Genetic evaluation for automatic milking system traits in the Netherlands

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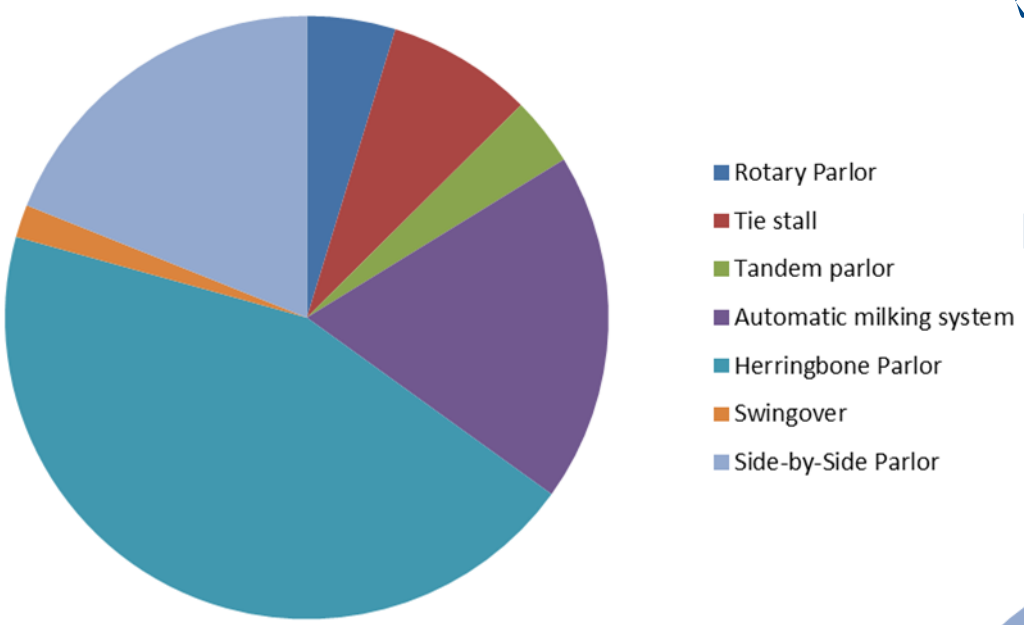
Introduction

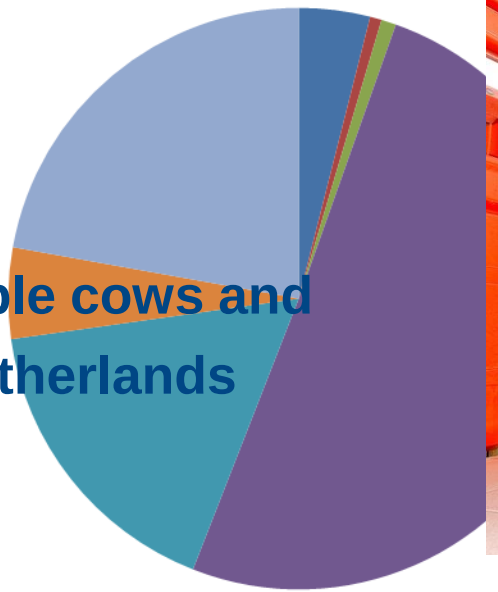
Parlor type distribution in 2014



king systems (AMS)

