

# Pig Science - Breeding

Peter von Rohr

2023-03-15

# Program

Datum	Day	Room	Time	Dozent	Topic
22.02.23	Wednesday	LFW B2	8:15 - 10	SN	Introduction, Genetics
01.03.23	Wednesday	LFW B2	8:15 - 10	SN	Genetics
08.03.23	Wednesday	LFW B2	8:15 - 10	SN	Genetics
15.03.23	Wednesday	LFW B2	8:15 - 10	PvR	Breeding
22.03.23	Wednesday	LFW B2	8:15 - 10	SN/PvR	Student presentations 1
29.03.23	Wednesday	LFW B2	8:15 - 10	SN/GB	Student presentations 2
05.04.23	Wednesday	LFW B2	8:15 - 10	GB	Feeding & Meat Quality
12.04.23	Easter break				
19.04.23	Wednesday			PvR	Breeding
21.04.23	Friday	Excursion Agrovet Strickhof			Pig housing, constitution
26.04.23	Wednesday	LFW B2	8:15 - 10	PvR	Breeding
03.05.23	Wednesday	LFW B2	8:15 - 10	GB	Feeding & Meat Quality
10.05.23	Wednesday	LFW B2	8:15 - 10	GB	Feeding & Meat Quality
17.05.23	Wednesday	LFW B2	8:15 - 10	CK	Sustainable pigs
24.05.23	Wednesday	No lecture			
31.05.23	Wednesday	LFW B2	8:15 - 10	SN	Exam

## Program - Breeding

Week	Date	Topic
1	2023/03/15	Extension of Breeding Programs
2	2023/04/19	Genomic Selection in Pigs and other species
3	2023/04/26	Breeding Program via Aggregate Genotype

# Information

- ▶ Lecturer: S. Neuenschwander, C. Kasper, G. Bee, P. von Rohr
- ▶ Date: Wednesday 8-10
- ▶ Mode: in person
- ▶ Room: LFW B2
- ▶ Moodle:  
<https://moodle-app2.let.ethz.ch/course/view.php?id=19265>
- ▶ Website: <https://charlotte-ngs.github.io/psbss2023>
- ▶ Questions: during the lecture and during the exercise hour or via e-mail
  - ▶ Peter von Rohr ([peter.vonrohr@usys.ethz.ch](mailto:peter.vonrohr@usys.ethz.ch))

# Course Objectives

## The students

- ▶ understand the theoretical background and the practical application of the prediction of breeding values in a livestock breeding
- ▶ know how to interpret predicted breeding values.

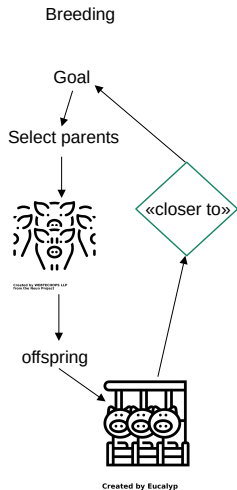
→ What is the meaning of a predicted aggregate genotype —9 index points

→ What is the difference between production and breeding

## Further Reading

- ▶ Willam und Simianer: Tierzucht - Grundwissen Bachelor (Ulmer, UTB 3526 2011). This book gives an introduction into evolution, livestock production and breeding programs.
- ▶ Falconer and Mackay: Introduction to Quantitative Genetics (Longman). The de-facto standard in the area of quantitative genetics uses many examples from experimental research to illustrate the concepts of quantitative genetics.
- ▶ Mrode: Linear Models for the Prediction of Animal Breeding Values (CABI Publishing, 2005). The main focus is on prediction of breeding values using different models.

# Terminology



## Production



## Husbandry



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... and into many other products according to  
[https://www.ted.com/talks/christien\\_meindertsma\\_how\\_pig\\_parts\\_make\\_the\\_world\\_turn](https://www.ted.com/talks/christien_meindertsma_how_pig_parts_make_the_world_turn)

# Scientific Definition

*“Selection and Mating of parents are used such that offspring generations are closer to a defined goal.”*

