Sommet de élevage
Clermont-Ferrand, France
4 au 7 octobre, 2006
BRUNE 2006

First results from a crossbreeding experiment Brown Swiss x Holstein in a high yielding herd

Prof. Dr. Hermann H. Swalve
Institute of Agricultural and Nutritional Sciences
Martin-Luther-University Halle-Wittenberg
Halle/Saale, Germany

Aim of the project

- Assessment of the "procedure"
  „Two breed terminal cross" BS x HOL

- This is not a „crossbreeding experiment" in the strict sense from which crossbreeding parameters can be estimated

- Background
  - Hypothesis: Better functional traits in crosses?
  - A terminal cross would work if semen sexing would (really) be possible

Time frame of the experiment

- Plans: Summer 2002; inseminations started in autumn of 2002

- Period to cover: 2003 to 2008/2009
  - » Calvings — July 03 till April 04
  - » Calf rearing — July 03 till Aug. 04
  - » Heifer rearing — Nov. 03 till June 06
  - » Inseminations — Aug. 04 till Oct 06
  - » 1st Lactations — from July 05
  - » Last 1st calving — June 06

Experimental station LLG Iden

Herd performance at the start of the experiment

- **376 cows**
- **Production traits, herd average 2003**
  - **» 11,186 milk kg**
  - **» 422 Fat kg**
  - **» 380 Protein kg**

Note: 3x, but not M.E.!

Experimental station LLG Iden

Housing of calves

- Single-housing up to two weeks

» Outside

» Inside

Experimental station LLG Iden

Housing of calves

❖ Group-housing of older calves

» No insulation, open barn

» Feeding stations for milk replacer and concentrates

Experimental station LLG Iden

Heifer rearing

- Also open barns

- On pasture when pregnant

Experimental station LLG Iden

Housing of cows

- Open barn with cubicles

» 3 feed groups
(7.2, 7.0 &
6.8 NEL/kg day)

» 1 Dry cow group

» 1 Transition group

Experimental station LLG Iden

Milking of cows

- 2 x 16 side by side parlour, 3 x per day

General outline of the experiment

- Two groups to be compared: Crossbred BS against Holstein purebreds
- Use of 10 sires per group, do not attempt to use "average" bulls but rather the top bulls readily available at the time of experiment
  - Brown Swiss bulls that were in heavy use in Germany
  - Domestic Holstein bulls in heavy use
- Around 15 inseminations per bull
  (15 x 10 x 2 = 300 = cows needed)
- Equal distribution across parities and cow EBVs

Holstein sires

Name	Number (D)	Sire	Birth year	Country	TMI (2002/2006)
Riverland	820498	Rudolph	1997	DE	140 130
Blauer	456087	Bonatus	1997	DE	137 112
Gibor	667908	Gibbon	1997	F/DE	137 131
Eminenz	810471	Esquimau	1996	DE	136 125
Zunder	820416	Zack	1997	DE	134 112
Zador	138800	Zack	1997	DE	134 113
Zecher	801025	Zebo	1997	DE	132 117
Ticket	810477	Airliner	1996	US/DE	130 124
Pedant	399475	Prelude	1994	DE	128 115
Predello	800285	Prelude	1994	DE	126 118

Brown Swiss sires

Name	Number (D)	Sire	Birth year	Country	Prod. Index (2002/2006)
Goldfinger	608177	Gordon	1997	ITA	150 113
Gordon	608014	Westley	1990	ITA	149 119
Vivo	78975	Vinos	1994	DE	139 112
Pronto II	608026	Ensign	1995	CAN	130 124
Collection	608073	Blend	1992	US	130 113
Amaranto	434728	Pete Rose	1995	ITA	134 116
Vinbrei	78775	Vigate	1993	DE	129 106
Jublend	340825	Jupiter	1997	DE	129 118
Hucos	340840	Huvic	1997	DE	127 114
Simvitel	78380	Simon	1992	DE	126 110

