

The pig performance testing scheme in Zimbabwe

Kennedy Dzama (2002)

*The Department of Paraclinical Veterinary Studies, University of Zimbabwe, P.O. Box
MP167, Mt Pleasant, Harare, Zimbabwe*

Introduction

Commercial pig production in Zimbabwe largely involves the use of exotic pig breeds numbering approximately 104 thousand out of a total of 295 thousand pigs (CSO 1999a, 1999b). In pig production there are many traits of economic importance and improving these traits requires improvement of the environment together with genetic improvement. The genotype of an animal sets a ceiling to which the animal can be improved through manipulation of the environment. It is, therefore, important to complement advances made in management practices by improving the pigs genetically.

Genetic improvement within breeds can only be achieved by means of selection. Selection is the act of choosing those animals which will be the parents of the next generation and which have the highest breeding value. Information on the breeding value of an animal can be obtained by testing its relatives, e.g. sibs and progeny, or by evaluating the animal's own performance. In Zimbabwe genetic evaluation of pigs is done only for the large-scale commercial pig production sector.

Genetic evaluation scheme in Zimbabwe

In Zimbabwe, the Pig Industry Board (PIB) has the mandate for genetic evaluation of pigs. This is done in two ways;

1. nucleus testing which is done centrally at the PIB station in Arcturus 30 km east of Harare; and
2. multiplication testing which is done on farm.

In both the nucleus and multiplication tests, animals are evaluated based on their own performance. Progeny testing was once a component of the nucleus test but was stopped in the early 1980s. The board at that time viewed it as an expensive methodology, which also took a long time to yield results. The current nucleus test evaluates two traits—backfat thickness and feed conversion efficiency (FCE)—while the multiplication test evaluates growth rate and backfat thickness.

Nucleus testing

This is conducted at the PIB station in Arcturus. Pig breeders from all over the country bring their animals to the central station at the PIB for testing. This system necessitates the bringing together of animals from different sources, which is contrary to the basic principles of disease control. To reduce the risk of spreading diseases the animals are quarantined for three weeks at the PIB quarantine station before being moved into the main station. While the animals are in quarantine, a veterinarian inspects them on a weekly basis. Any animal that dies in the station is sent to the veterinary laboratories for post mortem.

The breeder pre-selects the animals to be sent for testing. Both boars and gilts are eligible for testing. Pigs are only taken in for testing if they are from gilt litters of not less than 9 born and 7 weaned and sow litters of not less than 10 born and 8 weaned. Control over numbers weaned per litter assists in standardising the pre-test environment.

Performance is measured from 35–86 kg live weight. During this period the pigs are individually fed and all the feed issued is recorded. The animals are tested on a restricted feeding system. Any treatments carried out on the pigs are recorded. At the end of the test, the FCE is calculated and backfat thickness measured. The amount of fat is measured at the P2-position, which is 7½ cm from the midline along the last rib. This is the same position used by government graders on slaughtered pigs throughout the country. The two measurements (FCE and backfat thickness) are used to decide whether to cull or keep an animal. Other data available on the animal include its pedigree, date of birth, its birth weight, 21-day weight and weaning weight.

Selection is based on a method referred to as independent culling levels (ICL). With ICL, a minimum standard is set for each character and an animal is kept if it exceeds the standard for all characters. At PIB each combination of the two traits is given a score. This score is calculated based on the profitability potential of a herd with that trait combination. The profitability potential is based on an income over feed costs index. The base profitability potential is set at 100, representing a backfat thickness of 20 mm in boars and 21 mm in gilts and a FCE of 2.7 between 35 and 86 kg. Proportional figures for different levels of performance are then calculated from the baseline. In the PIB nucleus test, all pigs that score below 100 are culled. Selection is therefore based on the animal's phenotype and an economic score. Neither genetic values or breeding values are calculated, nor are they used for making selection decisions in this test.

