ICAR 2023 TOLEDOSPAIN

Rumigen

TOWARDS IMPROVEMENT OF **RUMI**NANT BREEDING
THROUGH **GEN**OMIC AND EPIGENOMIC APPROACHES

Towards new breeding tools in a context of climate change: Fertility results of the RUMIGEN project on new phenotypes for heat tolerance traits

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ICAR Meeting

(Toledo, Spain, May 21st to May 26th, 2023)

Material - I

Holstein (FRA, SPA, NLD)

Montbéliarde (FRA)

Reproductive performance: Provided by Breeder Associations

- AI records (**Conception Rate (CR)** = Success/Failure) of **first inseminations in first lactation cows**.
- Period: 2010- 2020

	HOL-FRA	HOL-NLD	HOL-SPA	MON-FRA
No Records/cows (Millions)	4.4	0.42	0.47	0.84

Material - II

Daily weather information: Provided by national Meteo Agencies

- France : Grids of 8x8 km
- NLD : 34 weather stations
- Spain : 410 weather stations

Heat load measure = Temperature Humidity Index

THI = (1.8*T+32)-(0.55-0.0055*RH)*(1.8*T-26)

T =average daily temperature (°C)

RH = average daily humidity (%)

Methods - I

→ Estimation of the effect of a variation of THI at the population level:

$$y_{ij} = \text{THIc} + \sum \text{other fixed effects}_{i,j} + a_i + e_{ij}$$

- y_{ij}: CR (0/1) at first AI in first lactation for cow i
- **THIc** (fixed class of THI): averaged over the day of AI and 7 days post- AI
- **Random effects**: a_i animal additive genetic value, p_i : cow permanent environmental effect, e_{ij}: residual; other random effects: service sire (FRA, NLD), Herd-year (SPA)
- **Other fixed effects**
  - FRA: CG,Ss, VWP AC, DW, SS
  - NLD: CG, YM, DW, AB, SS
  - SPA:VWP, AC

  CG=Contemporary group (HY), Ss=Season, YM= Year-Month of calving, VWP (voluntary waiting period), AC=Age at calving, AB= Age of bull, DW=day of the week, SS=sexed semen

Methods - II

→ **Estimation of comfort threshold and slope of loss in fertility**

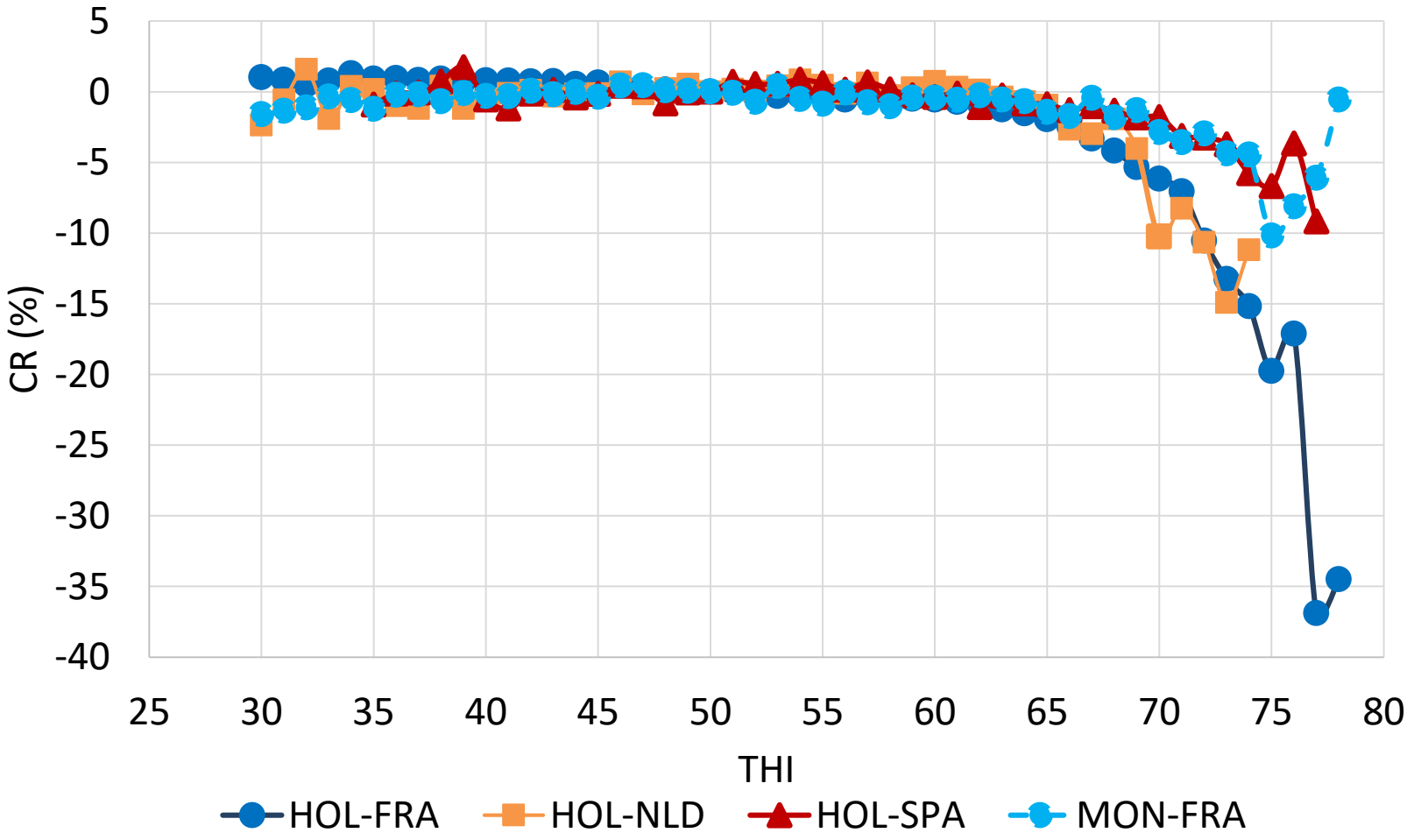
$$\widehat{THI}_i = LP(THI,3) + e_i$$

- $\widehat{THI}_i$: estimate of THI i effect from previous analysis
- LP(THI,3): Cubic Legendre polynomial for THI values