Distribution of pregnancies by genotype of sire and lactation

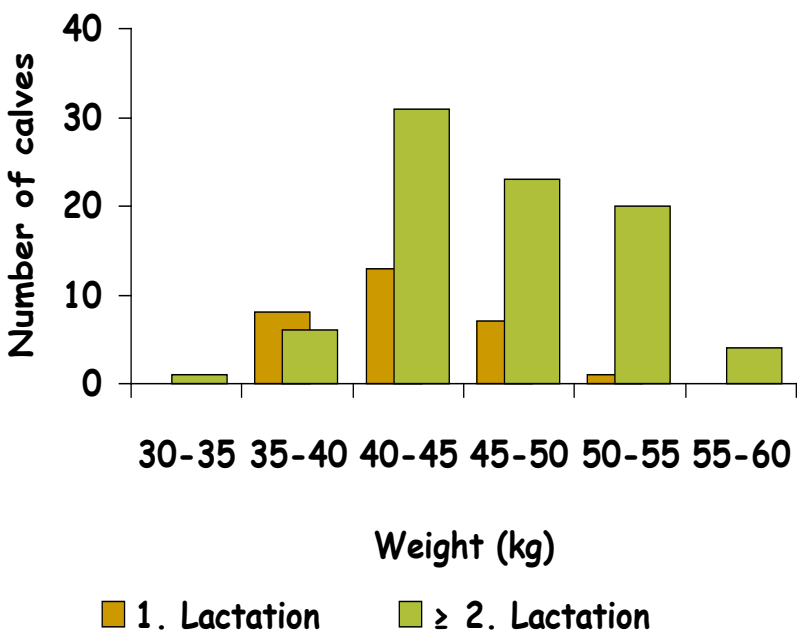
	HOL	BS	Total
Heifers	34	35	69
1. Lactation	38	37	75
2. Lactation	20	15	35
3. Lactation	21	21	42
4. Lactation	14	11	25
5. Lactation	4	5	9
	131	124	255

Analysis of births of the animals in the experiment

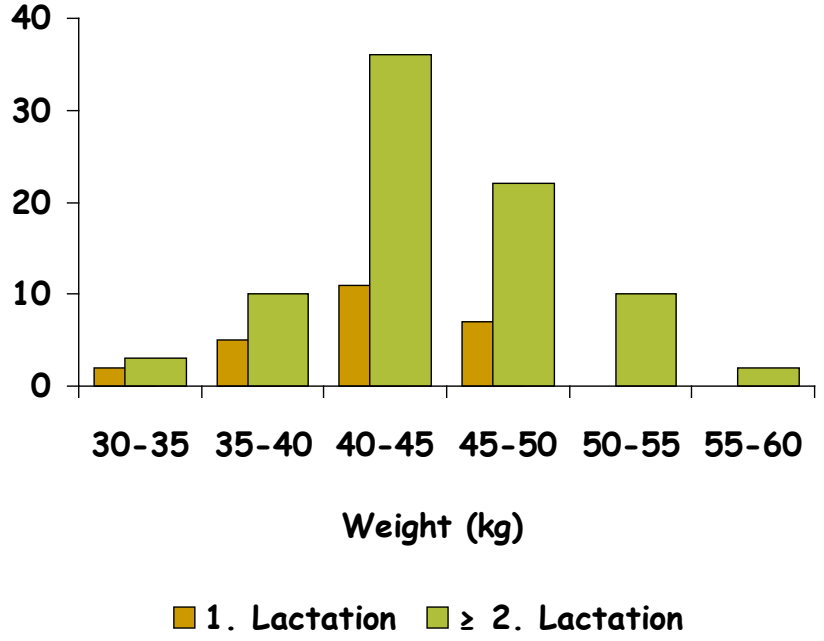
- Stillborn calves were not included in the analysis!
  (Reason: Some 20-kg-losses, some heavy ones …)

- Statistical model:
  - Univariate
  - Fixed effects included in the model:
    - Genotype-Sex
    - Parity of dam – Weight of dam

Distribution of birth weights by genotype and lactation number



BS x HOL
(n=114)



HOL x HOL
(n=108)

LSMEANS for genotype x sex of birth weights

		Birth weight (kg)	
GENOTYPE	SEX	LSMEANS	s.e.
BS x HOL	male	47,1 [a]	0,7
	female	42,4 [bc]	0,6
HOL x HOL	male	44,2 [b]	0,7
	female	40,6 [c]	0,7

