Theme 5: Fertility and Breeding

BREEDING PROGRAM FOR A DAIRY FARM (MEDIUM & LARGE) Level 3

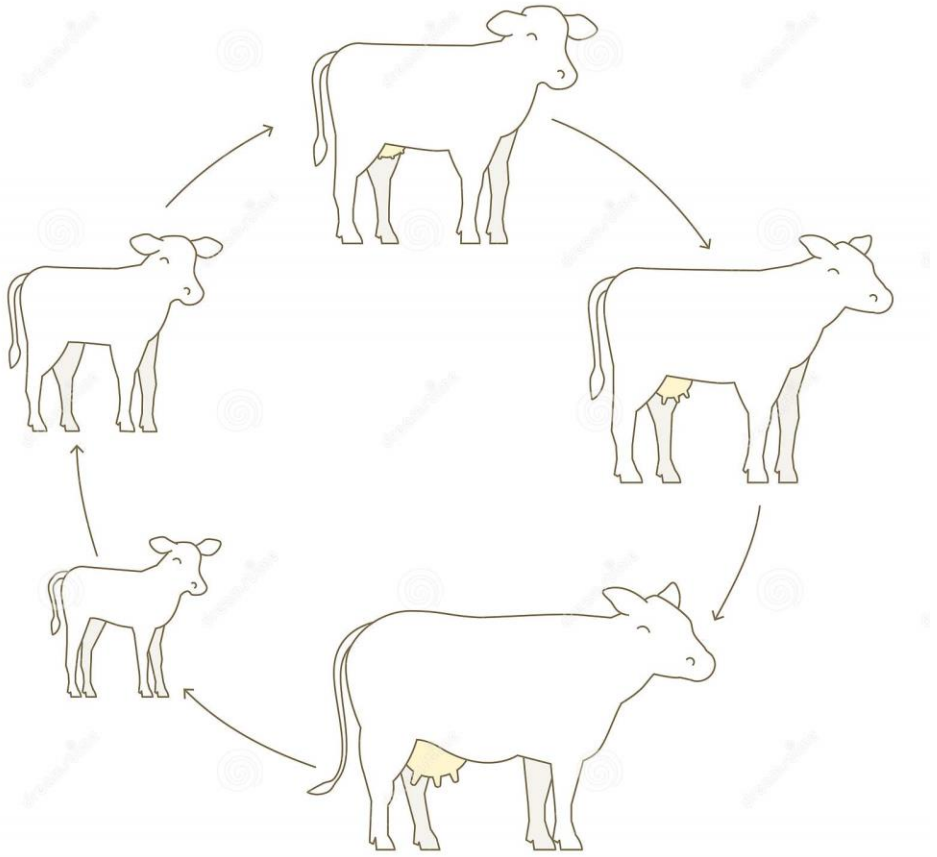
Topic	Training & information Content
5.1	Dairy Cattle Breeds and Breeding
5.2	Breeding program for a dairy farm (medium & large)
5.3	Conformation, Type classification and judging
5.4	Cow handling
5.5	Milk production recording
5.6	Heat Detection
5.7	Artificial Insemination
5.8	Pregnancy Diagnosis
5.9	Fertility Management
5.10	Cows with abnormal discharge
5.11	Fertility disease recording
5.12	Calving recording
5.13	Use of Key Performance Indicators

1. You will learn about (learning objectives):

- ❑ Selection & Breeding strategies
- ❑ Importance and influences of traits
- ❑ Heritability's
- ❑ Heterosis
- ❑ Complexity of breeding indexes/values

2. Background

- Breeding is not a tool that will immediately lead to better results, it’s an ongoing process
- Breeding will have a chance to become successful when management aspects are fully under control
- Without selection, there is no chance of any improvement
- Beware that there are several selection methods with totally different outcomes. Outcomes also depend on the environment which selection method is most suitable

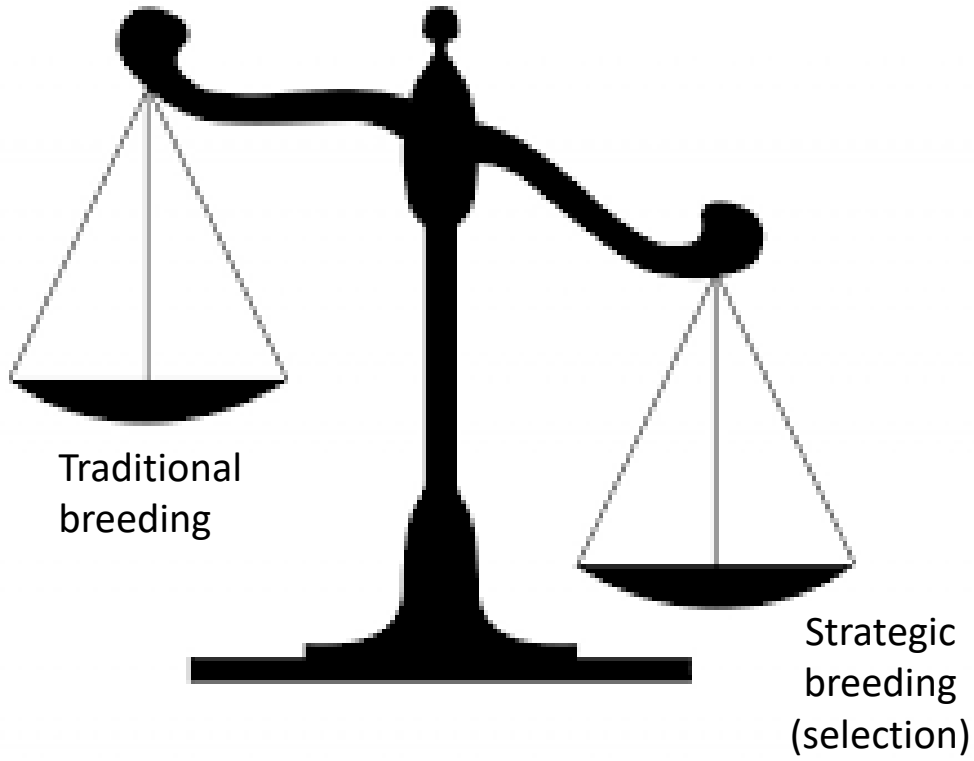


3. Breeding strategies complements selection

Breeding = Selection

- Breeding strategies include;

1. Selection of cows to breed cows
2. Selection of cows to breed bulls
3. Selection of bulls to breed cows
4. Selection of bulls to breed bulls



4. Important ‘You Knows’ before going into breeding

- The impact of genetics and environment
- Being aware of all the heritabilities
- How to use Heterosis

- There are many breeding systems that one can choose;
  - Pure Breeding
  - Cross Breeding
  - Grade up
  - Back crossing/crisscrossing
  - Rotational crossing

- Being aware of the genetic recessives in some breeds

5. Genotype by Environment interaction

- In the illustration alongside;
  - The influence of E is heavily underestimated, actionally everything else than pedigree is part of E
  - The E is like a chain, the chain is as strong as the weakest link
  - The strength of P depends on G for maximum 25% and on E for 75% or more.

