DEBRECENI EGYETEM

PRACTICAL EXERCISES FOR THE COURSE OF ORGANISATION OF BREEDING

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A Debreceni Egyetem fejlesztése a felsőfokú oktatás minőségének és hozzáférhetőségének együttes javítása érdekében
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Content

Aims

Fulfilling the course, students will be able to deal with breeding organisations, setting up breeding programs for different species, calculating economic weights, organising shows, exhibitions, communication to farmers and government officials.

Developed competencies

Understand the modern genetic background that are necessary to design an up-to date breeding program.

Familiar with the stakeholders of a breeding program.

- Become committed to objective approach of science;
- Able to perform research and innovation tasks furthermore to coordinate and organise advisory service for animal breeding organisations;
- Able to design and analyse breeding programs.

Contents

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Exercise 1. Please define breeding objectives in ruminant animals, in different economic and management circumstances

Purpose of the exercise: The student will be able to collect and analyse information needed for defining breeding objectives in different circumstances for ruminant animals.

Required knowledge: Consumer, marketing trends in animal breeding.

Guidance: The definition of breeding objectives are depending on consumer demand, reflected on economic weight, heritability of the trait (whether the trait can be improved by selection) and the correlation between the traits in question. The trade-off between production and fitness traits is recognised and the balanced breeding philosophy has been adopted in many livestock species.

The ruminant sector is more disperse, and operated by small or medium sized enterprises compared to monogastric sector. However cattle genebanks (artificial insemination companies) are international and provide their breeding material worldwide. Defining breeding objectives is an iteration process, one needs to be aware of the trends. "In future production will increasingly be affected by competition for natural resources, particularly for land and water, competition between food and feed, and by the need to operate in a carbon-constrained economy." *P.K. Thornton (2010): Livestock production: recent trends, future prospects. Phil. Trans. R. Soc. B 365. 2853-2867. Please read the article above, and discuss the relevance for your country.*

The success of a breeding program can be evaluated on the basis of phenotypic and genetic trends. Please open the following website and compare the progress achieved by different breeds and draw your conclusion https://queries.uscdcb.com/eval/summary/trend.cfm

Consumer demand for milk and meat production is forecasted to increase, which necessitates more and profitable dairy cows and more efficient beef production from dairy herds. Semen sorting by sex, or sexed semen technology constantly improves to reach the same fertility as "conventional" sperm. The mating practice is to inseminate the high genetic value (usually the heifers) with X chromosome carrier sperm that is needed for replacement, and the rest with beef Y chromosome sperm. *Weigel, K. A. J. Dairy Sci. 2004. E. Suppl. E120-E130. proposed several strategies to improve the widespread use of sexed semen in dairy cattle. Has the technique of sexing semen improved since 2004? In what way? How popular is the sexed semen use in your country? For answering the question you can read Norman et al., 2010. J. Dairy Sci. 93. 3880–3890. The sexed semen usage and the profitability also depends on alternative breeding strategies (Murphy et al., 2016. J. Dairy Sci. 99. 6680-6692.). Please read and discuss the possible alternatives. Do you have suggestion for more alternatives?*

Overall, the profitability of sexed semen usage depends on the genetic value of the bull and the pregnancy rate.
Do you find any supporting evidence of this statement in the following paper? Cottle et al. J. 2018. Dairy Sci. 101. 4498-4512.
The commercialisation of genomic testing dramatically changed the dairy cattle breeding schemes. https://www.uscdcb.com/ The selection on the basis of genomic breeding value compared to estimated breeding value based on progeny testing increased genetic progress. Genomic screening of young animals for replacement is economic question.
The combination of sexed semen usage and genomic testing offers several possibilities as discussed in Newton et al. 2018. J. Dairy Sci. 101. 6159-6173. After reading the paper, please discuss the possible outcome of the combined methods for future genetic progress. Can you envisage other genomic or any other reproductive techniques that could further increase the genetic progress? Can you see any side effect of these technologies? What would you suggest, to overcome these side effects?

In sheep breeding disease resistance came into focus recently. *Please read Cloete et al (2014): The adaption of the South Africa sheep industry to new trends in animal breeding and genetics: A review. South African Journal of Animal Science 44 (No. 4). Why disease resistance became important in sheep breeding? Is this important in other species? How will that effect the other traits?*

The geographical environment significantly influences the breeding objective. In the tropics dairy production systems due to the feed scarcity the profitability is expected to be improved mainly by genetically improved animals and not by increased herd size. *Why do you think this the reason? Wahinya et al (2015): Economic and biological values for pasture-based dairy cattle production systems and their application in genetic improvement the tropics. J. Anim. Prod. Adv. 5(5). 664-675.*

MOET, multiple ovulation and embryo transfer is a series of reproductive techniques which includes superovulation of donor (of high genetic value) female, mating, embryo recovery of the embryos, and transfer of fresh or frozen embryos to recipient (of lower genetic value) females. The embryos can be evaluated and splitted before transferring. This is frequently used in dairy nucleus herds and in sheep nucleus flocks are also practiced.
Please read Terawaki, Y. and Asada, Y. (2002): Asian-Aust. J. Anim. Sci. Vol. 15, No. 12: 1686-1689. to answer the following question:
What is the effect of MOET on genetic progress? How does it effect the inbreeding? How does the number of embryos per cow effect the inbreeding? Is there an optimum between genetic progress and inbreeding rate? What would you choose „traditional" artificial insemination without ET or with ET from the longterm progress perspective? Would genomic screening of the donor cow is necessary?
Studying the paper of Ruane, Genet. Sel. Evol. 1991. Vol. 23. 47-65. to answer the following question: what are the possible alternative mating designs and selection strategies in a MOET scheme? What is your further suggestion to investigate or put it into practice?