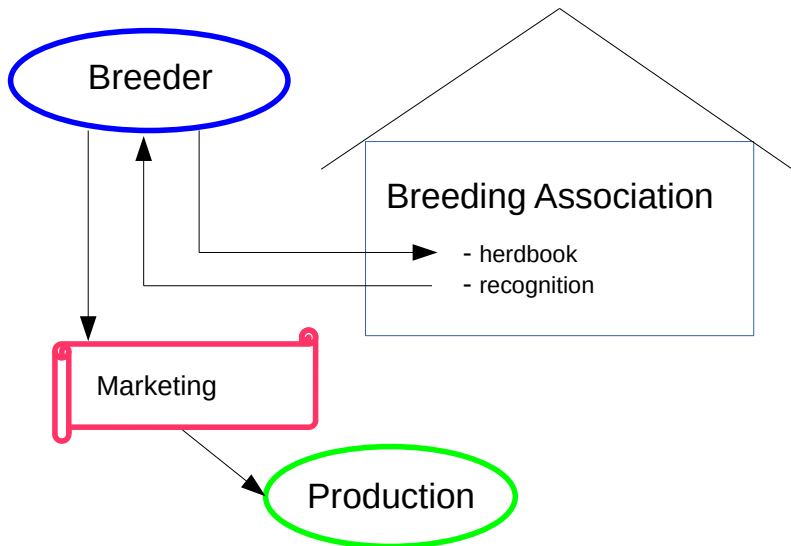
- ▶ Distinction between
  - ▶ livestock breeding and production
  - ▶ cattle breeding and milk or beef production
  - ▶ pig breeding and pork production and
  - ▶ chicken breeding and egg producers



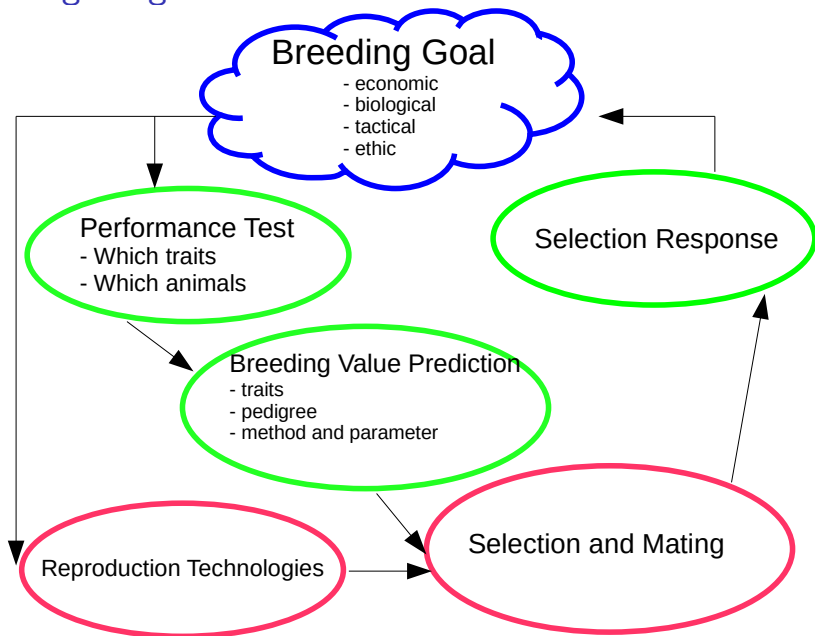
# History

- ▶ Formations of breeding organisation (BO)
- ▶ Tasks of BO: herdbooks and certification
- ▶ Crisis at beginning of 20<sup>th</sup> century lead to federal regulations
- ▶ Developments of technologies
  - ▶ Reproduction
  - ▶ Molecular biology
  - ▶ Computer science

# Breeding Organisations



# Breeding Programs



# Parts of Breeding Program

- ▶ Applied prediction of breeding values is a part of the breeding program
- ▶ Design and planning of a breeding program requires to answer the questions
  - ▶ What goal do we want to achieve
  - ▶ What measures do we want to use to achieve the goal

# Types of Breeding Programs

Two types of breeding programs

1. Focus on **selection response**

- ▶ countries with limited resources
- ▶ big farms or big companies

2. Focus on clients and services

- ▶ cattle and pig breeding of developed countries
- ▶ economic interest of companies and farms

# Breeding Goals

## Types of breeding goals

- ▶ economic
- ▶ biological
- ▶ tactical
- ▶ ethical

## Breeding goals might be formulated in different ways

- ▶ **political**: description of idealized image of future animal.  
Often conflicting and not verifiable
- ▶ **scientific**: mathematical description of direction of desired change. Measurable via selection response

# Performance Testing

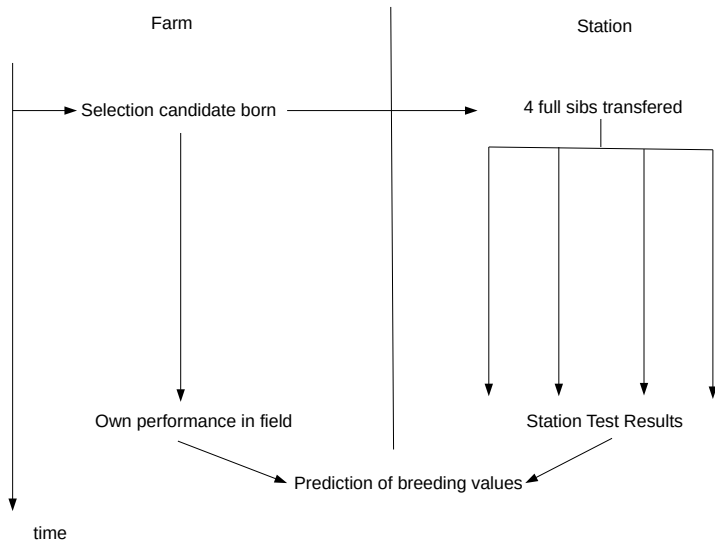
- ▶ Basic question: What trait is measured when for which animals
- ▶ Breeding should be based on data
- ▶ Quality of derived parameters (heritability, predicted breeding values) depend on accuracy of collected data
- ▶ Data collection used for performance testing often started for different reasons
  - ▶ milk sample testing: quality of product
  - ▶ station testing in pigs: correction of environment

