Influence of Genomics on Breeding Organisation and Dairy Farms

135th Anniversary of Estonian Herdbook
22 October 2020

Egbert Feddersen, German Livestock Association

Euroopa Maaelu Arengu Põllumajandusfond: Euroopa investeeringud maapiirkondadesse

A. Influence of Genomics on Breeding Organisation

10 years ago.....

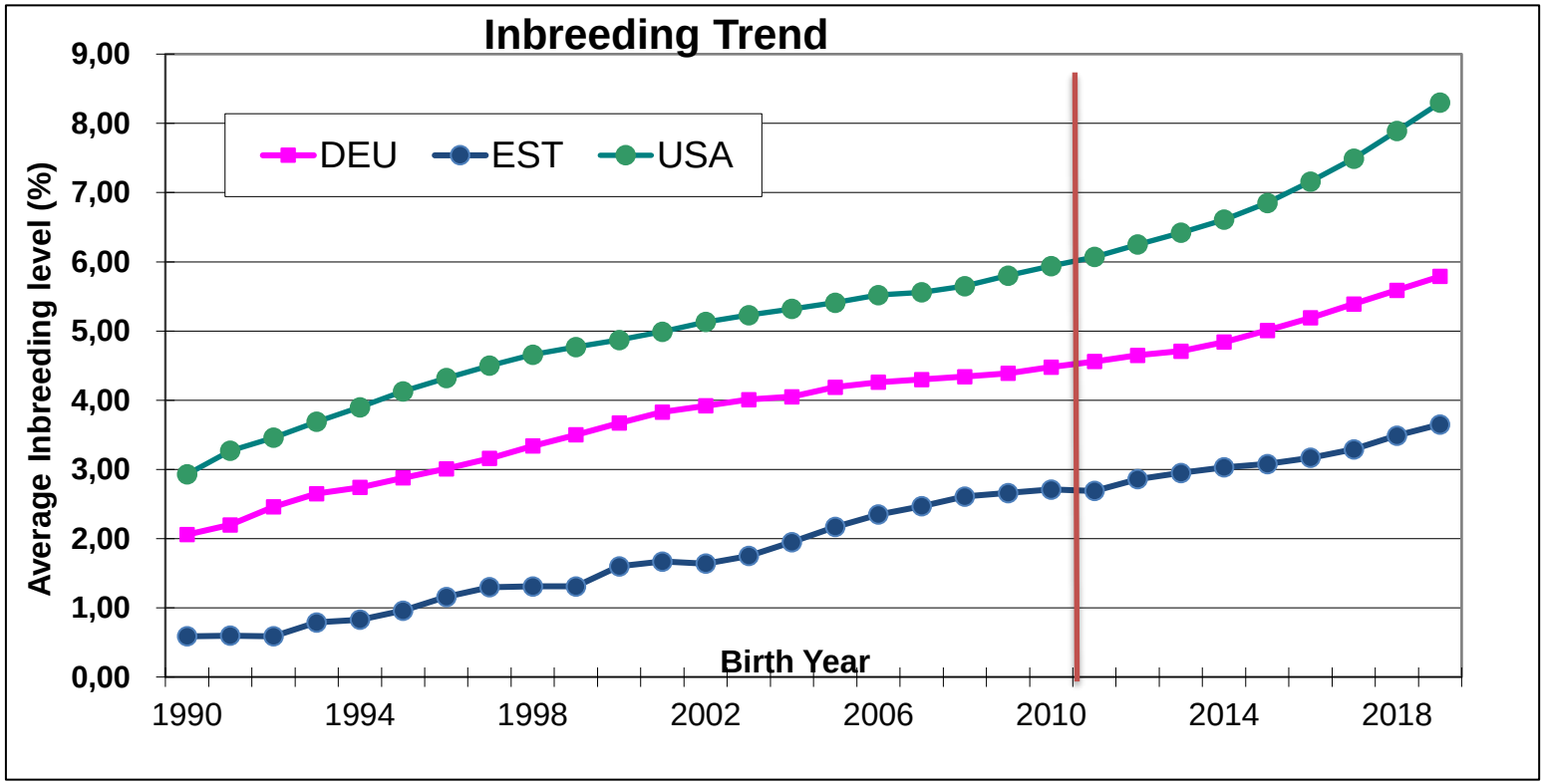
Q: Will the service of herdbook organisations change?