It is a continuous argument in livestock breeding, whether we breed for a narrow market segment (environment) or for a broad segment (environment) that implies adaptability. *Please read the paper of Canario et al. (2013): Genetics of behavioural adaptation of livestock to farming conditions. Animal. 7:3, 357-377. What is your opinion? Is there a mixed alternative?*

Whether to import highly productive European breeds or improve the indigenous breeds in other continent like Africa is still an open question. Or not? *Please collect evidences.*

"Phenotypic plasticity if adaptive may allow species to counter the detrimental effects of extreme conditions…" Chevin and Hoffman (2017): Evolution of phenotypic plasticity in extreme environments. Phil. Trans. R. Soc. B 372:20160138. *Is the selection for phenotypic plasticity the answer for breeds adaptable to different environment? Is this also the answer for the environmental change? How will this affect the production and fitness traits?*

Exercise 2. Breeding objectives in monogastric animals, economic and management circumstances

Purpose of the exercise: The student will be able to collect and analyse information needed for defining breeding objectives in different circumstances for ruminant animals.

Required knowledge: Consumer, marketing trends in animal breeding.

Guidance: In ruminant animals the pure breeding is the dominant breeding method. Commercial farms predominantly use pure cattle or sheep breeds producing market products. The breeding is in the control of the collective breeding organisations which set their breeding goals by consensus of the breeders considering their profit and social demand. Unlike dairy cattle, biological limits have not been challenged in beef and sheep breeds. In monogastric breeding however in poultry species and in many of the pig breeds biological potentials are almost reached. The breeds, or lines are selected for crossbreeding, and the breeding is controlled by private (rarely collective) companies. The broiler breeding managed through a sophisticated stratified pyramid structure. The typical is a 4-way cross, where 2 female pure lines are selected for fertility and egg quality and 2 male lines for meat production. At the top of the pyramid the nucleus is situated, which is also stratified, from top to the bottom: pure lines, great grandparents, grandparents; the next level downwards are the parents, the producers of the broiler eggs; the lowest level is the commercial broiler flock. The grandparents are crossed with grandparents from another line. The grandparent crosses result in F1 (female line) parents, that are also crossed with F1 parents (male lines).
The pure line and the F1 animals are often owned by the breeding companies.

Monogastric meat more accessible to consumers compared to ruminant meat. The price influenced by the management, technology and prolificacy of the species. *Do you think the lower monogastric price also means lower quality demand?*

Le Roy gave an overview on the new traits in pig breeding. Le Roy (2002): New traits in pig breeding. 7th World Congress of Genetics Applied to Livestock Production, August 19-23, Montpellier, France. *Do you think his predictions are still valid nowadays? Has been a shift to other direction? In what extent and what way?*

Merks and his coworkers ten years later further elaborated on the topic. They named vitality from birth to slaughter, uniformity at different levels of production, robustness, welfare and health and phenotypes to reduce carbon footprint are essential traits for producers and consumers. (Merks et al. (2012): New phenotypes for new breeding goals in pigs. Animal. 6:4 pp 535-543.) *How do you think now, comparing to Le Roy's view, had the traits to improve changed since? What is your expectation for the coming years?*

Pig and poultry breeding is more globalised than cattle or sheep breeding. *Do you think the same traits are important for poultry and pigs in every part of the world? What are the important traits for your farmers?*

The Aviagen is a well-known turkey breeding company. http://www.aviagenturkeys.com/en-gb/?redirectedfrom=en-us *Please explore their breeding objectives. Can you find an another turkey breeding company? Are their breeding objectives different from the one in Aviagen?*

"In the three and 4-way commercial turkey cross system, sire lines are mainly selected for meat production traits such as body weight, meat quality and feed efficiency, whereas selection is primarily focussed on growth and egg production traits in dam lines" Nestor et al., (2006): Genetics of growth and reproduction in the turkey. 16. Effect of repeated backcrossing of an egg line to a commercial sireline. Poultry Science. 85:1550–1554.

Is this different from the broiler breeding?

The balanced breeding philosophy (balancing between health or fitness traits and production traits) can also be adopted in turkey breeding. *Why Kapell et al (2017) came to this conclusion?*
Kapell et al. (2017): Genetic basis for leg health and its relationship with body weight in purebred turkey lines. Poultry Science 96:1553-1562.

How the duck and goose breeding differ from other poultry breeding species? You can explore e.g.:
https://www.cherryvalley.co.uk/companypage

Geese have never been exploited commercially as much as chickens or even ducks have been. *What possibilities can you see in geese breeding?*

Exercise 3. Calculation of economic values

Purpose of the exercise: The student will be able calculate the economic weight for different production systems in different species.

Required knowledge: Consumer, marketing trends in animal breeding. Production circumstances and the knowledge of the production and economic parameters.

Guidance: The economic weight is the change in profit (Income – Cost) by one unit change in the trait without the change in other traits in the breeding objective. This is why it is called partial economic weight. The economic weight (a) is then used as a multiplicator of the relevant breeding value (g) to arrive to the aggregate breeding value.

