

Emerging technologies in animal breeding

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SUMMARY

- Genomic selection has revolutionised animal breeding, but there are several emerging areas of research currently under investigation to further increase genetic gain.
- Technology is now available to measure milk fatty acid content, especially saturated fat content, on all milk recorded cows and bulk milk samples at no extra cost.
- Development of a sentinel “Next Generation” herd will allow monitoring of expected trends in key traits from breeding, and how these elite animals perform in contrasting production systems.

INTRODUCTION

The tools used in animal breeding have changed dramatically in the past decade, from the introduction of a multi-trait selection index, the EBI in 2001, to the launch of genomic selection in Ireland in 2009. Research into animal breeding is continually evolving and there are several new and exciting projects currently underway at Moorepark, many in collaboration with the Irish Cattle Breeding Federation (ICBF). Here, we summarise some of these areas of research, which include improving the use of existing technologies to further increase genetic gain, as well as identifying new traits of interest and disseminating the research results back to farmers in novel, easy to use, and easy to understand applications.

FURTHER EXPLOITING EXISTING TECHNOLOGIES

Mid-infrared spectrometry (MIR) is a tool which has been around for a long time, and is the method routinely employed by milk recording organisations world-wide to determine the quantity of fat, protein and lactose in milk samples. Milk constituents for an individual or bulk milk sample are determined by shining light through the milk sample at over 1,000 different wavelengths. The absorbance of light through the milk sample is recorded, and the resulting spectrum used to quantify the proportion of fat, protein, and other milk constituents. Moorepark, in collaboration with other European research institutions has embarked on a project to obtain more information from the spectrum, which is routinely generated at least four times annually for over 400,000 milk recorded cows in Ireland as well as all milk bulk tank samples.

The RobustMilk project was initiated with an objective to provide tools to aid breeders to select healthier cows that produce healthier milk. Using the MIR spectrum generated from routine milk recording, equations have been developed which accurately predict the levels of fatty acids in milk (for example the amount of saturated or unsaturated fat in milk) as well as the energy balance of the cow that produced the milk. Both are important because of their link to human and cow health.

Research is also ongoing to quantify other constituents in milk using MIR spectrometry including milk lactoferrin content, minerals in milk, and milking machine detergent residues. If successful, equations could be routinely applied to the routine national milk recording service and the resulting data used to identify genetically elite cows.

THE NEXT GENERATION

Genetic gain is accelerating in Ireland at an ever-increasing pace. With genomic selection of females now a reality, the acceleration in genetic gain within the national herd is set to increase further. An obvious advantage of increased genetic gain is the higher number of higher EBI animals in our herds. However, how can we be certain that selection is going in the correct direction for all traits? Are we confident that we have not missed out on any important traits in the EBI, and that by rapidly accelerating genetic gain, we are not rapidly sending a currently unaccounted for trait in the wrong direction? For example, most dairy farmers will remember the detrimental effect that decades of aggressive selection for milk yield had on fertility of our dairy cows.

Initiation of a “Next Generation Herd” is a research project currently proposed at Moorepark. The herd would comprise 170-180 of the highest genetic merit cows in the country managed alongside a smaller number of cows of current national average genetic merit. The high EBI cows represent the future of our national dairy herd, and detailed observations on these cows for difficult to measure traits such as feed intake, methane emissions and energy balance, amongst others, would be undertaken routinely. The objective of establishing such a sentinel herd is to allow us to monitor trends in all important traits, including the traditionally difficult to measure traits, to ascertain the suitability of the high EBI animal to futuristic management systems, to enhance the development of the EBI and to ensure coordinated and sustainable genetic gain into the future.

TRAITS OF THE FUTURE

Several other animal breeding related research projects are underway at Moorepark. Two separate European collaborative projects, GreenhouseMilk and OptiMIR have just commenced. The objective of the GreenhouseMilk project is to investigate the influence of genetics on environmental footprint in particular greenhouse gas emissions and cow production efficiency. The OptiMIR project is an international project including both Moorepark and the ICBF with the objective of further exploiting MIR and related technology by generating tools that interpret on-going research results into readily and easily usable decision support.

Geneticists at Moorepark also continue to work closely with the ICBF and the dairy and beef industry in providing research for the national genetic evaluations as well as the national breeding programme.

More information on the international collaborative projects mentioned in this article is available from their dedicated websites: <http://www.robustmilk.eu>, <http://www.optimir.eu> and <http://www.sac.ac.uk/greenhousemilk>.

CONCLUSION

The animal breeding research projects currently underway focus on developing and exploiting the best technology available to continually increase long term genetic gain in a sustainable manner.