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Pig breeding, selection and hybridisation in Italy

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During the last 15 years, the Italian pig herd has stabilized at around 9,000,000 head. During the same period, the per capita consumption of pork more than doubled, passing from 10.7 kg to 23.0 kg. Production also doubled, while imports more than tripled. As a result of these changes, self-sufficiency during the same period declined from 80% to 71% (Table 1). 72% of the pig herd is concentrated in northern Italy and in two regions in particular: Emilia-Romagna and Lombardy where about 4,500,000 pigs are bred, equal to 50% of the entire Italian stock. About 15% of the herd is bred in the central Italian regions while southern Italy and the islands account for the remaining 13%.

Another interesting aspect of Italian pig breeding is the tendency to concentrate breeding in large farms. According to data from the 1981 census, about one third of the pig stock is concentrated on only 1,864 breeding farms with more than 1,000 head each, another third is bred on 9,297 farms each containing from about 100 to 1,000 head, while the remaining third is bred on 989,701 farms with less than 100 head each. This tendency to concentrate, which has been accentuated during the past few years, is true of all types of breeding activity: reproduction, fattening and closed cycle.

I - Productive trends

Compared to that of other countries, Italian pig production differs by the high, live weight at slaughter.

The national average for live weight is 142 kg for heavy pigs, but this becomes increasingly higher

in the northern Italian regions where the breeding farms, slaughterhouses and processing industries are concentrated.

This productive trend is determined by the meat processing industry which requires heavy cuts and mature meat for the production of processed meats. These can only be supplied by pigs slaughtered at an age of at least 10-12 months (Russo, 1986). In particular, it is the weight of the hams and the necessity for mature, firm and not watery meat which determines the slaughtering weight.

The weight of the ham is very important since, besides representing more than 40% of the value of a carcass, this cut must weight at least 9.5 kg and preferably 11-13 kg after trimming in order to achieve the final minimum weight of 7 kg, according to the Parma ham standard.

Meat maturity is essential to ensure excellent quality seasoned products and to reduce weight losses to the minimum during the seasoning period.

These characteristics condition the choice of breeds and selection programmes.

Besides the production of the heavy pig for processed meat, a lighter pig has also been produced over the last few years with a final live weight varying from 100-120 kg. It is mainly used for the production of fresh meat.

This type of pig, which represents not more than 20% of Italian production, has only recently been taken into consideration in official selection

programmes, to date exclusively designed to improve the heavy pig.

On the contrary, the improvement of the lightweight pig has always been one of the main objectives of hybrid pig producers.

II - Raised breeds

In Italy, the main breeds raised (in their pure form) are the Large White and Landrace. Duroc, Hampshire, Pietrain and Spot breeds are also bred, especially for industrial crossing purposes. The old local breeds have disappeared or survive in very rare instances.

As regards the consistency of individual breeds, the only possible reference is represented by statistics concerning animals registered in the Herd Book (Table 2).

Large White account for about 74% of the registered animals and largely predominate the other breeds. This breed was brought from England towards the end of the last century and was first used for crossing with local breeds. After this, it became established as a purebred animal in breeding farms while the local breeds were gradually eliminated.

This establishment of the Large White was due to its good fertility and prolificacy, its known characteristics appreciated in all countries and to certain important attributes particularly suitable for Italian breeding purposes such as: great size, ability to maintain a good growth rate even at heavy weights without accumulating excessive quantities of fat and with a favourable feed efficiency, strong limbs and the ability to adapt to unfavourable environmental fattening conditions, and excellent meat quality.

The Italian Large White breed was mainly formed by breeding animals imported from England and from Holland in recent years; imports from other countries such as France, Ireland, etc. have also contributed to a lesser degree (Buiatti, 1978).

Landrace, which currently represents about 21% of the pigs registered in the Herd Book, was formed by breeding animals from Holland and, to a lesser extent, from England, France and Germany and more recently, from Denmark. The carcass characteristics are appreciated in this

breed, particularly the greater development of the ham and loin.

