Phenotypic trends for traits of the growing pig and the sow

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Looking backwards to move forward

Information about changes in performance of commercial pig populations is limited in Australia. At the workshop in 2006, genetic and phenotypic trends for the period from 2000 to 2005 were reviewed demonstrating genetic and phenotypic improvement in key performance traits such as growth rate, backfat and litter size (Hermesch, 2006). The average annual genetic gains from 2000 until 2005 based on 28 populations were 5 grams per day for growth rate, -0.15 mm for backfat and 0.07 piglets per litter for number of piglets born alive. Although phenotypic trends for eight Large White populations corresponded well with these genetic trends, data were limited in regard to the number of populations and traits investigated as well as the time period considered. Therefore, it was the aim of this study to provide a general overview of phenotypic trends for performance traits of the growing pig and the sow from 1996 until 2009 in Large White, Landrace and Duroc populations. Further papers presented at this workshop will then provide more detailed information about genetic and non-genetic factors influencing individual traits. It is hoped that discussions at the workshop will foster adoption of a wider range of traits for the development of strategies that combine genetic potential with the appropriate management practices to optimise performance and welfare of pigs.

Outline of data available

The analyses included 35 populations from 14 herds. A population was defined as a genotype performing in one environment. Therefore a herd may include multiple genotypes and an individual genotype may be represented in multiple herds. Phenotypic trends are shown for Large White, Landrace and Duroc breeds based on 14, 11 and 8 populations respectively. There was considerable variation in the size of individual populations and phenotypic trends were derived as the mean of the average annual performance of each population to avoid dominance of trends by the largest populations. Data from 1996 until 2009 were available for most populations. Phenotypic trends over this period also included data from five populations that had only data from 2005 until 2009 available, since their mean performances did not differ markedly from the other populations.

Traits of the growing pig included lifetime average daily gain, backfat at the P2 site and muscle depth along with information about the weight and age of pigs at recording. Reproductive traits of sows incorporated the number of piglets born alive and born dead. Weaning to conception interval and mating interval between the first and second parity were investigated to quantify rebreeding of primiparous sows. Limits for all traits were based on three standard deviations from the mean in each population.

Performance of the growing pig

1. Trends in observed performance

Lifetime growth rate has increased from approximately 600 grams per day in 1996 to approximately 670 grams per day in 2009 in all three breeds. This improvement in performance corresponds well with the mean annual genetic improvement of 5.0 grams per day observed by Hermesch (2006). Performance in backfat has improved in all three breeds, although the rate of improvement differed between breeds (Figure 1b). Mean performance in backfat was reduced most in Landrace which had the highest backfat in 1996. Mean performance between years was most variable for Duroc due to the reduced number of records available for Duroc populations in comparison to the other breeds.

These trends show observed performance in growth rate and backfat ignoring the effect of changes in weight at recording. Weight at recording was lowest in Duroc across all years (Figure 2a). However, mean weight at recording has increased in all three breeds during the last three years until 2009. The trends for mean age at recording (Figure 2b) are a consequence of the improvements in lifetime growth rate as well as changes in weight at recording, which is determined by market requirements. Age at recording has been reduced by approximately 14 days from 1996 and 2006 followed by a plateau or even an increase in age at test due to an increase in test weight, which reflects an increase in slaughter weight.