Phenotype = **G**enotype + **E**nvironment

How she looks,
How she grows,
How she produces.

Pedigree

The weather,
The farmer,
The food,
The barn .

Phenotype = **G**enotype + **E**nvironment

100 % = 25% + 75 % !!

6. Heritability (H^2)

- H^2 of a trait expresses that part of the superiority of parents which on average is passed on to the offspring i.e. heritable

- Heritability can be expressed as proportion of a percentage; it ranges from 0 to 100% or from 0-1.0

- All measurable traits have their own H^2

  - Production traits are categorized as high H^2
  - Linear traits are categorized as medium H^2
  - Management traits are categorized as low H^2

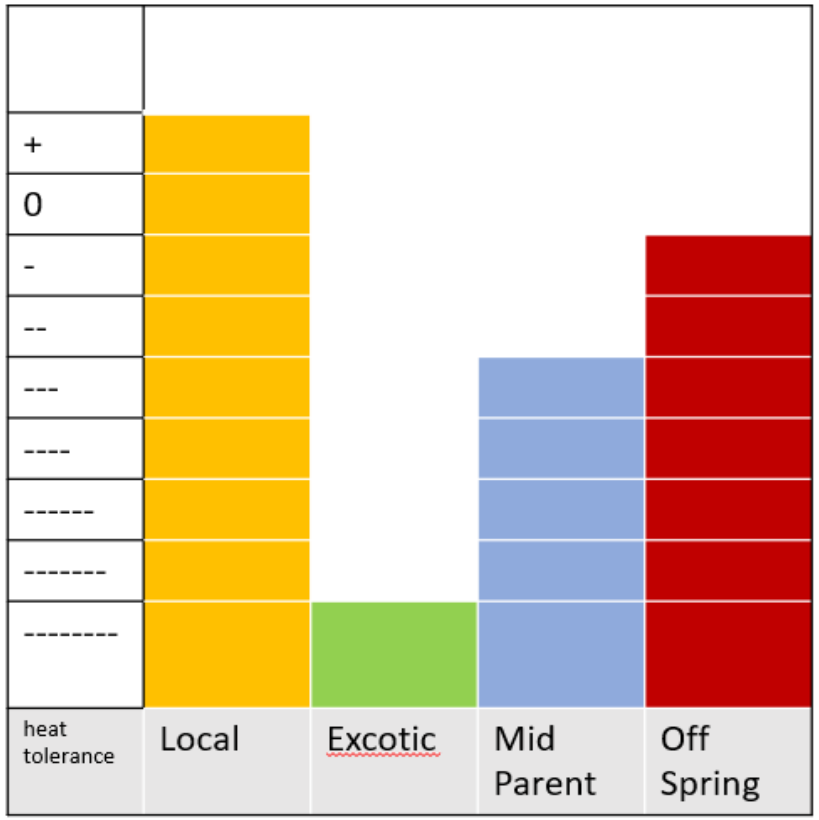
Note: *Exact heritability's might differ a little bit (country related)*

Example list of heritability's in Holstein and Jersey (USA/Canada)

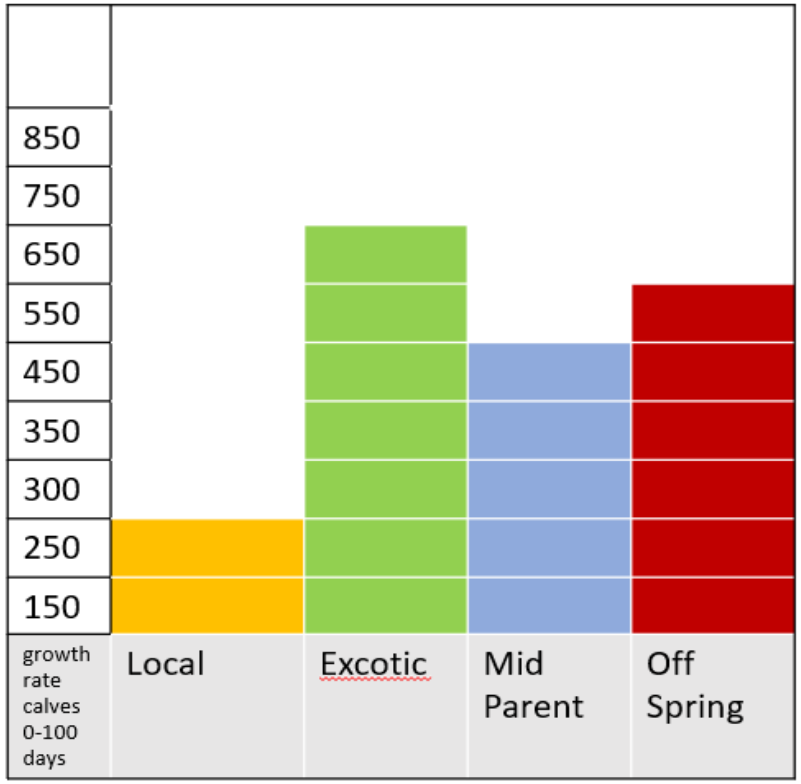
Trait	Hol.	Jer.	Trait	Hol.	Jer.
Production traits					
ME (mature equivalent) milk yield	0.30	0.35	Lifetime actual milk yield	0.15	
ME fat yield	0.30	0.35	Lifetime actual fat yield	0.15	
ME protein yield	0.30	0.35	Lifetime actual protein yield	0.14	
Fat percent	0.58		Days of productive life	0.13	
Protein percent	0.51		Somatic cell score, lactation average	0.10	
Lactose percent	0.43		Lifetime net income	0.20	
Age at first calving	0.14		Productive life, USDA	0.085	
First calving interval	0.05				
Linear type traits					
Stature	0.42	0.39	Feet and leg score	0.17	
Strength	0.31	0.25	Fore udder attachment	0.29	0.22
Body depth	0.37	0.25	Rear udder height	0.28	0.26
Dairy form	0.29	0.23	Rear udder width	0.23	0.23
Rump angle	0.33	0.31	Udder cleft	0.24	0.20
Thurl width	0.26	0.20	Udder depth	0.28	0.38
Rear legs side view	0.21		Front teat placement	0.26	0.24
Rear legs rear view	0.11	0.10	Teat length	0.26	0.26
Foot angle	0.15	0.10	Final score	0.29	0.23
Health, fitness, and reproductive traits					
Dry matter intake	0.30		Incidence of mastitis	0.06	
Body condition score	0.25		Incidence of ketosis	0.01	
Energy balance	0.20		Incidence of retained placenta	0.02	
Persistency of milk yield	0.11		Incidence of metritis	0.01	
Days to first breeding	0.04		Days to last breeding	0.06	
Number of inseminations	0.02		Interval to first luteal activity	0.16	

