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Coolpigs

OVERVIEW OF HEAT STRESS MANAGEMENT IN FATTENING PIGS

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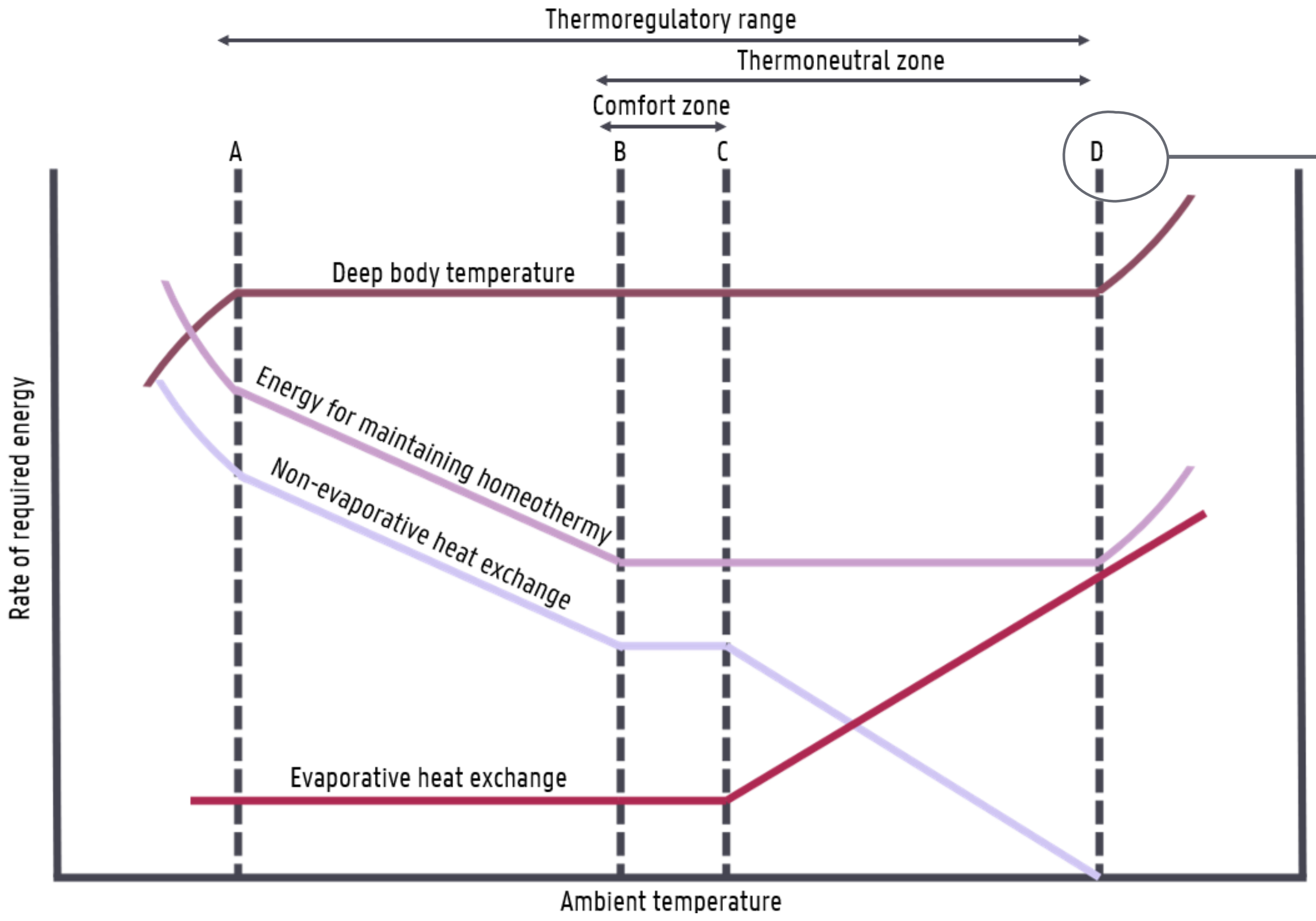
OUTLINE

- Thermoregulation
  - Physiology
  - Influencing factors
  - Heat stress: definition & consequences
- Heat stress reducing measures
  - Management
  - Climate-technical
  - Nutrition
    - Detailed study

THERMOREGULATION

Influencing factors and consequences

THERMOREGULATION OF THE PIG



From the moment when ambient temperature exceeds upper critical point (UCT)

More energy is needed to lose heat and homeothermy can not be maintained, resulting in a rise in body temperature

