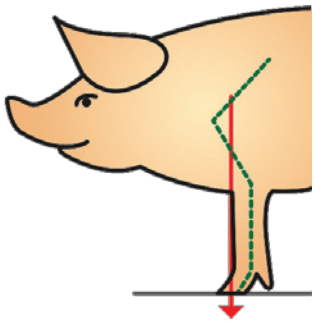


Breeding for robustness in pigs: 1. Conformation

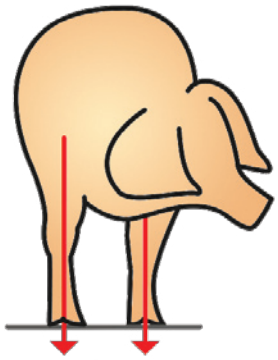
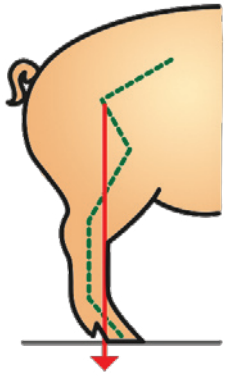
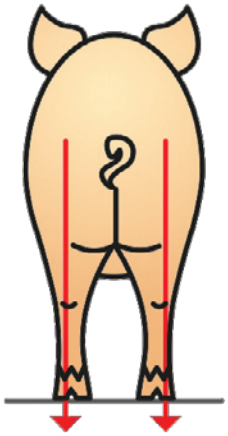


Fig. 1. Above, correct position of front legs, an example of good conformation score in front legs.

Fig. 2. Below, correct position of hind legs, an example of good conformation score in hind legs.





This is the first of two articles on breeding for robustness in pigs and focuses on conformation. The second article will cover sow longevity.

The breeding of robust pigs is a substantial key input factor to global pig production and ensures healthy and strong animals. Robust pigs are more resistant to changes in their environment. They stay fit and free of infections and diseases and maintain a high productivity.

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This improves the financial position of pig producers and improves animal welfare in pig production. To ensure robust finishers and sows, pig breeding companies have included indicator traits for robustness (such as conformation and longevity) in their breeding goals for many years.

However, as productivity increases, so does the importance of robustness and balanced breeding goals. A balanced breeding goal will not only focus on increasing productivity, but also ensure genetic gain in health and survival to improve the robustness of the pigs.

Robustness covers a variety of traits

Robustness covers a variety of traits including both productivity and health-related traits in relation to challenging environments or simply changes in the environment.

Such challenging environments might include suboptimal nutrition, high pathogen loads, temperatures that are too high or too low, or insufficient ventilation.

Robustness reflects the ability to adapt to any of these. Some breeding companies will define robustness as production efficiency, for example feed conversion, growth, meat percentage, or fertility in a challenging environment. Others also define it as resistance or tolerance to diseases and injuries, as well as reduced culling and mortality losses. However, these latter traits can be challenging to improve through genetic selection because they are difficult or costly to record, of low frequency – particularly in nucleus herds – and have low genetic variability and heritability.

Breeding companies, therefore, attempt to identify indicator traits that can be more easily measured in nucleus herds and have a higher level of genetic variability and heritability.

Conformation is an indicator for robustness

One such indicator trait for robustness is conformation, which reflects the strength and health of a pig's legs, hooves, and back, and includes anatomical anomalies that can be either innate or due to, for example, suboptimal nutrition, housing or infections.

Selection for improved robustness through conformation is expected to increase productivity and welfare, as well as to benefit the production period of finishers and production sows through a reduced risk of culling. Conformation problems can cause lameness, increase the risk of finisher culling, and are typically reported as the reason for 10-15% of sow culling. Moreover, lameness is known to involve pain and stress for the pig and to reduce productivity.

In finishers, lameness is related to reduced feed intake and growth, and in production sows, lameness is negatively correlated to the sow's reproductive ability. Conformation is, therefore, an obvious indicator trait to achieve genetic gain in robustness.

