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Crossbreeding in Germany

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Material & Methods

- National data from Holstein herds
- Crosses between Holstein Black & White and Fleckvieh, Jersey, Brown Swiss or Red Breed
- F_1-crossbreds (40 - 60% of Holstein genes)
  + purebred Holstein Black & White contemporaries
- Only herdbook herds
- From birthyear 2001 till official evaluation in April 2009 (vit)

Main editing
- Only crossbreds with a purebred Holstein dam
- At least 2 crossbreds and 2 purebred herdmates within one herd-year

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Editing

Total lactation milk production traits
- 1st lact.: year of calving ≥ 2002
- 2nd lact.: year of calving ≥ 2003

- days in milk: 250 to 360 days
- milk yield: 1st lact. 3,000 to 15,000 kg
  2nd lact. 3,000 to 16,000 kg
- protein yield: 60 to 675 kg
- fat yield: 60 to 825 kg

- 1st lact.: calving interval 0 or between 280 and 660 days
- 2nd lact.: calving interval 0 or between 280 and 700 days

- age at first calving 500 to 1,400 days
- age at second calving 780 to 2,060 days

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Material

Fleckvieh x Holstein

lact	before editing		after editing		herds, no.
	Hol	Fl x Hol	Hol	Fl x Hol	
1	634,309	10,243	22,239	3,316	416
2	373,497	3,901	8,097	1,481	213

Jersey x Holstein

lact	before editing		after editing		herds, no.
	Hol	J x Hol	Hol	J x Hol	
1	634,309	3,650	32,988	2,172	177
2	373,497	2,253	12,141	1,035	107

Material

Brown Swiss x Holstein

lact	before editing		after editing		herds, no.
	Hol	BS x Hol	Hol	BS x Hol	
1	634,309	2,074	8,673	958	129
2	373,497	1,196	4,014	456	71

Red Breed x Holstein

lact	before editing		after editing		herds, no.
	Hol	R x Hol	Hol	R x Hol	
1	634,309	1,297	4,699	492	51
2	373,497	617	182	110	10

Models for production traits

$$y_{ijklm} = herd_i + cys_j + dim + age_k(breed_m) + ci_l(breed_m) + breed_m + e_{ijklm}$$

y_{ijklm}	- dependent variable
$herd_i$	- fixed effect herd
cys_j	- fixed effect year-season of calving
dim	- covariate days in milk
$age_k(breed_m)$	- fixed effect age at first calving
$ci_l(breed_m)$	- fixed effect calving interval
$breed_m$	- fixed effect breed
e_{ijklm}	- residual effect

$$y_{ijklm} = hl_n + cys_j + dim + age_k(breed_m) + ci_l(breed_m) + breed_m + breed_m \times hl_n + e_{ijklm}$$

hl_n	- herd level of production

Model for fertility traits - 1st lactation

$$y_{ikm} = herd_i + cys_k + breed_m + e_{ikm}$$

y_{ikm}	- dependent variable
$herd_i$	- fixed effect herd
cys_k	- fixed effect year-season of first calving
$breed_m$	- fixed effect breed
e_{ikm}	- residual effect

Threshold model for stillbirth

$$y_{iopqr} = \Phi\ (herd_i + cy_o + cs_p + breed_m + sex_q + sire_r)$$

y_{iopqr}	- dependent variable
$herd_i$	- fixed effect herd
cy_o	- fixed effect year of calving
cs_p	- fixed effect season of calving
$breed_m$	- fixed effect breed
sex_q	- fixed effect gender of calf
$sire_r$	- fixed effect breed of sire

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Fleckvieh x Holstein

Fleckvieh x Holstein 1st lactation

	mkg	ecm, kg	fkg	pkg	fper	pper
Hol	7,380**	7,398**	298**	247**	4.07	3.35
Fl x Hol	6,963	7,110	290	238	4.17**	3.42**

by herd production level:

	hl[1]	Hol	Fl x Hol
mkg**	1	7,204**	6,650
	2	8,320**	7,570
ecm**	1	7,272**	6,787
	2	8,320**	7,707
pkg	1	246**	227
	2	280**	262

	hl[1]	Hol	Fl x Hol
fkg**	1	293**	277
	2	333**	311
pper**	1	3.42	3.42
	2	3.38	3.47**
fper	1	4.10	4.17**
	2	4.04	4.13**

[1] hl 1 ≤ 7,700 kg milk yield, hl 2 > 7,700 kg milk yield

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Fleckvieh x Holstein

Fleckvieh x Holstein Fertility traits 1st lactation

	dfs	do	ifl	ci	insem	nr56
Hol	79	122	28.1	403	1.65	0.70
Fl x Hol	72**	99**	19.0**	381**	1.50**	0.73**

dfs	- days first service	insem	- number of inseminations
do	- days open	nr56	- non return rate (56 days)
ifl	- intervall first to last insemination		
ci	- calving intervall		

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Fleckvieh x Holstein

Fleckvieh x Holstein Stillbirths

	1st Calving	2nd Calving	3rd Calving
Hol	10.4 %**	6.4 %*	4.2 %
Fl x Hol	6.5 %	4.9 %	4.0 %

