Alternatives, Risks and benefits

Animal Breeding can be very effective in changing properties of populations. Examples include increases in production in high input breeds, but also increasing disease resistance. An example of the latter is the successful breeding program against scrapie in the Netherlands. Scrapie has been around for hundreds of years, but only after the discovery of genetic variants being resistant to scrapie and the following breeding program the incidence could be decreased. However, less beneficial changes because of animal breeding have occurred as well. Especially when the breeding goal was too narrowly focused on production increases problems with health and welfare have occurred as a side effect. In Holstein cattle, for example, a tremendous increase in milk production has been achieved, but mastitis incidence has increased and getting cows pregnant often proves problematic.

With the rapid developments in molecular biology genomic selection has become possible. In genomic selection breeding values are determined with the help of dense marker maps. First a reference population is formed of animals with reliable breeding values, based on own performance data and performance data of relatives. Than these animals are types for genetic markers. The standard now is a 50K SNP marker chip, but numbers will soon increase. With a statistical model than a breeding value for each separate marker allele is estimated. Next, with the help of this statistical model, breeding values can be computed for typed animals without performance records, or a reliable pedigree. The main advantage is that breeding values become available much earlier, and consequently breeding programs can be accelerated. Especially, for difficult to measure traits, e.g. traits late in life, post slaughter traits or traits only expressed in one sex, advantages can be great. A, still futuristic, development may be so called velo- or whizzo-genetics. Here cell cultures derived from oocytes are set up in the laboratory. With genomic selection the best cultures are selected and after inducing meiosis and fertilization the next generation is again cultured in the laboratory.

The current situation is that the large breeding companies with global high input/high output breeds are implementing genomic selection. Benefits are possible for low input breeds as well. Performance based breeding values for special traits such as methane emissions or performance on special diets may be recorded on a part of the population, while selection may take place using all typed animals. However, the reference population should be of considerable size (e.g. >2000 animals) and closely related to the rest of the population.

The ethical questions can be illustrated with the example of breeding for polledness in dairy cattle. Nearly all dairy cattle in NW Europe are being dehorned, which is a painful process. Breeding polled animals may be an alternative. Polledness is based on a single gene with polled being dominant over horned. Currently, polled animals are rare and

generally have low breeding values. A classical breeding program may result in polled cattle with high genetic merit in about 20 years, and can be successful as illustrated by Fleckvieh in Germany. With genomic selection such a breeding program can be reduced to <10 years. Social research in the Netherlands indicated that citizens judge the livestock on the effect on animal welfare, whereby the idea is that the more natural processes are the better for livestock. Genetic modification is seen as unnatural and bad for animals and society. No distinction is made between animal breeding and genetic modification. Horns are seen as natural and no distinction is made between polled animals and dehorned animals. Farmers also indicate that animal welfare is very important, whereby animal welfare is mainly achieved by good care for the animals. Genetic modification is also judged negatively but animal breeding positively. Informing citizens about livestock and animal breeding changes the opinion of part of them. Whether or not breeding for polledness is judged positively depends on how natural polledness is judged (i.e. is it seen as a genetic defect or as a trait that occurs naturally since prehistoric times), and whether polled animals are judged to be functioning perfectly normal. Furthermore, the discussion is whether animals should be adapted to the production environment or the other way around.

The discussion around breeding polled cattle shows that the ethical aspects not so much concern genomic selection but more whether the breeding goal is acceptable. The main effect of genomic selection is that it accelerates breeding programs. Whizzo-genetics will be totally unacceptable to the general public, at least in the Netherlands. On the other hand, genomic selection can be beneficial for low input breeds as well, but it may be problematic to form a reliable reference population.

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