2020: The influence of genomics has changed the service of the breeding organisation

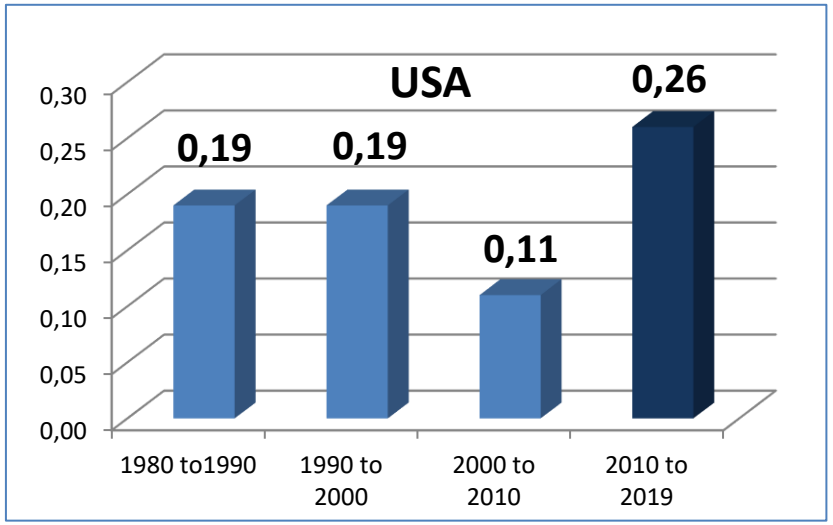
- Type classification 2020: →*decreased numbers of bulls tested; >50%*
- Milk recording 2020: → more and *different frequency of service*
- Genotyping service, parentage verification 2020: →*is partly offered*
- Can we keep the farmers influence due to Competition of private companies? 2020: →*it is possible so far*

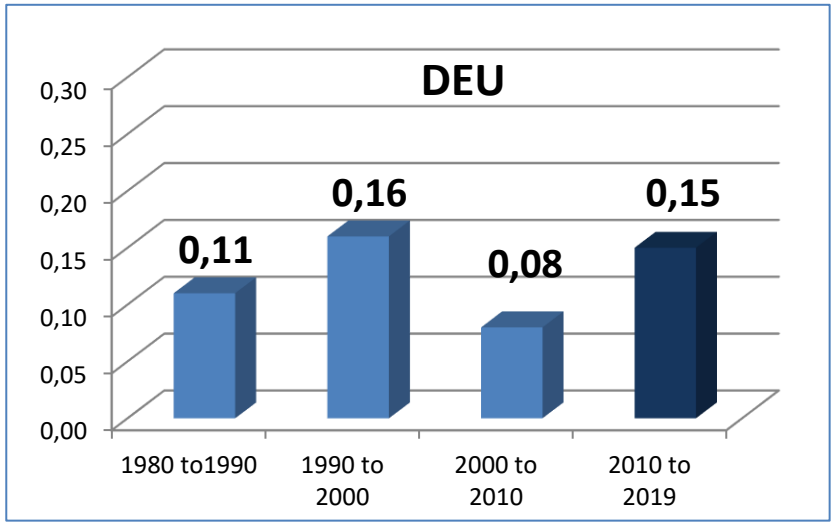
Q: What will be the change of breed development goals

