GxE interactions in Churra dairy sheep: Heterogeneity across lactations and reaction norms

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Introduction

- Wide environmental variability in Churra Sheep
  - Technological degrees in herds
  - Degrees of intensification
    - Productive
    - Reproductive
  - Geographical
    - Plane land
    - Mountains
- Is this wide variability interacting with genes?

Mountains

Plane Lands

Intensive

More intensive…

Introduction

- Genetic parameter estimates are lower than those obtained in other populations performing under more homogeneous environment (Lacaune), although the main factors considered are the same.

- Some evidences of GxE interactions and Heterogeneity across lactations:
  - Production (Cappelletti, 1998, Ph.D. Thesis)
  - Longevity (El Said et al., 2005, Livestock Science)

Objectives

- Does exist genetic heterogeneity across lactations for milk yield?
- Are GxE interactions relevant factors in the determination of milk yield?

Material & Methods

- Animals
  - 89,602 Test Day Records (2000-2008)
  - 7,242 Ewes
  - 6,807 Contemporary Groups - HTD (34 Herds)
  - 18,527 Genealogical Records
  - 42 Genetic Groups (Year & Sex)

Material & Methods

- Data Edition Criteria
  - Ewes sired by AI rams with at least 10 daughters.
  - Ewes at least 12 months old.
  - First lactation records should be recorded.
  - Records produced in the first 27 weeks of lactation.
  - A minimum of 4 controls per lactation was requested.
  - For considering data from a herd a minimum of 750 records should be present in that herd.

Statistical Models

- Univariate models
  - All lactations are repetitions of the same trait
- Multivariate models
  - 1st, 2nd y >= 3rd are different but correlated traits
    - For investigating heterogeneity across lactations

Statistical Models

- Random Regression models
  - Trait's variances change throughout an environmental scale
    - For investigating GxE interactions (reaction norms)
- Animal Repeatability models
  - Trait's variances are constant along the environmental scale
    - They were used in models without GxE interactions

Statistical Models

$$\mathbf{x}'_h\boldsymbol{\beta} = HTD_{it} + L_{jt} + AGE(L)_{jt} + BA_{kt} + C_{lt} + WIL_{mt}$$

- NO GxE

UAR

$$y_{hp} = \mathbf{x}'_h\boldsymbol{\beta} + a_p + p_p + e_{hp}$$

MAR

$$y_{hpt} = \mathbf{x}'_h\boldsymbol{\beta} + a_{pt} + p_{pt} + e_{hpt}$$

- GxE

$$y_{it} = HTD_{it} + e_{it}$$

RR-UAR

$$y_{hp} = \mathbf{x}'_h\boldsymbol{\beta} + a_{\mathrm{int},p} + \widehat{HTD}_i \times a_{slo,p} + p_{\mathrm{int},p} + \widehat{HTD}_i \times p_{slo,p} + e_{hp}$$

RR-MAR

$$y_{hpt} = \mathbf{x}'_h\boldsymbol{\beta} + a_{\mathrm{int},pt} + \widehat{HTD}_{it} \times a_{slo,pt} + p_{\mathrm{int},pt} + \widehat{HTD}_{it} \times p_{slo,pt} + e_{hpt}$$

Fitting Test (LRT)

	d.f.	-2log(L)	AIC
UAR	82,655	455,386.82	455,392.82
RR-UAR	82,651	451,378.80	451,396.80
MAR	82,640	396,874.02	396,928.02
RR-MAR	82,610	390,322.77	390,484.77

d.f.: ***N – rank(X) Fixed model – (# Genetic Groups - 1) – # Var. Comp.***
89602 – 6903 – 41 – nº V.C.

	UAR		RR-UAR		MAR	
	-2log(LR)	Δ g.l.	-2log(LR)	Δ g.l.	-2log(LR)	Δ g.l.
RR-UAR	4008.02	4				
MAR	58512.80	15	54504.78	11		
RR-MAR	65064.05	45	61056.03	41	6551.25	30

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	UAR		**RR-UAR**		**MAR**	
	-2log(LR)	**Δ d.f.**	**-2log(LR)**	**Δ d.f.**	**-2log(LR)**	**Δ d.f.**
RR-UAR	P-VALUES = 0					
MAR						
RR-MAR						