Selection for conformation

Robustness of pigs is an important part of DanBred's breeding program and has been for many years. Both conformation and longevity have been included in the breeding goals for all three breeds in the breeding program: DanBred Landrace, DanBred Yorkshire, and DanBred Duroc. In fact, DanBred has carried out selection for conformation since 1995.

Phenotypic records on conformation are collected by expert technicians, who allocate a subjective conformation score to each pig. The score is based on an evaluation of the pig's front and hind legs as well as its back and general carriage.

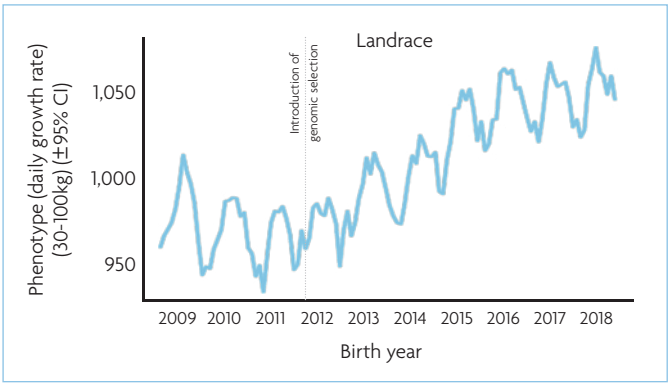
The pig's conformation is assessed while the animal is moving, because limping and lameness are not always visible in an immobile pig. To obtain an accurate and objective evaluation of conformation with the highest possible genetic variation and heritability, it is important to have an optimal environment while scoring.

Such an environment would include an anti-slip floor, and optimal light and space conditions to enable a full view of the pig and its movements – not only from the back but also from the front and side. Moreover, the pigs must be accustomed to human handling, otherwise they will be stressed during the evaluation, which could cause a different movement pattern. Lastly, proper training of the technicians is important to maximise objectivity as well as intra- and inter-observer repeatability.

Examples of undesirable conformation characteristics include inwardly or outwardly curved front legs or swayback. Examples of desirable conformation characteristics are a smooth back line and no problems observed on the legs or hooves (Figs. 1 and 2). In total, ~100,000 pigs from 23 breeding herds are performance tested each year and receive phenotypic records on conformation.

Balanced genetic progress

Selection for improved conformation has contributed to a robust DanBred pig that grows 150-200g/day faster and has a meat percentage that is 1.5-2.5 percentage points higher than 10 years ago (Figs. 3-5). With such considerable genetic progress for productivity, simultaneous selection for health- and survival-related traits, such as conformation has been paramount to ensuring healthy and



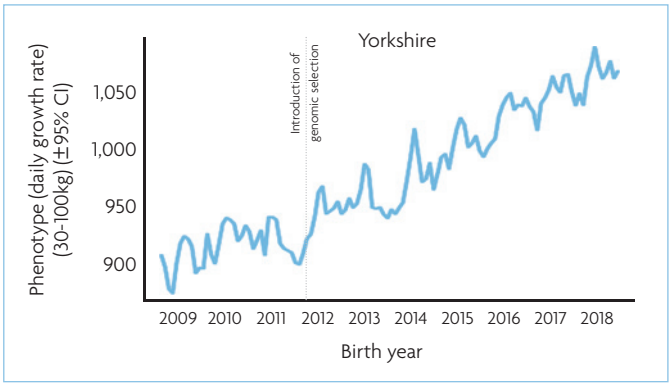


Fig. 3. The cumulative phenotypic gain of daily gain (30-100kg) from 2009-2018 in DanBred Landrace and DanBred Yorkshire, respectively.

robust pigs. It is an important reason why DanBred have never experienced any serious health issues in its breeding stock.

In the 80s and 90s, the bad example, not to be followed, is the leg health and reproductive issues in the broiler breeding industry after having selected their lines based almost solely on growth and breast meat content.

