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GENETIC PARAMETERS AND GENETIC TRENDS IN THE SINO-EUROPEAN TIAMESLAN COMPOSITE LINE

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SUMMARY

Genetic parameters of days from 20 to 100 kg (D20-100), average backfat thickness at 100 kg (ABT), teat number (TN), litter size at birth (TNB) and at weaning (NW) were estimated in the Sino-European *Tiameslan* composite line using restricted maximum likelihood (REML) methodology applied to a multiple trait animal model (MTAM). Genetic trends were then computed by averaging MTAM best linear unbiased predictions (BLUP) estimates of breeding values. The *Tiameslan* line was created between 1983 and 1985 by mating *Meishan x Jiaxing* crossbred Chinese boars with sows from the *Laconie* composite male line. It has then been selected on an index combining ABT and D20-100. Performance data from a total of 10655 pigs (5298 males and 5357 females) from 1516 litters were used in this study. The model used for D20-100, ABT and TN included the sex x batch combination as a fixed effect, the birth litter and the additive genetic value of each animal as random effects and final weight (ABT) or inbreeding coefficient (D20-100) as covariates. The model for TNB and NW included parity and farrowing batch as fixed effects, sow permanent environment and additive genetic value of each animal as random effects, age within parity, sow and litter inbreeding coefficients as covariates. Heritability estimates were 0.71±0.02, 0.39±0.02, 0.53±0.02, 0.15±0.03 and 0.08±0.03, respectively, for D20-100, ABT, TN, TNB and NW. The genetic correlation between DE20-100 and ABT was positive, i.e. favourable (0.18±0.03). TN had low genetic correlations with both DE20-100 and ABT (respectively, 0.09±0.03 and 0.06±0.04). DE20-100 had unfavourable genetic relationships with both TNB and NW (respectively 0.18±0.07 and 0.39±0.08). Genetic correlations between ABT or TN and litter size were close to 0 at birth and positive, i.e. unfavourable for ABT (0.16±0.06) and favourable for TN (0.34±0.14) at weaning. Large genetic trends were obtained for D20-100 and ABT (respectively, -1.2 day/year and -0.6 mm/year). Genetic trends for TN, TNB and NW were slightly positive.
Keywords: pig, genetic parameters, Chinese breeds, composite line

INTRODUCTION

Prolificacy becomes a major component of the economic efficiency of pig production, but is difficult to improve through selection because of its low heritability (around 0.1 - Haley *et al.*, 1988). Another possible way to increase sow prolificacy is to take advantage of the outstanding reproductive ability of some native Chinese breeds such as *Meishan*, *Jiaxing*, *Fengjing* or *Min* breeds. Legault and Caritez (1983), Bidanel (1993), Haley *et al.* (1995) and Young (1995) confirmed the high prolificacy, the good mothering ability and the strong hardiness of *Meishan*, *Jiaxing*, *Fengjing* and *Min* purebred and crossbred sows. However, their poor growth and carcass performance makes it very difficult to use them in crossbreeding systems, particularly in markets where heavy slaughter weights are required (Bidanel *et al.*, 1991). This problem may be overcome by creating a « Sino-European » composite line and selecting it for growth and carcass traits (Bidanel *et al.*, 1991). The Pen Ar lan breeding company has undertaken since 1983, in

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collaboration with INRA, the constitution and selection of a Sino-European composite population, the *Tiameslan* line. Estimated genetic parameters and genetic trends after 12 years of selection, as well as first results on the use of the *Tiameslan* line in crossbreeding, are presented in this paper.

MATERIAL AND METHODS

Creation and selection of the Tiameslan line. The Tiameslan line was created by mating in the summer of 1983 by mating 21 *Meishan* x *Jiaxing* F1 boars to 55 multiparous European sows selected for their high reproductive performance. No immigration has occurred later. Sows were allowed to produce only one litter until 1988 and were kept for several litters as in a standard nucleus herd since then. The size of the line has changed from around fifty sows in early generations to more than 200 sows. All male and female animals were recorded for teat number (TN) at birth and, with the exception of animals born in small litters and of a limited number of runt piglets, were performance tested between 20 and 100 kg live weight. They were given *ad libitum* access to a diet containing 3200 kcal of DE and 17.5% CP. Animals were weighed at the beginning and at the end of the test period and measured for backfat thickness (BT) on the same day as final weight. BT was measured on each side of the spine at the levels of the shoulder, the last rib and the hip joint. A total of 10655 pigs (5298 males and 5357 females) from 1516 litters were performance tested. Breeding animal were selected on an index comprising the average of the six BT measurements (ABT), adjusted to a 100 kg basis, and days on test (DT), computed as the difference between the age at the end and at the beginning of the test period, adjusted to 100 and 20 kg, respectively. More details on the creation and selection of the *Tiameslan* line can be found in Ducos *et al.* (1992).