this system

New build milking



stem

Aim: **Breeding AMS suitable cows and application in the Netherlands**

Trait definition

AMS efficiency =

Produced amount of milk in kg per total AMS time in minutes

Milking interval =

Time between 2 consecutive successful milkings in minutes

Habituation of heifers =

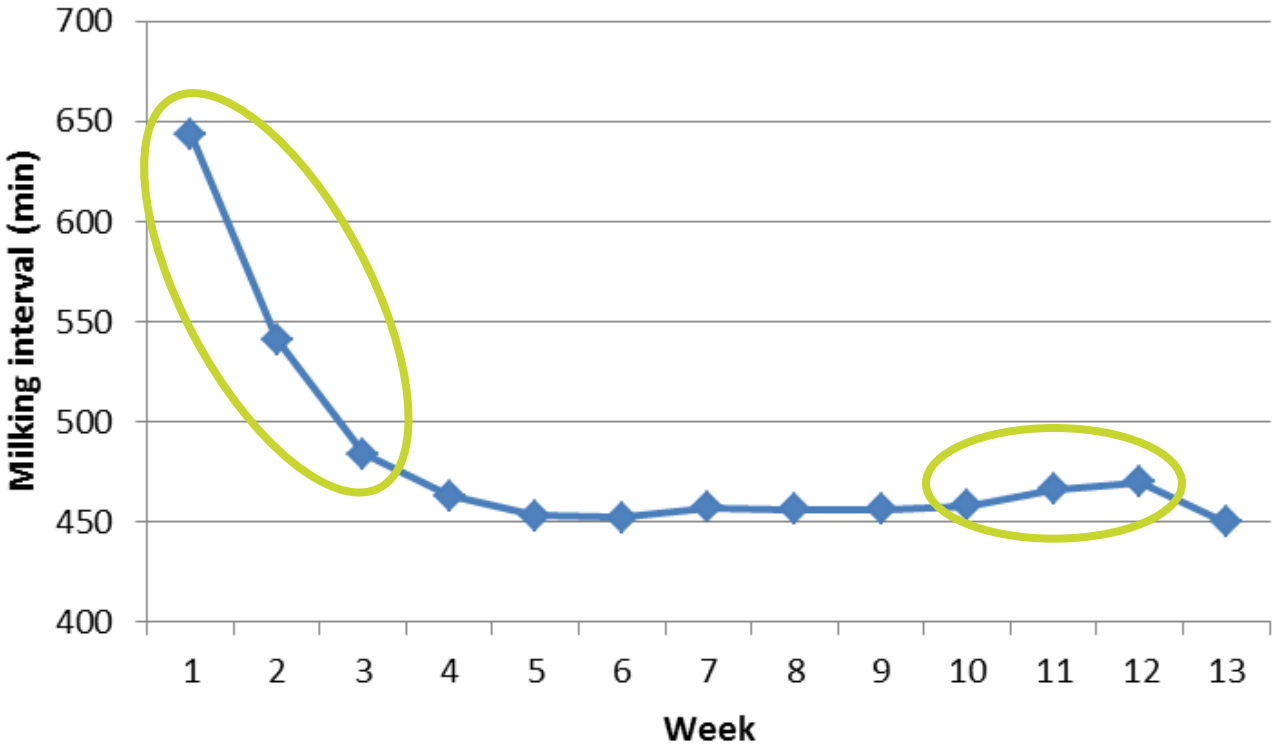
Time period a heifer needs to get familiar with the AMS =

Comparing the milking interval in the first three weeks after calving with a period later in lactation (week 10 – 12)

Successful milking

- AMS marks milking as 'True'
- Milkyield between 1.6 – 40.0 kg per milking
- Milking interval between 240 – 1200 minutes

Trait definition – Habituation of heifers



Week 1, 2, 3 = average interval 578 min
Week 10, 11, 12 = average interval 492 min

Habituation = 578 – 492 = 86 minutes

Data available

Data available in breeding value estimation

Year	Heifers	Cows	Total
2010[1]	0.007	0.01	0.017
2011	5	11	16
2012	37	82	119
2013	51	114	165
2014	54	127	181

Numbers are given in millions.

1 = observations from 2002 to 2010

Since 2010 enormous increase in number of observations.