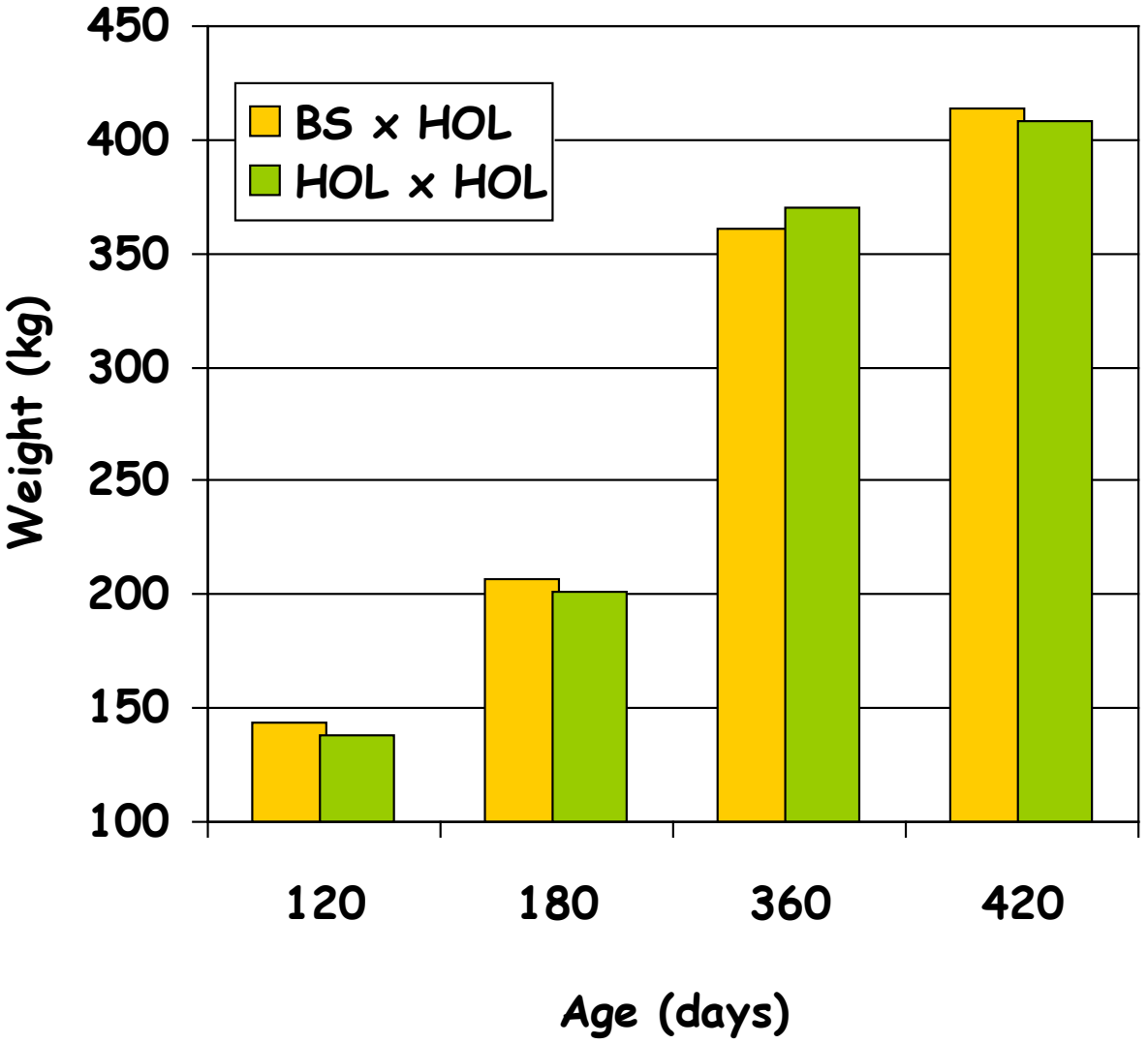
[abc] Significant differences ($p < 0,05$)

