LESSON 2

BREEDING & SELECTION

AIMS
Select appropriate pig breeds for different purposes.
Explain the management of the breeding of pigs.

Pig farmers should aim to rear animals that will produce first grade pork or bacon. To do this, they must have a clear picture in his mind of what is required from the carcasses of first grade animals. The tools they will use to achieve such animals are heritability, performance and progeny testing.

HERITABILITY IN PIGS

Heritability describes the chance of parents passing certain traits on to their offspring. Traits can be highly heritable and easily passed on, or of low heritability and difficult to inherit. With pigs, the commercially valuable traits are also highly heritable. These traits are listed below:

TRAIT	HERITABILITY
Daily Live mass Gain (after weaning)	30%
Food Conversion	35%
Back fat Thickness	50%
Lean Meat % in the carcass	45%
Carcass Length	50%

All these traits have a high economic value and, because they are highly heritable, a farmer can rapidly improve his pig herd by the careful selection of boars. For example, a boar with a good long back will increase the carcass length of the offspring within two or three generations.

Two traits that have low inheritability are litter numbers and weaning weights. These traits depend more on management than on genetic factors. Correct feeding of the sow during pregnancy can improve litter numbers while weaning weights depend on the ability of the sow to produce milk.

TESTING PIG PERFORMANCE

Performance Testing

Performance testing measures the performance of an animal while it is growing. Pigs are performance tested during the period from weaning to bacon weight (i.e. from about 22 kg to 85 kg live mass). During this period, the pigs are fed on a standard ration and records are kept of the live mass gain, food intake and food conversion, days to bacon weight, back fat thickness etc. In this way, the performance of one pig can be compared to that on another.

Progeny Testing

Progeny testing involves measuring the performance of young pigs belonging to one boar to see whether the boar is passing on his good traits to his offspring. During this period, the young pigs are being performance tested while the boar is being progeny tested at the same time. It stands to reason that the conditions of both the performance and progeny tests must be the same as the normal feeding and management of the animals under commercial conditions. A boar that does well in a progeny test under good conditions cannot be expected to produce offspring that will do well under poor conditions of feeding and management.

POINTS FOR SELECTION

The first and foremost aim of any pig breeding program should be to register an improvement in the commercial traits of the herd with each generation of piglets born. Luckily, this is a fairly easy task with pigs as many of the commercial traits are highly heritable. Points that the farmer should actively select for are:

a) **Birth weight of the litters**
b) **Litter size :** the number of piglets born in each litter
c) **Live mass gain :**
    a. birth to weaning (a measure of the milking capacity of the sow)
    b. weaning to slaughter at either pork or bacon weights (a measure of the pig's ability to grow quickly provided that feeding and management of the herd is good). Every pig has the genetic potential to grow well. For maximum growth, however, the pig must be from good stock and its feeding and management must be good)
d) **Food conversion:** the amount of food required to put on 1 kg of live mass gain. Food conversion is measured by means of a ratio. For example :
   FOOD CONVERSION RATIO (FCR) of 3.5: 1 – this means that 3.5 kg meal is needed for 1 kg live mass gain.
   80% of the cost of producing a bacon pig is the cost of the food eaten by the pig so you can see that this is an important characteristic.
e) **Length of carcass:** a long carcass is required in bacon production because it produces more bacon.
f) **Back fat thickness:** too much back fat will cause the pig's carcass to be down-graded.

If you look at the table at the start of this section, you will see that, apart from the first two traits, all the other characteristics are highly heritable. This means that pig herds can be improved very quickly by the careful selection of a boar that shows a long body, low back fat thickness and good food conversion.

DIFFERENT TYPES OF PIG BREEDING

Pure Breeding

The mating of two animals of the same breed is called **pure breeding.** The mating of two pure bred animals registered by the same Breed Society is called **pedigree breeding.**

Pure breeding depends on heritability and selection to be effective. The breeder must know what characteristics he wants in his pigs and he must select for those traits. Animals that have those traits are kept in the herd. Animals that do not show the correct traits must be culled from the herd.

Pure breeding is a highly specialised form of animal breeding, requiring great skill and very good management on the part of the breeder. Most often, it is practiced by pedigree pig farmers who supply commercial farmers with animals for use in cross breeding. It is an expensive operation because the breeder must keep several boars from different lines to avoid the dangers of inbreeding. Pure breeding is discussed in detail in the Animal Breeding course.