Even if there are many purebred breeding farms for the production of animals for slaughter, Landrace has become established as a breed cross with Large White in order to obtain animals for fattening purposes or hybrid sows to use for breeding.

The Belgian Landrace has also been introduced into Italy, but this is considered a different breed from the Italian Landrace. For this reason, there is a separate section in the Herd Book for this animal. The Belgian Landrace is used in the same way as the Piétrain for crossing purposes, in order to produce 100 - 110 kg pigs to be mainly used for fresh meat consumption. The main reason for which the Belgian Landrace is kept distinct from the others is due to the inferior quality of its meat and, in particular, to the greater frequency with which it presents PSE muscles. This, which in Italy is a disadvantage for fresh consumption, becomes an even more serious inconvenience for the production of seasoned, salted and raw salami.

There is also a Herd Book for Duroc, Hampshire and Spot breeds but their total numbers do not exceed 5% of all registered animals.

The Duroc breed is becoming more widespread and during the past seven years has passed from 210 registered head to 2,219. Interest in this breed lies in its use as a terminal boar for the Landrace x Large White sow for heavy pig production. This breed could become even more widespread if current research excludes negative effects on meat quality.

III - Organization of genetic improvement

Genetic improvement programmes concerning the various breeds are mainly based on genealogical selection and on boar testing in stations.

The whole official genetic improvement activity is effected by ANAS (National Pig Breeders' Association) under the supervision of the Ministry of Agriculture.

During 1984, 362 breeding farms with different breeds subscribed to genetic improvement

activities, as shown by **Table 3**. The Piétrain Herd Book was abolished at the start of this year owing to lack of registrations.

IV - Genealogical selection

The objective for all breeds, but particularly for Large White and Landrace, is to select in order to achieve a strong pig with great size suitable for the meat processing industry, having a high aptitude for the production of excellent quality meat even at high slaughter weights.

For this reason, all registered animals are morphologically evaluated while boars are tested in the stations.

Besides this, selection is also effected in order to improve fertility, estimated by the age of the animal at first farrowing and by the interval between farrowings, prolificacy, gauged by number of piglets born alive and the breeding abilities of the sows, judged by the number of weaned piglets. Minimum values have been established both for morphological evaluation and breeding characteristics; these must be reached by both boars and sows before definitive registration in the Herd Books is permitted.

All these data are given to the individual breeders who are thus able to use them for their own selection programmes.

V - Genetic control stations

There are currently four testing stations for boars in Italy, with a total capacity of 1,296 places making it possible to check about 700 boars each year.

The first station began in 1960 while the latest started operations in 1979.

Until 1979, the genetic evaluation of boars was effected by means of progeny testing according to the classic Danish method, but with an important variant as regards the final test weight, fixed at 125 kg, to approach Italian market requirements tending towards the production of a heavy pig.

Although results were achieved (**Table 4**), this testing system was hardly efficient with regard to

a general improvement of pig production owing to the low number of boars which were tested and the irregularity with which individual breeders could test. The fact that evaluation could be achieved when the boar was at the end of its productive life or actually eliminated also counted. All this, together with the high cost, resulted in the substitution of progeny testing with the combined test. This was started in 1974 and became the only test carried out in Italy from 1979 onwards.

Up to 1984, the combined test was effected by testing a group of four piglets from the same litter during the 35-125 kg weight interval. These piglets, two male and two female animals, were kept in individual boxes and fed to appetite for half an hour twice a day.

All animals in the group were checked in order to gauge the live weight gain, the feed efficiency and the thickness of side backfat by ultrasound while, at the end of the test, the females were slaughtered and the carcass characteristics checked. Final evaluation of the two young boars was effected by means of a selection index which took all gauged characteristics into account and was expressed by a score varying from 0 to 200 points.

Boars which failed to exceed 100 points were slaughtered while the others were used for breeding purposes after a morphological evaluation by Herd Book experts.

Thus accomplished, the combined test has made it possible to use station capacities to the maximum with checks on about 1,200 boars per year and fairly interesting results as shown by data published by ANAS (1985) and indicated in **Table 5**.