PARAMETERS AFFECTING UPPER CRITICAL TEMPERATURE

Animal-related parameters

Body weight

Genetics

Physiological status

Animal species

PARAMETERS AFFECTING UPPER CRITICAL TEMPERATURE

Environment-related parameters

Ambient temperature

Relative humidity

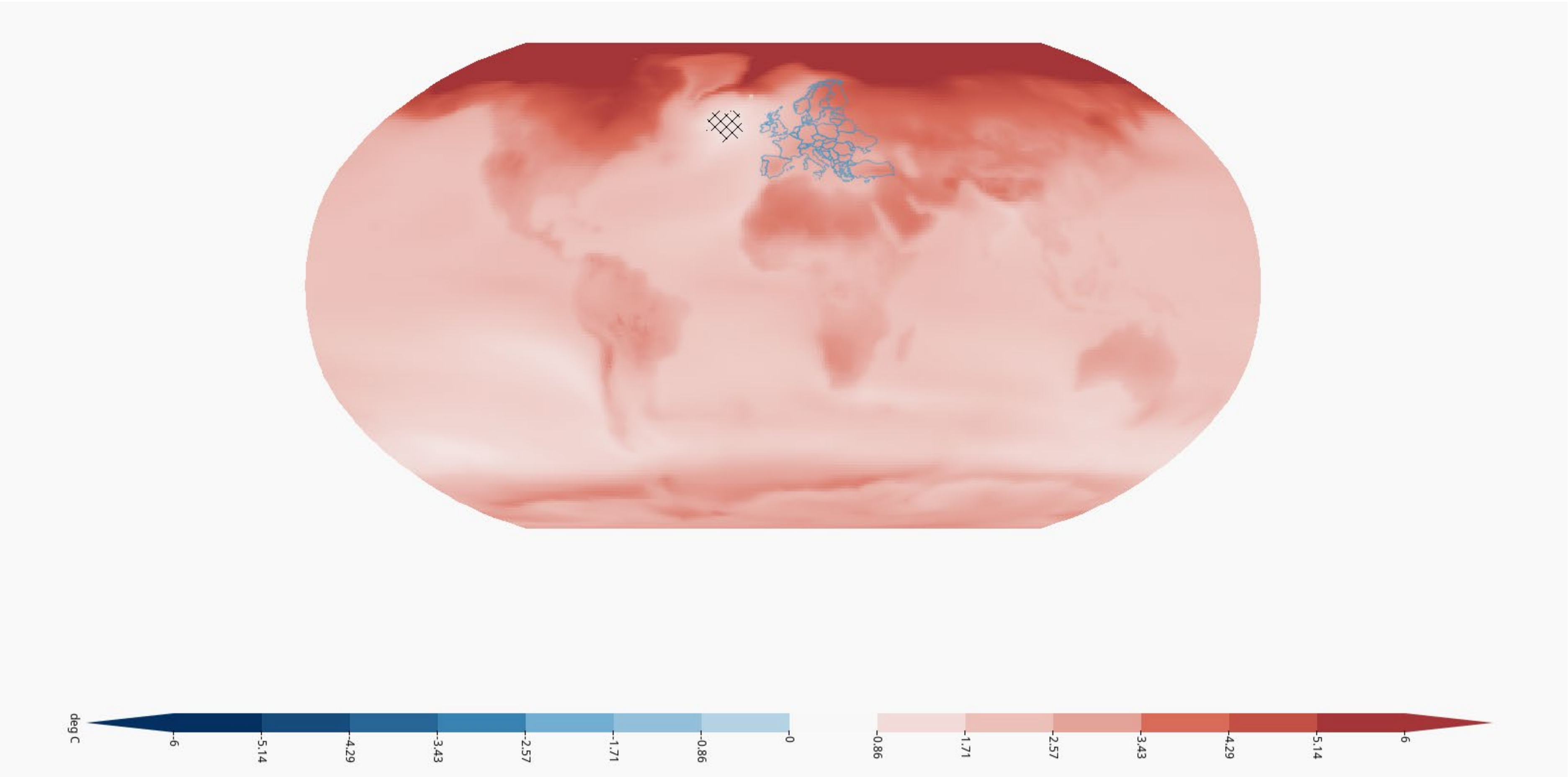
Air speed

Ventilation

Housing and farm specifics

CLIMATE CHANGE WORLDWIDE

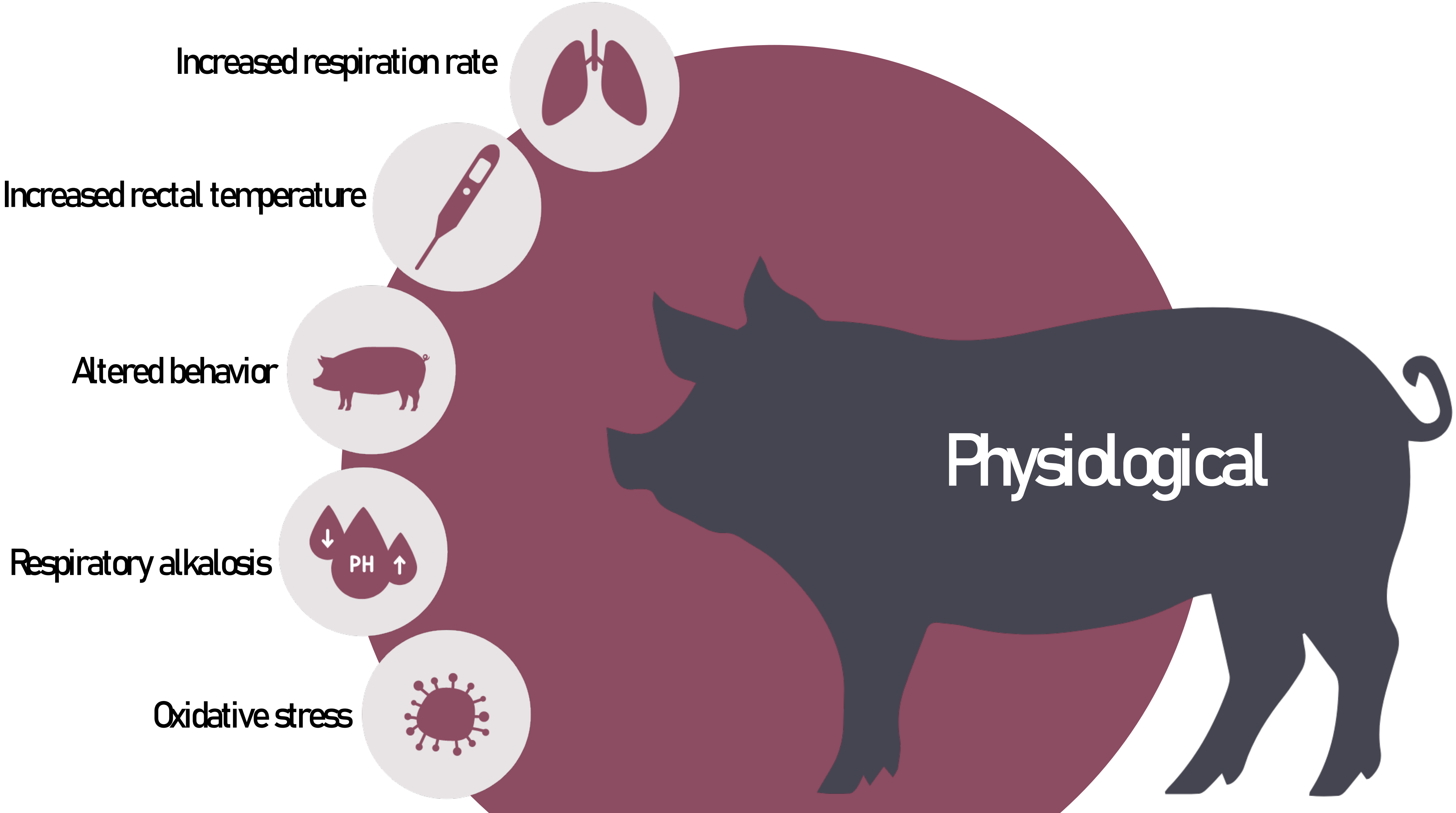
Change in temperature compared to 1850-1900