Cross Breeding

The mating of two animals of different breeds is called cross breeding. Cross breeding produces improvements in the offspring due to a large number of fresh genetic combinations coming into existence. This condition is called **heterosis or hybrid vigour**. Its most noticeable effect is improved commercial performance. The commercial farmer is looking for animals that perform well whereas the pedigree breeder is looking for animals that both perform well and transmit good performance to their offspring. The commercial farmer has a far easier task than the pedigree breeder!

The advantages of cross breeding are:

(a) The crossbred offspring combines the best qualities from both parents. If the parent's pure breeds have been selected for good economic traits, these can be brought together in the crossbred.
(b) The effects of hybrid vigour can improve the commercial performance of the cross bred animal. Hybrid vigour has most effect on those traits that have a low heritability, such as litter numbers and birth weights. A crossbred sow usually produces larger litters and more milk than a purebred sow.

The disadvantage of cross breeding is that the crossbred animal will not pass on its improved performance to any offspring. Hybrid vigour is strongest in the first cross (F1 generation) and it has much less effect in the second and subsequent generations of crossbreds.

As an example, if a Large White boar is mated to a Landrace saw, the offspring will show the effects of hybrid vigour. If two of these crossbreeds are then mated, the crossbreeds produced by this mating (the F2 generation) will not have the performance of either of their parents. However, if a crossbred sow from the F1 generation is mated to a boar from a different pure breed (for example, a Welsh boar), the offspring of that cross will show hybrid vigour and perform well. It is for this reason that the breeders of hybrid pigs have to look for a number of pure breeds to introduce into their crosses.

SYSTEMS OF CROSSBREEDING IN PIGS

Many systems of crossbreeding are employed by farmers and breeders, and to obtain the maximum benefit, the crossbreeding program must be carefully designed.

Single Cross

The simplest example of crossbreeding is to mate a boar from one breed to a saw from another herd. The boar should be from a strain of pure breed that is noted for its superior conformation, performance and lean meat production. The sow should be from a strain of pure breed noted for its fertility, mothering ability, performance and carcass quality.

An example of this single cross is the Blue Pig produced by mating a Large White boar with a Wessex sow. The offspring show hybrid vigour, they are well-mothered, fairly uniform and they inherit qualities of performance and meat production from their sire. The big disadvantage of the single cross is that two pure bred herds must be kept in order to supply the parents for crossing. Alternatively, the purebred stock must be purchased. This system fails to make full use of the hybrid vigour from the crossbred sows since these are slaughtered and not used for breeding.

Backcrossing or Crisscrossing

In this system, two pure breeds are mated in a single cross to produce a cross bred pig.

1st cross: (Large White boar) x (Landrace sow) = (Crossbred)

LW x L = LWL

The gilts from this cross are then mated back to a boar from either of the two original breeds:

2nd cross: LW x LWL = LWLWL

These gilts are then mated back to a boar from the other breed used in the original cross:

3rd cross: L x LWLWL = LLWLWL

This system results in about two thirds of the inheritance coming from the breed of the boar last used, and one third from the other breed. There is some variation from one generation to another and, if the system is followed on a long term basis, some hybrid vigour reduces the need for the continual introduction of fresh, pure bred parents.

Rotational Crossing or Cyclical Crossing

This system attempts to retain the hybrid vigour which was attained when the first crossbred sows were used for breeding purposes. It makes use of pure bred boars from several different breeds. With this system, the decline of hybrid vigour is much smaller than with crisscrossing provided that pure bred boars are used each time. Rotational crossing demands a large herd in order to justify the cost of keeping different boars.

In the following example: D (Duroc), H (Hampshire).

1st cross:	LW	x	D	=	LWD
2nd cross:	L	x	LWD	=	LLWD
3rd cross:	H	x	LLWD	=	HLLWD

This is the system which the breeders of hybrid pigs. The required qualities are brought into the hybrid by selecting boars from different pure breeds. The hybrid vigour improves the fertility and mothering qualities of the hybrid sows while the bacon qualities, length, lean meat etc. come from the boars used. Many pure breeds of pigs that were of minor importance are being improved and herd numbers increased in order to provide the boars needed for the many hybrid breeding programmes which are being carried out in different parts of the world at present.

What ever system of cross breeding is used, it is essential that the best pure bred stock is used, particularly from the point of view of carcass quality and performance. Although crossbreeding brings about an immediate advantage in hybrid vigour, this advantage is not cumulative. The best method of improving the quality of crossbred animals is by improving the quality of the pure bred animals used in the crossbreeding program. Pure breeds are improved by careful selection based on the heritability of traits and by performance and progeny testing.

