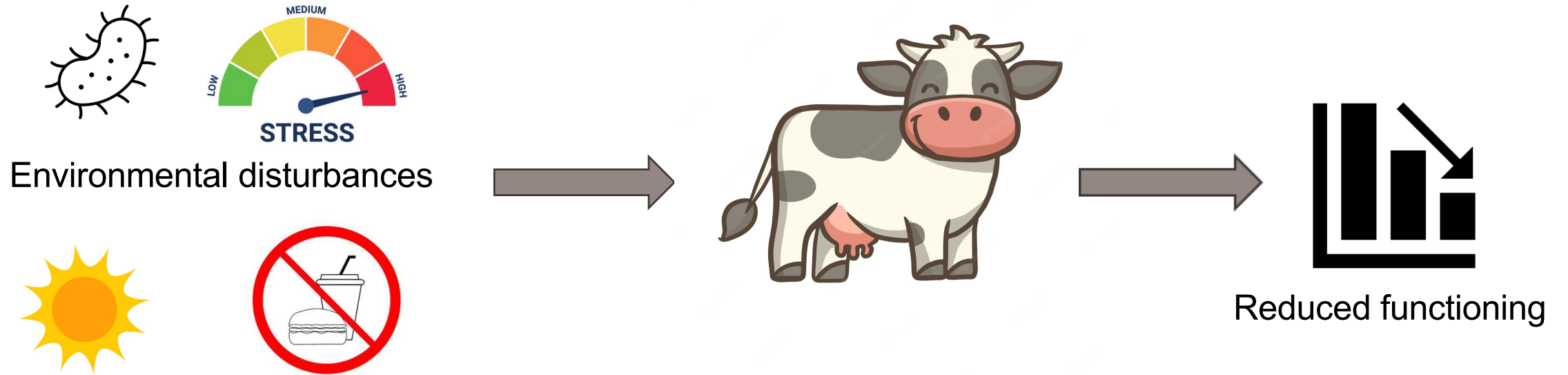


Breeding for resilience in the Netherlands and Flanders

Niek Meijer | 21 November 2023



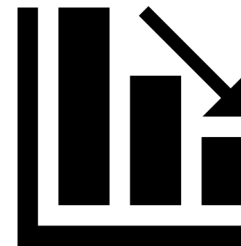
Resilience



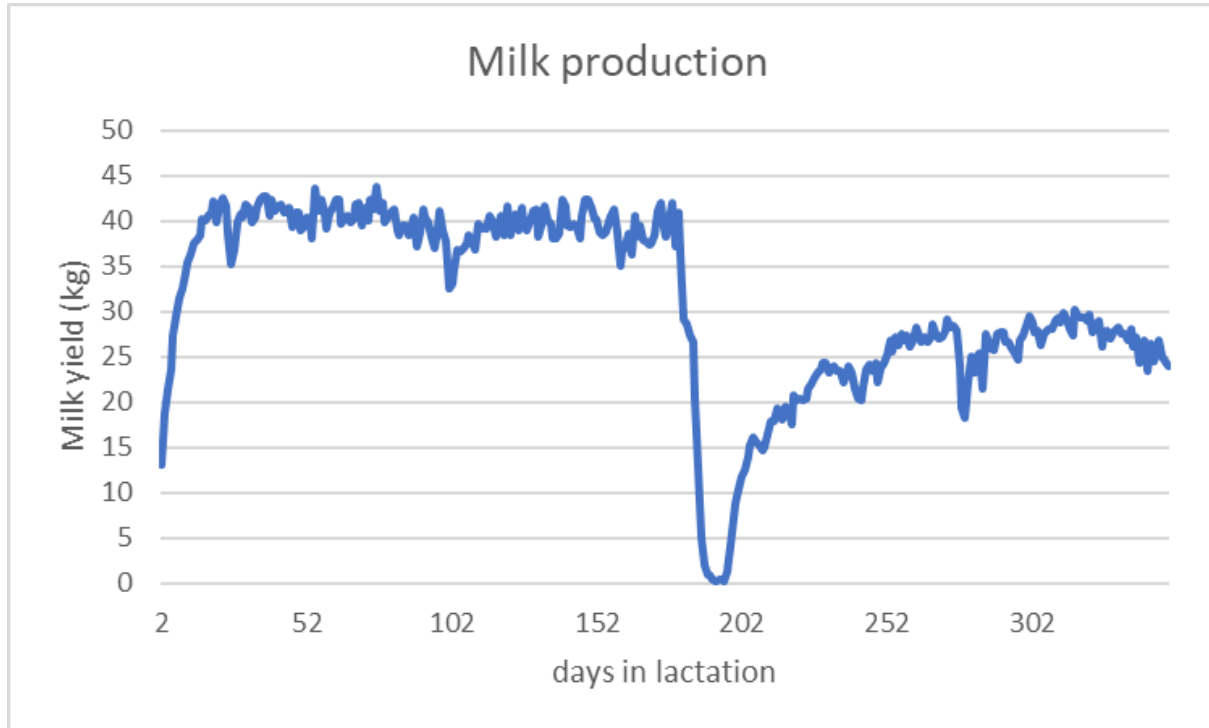
Resilience

***The ability to be minimally affected by disturbances
AND / OR
to recover quickly when affected***
Colditz & Hine, 2016

Reduced functioning → decreased milk production



How to measure resilience ?

