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Genetic parameters and response to selection in several herds of Iberian pigs for piglets weight at 90 days of age

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Abstract. The Piglet Index is included in the official genetic scheme for the iberian pig breed, managed since 1992 by the Spanish Association of Iberian Pig Breeders (AECERIBER). This index allows the farmers to select the candidates according with the breeding value for piglet weight at early ages. The data analysed in this work came from 14 breeds with, at least, 1000 piglets controlled in their weight in 10 different seasonal batches. First, heritabilities (h^2) and litter effect coefficient (c^2) estimates were calculated in each breed using an animal model with fixed and random effects. After, the regression of the average breeding value along time (genetic trend) was estimated also in all 14 breeds. Heritabilities and litter coefficients estimates are quite heterogeneous in their values. So, h^2 ranges from 0.00 to 0.24 and c^2 from 0.15 to 0.64. In eight breeds h^2 reaches values next to zero, results that stress the importance of the quality information (genealogic and productive) provided by the breeder. Genetic trend were positive and significant in eight breeds.

Keywords. Piglet index – Heritability – Genetic trend.

Paramètres génétiques et réponse à la sélection dans plusieurs troupeaux de porcs Ibériques pour le poids des porcelets à 90 jours d'âge

Résumé. *L'index concernant les porcelets est inclus dans le schéma génétique officiel pour la race Ibérique de porc, contrôlé depuis 1992 par l'association espagnole des sélectionneurs de porc Ibérique (AECERIBER). Cet index permet aux éleveurs de choisir les candidats selon la valeur génétique d'amélioration pour le poids des porcelets à un âge précoce. Les données analysées dans ce travail proviennent de 14 élevages avec, au moins, 1000 porcelets contrôlés pour leur poids dans 10 différentes parités saisonnières. D'abord, des estimations d'héritabilité (h^2) et de coefficient d'effet de la portée (c^2) ont été calculées dans chaque élevage en utilisant un modèle animal avec des effets fixes et aléatoires. Après, la régression de la valeur génétique d'amélioration moyenne sur le temps (tendance génétique) a été estimée également dans chacun des 14 élevages. Les estimations d'héritabilités et de coefficients de portée sont tout à fait hétérogènes quant à leurs valeurs. Ainsi, h^2 s'étend de 0,000 à 0,243 et c^2 de 0,153 à 0,640. Dans huit races h^2 atteint des valeurs proches de zéro, résultats qui soulignent l'importance de la qualité de l'information (généalogique et productive) fournie par le sélectionneur. La tendance génétique était positive et significative dans huit élevages.*

Mots-clés. *Index des porcelets – Héritabilité – Tendance génétique.*

I – Introduction

In 1992 the Ministry of Agriculture approved the Official Genetic Improvement Scheme for the Iberian Pig Breed (BOE 1992). Since the beginning of the selection program the Spanish Association of Iberian Pig Breeders has managed this Scheme. Besides a genetic index for finishing pigs (the so call Complete Cycle Index, AECERIBER 1998), several breeds take part in the scheme evaluating piglets for weight at early age (an intraherd Piglet Index, AECERIBER, 1998). The present work is a summary of the activity carried out for 14 herds with more than

1000 piglets controlled in their weights, distributed in, at least, 10 batches (group of piglets born in the same year-season). In order to preserve the identity of the herds involved in this article, they are named as H1-H14.

II – Herds and data

Table 1 gives details of the information related with the 14 herds included in this study.

The quantity and quality of the information in each herd is quite unequal; so are their sizes. As example, some of them weigh piglets once a year (H12 with 12 batches controlled in 11 years) while others, as H8, has records nearly in all the piglets born in the herd.