7. Heterosis

- **Heterosis** or **hybrid vigor** is the enhancement of traits of an offspring over the traits of parents. This enhanced characteristics or superior nature is described as heterosis. This happens due to high genetic variation in the genomes of the offspring.



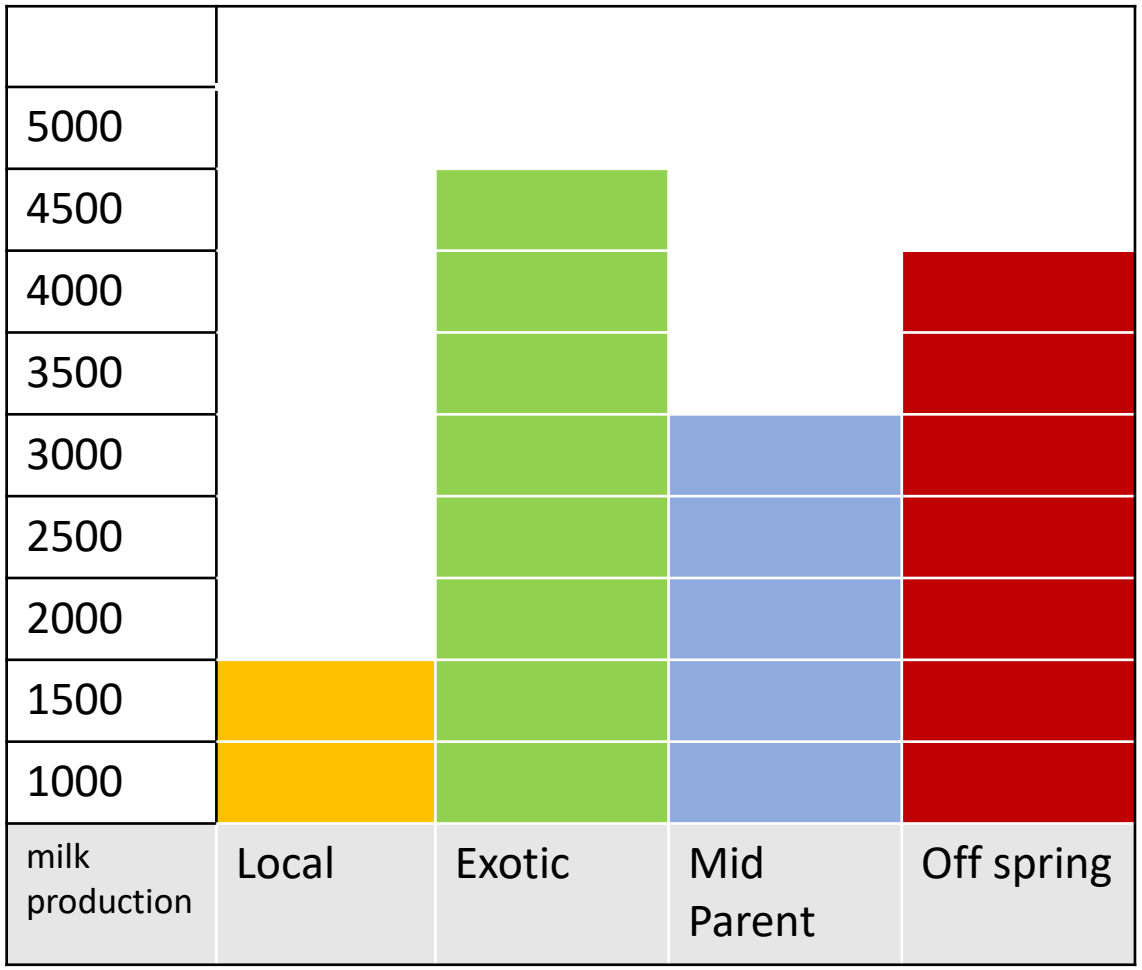
Heat tolerance or the offspring is much higher than expected (mid parent) …called Heterosis



Growth rate of the Off Spring is higher than expected (mid parent)…called Heterosis.

7.1 Heterosis Cont'd…

- Genetic variation increases when genetically different parents mate with each other. Heterosis is shown due to dominance or overdominance. The offspring are more adapted to the environments since they possess higher levels of fitness



The difference between "Mid Parent" and Off spring is called the Heterosis effect

8. Traditional Breeding Strategy

- One bull is used for the whole herd
- Bull selection is usually based on general external appearance
- Often, a bull stays in farm for too long. This causes inbreeding, infertility, poor performance.
- There is Low/No genetic progress

X

Any bull is used without pedigree information. Selection usually takes place based on external appearance. Examples of external appearance are Size and Body weight, Skin color. External traits don't give any information about economical qualities