Analysis of weights and body measurements

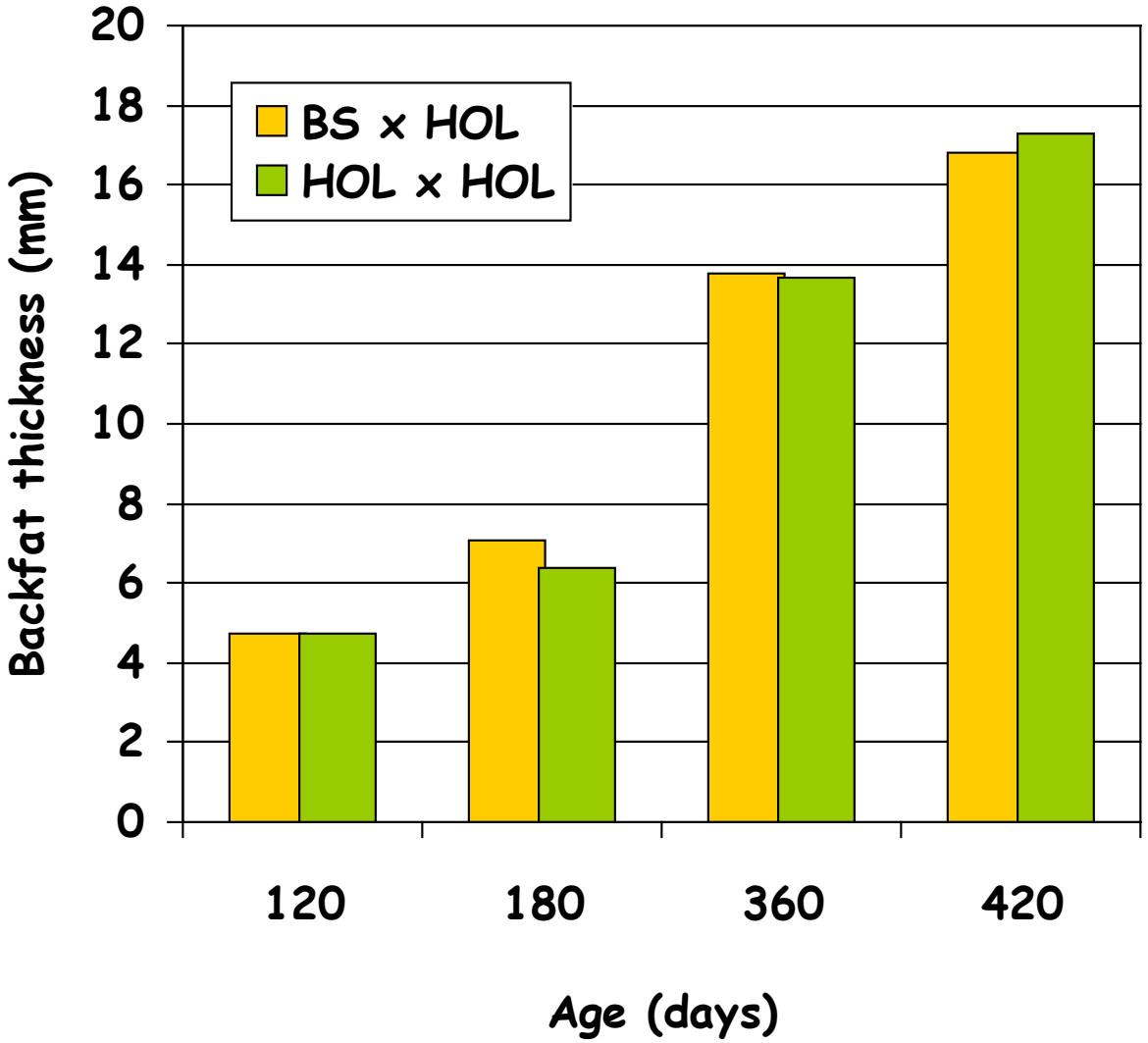
- Weighings at days 120, 180, 360, 420

- Statistical model:
  - Univariate within weighing days
  - Fixed effects included in the model:
    - Breed
    - Feed group
    - Season
    - Parity of dam
    - Regression for individual age difference