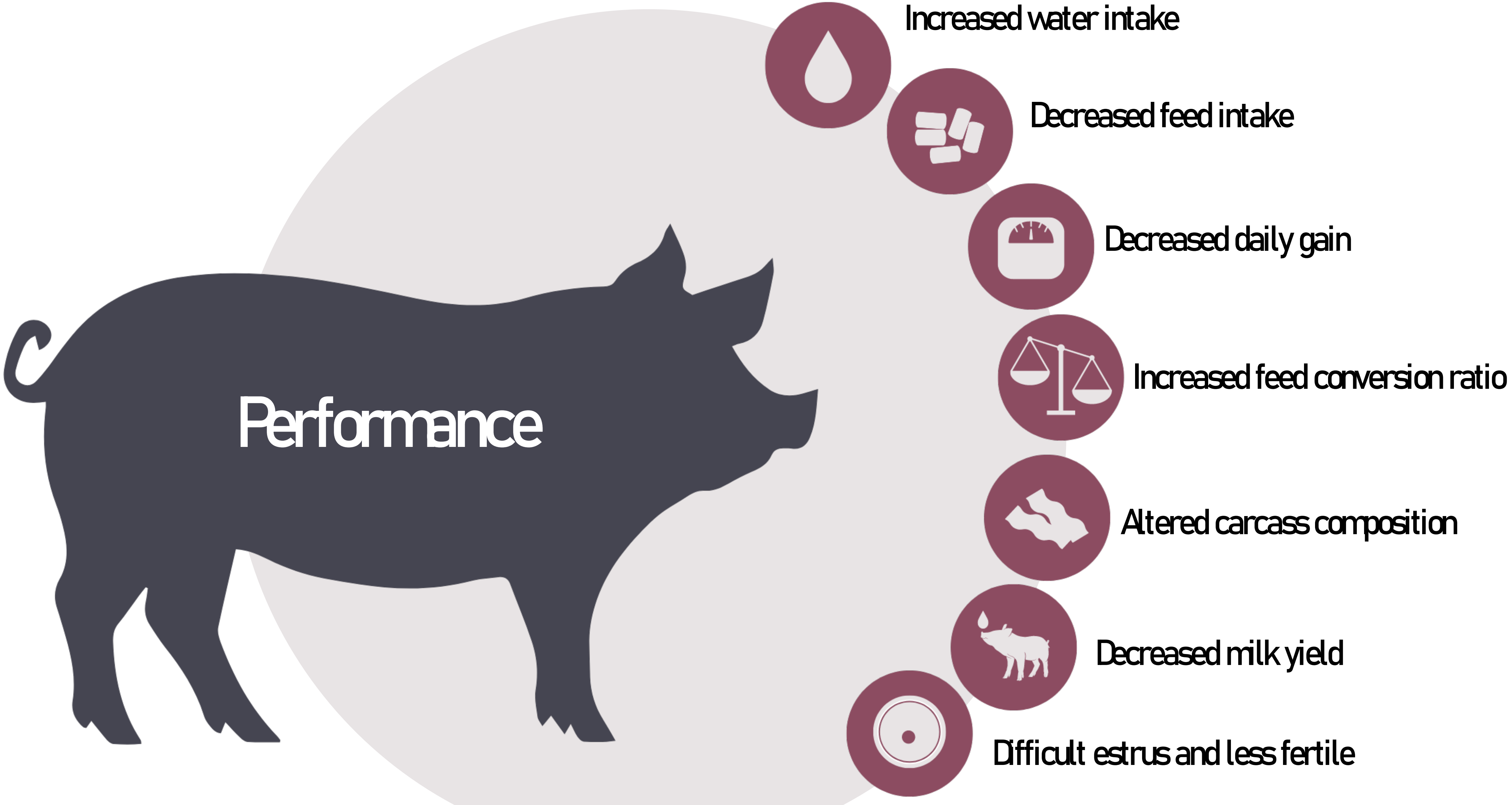
HEAT STRESS IN FARM ANIMALS

- Pigs are sensitive for heat stress due to
  - Lack of sweat glands
  - Thick subcutaneous fat layer
  - Limited lung capacity
  - Selection on high productivity
  - Housing conditions
  - ...

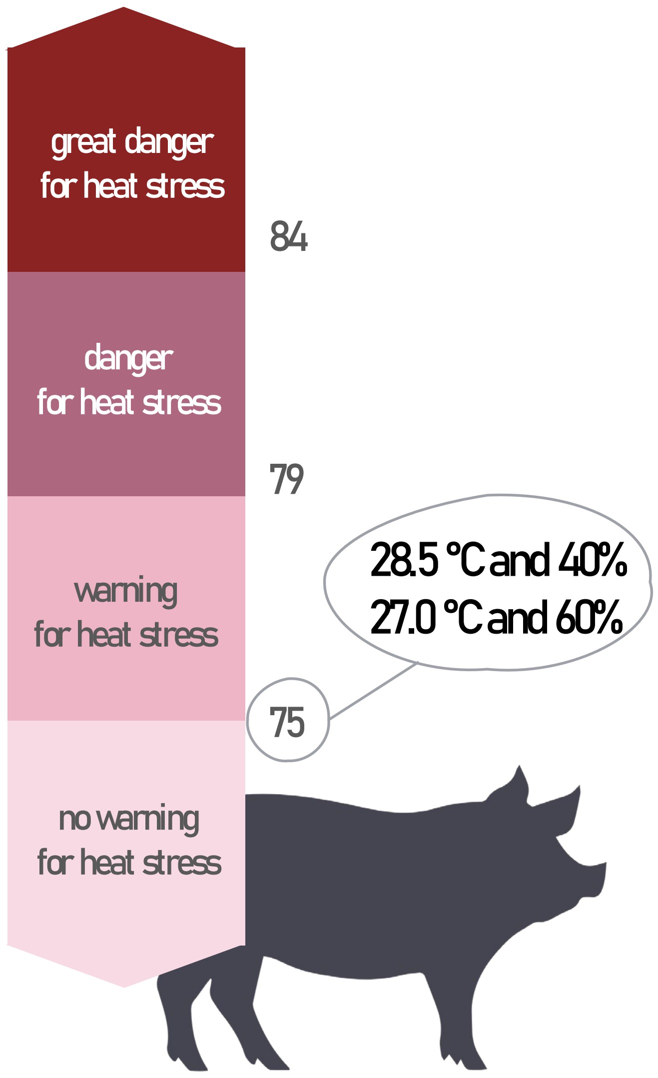
CONSEQUENCES OF HEAT STRESS



CONSEQUENCES OF HEAT STRESS



MEASURING HEAT LOAD/STRESS



- Temperature humidity index (TH)
    - Index combining temperature and relative humidity
    - Boundaries dependent of animal species
- Changes in physiology & performance
    - Increased respiration rate in combination with increased rectal temperature
    - Decreased feed efficiency: when the decreased feed intake results in impaired daily gain

MEASURING HEAT STRESS

HEAT STRESS REDUCING MEASURES

Looking for practical, realistic measures against heat stress for pig farmers

VLAIO Coolpigs PROJECT

Feed additives

Stocking density

Feed composition

Transportation time

Cooling systems

Genetics

Fogging in barn

Water additives

Air speed

Misting in lairage

Effect of antioxidants

Effect of stocking density

MANAGEMENT STRATEGIES

MANAGEMENT STRATEGIES

- lower stocking density -

MANAGEMENT STRATEGIES

Lower stocking density

Eu legislation:

- 85 – 110 kg: 0.65 m²/animal
- >110 kg: 1 m²/animal

EU Council Directive 2008/120/EC

Benefits for heat stress:

- Less direct contact with pen mates
- Choosing to move away from pen mates
- Better access to the cooler floor

→ Increase heat radiation and encourage convective heat losses
Mount (1979), Huynh (2005) & Dewulf et al. (2007)

→ Beter productivity during heat stress
Kerr et al. (2005), White et al. (2008) & Schauberger et al. (2019)

→ What about physiology?