Weekly increase of ± 3.5 mln valid observations in 2014

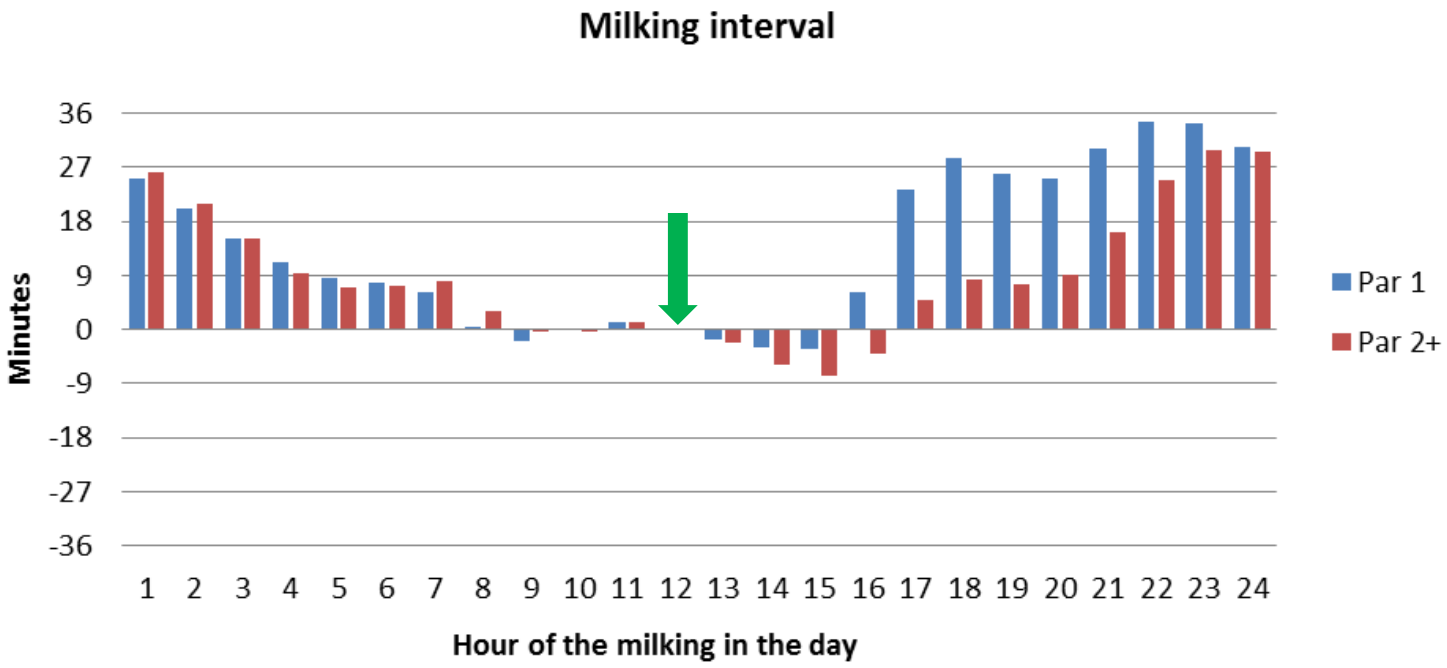
Statistical model

- **Multitrait animal model**
  - 3 traits, 2 parities
- **Effects**

	AMS efficiency		Milking interval		Habituation of heifers
	Parity 1	Parity 2+	Parity 1	Parity 2+	Parity 1
Herd x year x month	X	X	X	X	
Herd x year					X
Parity x days in milk	X	X	X	X	
Age at calving	X		X		X
Month of calving	X	X	X	X	X
Year x time of the milking			X	X	
Diff. in milk yield week 1 – 3 and week 10 – 12					X
Heterosis	X	X	X	X	X
Recombination	X	X	X	X	X
Animal	X	X	X	X	X
Permanent environment	X	X	X	X	
Error	X	X	X	X	X

Effects – Time of the milking

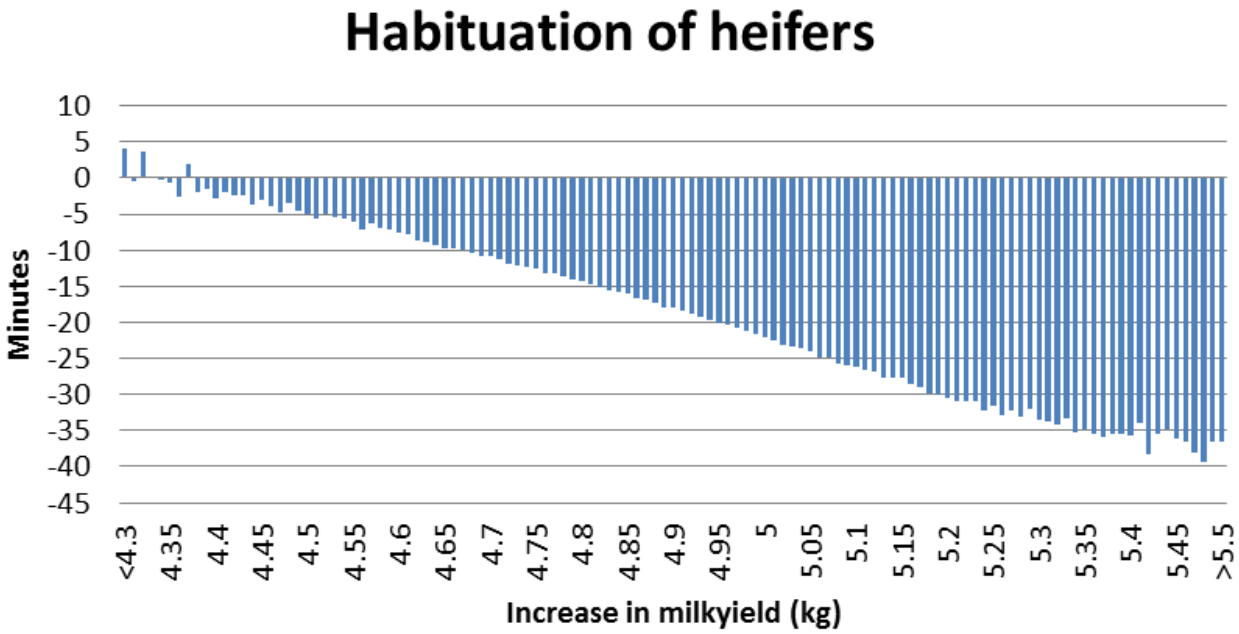
The effect of the time of the milking on milking interval.
Effects are expressed in relation to a milking at 12 o'clock.