8.1 Traditional Breeding Strategy Cont'd…

Selection of cows to breed cows

X

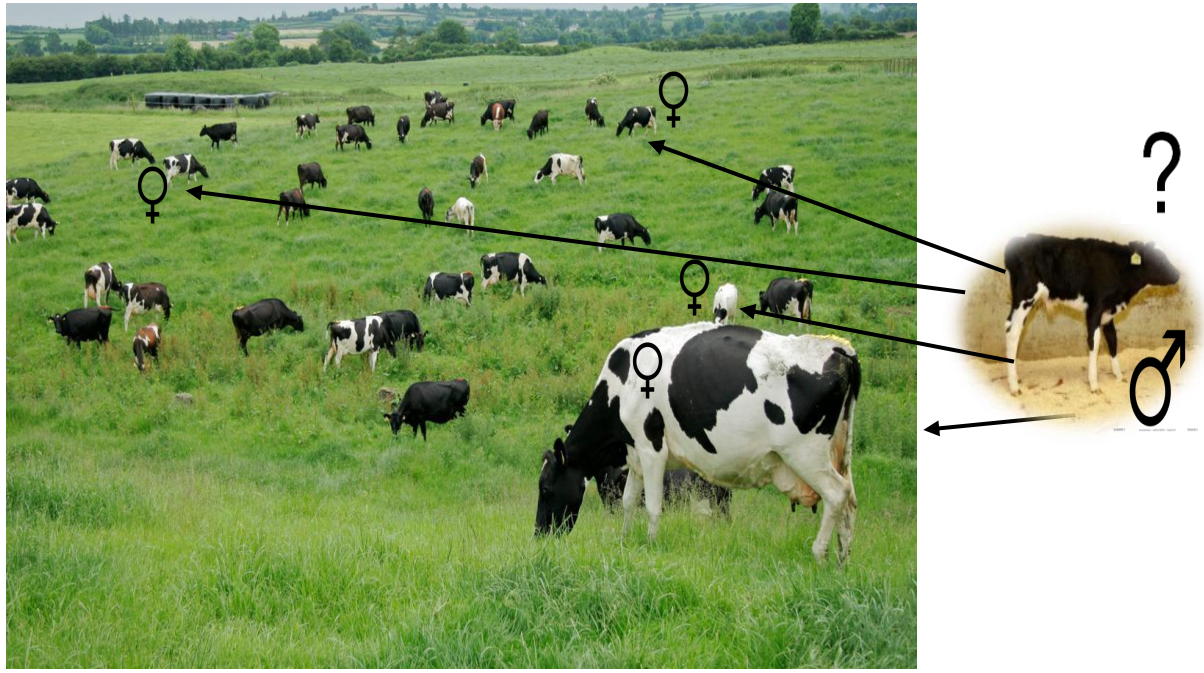
The results of this breeding strategy is mostly disappointing. <u>No improvements!</u>

9. Selection

- In case of natural mating and/or AI is not available;
  - more emphasis on <u>bull selection</u>
  - <u>data collection</u> is extremely important to make progress

- In general, bulls have a major impact on the performance of the cows:

  - If the mother of the chosen bull is a good producer, his daughters have a high chance to become good producers as well
  - When the gestation period of the chosen bull has been very long, his calves will also have longer gestation periods, leading to dystocia/mortality.



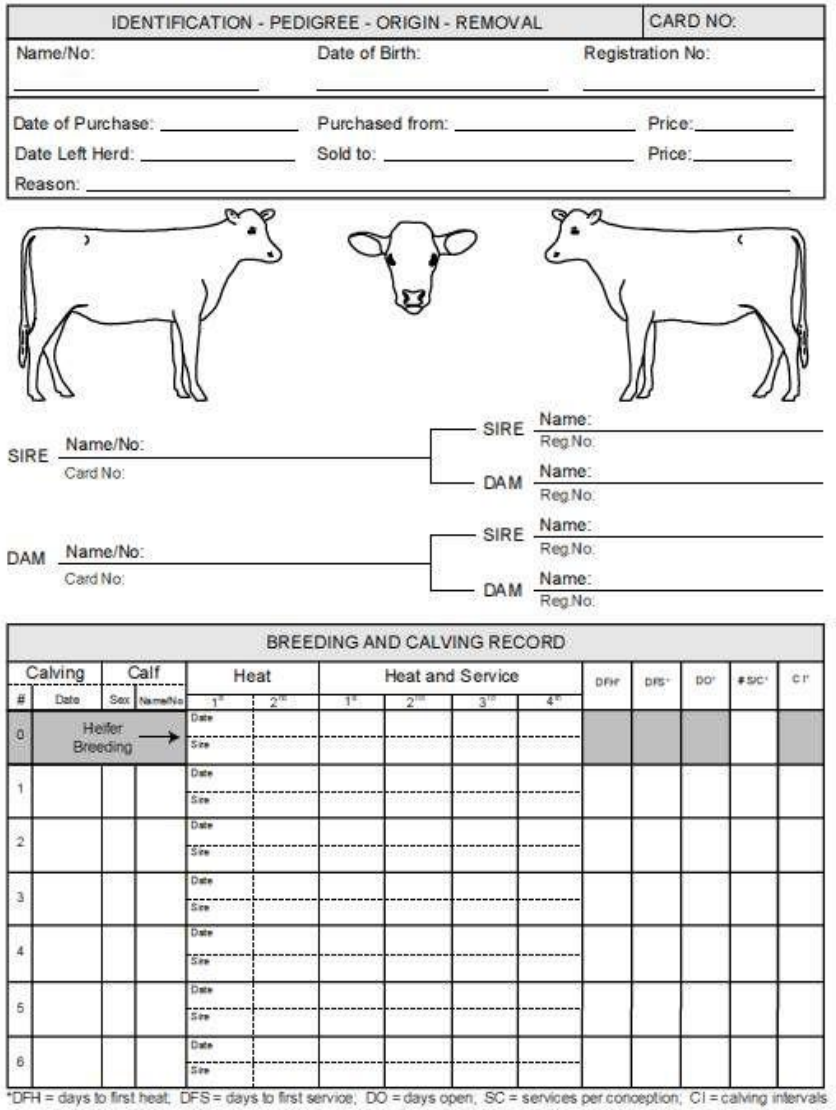
9.1 Selection Cont'd…

No Breeding without Selection
No Selection without data

- When data is administrated in the right way and interpretated correctly, it's the key to a <u>successful</u> breeding program.

Cow identification: ……

Day	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Week:							
AM yield							
PM yield							
Day							
Week:							
AM yield							
PM yield							
Day							



10. Breeding data

- When enough data is available within a breed and region, it is possible to calculate “correction factors”.

