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# Reaction norm for fat plus protein daily yield to evaluate genetic tolerance to heat stress in goats

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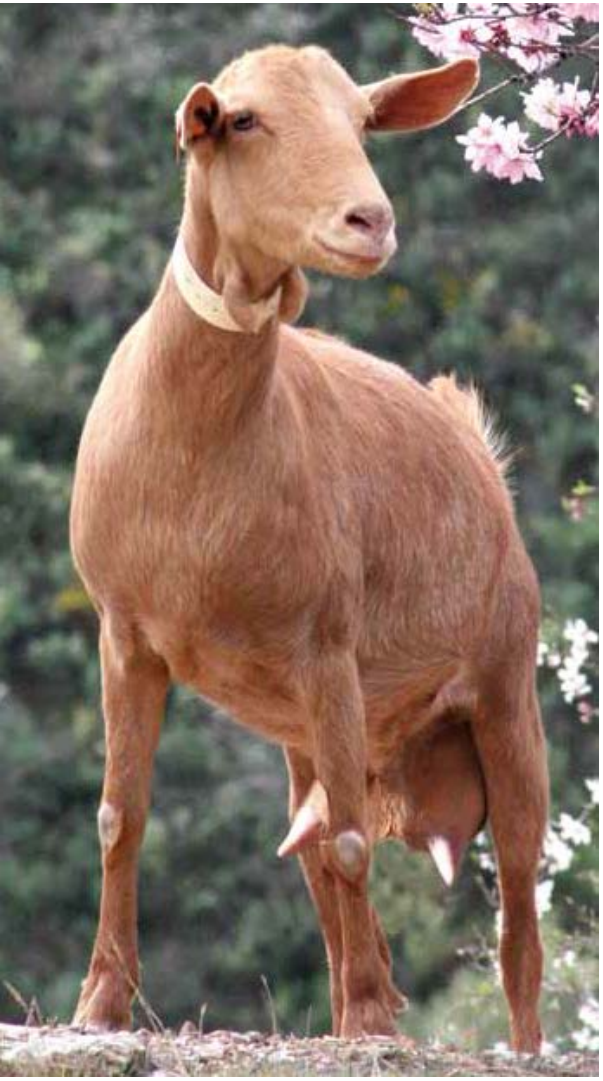
# Introduction



•Drastic climatic changes have been predicted for the southern regions of Spain within the next 30 years (European Environment Agency, 2009), with temperatures and drought periods significantly increasing.

•The largest part of goats in Spain are raised in these regions, often under extensive or semi-extensive type of managing linked to the very fragile *dehesa* system.

•In order to cope with these climatic changes, animals more robust to extreme conditions will be needed.

# Introduction

•Menéndez-Buxadera et al. (2012) found an important genetic variation for the response to heat stress in two breeds of goats (Murciano Granadina and Payoya) and one breed of sheep (Merino de Grazalema) in Andalusia. Finocchiaro (2005) observed similar variation in dairy sheep in Valle de Belice in Palermo, Italy.

•Cheese industry pays goat farmers for the amount of fat plus protein delivered, being this the main selection criterion in the breeding programs of local breeds of goats.

# Introduction

## Objective

The aim of this work is to present and compare the main results of the genetic (co)variance components of the effect of heat stress on fat plus protein yield, obtained with reaction norm models, in two Spanish breeds of dairy goats, (Malagueña and Florida).