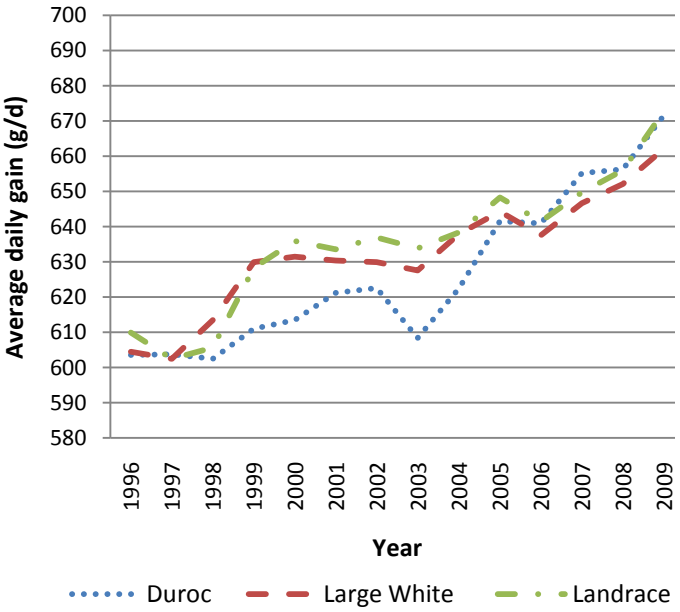

Figure 1a. Phenotypic trend for lifetime growth rate for Duroc, Large White and Landrace populations

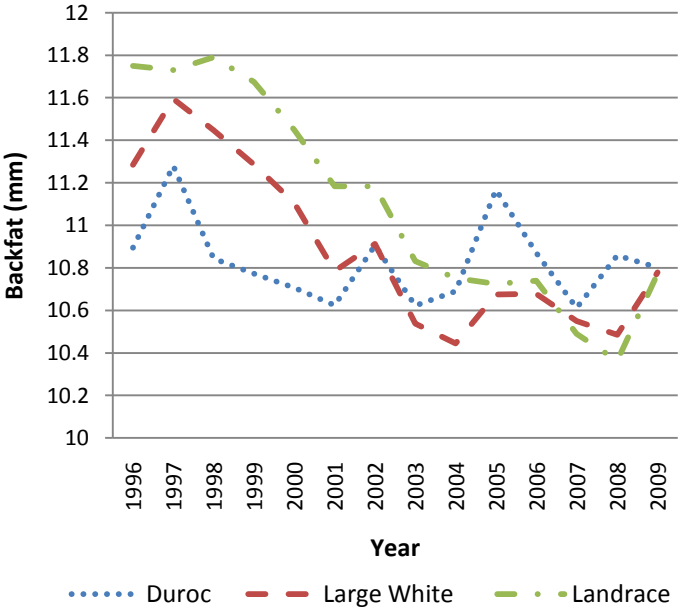

Figure 1b. Phenotypic trends for lifetime growth rate in Duroc, Large White and Landrace populations

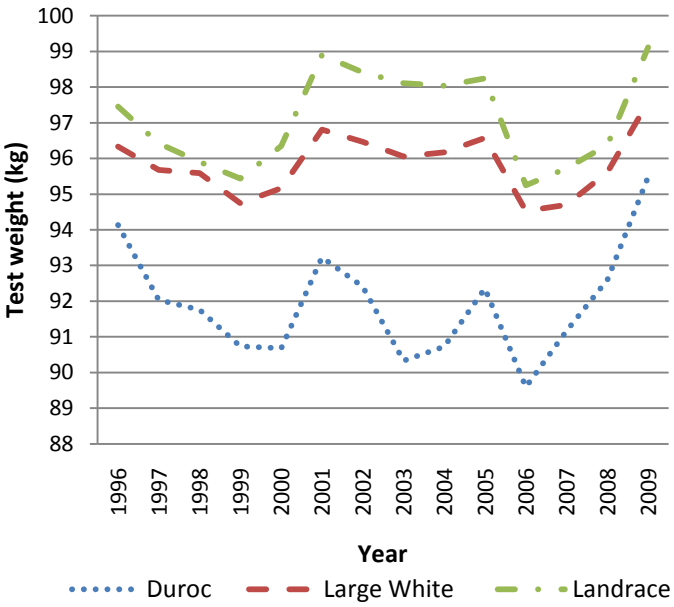

Figure 2a. Phenotypic trends for test weight in Duroc, Large White and Landrace populations

