# Breeding for Robust Cows

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# Outline

- Discussions on Robustness
  - What is robustness?
  - Why demand for robustness?
- Genetics to improve robustness of dairy cows

# Robustness

# Robustness versus control paradigm

- Control paradigm: Avoiding disturbances to happen
  - “Pathogen free, ideal climate …”
  - “If the farmer would only do as told …”
- Robustness: Handling disturbances
  - “Another breed only realistic option left open to …”
  - “I do not want all the hassle …”

# Definition of robustness

"The capacity to handle environmental disturbances in commonly accepted, economic and sustainable farming systems"

Jan ten Napel et al. 2005

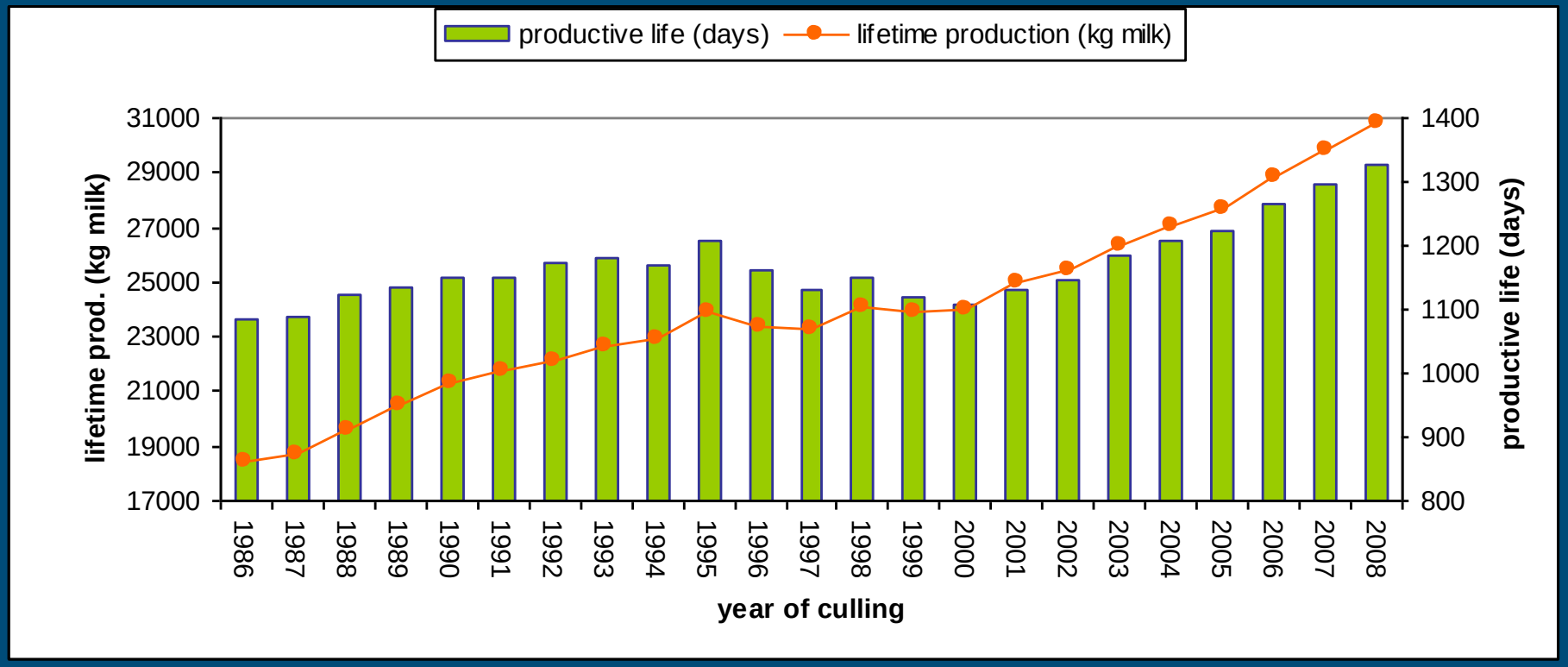
# Why demand for robustness?

# Why more interest for robustness?

- Negative effect of selection for productivity?


- Interaction of management with genetics?