# Material and Methods

## Data

•Fat plus protein yields registered monthly, provided by the corresponding breeders association (ACRIFLOR and CABRAMA)

•Climatic data registered in weather stations less than 20 Km from the farms, provided by the Spanish Meteorological Agency (AEMET)

•THI=[ T–(0.55*(1-RH))*(T–14.4)], T= temperature ºC, RH= relative humidity (Finochiaro et al., 2005)

| | Florida | Malagueña |
|---|---|---|
| **No. of records** | 129450 | 160067 |
| **No. of animals in the pedigree** | 12268 | 14089 |
| **Nº of Flock** | 20 | 17 |
| **No. of Flock-date at recording** | 725 | 637 |
| **Average daily milk yield (kg)** | 2301.3±1100 | 2014.7±956 |
| **Average daily fat + protein yield (g)** | 189.2±83.2 | 161.6±71.0 |
| **Average THI** | 21.5±5.9 | 21.4±5.6 |

# Statistical analysis

ASReml 3 software and norm of reaction model:

$$y_{ijklmn:thi} = HTD_i + fixed_j + f(\Phi_{thi:q})_k + r(a;\Phi_{thi:q})_l + r(p)_m + e_{ijklmn}$$

**HTD**: herd-test day

fixed: age at kidding, kids born, week of lactation and daily milkings