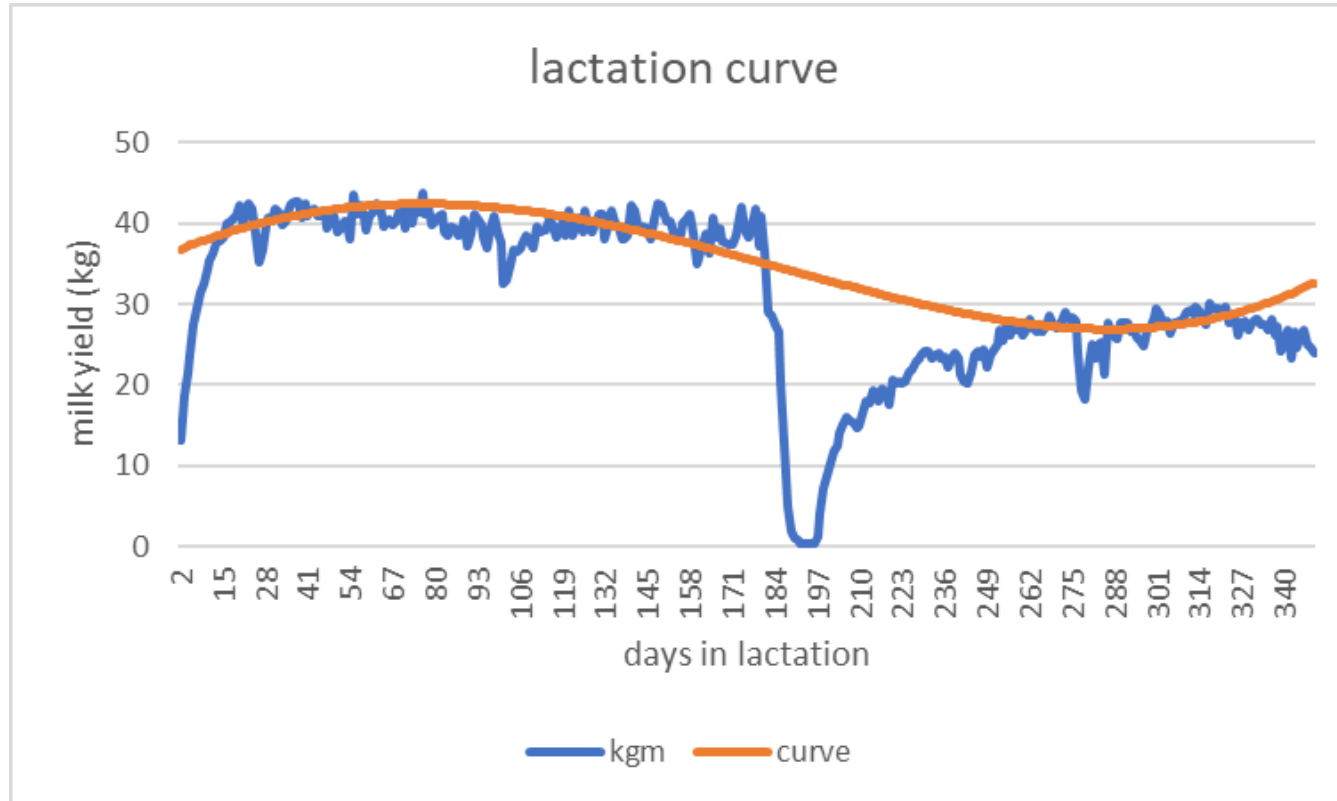


- 4.8 billion milkings

- from individual milking to daily milk yield