# Lifetime yield & Productive life

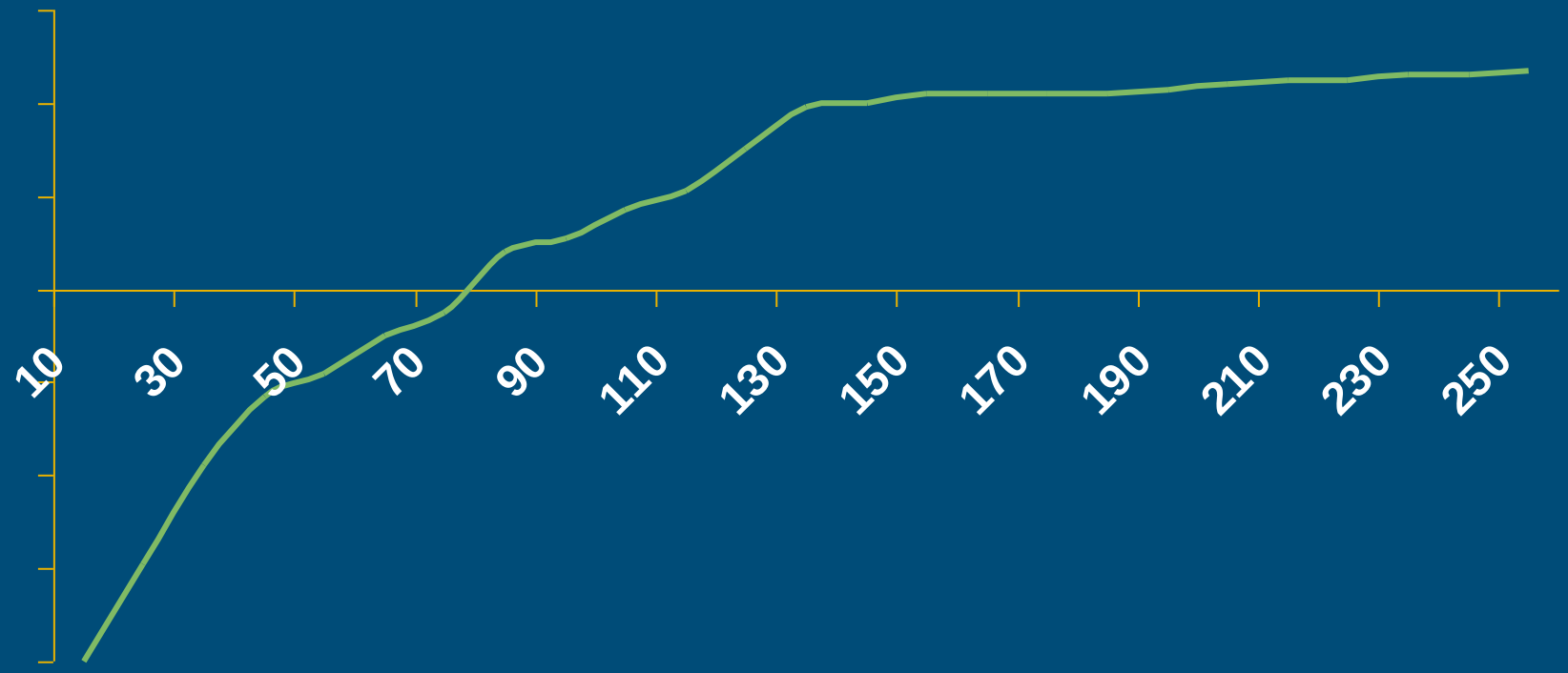



Source: CRV

# Lifetime yield & Productive life

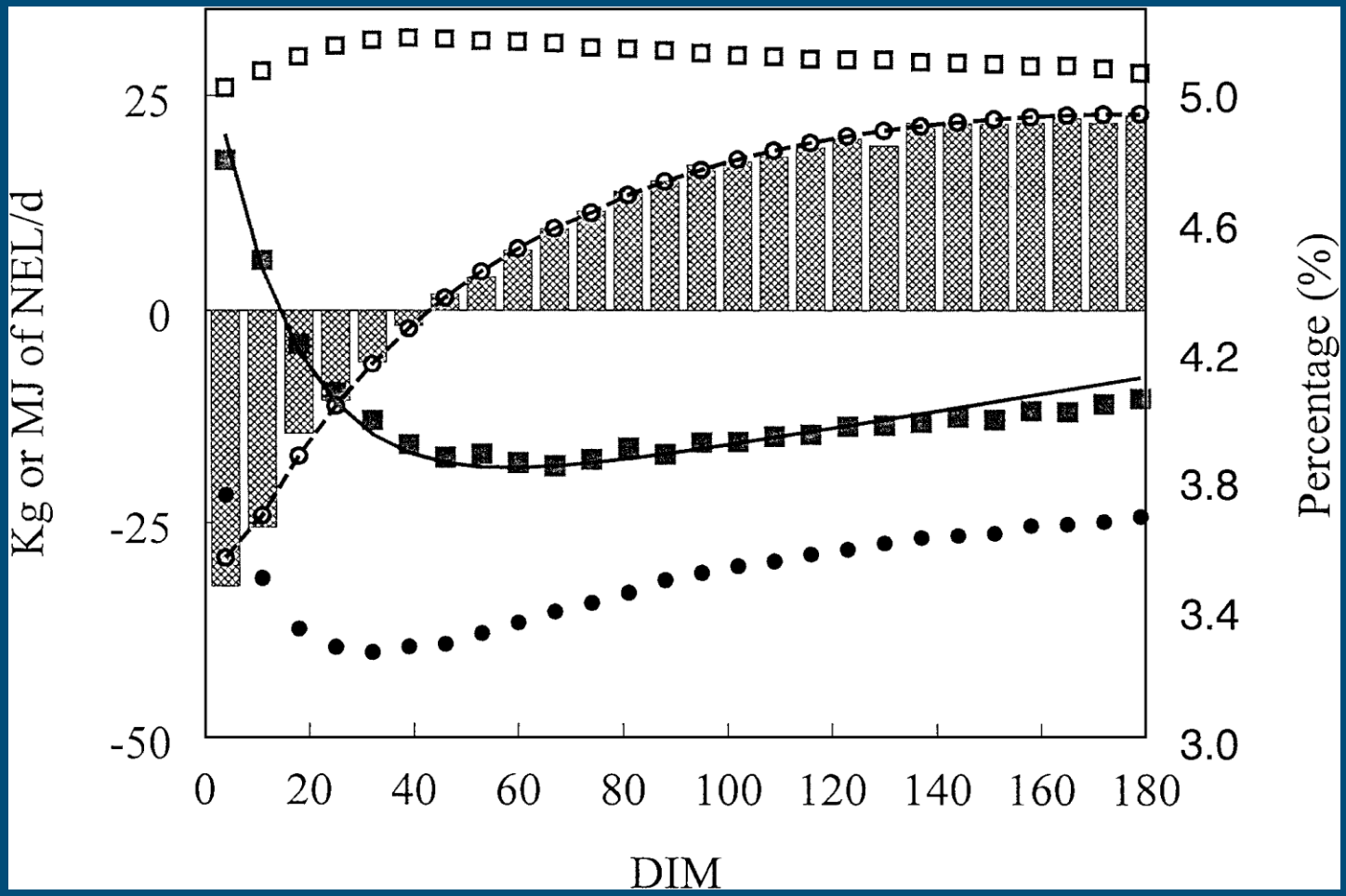
- **Productive life increases**
  - above 1300 days
- **Lifetime yield strong increase**
  - +10,000 kg milk in 15 years
- **Modern cow better economic efficiency**

# Energy balance during lactation




Berry et al. (2006)

# Energy balance & Milk production




□ = milk prod.