**$f(\Phi_{thi:q})$**: fixed function of the covariable THI modelled with a second order (q=2) Legendre polynomial coefficient ($\Phi$)

**$r(a;\Phi_{thi:q})$**: vector of the additive genetic function of each animal; thi:q the THI covariable modelled with a first order (q=1) Legendre polynomial

**r(p)**: a random function of permanent environmental effects *p* of each animal with data

**e**: residual random term with homogeneous variance

# Statistical analysis

- (Co)variance components:

$$\mathbf{V(y)} = \Phi \begin{bmatrix} A\sigma^2_{a_o} & A\sigma_{a_{so}} \\ A\sigma_{a_{os}} & A\sigma^2_{a_s} \end{bmatrix} \Phi' + I_p\sigma^2_p + e$$

*o*: intercept; *s*: slope; ***I***: identity matrix; ***A***: relationship matrix

- $h^2$ and r at all THI points, estimated using the elements of $\Phi$ for the corresponding level of THI

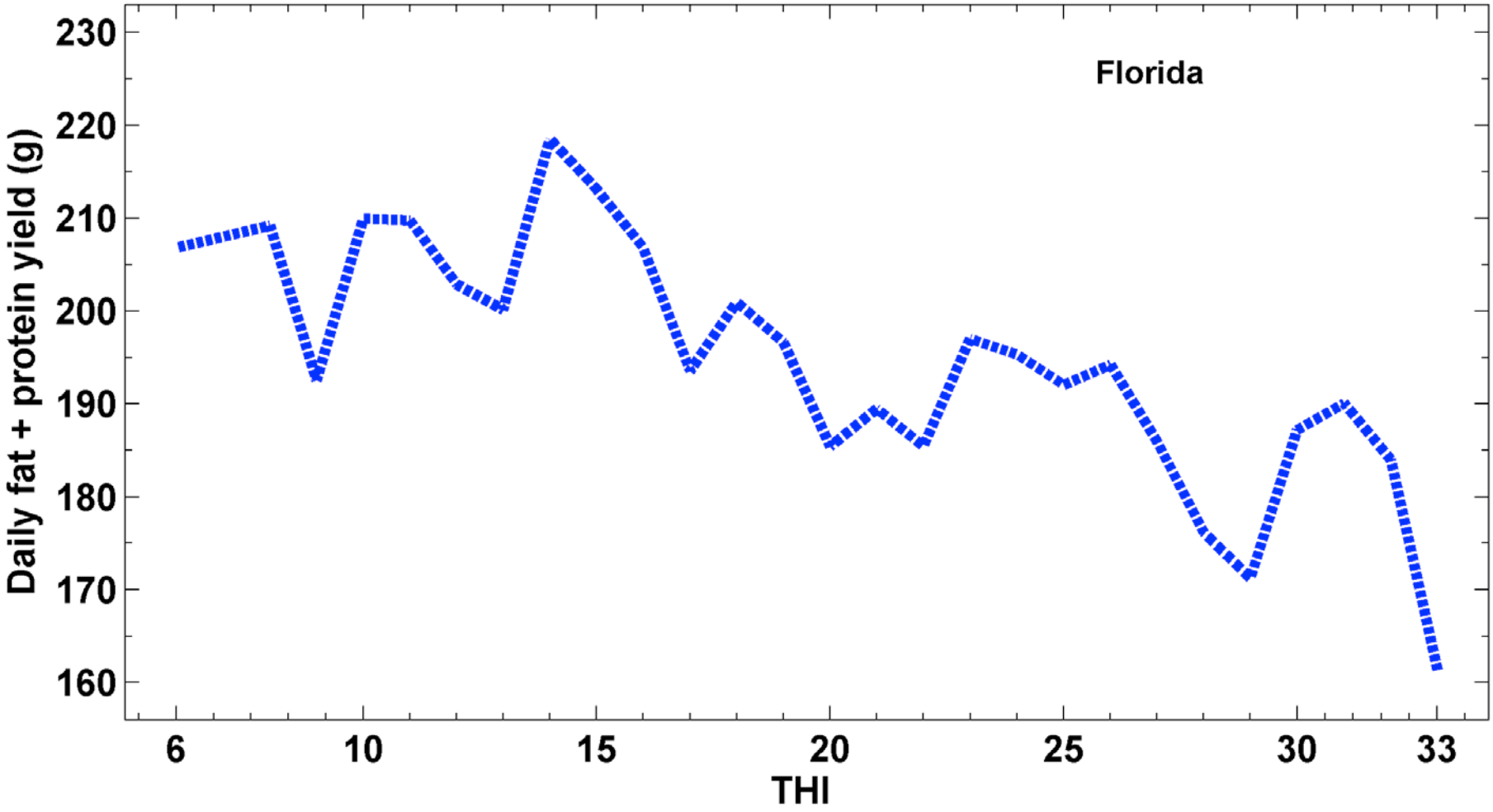
- BV at any point of THI calculated with $EBV^i_{thi} = \sum_{p=0}^{1} \Phi_{thi}\ a'_i$

