

Keeping the Genealogical Structure of Paternal Breed Nuclei in Pigs

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Abstract

For a long period of time pigs as farm animals were considered producing a single ware, pork. Not very long ago the pork market became interested in lean meet. Some breeders tried to have it from the old breeds and have a lent genetic progress. Other breeders decided to follow the hybridization schemes used in poultry to produce broilers. But in strains with high daily gain and gross muscles the sows fertility declined and by then by disjunction selection they have isolated strains of high fertility. Then the final animal for the market was the cross piglet obtained from these two kinds of strains or lines. The third kind of breeders decided to specializing breeds, selected for as much as possible muscle mass as paternal breeds and breeds specialized for high fertility as maternal breeds. The present paper will present the movement taking place in the genealogy of a breed nucleus of 200sows with closed reproduction. The goal of the families' movement analysis is to find out how to ensure a convenient genealogy structure preventing consanguinity when some families are extinct by selection for daily gain.

Keywords: consanguinity, genealogy in pig breeding, hibridization in pork production, swine paternal breeds

1. Introduction

For a long period of time in the human history pigs were considered producing a single good only, the pork. That time people appreciated fat carcasses because they offered an energetic food and one useful substance for many other purposes. Later when vegetable oils on a larger scale have been consumed and pork was produced for the market people became interested in lean carcasses. For this reason new fast growing swine breeds have been developed. But there is genetically contradiction between deposited and excreted production of organisms and in these new fast growing breeds fertility of sows depressed. Then breeders specialized pig populations in maternal and paternal ones. Some breeders solved the question by hybridization crossing selected maternal and paternal lines. Line, in farm animal genetics, is a small population, a group of animals that reproduce closely, in inbreeding. But

inbreeding presents the risk of undesired concentration of lethal genes and of genetically disturbances conducting to the selection program failure. Since risk of inbreeding depends on the number of family in an animal population this paper proposes to show up effect of selecting new genitor boars by daily gain self performance when in a small pig farm with closed reproduction the family structure of the flock is not supervised. Closed reproduction is wanted to prevent the contamination of the flock by bringing foreign animals in a farm of sensible animals to infectious pathogenic agents.

2. Materials and methods

The present research is based on the retro analysis of the data resulted from the official control of the daily gain performance of female progeny in a Large White farm on closed reproduction.

The reproduction flock consists, usually, from about 450 sows and about 40 boars [1]. Young

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pigs are tested for the daily gain between 91±3 days and 182±3 days of age. The thickness of the under skin fat layer is measured as well. Test series are formatted each week. Series in the present analysis are formatted out of four weekly

ones. The piglets weighting less than 20 kg at the age of 91±3 days were not accepted in the test [3]. The family structure of the flock wasn't supervised. The current family structures shown in table 1.

Table 1. Family structure of the pig flock

Family code	Cod number of boars	First series				Last series				Total series				
		Series start	Boars no.	Sows no.	Progenies no.	Series start	Boars no.	Sows no.	Progenies no.	Boars no.	Groups' no.	Sows no.	Progenies no.	
1	A	1	4.05	1	1	5	4.05	1	1	5	1	1	1	5
2	B	2.4	4.05	2	3	15	5.05	1	1	10	2	3	4	25
3	C	3	4.05	1	2	10	5.05	1	1	2	1	2	3	6
4	DD	5.6.76.66	4.05	2	4	18	3.06	2	13	45	4	11	45	285
5	EE	7.14.68	4.05	2	7	23	1.06	1	3	20	3	9	21	146
6	FF	8.67.74.75	4.05	1	4	17	3.06	1	7	54	4	11	38	281
7	GG	31.32.53.69.77.78	4.05	1	3	10	3.06	1	4	33	6	28	60	450
8	HH	9.12.27.70.71.72	4.05	3	5	12	3.06	2	11	27	6	19	53	197
9	II	11.15.21.49.65	4.05	3	6	17	3.06	1	3	20	5	19	40	153
10	JJ	13.22.23.37.73	4.05	1	2	3	3.06	1	4	17	5	15	40	165
11	K	10.19.30.43.45.48	4.05	2	4	15	12.05	1	2	7	6	20	39	138
12	L	16.26.47	4.05	2	5	14	3.06	1	3	8	3	18	35	144
13	M	17.33.38.59.61	4.05	3	10	25	3.06	1	1	5	5	33	78	322
14	N	18.46	4.05	1	1	1	3.06	1	3	15	2	10	22	100
15	O	20.29	4.06	2	4	8	11.05	1	1	6	2	12	25	101
16	P	24.42.58	4.06	1	2	3	3.06	2	8	24	3	20	58	219
17	Q	25.51	4.05	1	2	5	3.06	1	2	6	2	16	29	146
18	R	34.35	4.05	2	5	10	11.05	1	1	10	2	7	14	38
19	S	36.41	4.05	2	4	18	3.06	1	5	23	2	10	28	94
20	T	39.60	4.05	1	1	1	3.06	1	1	3	2	12	25	88
21	U	44.55	6.05	2	5	10	3.06	2	8	28	2	15	39	165
22	V	40	4.05	1	1	2	11.05	1	3	9	1	8	25	85
23	W	28	5.05	1	2	4	9.05	1	2	2	1	5	10	53
24	Y	54	6.05	1	2	2	3.06	1	2	5	1	10	26	93
25	Z	56	8.05	1	2	5	2.06	1	2	5	1	2	4	10
26	Ch	63	8.05	1	2	4	1.06	1	2	9	1	5	12	53
27	Gh	52	9.05	1	1	4	3.06	1	1	2	1	6	12	48
28	X	50.57.62.64	6.05	1	2	2	3.06	1	2	8	4	19	44	186
total											78	346	830	3796

