

Do efficient cows perform well in all environments?

The prediction of dairy cow efficiency in high- and low-quality environments

Problem

When selecting for a livestock trait, we don't have a comprehensive view of the underlying biological mechanisms, but can only select on what we observe in a particular environment. However, if some biological strategies work well in one environment, they may not be well-adapted to another. This is particularly true with complex traits like feed efficiency (FE), which is composed of other underlying elementary traits that are difficult to measure.

Solution

We used computer simulation to test this on a population of virtual cows. We created 20,000 cows, all different in terms of acquisition (their feed intake capacity) and allocation (how they split their intake between milk, body reserves, and other functions). We placed the cow population in seasonal calving farming system, with 4 different nutritional environments, ranging from poor to good. To see if the environment impacts breeding values, we estimated the genetic parameters for traits linked to FE, recorded both in the short-term (during 2nd lactation) and in the long-term (lifetime-level).

Outcome

We found that the best combinations of acquisition and allocation were different for the different environments (Figure 1). Producing more milk during 2nd lactation is genetically linked with the short-term FE. However, the link between these traits and long-term FE, recorded at lifetime level, decreases as the environment becomes more constraining. In contrast, the link between body reserves and lifetime FE is positive and increases when the environment becomes more constraining.

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Publication

Exploring underlying drivers of genotype by environment interactions in feed efficiency traits for dairy cattle with a mechanistic model involving energy acquisition and allocation [\(Link\)](#)

Keywords

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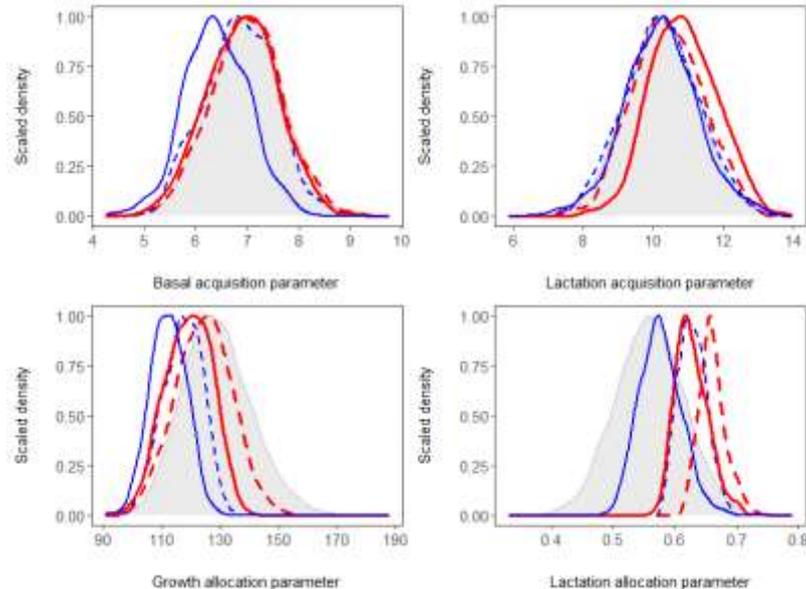


Figure 1. Distributions of the parameters reflecting the underlying mechanisms of the cows (resource acquisition and allocation) for the general population of cows (in grey) compared to 4 types of best performing cows regarding feed efficiency (FE). Red dotted line: the 5% best cows for FE recorded in the short-term in good environment. Blue dotted line: the 5% best cows for FE recorded in the short-term in poor environment. Red plain line: the 5% best cows for FE recorded in the long-term in good environment. Blue plain line: 5% best cows for FE recorded in the long-term in poor environment.





Practical recommendations

- When using short-term FE as a selection criterium in dairy cattle, local farming conditions need to be considered
- For high-quality environments, selecting cows that are the most efficient in the short-term (during 2nd lactation) will lead to selection of cows that are also the most efficient at the lifetime level.
- For low-quality environments, selection of cows with a lower production focused allocation will result in selection of cows with a good lifetime FE

On-farm application

After incorporation of the results (and the models involved) by breeding companies, options will arise to take these local farm environment effects into account when recommending bulls to dairy farmers.

“GENomic management Tools to Optimize Resilience and Efficiency - GenTORE” is an H2020 project which aims to develop innovative genome-enabled selection and management tools to empower farmers to optimize cattle resilience and efficiency in different and changing environments.
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