$\boldsymbol{a_i}$ vector of additive genetic random regression coefficients corresponding to each animal

$\Phi_{thi}$ vector of first-order Legendre polynomial coefficients evaluated at THI

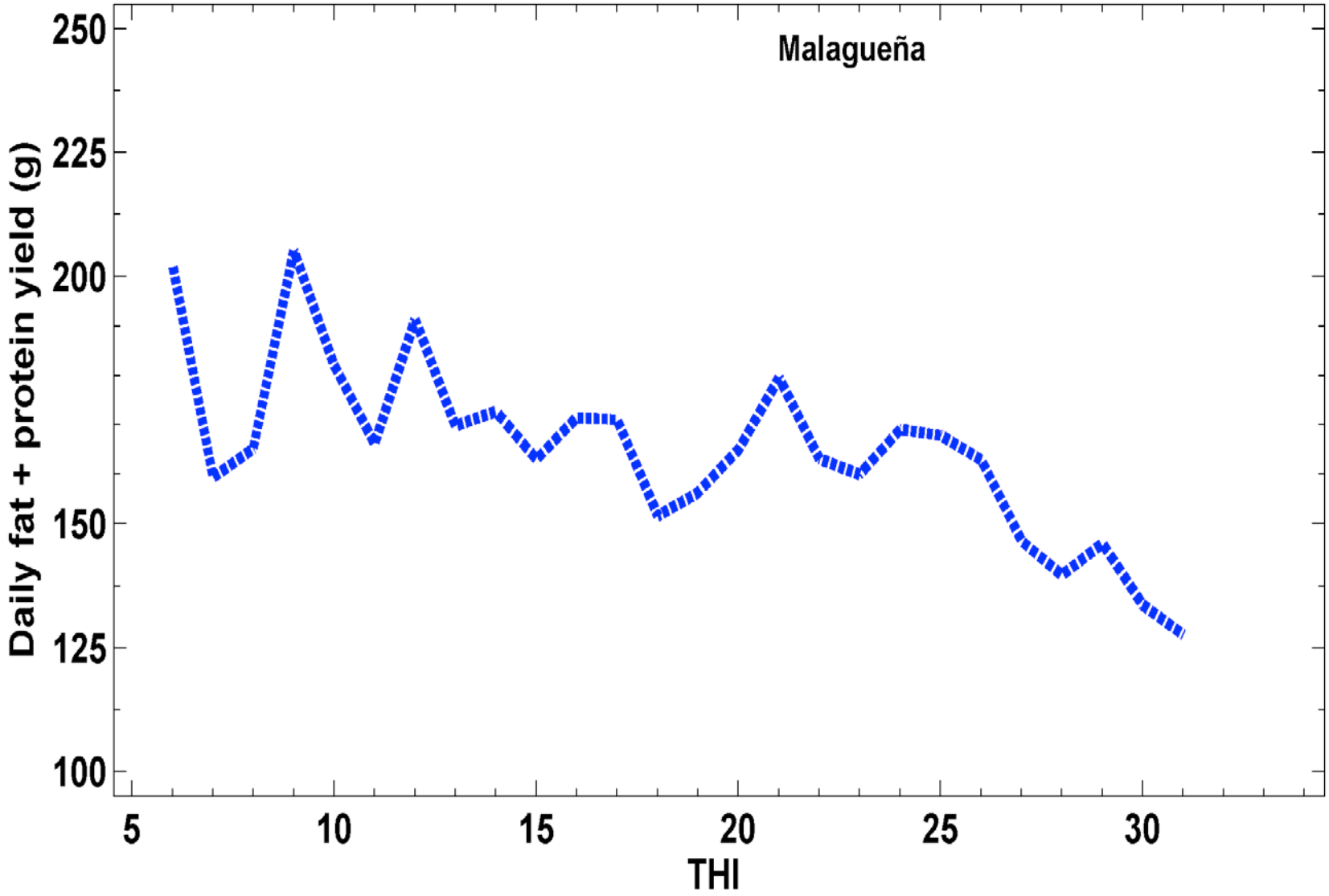