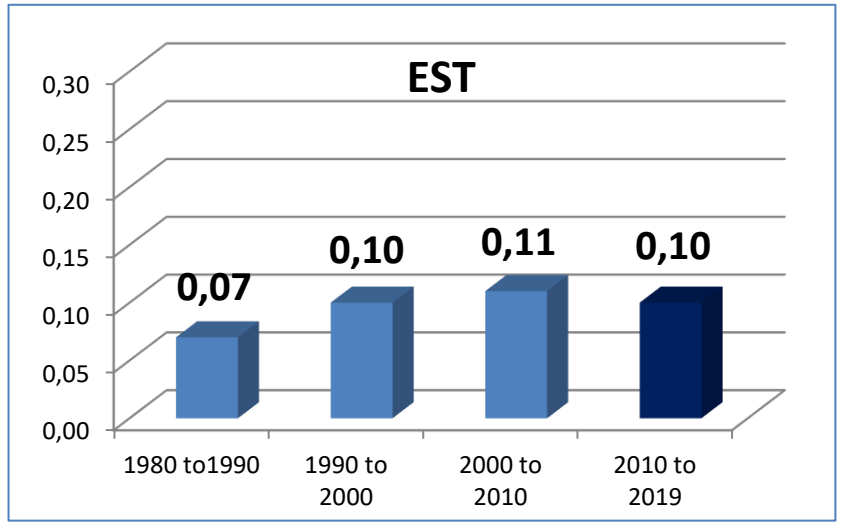
- Reduced generation interval
- Faster progress in fertility and health trai 'es
- Increase of inbreeding is possible



- In times of Genomics inbreeding has increase in the female populations
- The inbreeding in the AI-bulls is higher (USA: 14,3%)







10 years ago.....
Influence of Genomics on breeding organisation?

Q: Where will breeder's send their samples?
2020: *Yes, Breeder's send their samples to national or international partners*

Q: Do countries exchange genomic information on cows?
2020 : *Countries exchange genomic information on cows and bulls (international cooperations)*

Q: Herd-books need access to all genomic information
2020 : Most of them have or use the service of international partners

Q: Can HB-associations protect the interests of members?
2020 : Yes, if they offer competitive and reliable service

Q: Will all genomic information be published?
2020 : Yes, gEBVs; but not any genomics formulars

Consequences for the herdbooks

- Individual herd-books have different structures.
  - Traditional Herdbook Associations.
  - Herdbook Associations with Milk Recording *(DHI)*.
  - Breeding Associations with Evaluation Centre.
  - Breeding Organisation *(including Herdbook and AI)*.
  - Fully Integrated Breeding Company.

Traditional Herdbook Associations
(AUT, DNK, SWE, FRA, TUR)

- **Characteristics**
  - Focus primarily on registration, classification and showing
  - Source for pedigrees
  - Not involved in any milk recording or AI business

- **Expected development**
  - Reduced demand *(type classification, registration)*
  - Parentage verification with more accuracy through genomics
  - Will future generations be convinced of the relevance of the traditional service?

➡ Loss of income
They will disappear in medium term

Herdbook Associations with Milk Recording (DHI)
(ESP, UKE)

- **Characteristics**
  - Traditional herdbook tasks *(classification, registration, pedigree)*
  - Collection of performance data
  - Government mandated ear tag registration
  - Association staff with multi tasks in farm data collection *(great advancement!)*

- **Expected development**
  - Associations to enlarge their service to genomics
  - Closer co-operation with AI industry

Breeding Associations with Genomics Service and Evaluation Centre

(ITA, POL)

- **Characteristics**
  - Traditional herdbook activities
  - parentage information may be obtained by genomics
  - High advantage due to the data access, but
  - Limitation on personal contacts to members

- **Expected development**
  - To enlarge the service for farms
  - Need to integrate with on-farm services
  - Will further increase cooperation with other service partners

Breeding Organisation (including Herdbook, AI, Genomic Service and Sales)
(DEU, (EST))

- **Characteristics**
  - To offer full service to farmers
  - Controlling the data flow
  - Genotyping service is established

- **Expected development**
  - Further enlarge the costumer service *(new traits)*
  - Built up the partnership with the costumers (farm contracts)

Fully integrated Breeding Company
(DEU, NLD)

- **Characteristics**
  - optimum solution to deliver a comprehensive range of services
  - Has integrated Milk and Performance Recording
  - integration of further services are easily possible
  - Genomics is of great benefit to this structure, it maximise the use of information in all parts of the business
    - identification of the best bloodlines, sire selection, progeny testing through to semen sales, herdbook tasks and data collection
    - using information collected in other sectors of the business.