In this research the family structure was built up by paternal origin like in human sociology.

In the above table boars are grouped in paternal families. Capital letters have been used to symbolize families. The families symbolized with two capital letters have a known grandfather. In the other families only the common father is known. In the "X" code boars with unidentified father have been grouped. The order of families resulted from the month when any of the family boars had progeny what entered the test. Series are formed of groups of piglets entering the test at

the same time. The piglets in a group have the same father and the same mother. The first test series used in this paper is placed in April 2005 year (4.05). The last one is placed in March 2006 (3.06). Thus these two series are included entirely in the table (boars, sows and progenies). That means that in January 2005, when the piglets of the first test series were born, a number of 35 boars and of 75 sows were present in the pig flock of the farm. For the same reason a number of 20 boars and of 77 sows have been present in the flock in December 2005 when the piglets which

tered the last test series were born.

Since a sow has two farrows per year the permanent number of fed sows should be estimated as something like around 450 heads. For half of the year the number of fed boars should be about 40 heads. The sow target per boar is approximated as 11 sows. The families'

sustainability is appreciated by the number of groups each family have produced and also by the time interval between the first and the last series of piglets entering the performance test. Results of selection test by the mean daily gain between 91 ± 3 and 182 ± 3 days of age are given in the table 2.

Table 2. Rank of families concerning active fertility and progenies daily gain in the self performance test

r. cr.	Fam. code	Family's boars	Reproduction			Sons			Daughters			Common	
			Sows	progeny	Rank	No.	Gain	Rank	No.	Gain	Rank	Gain.	Rank
1	A	1	1	5	28	2	500	9	3	409	28	445	27
2	B	2,4	4	25	25	13	475	25	12	418	27	448	26
3	C	3	3	6	27	0	x	x	6	424	26		x
4	DD	5.6.76.66	45	285	4	120	492	16	165	467	4	478	7
5	EE	7.14.68	21	146	19	70	496	11	76	461	11	479	6
6	FF	8.67.74.75	38	281	2	135	472	27	146	452	15	462	25
7	GG	31.32.53.69.77.78	60	450	5	223	492	17	227	467	5	480	5
8	HH	9.12.27.70.71.72	53	197	8	76	507	4	121	449	22	471	18
9	II	11.15.21.49.65	40	153	11	52	495	12	101	452	16	467	23
10	JJ	13.22.23.37.73	40	165	6	86	490	18	79	447	23	469	21
11	K	10.19.30.43.45.48	39	138	12	56	495	13	82	452	17	469	20
12	L	16.26.47	35	144	9	69	489	20	75	450	19	469	22
13	M	17.33.38.59.61	78	322	1	147	489	19	175	460	12	473	15
14	N	18.46	22	100	15	42	474	26	58	475	2	475	13
15	O	20.29	25	101	16	38	502	6	63	461	9	476	10
16	P	24.42.58	58	219	3	91	492	15	128	467	3	477	9
17	Q	25.51	29	146	13	66	495	14	80	452	18	471	19
18	R	34.35	14	38	23	18	512	1	20	443	25	476	11
19	S	36;41	28	94	14	46	510	2	48	453	14	481	3
20	T	39.60	25	88	18	43	496	10	45	461	10	478	8
21	U	44.55	39	165	10	61	489	21	104	462	8	472	17
22	V	40	25	85	20	45	501	8	40	457	13	494	1
23	W	28	10	53	24	25	478	24	28	467	6	472	16
24	Y	54	26	93	17	47	507	5	46	478	1	493	2
25	Z	56	4	10	26	6	483	23	4	464	7	474	14
26	Ch	63	12	53	21	30	504	7	23	450	20	481	4
27	Gh	52	12	48	22	25	485	22	23	447	24	467	24
28	X	50.57.62.64	44	186	7	88	507	3	98	449	21	476	12

The second table intends to classify pig families by two criteria: a) family's active fertility expressed by the number of piglets that entered the performance test b) the average daily gain of the piglet groups given by each family.