# Results

**Daily fat plus protein yields of Florida goats through the scale of  THI values on test day**



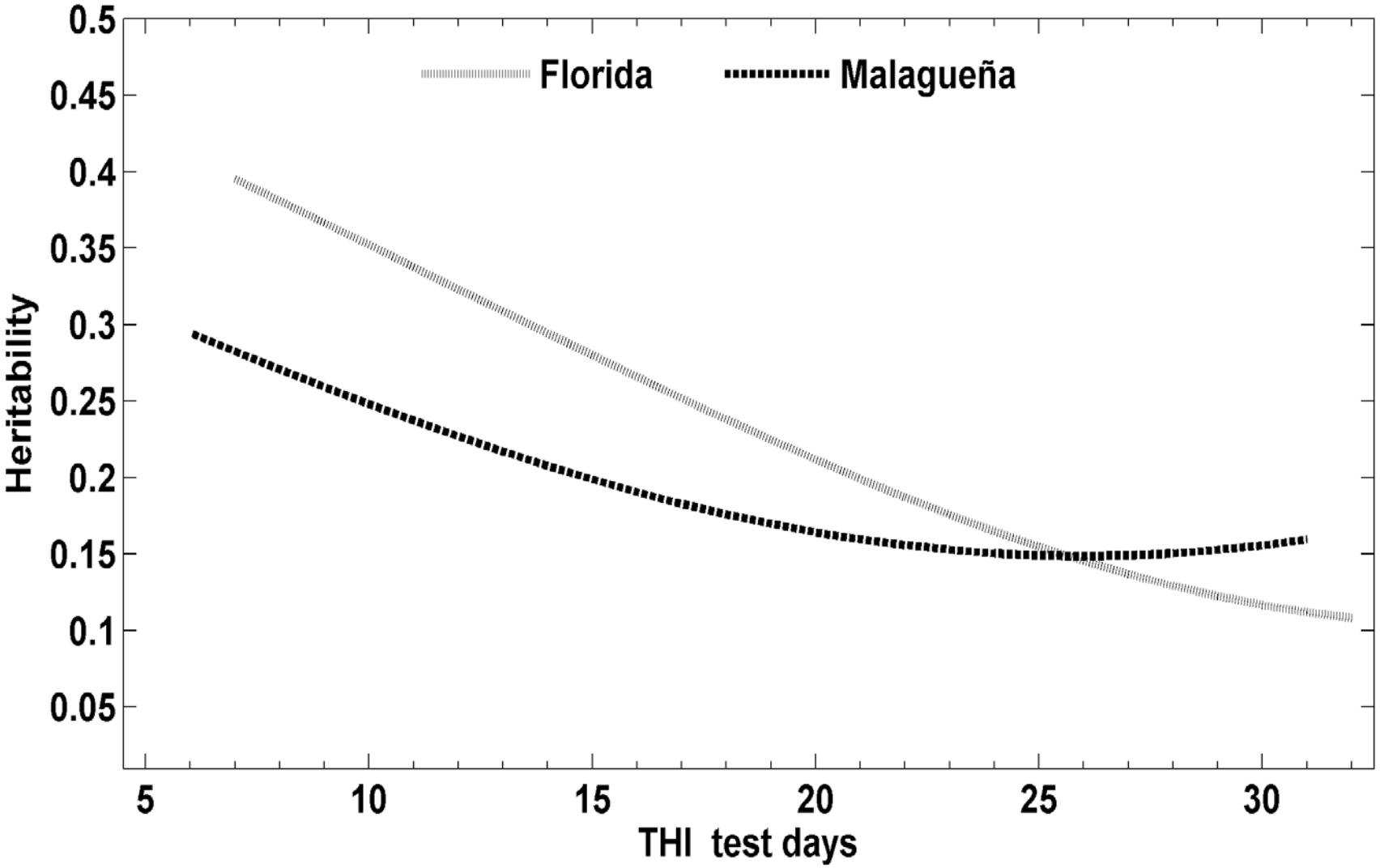
Results

# Daily fat plus protein yields of