8. Application of breeding programmes

The topic of today's lecture is Application of Breeding Programs.
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In today's lecture we will give information on the components of breeding work, the formal definition of a breeding programme and its structure, later we will discuss in more detail the interspecies differences in the development of breeding programmes and the breeding of cattle.
To begin, we'll talk a little bit about the basic steps of the breeding work.
A prerequisite for making qualified decisions in breeding is the testing of traits and therefore the detection of individual performance of individuals in breeding populations in a system of performance control, which has legislative support in national legislation, including executive regulations.
Performance testing is carried out by an authorised recognised breeding organisation involved in the breeding process. It consists of the regular collection of data on the own performance of the animals on the basis of a set uniform methodology.
The results of the animal testing enable rankings of the animals according to their performance and, on the basis of the set criteria, individuals suitable for breeding are selected.
The transmission of genetic superiority of the selected individuals to the offspring generations and thus the continuous improvement of the populations is then implemented in the form of breeding programmes.

Breeding program is:
- a system of breeding practices leading to the modification of those traits and characteristics that are essential for the achievement of a breeding objective
- while maintaining good health and breeding economics

Formally, it consists of biological, technical and economic parts.

The biological part contains:
- Breeding Objective
- A set of requirements for traits and features to form in the population over the long term
- Performance recording systems
- Methods for evaluating performance data
- Statistical processing of data and estimation of breeding values
- Selection types and methods
- whether it is stabilising or directive selection and, in fact, the procedures of simultaneous selection according to selection indices are now used
- Breeding methods
- in the classical, broader sense, the use of pure-breeding or cross-breeding
- Programme evaluation

The technical part contains:
- Assessment of existing technical equipment
- Planning of new technical equipment

(equipment, laboratory instruments, etc.)

The economic part presents:
- Economic evaluation of the main alternative of the breeding programme
Now let's look at the interspecies differences that need to be taken into account in the formation of the breeding programs:
- Level of industrialization
- The proportion of human labour in livestock production needs to be taken into account. A significantly higher degree of automation is used in poultry and pig farming than in cattle, sheep or goat farming.
- Direction of performance
- In principle, focusing on a single performance direction, e.g. meat production in the case of pigs, it is possible to achieve a higher level of production intensity and a better genetic gain than in the case of cattle breeding in a multipurpose type, where there are two or more performance directions.
- Reproductive intensity
- The basic difference arises from whether the animals are uniparous or multiparous. Uniparous animals have a low reproductive intensity, typically one offspring per litter per mating season. Multiparous animals have multiple litters and thus a higher reproductive rate, which ultimately means that we can achieve higher genetic gain through higher selection intensity.
- Duration of use of animals for breeding purposes
- Large livestock such as cattle and horses have a long generation interval, persist in breeding for a relatively long period of time and influence the genetic make-up of several successive generations of animals. For animals with a short genetic interval, typically poultry and pigs, the use for breeding purposes is shorter and the animals are used to produce offspring for breeding purposes for a shorter period of time.
- Scope of breeding
- It makes a difference whether we have a small intensively bred part of the population in the form of a breeding nucleus or whether the breeding is carried out in the whole population. Breeding programmes with a breeding nucleus will be discussed later in this presentation.

Cattle Breeding Programs
Classical
- Large active population
- Performance control of the whole animal population, all individuals of the breed, e.g. all Holstein dairy cows
- artificial insemination
- high selection intensity due to the high number of animals involved in performance control.
The objective is selection:
- sires of sons
- sires of dams
- mothers of the sons
- mothers of the dams
- a test of young sires - future fathers of sons - through whom genetic superiority is passed on from generation to generation
Modern
- biotechnologies of reproduction
- ET, superovulation, estrus synchronisation
- breeding nuclei

- open
- closed
- impact of selection pathways on genetic improvement of the population/breed
- intensification of female reproduction improves the use of the genetic potential of the female part of the population in breeding and increases their share of the genetic gain

Systems of Use of sires:
- Proven sire systems
- genetic gain is mainly made up of
through highly reliably selected sires of sons

- long-term retention of ID
- typically 20-30,000 IDs are stored and these are used for targeted maiting
- the breeding bull is only at the insemination station
for a limited period of time until the required number of IDs is reached, after which it is slaughtered, the decision to use them is made after sufficient testing.