Statistical analyses. (Co)variance components for DT, ABT, TN and litter size at birth (TNB = total number born) and at weaning (NW = number of piglets weaned) were analysed using restricted maximum likelihood (REML) methodology applied to a multiple trait animal model. The model for DT, ABT and TN included the sex x batch combination as a fixed effect, the birth litter and the additive genetic value of each animal as random effects and final weight (ABT) or inbreeding coefficient (DT) as covariates. The model for TNB and NW included parity and farrowing batch as fixed effects, sow permanent environment and additive genetic value of each animal as random effects, age within parity, sow and litter inbreeding coefficients as covariates. The analyses were performed using the 3.2 version of the VCE software (Groeneveld, 1994). Genetic trends were estimated by averaging breeding values of animals with records at each generation (until 1988) or each year (after 1988). Breeding values were computed using the same model as described above and previously estimated variance components. The PEST software (Groeneveld *et al.*, 1990) was used to run these analyses.

RESULTS AND DISCUSSION

Average values and phenotypic standard deviations for the 5 traits studied are shown in table 1. It should be noticed that phenotypic standard deviations for ABT and, to a lesser extent DT, are much larger than usual literature values.

Estimates of genetic parameters and of phenotypic and genetic trends are shown in table 1 and figure 1, respectively. Heritability values for ABT and TN are larger than average literature values (Stewart and Schinckel, 1990 ; Ducos, 1994 ; Ligonesche *et al.*, 1995) and those previously obtained for ABT by Ducos *et al.* (1992). Conversely, heritability estimates for DT, TNB and NW do not widely differ from average literature values. ABT and DT tend to be favourably correlated. They show low genetic correlations with TN, but have unfavourable genetic relationships with NW and, for ABT, with TNB. The low genetic correlations between production traits and teat number is in agreement with most literature estimates (e.g. see Ligonesche *et al*., 1995). Production traits are also usually considered as genetically independent of litter size (Haley *et al.*, 1988). The genetic antagonism evidenced in the *Tiameslan* line may either come from the existence of linkage disequilibrium between genes affecting production and reproductive traits or from pleiotropic effects of quantitative trait loci. A linkage disequilibrium was obviously present in F1 animals and may have been maintained in later generations due to selection for growth rate and carcass leanness. ABT decreased at a rate of 0.6mm/year during the first ten years and then remained almost constant. DT also improved at a higher rate during the first ten years, at a rate of about 1.2 day/year. The lack of improvement over the last few years is due to changes in the selection objective: main efforts were towards the eradication of the unfavourable allele at the RN locus (Le Roy *et al.*, 1990). Genetic trends for teat number and litter size at birth and at weaning were slightly positive, in spite of the negative genetic correlations between NW and both ABT and DT.

Table 1. Mean values and phenotypic standard deviations for the five traits studied.

Traits[1]	# records	Average performance	Phenotypic standard deviation
ABT	10453	11.7	3.4
DT	10453	114.4	9.5
TN	10163	14.9	2.1
TNB	1515	12.0	3.2
NW	1515	10.1	2.9

[1]ABT = average backfat thickness; DT = days on test (20 to 100 kg); TN = teat number ; TNB = total number born alive/litter ; NW = number weaned/litter.