Malagueña goats through the scale of THI values on test day



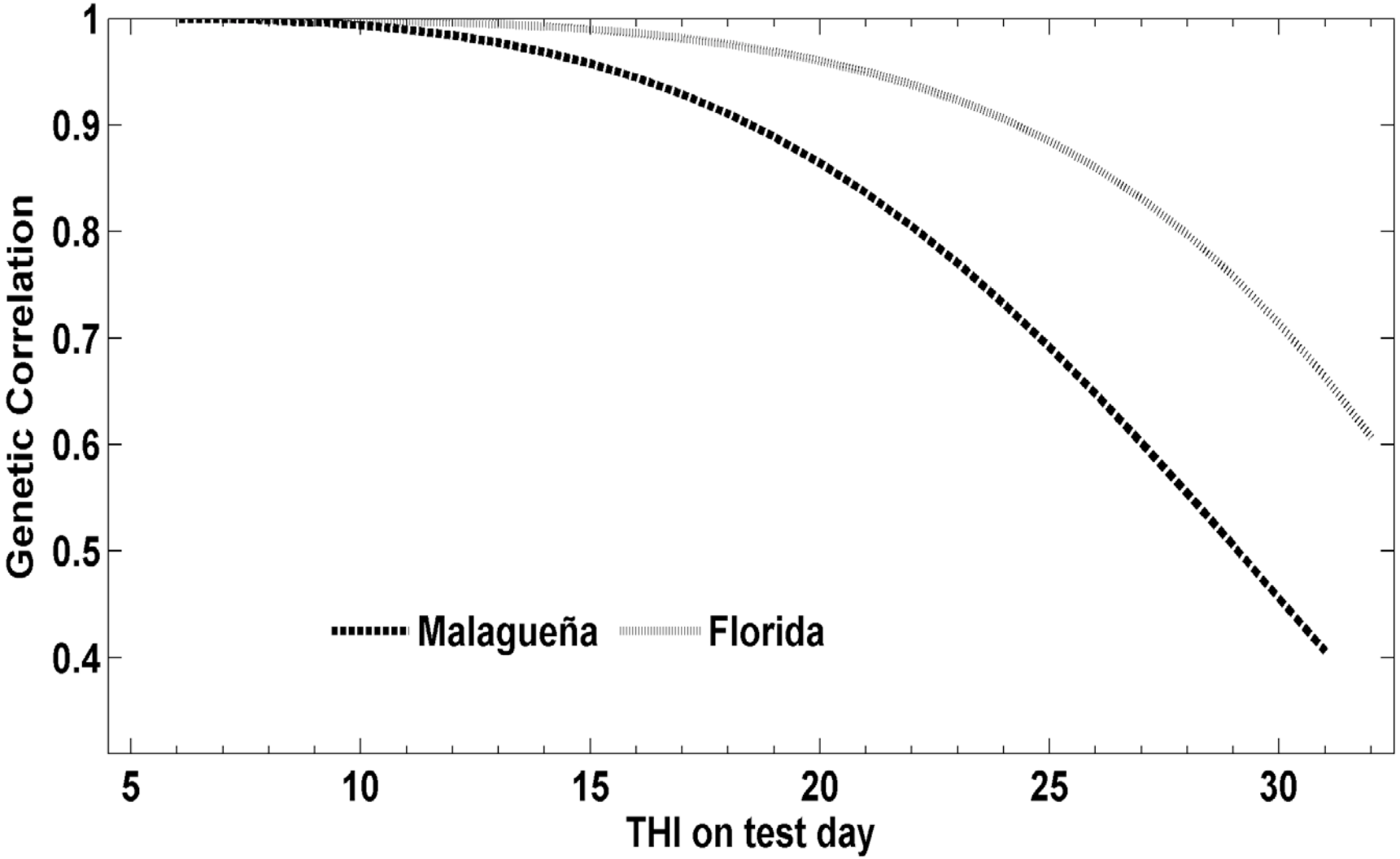
Results

# Heritability of daily fat plus protein yield through the scale of THI values on test day in Florida