MANAGEMENT STRATEGIES

Lower stocking density

Start-up at 1.2 m²

Start-up at 1.0 m²

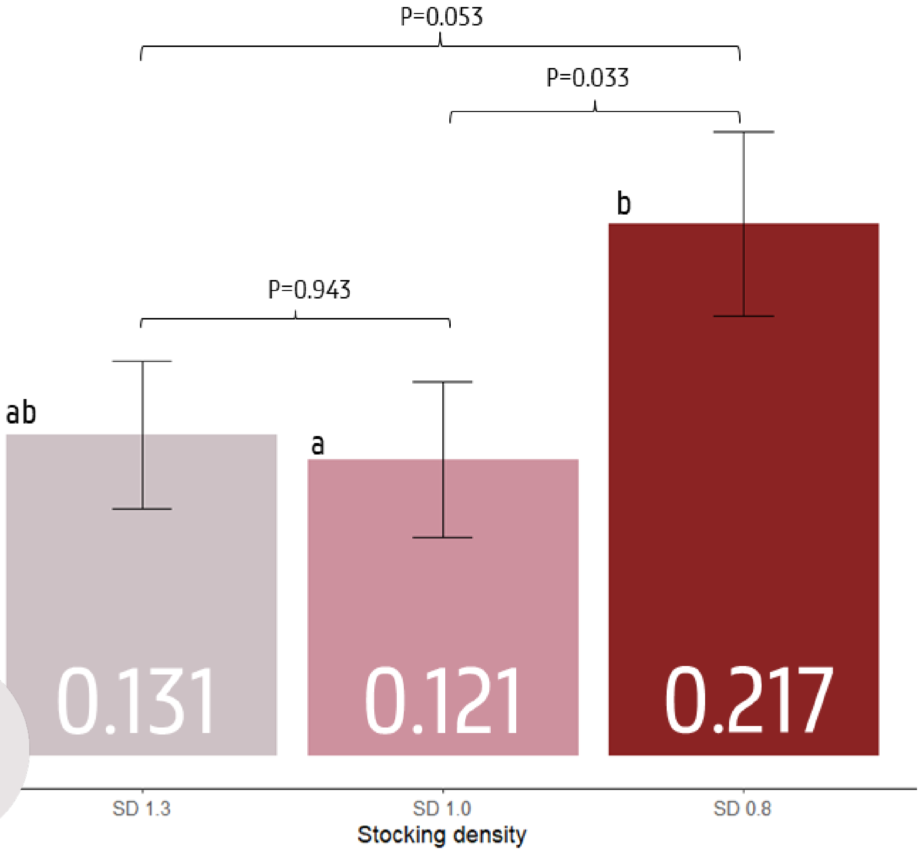
Start-up at 0.8 m²

Half-grid floor
Pen size: 4.8m²
4 compartments

MANAGEMENT STRATEGIES

Lower stocking density

Increase in rectal temperature during heat wave



Pigs under high stocking density are less able to maintain internal metabolic temperature

- Increased radiant heat emitted from pen mates
- Less floor area for sensible heat loss via conduction

0.8 m²/animal

1.2 m²/animal

Published study

MANAGEMENT STRATEGIES

- genetics -

MANAGEMENT STRATEGIES

Genetics

- Pigs selected on high growth performance, have a reduced capacity for coping with heat stress (greater effect on ADG and FCR in more recent studies)
  Renaudeau et al. (2011)

→ Increased heat production
  Brown-Brandl et al. (2001)

- Greater heat stress tolerance in tropical breeds compared to temperate climate breeds

→ Lower metabolic heat production resulting from reduced productive potential
  Gourdine et al. (2007), Gourdine et al. (2021), Renaudeau et al.(2007), Rauw et al. (2020) & Silió (2000)

→ Financial sustainable (higher production costs attributed to slower growth and fatter carcasses)?
  Gourdine et al. (2021) & Rosé et al. (2017)

MANAGEMENT STRATEGIES

Genetics

Offspring of terminal sire line selected on
optimal carcass quality

ADFI: 2.1 kg/day
ADG: 0.9 kg/day
FCR: 2.31
Lean meat: 67 %
Back fat: 7.4 %

VS

Offspring of terminal sire line selected on
optimal growth

ADFI: 2.4 kg/day
ADG: 1.0 kg/day
FCR: 2.38
Lean meat: 62 %
Back fat: 8.6 %

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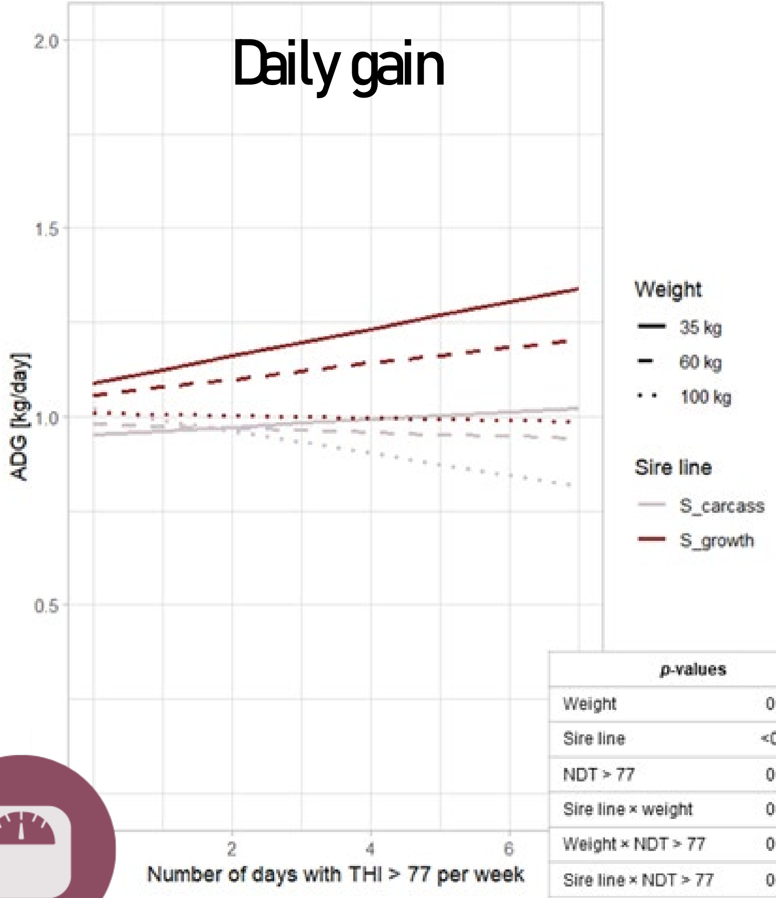
MANAGEMENT STRATEGIES