- → **These integrated structures are in a strong position to develop and expand *(all services under one roof)*.**

B. Herd Genotyping

A platform for the implementation of direct breeding values for animal health and a tool for genomic herd management

KuhVision + Herd genotyping

Aims of the projects

- creating a female reference population
- implementing new breeding values (e.g. health traits)
- genomic herd management system for farmers

Current status

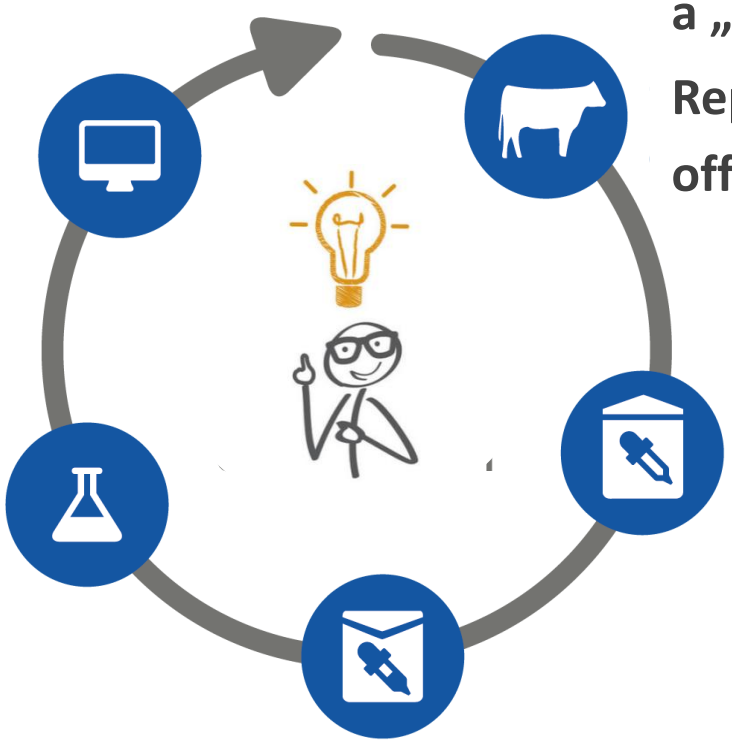
- 1.810 farms take part → increase of 20 farms per month
- 552,000 genotyped female animals
- > 17 % of registered Holstein cows are genotyped
- >185,000 cows calved already and have phenotypes

How does it work?

Female calf is born on a „Kuh*Vision*-farm“.

Report of birth to the official German database

Farmer receives GEBV via Internet portal „NETRIND*genom*“
(web based)



Automatic mailing of the Tissue-Sampling-Tag to the farmer

Automatic analysis in the lab and breeding value estimation by data center vit

Easy sampling and shipping the sample to the lab

Advantage for the farmer

- Full information about the genetic level of the herd
- Possiblity to select animals in an early stag
  - Which calf to raise?
  - Which cattle to sell?
  - Which cattle to inseminate with sexed semen?
  - Which cows to breed with a beef breed?
- Higher breeding progress
- Increasing the herd health

The herd at a glance for the genomic management!

