Linking genomics to efficiency and environmental traits in dairy cattle

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Measuring CH_4 production directly from animals is still difficult and hinders both management practices and direct selection to reduce CH_4 emissions. However, developments are under way to develop phenotypic CH_4 measurements; e.g., using (1) laser guns; (2) Fourier Transformed Infrared (FTIR) measuring units; or (3) large scale respiration chamber experiments. Next to these phenotypes, indicators of CH_4 emissions can also be defined with either mid infrared profiles in the milk or feed intake records (e.g. residual feed intake (RFI), or CH_4 predicted from feed intake and diet composition (i.e. the International Panel on Climate Change Tier-2)). RFI (MJ/d) is calculated as the difference between net energy intake and calculated energy requirements for maintenance (based on metabolic live weight) and milk production. In an experimental dataset of 548 heifers, we showed that it is possible to decrease predicted CH_4 emission by selecting more efficient cows (genetic correlation of 0.6 with RFI). However, both the direct phenotypes and most of the indicator traits are difficult and expensive to measure on a large scale, and therefore genomic selection is a promising tool to make progress in breeding environment-friendly cows, since it relaxes the need for information on performance of all animals or their close relatives. In our studies, we have shown that with current genetic parameters a reduction in predicted CH_4 in the order of 11 to 26% in 10 years is theoretically possible, using genomic selection. To double this genetic gain a large reference population (>5,000 animals is required). Therefore, a combined approach, including feeding, management and genetic selection, is likely the best approach to successfully reduce CH_4 emission.