Wrap-up Seminar
Newsletter May 2024

Learn more about Breed4Food - wrap-up seminar

In this newsletter the following subjects are addressed, which were all part of the Breed4Food seminar:

By clicking on the diverse subject titles above, you have the option to go to an item directly.

Influencing the world: 150 years of Dutch breeding

In line with CRV's 150 years anniversary, the Breed4Food community and invitees were invited to reflect on the past, present and future of animal breeding in the biannual Breed4Food seminar on 2 May 2024. The seminar was hosted by CRV at their new head office in Arnhem.
With a focus on the dairy industry, the participants were walked through some of CRV's recent achievements, while also the floor was opened for the partners Hendrix Genetics, Topigs Norsvin and Wageningen University and Research to reflect on the challenges and opportunities in other species.

Angus Haslett, CEO of CRV, welcomed the in total 80 in person participants, and another 11 online, to join in the celebration of 150 years of CRV. He stated that CRV is very proud to be part of Breed4Food, and challenged the Breed4Food community to contribute to the challenge to feed the world. Han Swinkels chaired the afternoon and introduced the program. Each of the partners presented important achievements and developments. The seminar was concluded by a guest presentation by John Cole, who currently is Chief Research & Development Officer at the Council on Dairy Cattle Breeding in the US.

Influencing the world: the origin of the Holstein Friesian

Chris Orrett from CRV took the audience on a journey through history. The ongoing discussion and polarization about the human diet seems to ignore evidence that humans have been omnivorous for as far back in history as there is empirical data about the human diet. Domestication and spread of cattle started 10,000+ years ago. This coincided with the emergence of lactase persistence, of which the frequency was increased in those populations where cows were milked, and the milk was consumed.

The Holsteins originate from a cross of Black cattle (from the Batavi) and White cattle (from the Frisii). Exportation to the US started as early as 1621, but the influence thereof was limited due to disease outbreaks, and it were the exports in the 1900s that led to the establishment of the Holstein breed in the US. Today, the Holsteins are said to have a narrow window of environments in which they perform optimally, and the question is which future environments across the world fit in this window. In addition, challenges vary across the world. Improving food security has different priorities in different parts of the world, from reducing food loss in the Western world to securing availability of sufficient food in developing countries. The challenge for us animal breeders is to efficiently design solutions for all these different priorities.

Single step: Implementation of dairy cattle genetic evaluations

Herwin Eding from CRV outlined the current single step genetic evaluations for dairy cattle in the Netherlands and Flanders, and the route that was undertaken to establish its implementation. Developments of a dedicated solver that evaluated into hpblup, one of the solvers in the MiXBLUP software suite, started ~7 years ago, with Jérémie Vandenplas being the main developer. Back then, CRV defined a challenging set of requirements for the software, that all have been met in the meantime. Herwin highlighted several examples of additional features that were implemented along the way, including efficient storing and use of genotypes as well as including genetic groups.

At CRV, a single step SNPBLUP model is used, which uses national observation data and deregressed breeding values of foreign bulls. The current Dutch/Flemish single step evaluations cover 20 trait groups including in total 250 traits. In addition to Holstein, several other populations are evaluated, including amongst other crossbreds in New Zealand and MRY in the Netherlands. An important added value of the single step is that cows are readily included in the reference population, next to domestic and foreign bulls. While there are still important challenges for particular evaluations, overall, the implementation of the single step has been very successful, as it increased reliabilities for almost all traits, with improvements in reliability up to 20-25 percentage points for longevity, udder health and claw health.

How Hendrix Genetics realized the golden egg in 150 years' time

Gosse Veninga from Hendrix Genetics presented the past, present and future of breeding laying hens. In layer breeding, commercial animals are produced by 4-way crossbreeding, which was initially copied from corn breeding. Leveraging the multiplication power of the pyramid is key to produce sufficient layers to meet the demand. Like other species, layer breeding earlier on adopted breeding value estimation and genomic prediction in the last 15 years, and currently is looking into new technologies. Pure lines are still kept in cages, but the commercial herd environments involve aviary systems with large groups of animals. With currently only two main layer breeding companies left, layer breeding is a global activity, and Hendrix sells layer parent stock around the world. Having global operations and access to the different markets, including distribution, is therefore key.

In 50 years, the number of eggs per hen housed has increased from 240 to 500, reaching close to 1 egg per day per hen. This partly is realized by increasing the laying rate, but also by considerably extending the laying period, which is currently 100 weeks. Further improvement can mostly be realized by extending the laying period. Achieving robust performance under variable circumstances is very important. There is increasingly more focus on measuring phenotypes and genotypes at the commercial level. Moving forward, an important aim is to measure behaviour with sensors and digital phenotyping.