$H = a_1 \times g_1 + a_2 \times g_2 + \ldots + a_n \times g_n$

The series of equations (presented in the table below) were obtained from Gibson, J.P. (1994): An introduction to the design and economic of animal breeding strategies. University of Guelph. The economic weight is calculated for a beef system for three traits. Let us assume N (number of females on the enterprise) is 200, number of daughter progeny per breeding female (n) is 0.4, weight of product per weaned animal is 260 kg (w), returns per unit product 2.2 Euro/kg (r), cost per weaned animal per day 1 Euro (c_1), cost per breeding female per year 105 Euro (c_2), days to market weaned animal 280 days (d). These figures are from the present Hungarian circumstances, where beef is sold soon after weaning.

Calculating the economic weight per unit product: for number of daughter progeny per breeding female is $v_n = 105/(0.4^2 \times 260) = 2.52$; for days to market of weaned animals $v_d = -1/260 = -0.0038$; for weaning weight $v_w = 1/260^2 \times (1 \times 280 + 105/0.4) = 0.008$. As in every species the prolificacy has got the highest economic weight, followed by the product and the efficiency of the production.

How the changes in the cost, return and in the performance will change the relative value of the economic weights, please explore different alternatives.

You can read the following papers on economic weights and discuss the methods of calculations and the relative economic difference of reproduction, production traits.

Legarra et al. (2006): Economic weight of fertility, prolificacy, milk yield and longevity in dairy sheep. Animal. 1: 193-203.
Cartuche et al. (2014): Economic weight is rabbit meat production. World Rabbit Science. 22: 165-177.
Komlósi et al. (2010): Economic weights of production and functional traits of Holstein-Friesian cattle in Hungary. J. Anim. Breed. Genet. 127: 143-153.

Table 1. Profit equations and economic weights for beef cattle

Perspective	Profit equation	Economic Weight, v_i		
		v_n	v_d	v_w
Per enterprise	$P_1 = N(nwr - nc_1d - c_2)$	$N(\overline{w}r - c_1\overline{d})$	$-N\overline{n}c_1$	$N\overline{n}r$
Per female	$P_2 = nwr - nc_1d - c_2$	$\overline{w}r - c_1\overline{d}$	$-\overline{n}c_1$	$\overline{n}r$
Per individual	$P_3 = wr - c_1d - \frac{c_2}{n}$	$\frac{c_2}{\overline{n}^2}$	$-c_1$	r
Per unit product	$P_4 = r - \frac{c_1d}{w} - \frac{c_2}{wn}$	$\frac{c_2}{\overline{n}^2\overline{w}}$	$\frac{-c_1}{\overline{w}}$	$\frac{1}{\overline{w}^2}\left(c_1\overline{d} + \frac{c_2}{\overline{n}}\right)$

* n = number of daughter progeny per breeding female per year; w = weight of product per slaughter animal; r = returns per unit product (price); c_1 = cost per slaughter animal per day; c_2 = cost per breeding female per year; d = days to market for slaughter animals.

Exercise 4. Breeding pyramid

Purpose of the exercise: The student will be able to design different types breeding stratification.

Required knowledge: Prolificacy, mating structure and generation interval of different species.

Guidance: The breeding pyramid a stratified operation. In the apex, the nucleus supposedly consists the genetically elite animals which passes down its superiority trough tiers. The number of tiers depends on the cost and prolificacy of the species. In a closed nucleus breeding program, as is the case in pig and poultry breeding, after the breeding animals for the nucleus are chosen, no animals from outside the nucleus are allowed to the nucleus population.

If we assume that 1 pure line hen can have 15 female descendants, in the next level (great grand-parent) those 15 hens can have 40 female descendants each, in the next level (grand-parent) those 600 hens can have 40 female offspring again that makes 24 000 parents and those parents with 120 hatching eggs result in 2 880 000 broiler chickens.

How the broiler chicken numbers would increase, if managed to increase the reproduction rate by 5%, by 10% at each tiers?

In the above example 5 tiers are presented, however in pig breeding we usually operate a 3-tier system: nucleus (pure lines), multiplier (F1) and commercial tier.

Let us assume a sow produces 16 female piglets per year. How many finished pigs (mixed gender) can be sold per year from the commercial farms?

In cattle, sheep, goat and dog breeding however, the recorded, whole population is screened, males and females on the basis of their breeding value can enter the nucleus. This is called open nucleus breeding. The “stratification” is based on sex and genetic merit. Sires of sons (SS) are the top 1-2% of the population with high accuracy and breeding value. Sires of daughters (SD) the top 10-15% of bulls with high accuracy but lower breeding value than the SS. Dams of sons (DS) are intensely selected (0.1-0.5%) with moderate accuracy but high breeding value. Dams of dams (DD) are needed the most (90%), depending the reproduction and survival capacity of the species having moderate accuracy.