From the start of 1985, the combined test was modified in order to evaluate the boars in conditions more similar to those of the Italian pig breeding situation.

The test group was reduced from four to three pigs, eliminating a female. Furthermore, one of the two males was castrated. Thus the group now consists of an entire male, a castrated male and a female.

The final test is now 145 kg.

Final evaluation is done with a selection index which, on the one hand, takes into account the daily liveweight gain, the feed efficiency and the backfat thickness measured with ultrasounds for

all three animals in the group and, on the other hand, the percentage of lean cuts gauged after the castrated male and female have been slaughtered.

Besides this evaluation, there is another one when the live weight of 95 kg has been reached, and with a selection index which only takes into account the characteristics which can be gauged *in vivo*. This evaluation above all concerns breeders involved in the production of the lightweight pig.

VI - Meat quality and halothane test

It has already been mentioned how important meat quality is for Italian pig breeding. In order to watch this aspect, the pigs slaughtered at the end of the combined test are tested for pH value and the colour of certain muscles. The data obtained indicate that these characteristics keep to values considered normal. This is in accordance with the results of an investigation done at breeding farm level in which 4.1% of about 1,000 carcasses examined had PSE meat and only 0.5% had DFD meat (Russo *et al.*, 1985).

To maintain meat quality, there is now a selection program against the gene for halothane sensitivity which, as is known, is associated with PSE.

Towards the end of 1978, the halothane test was introduced for all pigs entering testing stations. After an initial period, in which the only adverse measure was the suggestion to breeders to eliminate positive boars, it is now compulsory to eliminate the whole group and the parents if the test gives positive results in only one of the three animals. These provisions have made it possible to lower the already low frequency of halothane positive animals in the Large White and Landrace breeds. In 1981, these were respectively 0.4% and 11% for Large White and Landrace, while these figures dropped to 0.16% and 3.25% in 1984 (Malagoli, 1986).

VII - Farm performance test of gilts

The farm performance test of gilts has recently been officially established in order to strengthen breeding activities within breeding farms themselves. Gilts are bred in groups and, when

they reach a live weight of 80 to 100 kg, they are evaluated by means of a selection index which takes into account the daily live weight gain and the backfat thickness measured by ultrasounds.

The measurements and all control operations are carried out by ANAS personnel. Owing to the conditions under which they are done and the method by which the index is formed, farm performance tests are useful for the choice of gilts on the breeding farm.

VIII - Artificial insemination

There are no official statistics in Italy concerning the use of AI in pigs. There are currently seven official AI centers for cattle, which also collect and distribute fresh boar semen. On the whole, it is estimated that 5-6% of all sows are inseminated with the semen distributed by these centers. Furthermore, there are about 300 farm centers used by one or more breeders. AI is not generally very widespread. It is even less used as a means for genetic improvement. AI is, in fact, only used on farms for multiplication purposes, almost always in order to effect crossing programs since until last year, its use was forbidden in registered animals. The Central Technical Commission of ANAS recently approved regulations for the use of AI for the breeding of animals registered in the Herd Book. For this reason, temporary authorization can be given only to boars with a combined test score of at least 180 points, maximum points for the morphological evaluation and which are sons of a boar checked on a station with positive results. Authorization becomes definitive if the boar has a positive result for progeny testing achieved via the combined test of four groups of young.

In any case, a boar authorized for AI cannot inseminate more than 50 sows registered in the Herd Book each year.

IX - Hybridisation

There are 15 companies in Italy which operate in the hybrid pig production field. Of these, two are Italian and deal with all the hybrid production process phases: selection, multiplication and marketing. The others are sole agents of foreign companies and only deal with the multiplication and marketing phases, importing the selected

animals from the respective countries. Of the foreign companies, eight are British, eight Dutch, one German and one Belgian. The first two companies became established in Italy towards the middle of the 1960s while all the others started from 1970 onwards.

On the whole, and according to data supplied by these companies, about 50,000 hybrid gilts are put on the market in Italy each year.

Considering that the total number of sows in Italy is around 750,000 head and yearly replacements amount to about 40%, hybrid sows represent about 15-17% of the total.