Table 1. Number of piglets controlled, batches and period were they took place, litters, breeding animals parents of the piglets, animals in the pedigree and, finally, sows registered in the Herd Book of the breed (census herd) in the 14 herds

Herd	Piglets controlled	Batches	Period (year-season)	Litters	Boars	Sows	Pedigree	Census
H1	1093	17	spr04-aut09	139	13	80	1132	66
H2	1890	20	aut99 - aut09	365	17	83	1928	31
H3	3382	24	spr04-aut09	544	12	125	3453	43
H4	1068	13	spr04-aut09	219	18	118	1153	113
H5	3009	27	aut94-aut09	492	23	110	3067	26
H6	2900	24	aut94-spr09	528	38	187	3266	107
H7	1930	14	aut99-spr09	310	28	229	2330	190
H8	7138	45	aut00-sum09	1188	18	369	7859	162
H9	1887	15	spr04-aut09	297	19	187	2039	147
H10	2242	15	aut01-aut09	324	20	136	2390	78
H11	2147	11	spr02-spr08	345	25	155	2264	58
H12	1289	12	aut99-aut09	195	14	128	1413	80
H13	2485	14	win01-spr07	453	35	153	2668	49
H14	4233	25	sum91-aut07	731	57	480	4502	69

Table 2 contains the main statistics in the 14 herds. The final value of the trait was the weight at the exact ages indicate in the Table obtained after a correction based in the daily gain between two consecutive weights.

Only H3, H4 and H9 work on the piglet weight at ages earlier than the rest (65-70 days), which is reflected in an inferior average weight, around 20 kg. The trait can be considered like of moderate variability, with coefficient of variation located between 17% (H10) and 27%. (H6, H7 or H9). It is important to emphasize that there are neither genealogic nor productive connections between the herds, except for some boars purchased among them. As the herds have specific conditions of climate, geographic location, facilities and handling, feeding, etc, the averages of Table 2 cannot be compared.

III – Analysis and results

1. Genetic parameters

In the first place an analysis of components of variance in each one of the herd has been carried out, with the purpose of calculate the genetic and environmental parameters. In Table 3

the obtained results appear, obtained by maximum likelihood with a linear model that includes sex and batch as fixed effects and animal and litter as random effects.

Table 2. Ages of weight, averages, standard deviations and coefficients of variation in the 14 herds

Herd	Age (days)	Average weight (kg)	Standard deviation (kg)	Variation coefficient
H1	90	29.9	5.4	18.1
H2	90	26.6	6.2	23.3
H3	70	20.4	3.9	19.3
H4	65	21.6	5.6	25.8
H5	90	27.8	5.2	18.6
H6	90	25.3	6.8	26.9
H7	90	25.0	6.9	27.4
H8	90	26.1	5.2	19.8
H9	70	19.6	5.3	27.3
H10	90	30.4	5.2	17.0
H11	90	24.3	5.2	21.6
H12	90	26.3	6.1	23.4
H13	90	24.0	5.4	22.3
H14	90	25.0	6.2	24.9

Table 3. Variance components (Va, Vc, Ve y Vp), heritabilities and litter coefficients in the 14 herds

Herd	Variance components				Heritability	Litter coefficient
	Vp	Va	Vc	Ve		
H1	8.30	0.08	1.27	6.95	0.01	0.15
H2	16.68	3.19	5.91	7.58	0.19	0.35
H3	7.75	0.38	4.96	2.40	0.05	0.64
H4	21.53	1.19	8.21	12.14	0.06	0.38
H5	22.20	1.16	9.38	11.66	0.05	0.42
H6	23.24	1.76	10.06	11.42	0.08	0.43
H7	11.64	0.00	3.81	7.83	0.00	0.33
H8	14.81	3.33	2.55	8.92	0.23	0.17
H9	14.22	3.30	5.03	5.90	0.23	0.35
H10	19.80	4.20	4.26	11.35	0.21	0.22
H11	23.56	1.66	9.42	12.49	0.07	0.40
H12	29.84	7.24	13.57	9.03	0.24	0.46
H13	24.51	1.62	7.84	15.06	0.07	0.32
H14	23.54	2.62	7.56	13.36	0.11	0.32

The results are very different among herds, as much in the variance components (differences in the total variance very great in H1 and H3 as opposed to H12), as in the coefficients. Whereas in five herds (H2, H8, H9, H10 and H12) estimates of h^2 present values next to those found in other similar studies (between 0.20 and 0.25) in Iberian pig or in white coat races (NSIF, 2002) which allows to suppose significant answers to the selection, in other eight herds (H1, H3, H4, H5, H6, H7, H11 and H13) these values of h^2 are very low, less than 10%. In a last herd (H14), heritability reaches an intermediate value between the other two groups.