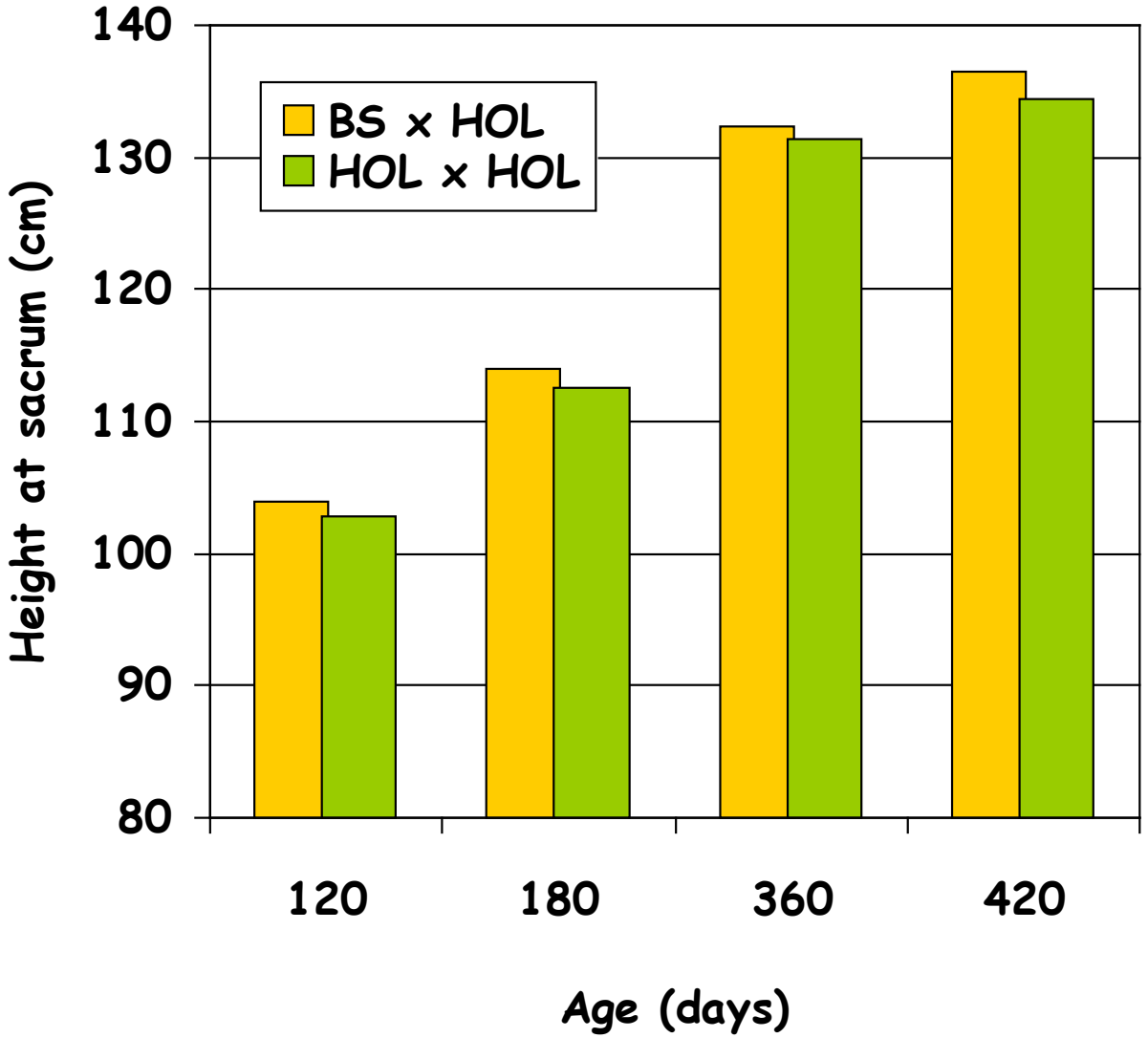
LSMEANS for genotype of weights during the heifer rearing period



LSMEANS for genotype of backfat thickness during the heifer rearing period



LSMEANS for genotype of height at sacrum during the heifer rearing period



Analysis of claw measurements

- Measurements taken throughout the first year at days 180, 270, 360

- Statistical model:
  - Univariate repeatability model
  - Fixed effects included in the model:
    - Genotype-Feed Group
    - Animal within Genotype – Feed Group
    - Age as a covariate (linear, quadratic)

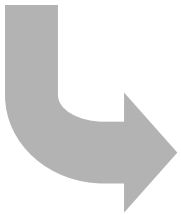
Differences (BS x HOL) – (HOL x HOL) for claw measurements

	Front, right		Rear, left	
Trait	Difference	P-Value	Difference	P-Value
LDW, lateral	0,057	0,1133	0,003	0,9421
LDW, medial	-0,002	0,9563	0,001	0,9875
Heel length, lateral	0,212	<,0001	0,189	0,0002
Heel length, medial	0,196	<,0001	0,140	0,0032
Heel depth, lateral	0,221	<,0001	0,171	0,0001
Heel depth, medial	0,297	<,0001	0,210	<,0001
Heel width, lateral	0,099	<,0001	-	-
Heel width, medial	0,112	<,0001	-	-
Diagonal, lateral	0,062	0,1318	0,025	0,6616
Diagonal, medial	0,051	0,2351	0,104	0,0432