Benefits for farmers

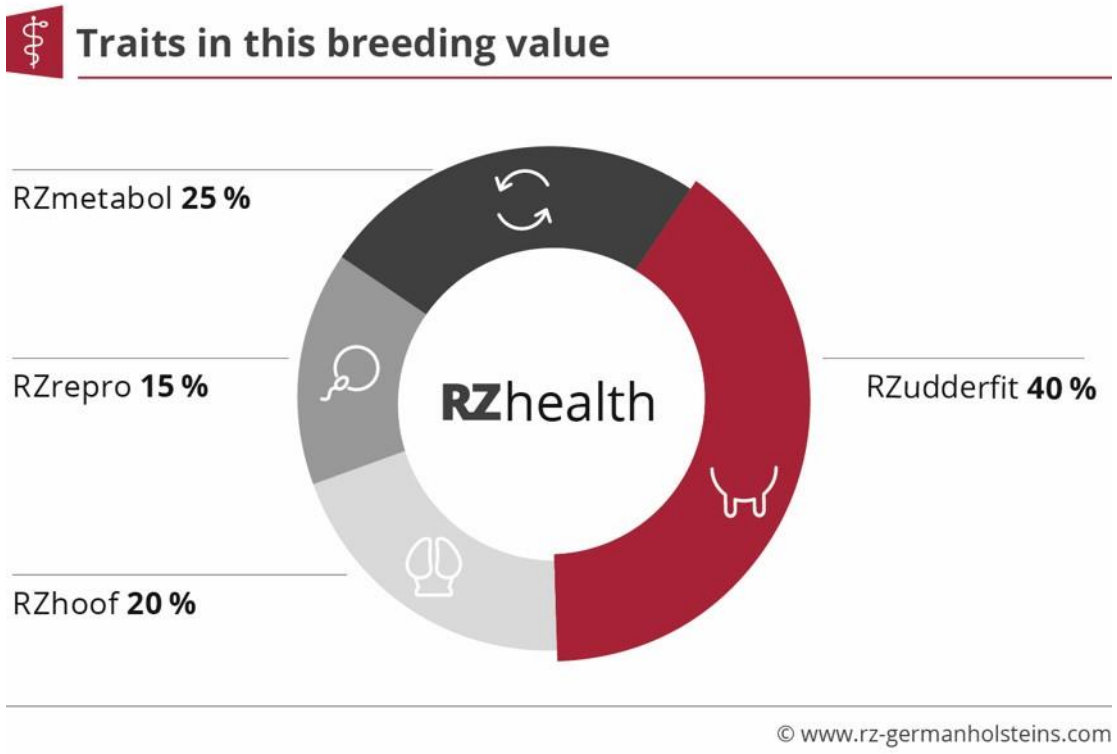
- 6 different health breeding values for genotyped animals
- Economic breeding value
- Another 42 breeding values within performance, functionality and conformation
- Information about genetic peculiarities (horn status, red factor …) and genetic defects (Brachyspina, BLAD, CDH, Haplotypes HH1-HH6)
- β- und κ- casein type
- regular health reports about the own herd