Age at calving	Average milk production	Calculation	Correction factor
26- 30 months	6,0 kg’s	6/10,3	0,582
31- 35 months	6,5 kg’s	6,5/10,3	0,631
36-40 months	7,0 kg’s	7/10,3	0,679
41 -45 months	7,5 kg’s	7,5/10,3	0,728
46 -50 months	8,5 kg’s	8,5/10,3	0,825
51 -55 months	9,3 kg’s	9,3/10,3	0,902
56 -60 months	9,8 kg’s	9,8/10,3	0,951
61 -65 months	10,3 kg’s	10,3/10,3	1,000
66- 70 months	10,2 kg’s	10,2/10,3	0,990
71-75 months	9,9 kg’s	9,9/10,3	0,961
76 -80 months	9,7 kg’s	9,7/10,3	0,941

In this example, cows that have calved between 61 and 65 months of age produced the highest amount of milk. In general it means that all the other cows younger than 61 months have a good chance to increase their milk production….but by how much? Use the correction factors.

10.1 Breeding data Cont'd…

How to use correction factors

- A farmer has 5 cows with good milk production, all cows are pregnant of the same bull. From which cow must the farmer keep a bull calf?

Cow	Age	Milk prod	Ranking	Corr fact	Calculate	Corr Milk	Bull mother Ranking
A	29 months	8,1	5	0,582	8,1/0,582	13.9	2
B	43 months	10,3	4	0,728	10,3/0,728	14,1	1
C	57 months	12,8	2	0,951	12,8/0,951	13,5	3
D	64 months	13,2	1	1,000	13,2/1,000	13,2	4
E	79 months	11,0	3	0,941	11,0/0,941	11,7	5

At the moment cow D is the highest producer, but when cow A, B & C become older we expect more milk from these three cows. Because of this, we advice the farmer to keep a bull calf out of cow B.

11. Breeding Program

- Drawing a sound breeding program entails:

Step 1: What do you have?
- Strong and weak points of your cows
- Record analysis
- Make a priority list

Step 2: What do you want?
- To improve(max 3 traits /generation)
- Bull selection

Step 3: What do you do?
- Which cow combined with which bull

12. The importance of a well-considered breeding plan

- A breeding plan is a document that is used for years until the results become visible and, above all, measurable. Only then should the chosen breeding plan be re-examined

- The challenge is to present the chosen breeding plan clearly and simply using the three steps, 1e - What do I have, 2e - What do I want, 3e - What do I do.

- Results of the agreed breeding plan will be visible (at the soonest) after one year when the calves are born

- Results of the agreed breeding plan will be measurable (at the soonest) after 3-4 years when the first heifers come in milk

Beware: Breeding is a long-term policy!

13. Breeding Program: Score form

What do I have;

- How do my cows look like, and what needs to be improved to optimize performance

What do I want;

- The form says ; you must try to find a bull mother with a high production with short teats and a lot of capacity with a nice sloped medium rump

What do I do;

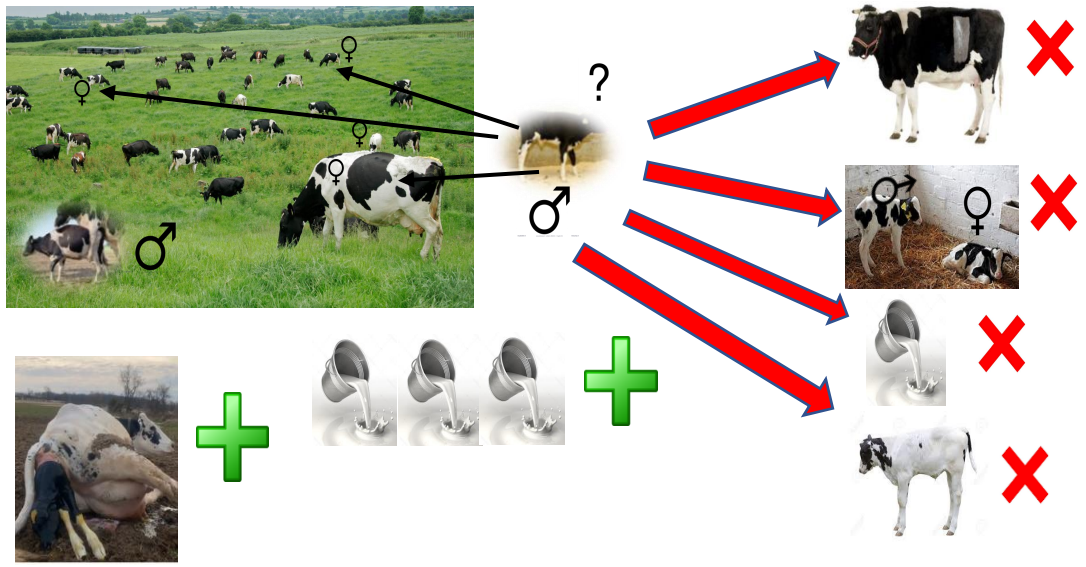
- With the outcome you can try to find a bull/bull mother

stature	low		tall
depth	shallow		deep
chest width	narrow		wide
rump angle	high		sloped
rump width	narrow		wide
udder depth	shallow		deep
teat length	long		short
udder cleft	weak		strong.
milk production	low		high
fertility	poor		good
udder health	poor		good