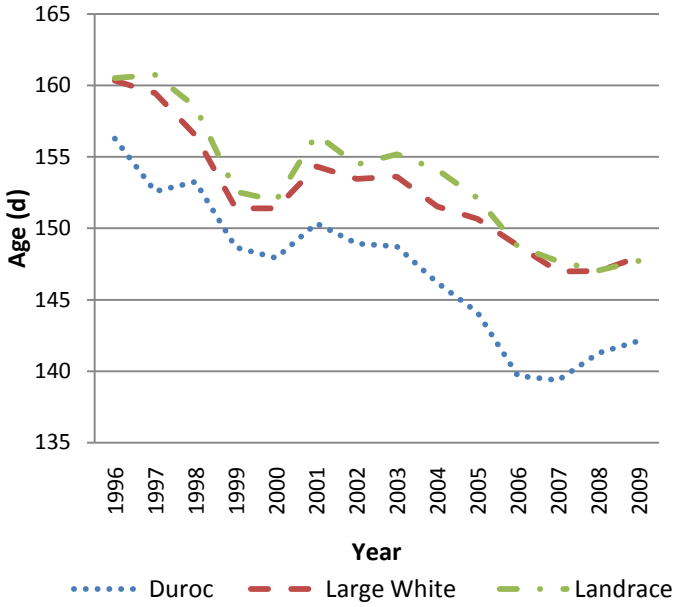

Figure 2b. Phenotypic trends for age at test in Duroc, Large White and Landrace purebred populations

2. Trends in growth rate and backfat adjusted to 95 kg body weight

The phenotypic trend for growth rate adjusted to 95 kg body weight was highest for Duroc (Figure 3a) due to their lower test weight. Improvement in adjusted growth rate was approximately 60 grams per day in Duroc and 50 grams per day in Large White and Landrace. Therefore, some of the improvement in observed growth rate was due to an increase in test weight from 2006 and 2009. A heavier weight at test increased growth rate considerably. Growth rate improved by 5.6 grams per day for each kg increase in body weight at test. Therefore, comparison of mean performance of growth rate should take differences in test weight into account.

Backfat adjusted to 95 kg body weight reduced by approximately 1.2 mm from 1997 until 2004 in Large White and Landrace (Figure 3b). Since then, backfat levels at a constant weight have remained relatively stable in these two breeds. Means were more variable in Duroc due to the lower population sizes. However, performances in backfat adjusted to 95 kg body weight were similar for all three breeds in 2009. Landrace is predominantly regarded as a maternal breed. However, reduction in backfat was strongest for this breed resulting in the lowest backfat since 2007. This demonstrates the low fatness levels prevalent in maternal genotypes in Australia due to the strong market incentives for leanness.

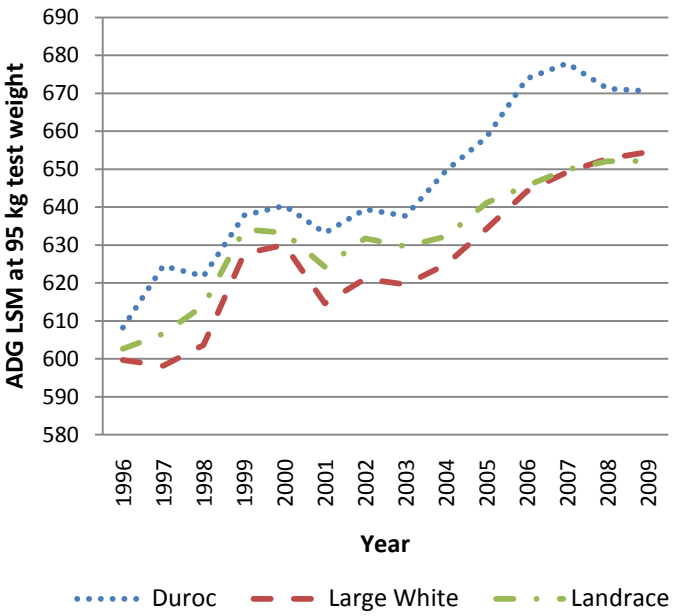

Figure 3a. Least Squares Means (LSM) for growth rate adjusted to 95 kg test body weight