Method: change points in trajectories (Segmented R-package (version 1.6-4))

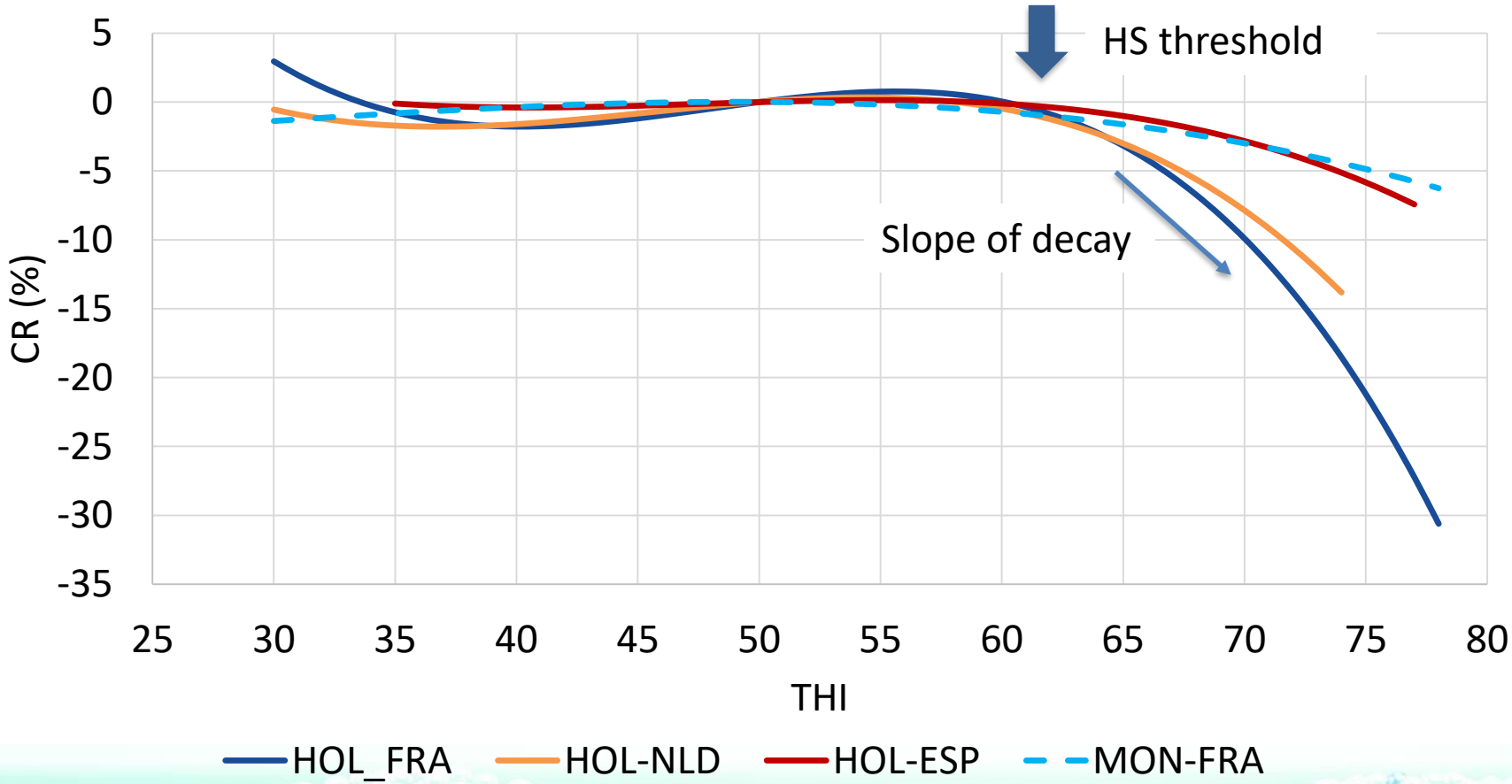
Results - I

Estimated effect of THI on Fertility (CR)- Solutions for THI classes



Results - II

Cubic polynomial fit and estimates of comfort threshold and subsequent slope of decay in fertility



Results - II

Cubic polynomial fit and estimates of comfort thresholds and subsequent slopes of decay in fertility

Breed-Country	Threshold (THI units)	Slope (%CR/unit THI)
HOL-FRA	63	-1,29
HOL-NLD	62	-1,04
HOL-SPA	64	-0,51
MON-FRA	61	-0,48

Conclusions

- A negative impact of heat stress on fertility was observed in all breeds/countries
- Consistent patterns of ‘Broken line’ (no response to increasing THI up to HS threshold and subsequent decay) for all breeds/countries
- HS thresholds: small differences across countries (highest for HOL-SPA, lowest for MON-FRA)
- Heat stress effect (slopes of decay after threshold) differed across breeds/countries (largest for HOL-FRA and HOL-NLD, smallest for HOL-SPA and MON-FRA)

RUMIGEN PARTNERS

Thank you for your attention

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