Genetics



p-values	
Weight	0.177
Sire line	<0.001
NDT > 77	0.248
Sire line × weight	0.008
Weight × NDT > 77	0.042
Sire line × NDT > 77	0.020

Older fattening pigs selected for optimal carcass quality had declining daily gain during prolonged heat stress, whereas daily gain of pigs selected for optimal growth decreased less

duration of heat wave

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Study in submission

CLIMATE-TECHNICAL STRATEGIES

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- extra axial fans-

CLIMATE-TECHNICAL STRATEGIES

Extra axial fans

Forced convection is one of the most effective ways of improving an animal's heat loss

Godyń et al. (2020)

Better feed efficiency & daily gain in mechanical ventilated (higher air speed) vs. natural ventilated barns

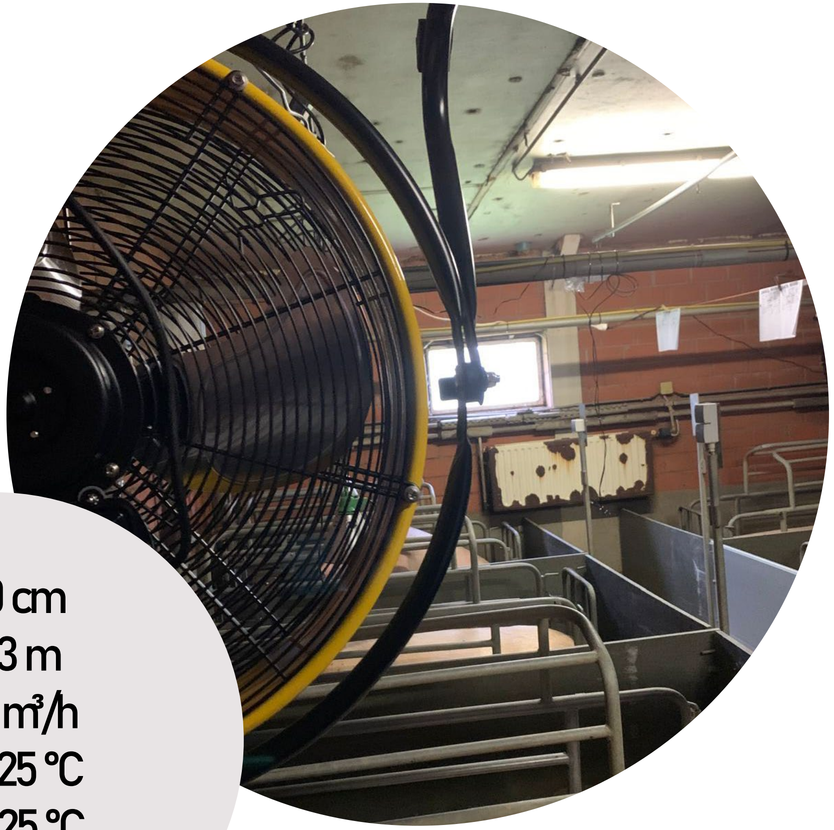
Stender et al. (2003) & Wegert et al. (2017)

Better daily gain & feed intake with increased air speed at > 24 °C

Massabie et al. (2001)

CLIMATE-TECHNICAL STRATEGIES

Extra axial fans



Ø 70 cm
H 1.3 m
6600 m³/h
On: > 25 °C
Off: < 25 °C
Door ventilation

2 axial fans in farrowing house

Mixing fresh oxygenated air with the air present in the unit

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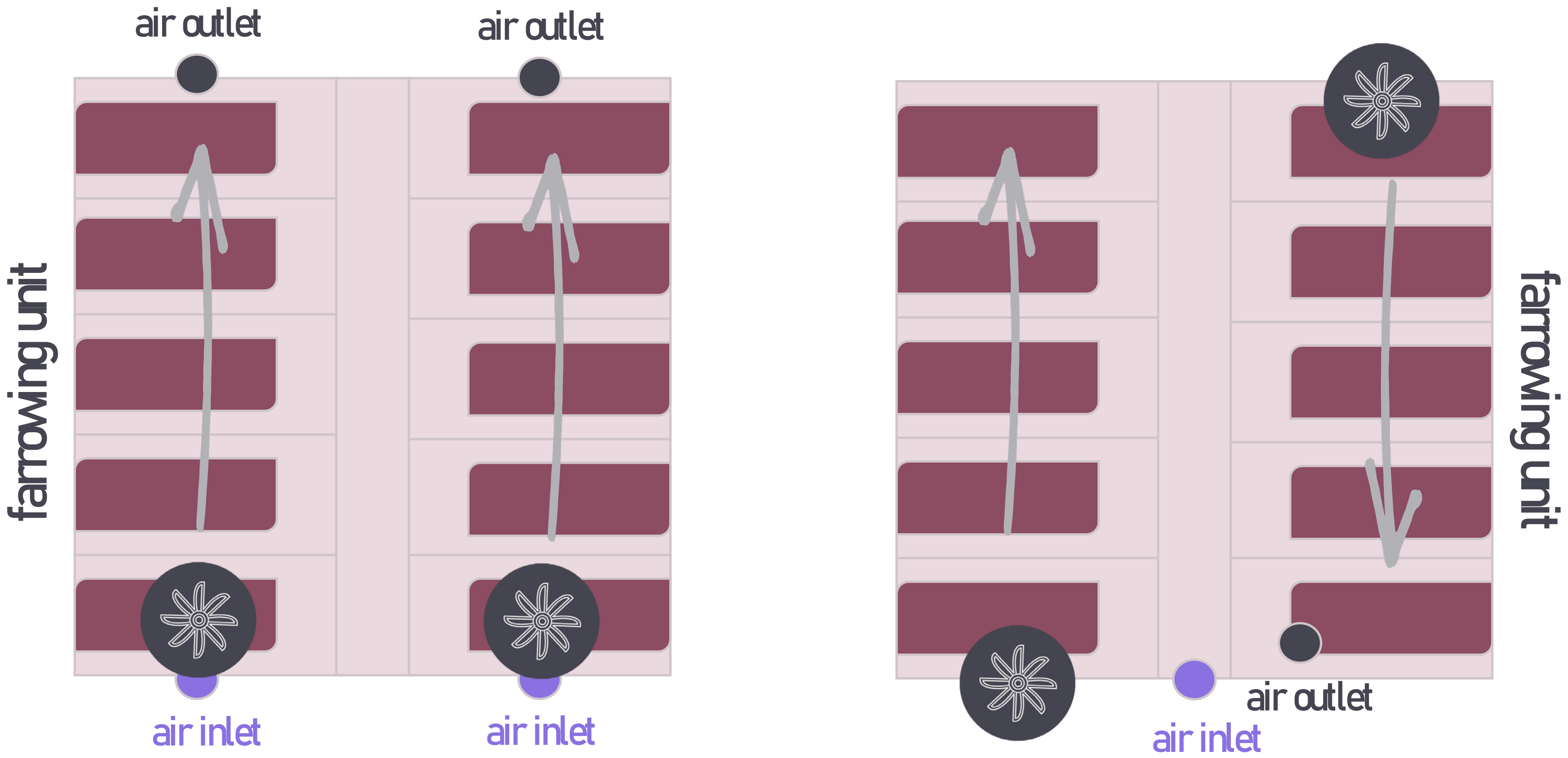
CLIMATE-TECHNICAL STRATEGIES