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Jersey x Holstein

Jersey x Holstein 1st lactation

	mkg	ecm, kg	fkg	pkg	fper	pper
Hol	7.847**	7.813**	311	264**	4,02	3,38
J x Hol	6.936	7.455	313	250	4,56**	3,62**

by herd production level:

	hl[1]	Hol	J x Hol
mkg**	1	7.638**	6.770
	2	8.721**	7.372
ecm**	1	7.699**	7.309
	2	8.603**	7.933
pkg**	1	260**	245
	2	294**	267

	hl[1]	Hol	J x Hol
fkg*	1	310	308
	2	339*	333
pper	1	3,42	3,64**
	2	3,40	3,63**
fper**	1	4,09	4,60**
	2	3,93	4,56**

[1] hl 1 ≤ 7,900 kg milk yield, hl 2 > 7,900 kg milk yield

Jersey x Holstein

Jersey x Holstein Fertility traits 1st Lactation

	dfs	do	ifl	ci	insem	nr56
Hol	82	120	36.1	400	1.92	0.61
J x Hol	74**	102**	26.3**	382**	1.73**	0.62

dfs	- days first service	insem	- number of inseminations
do	- days open	nr56	- non return rate (56 days)
ifl	- intervall first to last insemination		
ci	- calving intervall		

Jersey x Holstein

Jersey x Holstein Stillbirths

	1st Calving	2nd Calving	3rd Calving
Hol	12.7 %**	5.3 %**	5.4 %**
Jersey x Hol	9.0 %	3.7 %	2.8 %

Brown Swiss x Holstein

Brown Swiss x Holstein 1st lactation

	mkg	ecm, kg	fkg	pkg	fper	pper
Hol	7,652**	7,614	303	257	4.00	3.37
BS x Hol	7,438	7,571	305	258	4.14**	3.48**

by herd production level:

	hl[1]	Hol	BS x Hol
mkg**	1	7,267	7,276
	2	8,812**	8,372
ecm*	1	7,210	7,279
	2	8,564	8,444
pkg*	1	241	247(*)
	2	292	291

	hl[1]	Hol	BS x Hol
fkg	1	288	291
	2	335	337
pper**	1	3.33	3.41**
	2	3.32	3.49**
fper**	1	3.99	4.05
	2	3.83	4.07**

[1] hl 1 ≤ 7,900 kg milk yield, hl 2 > 7,900 kg milk yield

Brown Swiss x Holstein

Brown Swiss x Holstein Fertility 1st Lactation

	dfs	do	ifl	ci	insem	nr56
Hol	80	119	31.2	399	1.78	0.64
BS x Hol	75**	103**	22.0**	385**	1.58**	0.64

dfs	- days first service	insem	- number of inseminations
do	- days open	nr56	- non return rate (56 days)
ifl	- intervall first to last insemination		
ci	- calving intervall		

Brown Swiss x Holstein

Brown Swiss x Holstein Stillbirths

	1st Calving	2nd Calving	3rd Calving
Hol	10.0 %**	4.8 %	-
BS x Hol	5.6 %	3.7 %	-

Red Breed x Holstein

Red Breed x Holstein 1st lactation

	mkg	ecm, kg	fkg	pkg	fper	pper
Hol	7,685	7,753	315	257	4.13	3.34
R x Hol	7,635	7,892	325(*)	262	4.29**	3.43**

by herd production level:

	hl[1]	Hol	R x Hol
mkg*	1	7,096	7,006
	2	8,607*	8,225
ecm	1	6,948	6,976
	2	8,301	8,170
pkg	1	231	231
	2	279	277

	hl[1]	Hol	R x Hol
fkg	1	276	281
	2	324	325
pper**	1	3.26	3.31*
	2	3.23	3.36**
fper	1	3.91	4.04*
	2	3.77	3.95**

[1] hl 1 ≤ 8,050 kg milk yield, hl 2 > 8,050 kg milk yield

Red breed x Holstein

Red Breed x Holstein Fertility traits 1st Lactation

	dfs	do	ifl	ci	insem	nr56
Hol	81	118	32.6	398	1.89	0.56
R x Hol	74**	100**	22.4**	379**	1.68*	0.61(*)

dfs	- days first service	insem	- number of inseminations
do	- days open	nr56	- non return rate (56 days)
ifl	- intervall first to last insemination		
ci	- calving intervall		

Red breed x Holstein

Red Breed x Holstein Stillbirths

	1st Calving	2nd Calving	3rd Calving
Hol	11.8 %**	4.9 %	-
R x Hol	5.1 %	3.3 %	-

Conclusions (1)

- partially crossbreds reached the production level of pure Holsteins
  - ➔Fleckvieh and Jersey did not,
  - ➔Brown Swiss ✓,
  - ➔Red Breed only 1st lactation
- purebred Holstein cows were more superior in herds with high production level (milk yield)

Conclusions (2)

Fertility
- heifers: only small differences
- 1st lactation: notable advantages for crossbreds

Stillbirths
- advantages for crossbreds (especially 1st calving)

Further comments

- results valid for F_1 – generation only
- implementation of crossbreeding system would be necessary (e.g. rotational cross)
  - ➔ heterosis is not completly usable
  - ➔ management efforts increase
  - ➔ animals show more variability
- other traits were not considered (e.g. handling, udder quality)
- suitability of breeds and sires for crossbreeding differs (breeding values are population specific, some sires do well, others do not)

Thank you for your Attention