The target of these data is to show eventual relations between family sustainability and daily gain performances of progenies.

3. Results and discussion

Family structure of the flock (see table 1) consists of 27 families formed by the male ancestors and a group of 4 boars (marked as X family) with unknown fathers. There are 7 families marked with 2 capital letters (DD; EE; FF; GG; HH; JJ; KK). Let us call them "old families". This family class contains at least 3 boars and some grand fathers. There are 11 families marked with one capital letter (K; L; M; N; O; P; Q; R; S; T; U) having at least 2 boars in their structure, but no grandfather. Let us call them "young families".

Other 6 families marked with one capital letter (V; W Y; Z; Ch; Gh) represented, each of them, by 1 boar will call “new families”. Three families, at the beginning of the table, marked also with 1 capital letter (A; B; C) which have a short presence will “in extinction families”. The boars included in X class will be discussed one by one as possible genitors of “future families”.

More boars (33 heads) pertain to the old families and the young families (31 heads). Number of boars of the in extinction class (4 heads) is more or less in balance with the number of boars (6 heads) in the new family class. Some boars are living the flock from the old and from the young families as well since, counting per boar, the presence of the old family ones is 98% and of the young families 90%. Nevertheless the boars of the new families are the most active since they give 6,38 groups for performance test with a presence of only 60% of the time. The number of groups given for the test by one boar of the old family is rather low (3.39) what means they have some periods of inactivity. Better activity have the boars of the young families giving 5, 64 groups for the performance test.

Then we can conclude that a target of 10 sows per boar in a flock of 450 sows allows to have, in a

two generation pedigree, more families than the necessary one to avoid inbreeding. Also we see that there are families which are going to extinction.

Using the data from table 2 we shall try to verify if there are any relations concerning growth performance and the proposed family classes. In order to answer this question we propose the “active fertility” as the index pig families participate to the performance test series formatting. This index indicating the number of groups of piglets entering the test will be put in relation with the common daily gain performance of progenies doesn't matter of sex. The correlation between these two indices will show the influence of growth performance on the active fertility. Similar analysis is provided inside the main pig families. Necessary data are given in table [3].

Data in table 3 show a covariance of active fertility (x) and of the common daily gain (y) of 69. The variance of x is equal to 1.87 and the variance of y is equal to 15788. Thus the correlation coefficient of correlation is 0.40. This argues for a good genetic value of the selected boars.

Table 3. Statistics of traits indicating the correlations between “active fertility and growth performance

Families	n	Active fertility (x) statistics				$\sum xy$	Daily gain (y) statistics			
		x	s ²	$\sum x$	$\sum x^2$		y	s ²	$\sum y$	$\sum y^2$
Common	28(1-28)	4.40	1.86	123.14	594.17	58157	473.07	101.78	13246	6269116
Extinction	3(1-3)	4.42	3.15	13.25	69.23	6039	455.33	161	1366	622458
Old	7(4-10)	5.64	2.75	39.46	241.95	18664	472.28	45.88	3306	1561660
Young	11(11-21)	3.91	0.35	43.0	172.01	20383	474.27	15.87	5217	2474427
New	6(21-27)	3,87	0.72	23.2	94.25	11125	480.17	102	2881	1383995
X	1	4.09	0	4.09	16.73	1946	476.00	0	476	226576

The similar estimation for the 7 “old families” shows a covariance of the traits equal to 2.64, a variance of “x” equal to 2,75 and a variance of “y” equal to 46.88. Resulting coefficient of correlation is 0.21. In the 11 young families covariance measures – 1, the variance of x measures 0.36 and the variance of y measures 16. Correlation coefficient measures 0.42. In the “new families”, whose number is 6, the covariance is -4, the x variance is 0.72 and the y variance is 103. The correlation coefficient resulted is 0.46. For the three “in extinction” families the covariance has the value 2, the variation of x has the value 4.26

and the variation of y has the value 160.59. Correlation coefficient value is 0.08.

The good correlation between “active fertility” (number of progenies entering the performance test) is more a question of management than of genetics. Old boars are used less than the young boars.

Some families are going to extinction. That fact is inherent when selection is provided. A three generation pedigree allows to keep inbreeding under control by the number of families.

4. Conclusions

On the basis of the original researches, we can conclude:

A sow target of 10 – 12 sows per boar in a flock of 450 heads allows having a large number of pig families, enough to avoid inbreeding.

Generally speaking boars are correctly selected by their growth performances.

The good correlation between “active fertility” (number of progenies entering the performance test) is more a question of management than of genetics. Old boars are used less than the young boars.

Some families are going to extinction. That fact is inherent when selection is provided no matter what criteria are used.

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