Genetics of conformation

Conformation is a low to moderately heritable trait, with estimated heritability in studies on Landrace and Yorkshire pigs typically varying between 0.04 and 0.15. The heritability will vary not only due to differences in breed, but also due to differences in the environment in which it is recorded, the environment in which the pigs have been raised, and the expertise of technicians.

In recent years, the heritability of conformation in DanBred Landrace, DanBred Yorkshire, and DanBred Duroc respectively have been 0.19, 0.15, and 0.20. The heritability determines the potential for genetic progress for conformation, but to achieve progress in robustness, favourable genetic correlations to other robustness traits are required.

A study from 2015 on DanBred pigs showed that the conformation score had a favourable genetic correlation to the number of live-born piglets of up to 0.36, as well as a favourable genetic correlation to the weaning-to-service interval in second parity of -0.35. This means that pigs with a higher (good) conformation score tend to give birth to more live piglets and come more quickly into heat after weaning than pigs with a lower (bad) conformation score.

Maximising future progress

DanBred has developed a new method to evaluate the conformation of pigs in the performance test in the breeding program. This new method has been proven to ensure improved utilisation of the conformation recordings to determine genetic differences in robustness among the candidates. The new method involves a new definition of the conformation trait, which makes it easier to differentiate between the best pigs, thereby allowing for more accurate selection of the strongest pigs as parents for the next generations.

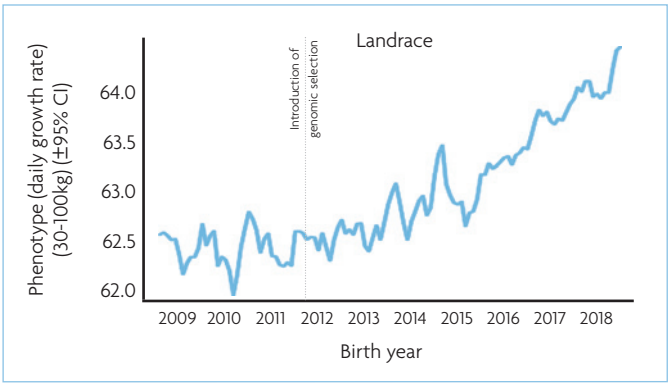
The new trait definition includes more categories on both front and hind legs, back, and general carriage, and has a higher genetic variance and heritability compared to the previous conformation definition.

With the new method, the heritability and predictive ability are improved by 10% compared to the previous conformation definition.

The heritability for conformation, i.e. the differences between pigs that are caused by genes and not environment, is now as high as 22%.

The new method will be implemented during the summer of 2019 and it is expected to result in increased genetic progress for conformation by up to 5%. ■

Fig. 4. The cumulative phenotypic gain of meat percentage from 2009-2018 in DanBred Landrace and DanBred Yorkshire, respectively.



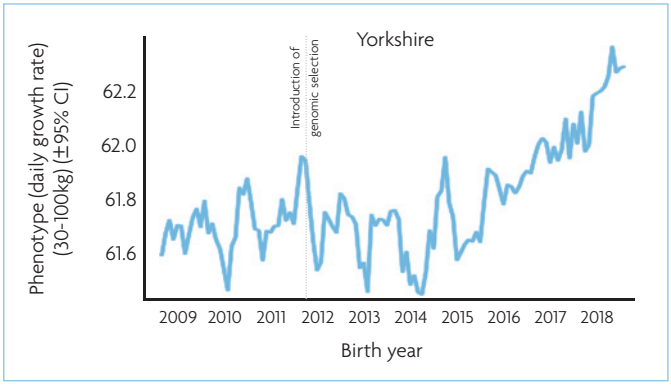


Fig. 5. The genetic gain of conformation from 2008-2018 in DanBred Landrace and DanBred Yorkshire, respectively.