Table 2. Estimates of genetic parameters in the Tiameslan line[1]

Traits[2]	ABT	DT	TN	TNB	NW
ABT	**0.71±0.01**	0.18±0.03	0.09±0.03	0.18±0.07	0.39±0.08
DT	0.06±0.01	**0.39±0.02**	0.06±0.04	- 0.04±0.07	0.16±0.06
TN	0.02±0.01	0.01±0.01	**0.53±0.01**	- 0.09±0.09	0.34±0.14
TNB	0.06±0.01	- 0.03±0.01	- 0.04±0.01	**0.15±0.03**	0.73±0.06
NW	0.08±0.01	0.06±0.01	0.08±0.01	0.70±0.02	**0.08±0.03**

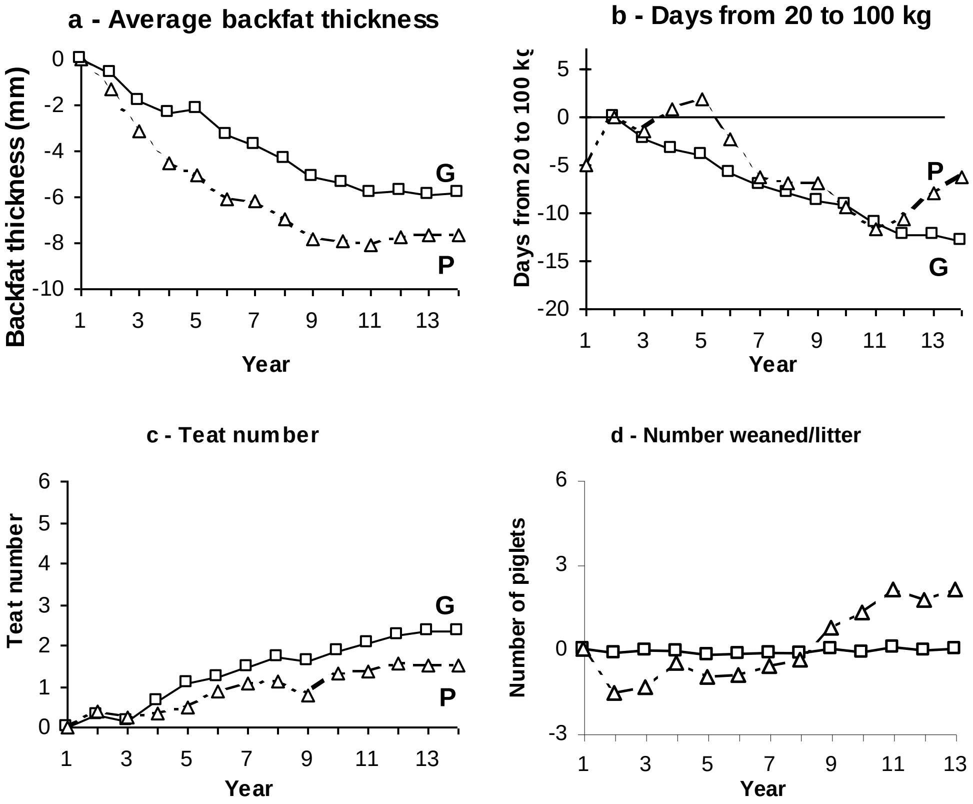
[1]Heritabilities (±s.e.) on the diagonal, phenotypic and genetic correlations below and above the diagonal, respectively). [2]See table 1 for the definition of the traits.

The *Tiameslan* has been used since 1994 as a grand parental line in a three way cross to produce sows for the French market. A comparison of growth and carcass performance of *Tiameslan*, *Carelie* (a variety of *Finnish Landrace*) and reciprocal F1 crossbred animals showed that *Tiameslan* animals still have a lower growth rate than *Carelie* pigs (+14.2 days for DT), but that this disadvantage was offset by a large heterosis effect (+13.4 days for DT). The disadvantage of the *Tiameslan* line with respect to carcass lean content has been reduced to 1.6 points of percentage (Tasias I Pitarch, 1995). With regard to litter size, on-farm results tend to show some superiority of the three-way crossbred sow involving the *Tiameslan* line as compared to their herd contemporaries, but this advantage remains to be precisely evaluated.

CONCLUSION

These results clearly show that Sino-European lines can be successfully selected for growth rate and carcass lean content without deteriorating reproductive performance. Recent advances in the knowledge of genes responsible for the differences between prolific Chinese and European breeds for economically important traits (e.g. Milan *et al.*, 1998) should be very helpful for more efficient selection strategies and a better genetic control of these lines.

Figure 1. Estimated phenotypic (P) and genetic (G) trends for economically important traits in the *Tiameslan* composite line



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