

CROSSBREEDING IN THE BREEDING SCHEME

NEW TOOLS FOR EVALUATING AND MANAGING SYSTEMATIC CROSSBREEDING AT HERD LEVEL AND RESULTS FROM CROSSBREEDING IN DENMARK

**MORTEN KARGO
SEGES, AU**

Nordic Workshop

Park Inn

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Den Europæiske Landbrugsfond for Udvikling af Landdistrikterne:
Danmark og Europa investerer i landdistrikterne

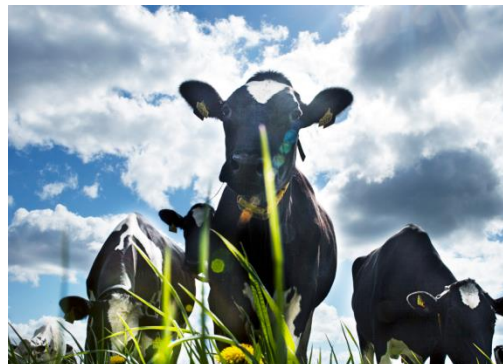


Miljø- og Fødevareministeriet
NaturErhvervstyrelsen

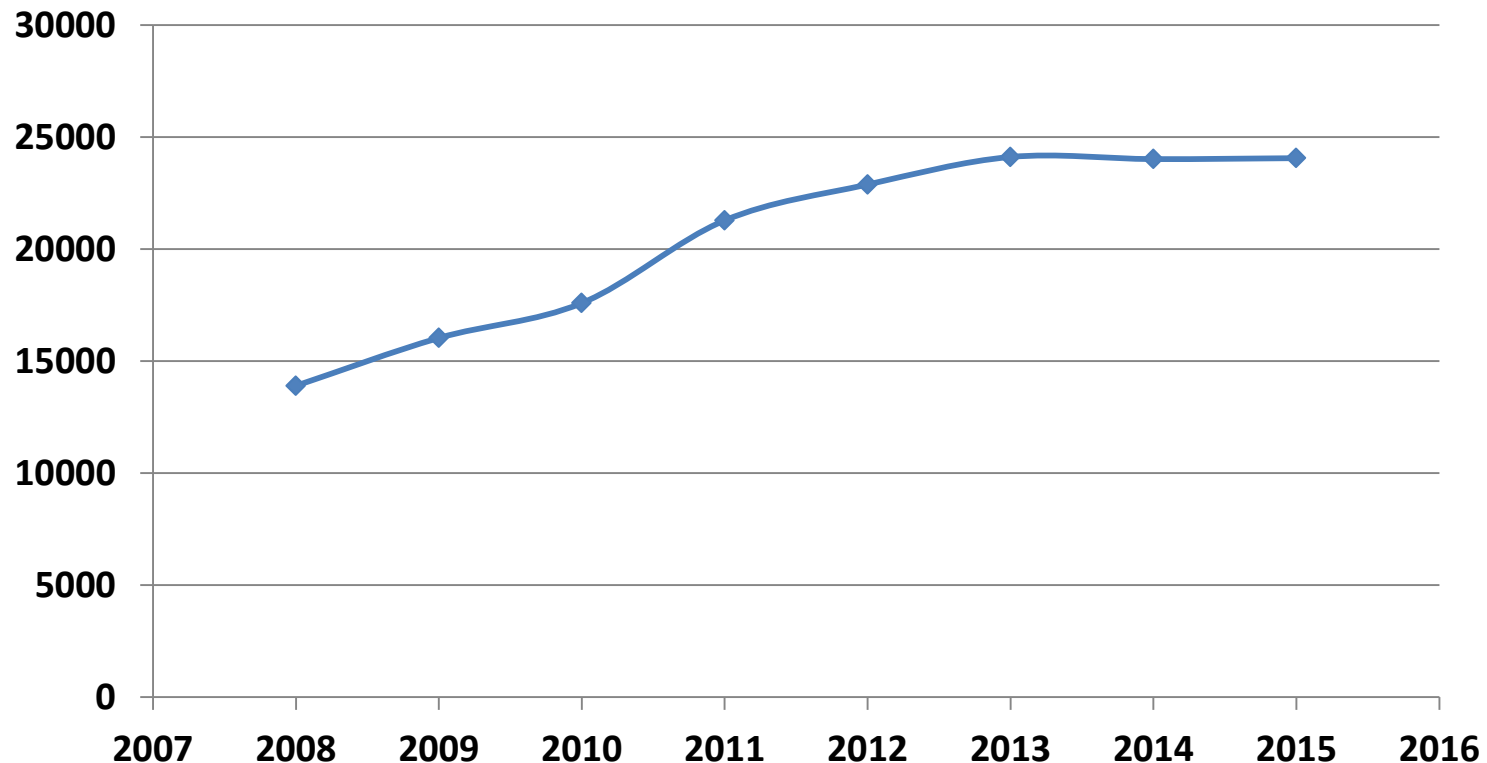


Den Europæiske Landbrugsfond
for Udvikling af Landdistrikterne

Se EU-Kommissionen, Den Europæiske Landbrugsfond for Udvikling af Landdistrikterne



Number of born crossbred dairy heifers from systematic crossbreeding programs in Denmark



Approximately 9 % of all born heifers calves

Systematic crossbreeding in Denmark

- Approximately 59.000 crossbred cows in yield control
 - Increasing
 - Fewer random
 - More systematic
 - 12 % genetic contribution from beef breeds
 - Therefore this group is bad for comparisons
 - Nearly 9 % genetic contribution from Jersey