For animals passing the nucleus test, a visual appraisal on external features is also done. In doing the visual appraisal the following factors are considered:

- pigs with obvious faults such as genetic conditions like hernia and cryptorchidism are rejected and pigs with leg weaknesses are also culled
- the gait of the animal should be free and easy and not stiff
- the pasterns should be short and inclined upright
- widely open and unbalanced digits are undesirable
- the animal to be selected should be wedge-shaped
- the shoulders should be light in relation to the hams
- the hams should be filled down to the hock
- the animal should have at least twelve well-developed and evenly spaced teats animals with blind or inverted teats are culled
- males with poorly developed testicles are culled

A disadvantage of this system is that it is subjective but the best guideline is to keep a picture of an ideal pig in mind. Culling of animals with excellent index scores is avoided if possible. The breeder is notified of the results of the animal. Animals that fail the test are sent for slaughter and approved animals are sold back to the breeders. The breeders can either sell the animals or retain them on their farm for further breeding.

Multiplication testing

The test is conducted on the breeders' farms by PIB officers. The animals tested are the progeny from either nucleus or multiplication tested animals. Animals are pre-selected in the same manner as in nucleus testing. Recording is carried out by the farmer using performance cards supplied by PIB. Information recorded includes the animal's pedigree, date of birth, its birth weight, 21-day weight and weaning weight. After weaning, animals are weighed periodically depending on the farmer's preference. The test runs until the pigs attain a weight of 86 kg. The PIB staff visit the participating farmers once a month to see if records are being collected properly and to answer any queries the farmers may have about the scheme. In multiplication testing, the number of animals tested is not limited. Approval is based on the animal's age at 86 kg, which is an indirect measure of average daily gain and also the amount of backfat at the P2 position. As in the nucleus test, the system is based on independent culling levels and the following approval standards are used:

	<u>Boars</u>	<u>Gilts</u>
Age to reach 86 kg	≤170 days	≤175 days
Backfat at position P2	≤19 mm	≤20 mm

Any animal with values above the stated values is culled. Animals that pass the test are used within the herd or made available for sale to other producers. Some breeders even export seed-stock animals to countries in the region.

Strengths and weaknesses of the scheme

Traits

Selection of pigs at both the nucleus and multiplication stages is based on two traits only while others traits like litter size and conformation are selected for indirectly during pre-selection. There is clearly a need to include other economically important traits in the current selection programmes. Traits like litter size, mortality, three-week weight (which is highly correlated with the dam's ability to produce milk), weaning weight and boar fertility are important in Zimbabwean pig production systems (Mungate et al. 1999). To improve accuracy of selection of some traits with low heritabilities, e.g. litter size, it may be necessary to employ progeny testing at the nucleus level (Shoniwa and Dzama 1995).

Progeny testing

Initially progeny testing was used to evaluate the genetic merit of pigs at PIB. Progeny testing was abandoned because it was considered costly and it also took more time to assess the animals compared with assessment of the animal's own performance. Despite these demerits, progeny testing in combination with the animal's own performance would provide a strong foundation for testing animals at PIB, especially if the set of traits is expanded to include litter size as recommended. The accuracy of selection for traits with low heritabilities, like litter size, will be enhanced significantly. The accuracy of prediction of additive genetic value from records on 30 progeny for a trait with a heritability of 0.1 would be twice as great (0.66) as that of predicting breeding value from the animal's own record (0.32). In addition progeny testing is important for evaluating traits which are sex limited (e.g. litter size) or traits where destructive sampling is involved (e.g. carcass traits).

If progeny testing is reintroduced at PIB it may become necessary to promote extensive use of artificial insemination (AI). This will enable boars to be used faster and more widely— thus generating larger databases for more accurate evaluations. Currently the use of AI in the industry is almost non-existent. The economic benefits in terms of increased FCE, improved litter sizes and leaner carcasses derived from accurate selection of pigs of high merit at national level far outweigh the costs of progeny testing.

Data management and analysis

Progeny testing will result in generation of large data sets, which will inevitably need to be stored on a powerful computer. Data on animals' progeny and relatives will not only be collected on station but also on farm through the existing PIB multiplication scheme. Even though data collection and record keeping at the PIB is meticulous, there is need for computerisation. The database created will be analysed with powerful statistical tools to generate estimated breeding values (EBV) for the traits of interest. An EBV is an estimation of the genetic value of an animal. It indicates its value as a parent. EBVs can be updated as more information on the animal's progeny and relatives becomes available. EBVs can be used to construct a selection index incorporating the breeder's choice of traits. The current selection methodology in use at the PIB uses phenotypic records and breeding values are not computed.

