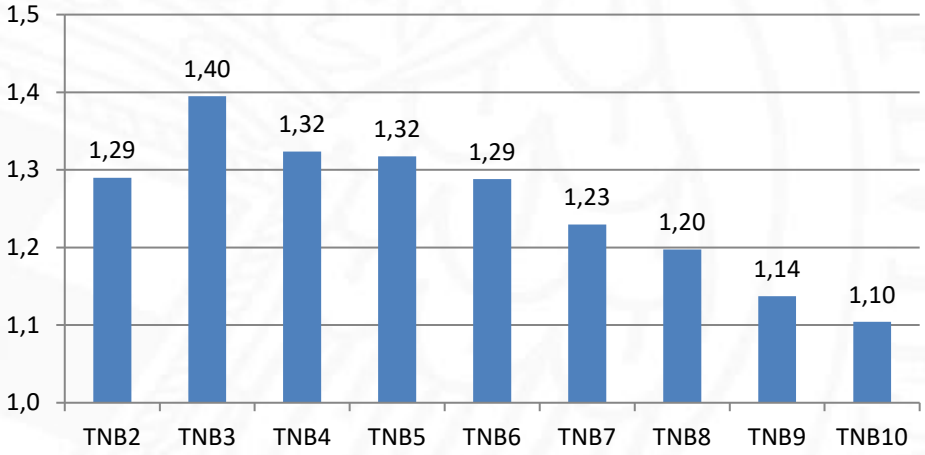
RESULTS AND DISCUSSION

Systematic effects BW



Average Expected birth weight: 1.25





INTRODUCTION

Applications in Livestock specie, examples

	Trait	Author
Rabbits	Litter size	Ibáñez-Escriche *et al.* (2008a).
Pigs	Litter size, weight, number of teats	Ibáñez-Escriche *et al.* (2008b), Felleki *et al.* (2012), Felleki y Lundeheim (2015), Sell-Kubiak *et al.* (2015).
Poultry	Weigth	Mulder *et al.* (2009), Wolc *et al.* (2009).
Beef and dairy cattle	Weigth, dairy milk	Fina *et al.* (2013), Rönnegård et al. (2013).
Aquaculture	Weigth	Mulder *et al.* (2009), Janhunen *et al.* (2012), Marjanovic *et al.* (2016), García-Ballesteros *et al.* (2021).