The result obtained in H7, since the additive genetic variance is zero ($h^2 = 0$), and in H1 where

h^2 remains in 0.01, is worthy of mention. In the Iberian pig, even though the handlings and facilities in many farms are remote still of the habitual ones in intensive pig production, in which the environmental factors are controlled and are more homogenous, it is not expectable that the contribution of these environmental factors to the total variance of the character (values of Ve and Vc) is so important in magnitude so as that the coefficient of the genetic variance (that is, the heritabillity) is practically null. Therefore, these values of h^2, almost null, must be related to the quality of the information that from the herd has been transmitted to carry out the genetic evaluations, or because the genealogies are not the correct ones, or because abundant errors in the weights taken in the pigs exist.

The effect of the common environment that the pigs born in the same litter share, is very important in these traits measured in so early ages. Apart from three herds, again H1, H8 and H12, c^2 always surpasses 30%. Possibly in camping farrowing systems these environmental factors have greater importance. However, in H3 c^2 reached 64%, value that seems excessive for the weight to 70 days.

2. Genetic trends

The average of the genetic evaluations of all the piglets born in the same batch were obtained using the parameters of Table 3. Later, the value of the regression over the time of this average was calculated, as an estimate of genetic trend. Table 4 and the Figure 1 (herds H2 and H8) show these results.

Table 4. Coefficient of determination (R^2) and of regression (b), probability associated with b=0, cumulative response, percentage of the response over the mean trait ant economic response per piglet in the 14 herds

Herds	R^2	*b* (kg)	Prob>T	Cumulative response (kg)	Percentage over the mean trait	Economic response per piglet (€)
H1	0.39	0.003	0.0070	0.04	0.15	0.02
H2	0.96	0.251	0.0001	5.02	18.87	1.94
H3	0.08	0.002	0.1819	0.05	0.26	0.02
H4	0.07	0.010	0.3831	0.13	0.61	0.05
H5	0.70	0.028	0.0001	0.76	2.72	0.29
H6	0.72	0.038	0.0001	0.90	3.56	0.35
H7	0.21	0.000	0.1004	0.00	0.00	0.00
H8	0.64	0.036	0.0001	1.62	6.19	0.63
H9	0.11	0.037	0.2327	0.56	2.87	0.22
H10	0.66	0.080	0.0002	1.20	3.93	0.46
H11	0.40	0.053	0.0374	0.59	2.41	0.23
H12	0.20	0.098	0.1423	1.17	4.47	0.45
H13	0.33	0.031	0.0196	0.43	1.81	0.17
H14	0.18	0.026	0.0356	0.65	2.58	0.25

The results of Table 4 show a positive and significant genetic response in herds H2, H5, H6, H8, H10, H11, H13 and H14. In four of them (H2, H8, H10 and H14) estimates of h^2 were elevated and the suitable selection of the breeding animals has allowed this good outcomes. In other two (H5 and H6) in spite of the low value of h^2 (0.052 and 0.076, respectively) their perseverance in the participation of the Scheme and the selection carried out throughout this period has been translated also in positive responses (around 3% of the trait mean). The genetic trend in herds H9 and H12 indicates values similar to the previous ones, but the adjustment to the regression is very weak, non significant, due to great fluctuations that move away much of the regression straight line. In the four remaining herds (H1, H3, H4 and H7),

both because of the low heritability as of the own selection of breeding animals, the results pointed to absence of response.

Some comments needs the results of H2, whose policy of selection of boars and sows is totally conditioned by the breeding values of the candidates. It allows an accumulated response of 29% of the trait mean (Figure 1). The approximated economic response would be of almost 2 € per piglet maintained in the farm until 90 days of age. Figure 2 corresponds to the phenotypic trend in H2.