Crossbred animals have production like Holsteins and are more robust (2017)



Fleckvieh X Holstein



Jersey X Holstein



Montbeliarde X Holstein



RDC X Holstein



305-day yield – compared to Holstein

Fat + Protein, 1 st lactation	- 9	8	20	7
Fat + Protein, 2 nd lactation	- 27	- 1	-1	-3

Survival (% point) – compared to Holstein

Survival to 2 nd lactation	3	3	3	2
Survival to 3 rd lactation	10	8	12	5

Cross bred animals have production like Holsteins and are more robust ⁽²⁰¹⁷⁾



Fleckvieh X Holstein



Jersey X Holstein



Montbeliarde X Holstein



RDC X Holstein



Fertility- compared to Holstein

1. to last e ins, 1. parity	- 7	- 11	- 7	- 6
1. to last ins. 2. parity	- 20	- 14	- 14	- 9

Mastitis treatments (% point) - compared to Holstein

1. parity	- 0,2	+ 1,7	+ 1,1	- 1,9
2. parity	- 2,8	- 1,5	- 3,6	- 2,0

Genetic analyses from Denmark

(first lactation)

Breed level compared to Holstein

	Protein (kg)	SCC (#/ml)*	DCFI**
Nordic Red	- 4	- 9.000	-8
Jersey	- 40	+ 16.000	-5

Heterosis

	Protein (Kg)	SCC (#/ml)	DCFI**	Days empty
HF*Nordic Red	6	- 2.000	- 2	- 5
HF*Jersey	12	- 7.000	-2	-12