Using the equation Rendel and Robertson (1950): Estimation of genetic gain in milk yield by selection in a closed herd of dairy cattle. J. Genet. 50:1-8. we can calculate the selection response.

$$R=\frac{i_1 r_{g.I_1} \sigma_{g_1} + i_2 r_{g.I_2} \sigma_{g_2} + i_3 r_{g.I_3} \sigma_{g_3} + i_4 r_{g.I_4} \sigma_{g_4}}{L_1+L_2+L_3+L_4}$$

Where i is the selection intensity, $r_{g.I}$ is the accuracy of the breeding value, σ is the genetic variance of the breeding value, L is the generation interval. Let us assume the following numbers in a dairy cattle breeding program:

Pathway	Proportion selected (p%)	Intensity (i)	Accuracy ($r_{g.I}$)	Generation interval (L)
Sires of sons	2	2.42	0.90	6
Sires of daughters	10	1.75	0.90	7
Dams of sons	0.5	2.89	0.60	5
Dams of daughters	90	0.19	0.60	6

(Adopted from Gibson, J.P. (1994): An introduction to the design and economic of animal breeding strategies. University of Guelph)

Let assume the σ (genetic variance of the breeding value) is the same in all path.

$$R=\frac{2.42 \text{ x } 0.9 + 1.75 \text{ x } 0.9 + 2.89 \text{ x } 0.6 + 0.19 \text{ x } 0.6}{6+7+5+6}\sigma_g$$

$= 0.233\ \sigma_g$ per year.

Response can be expressed in standard deviation unit, in absolute unit (milk kg per year), or as % of the mean. If we assume the heritability of milk yield is 0.25 and the phenotypic variation of coefficient (CV%) is 18, with an average production of 6000 kg, then σ_g is 540 kg milk. Hence R = 125.8 kg milk per year, that is 2.1% per year.

Change the proportion selected and the accuracy within a reasonable limit and calculate the selection response per year in dairy cattle. How this would be changed if we used genomic selection,

where the accuracy and generation interval change? Assuming no correlation between the traits, what would be the response in milk fat, protein, and calving ease?
Are these figures relevant for dairy sheep? What would be the response considering these four path in meat sheep breeding in growth rate and ultrasound backfat thickness?

Please read the following article and explain in what way the information nucleus is a new concept?
Fogarty The information nucleus – A new concept to enhance sheep industry genetic improvement. Proc. Assoc. Advmt. Anim. Breed. Genet. 17: 29-32.

In their paper Mueller and James showed the accuracy of breeding value in open nucleus: https://www.researchgate.net/profile/Joaquin_Mueller/publication/237121598_DEVELOPMENTS_IN_OPEN_NUCLEUS_BREEDING_SYSTEMS/links/55db086508ae9d6594921edd/DEVELOPMENTS-IN-OPEN-NUCLEUS-BREEDING-SYSTEMS.pdf

How will the inbreeding be effected by using the open nucleus system?

How the genetic progress expected to change in the Australian beef industry by implementing the open nucleus scheme? http://www.aaabg.org/livestocklibrary/2011/banks399.pdf

Exercise 5. Rules, Laws and Registrations related to animal breeding

Purpose of the exercise: The student will be able to compare the different means that govern the operation of animal breeding in different countries.

Required knowledge: basic terms of animal breeding.

Guidance: Different countries regulate their breeding operations at different levels. The history of animal breeding, the size and the importance of the industry and the social expectations are reflected in the regulations in the standards.

Please study the sections of the Regulation (EU) 2016/1012 of the European Parliament and of the Council on zootechnical and genealogical conditions for the breeding, trade and entry into the Union of purebred breeding animals, hybrid breeding pigs and germinal products.
How the breeding program, breeding book, breeding associations are defined? What is the right and obligation of a breeder and a breeding organisation? What types of authorities can control the breeding? What types of licenses the have? What are the steps for recognition of a breed society? In what cases a breeding society can be refused? What a breeding program consists of? What is the structure of a breeding book?

https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32016R1012&from=EN

The Lao People's Democratic Republic issued the Law on Livestock Production and Veterinary Matters is 2008.
https://www.wto.org/english/thewto_e/acc_e/lao_e/WTACCLAO17A1_LEG_1.pdf

Please compare the EU and Lao regulations in details, depth, sections. What is the major difference, what suggestion do you have? How the disease control regulated in both? Is there a difference in the transport or entry of foreign breeding material into the country or the EU? Is there any promotion element in the EU regulation? What about the sanctions?

In the United States of America the United States Department of Agriculture is responsible for Animal Policy and Regulatory Issues. *Please visit the website and compare the sections to the EU sections:*
https://www.ers.usda.gov/topics/animal-products/animal-policy-regulatory-issues/
What is the difference between the two approaches from a farmer's point of view? As a consumer what is your opinion on food safety and health, welfare, environmental issues?

In the regulation of the livestock sector for Kenya there are characteristic differences compared to the EU, USA or Lao regulations. *What are these?*

https://www.kenyamarkets.org/wp-content/uploads/2019/10/Draft-Livestock-Breeding-Bill-May-2015.pdf

How the mobilization of pastoralists and indigenous animal keepers are regulated? What is the role of the Community based breeding schemes in Kenya?

Exercise 6. Animal breeding organisations

Purpose of the exercise: The student will be familiar with the activities of the animal breeding organisation in different countries.

Required knowledge: basic terms of animal breeding.

Guidance: The legislations in a country defines the role of the animal breeding association as a professional community, which is the service of its members for a common good.

What is the purpose of the World Holstein Friesian Association? https://www.whff.info/

*How the Irish Cattle Breeding Federation serves its members? What is the activity of the organisation? Is it in conformity with the Regulation (EU) 2016/1012 of the European Parliament and of the Council on zootechnical and genealogical conditions for the breeding, trade and entry into the Union of purebred breeding animals, hybrid breeding pigs and germinal products.*https://www.icbf.com/wp/ *How the Federation follows the trend in livestock breeding? Has the Federation adopted any issues of sustainability? Do you have any further suggestion for improvement? What would you implement in your organisation from the Irish example? Can you find innovation elements is the activities?*

What is the purpose of the World Holstein Friesian Association? https://www.whff.info/
What is the difference in activities of an umbrella, international organisation to a national organisation?