Example of how a score form can look like

14. Breeding strategy

Selection of cows to breed bulls

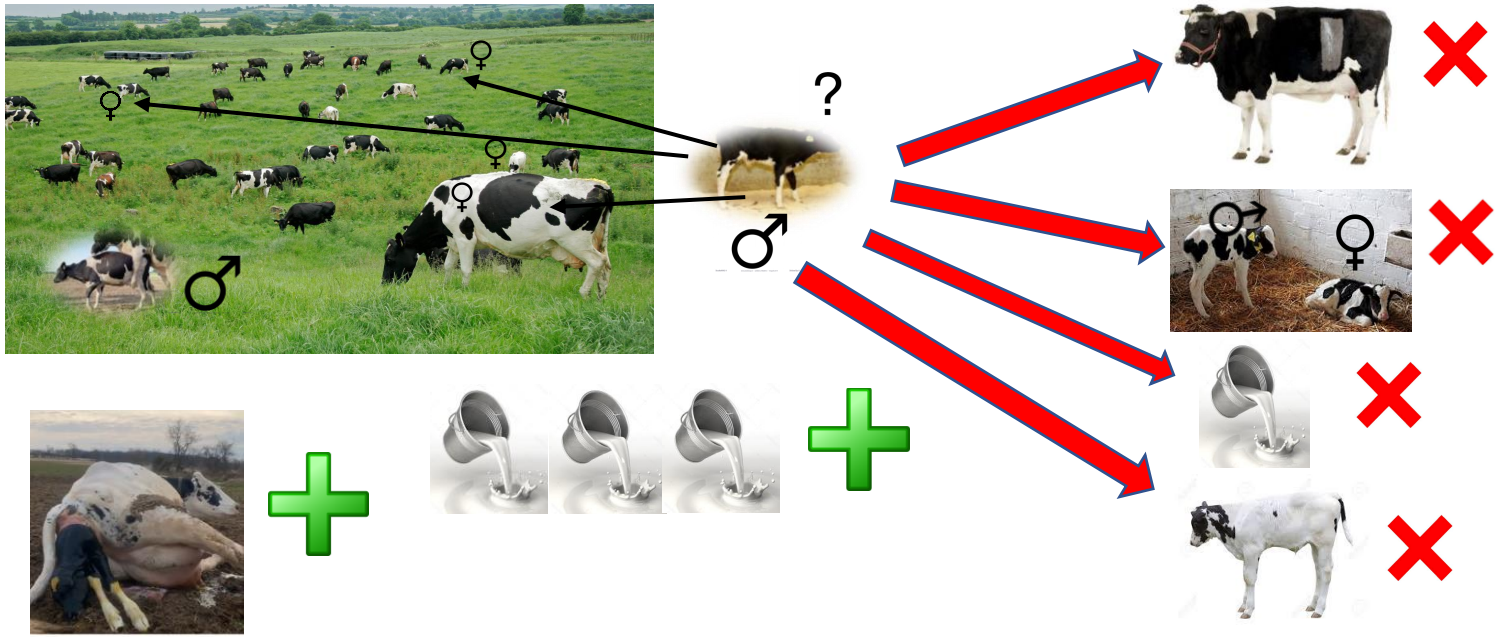


This breeding strategy requires patience, the results will only be visible in 5 years, a long-term policy though

14.1 Breeding strategy Cont'd…

Estimates and Assumptions

- Bull is born out of high producer - his daughters may do well
- Bull is born easily without assistance - his calves have a high chance to get born easy
- Bull is born out of fertile mother - his daughter probably will also be fertile



Bull is born out cesarian.
Bull is born out twins(female/male)
Bull is born out low prod cow.
Bull calf is completely white

Dystocia/mortality.
Infertile bull.
Low producing off spring
Offspring sensitive for sunburn.

15. Artificial Insemination (AI)

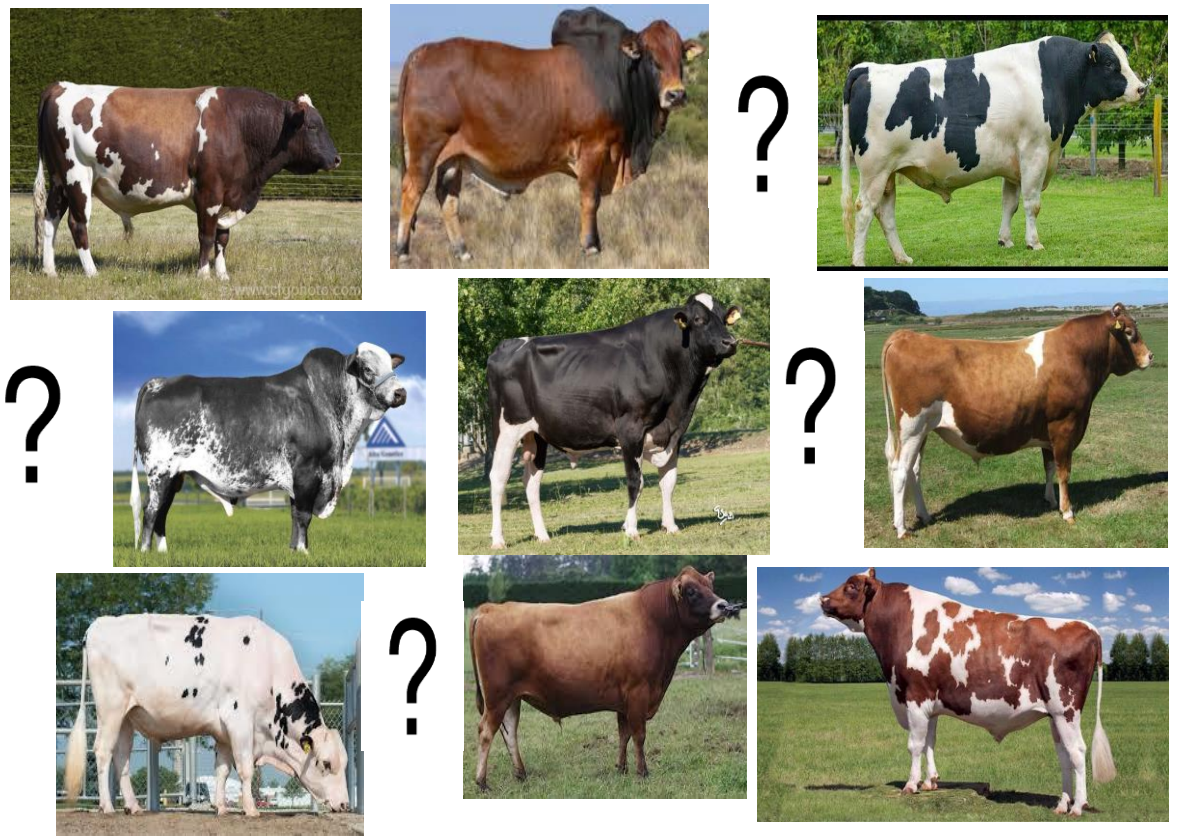
AI is;

- A tool that helps farmers increase the genetic potential of their herd
- A tool that helps eradicate infertility
- A tool that helps speed up the accomplishment of the breeding goal
- A tool that offers the possibility to mate each cow individually, whereby qualities and shortcomings are considered

16. Selection of bulls to breed cows

Questions to be answered:

1. Which breed do you prefer? *(Refer to theme on Cattle Breeds)*
2. Does the breed fit into the environment?
3. Is the breed (semen) available?
4. Are competent AI technicians available?
5. Do we know how to interpretate the data?