and



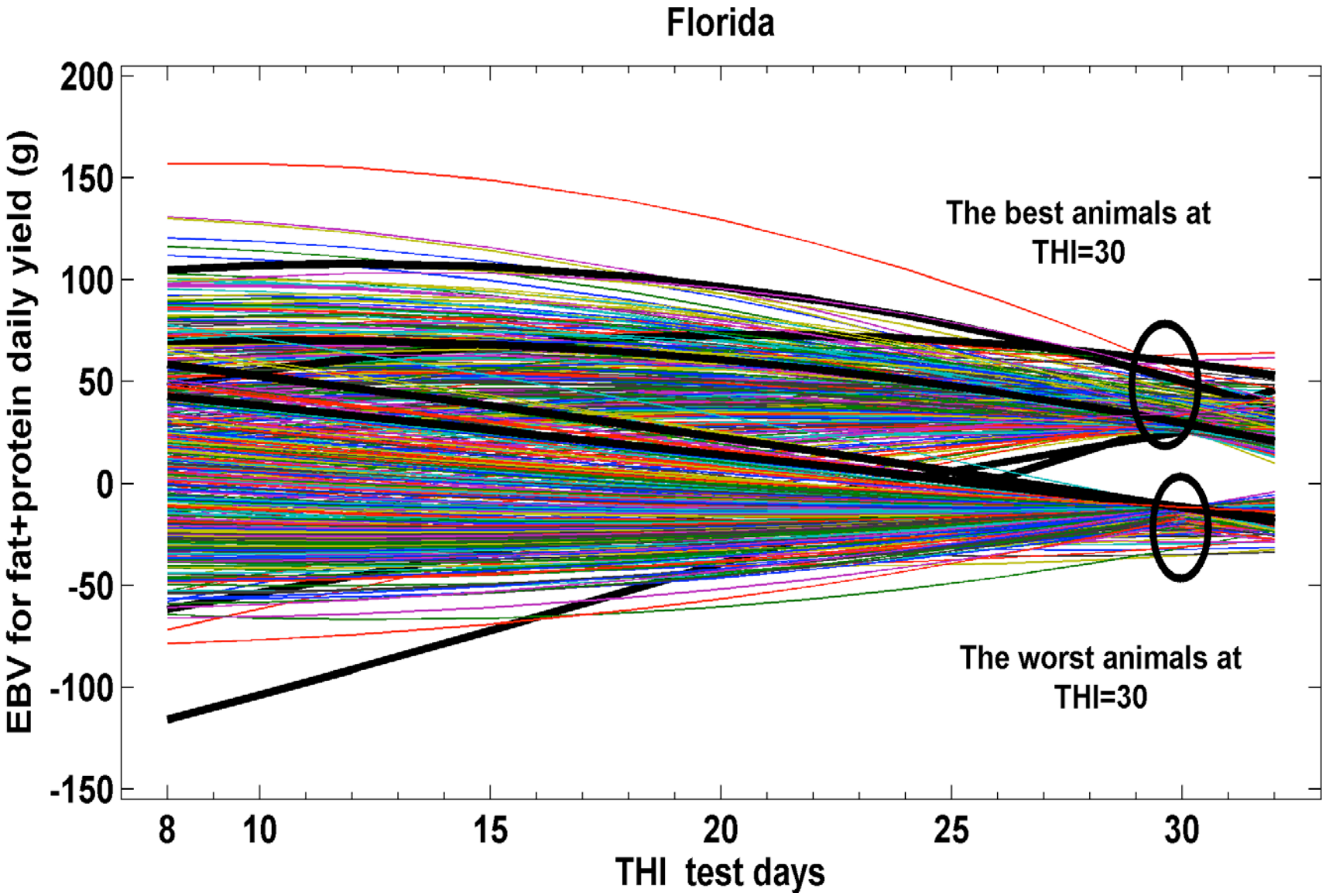
Results

# Genetic correlations of daily fat plus protein yields at THI=7 and the same trait at all other values of THI on test day in Florida and Malagueña goats