This figure only refers to hybrid pigs produced according to precise crossing programs including the use of breeding animals belonging to two or more breeds, specifically selected for this purpose.

In reality, crossbreeding is a much more widespread practice. Almost all breeders cross Large White with Landrace and some effect backcrossing or threeway with the use of a third breed. Currently, Duroc has a certain popularity as a third breed.

Initially, the production of hybrid pigs tended towards animals with a live weight of 90-120 kg for fresh meat consumption, or 130-140 kg for mixed use. Following this, most of the companies directed their efforts towards the production of a heavy hybrid suitable for the Italian market and industry.

By schematizing, it is possible to affirm that for the utilized breeds, Belgian and German hybrids are slaughtered at a live weight of 90-110 kg and are almost exclusively used for the consumption of fresh meat. Dutch hybrids are brought to weights of even 130-140 kg and are used for the production of cooked ham and cured processed meats.

The Italian companies and almost all British companies tend towards the production of two types of hybrid: one suitable for the production

of lightweight pigs and one for the production of heavy animals.

This objective is attained by the use of different boars on a single type of hybrid sow obtained by crossing selected lines of Large White and Landrace breeds. In the case of the lightweight pig, the boars are hybrids obtained by the use of Belgian breeds or others with a very accentuated muscular development. In the case of heavy pigs, hybrids or purebred boars of the same breed as the sows are used.

There has been a certain conflict between producers of hybrids and breeders of purebred animals. This has mainly been due to the fact that while these latter follow a genetic improvement programme under official State control, there are no provisions for hybrid pigs governing the introduction of groups of founder animals from abroad, production and genetic control. This conflict has now been attenuated and both sides hope for an integration of activities for a more efficient improvement of pig production in general.

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Table 1: Evolution of pig breeding in Italy

		1970	1980	1985
Total pig population	N	8,980,400	8,928,000	9,169,000
Sows	N	783,400	744,000	763,000
Meat production	} tons	458,000	798,000	11,120,000
Meat imports		127,300	426,500	5,160,000
Meat exports		12,200	25,500	530,000
Meat consumption		573,100	1,191,900	16,280,000
Self-sufficiency	%	79.9	71.7	68.3
Per capita consumption	kg	10.7	20.8	28.6

Source : Eurostat

Table 2: Number of pigs of various breeds registered in the Herd Book in 1984

Breeds	Boars N	Sows N	Young N	Total N
Italian Large White	1,271	12,475	32,434	46,180
Italian Landrace	532	2,788	9,672	12,992
Belgian Landrace	9	45	273	327
Hampshire	9	44	259	312
Duroc	83	341	1,795	2,219
Pietrain	2	5	33	40
Spot	5	42	85	132
Total	1,911	15,740	44,551	62,202

Source : Anas

Table 3: Number of farms and average number of pigs per farm registered in the Herd book of different breeds in 1984

Breed	Farms N	Pigs per farm N
Italian Large White	197	233
Italian Landrace	115	113
Belgian Landrace	10	33
Hampshire	4	78
Duroc	31	71
Piétrain	3	13
Spot	2	66

Table 4: Results of progeny-tested boars of the Large White breed in 1960 and 1977

Trait	1960	1977
Daily live weight gain g	548	592
Feed conversion index FU/kg	3.53	3.19
Carcass yield %	79.52	80.73
Backfat thickness mm	42.50	34.90
Total lean cuts %	54.92	60.80
Untrimmed ham %	20.90	22.31
Total fat cuts %	37.60	31.72

Table 5: Results for combined-tested boars during the three year periods

Traits	Large White		Landrace	
	1979-81	1982-84	1979-81	1982-84
Daily live weight gain (1) g	731	764	718	761
Feed conversion index (1) FU/Kg	3.17	3.05	3.25	3.10
Average backfat thickness (2) mm	21.83	15.57	22.53	18.70
Ham (3) %	22.89	23.80	23.18	23.84
Loin (3) %	16.22	16.63	16.43	16.72

(1) Taken on boars

(2) Taken on boars by ultrasound

(3) Taken on slaughtered gilts