* Average 71.000

** Days from calving to first insemination

Heterosis for longevity

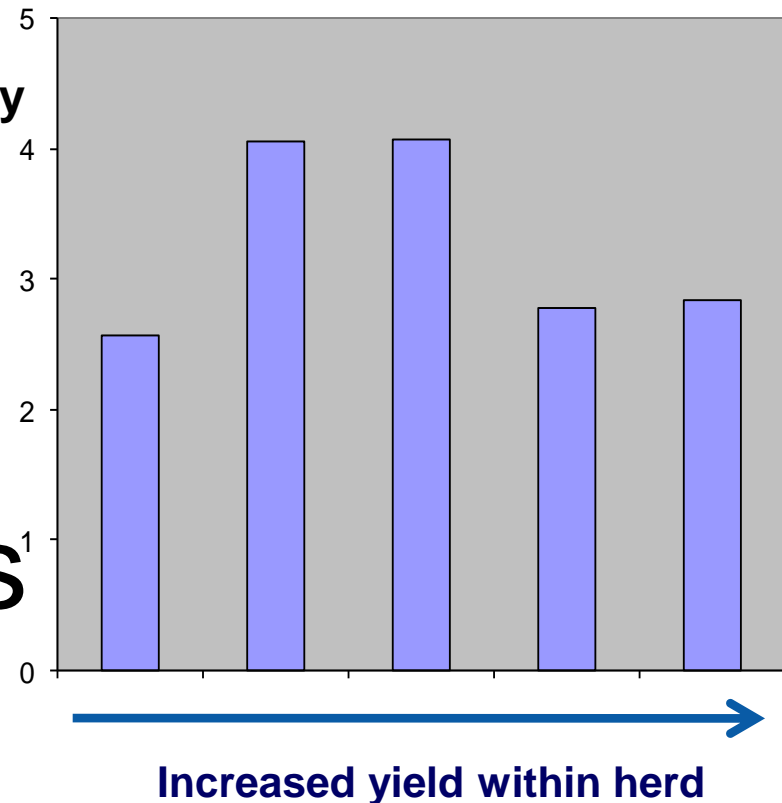
Survival until end of fifth lactation

	HF x Nordic Red		HF x Jersey		Nordic Red x Jersey	
	%	days	%	days	%	days
5th lact	+ 8.5	+ 65.2_(15.1)	+ 6.2	+ 48.5_(23.6)	+ 7.2	+ 56.2_(42.1)

J. B. Clasen, E. Norberg, P. Madsen, J. Pedersen & M. Kargo

Is heterosis existing under good management levels?

Heterosis (%) between Danish Jersey and US Jersey for protein yield in Different management levels
(Kargo et al., 2012. JDS)



The answer is yes

Is heterosis existing under good management levels?

- A Danish investigation

- RDM * Holstein crosses compared to Holstein
 - Appr. 100.000 Holstein og 15.000 crosses
 - At least 5 crosses per herd*year
 - Three management levels

Management level	Mean – first parity, Kg F+P
High	675
Average	611
Low	532

Crossbred performance compared to Holstein under different management levels

Management level	High	Average	Low
Kg fat + protein, 1. parity	+ 7	+ 7	+ 3
Kg fat + protein, 2. parity	- 4	-12	- 7
Still birth at first calving	- 30 %	- 38 %	- 35 %
Mastitis treatments , 1. parity	- 15 %	- 15 %	0
Mastitis treatments , 2. parity	- 14 %	- 11 %	- 6 %

Performance of crossbreds

- Yield – a little better than Holstein level
- Functionality and robustness – a little better than the level of colored breeds

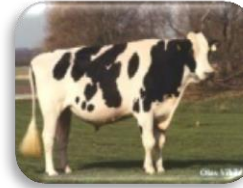
THE SEGES PLAN 2020

- 40 % of the dairy herds use systematic crossbreeding programs
- 150.000 slaughtered beef*dairy crosses
- A replacement rate of 32 %.
 - This can only be achieved with a systematic use of beef semen in combination with improved management



Combi-Cross

Step 1
Pure
Breeding



Step 2
Two- breed cross



Step 3
Three-breed cross



Step 4
Beef Cross



The idea behind Combi-Cross

- The advantages of pure breeding and cross breeding are combined
- The level of the purebred nucleus is increased due to use of Sexed Semen
- The functional "F1-animals" express their full heterosis
- The three-cross cows give birth to beef crosses



Assessing the economically consequences through SimHerd Crossbred

- A supplementary tool to SimHerd
- The program can judge different crossbreeding strategies within a herd
 - Systems
 - Rotational
 - Combi - Cross
 - Breeds