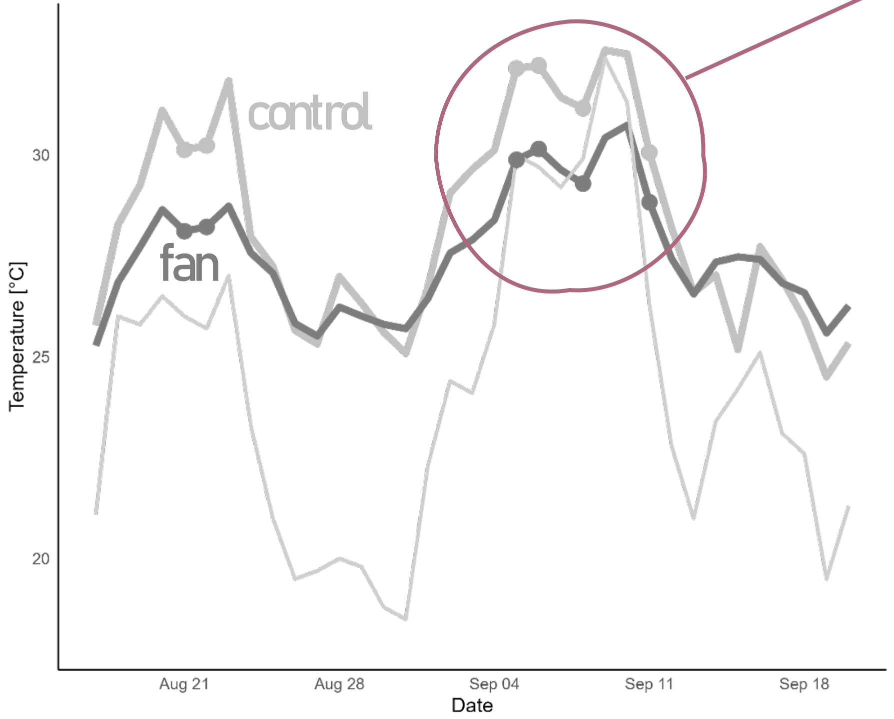
Extra axial fans

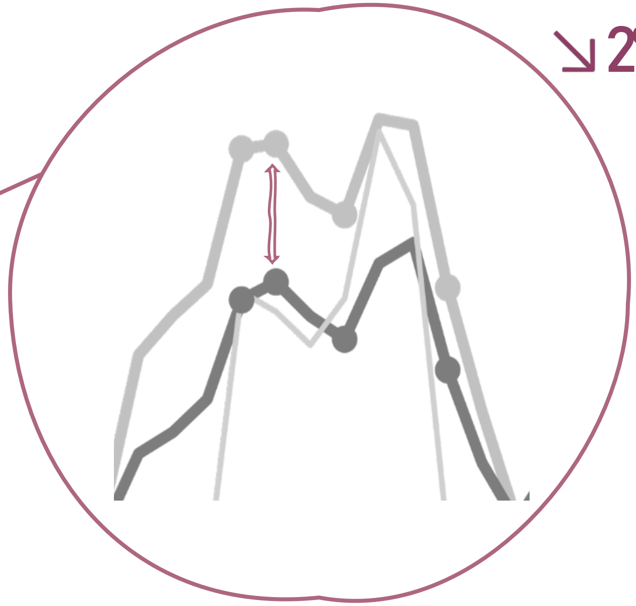


CLIMATE-TECHNICAL STRATEGIES

Extra axial fans

Maximum temperature per day





↘ 2°C

Mixing fresh air better with air present in the compartment

	Control	Fan
Max temperature (°C)	32.8	30.8
Max TH	82.6	80.9
Number of days >30°C	14	4

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Ongoing study

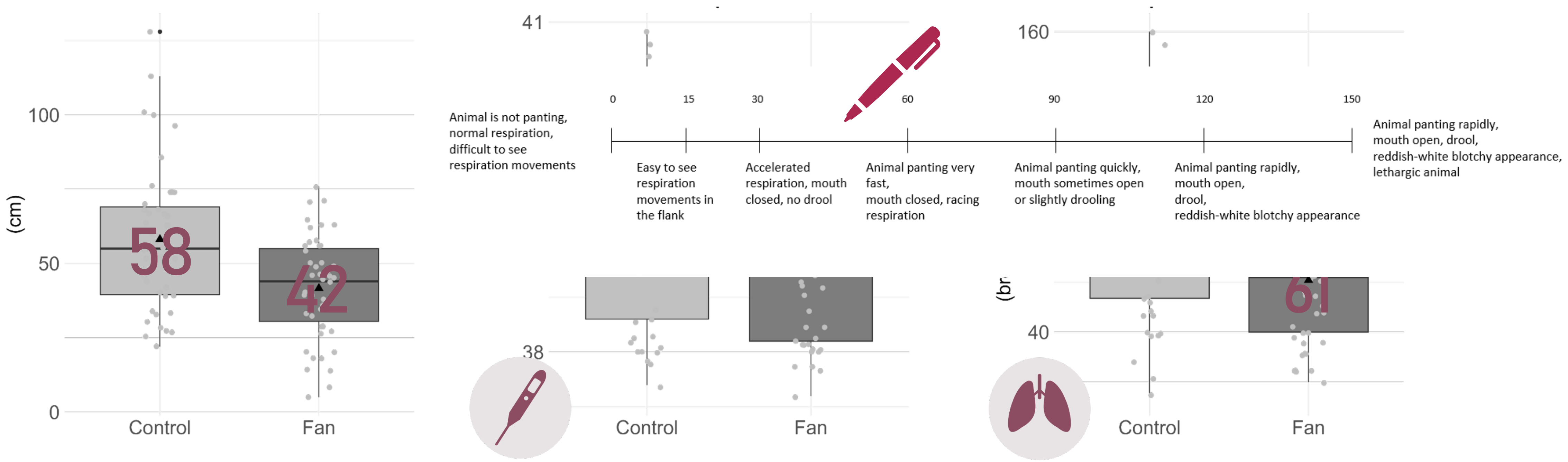
CLIMATE-TECHNICAL STRATEGIES

Extra axial fans

Heat stress score (0-150)