- systems "Waiting bulls"
the breeding bull is only at the insemination station
for a limited period of time while obtaining the ID needed for test mating,
he is then placed in a waiting position in the stall and waits for
the result of the testing and then the production of further IDs is carried out
- in some countries, waiting bulls are placed in the production herds and natural breeding. At the same time current health and veterinary regulations, it is not possible to transfer bull from natural breeding can be used for ins. stations.
- systems of young sires
- typically only a limited number of IDs are frozen (600
- 1500), the greater part of which is used for mating without prior
screening. The rest of the IDs remain in the gene bank for future use.
- the genetic gain is mainly made up of through a short generation interval, the disadvantage is the low rate of of such breeding bulls
- at present, with the use of genomic information is it possible to achieve a higher reliability of their selection.
MOET -Multiple ovulation and embryo transfer
As can be seen in the table:
Juvenile -two generations of MOET offspring - full siblings
-while biological reproduction takes place and cows produce milk
- extreme shortening of the generation interval

Adult
-one generation of MOET offspring
- additional information source in the form of performance of full siblings is used for selection
- in the breeding programme thus, i tis ensured a male offspring from each targeted mating.
Very often in breeding practice we encounter breeding pyramid, as can be seen in the picture. The population is divided into breeding level A - in which the breeding is carried out, as we have described it so far. The animals are bred intensively, they represent the nucleus of the population, these animals are evaluated, their breeding values are calculated and of course they

produce generations of offspring and in this way the genetic improvement of the population is ensured.
Subsequently, individuals are produced from the breeding population. They are used as parents for the so-called multiplier herds, which serve to produce a sufficient number of parent individuals that will produce individuals - the final product, the resulting hybrids for the production herds, for the production circuit. Very often this is done in this form in poultry or pig breeding, as we see in the picture on the right.
Between each level of breeding A - breeding, B - multiplier, C - production herds, we have some genetic lag, we can notice that genetic progress is made at the top of the pyramid and that genetic superiority goes downwards in the form of that genetic lag.
The transfer of genetic information from parents to offspring is in breeding program implemented through mating plans.
We distinguish general mating plans that are typical in the selection paths of mothers of daughters or specific ones that are used for targeted mating, I am talking about elite mating of fathers of sons with mothers of sons, or test mating of future fathers of sons. There are corrective mating plans, which monitor the improvement of e.g. of some type traits, or compensatory mating plans, whether homogeneous or heterogeneous, which serve to compensate for some undesirable biological phenomena, e.g. solving problems with the growth of relatedness in the population.
So far, we have talked about genetic evaluation, where we are interested in how high a genetic gain we can achieve in the population after one selection cycle within the breeding program, but genetic evaluation can also mean the evaluation of changes in the genetic parameters of the population, such as heritability as well as influencing other genetic parameters between traits and characteristics in the population. In the long term, genetic gain is transformed into the so-called genetic trends.
In any case, the farmer is interested in profit, so economic evaluation is also important, we are talking about economic profit. The basic assumption is that there are estimated economic weights in the population for traits and characteristics that are part of the breeding goal, or the economic efficiency of production is evaluated. It is clear what the relationship between economic and genetic traits is because the traits in the breeding goal should be measurable, heritable and related to the economics of breeding.
In this picture, it is possible to see a typical decision-making way of suitable alternative. Program, where we compare the increase of inbreeding against the genetic gain, and possibly the generation interval in the population, which of course affects the economic efficiency of breeding.
It is necessary to be aware of the biological aspects of livestock breeding. If we were to expect a linear genetic trend, e.g. the shortening of the age at which broilers reach slaughter weight, as indicated in this graph, so if in 1950 it took 13 weeks for a one-day-old chicken to grow into a broiler with a slaughter weight of 2.2-2.3 kg, in 1990 it was a little over 7 weeks, if we connected it with a straight line, it would mean that in 2050 a chicken will be born today and will reach slaughter weight tomorrow. In practice, it doesn't work that way, and that's why you have to think about biological aspects and the biological background of production when breeding.
A few sentences about the work in small populations. In addition to large, global, cosmopolitan populations and global breeding we also have breeding programs for local, small and sometimes endangered populations.
The basic objective is:
preservation and competitiveness of small populations
preservation of the breed type, while it is not an economic goal
more intensive use of biotechnical progress and related increasing the reliability of dam selection
shortening the generation interval of females and males through earlier selection decisions
extension of performance control in females
modernization of own-performance control in males

I assume you are interested in the topic. Within this module, or in other modules you will learn more information that cannot be covered in this presentation. I look forward to meeting you sometime in the future and thank you for your attention.