Across-breed Analyses

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The main breeding objective for pigs includes several traits such as growth, carcase quantity, carcase quality and reproduction. Because of known negative genetic correlations between some of these traits (the highest known is between meat quantity and meat quality) the pig industry started very early to use crossbreeding programs to overcome these antagonisms. With antagonistic traits in the breeding goal the total possible genetic gain within a breed is reduced. There are two possible solutions to overcome antagonistic relationships: using synthetic lines or using crossbreeding programs, with synthetics only additive breed effects and a small amount of heterosis could be used. Defined crossbreeding programs enable the breeder to use breed differences, full individual and maternal heterosis and additive maternal and paternal breed effects. For practical reasons in some breeding programs synthetic terminal sire lines instead ofFlor purebred terminal sires are used. Today 3-breed or 4-breed crosses are used in commercial fattening in several countries. The genetic progress within a breed depends on the accuracy of estimation of breeding values (additive genetic values) to select parents for the next generation. In a crossbred situation the progress in the final crosses depends on the additive genetic effects of the parents involved as well as on breed differences and heterosis observed.

Do we need an across-breed evaluation?

A simple definition of an Across-breed Estimated Progeny Difference (EPD) could be given as follows:

$$\text{Across-breed EPD} = \text{Breed Effects} + \text{Heterosis} + \text{Within-breed EPD}$$

Because the estimates of average breed effects and heterosis (only obtained from crossbreeding experiments) have to be seen as fixed for short or medium time periods an Across-breed EPD can easily be calculated out of a within-breed evaluation. Be aware that there exists an Across-breed EPD for every combination of breeds for every animal!

Within modem breeding programs in pigs the decision of what breeds should be used as sires and as dams is made before the program starts depending on known or estimated breed effects and heterosis. When this decision is made there is no need for an across-breed evaluation. For most of the important traits in pigs there are large breed differences compared to heterosis and within breed differences between animals. For reproduction and fitness criteria large heterosis effects are known.

On the other hand there are some arguments to do an across-breed evaluation. In the case that purebred and crossbred information are available and combined into one evaluation analysis with the appropriate model we would have an across-breed evaluation, but the selection would still take place within breed. To get more accurate estimates of fixed effects (season or herd effects) in an evaluation could be a second reason to do an across-breed analysis with only purebred information available. This type of analysis then requires the assumption that there are the same variance- and covariance components for all breeds analysed. These models assume also that the fixed effects for purebred and for crossbred animals are the same which means no breed or cross by environment interaction.

In summary there is a need in modem breeding programs to adopt the evaluation systems so crossbred information could be included in purebred analyses. In such a complete analysis with purebred and crossbred information we would get breeding values for animals from all stages in a breeding program. These breeding values could be used to select within each group (breed or cross) of animals. In the case of using Fl crosses to produce the final crossbred product only the superiority of selected animals within the purebred lines will accumulate over time. The selection within Fl crosses can only increase the commercial production level for one generation.

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