Rectal temperature

Respiration rate



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Ongoing study

CLIMATE-TECHNICAL STRATEGIES

- high pressure fogging -

CLIMATE-TECHNICAL STRATEGIES

Hgh pressure fogging

The transition of water into gas (and associated thermal energy) will reduce air temperature

Simmons & Lott (1996)

→ Decrease in respiration rate

Godyn et al. (2018)

→ Increased air relative humidity!

Godyn et al. (2020)

CLIMATE-TECHNICAL STRATEGIES

Hgh pressure fogging

70 bar
Step-wise with °C
min pulse time 45s
max pulse time 240s

On: > 27.5 °C
Off: > 75 %

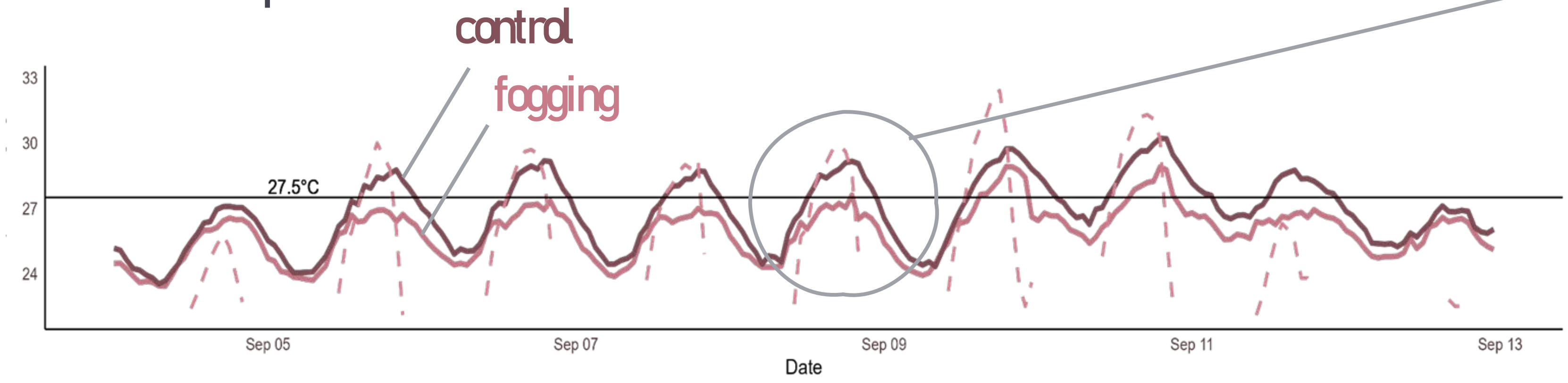
Hgh pressure fogging in compartment

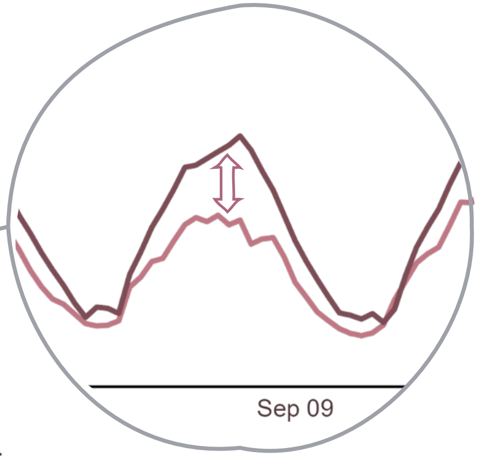
Dropping air temperature by adiabatic cooling