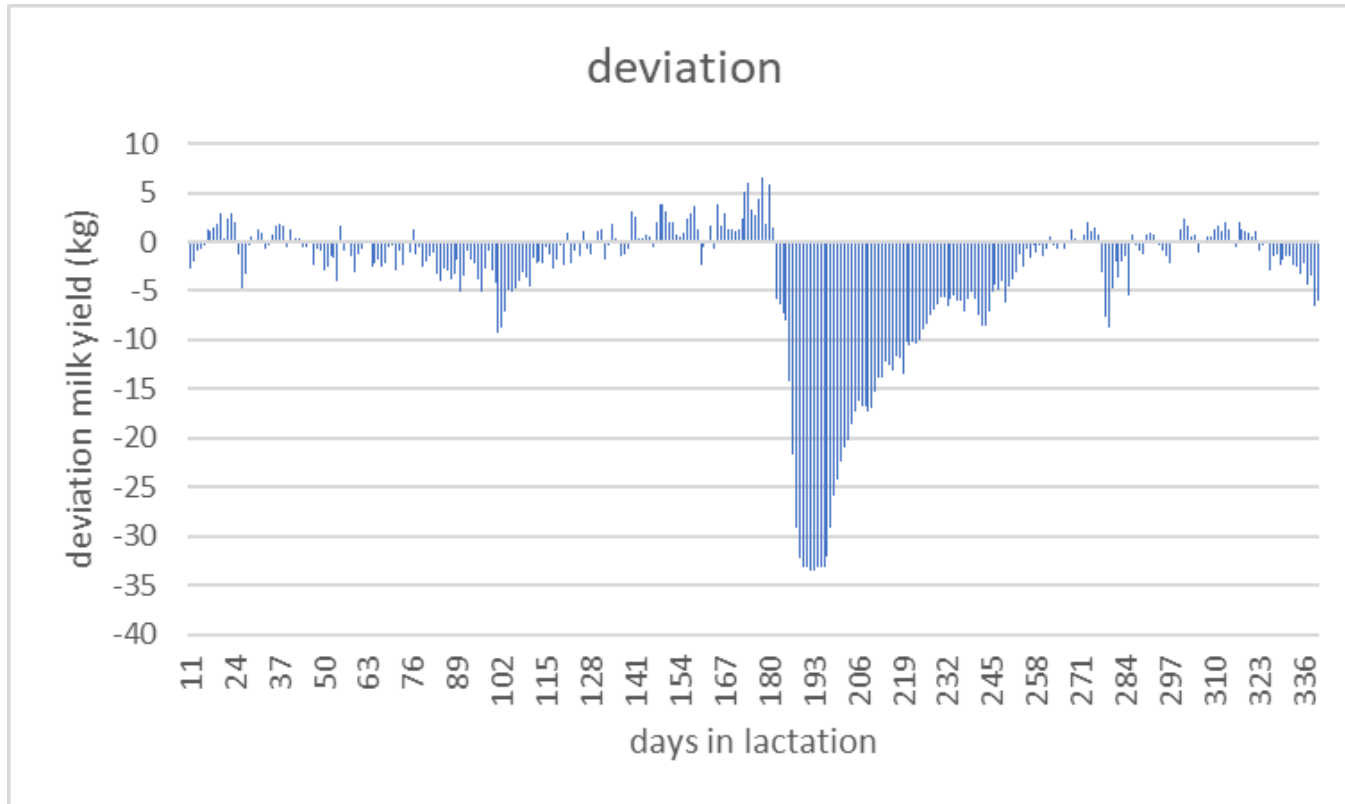
- > milking interval
- > milk yield

How to measure resilience ?