● = protein%

■ = fat%

De Vries & Veerkamp, 2000

# Genetics and robustness

# Outline: Selecting more robust animals

- Robustness at system level
  1) Biodiversity
  2) Associative effects √
- Robustness at animal level
  3) Genetic heterogeneity
  4) Multi-trait selection √
  5) Macro environmental disturbances √
  6) Micro environmental disturbances √
- Robust systems within animal
  7) SABRE: genomics examples trying to understand biological system: fertility, mastitis, immune system

# 2) Robustness at system level: Associative effects

- Animal has an effect on other animals in the group, sometimes ‘best at a cost for the rest’

- Examples:
  - Cannibalism in chicken
  - Competition with feeding
  - Social stress (behaviour, aggression, tail biting, etc.)
  - Contagious diseases

# 4) Robustness at animal level: Multi-trait selection

- Include health & welfare traits in breeding
- Scandinavian countries set example in dairy
- Genetic Improvement of Functional Traits (GIFT-EU)
- Since 1990's most breeding goals adapted
  (Dairy cattle: Miglior et al JDS 2005)

# 4) Robustness at animal level: Multi-trait selection

- How many traits do you need to consider?
  - fertility, longevity, health, feet&legs
  - energy balance, management ease
- Robustness is not multi-trait selection!
  - Robustness is about capacity to handle disturbances
  - Genotype by environment interaction
  - Environmental sensitivity

# 5) Robustness at animal level: Macro disturbances

- Does animal fit the system i.e. countries, farms or farming systems?
- Environmental sensitivity and reaction norm models
  (Falconer et al, Strandberg et al; Calus et al; Windig et al; Mistzal)

# 6) Robustness at animal level: Micro disturbances

- Not all environmental disturbances are known, measured or definable on a scale!
- What about unknown day to day disturbances, e.g. weather, feed, farmer?
- Is residual variation heritable?

ROBUSTMILK

EU-project with partners in:

- The Netherlands
- Belgium
- Ireland
- Scotland
- Sweden

www.robustmilk.eu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# RobustMilk

**To improve robustness of dairy cows and to make their milk healthier for humans**

- Aim: to develop new useful and practical technologies to allow dairy farmers and the dairy industry to refocus their selection decisions to include additional traits such as milk quality and dairy cow robustness

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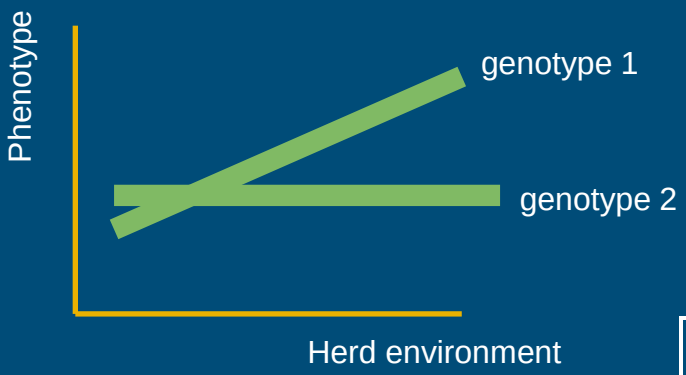
# 5+6) Robustness at animal level: Macro & Micro

- Statistical models for robustness
  - Genotype by environment interaction
  - Macro- and micro-environmental sensitivity
- Statistical tools for milk quality (SCC)
  - Longitudinal data analysis
  - Also look at variation in SCC
- Joint model for robustness and milk quality

# 5+6) Robustness at animal level: Macro & Micro




**Genotype by environment interaction**
= Genetic variation in environmental sensitivity
= Non-parallel reaction norms

| | **Macro-environments** | **Micro-environments** |
|---|---|---|
| Are environments identifiable? | Yes | No |
| How is it observed? | Multi-trait model<br>$r_A < 1$<br>Reaction norm model<br>$\sigma^2_{A_S} > 0$ | Genetic heterogeneity of environmental variance<br>$\sigma^2_{A_v} > 0$ |

# 5+6) Robustness at animal level: Macro & Micro

Bull A

Micro environment

Bull B

Son of Bull A

Son of Bull B

# Conclusions

- Robustness: Handling disturbances at system or animal level *vs.* control paradigm
- Genetic selection can make major contribution
  - multi traits selection is not solving everything
  - focus on handling disturbances
  - in combination with improved productivity and product quality
- Rather than discuss the slight reduction in genetic ability from selection for production only, discuss breeding for robustness to cope with future farming systems

**Animal breeders offer lot of options to improve robustness, with productivity and quality traits!**

# Thanks for your attention

Any questions?