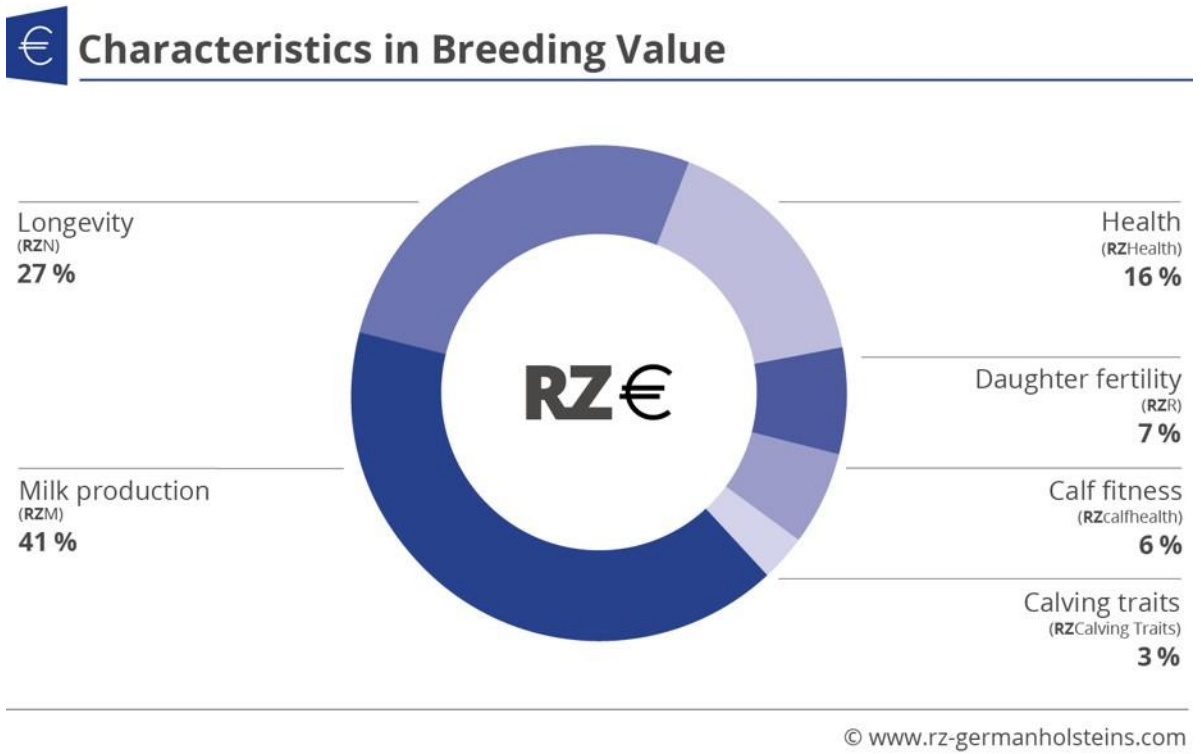
RZhealth RZudderfit RZhoof

RZrepro RZmetabol RZcalfhealth

RZ€

New breeding values resulting from KuhVision and other projects





Genomic Herd Management

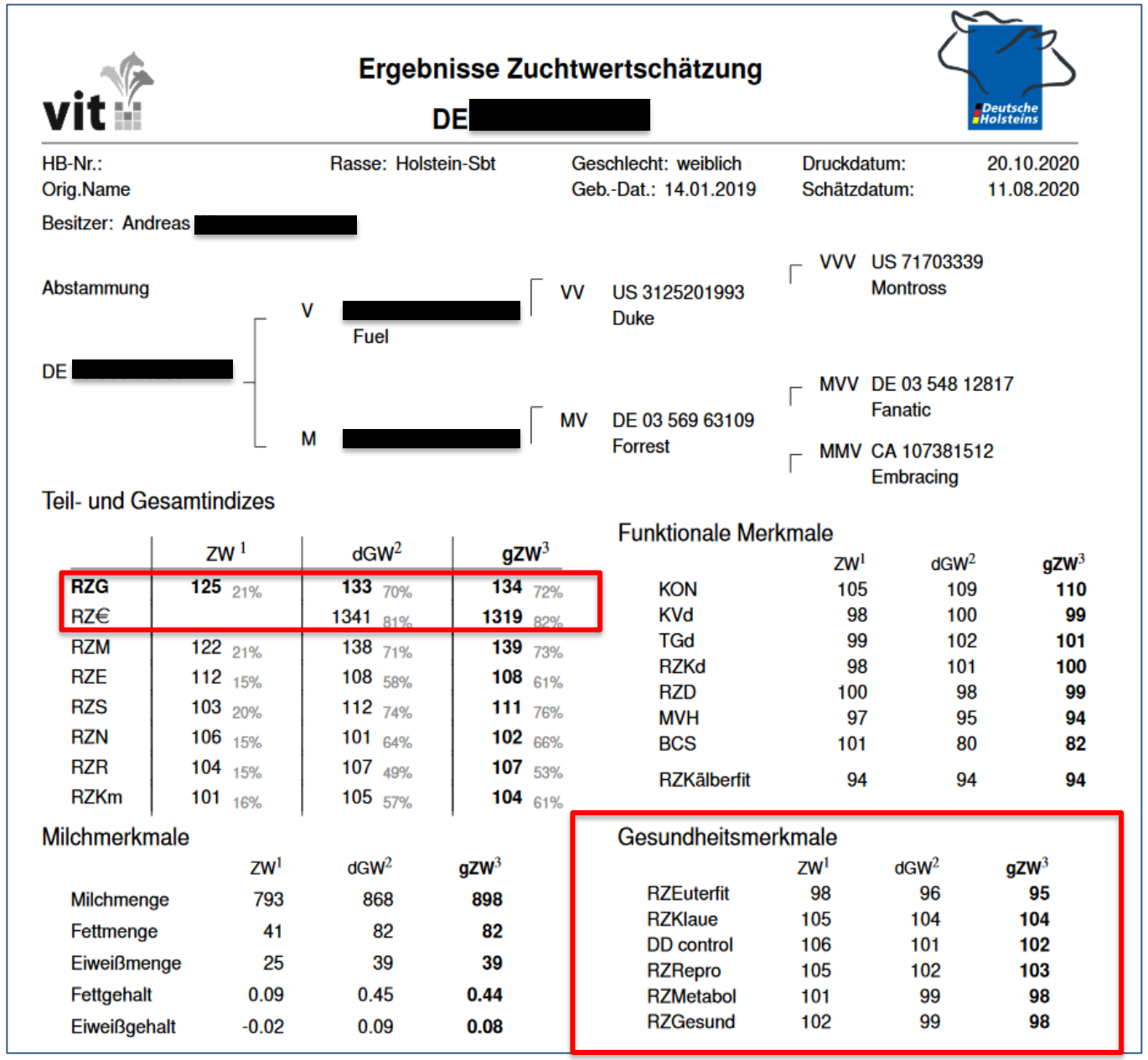
- breeding values for direct health traits
  → evidence of genetic susceptibility to economically significant disease complexes
- compensation of genetic weaknesses in animal heal
  e.g. support for the Mortellaro recovery