The Holstein Association USA is a member of the World Holstein Friesian Association http://www.holsteinusa.com/ *What is the difference in activities between the two organisation? How complete the activities of the Holstein Association USA?*

Are these webpages updated?

When you compare the American to the Canadian cattle association, what difference can you conclude? https://www.holstein.ca/en/Public

When you explore the Australian Association of Stud Merino Breeders website: https://merinos.com.au/ what conclusion can you make comparing to a cattle association? Merino South Australia is a member of the previous organisation. https://www.merinosa.com.au/

The Thoroughbred Breeders Association in the UK is the oldest animal breeding association. What information do you think is important for the present breeders? https://www.thetba.co.uk/

Exercise 7. Conformation assessment

Purpose of the exercise: The student will be familiar with the differences in conformation assessment in different species and utilisations and elaborate on future developments.

Required knowledge: basic terms of animal anatomy.

Guidance: Conformation assessment is a visual tool for judging an animal's ability to conform with the breeding purpose and a reflection of production, reproduction, health and technological adaptability. The linear type traits are the most commonly used means on a 1 to 9 point scale. We can observe an evolution amongst the type traits. New traits are continuously added to the ones used already.

Dairy cattle

The International Committee for Animal Recording (ICAR) standardized the type traits. Presently stature, chest width, body depth, angularity, rump angle, rump width, rear legs set, rear legs rear view, foot angle, fore udder attachment, rear udder height, central ligament, udder depth, front teat position, locomotion, body condition score are approved standard traits. The last two just recently have been included. Provisional ones are: top line, hock quality, bone structure, rear udder width, teat thickness, muscularity.

What are of these traits reflect production, reproduction, health?
You can find the visual guide at the following website:
https://www.icar.org/wp-content/uploads/2015/08/Conformation-Recording-CR-WG.pdf

Is there a debate on the usefulness of the conformation assessment? Please read the following opinion:
http://www.thebullvine.com/dairy-cattle-classification/does-the-current-conformation-evaluation-system-work-for-commercial-breeders/

Please use a square grid sheet to draw a dairy cattle for the side view with the following linear scores: body depth-6, angularity-4, rump angle-7, foot angle-3, fore udder attachment-2, teat length-6, udder depth-2. From the rear view: stature-2, rump width-8, rear legs rear view-1, front teat placement-6, rear udder height-5, central ligament-7, rear teat placement-1, hock development-8, bone structure-9, rear udder width-2, muscularity-4.

Please find a Holstein Friesian bull which is suitable for the mating of this cow to improve the traits in her progeny. E. g. https://www.cgen.pl/indeksy/ocena/buhaj/ranking

Please use a square grid sheet to draw a dairy cattle for the side view with the following linear scores: body depth-2, angularity-6, rump angle-4, foot angle-1, fore udder attachment-2, teat length-4, udder depth-5. From the rear view: stature-8, rump width-6, rear legs rear view-5, front teat placement-2, rear udder height-3, central ligament-2, rear teat placement-6, hock development-2, bone structure-5, rear udder width-6, muscularity-8.

Please find a Holstein Friesian bull which is suitable for the mating of this cow to improve the traits in her progeny. E.g.

https://breedingdairy.ahdbdigital.org.uk/tables.asp?preview=1&t=SAC_Bull_report_pli_uk_ONLY_semen_available_HOL&i=1&b=HOL#.Xyr5yzVS9PY

Beef cattle

The ICAR has also standardized the beef type traits, those are the followings: frame traits - body length, back length, chest width, thurl width, body depth, chest depth, flank depth, length of rump, height at withers, height at rump, rounding of ribs, rump angle, tail set, width at pins, width at hips; muscularity traits- muscularity shoulder top view, muscularity shoulder side view, back width, thickness of loin, thigh rounding side view, thigh width rear view, thigh length, body condition score; type traits- muzzle width, top line, skin thickness; leg traits- front legs front view, fore pasterns side view, rear legs rear view, rear legs side view, hind pasterns side view, claw angle, thickness of bone; udder traits- thickness of teat, teat length, udder balance, udder depth.

What are of these traits reflect production, reproduction, health?
You can find the visual guide at the following website:
https://www.icar.org/wp-content/uploads/2015/08/Conformation-Recording-CR-WG.pdf

What are the main difference between the dairy and the beef assessment?

Please use a square grid sheet to draw a dairy cattle for the side view with the following linear scores: body length-2, back length-4, body depth-6, chest depth-3, flank depth-7, length of rump-4, height at withers-8, height at rump-6, rounding of ribs-4, rump angle-5, tail set-2, muscularity shoulder view-7, thickness of loin-8, thigh rounding side view-8, top line-6, fore pasterns side view-7, rear legs side view-8, hind pasterns side view-2, claw angle-5, thickness of bone-2, thickness of teat-9, teat length-3, udder balance-2, udder depth-4.

Recently image analysis and artificial intelligence is underway to support the conformation assessment in livestock.
https://www.frontiersin.org/articles/10.3389/fsufs.2019.00030/full
What do you think, can this technique replace the human judgement?

Is there a genotype difference that can be assessed by conformation? Please read the following paper: Wójczik et al (2011): Conformation assessment of Charolaise cows and crossbreds with various proportions of genes of this breed. Acta Sci. Pol., Zootechnica 10 (2) 99-104.