Milkings during the days tends to shorter intervals in regard to milkings during the night.

Effects – Increase in milk yield

The effect of the increase in milk yield on habituation of heifers.



Increase in milk yield gives a shorter milk interval,
the heifer habituates faster.

Parameters

Phenotypic means			
Parity	AMS efficiency (kg/min)	Milking interval (min)	Habituation of heifers (min)
1	1.48 ± 0.45	524 ± 152	
2+	1.70 ± 0.52	500 ± 157	
Overall	1.61 ± 0.52	507 ± 153	81 ± 102
Genetic parameters Heritability			
1	0.191	0.082	
2+	0.173	0.064	
Overall	0.273	0.119	0.069
Genetic standard deviation			
Overall	0.20	36	20

AMS efficiency

$$\frac{\text{Milk yield of the milking (kg)}}{\text{Total AMS box time (min)}} = \frac{10.5}{6.9} = 1.6$$

Time milking 1 – 9: 08:00h

Average week 1, 2, 3

Average week 10, 11, 12

Milking interval of heifers

(average milking interval week 10 – 12) – (average milking interval week 1 – 3)

Time milking 1 – 9: 16:30h

$= 480$ min

$16:30 - 08:00 = 8h \text{ and } 30 \text{ min} = 510 \text{ min}$

$570 - 480 = 90 \text{ min}$

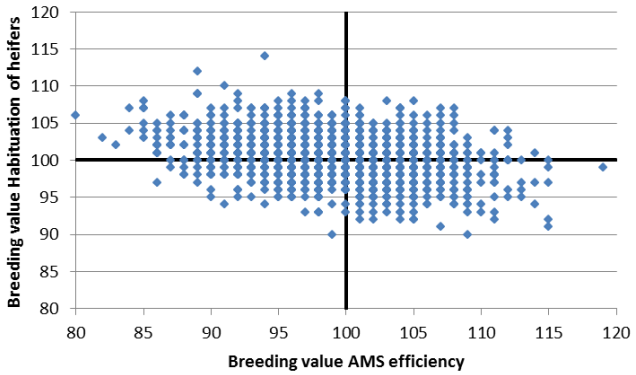
Habituation of heifers

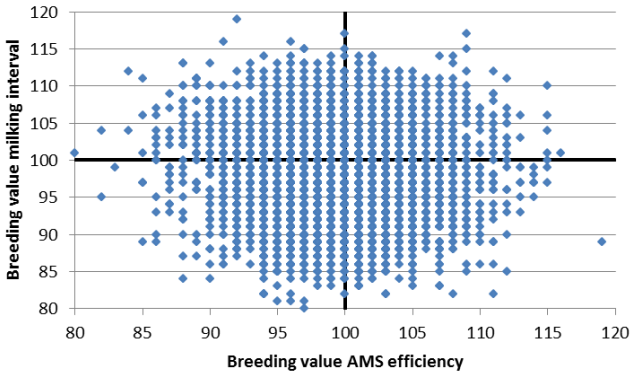
Habituation = 570 - 480 = 90 min

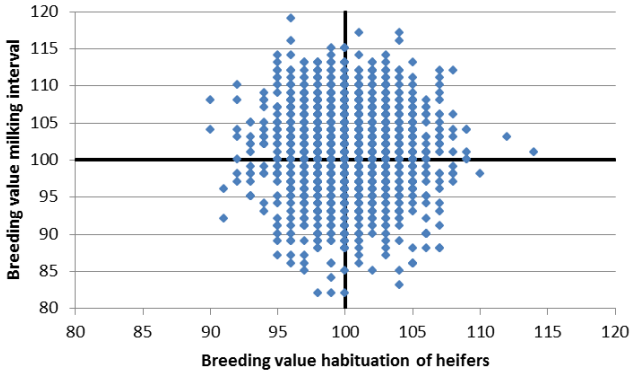
Genetic correlations between the AMS traits

Genetic correlations and heritabilities of the AMS traits.