- Fit a lactation curve (day 1 – 350)
- Polynomial quantile regression

How to measure resilience ?



- Calculate deviation (day 11 – 340)

- Use deviations for calculation of the traits

Resilience – trait definition

- **Recovery**
the time it takes to recover from a disturbance
- **Stability**
the amount of disturbances that were met during a lactation

Recovery

- Autocorrelation between deviation from the current day and previous day over the whole lactation.
- Correlation → observations between -1.0 and +1.0
- Low correlation is desirable

parity	mean	sd	min	max
1	0.56	0.20	-0.21	0.98
2	0.56	0.19	-0.26	0.99
3+	0.56	0.19	-0.32	0.98

Stability

- Natural logarithm of the variance based on all deviations during a lactation
- Lower variance is desirable

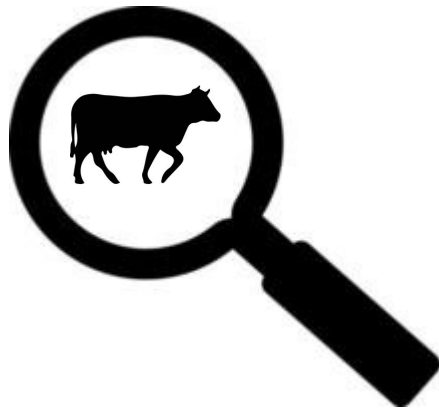
parity	mean	sd	min	max
1	1.57	0.67	-1.01	3.95
2	1.85	0.69	-0.74	4.30
3+	2.06	0.70	-0.98	4.64

Data

- 4.8 billion milkings
- 5.6 million lactations before selection
- 3.4 million lactations after selection
 - 2.7 million Automatic Milking System
 - 0.7 million Electronic Milk Measurement
- 2.5 million cows
- 6,700 herds
- data from 2010 onwards

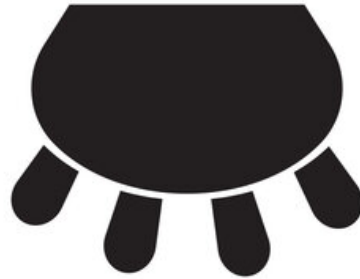
Traits

2 characteristics



- Recovery
- Stability

3 parities



- Parity 1
- Parity 2
- Parity 3+

2 milking systems



- Automatic milking system (AMS)
- Electronic milking measurement (EMM)

- 12 traits in total
- traits based on AMS are the breeding goal trait

Model

1. herd * year * season
2. lactation stage
3. age at first calving in months (*parity 1 and parity 2*)
4. parity (*parity 3+*)
5. deviation in milk yield compared to herd mean (*kg/d*)
6. milk yield (*kg/d*)
7. heterosis
8. recombination
9. inbreeding
10. additive genetic effect (*EBV*)
11. permanent environmental effect

Genetic parameters

Heritability

	AMS	EMM
Recovery 1	0.07	0.04
Recovery 2	0.04	0.03
Recovery 3+	0.04	0.02
Stability 1	0.09	0.05
Stability 2	0.06	0.05
Stability 3+	0.09	0.04

- AMS higher heritability

- Stability higher heritability

Genetic parameters

Genetic correlations between observations from AMS and EMM

	Recovery	Stability
Parity 1	0.76	0.90
Parity 2	0.63	0.88
Parity 3	0.35	0.91

Genetic correlations between parities

	Recovery	Stability
Parity 1 – 2	0.98	0.98
Parity 1 – 3	0.84	0.91
Parity 2 – 3	1.00	0.98

Relation with other traits

	Recovery	Stability
Milk production	-0.14	-0.36
Fertility	0.08	0.31
Ketosis	0.16	0.49
Longevity	-0.06	0.33
Metabolic disorders	0.14	0.48
Claw health	-0.03	0.14
Reproduction disorders	0.06	0.15
Udder health	0.22	0.50

- 55% of the variance in resilience can be explained by other health traits and longevity
→ added value !