Reading the paper of Laven et al (2015): Measuring claw conformation in cattle: assessing the agreement between the manual and digital measurement. Animals 5. 687-701. what do you think of the importance of the claw conformation?

Within the dairy cattle improvement program local breeds were assessed in Ethiopia. Mammo et al. (2017): Conformation traits of dairy cattle populations in selected districts of Northwestern Amhara,

Ethiopia. Biodiversitas. 18:4. 1669-1679. *How differently the assessment was conducted to the ICAR guidelines? What is the difference in conformation amongst the breeds?*

Sheep

Comparing the beef assessment to the type traits of meat sheep, what difference can you observe? http://cemonterey.ucanr.edu/files/229668.pdf

Goat

When you study the paper of McLaren et al. (2016): Genetic correlation of linear type traits and their relationship with milk yield throughout lactation of mixed breed dairy goats. Journal of Dairy Science. 99:5516-5525. what do you think of the relevance of the type traits in prediction of the milk production?

Why hoof conformation is important in dairy goats? Deeming et al. (2019): The development of a hoof conformation assessment for use in dairy goats. Animals. 9. 973.

Pig

Selection for conformation in pig is selection for robustness: https://danbred.com/en/breeding-for-robustness-in-pigs-conformation/

Horse

In horse the balance is the key to robustness:
https://extension.uga.edu/publications/detail.html?number=B1400

How do you explain the difference between robustness and balance?

Exercise 8. Databases of breeding organisations

Purpose of the exercise: The student will be familiar with the need of different databases in animal breeding and the necessity of future developments.

Required knowledge: basic terms of informatics.

Guidance: The expectations about the databases in the livestock industry are the followings: able to store large amount of data, able to communicate with sensors that upload information in digital form (automated), support the traceability, databases could communicate each other without barriers, secure, only registered users, with license can have access, accessible on a 0-24 hours basis by a mobile, easily manageable by the users, linked to a helpline.

Databases are national or global. *Please visit https://secure.nlmd.co.uk/default.asp the National Livestock Management Database in the UK. What are the main characteristics of the database?*

The following website is a good example how the farming community is served at a high level with up-to-date information https://farmplan.co.uk/livestock/
What is your finding?

The livestock breeder works with large amount of historical data that increases the precision of evaluation. A set of different software can be found on this site:
http://ibreedsystems.com/index.htm

The most widely used databases are the bull selection databases like
http://www.selectsires.com/?version=20180803
https://absbullsearch.absglobal.com/
https://www.dairynz.co.nz/animal/ for dairy sires,
https://ramselect.com.au/#/home for rams,

In the life of a dairy cow we collect the following data: animal identification, sex, date of birth, sire, dam, herd identification, health status, health treatment, transfer to other location, breeder or culling, culling reason, sale, weaning date, weight at different ages (birth, weaning, at 12 month, monthly weighing is optional), date of insemination, inseminating sire, inseminator, calving date, calving ease, abortion-stillbirth, milk yield, fat yield, protein yield, somatic cell count, milking speed, temperament-workability, conformation type traits.

What sorts of traits do we collect for beef cattle, meat sheep, dairy sheep, wool sheep, dairy goat, meat goat, pig? What are the common fields and what are the different ones specific for a species or utilisation?

Please set up a database using Microsoft Excel or Microsoft Access for dairy cattle, beef cattle, meat sheep, dairy sheep, wool sheep, dairy goat, meat goat, pig. Please use different worksheets, tables for different age groups, for different activity (e.g. milk production, insemination, weighing)

and link these table (worksheets) by the identity of the animal. Please search for all the record of one specific animal.

Exercise 9. Communication of animal breeding organisations (webpages, newsletters, exhibitions, open days)

Purpose of the exercise: The student will be familiar with the several possible activities of a breeding organisation and compare differences in their communication.

Required knowledge: basic terms of informatics and communication.

Guidance: The breeding organisation is a professional body which conduct several activities. These type of activities depend on the popularity of a breed, economic importance of the breed, cultural heritage and other interest of the breeders. To communicate these activities effectively several communication tools are used. The economic importance, the intensity of production influences the amount and freshness of information an organisation provides to its members. Some of the information is for the public (to gain acceptance of the society and future member, especially the youth, and also of the consumer) and some information is restricted to the members.
Although information about events, opinions are placed on Facebook, Twitter, organised, structured information can be found on webpages.

In the following section we list webpages of breeding organisation. *Please evaluate these communication tools according to the completeness, adequacy, up-to-dateness, clarity, ease of use, design, attractance. Does the organisation provide its vision, strategy? Is there any information on marketing, sales, process, show events, open days, competitions, awards, scholarship, meetings, conferences, on services? Is there a newsletter sent to the breeder? Does the organisation publish journal, magazine? Do they provide information, events, activities for the youth? Is there information on genetic evaluation, conformation assessment? Is there any educational element (text, video) on the webpage? Does the organisation provide information on research and development? Do they offer career opportunities?*

Holstein Friesian cattle

Holstein Association USA
http://www.holsteinusa.com/

Holstein Canada
https://www.holstein.ca/en/Public

Holstein Australia
https://www.holstein.com.au/

Holstein UK
http://www.holstein-uk.org/the-holstein-breed
http://www.holstein-uk.org/member-services/the-journal

Hereford cattle

The Hereford Cattle Society, United Kingdom
http://www.herefordcattle.org/

American Hereford Association
https://hereford.org/

Canadian Hereford Association
http://www.hereford.ca/
http://www.hereford.ca/1_gallery.php