	Efficiency	Milking interval	Habituation of heifers
Efficiency	0.27		
Milking interval	-0.10	0.12	
Habituation of heifers	-0.52	-0.17	0.07







Presentation Breeding Values

- Relative Breeding Value (average 100 – variance 4).

- A BV AMS efficiency > 100
  - animals in the daughter group realize a higher production / minute.
- A BV milking interval > 100
  - animals in the daughter group visit the AMS more frequently.
- A BV habituation of heifers > 100
  - animals in the daughter group attain the final milking interval *faster.*

Trait	Relative breeding value	Half breeding value *(effect on progeny)*
Efficiency	104	0.08 kg / minutes
Milking interval	104	- 16.5 minutes
Habituation of heifers	104	- 9.1 minutes

AMS efficiency in practice

Assumptions:

- Level of the herd is average (breeding value 100)
- Total available AMS time is 20h
- Other factors do not change

Table shows the direct effect of the use of bulls with breeding values 92, 96, 100, 104 or 108 for AMS efficiency

Example calculation breeding value 104 (1 SD):

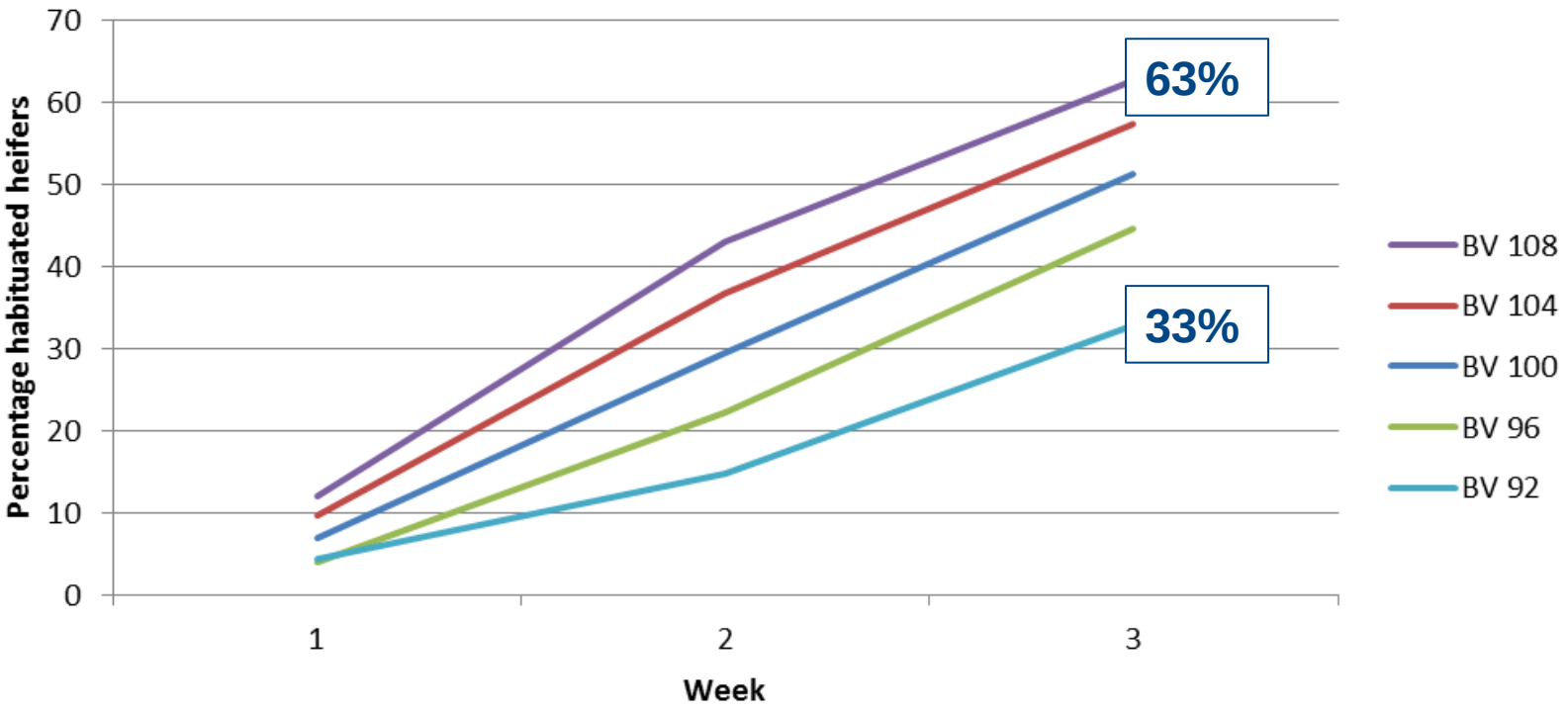
4 points breeding value = 1 Standard Deviation = 0.18 kg / minute

