THEMATIC ARTICLE

Choosing the right breeding route!

When a useful trait is missing, should breeders use crossing or gene editing?

EXECUTIVE SUMMARY

When a useful trait is missing from a livestock breed, breeders may try to introduce it through traditional crossing or, in specific cases, through gene editing. RUMIGEN's comparison shows that neither route is automatically better. Traditional crossing is more familiar and often more accepted, but it can take many generations and may also bring unwanted parts of the donor breed's genome. Gene editing can be faster and more targeted, but it requires strong safeguards, clear regulation, careful animal health and welfare checks, and public trust. The key message is that breeding innovation should be assessed case by case: the right tool depends on the trait, the species, the urgency, the available evidence and societal acceptance.

THE ISSUE

Sometimes, a useful trait exists in one breed of animal but not in another.

For example, one breed may carry a natural genetic variant linked to disease resistance, heat tolerance or another valuable characteristic. Breeders may want to introduce that useful trait into a breed that lacks it.

There are two main ways to do this: traditional crossing between breeds, or gene editing.

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What is traditional crossing?

Traditional crossing, also called introgression, means crossing animals from the target breed with animals from another breed that already carry the useful trait.
The offspring are then bred back again and again with the target breed. The aim is to keep the useful trait while gradually recovering most of the original breed's characteristics.
This method is familiar and often more accepted by society. But it takes a long time, usually many generations. It can also bring along other parts of the donor breed's DNA, not only the useful trait.

What is gene editing?

Gene editing is a newer method that can introduce a specific known genetic change directly into the breed of interest.
This can be faster and more targeted than traditional crossing. It can also help researchers test whether a useful genetic change really works in a certain breed or species.
But gene editing also raises questions. It may face legal restrictions, public concern and the need for strict checks on animal health, welfare, safety and long-term breeding use.

What did RUMIGEN show?

RUMIGEN looked at both routes as possible tools for animal breeding.
The project showed that the question is not simply whether one method is "better" than the other. Each has advantages and limits.
Traditional crossing may be more accepted and can help maintain or create genetic diversity, but it is slower and less precise.
Gene editing may be faster and more targeted, but it needs stronger safeguards, clear regulation, careful testing and public trust.

Why is this important?

Livestock breeding faces growing challenges, including climate change, animal disease, welfare demands and the need to protect genetic diversity.
No single tool can solve all these challenges. The best route depends on the trait, the species, the breed, the urgency of the problem and the expectations of society.

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What does this mean in practice?

- Use traditional crossing when the useful trait is already present in the same species and time is less critical.
- Consider gene editing only when the target genetic change is clearly known and the expected benefit is well justified.
- Check animal health, welfare and performance before any wider use.
- Protect genetic diversity, whichever breeding route is chosen.
- Assess each case separately instead of treating all breeding technologies in the same way.
- Keep the public informed through clear, honest and transparent communication.

Key takeaway

Breeding innovation is not about choosing one tool for every problem. Traditional crossing and gene editing can both have a role. The priority is to choose the right route for the right purpose, with clear benefits, strong safeguards and public trust.
Based on the RUMIGEN background note comparing introgression and genome editing in farm mammals.

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