Herefords Australia
https://www.herefordsaustralia.com.au/

Charolais

Charolais Society Australia
https://charolais.com.au/

Charolais Breeders New Zealand
http://www.charolais.net.nz/

American Charolais International Association
https://charolaisusa.com/

Merino

Australian Association of Stud Merino Breeders
https://www.merinos.com.au/

Dohne Merino South Africa
https://dohnemerino.com/

Suffolk

Suffolk Sheep Society, United Kingdom
https://www.suffolksheep.org/

Thorougbred Breeders Association, United Kingdom
https://www.thetba.co.uk/

British Association of True Working Kelpies
https://www.batwk.co.uk/

American Working Collie Association
http://www.awca.net/

Exercise 10. Breeding programs of horse associations

Purpose of the exercise: The student will be familiar with the several elements and design of horse breeding programs.

Required knowledge: principles of quantitative genetics.

Guidance: The breeding program is a stratified into the following steps: 1. Definition of breeding objective, economic value evaluation, knowledge of market conditions; 2. Definition of selection criterias; 3. Collection of data, performance recording; 4. Genetic parameter estimation; 5. Breeding value estimation; 6. Selection; 7. Mating; 8. Evaluation of breeding program.

Please find some information on horse breeding programs:

https://horses.extension.org/developing-a-horse-breeding-program/
https://www.thetba.co.uk/
https://www.kwpn.org/kwpn-horse/selection-and-breedingprogram/breeding
https://english.kfps.nl/Breeding/Breedinginformation/Breedingprogram.aspx
https://www.grc-rcmp.gc.ca/en/musical-ride/horse-breeding-program
https://willowviewhillfarm.com/breedingprogram.html
http://www.wbfsh.org/GB.aspx
http://britishshowhorse.org/
http://www.idhba.ie/
https://www.usshba.org/
https://toba.org/
https://www.buckinghorsebreeders.com/Home
http://www.palominohba.com/
https://fhagbi.co.uk/
https://www.horsesportireland.ie/breeding/irish-sport-horse-studbook/
https://www.haflinger.org.au/
https://wpcsa.org/
https://arabianhorses.org/

Please answer the following questions:

What are the difficulties in the definition of the breeding objectives compared to other species?
What is the relative importance of production and fitness and managements traits in the breeding objective?
What is the horse breeder's approach to the importance of pedigree compared to other animal breeders? How important of the competition traits in the definition of breeding objectives?
What are the genetically inherited diseases what a breeder needs to take care of?
How specific are they to breeds?
What strategies the program contain to monitor and clear the breed from a specific genetic disorder?
How important of the inbreeding management? How the program sanctions on missing parent information?

In what circumstances and conditions can a horse breeder get reliable information on performance? Who (independent organisation or association) is responsible for the performance recording? What sorts of traits the breeders measure? How frequently? Is that used for selection or predicting breeding value?
Does breeding organisations provide uptodate genetic parameters?
What type of selection methods are practised? Are different traits considered for selection in males to females?
What is the importance of the conformation?
What type of breeding value evaluation is practiced?
How frequent is the breeding value reporting?
Is there any restriction or suggestion for using zootechnical or biotechnological methods in reproduction?
How the genetic progress is measured? Is it reported?
What type of breeding schemes is preferred?
All of these answers above does it depend on the history of the breed?
Is there any collaboration with organisations mentioned in the breeding program?
How frequently the breeding program is updated?

Exercise 11. Breeding programs of companion animal associations

Purpose of the exercise: The student will be familiar with the several elements and design of companion animal breeding programs.

Required knowledge: principles of quantitative genetics.

Guidance: According to the structure of the breeding program in excersize 10, please evaluate the breeding program of the different associations and compare them.

Please find some information on companion animal breeding programs:

https://www.dog-breeds.co.uk/
https://www.batwk.co.uk/
https://www.batwk.co.uk/
https://www.guidedogs.org.uk/about-us/national-breeding-centre
https://www.mdba.net.au/
https://bernesebreeders.btck.co.uk/
https://adbadog.com/
http://eastafricakennelclub.com/
http://leedsbagsd.com/
https://www.ngagreyhounds.com/Home
https://breedingbusiness.com/breeding-greyhound-dogs/

https://www.cat-breeds.co.uk/
https://tica.org/
http://www.russianblue.org.uk/
https://bengalcatassociation.co.uk/
https://sphynxcatassociation.org.uk/

https://theparrotsocietyuk.org/site/index.php/
https://lizardcanaryassociation.com/home/

Please answer the following questions:

What are the difficulties in the definition of the breeding objectives compared to other species?
What is the relative importance of production and fitness and managements traits in the breeding objective?
What is the companion animal breeder's approach to the importance of pedigree compared to other animal breeders? How important of the competition traits in the definition of breeding objectives?
What are the genetically inherited diseases what a breeder needs to take care of?
How specific are they to breeds?

What strategies the program contain to monitor and clear the breed from a specific genetic disorder?
How important of the inbreeding management? How the program treats on missing parent information?
In what circumstances and conditions can a companion breeder get reliable information on performance?
Who (independent organisation or association) is responsible for the performance recording? What sorts of traits the breeders measure? How frequently? Is that used for selection or predicting breeding value?
Does breeding organisations provide uptodate genetic parameters?
What type of selection methods are practised? Are different traits considered for selection in males to females?
What is the importance of the conformation?
What type of breeding value evaluation is practiced, if practised at all, or evaluation just based on phenotypes?
How frequent is the breeding value, or performance reporting?
Is there any restriction or suggestion for using zootechnical or biotechnological methods in reproduction?
How the genetic progress is measured? Is it reported?
What type of breeding schemes is preferred?
All of these answers above does it depend on the history of the breed?
Is there any collaboration with organisations mentioned in the breeding program?
How frequently the breeding program is updated?
How the breed conservation is important?