DD premium DD control

- precise replacement with the best animals in the herd
  → using sexed semen, rearing fewer calves
- reducing genetic defects
- Inter- farm comparison possible
- control of inbreeding
- computer-based programmes can help to keep an overview of the animals

Example

- data sheet for breeding values
  → information for farmers
- breeding values are displayed in the relative breeding value system
  - 100 represents the population mean
  - values above 100 are usually desired (apart from conformation)
  - standard deviation = 12



vit

Ergebnisse Zuchtwertschätzung

DE [redacted]

Deutsche Holsteins

HB-Nr.: Orig.Name
Rasse: Holstein-Sbt
Geschlecht: weiblich
Geb.-Dat.: 14.01.2019
Druckdatum: 20.10.2020
Schätzdatum: 11.08.2020

Besitzer: Andreas [redacted]

Abstammung

DE [redacted]
- V [redacted] Fuel
  - VV US 3125201993 Duke
    - VVV US 71703339 Montross
    - MVV DE 03 548 12817 Fanatic
  - M [redacted]
    - MV DE 03 569 63109 Forrest
    - MMV CA 107381512 Embracing

Teil- und Gesamtindizes

	ZW [1]	dGW[2]	gZW[3]
RZG	**125** 21%	**133** 70%	**134** 72%
RZ€		1341 81%	**1319** 82%
RZM	122 21%	138 71%	**139** 73%
RZE	112 15%	108 58%	**108** 61%
RZS	103 20%	112 74%	**111** 76%
RZN	106 15%	101 64%	**102** 66%
RZR	104 15%	107 49%	**107** 53%
RZKm	101 16%	105 57%	**104** 61%

Funktionale Merkmale

	ZW[1]	dGW[2]	gZW[3]
KON	105	109	**110**
KVd	98	100	**99**
TGd	99	102	**101**
RZKd	98	101	**100**
RZD	100	98	**99**
MVH	97	95	**94**
BCS	101	80	**82**
RZKälberfit	94	94	**94**

Milchmerkmale

	ZW[1]	dGW[2]	gZW[3]
Milchmenge	793	868	**898**
Fettmenge	41	82	**82**
Eiweißmenge	25	39	**39**
Fettgehalt	0.09	0.45	**0.44**
Eiweißgehalt	-0.02	0.09	**0.08**