Claw measurements, summary

- BS x HOL had increased lenghts, depths, and width of the claws

- No significant differences in dorsal lengths and diagonals



'compact claw'

Analysis of udder development

- Measurements taken three months before calving till one month after calving (monthly intervals)

- Statistical model:
  - Univariate repeatability model
  - Fixed effects included in the model:
    - Genotype, Feed Group, backfat thickness
    - Sire within Genotype
    - Age and days pregnant
      as covariates (linear, quadratic, cubic)

An example of udder development

BS x HOL

DOB: 12.08.03
Sire: Vivo
Ins. date: 18.10.04
DOC: 30.07.05







Measuring date	23.05.2005	04.07.2005	19.07.2005	30.09.2005
Age (days)	650	692	707	780
Days pregnant (days)	217	259	274	-
Days in milk (days)	-		-	62

LSMEANS of udder measurements

(Measurements before parturition)

Trait	BS x HOL	s.e.	HOL x HOL	s.e.	P-Value of difference
Suspensory ligament (cm)	50,40	0,88	47,78	0,98	**0,0517**
Udder height (rear)	73,73	0,59	75,62	0,64	**0,0318**
Udder height (front)	74,50	0,48	75,04	0,51	0,4496
Teat interval rear	4,23	0,16	4,59	0,17	0,1353
Teat interval front	9,71	0,15	9,87	0,16	0,4909
Teat interval left	5,97	0,20	6,13	0,22	0,6021
Teat interval right	6,12	0,19	5,92	0,22	0,5090
Teat width f/r	1,49	0,04	1,33	0,04	**0,0028**
Teat width r/r	1,40	0,03	1,40	0,03	0,6060
Teat width f/l	1,53	0,04	1,40	0,04	**0,0126**
Teat width r/l	1,48	0,04	1,33	0,04	**0,0044**
Teat length f/r	4,47	0,07	4,19	0,08	**0,0079**
Teat length r/r	3,61	0,07	3,48	0,08	0,2134
Teat length f/l	4,40	0,07	3,97	0,08	**<,0001**
Teat length r/l	3,64	0,07	3,42	0,07	**0,0302**

Udder measurements: summary

- Teats of BS x HOL tend to be wider and longer
- Udder height almost unaffected
- In tendency: Longer suspensory ligament for BS x HOL

Functional traits and cow production

- Losses of animals
- Fertility
- Calving performance
- Production performance

General overview of the crossbreeding experiment

	BS x HOL	HOL x HOL	Total
Pregnancies	124	131	255
Calves born total	134	134	268
Living calves at day 7	119	115	234
Neonatal losses till day 7	15	19	34
Neonatal losses (%)	11.2	14.2	12.7
Living females at day 7	66	56	122
Losses day 7 till day 180	8	2	10
Females in rearing	58	54	112
Losses day 180 till 1st insemination	1	0	1
Females inseminated	57	54	111
Losses till calving / not pregnant	2	3	5
Heifers calved	55	51	106
Culled after calving	5	6	11
Milking at present (09/06)	50	45	95

Number of perinatal and neonatal losses by sire

(thereof twins in parenthesis)

BS Sires	Male Calves	Female Calves	HOL Sires	Male Calves	Female Calves
Goldfinger	3(2)	2	Riverland	1	0
Gordon	0	1	Blauer	1	0
Vivo	1(1)	0	Gibor	0	0
Pronto II	0	0	Eminenz	3	0
Collection	1	0	Zunder	0	1
Amaranto	0	0	Zador	2(2)	0
Vinbrei	1	2	Zecher	2	1
Jublend	1	0	Ticket	1	1
Hucos	1	0	Pedant	1	1
Simvitel	1	1	Predello	3	1
Total	9	6		14	5

Losses of animals before and after calving

	BS x HOL	HOL x HOL	Total
Losses before calving (from insemination till calving)			
- Fertility	2	3	5
Total	*2*	*3*	*5*
Losses after calving			
- Insufficient production	3	2	5
- Sudden death	1	1	2
- Udder injury	1	1	2
- Milking speed		1	1
- Other injury		1	1
Total	*5*	*6*	*11*

Number of inseminations till pregnancy in the crossbreeding experiment for n = 106 heifers that actually calved

	1	2	3	4	5	6
BS x HOL	34	13	6	2	-	-
HOL x HOL	30	8	8	3	1	1

	Pregnant at 1st insemination	Pregnant at later insemination
BS x HOL	34	21
HOL x HOL	30	21

n.s.