17. Selection of bulls to breed cows: Breeding indexes/values

- Information /data from all over the world is available
- Breeding indexes/values do tell you how the daughters of a bull perform compared to the breed's standard in the country of origin
- The implementation of all these foreign information in the right way is a challenge. Breeding indexes/values of different breeds should not be compared.

PRODUCTION TRAITS

Daughters Avg. Milk (Kg)	12600
Fats (%)	3.71
Fats (kg)	467
Proteins (%)	3.09
Proteins (kg)	389

	Daughter fertility	105		Production (€)	275
+5%	Udder health	102	+6%	Longevity	553
	Hoof health	109		Feed efficiency	101

Production traits 2,475 dtrs, 1,252 herds, reliability: 91%

Kg Milk	% Fat	% Protein	Kg Fat	Kg Protein
578	0.40	0.14	62	33

Management/Health

SCC	103
Ketosis	102
Milking speed	112
Temperament	109
Daughter calving ease	103
Daughter calf vitality	102
Persistency	103
Maturity rate	98
Age of first calving	101
Body weight	106
Sire calving ease	102
Sire calf vitality	102

Outstanding new genomic Norwegian Red sires - Nor...

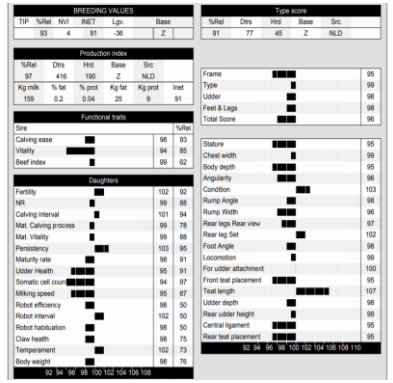
777HO03913 **UNIX**

12/2020	CDCB SUMMARY MACE			NM$ +222
Milk	+548	99%R	Fluid Merit $	+236
Fat	+26	+0.02%	Cheese Merit $	+216
Protein	+12	-0.02%	Grazing Merit $	+208
SCS	2.95	98%R	Gestation Len. +0	Fert. Index +0.2
PL	+0.8	96%R	Livability -1.4	Mastitis +0.2
DPR	-0.1	96%R	EFI 8.1%	gEFI 10.9%
HCR	+1.3		28532m 3.8%	1096f 3.1% 875g
CCR	-0.5		13952 Dtrs	4752 Herds 7% US

12/2020	CALVING SUMMARY		SCE 1.7 %
Sire Calving Ease	1.7%	99%R	50071 Obs
Daughter Calving Ease	2.3%	96%R	1002 Obs
Sire Stillbirth	4.2%	97%R	48470 Obs
Daughter Stillbirth	6.1%	94%R	928 Obs

12/2020	HA TYPE SUMMARY		TPI +2355
PTAT +2.40	98%R	UDC+2.40 FLC-0.05	BSC +0.41 6840 D / 2904 H
Stature	+2.06	Tall	
Strength	+0.66	Strong	
Body Depth	+1.46	Deep	
Dairy Form	+2.03	Open Rib	
Rump Angle	+1.12	Sloped	
Thurl Width	+1.73	Wide	
Rear Legs-Side	+1.24	Sickle	
Rear Legs-Rear	-0.21	Hock In	
Foot Angle	-0.05	Low	
Feet & Legs Score	+0.64	High	
F. Udder Attachment	+2.62	Strong	
Rear Udder Height	+3.43	High	
Rear Udder Width	+3.17	Wide	
Udder Cleft	+2.64	Strong	
Udder Depth	+1.86	Shallow	
Front Teat Placement	+2.47	Close	
Rear Teat P. Rear	+2.66	Close	
Teat Length	-0.95	Short	

Type Conformation		Reliability 93% 197 Daughters in 91 Herds	
Type Merit	Poor	Excellent	+1.25
Mammary	Poor	Excellent	+0.32
Legs & Feet	Poor	Excellent	+2.45
Stature	136cm	160cm	+0.43
Chest Width	Narrow	Wide	+0.28
Body Depth	Shallow	Deep	-0.50
Angularity	Coarse	Open Rib	-0.41
Rump Angle	High Pins	Low Pins	+2.54
Rump Width	Narrow	Wide	+0.34
Rear leg side	Straight	Sickled	-0.61
Foot angle	Low	Steep	+0.76
Fore udd att	Loose	Tight	+0.89
Rear udd ht	Very Low	Very High	+0.76
Udder supp	Broken	Strong	+1.01
Udder depth	Below Hock	20cm above	+1.67
Front teat pl	Outside	Close	+1.52
Teat length	Short	Long	-5.40
Rear teat pl	Apart	Close	+1.68
Teat pos side	Close	Apart	-0.36
Temperament	Poor	Good	-0.28
Ease of milk	Slow	Fast	+0.80
Locomotion	Poor	Excellent	+3.26
Cond Score	Low	High	+0.74



17.1 Breeding indexes/values Cont'd…

- Example: Study the two catalogues for legs and feet and teats of this cow versus those of the bull (next slide):