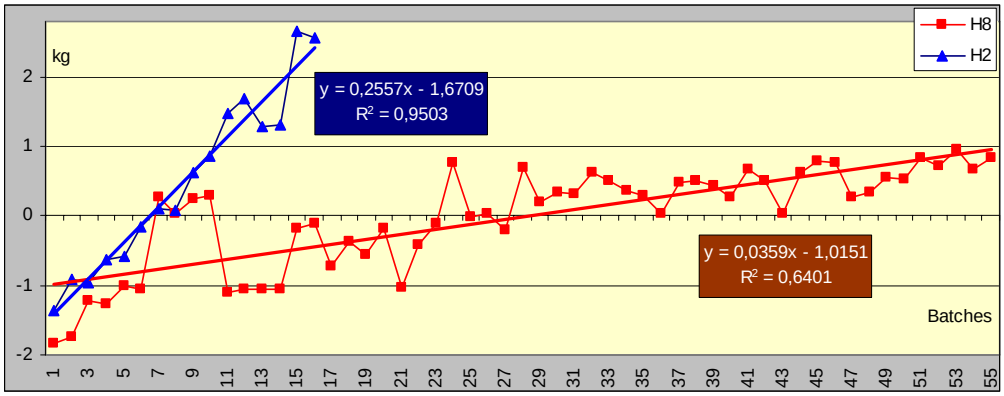

Fig. 1. Graphical representation of the average of the genetic evaluations of the animals born in each batch throughout time in the herds G8 and G2, with the line and the equation of the regression with its coefficient of determination, obtained in the analysis with the parameters of Table 3.

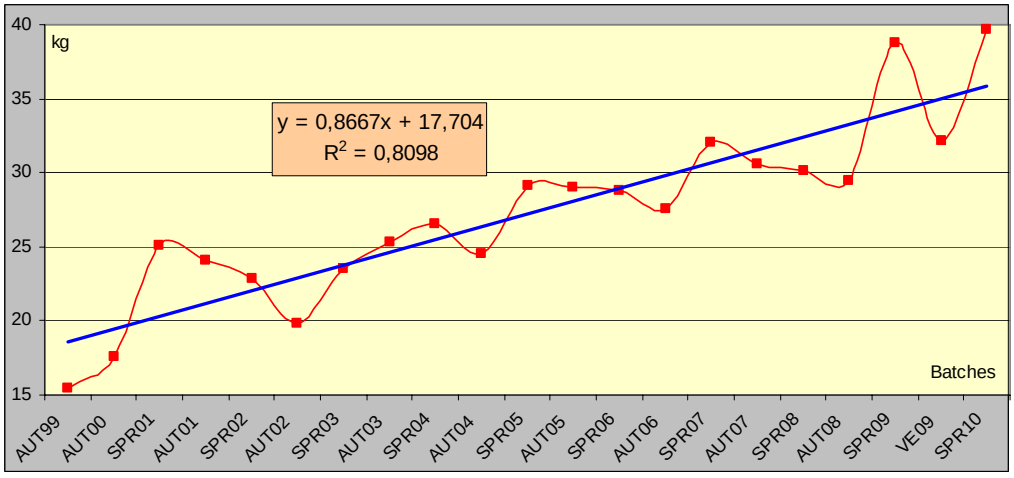

Fig. 2. Graphical representation of the phenotypic trend in the herds H2, with the line and the equation of the regression with its coefficient of determination.

IV – Conclusions

The present study allows drawing some lessons:

(i) It is possible to obtain important genetic improvements (like in herds H2, but also in H5, H6, H8, H10 or H12) in few years in certain characters of medium heritability, through the suitable election of the reproducers, especially of boars. Growth (average daily gain) and carcass composition traits (percentage of premium cuts), with greater economic relevance than piglet weight at early ages and that fulfils with the premise about h^2 magnitude, are excellent candidates for their selection in fattened Iberian pure pigs.

(ii) The genetic evaluation by itself, if it does not have any incidence in the selection of the new boars and sows, constitutes an extra effort without positive effects for the herd.

(iii) The quality of the productive and genealogical information provided by the herds to make possible the genetic evaluations is essential, since it affects to the correct estimation of the genetic parameters (heritability) and to the expected response to selection (possibility of erroneous selection of the breeding animals).

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