Gesundheitsmerkmale

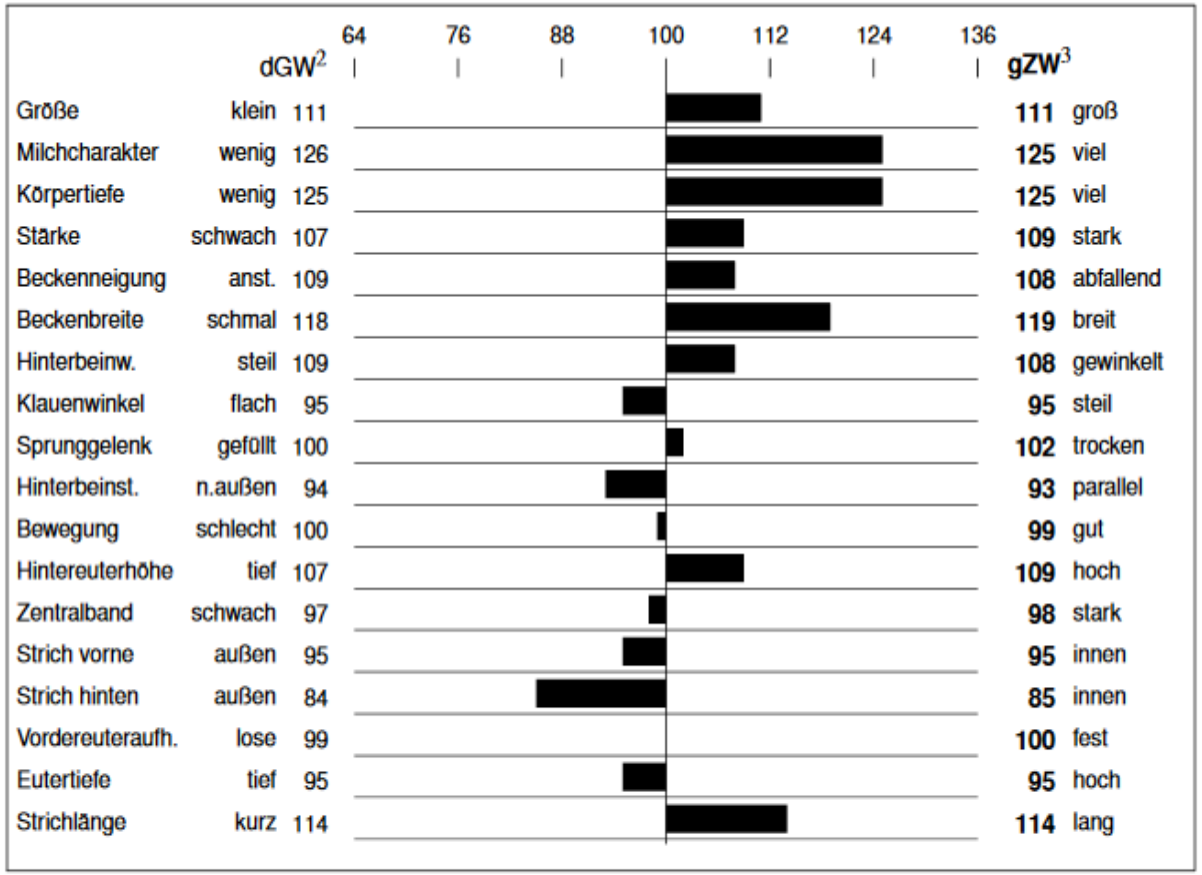
	ZW[1]	dGW[2]	gZW[3]
RZEuterfit	98	96	**95**
RZKlaue	105	104	**104**
DD control	106	101	**102**
RZRepro	105	102	**103**
RZMetabol	101	99	**98**
RZGesund	102	99	**98**

Example

conformation traits are displayed

as well as genetic peculiarities and defects

Exterieur



	dGW[2]	gZW[3]
RZE	108	**108**
Milchtyp	123	**121**
Körper	118	**117**
Fundament	98	**97**
Euter	100	**101**

[1] konventioneller ZW
[2] direkt genomischer Wert
[3] **genomisch kombinierter ZW = offizieller Zuchtwert**

20. Oktober 2020, genomische Zuchtwerte

Genetische Merkmale

BraSp	BLAD	RotF	VRC	HornSt	KK	HH1	HH2	HH3	HH4	HH5	HH6	CDH	BK
BYN	BLF	RDF	VRF	pp	AA	H1F	H2N	H3F	H4F	H5N	H6F	CDF	A22

Bull mating programme (BAP)

- Designed by vit *(in co-operation with German breeding organisations)*
- Consideration of: inbreeding, performance data, health traits, linear type traits and genetic characteristics (genetic defects, horn status)
- Genomic breeding values of female animals are included in the programme
- BAP enables the development of a farm strategy for farms taking part in KuhVision and herd genotyping
  - e.g. defining "knock-out criteria", which are taken into account for mating decisions
  - defining own breeding goal
  - marking animals for beef cattle semen or selling if an animal is below a threshold in a "knock-out criteria„ (regardless of it‘s RZG)

Conclusion

- Genotyping programmes have gained enormous popularity in a short time
- Increasing importance of genomic breeding values in herd management
- Improved opportunities in herd management

- Valuable tool for herd management
- A long-term approach for the improvement of animal health
- A high demand for advice from livestock farmers

Thank you for your attention

More information: www.rz-germanholsteins.com

Contact: Egbert Feddersen
German Livestock Association
Adenauerallee 174
53113 Bonn
holstein@rind-schwein.de