What is the SimHerd model

- and why useful

- SimHerd is a **dynamic, stochastic** and **mechanistic** simulation model of a dairy herd including young stock
- SimHerd can quantify the herd level technical and economic effects of
 - a change in management and/or
 - in cow level relationships

SimHerd as to day

- A cow is a cow independent of breed



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SimHerd Crossbred

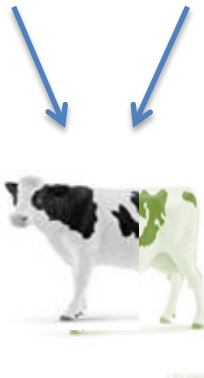
- A cow is characterised through own and parents breed composition

Parents



heterozygosity = degree of expressed heterosis

The animal



breed composition = degree of expressed breed affect

How

- Every single animal is given a genetic potential (additive and heterosis) at birth
- Breed- and heterosis effects for many traits defined based on a large review

- Yield
- Fertility
- Health
- Mortality
- Calving ease
- And more

Egenskab	Enhed*	Værdier for racer og racekombinationer til input						Møllenregning: forældrenes ¹ heterosis						Heterosis% bestemt fra litteratur						Møllenregning: $\sqrt{Krac1 + Krac2}$						Værdier for rene racer bestemt fra litteratur					
		Jersey	ROM	HF x JER	HF x ROM	ROM x JER	HF x JER	HF x ROM	ROM x JER	HF x JER	HF x ROM	ROM x JER	HF x JER	HF x ROM	ROM x JER	HF x JER	HF x ROM	ROM x JER	Jersey	ROM	HF x JER	HF x ROM	ROM x JER	Jersey	ROM						
Mælkefeber	OR	1,92	0,87	0,89	0,90	0,89	0,051	0,034	0,049	0,9	0,9	0,9	0,057	0,038	0,055	0,040	0,074	0,035													
Dystocia	OR	0,19	0,85	0,93	0,93	0,93	0,028	0,043	0,025	0,93	0,93	0,93	0,030	0,047	0,027	0,050	0,010	0,043													
Retained Placenta	OR	0,38	0,88	0,89	0,89	0,89	0,057	0,077	0,052	0,9	0,9	0,9	0,063	0,085	0,058	0,090	0,036	0,080													
Metritis	OR	0,38	0,87	0,89	0,89	0,90	0,050	0,068	0,046	0,9	0,9	0,9	0,056	0,075	0,051	0,080	0,032	0,070													
Displaced Abomasum	OR	0,50	0,90	0,90	0,90	0,90	0,007	0,009	0,006	0,9	0,9	0,9	0,008	0,010	0,007	0,010	0,005	0,009													
Ketosis	OR	0,49	0,87	0,90	0,90	0,90	0,034	0,042	0,031	0,9	0,9	0,9	0,038	0,047	0,035	0,050	0,025	0,044													
Digital Dermatitis	OR	0,64	0,67	0,83	0,83	0,84	0,401	0,405	0,356	0,9	0,9	0,9	0,445	0,450	0,395	0,500	0,390	0,400													