One of the biggest strengths of the scheme is that it has fostered the culture of keeping records among farmers. This will make computerisation and analysis of records easier. Farmers are already working in close liaison with PIB staff and this will make it easier to implement new programmes or upgrade existing ones.

One tool that can be used to compute EBVs is called Best Linear Unbiased Prediction (BLUP), (van Vleck et al.1987) consisting of mixed model equations which take into account the heritability of the trait, the amount of information available for each boar or sow, the genetic level of the herd, genetic trend and non-genetic factors such as management groups. In the southern Africa subregion, the genetic evaluation scheme in South Africa is the only one that uses BLUP to compute breeding values for breeding animals. Besides Zimbabwe no other country in the region has an organised performance testing and recording scheme.

Feeding system during test

In Zimbabwe, selection of breeding stock on the performance testing programme at PIB is based on the restricted feeding system. However, the majority of producers raise their pigs on an *ad libitum* feeding system. It is therefore important to test animals under the feeding system that their progeny will experience on the different farms. This will prevent genotype x environment interaction. Under the current system, the ranking of animals may differ under the two feeding regimes practised on farm and on station.

When one tests animals under a restricted feeding system one will be limiting the genetic potential of some animals. Testing of animals on an *ad libitum* or 'to appetite' basis has its disadvantages. As the pig proceeds to satisfy its appetite on an *ad libitum* system, its FCE will start to deteriorate and its lean content to decline because of increasing fat deposition. Thus, selection for carcass lean content and FCE on *ad libitum* feeding will tend to favour pigs with a lower appetite. Pigs with lower appetites have serious problems during and after lactation. It is imperative therefore that the feeding system during the test at PIB matches the one practised on farm.

Other constraints

The method of selection used by PIB is the ICL. This is not the most efficient method of selection in livestock production (Dzama 1993). The major disadvantage of using ICL is that superiority for one character is not allowed to offset lack of merit for a different character. In addition the profitability potential that is used to calculate the culling level needs to be updated frequently so that it is in line with the prevailing economic environment. The profitability potential currently in use at the PIB was last updated more than a decade ago.

Perhaps one of the most serious threats to the PIB performance testing scheme is the steady decline in the number of farmers participating in the scheme. The number of farmers actively involved in the nucleus scheme has declined from a peak of ten breeders in 1980 to the current three breeders, with more breeders set to exit in the near future. The pig population on large-scale commercial farms itself has fallen from 125 thousand in 1997 to 104 thousand in 1999 (CSO 1999a). Some of the reasons cited for the decline in the membership of the scheme include the land redistribution programme in Zimbabwe since 1980, unsuccessful attempts to form rival splinter schemes and lack of funding in the face of spiralling costs. The PIB officers have visited fewer and fewer farmers in recent years to conduct multiplication testing. In addition, the pig producers do not seem to appreciate the economic benefit from improved genetics primarily because of cheaper inputs like labour.

Conclusions

There is clearly a need to improve the reproductive performance, growth rates and carcass characteristics of pigs in Zimbabwe. This can be achieved by having sound genetic evaluation schemes. Certainly the PIB scheme provides a sound base from which to launch the proposed improvement programmes. This is possible because the basic infrastructure is there. Moreover, at the central station farmers already appreciate the value of record keeping. In future, it may also be necessary to include small-scale farmers who now keep more pigs than the large-scale commercial sector.

Questions for discussion groups

1. Do you think traits of economic importance are the same for all pig production systems worldwide and why?
2. Do you think African countries should have livestock evaluation schemes for production systems based on imported pigs?
3. Discuss the merits and demerits of progeny testing. Do you think the merits outweigh the demerits? Would you recommend it for testing pigs in your country?
4. Why is it that farmers may not be interested in joining national livestock testing schemes?

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