How the Dutch selection for self-reliance and efficiency can benefit all farm sizes

Hans Olijslagers from Topigs Norsvin took the participants around the world illustrating the impact of pig breeding in a wide range of farms. Topigs Norsvin is owned by Dutch & Norwegian farmers, has a strong R&D focus, and a high-end combined product portfolio. In 2022 they celebrated their 100 years anniversary. As in poultry, in pigs many consolidations have taken place, such that only a few pig breeding companies remain that have sufficient scale to invest in R&D to stay competitive. Around the world, there is a lot of diversity in both consumers and farmers. While farms in Norway have a maximum size of 100 sows, there are farms of >100,000 sows in the US. Other contrasts include high hygiene and lots of labour in Norway, versus high disease pressure and lack of labour in the US, as well as systems with a high technology level versus organic farmers in Denmark.

Topigs Norsvin serves all those clients by one type of sow, the TN70. This is achieved by balanced breeding, both looking at economic aspects and societal views. As an example, due to breeding the number of stillborn piglets decreases, while the number of liveborn piglets and the longevity of sows increases. Finally, to make future developments possible, large investments have been made in facilities to generate data in Canada (Innova) and Brazil (Inovare).

Reproductive technologies in cattle: past, present and future

Erik Mullaart and Marleen Broekhuijse (CRV) started posing the question: who is more important, the semen or the egg? First Artificial Insemination (AI) was done in 1850, in 1952 the first calf was born from AI with frozen semen. The Netherlands is the third largest country in terms of exporting semen. Semen fertility is key, but predicting it is not easy. A lot of data is generated, including quality checks, to evaluate and predict semen fertility, including observed fertility results in practice. The goal is to produce high standard, high quality, and high fertility semen products, that farmers trust. Erik highlights the commonalities and differences between the production of semen doses in cattle and pigs. One important parameter is motility.

In the end, several measures are combined to predict fertility of semen. From the semen to the egg and the embryo: In Vitro Production (IVP) is the method of choice for today's production of embryos. IVP involves fertilization and first 7-day development in the lab, followed by implantation in a recipient. With IVP a lot of offspring are generated from few top females, while shortening the generation interval (3.5-4 to 1.5-2 years). Despite the considerable increase worldwide in embryo production, it seems unlikely that transplantation of embryos will replace artificial insemination.

Developments of breeding and genomics: contributions of Breed4Food

Mario Calus (WUR) presented Breed4Food's contributions to animal breeding, aligning with the "Seven steps to set up a breeding program" scheme. For the first two steps ("Define production system" and "Define breeding goal"), animal breeders need to have a vision of the near future to define their breeding goals. In Work Package 5 (Ethics & Society), considerable attention is given to take an *inside out* rather than an *Outside in* perspective. Work Package 3 (The phenotyping interface) aligns with step 3 ("Collection of data"). The development of resilience indicators based on using daily phenotypes resulted in the implementation of breeding values for resilience at CRV, and the official release of those breeding values in April 2024.

Genetic modelling (step 4), through Work Package 1 (Core engine genomic prediction), is central to Breed4Food. Work Package 1 continuously works on extending features and improving the performance of the MiXBLUP software, both through software and hardware solutions. WP4 (Breeding program optimization) relates to step 5 ("Select & mate"), by developing selection criteria based on Mendelians Sampling Variance, and implementing digital twins of the partners' breeding programs using MoBPS software, to allow in silico optimization thereof. Prediction of crossbred performance in previous work is important for step 6: Dissemination. Finally, step 7 involves evaluation of the breeding program, by monitoring genome changes (WP2 - DNA informed breeding) and genetic trends following selection. Breed4Food's success relies on practical application of scientific knowledge through dedicated tool development, involvement of motivated and skilled researchers, and collaboration between the partners, as well as with external partners.

The next 150 years of animal breeding: a North American perspective

John Cole was asked to give his provocative perspective on current and future developments. The challenge today is not how to measure something, but how to measure it affordably at large scale. In this respect, automated phenotyping in plant breeding is very inspiring. The challenge is to convert the high volume of data and turn this into something useful, and to make sure the computing resources are available to do so. And it is very important to ask ourselves what are we actually trying to improve? In dairy cattle breeding we like bulls because packaging of semen is easy.

At the same time, semen is poorly differentiated, and assessing the true value of straws of different bulls is difficult. What if we replace semen with embryos? Potential limitations are costs, capacity to generate sufficient embryos, and variable skills of people that would have to transplant them. While perhaps controversial in Europe, *cloning* is a mature technology in the US. Looking forward, gene editing provides interesting opportunities to include beneficial genes from other species. Focussing on removing deleterious alleles, rather than fixing favourable alleles, may be easier due to easier detection of those alleles. Animal breeders have been very successful, but often have made many questionable assumptions about the future.

It is important to challenge our expectations of the future. What if cellular agriculture really takes off? If you don't need animals, you don't need animal breeders. Where will the cows be in 2050? Will Western genetics remain dominant? Lots of food for thought!

Article in Veeteelt - Dutch language

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