Resilience in practice

Netherlands and Flanders:

- mean EBV = 100

- std. EBV = 4

	EBV 92	EBV 100	EBV 108
Recovery – time to recover	14.0 days	10.9 days	7.0 days
Stability – number of disturbances	4.8	3.8	2.4



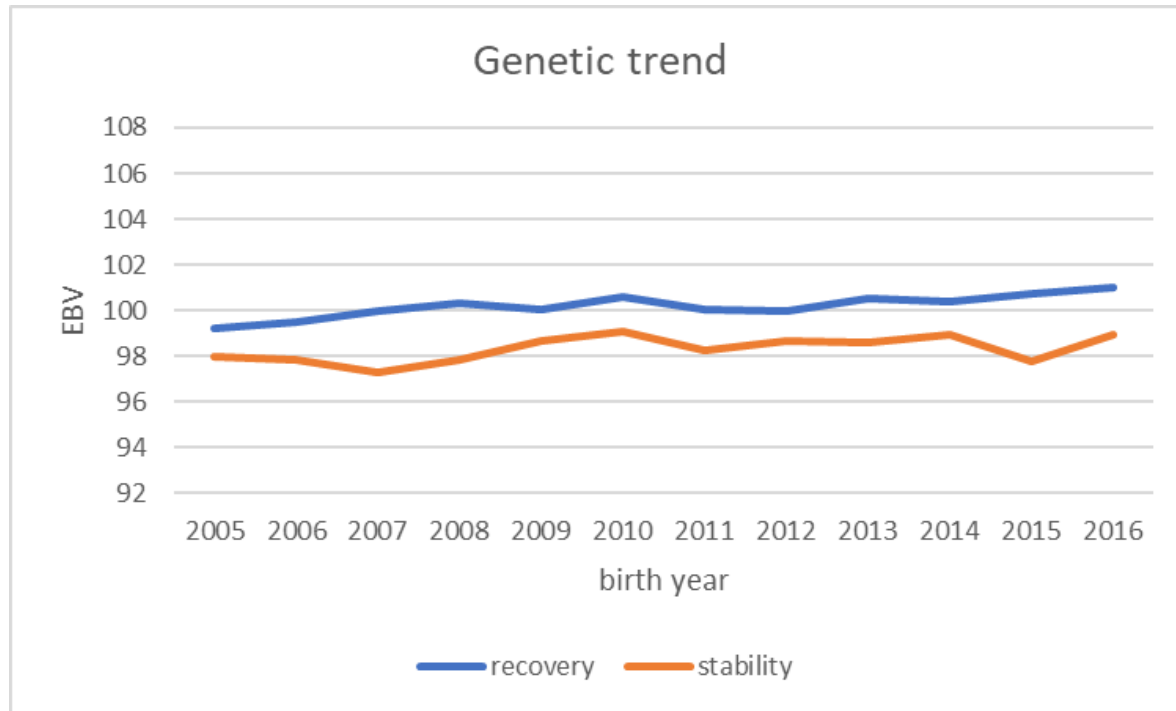
Breed differences

Breed	Recovery	Stability
Holstein	100.4	99.0
Dutch Friesian	100.4	106.0
Meuse-Rhine-Yssel (MRY)	101.5	107.3
Fleckvieh	106.0	103.0
Brown Swiss	103.5	100.8
Schwedish Red	101.6	99.9
Groninger Blaarkop	99.8	105.8
Jersey	105.2	108.4
Montbéliarde	103.8	101.1

- Dual purpose breeds and Jerseys are more resilient



Genetic trend



**Holstein bulls born since 2005*

- Genetic improvement in resilience because of positive correlations with health traits.
- Despite negative correlations with milk yield !!!

Publication

1. Total breeding value recovery (*recovery*)
2. Total breeding value stability (*stability*)
3. Index resilience (*resilience*)

Total breeding value = $0.41 \times \text{parity 1} + 0.33 \times \text{parity 2} + 0.26 \times \text{parity 3+}$

*traits based on AMS

*for both recovery and stability

Index resilience = $0.30 \times (\text{recovery} - 100) + 0.91 \times (\text{stability} - 100) + 100$

Breeding for resilience

- Healthy cows (positive correlations with health traits)
- Increased longevity (positive correlations with longevity)
- Captures health that is not in the current health traits
- Easy manageable cows
- Animal welfare
- April 2024





BETTER COWS > BETTER LIFE