Effects on daughters with mating with a cow with BV 100 = 0.18 / 2 = 0.09 kg/min

Per day = 0.09 * 60 * 20 = 108 kg / day

Description	Breeding Value				
	92	96	100	104	108
Extra kg milk per minute	-0.18	-0.09	0	0.09	0,18
Extra kg milk per AMS per day	-216	-108	0	108	216
Extra kg milk per AMS per year	-78,889	-39,445	0	39,445	78,889
Extra cows per AMS, with a production of 30 kg milk / day	-7.2	-3.6	0	3.6	7,2

Habituation of heifers



Relation between relative BV and percentage of heifers that are habituated at week 1 – 3.

What does a relative BV mean?

BV 100 = Habituation of 80 min
(= diff. in milk interval wk. 1-3 and wk. 10-12 is 80 min.)

BV 108 = Habituation 38 min = +2 SD
BV 104 = Habituation 59 min
BV 100 = Habituation 80 min = Average
BV 96 = Habituation 101 min
BV 92 = Habituation 122 min = -2 SD

Genetic correlations with other traits

	Efficiency	Milking interval	Habituation of heifers
Production traits			
Kg milk	0.28	**0.52**	**-0.53**
Percentage fat	-0.22	**-0.33**	**0.40**
Percentage protein	-0.24	-0.18	**0.35**
Kg fat	0.05	0.21	-0.05
Kg protein	0.18	**0.55**	**-0.35**
Conformation traits			
Conformation total	-0.06	**0.31**	-0.14
Frame	-0.03	0.24	-0.13
Dairy strength	-0.20	**0.30**	-0.18
Udder	0.03	0.16	-0.21
Feed & Legs	-0.13	**0.30**	0.05
Locomotion	-0.13	0.29	0.08
Condition score	**-0.31**	0.11	-0.10
Rear teat placement	-0.02	0.00	0.08
Front teat placement	0.01	0.24	-0.13
Teat length	-0.17	0.04	0.14
Udder depth	0.04	0.05	-0.12

Estimated genetic correlations between AMS traits and other traits.

	Efficiency	Milking interval	Habituation of heifers
Fertility traits			
Fertility index	-0.20	-0.21	**0.40**
Calving interval	-0.21	-0.18	**0.38**
Intv, calving – first insemination	-0.21	-0.07	0.29
Intv, 1st - last insemination	-0.18	0.19	**0.42**
Calving ease traits			
Calving ease index	0.03	-0.01	0.15
Mat, Calving ease	-0.03	0.13	0.28
Dir, birth weight	0.05	-0.01	-0.15
Udder health traits			
Udder health index	**-0.50**	0.15	0.14
Subclinical mastitis	**-0.44**	0.17	0.12
Clinical mastitis	**-0.54**	0.13	0.16
Somatic Cell Count	**-0.45**	0.20	0.11
Other traits			
Claw health	-0.12	0.28	0.09
Longevity	0.01	0.29	-0.06
Milking speed	**0.95**	-0.06	**-0.35**
Temperament	0.24	0.03	0.08

AMS – index (I)

- AMS traits correlated with other traits
- Selection on total merit index (NVI) effects AMS-traits

Expected selection response for AMS-traits after one generation selection on NVI (TMI)

Trait	Relative selection response
Efficiency	-15%
Milking interval	47%
Habituation of heifers	0%

AMS – index (II)

Breeding AMS suitable cows

- by making progress on AMS traits
- without decrease in udder health and production

Expected selection response after one generation selection on AMS traits

Trait	Focus on AMS traits	Focus on AMS traits and udder health
Efficiency	29%	38%
Milking interval	54%	18%
Habituation of heifers	-2%	11%
Udder health	-22%	1%
Milk	35%	9%
Fat	25%	15%
Protein	43%	15%

Conclusions

- > 30% cows are milked with AMS

- The analysis showed that AMS efficiency, milking interval and habituation of heifers are traits with genetic spread and economic importance.

  → Genetic improvement can be made

- Breeding ‘AMS cows’ is possible without decrease in udder health or production.