Interdigital Hyperplasia	OR	0,80	0,79	0,90	0,90	0,90	0,041	0,041	0,036	0,9	0,9	0,9	0,045	0,045	0,040	0,050	0,041	0,040													
Hoof horn diseases	OR	0,79	0,74	0,88	0,88	0,88	0,198	0,194	0,176	0,9	0,9	0,9	0,220	0,215	0,195	0,240	0,200	0,190													
Mastitis	OR	1,20	0,75	1,00	1,00	1,00	0,340	0,290	0,310	1	1	1	0,340	0,290	0,310	0,320	0,360	0,260													
Cow Mortality	OR	1,06	0,69	0,89	0,90	0,90	0,049	0,041	0,042	0,9	0,9	0,9	0,055	0,045	0,047	0,053	0,056	0,037													
Cell count	Additiv celler pr ml	7	-9	0	0	0	248	240	243	1	1	1	248	240	243	244	251	235													
Mælkeydelse, 1. laktation	Relativ, kg EXM 305 dage	0,87	0,97	1,03	1,03	1,03	7749	8141	7614	1,03	1,03	1,03	7523	7904	7392	8035	7010,8	7773													
Mælkeydelse, 2. laktation	Relativ, kg EXM 305 dage	0,87	0,95	1,03	1,03	1,03	8850	9236	8597	1,03	1,03	1,03	8592	8967	8346	9213	7971,692	8721													
Mælkeydelse, 3. laktation og ældre	Relativ, kg EXM 305 dage	0,87	0,94	1,03	1,03	1,03	9209	9595	8929	1,03	1,03	1,03	8941	9316	8669	9588	8294,333	9044													
Feed Conversion Efficiency (FCE)	Additiv ændring	0,02	0,00	0	0	0	0,89	0,88	0,89	1	1	1	0,890	0,880	0,890	0,88	0,9	0,88													
Start breeding, heifers	Additiv, mdr.	-1,5	0,5	0	0	0	14,3	15,3	14,5	1	1	1	14,3	15,3	14,5	15	13,5	15,5													
Insemination rate, heifers	OR	1,00	1,13	1,25	1,26	1,26	0,605	0,622	0,622	1,1	1,1	1,1	0,590	0,565	0,565	0,55	0,55	0,58													
Conception rate, heifers	OR	1,00	1,13	1,28	1,29	1,29	0,638	0,655	0,655	1,1	1,1	1,1	0,580	0,595	0,595	0,58	0,58	0,61													
Start breeding, cows	Additiv, dage efter klv.	-7	0	0	0	0	45,5	49,0	45,5	1	1	1	45,5	49,0	45,5	49	42	49													
Insemination rate, cows	OR	1,23	1,04	1,18	1,17	1,18	0,435	0,413	0,440	1,1	1,1	1,1	0,395	0,375	0,400	0,37	0,42	0,38													
Conception rate, cows	OR	1,38	1,28	1,19	1,19	1,21	0,484	0,473	0,517	1,1	1,1	1,1	0,440	0,430	0,470	0,4	0,48	0,46													
Stillbirth	OR	0,82	0,82	0,87	0,87	0,87	0,048	0,048	0,044	0,88	0,88	0,88	0,055	0,055	0,050	0,06	0,05	0,05													
Calv mortality after birth	OR	1,28	1,13	0,87	0,87	0,87	0,065	0,061	0,068	0,88	0,88	0,88	0,074	0,069	0,078	0,065	0,082	0,073													