	Number of inseminations per pregnancy
BS x HOL	1.56
HOL x HOL	1.82

n.s.

Number of daughters as calves and as actually milking cows

BS Sires	Living Females at day 7	Actually milking Cows	HOL Sires	Living Females at day 7	Actually milking Cows
Goldfinger	7	5	Riverland	7	6
Gordon	4	3	Blauer	6	6
Vivo	7	6	Gibor	4	2
Pronto II	6	6	Eminenz	11	11
Collection	7	5	Zunder	9	7
Amaranto	10	5	Zador	4	4
Vinbrei	6	3	Zecher	4	4
Jublend	5	4	Ticket	4	2
Hucos	5	5	Pedant	6	3
Simvitel	9	8	Predello	1	0
Total	66	50		56	45

Vitality (stillbirth) by category and genotype for births at first calving

	A	B	C	D	E
BS x HOL	44	6	2	2	2
HOL x HOL	38	5	3	1	2

A	Living calf, vital
B	Weak calf, surviving
C	Weak calf, death after birth
D	Death during delivery
E	Calf dead before birth

Calving ease by category and genotype for births at first calving

	I	II	III	IV
BS x HOL	20	9	23	4
HOL x HOL	14	13	19	2

I	No assistance, spontaneous delivery
II	Little assistance (one person)
III	Heavy assistance (> 1 person and/or puller used)
IV	Difficult birth, veterinary assistance

Comparison of milk production traits in the crossbreeding experiment on a per day basis (test day model analysis*)

(n = 105 heifers that calved and survived the first test day; weekly recordings (except SCS), n = 3293 test day records)

	Milk yield (kg)	Fat (%)	Protein (%)	Fat (kg)	Protein (kg)	SCS (pts)
BS x HOL	28,95	4,02	3,62	1,15	1,04	1,98
HOL x HOL	30,17	3,88	3,49	1,16	1,05	2,42
Significance (P-value)	<.0001	<.0001	<.0001	.23	.24	<.0001

*) Note: This form of analysis uses all records, i.e. complete and incomplete lactations. The model includes cow, genotype-age of calving, season of production-feed group and a mathematical function (Guo and Swalve, 1995) to account for the lactation curve. The majority of the heifers had around 200 days in milk, some already had a completed lactation, but some just started the lactation. The absolute values therefore are subject to change with each new analysis as time goes on.

Comparison of milk production traits in the crossbreeding experiment on a per day basis (test day model analysis*)

(n = 95 heifers that calved and are still in milk;
weekly recordings (except SCS), n = 3192 test day records)

	Milk yield (kg)	Fat (%)	Protein (%)	Fat (kg)	Protein (kg)	SCS (pts)
BS x HOL	30,43	4,02	3,60	1,23	1,09	1,93
HOL x HOL	31,12	3,88	3,49	1,20	1,07	2,38
Significance (P-value)	<.0001	<.0001	<.0001	.0003	<.0001	<.0001

*) Note: This form of analysis uses all records, i.e. complete and incomplete lactations. The model includes cow, genotype-age of calving, season of production-feed group and a mathematical function (Guo and Swalve, 1995) to account for the lactation curve. The majority of the heifers had around 200 days in milk, some already had a completed lactation, but some just started the lactation. The absolute values therefore are subject to change with each new analysis as time goes on.

Conclusions

- Brown Swiss crosses do well under the conditions of a high production level farm
- The experiment is still somewhat small to obtain significant differences with respect to functional traits like fertility and calving ease
- The experiment is also too small to make inferences about individual sires (but this was not the aim)
- With respect to losses, both groups are equal
- More data will be analyzed (blood parameters, conformation traits, etc.)

Many thanks go to:

Jessica Gühne,
Halle University
(07/03 till 06/06)

Stefan Blöttner,
Halle University
(from 05/06)

plus further team members in Halle: Dr. F. Rosner, R. Rex

and to the team of LLG-ZTT Iden:

H. Blum (Former director of LLG-ZTT)
Dr. G. Heckenberger (Acting director of LLG-ZTT)
Dr. B. Fischer
and the whole team of the research station

Thank you!