# Classification of Performance Tests

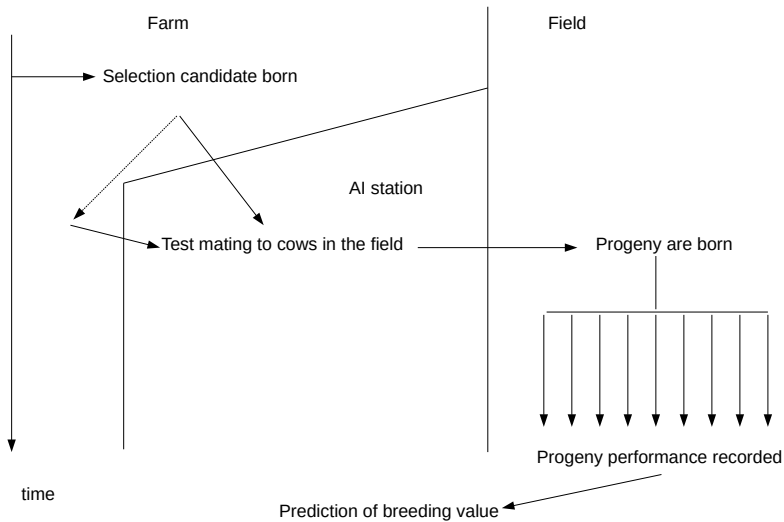
- ▶ Place
  - ▶ Station
  - ▶ Field
- ▶ Relationship between selection candidate and tested animal
  - ▶ own performance record
  - ▶ full-sib
  - ▶ progeny
- ▶ Traits
  - ▶ should have genetic variation
  - ▶ economic importance
  - ▶ measurable better than subjectively observed



# Examples: Pigs



# Examples: Cattle



# Prediction Of Breeding Values

- ▶ Done in most breeding programs
- ▶ Federal regulation
- ▶ Performance tests much more expensive
- ▶ Different intervals
  - ▶ cattle: three times per year
  - ▶ pigs: nightly or weekly

# Progress In Technologies

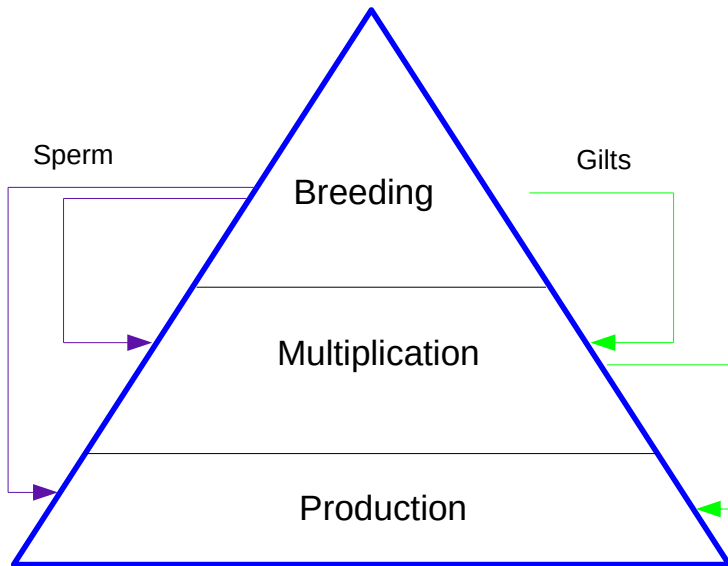
- ▶ Reproduction - AI
  - ▶ disease prevention
  - ▶ number of progeny per sire increased
  - ▶ better comparisons between herds
  - ▶ Future: more development on female side
- ▶ Molecular Biology
  - ▶ cheap and efficient large-scale genotyping
  - ▶ sequencing with more accuracy
- ▶ Computer Science
  - ▶ efficient evaluation of large amounts of data
  - ▶ big data technologies - continuous monitoring

# Differences Of BP Between Species

Breeding programs (BP) for different species have different structure

- ▶ **hierarchical**: pigs and chicken
- ▶ **flat**: cattle and horse

# Hierarchical Structure



# Monolithic Structure