Genetic Parameter Estimates

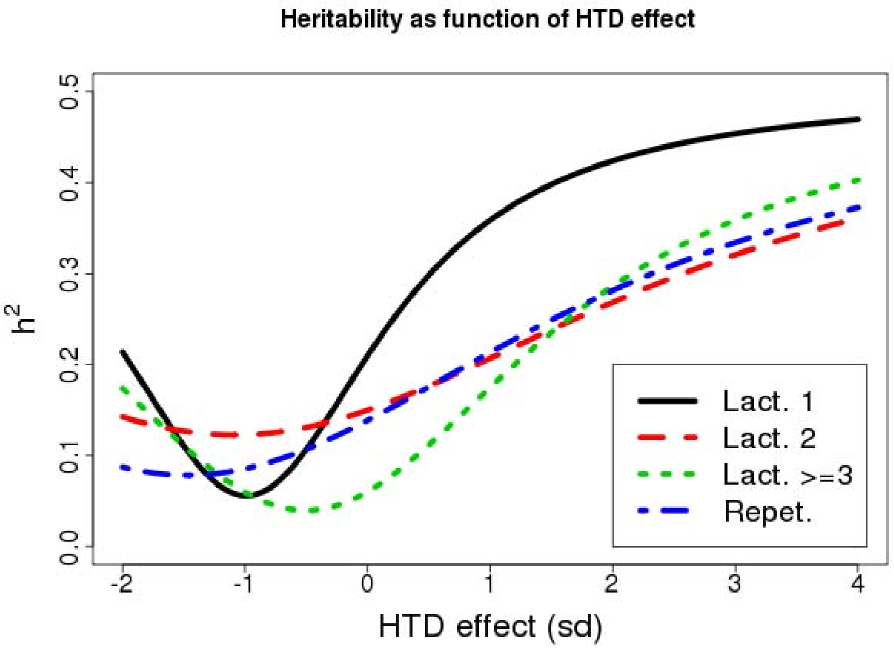
NO GxE

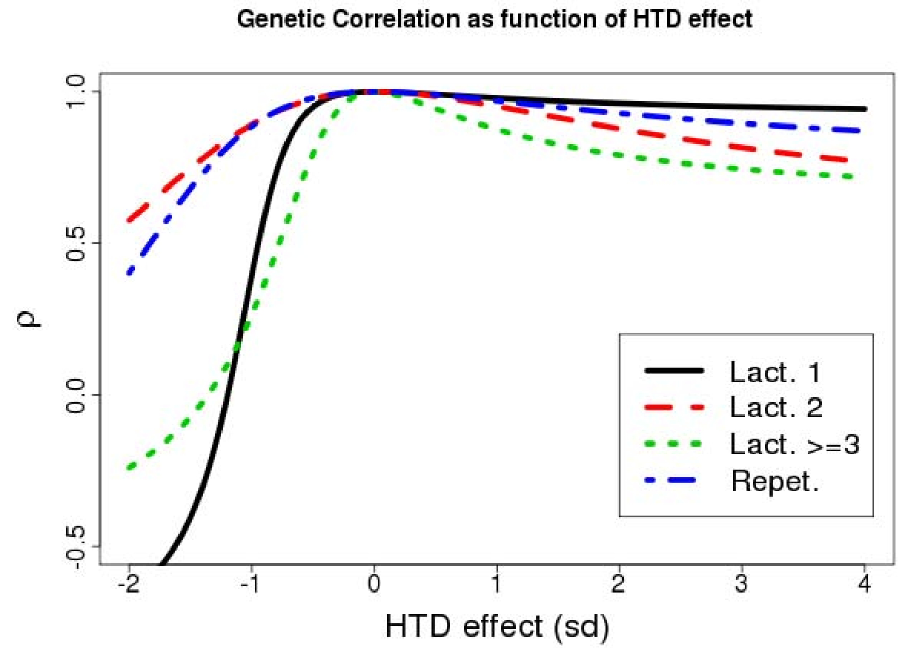
UAR	MAR		
h^2(Rep.)	1 Lact.	2 Lact.	>=3 Lact.
0.12	0.16	0.89	0.78
		0.13	0.81
			0.12

Genetic Parameter Estimates
GxE

	RR-UAR		RR-MAR	
	Rep.	1 Lact.	2 Lact.	>=3 Lact.
h^2 (@ 0)	0.13	0.19	0.13	0.05
$\sigma^2_{a,s} / \sigma^2_e + \sigma^2_{a,s} + \sigma^2_{p,s}$	0.05	0.16	0.03	0.08
$\rho_{inter\text{-}slope}$	0.72	0.91	0.49	0.61

Genetic Parameter Estimates GxE



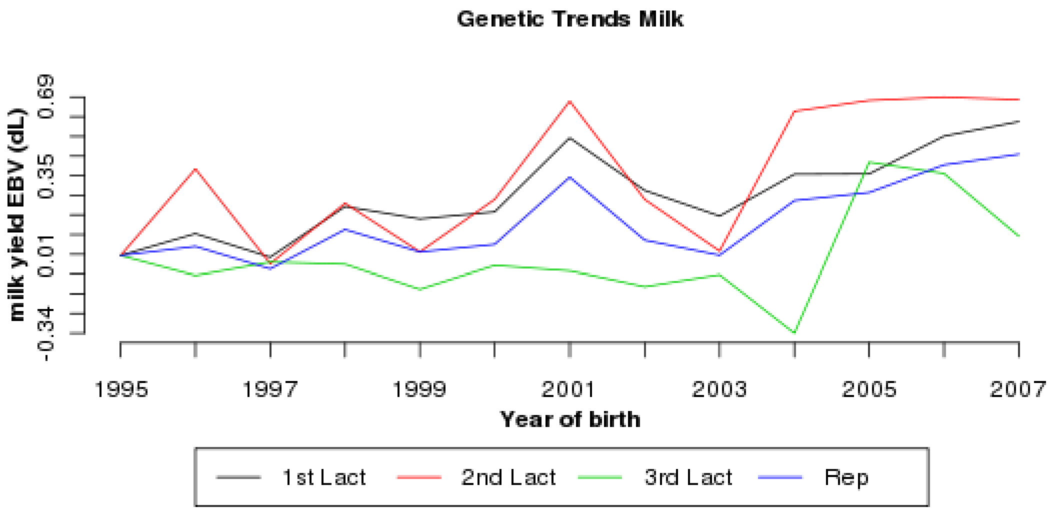


Conclusions & Discussion

- Heterogeneity across lactations is significant
  - First lactation shows the higher heritability
- GxE interaction is significant
  - First and >=Third Lactations!!!
- By considering these factors an increase in the genetic response would be expected
  - Animals will be selected considering the environment where they will perform
  - Will the different EBVs for a particular animal be reliable enough to guarantee the expected higher response?
- Increased Organizational difficulties in the selection schema
- Environment conservation.
  - To be efficient would not be needed to homogenize environmental conditions

Thank you for your attention !!

Genetic Trends: NO GxE



Genetic Trends: GxE