SimHerd Crossbred results

Average Holstein management level (conventional)

	HF	Jersey	Red
ECM per cow year	10022	- 1168	- 370
Calving interval	401	- 14	- 8
Replacement rate, %	41,1	- 4.7	- 3.7
# Treatments	1.61	-0.29	-0.34
Net return per cow year	9503	- 403	+ 368
Kr./kg ECM	0.95	+ 0.08	+ 0.07

Economically equal breeds



SimHerd Crossbred results

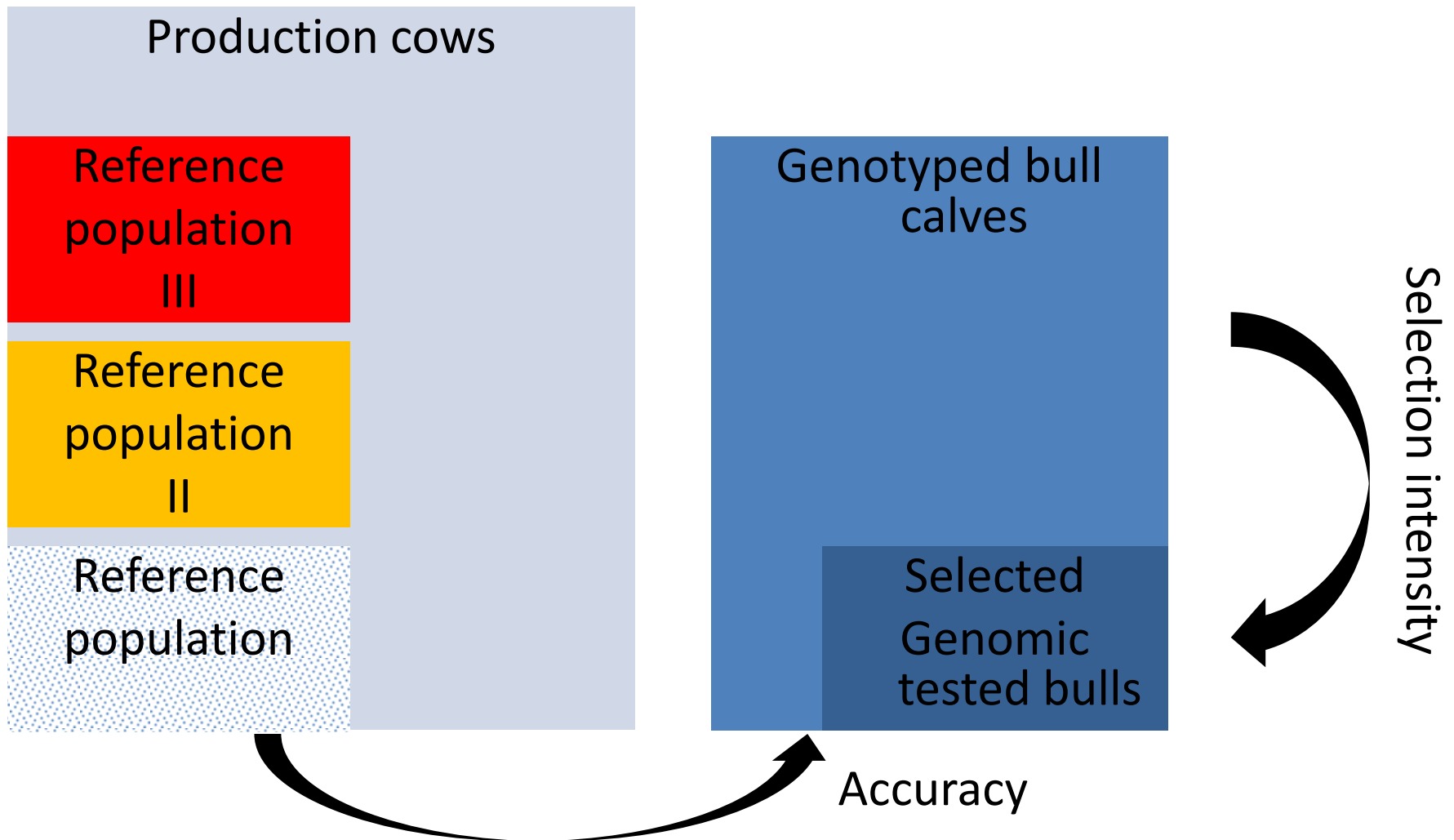
Average Holstein management level (conventional)

	HF	Zig-Zag HF*R	Rotationally HF*R*J	Combi - Cross
ECM per cow eyar	10022	+ 24	- 265	- 147
Calving interval	401	- 10	- 13	- 6
Replacement rate, %	41,1	- 3,6	- 5,7	- 3,6
# Treatments	1,61	- 0,24	- 0,32	- 0,22
NR per cow year	9503	+ 929	+ 712	+ 974
Kr./kg ECM	0,95	+ 0,09	+ 0,10	+ 0,11

Future breeding schemes at population level

- AI bulls selected for high performance of offspring in pure breeding
- AI bull selected for high performance in crossbred populations

The driving force behind genetic gain – using GS



More work will be done in

- SEGES crossbreeding projects
- Viking coordination – Hans Stålhammer
- GenTore
- Swedish/Danish Phd-project
 - Crossbreeding in dairy cattle
- New applications

Thank you for your attention 😊
Questions?