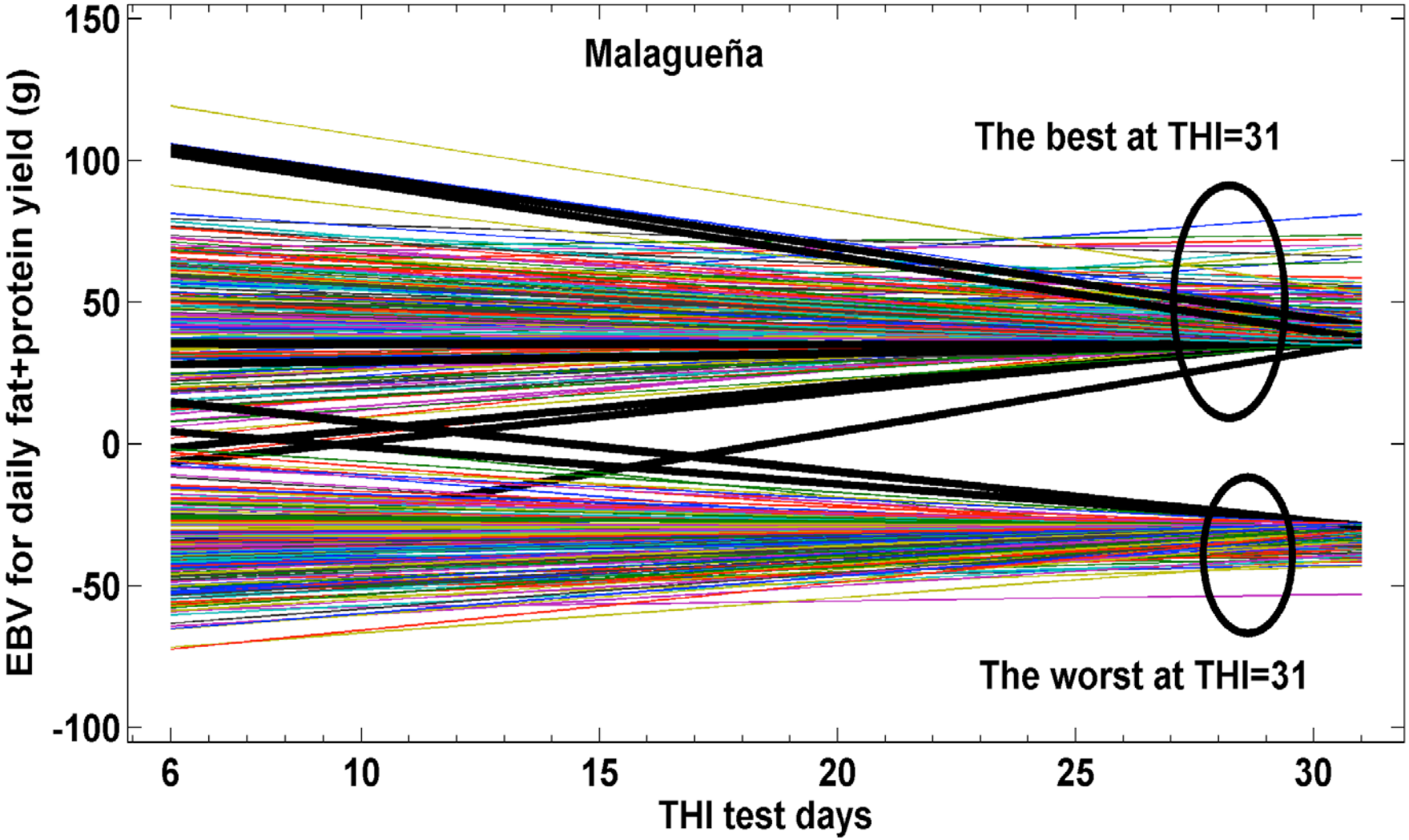
Results

# EBVs for daily fat plus protein yield of the best and worst Florida goats* through the scale of THI values on test day



Results

# EBVs for daily fat plus protein yield of the best and worst Malagueña goats through the scale of THI values on test day



# CONCLUSIONS

- Heritability of daily fat plus protein yield estimated at increasing THI values (on test day) tend to decrease.
- Genetic correlations between daily fat plus protein yields measured at THI=7 and at the rest THI values tend to decrease with increasing THI values.
- The genetic (co)variance components of daily fat plus protein yield are not the same throughout the scale of THI values, therefore the trait is different for each THI point.
- Three types of responses of EBV to THI were observed: (1) Sensitive, with estimated breeding values (EBV) decreasing as THI increase, (2) Robust, with EBV independent of THI, (3) Tolerant, with EBV increasing as THI increase. Genetic improvement of these breeds for stress tolerance is, therefore, possible.

# *Thank you for your attention*

**Special thanks are given to:**

*Asociación Nacional de Criadores de Ganado Caprino de Raza Florida (ACRIFLOR)*

*Asociación Española de Criadores de la Cabra Malagueña (CABRAMA)*

*Agencia Estatal de Meteorología (AEMET)*