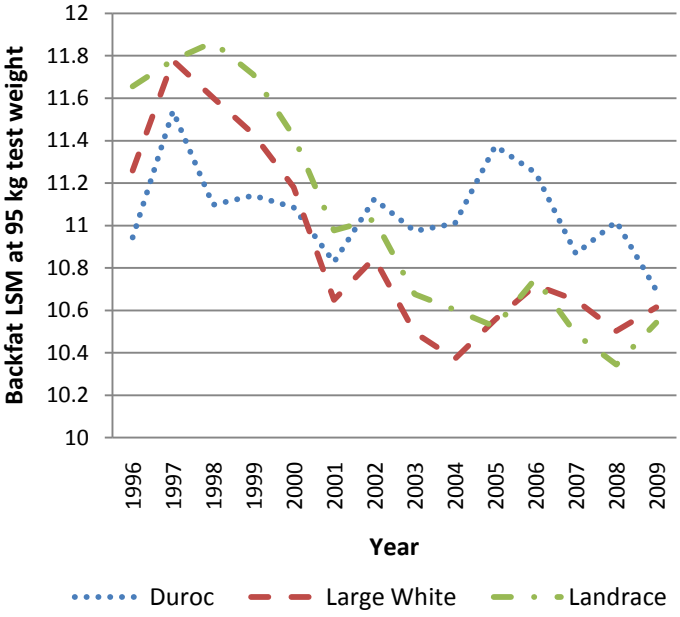

Figure 3b. Least Squares Means (LSM) for backfat adjusted to 95 kg test body weight

3. Phenotypic trends for muscle depth

Muscle depth was available for ten populations from 2001 until 2008. Raw phenotypic means show a general upward trend of one millimetre (Figure 4a). This trait is affected by the weight of animals and muscle depth adjusted to 95 kg live weight increased by 1.5 mm over seven years (Figure 4b). This phenotypic improvement of muscle depth of over 0.2 mm per year exceeded the mean genetic trend of 0.05 mm per year (Hermesch, 2006). However, it corresponds well with the mean genetic gain of 0.2 mm in this trait achieved by the top 25% of populations for this trait.

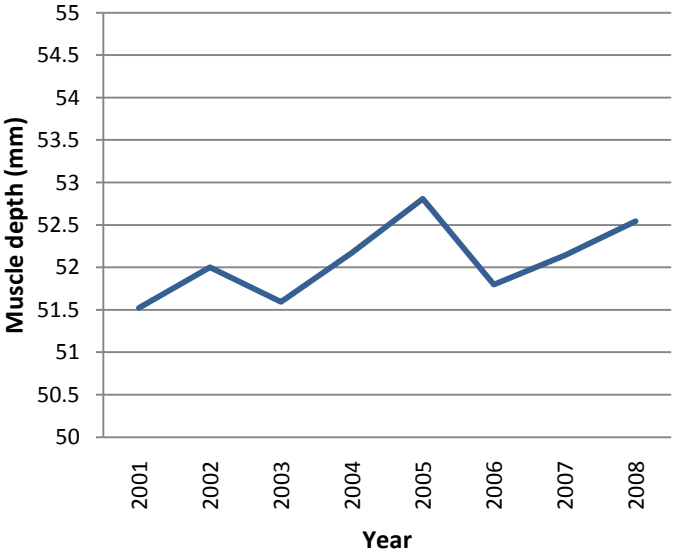

Figure 4a. Phenotypic trend for muscle depth observed in 10 populations

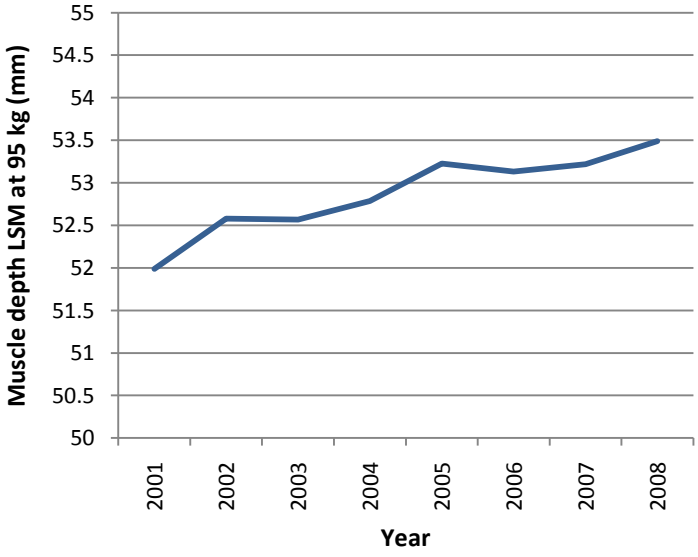

Figure 4b. Least Squares Means (LSM) for muscle depth adjusted to 95 kg test body weight