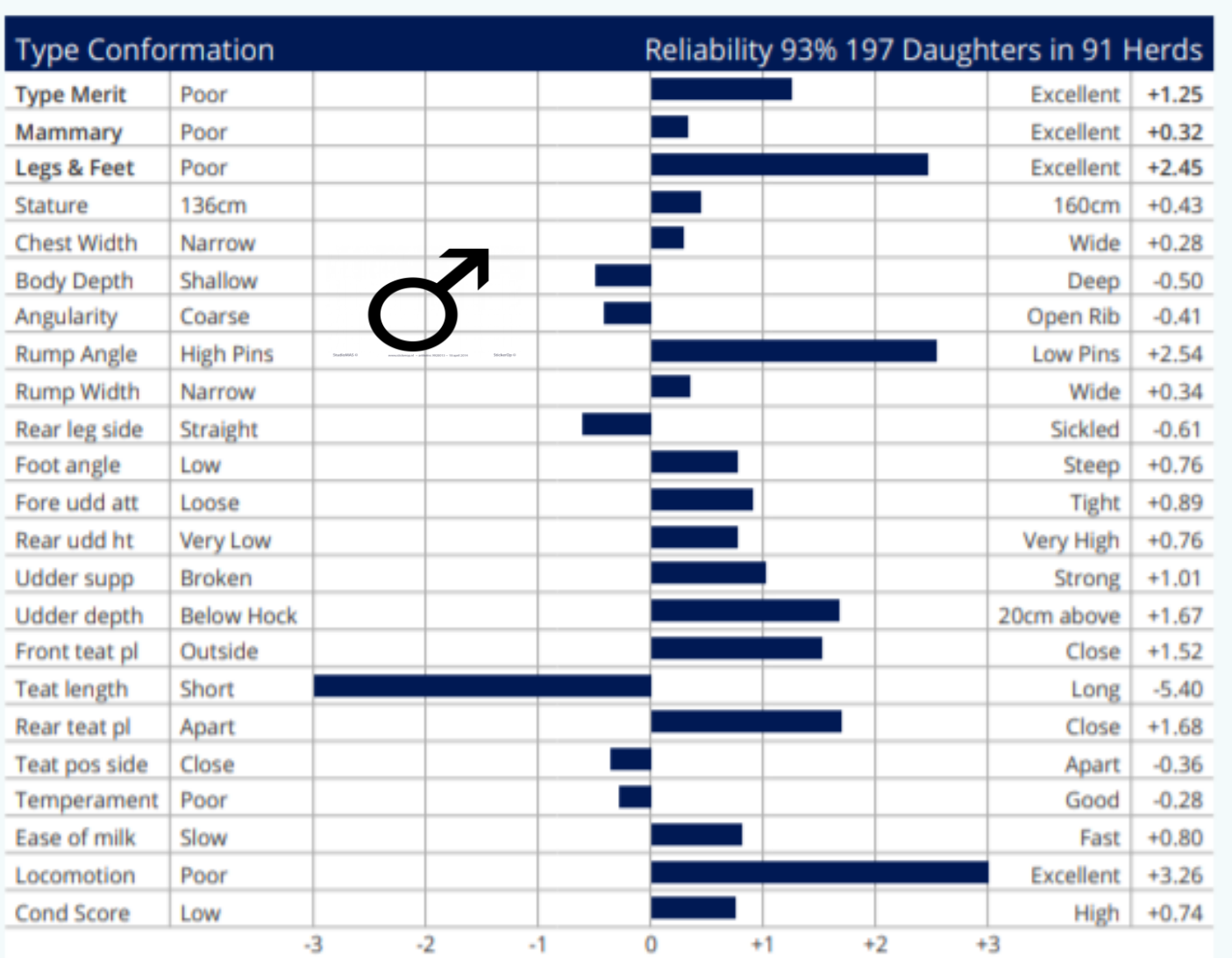
♀

	LINEAR TRAITS		DESCRIPTION										
1.	Rump Height	—	short 120cm	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	tall 160cm
2.	Chest Width	—	narrow	(1)	(2)	(3)	(4) X	(5)	(6)	(7)	(8)	(9)	wide
3.	Body Depth	—	shallow	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	deep
4.	Dairyness	—	course	(1)	(2)	(3)	(4)	(5)	(6) X	(7)	(8)	(9)	angular
5.	Rump Angle	—	high pins	(1)	(2)	(3)	(4)	(5) X	(6)	(7)	(8)	(9)	low pins
6.	Rump Width	—	narrow	(1)	(2)	(3)	(4)	(5) X	(6)	(7)	(8)	(9)	wide
7.	Rear Legs — side	—	straight	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	sickled
8.	Rear Legs — rear	—	cowhock	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	square
9.	Heel Depth	—	shallow	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	deep
10.	Fore Udder Attachment	—	loose	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	firm
11.	Fore Udder Length	—	short	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	long
12.	Rear Udder Height	—	low	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	high
13.	Rear Udder Width	—	narrow	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	wide
14.	Median Ligament	—	weak	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	strong
15.	Udder Depth	—	low	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	high
16	Front Teat Placement	—	outside	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	inside
17.	Rear Teat Placement	—	outside	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	inside
18.	Teat Spacing-Side	—	close	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	wide
19.	Teat Length — Fore	—	short	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	long
20.	Teat Length — Rear	—	short	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	long

17.2 Breeding indexes/values Cont'd…

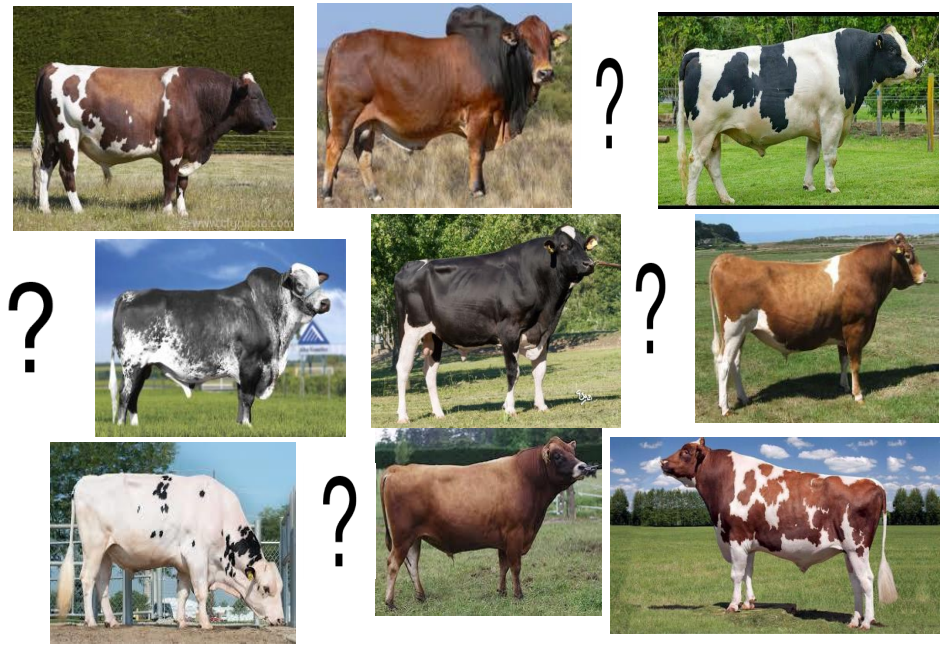
- Cow has poor legs and feet, bull's legs and feet are excellent + 2,45
- Cow's teats are short, bull's teats are very short – 5,40

Conclusion: Based on these data, this bull is not the desired choice for this cow, the teats of the intended daughter will probably be much shorter



18. Successful breeding strategy

Selection of bulls to breed cows



A very successful/good breeding strategy that has led to a big increase of milk production and improved udder conformation world wide

2015	2021	2026

- END -