CLIMATE-TECHNICAL STRATEGIES

Hgh pressure fogging

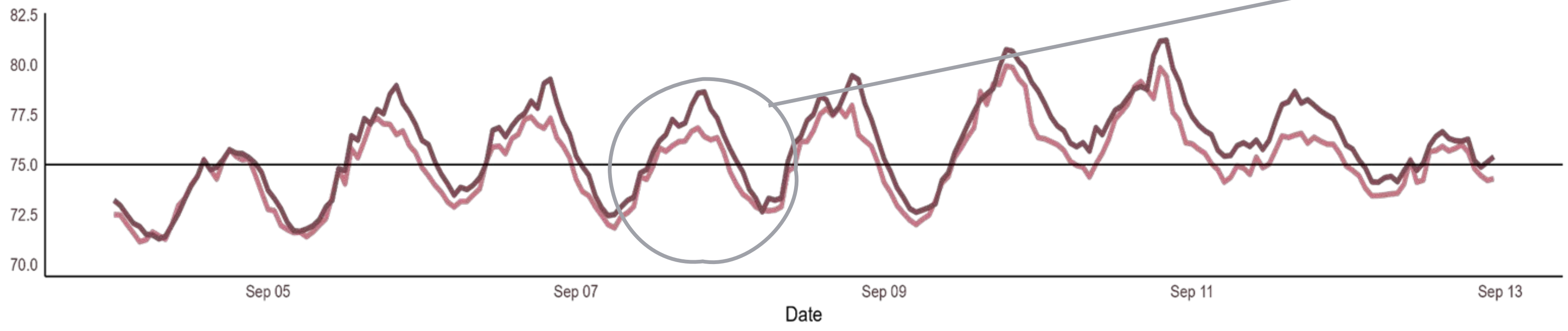
Ambient temperature

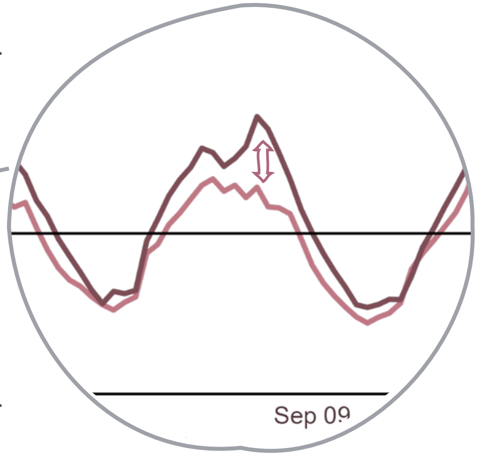




↘ 2.9 °C

TH per hour





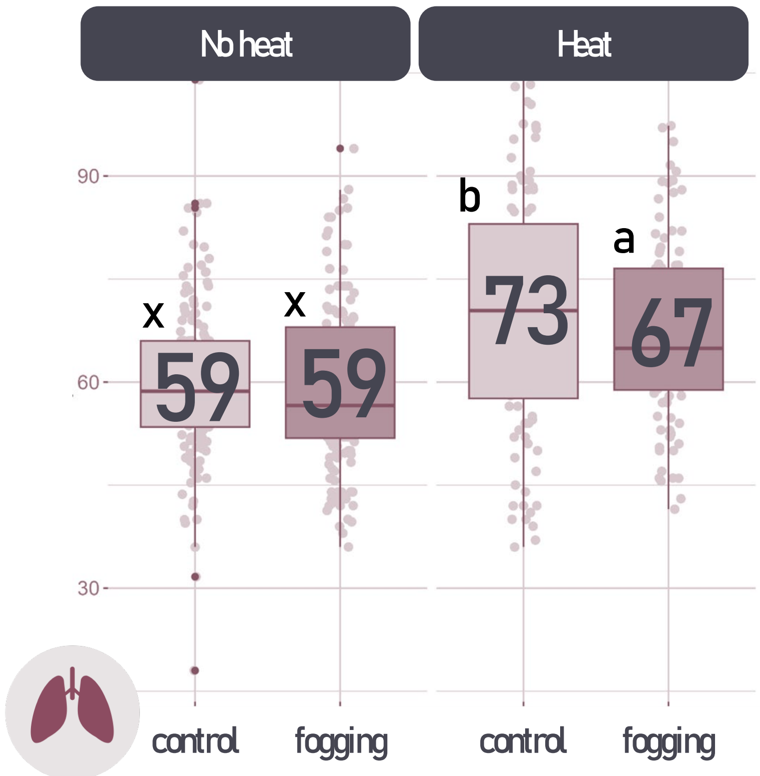
↘ 3.6 TH

Ongoing study

CLIMATE-TECHNICAL STRATEGIES

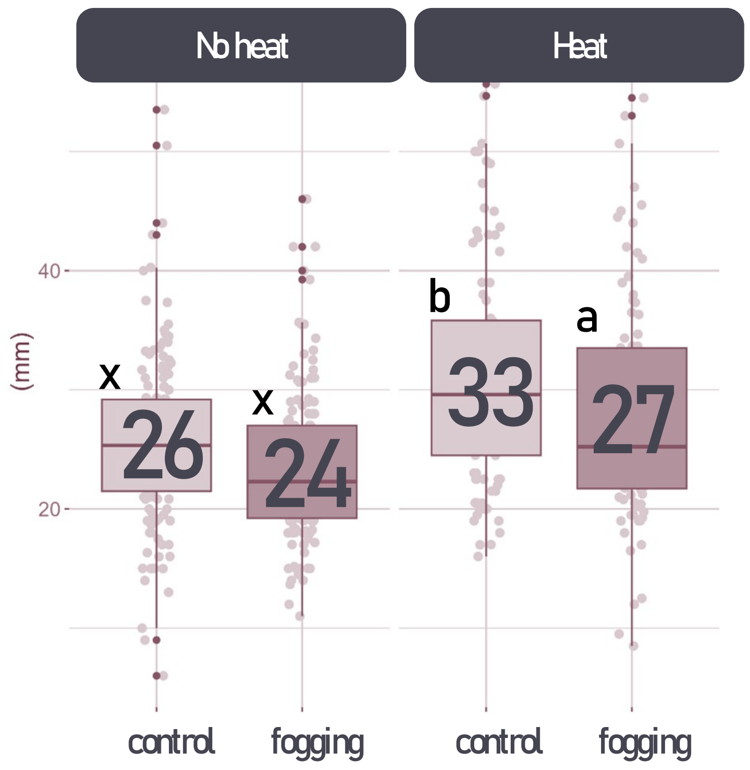
High pressure fogging

Respiration rate



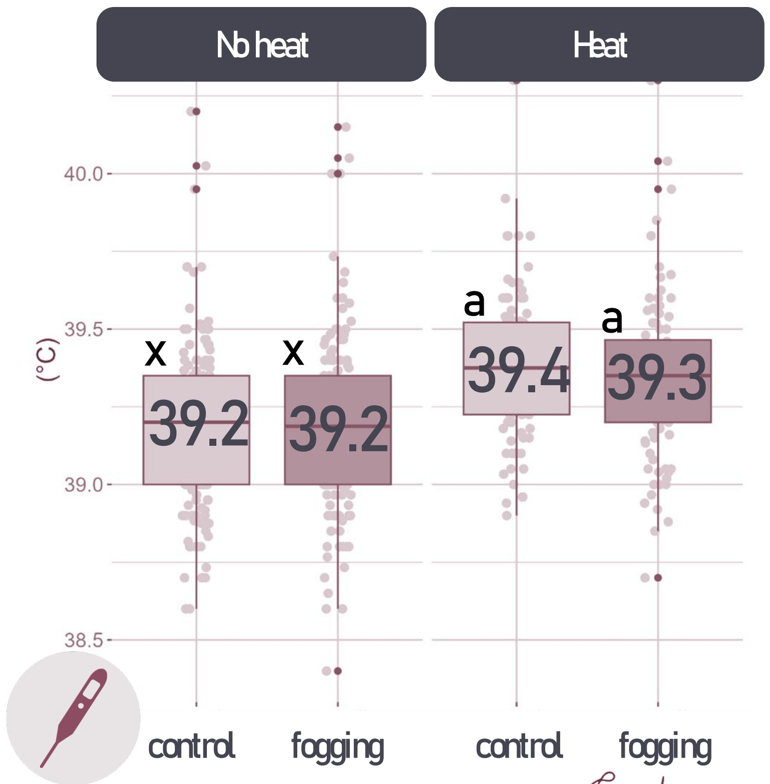
P-value (treatment within heat) = 0.017

Heat stress score (0-150)



P-value (treatment within heat) = 0.045

Rectal temperature



P-value (treatment within heat) = 0.862

Ongoing study

TAKE HOME MESSAGES

1. Management strategies

- Effects of genetics (optimal carcass vs. optimal growth) to lower heat stress in fattening pigs are rather limited
- Lowering stocking density can help physiological status of fattening pigs during periods of high heat load

2. Climate-technical strategies

- Extra fans in farrowing house can alleviate heat stress in sows
- High pressure fogging can lower ambient temperature and TH with the right relative humidity settings