Exercise 12. Breeding programs of ruminant animal associations

Purpose of the exercise: The student will be familiar with the several elements and design of ruminant animal breeding programs.

Required knowledge: principles of quantitative genetics.

Guidance: According to the structure of the breeding program in excersize 10, please evaluate the breeding program of the different associations and compare them.

Please find some information on ruminant animal breeding programs:

http://www.holsteinusa.com/
https://www.holstein.ca/en/Public
https://www.holstein.com.au/
http://www.holstein-uk.org/the-holstein-breed
http://www.holstein-uk.org/member-services/the-journal
http://www.herefordcattle.org/
https://hereford.org/
http://www.hereford.ca/
http://www.hereford.ca/1_gallery.php
https://www.herefordsaustralia.com.au/
https://charolais.com.au/
http://www.charolais.net.nz/
https://charolaisusa.com/

https://www.merinos.com.au/
https://dohnemerino.com/
https://www.suffolksheep.org/
https://www.dorpersheepsociety.co.uk/
https://www.canadiandorper.net/
http://damarasheep.co.za/

https://nzbgba.co.nz/
https://abga.org/
https://alpinesinternationalclub.com/
http://saanen.co.uk/

https://www.bas-uk.com/
https://llamas.org.nz/

Please answer the following questions:

What are the difficulties in the definition of the breeding objectives compared to different species? What is the relative importance of production and fitness and managements traits in the breeding objective?

What is the companion animal breeder's approach to the importance of pedigree compared to other animal breeders? How important of the competition traits in the definition of breeding objectives?
What are the genetically inherited diseases what a breeder needs to take care of?
How specific are they to breeds?
What strategies the program contain to monitor and clear the breed from a specific genetic disorder?
How important of the inbreeding management? How the program treats on missing parent information?
In what circumstances and conditions can a companion breeder get reliable information on performance?
Who (independent organisation or association) is responsible for the performance recording? What sorts of traits the breeders measure? How frequently? Is that used for selection or predicting breeding value?
Does breeding organisations provide uptodate genetic parameters?
What type of selection methods are practised? Are different traits considered for selection in males to females?
What is the importance of the conformation?
What type of breeding value evaluation is practiced, if practised at all, or evaluation just based on phenotypes?
How frequent is the breeding value, or performance reporting?
Is there any restriction or suggestion for using zootechnical or biotechnological methods in reproduction?
How the genetic progress is measured? Is it reported?
What type of breeding schemes is preferred?
All of these answers above does it depend on the history of the breed?
Is there any collaboration with organisations mentioned in the breeding program?
How frequently the breeding program is updated?
How the breed conservation is important?

Exercise 13. Breeding programs of monogastric animal associations

Purpose of the exercise: The student will be familiar with the several elements and design of monogastric animal breeding programs.

Required knowledge: principles of quantitative genetics.

Guidance: According to the structure of the breeding program in excersize 10, please evaluate the breeding program of the different associations and compare them.

Please find some information on monogastric animal breeding programs:

https://www.britishpigs.org.uk/duroc
https://pigs.co.nz/
https://www.middlewhite.co.uk/
https://www.largeblackpigs.org.uk/
https://www.roysfarm.com/welsh-pig/
https://nationalswine.com/
https://www.britishpigs.org.uk/hampshire
https://www.pietrainpedigreepigs.co.uk/
https://www.clrc.ca/associations/swine
https://www.hypor.com/en/about-us/
https://danbred.com/en/

http://en.aviagen.com/
https://www.lohmanngb.co.uk/
https://www.hendrix-genetics.com/en/
https://layinghens.hendrix-genetics.com/en/
http://www.babolnatetra.com/en/home/

Please answer the following questions:

What are the difficulties in the definition of the breeding objectives compared to different species?
What is the relative importance of production and fitness and managements traits in the breeding objective?
What is the companion animal breeder's approach to the importance of pedigree compared to other animal breeders? How important of the competition traits in the definition of breeding objectives?
What are the genetically inherited diseases what a breeder needs to take care of?
How specific are they to breeds?
What strategies the program contain to monitor and clear the breed from a specific genetic disorder?
How important of the inbreeding management? How the program treats on missing parent information?
In what circumstances and conditions can a companion breeder get reliable information on performance?
Who (independent organisation or association) is responsible for the performance recording? What sorts of traits the breeders measure? How frequently? Is that used for selection or predicting breeding value?
Does breeding organisations provide uptodate genetic parameters?

What type of selection methods are practised? Are different traits considered for selection in males to females?
What is the importance of the conformation?
What type of breeding value evaluation is practiced, if practised at all, or evaluation just based on phenotypes?
How frequent is the breeding value, or performance reporting?
Is there any restriction or suggestion for using zootechnical or biotechnological methods in reproduction?
How the genetic progress is measured? Is it reported?
What type of breeding schemes is preferred?
All of these answers above does it depend on the history of the breed?
Is there any collaboration with organisations mentioned in the breeding program?
How frequently the breeding program is updated?
How the breed conservation is important?