Performance of the sow

Performance in litter size has increased in Landrace in contrast to a more stable trend in Large White (Figure 5a). However, further investigations of litter size in the first and second parity in Large White and Landrace populations revealed an increase in litter size of approximately one piglet from 2003 until 2007 in these younger sows (Figures 6a, 6b). Comparison of these trends indicates that the lack of phenotypic improvement in litter size during this time period seems to be due to older sows.

The Duroc breed is predominately regarded as a terminal sire breed in Australia and less emphasis has been placed on genetic improvement of litter size in this breed. Therefore, the observed change in mean litter size across populations of 0.6 piglets over three years is mainly due to non-genetic influences including sampling effects in these smaller populations.

Number born dead has continuously increased in all three breeds since 1996 (Figure 5b). This increase in number of piglets born dead was largest in Duroc from 2002 until 2009. The unfavourable consequences of selection for lean meat growth and litter size on piglet survival have been outlined by Bunter (2009) and will be discussed further during this workshop.

Weaning to conception interval after the first parity has decreased by approximately four days since 1996 in all three breeds investigated (Figure 7a). However, there has been considerable variation in mating interval between the first and second parity (Figure 7b). This trait is affected by gestation length and lactation length. Gestation length did not vary considerably between years and a positive phenotypic trend in gestation length of approximately two days from 1996 until 2009 was observed. Lactation length was variable across years, although the exact reasons for this variation between years are unknown. The increased mating intervals observed in 2000 and 2008 coincided with a higher proportion of first parity sows with a short lactation length of less than 15 days. In these years, six and five per cent of gilts had a short lactation in comparison to one to two percent in other years.

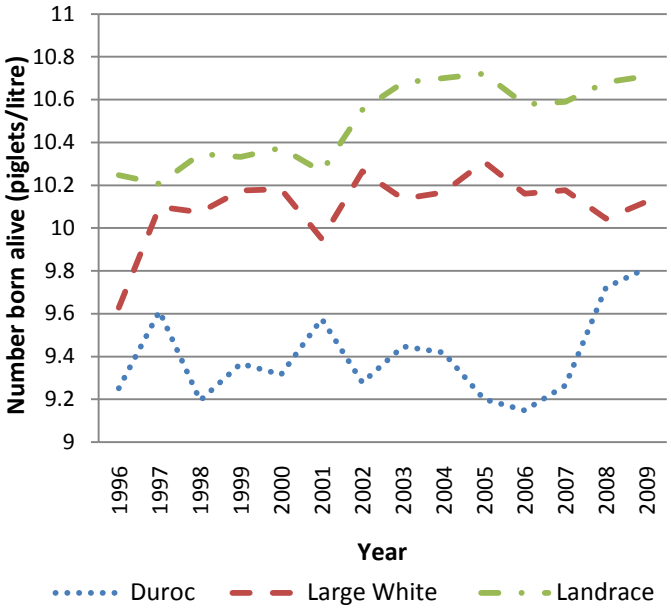

Figure 5a. Phenotypic trends for number born alive in Duroc, Large White and Landrace populations

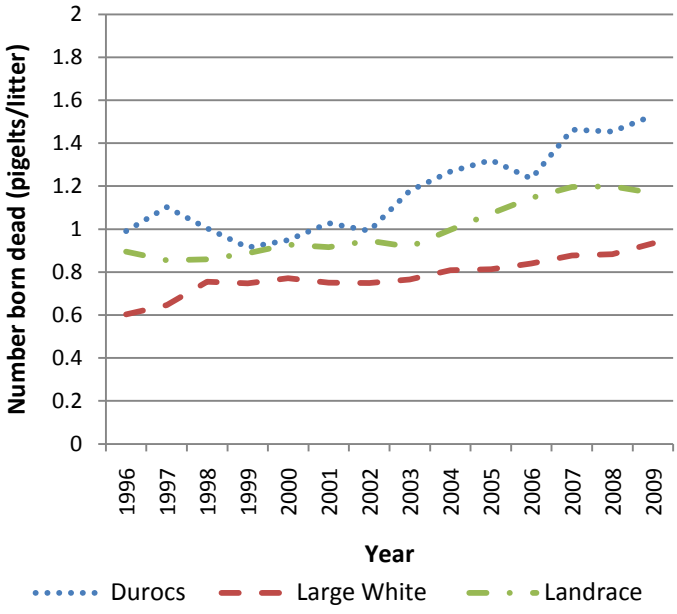

Figure 5b. Phenotypic trends for number born dead in Duroc, Large White and Landrace populations

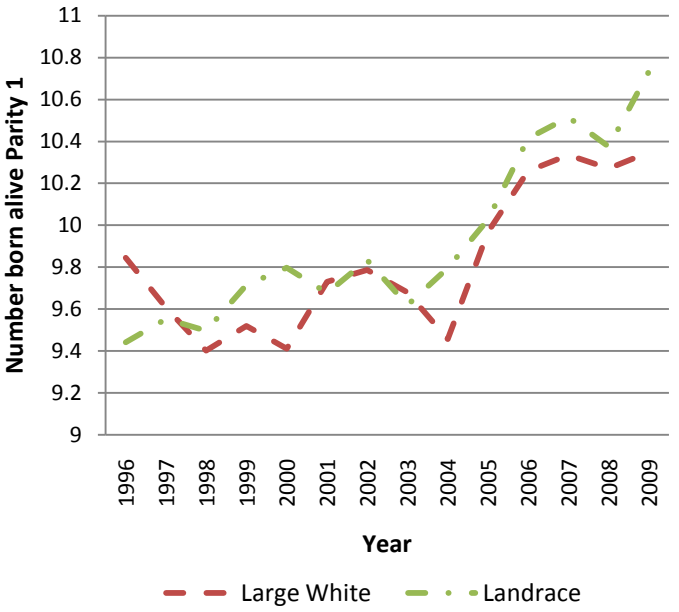

Figure 6a. Phenotypic trends for number of piglets born alive in the first parity in Large White and Landrace populations

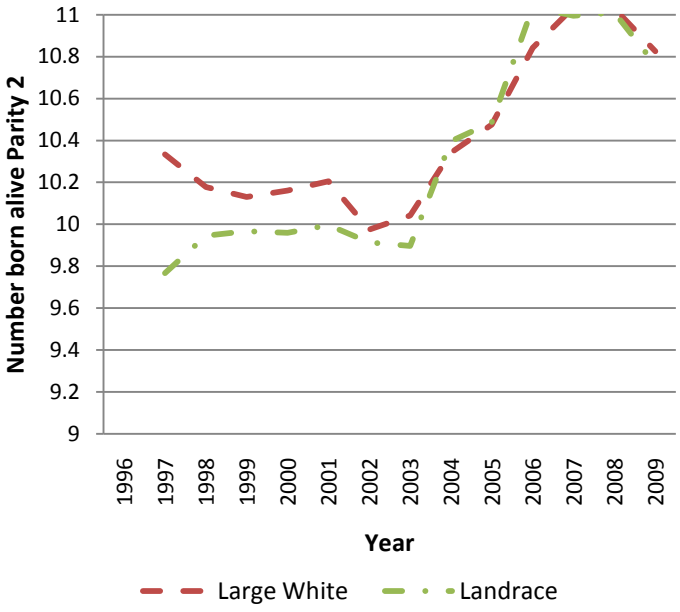

Figure 6b. Phenotypic trends for number of piglets born alive in the second parity in Large White and Landrace populations.

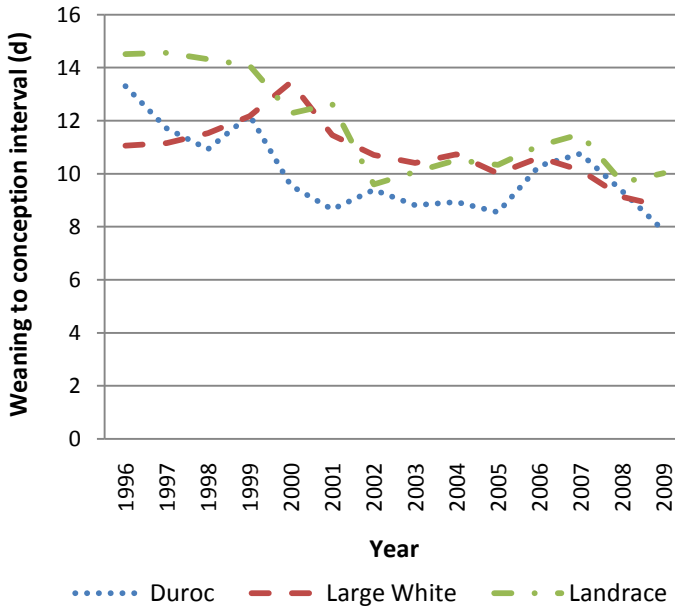

Figure 7a. Phenotypic trends for weaning to conception interval in Duroc, Large White and Landrace populations

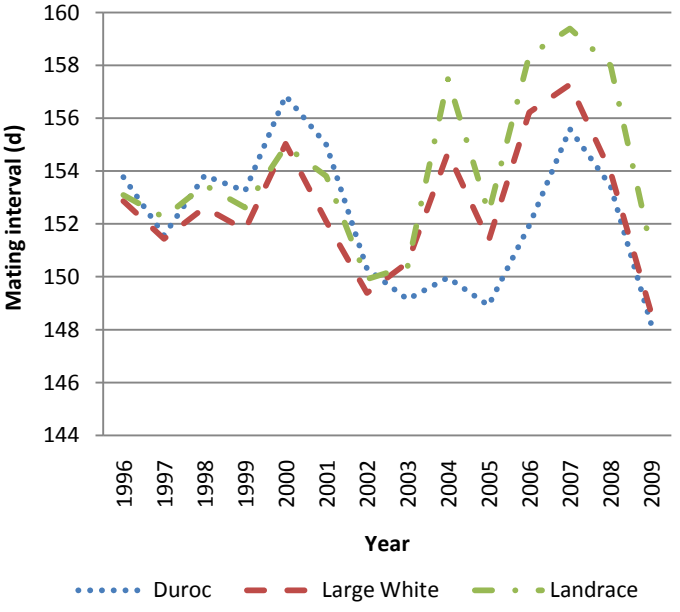

Figure 7b. Phenotypic trends for mating interval in Duroc, Large White and Landrace populations

Summary

There has been a continuous improvement in growth rate from 1996 until 2009, which reduced age at slaughter by about 14 days. Regression analyses demonstrated the effect of a higher weight at test on growth rate, which increased by 5.6 grams per day for each additional kg in weight at test. There was an emphasis on reducing backfat until 2003. Since then backfat levels have remained relatively stable. Muscle depth was improved by 0.2 millimetres per year in populations where this trait was recorded.

The rise in litter size was largest in Landrace which is predominantly regarded as a maternal breed. Number of piglets born alive increased by 0.2 piglets per year from 2003 until 2007 in first and second parity sows demonstrating the rate of improvement that is possible for this trait. However, there was also an increase in number of piglets born dead which requires further investigation. Weaning to conception interval after the first parity has decreased by approximately four days, although this improvement was not reflected in the phenotypic trend for mating interval which was variable between years.

Acknowledgements

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References

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Hermesch, S. 2006. “From genetic to phenotypic trends.” AGBU Pig Genetics Workshop, pp.59-65, http://agbu.une.edu.au/pig_genetics/workshop2006.html