HYBRID BREEDING

One of the first companies to carry out a hybrid pig breeding program was the British Oil and Cake Millers (COCM) in the UK. Their pig improvement scheme was begun in 1963 because research had shown that many commercial strains of pigs were unable to make the best use of the company's improved pig rations. Work was carried out on the company's farms in the UK with the aim of improving three breeds: the Landrace, the Large White and the Saddleback and to produce a three-way cross hybrid pig with an overall performance that was 25% than the average.

The scheme started with the purchase of one thousand weaner pigs, of which only 30% were acceptable genetically and visually. All the gilt pigs were performance tested, and the best 12-5% went into the foundation herd. The best sows were subsequently used to breed boars. The selection of boars was so strict that less than one in two hundred and fifty male pigs were finally used. The final hybrid pigs are used for both pork and bacon production.

Most breeders of hybrid pigs work with large numbers and use carefully selected and pure breeds. Two of these breeds are crossed to produce the hybrid sow with the benefits of improved litter numbers, milking ability and better health and vigour. The hybrid sow is then mated to an improved boar of another pure breed to produce the hybrid bacon or pork pig.

Hybrid sows are produced by "multiplying breeders" who get their breeding stock from hybrid breeding companies. These multiplying breeders usually work on a contract basis and are paid by the companies to look after the pigs. The commercial farmer buys his hybrid gilts from the company and the pure bred boars from the same company. A typical hybrid breeding program is shown in the table on the next page.

A typical hybrid breeding program

Breeding of Boars	Breeding of Sows		
A	B	C	Selection & improvement of purebred stock over several generations
A	B	C	
A	B	C	
Final boars sold to commercial farmers A	B	C	
A	B	C	
		B x C	
Key to Breeds A = Landrace B = Large White C = Saddleback		BC	Hybrid sows & Pure bred boars sold to commercial farmers
		ABC	Final hybrid bacon pig

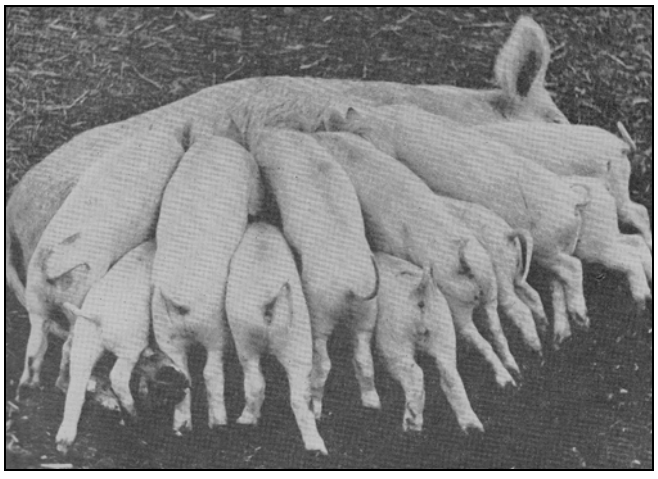
ARTIFICIAL INSEMINATION

The use of artificial insemination is increasing, particularly in minimum disease piggeries. Imported semen is frozen at minus 192 degrees celsius. This will store indefinitely. In Australia semen can be stored for up to 2 weeks at minus 16 to 20 degrees celsius. Storage of 3 to 4 days is the optimum if you want to maintain best quality semen.

Artificial insemination has several advantages. Firstly, for a reasonable price, a farmer can select the semen from some of the top boars in the country. The boars from which the semen is tapped will be in tip-top condition and free from disease and genetic imbalances. This means that the farmer can be confident about the quality of sperm he receives. Artificial insemination avoids the seasonal variations in boar fertility.

Secondly, artificial insemination removes the risk of transmitting venereal and other diseases while mating takes place. Uterine infections are dramatically reduced. In addition, the cost of keeping a boar is removed as is the need to keep a dangerous animal on the farm. The superior offspring gives the farmer improved profits.

Farmers who wish to use two or more boars in crisscrossing or rotational crossing schemes will find artificial insemination of great benefit. It provides the maximum genetic turnover in the shortest possible time without all the worry of purchasing unrelated boars.



SELECTING ANIMALS FOR BREEDING

Gilts

Gilt is the name given to a young female pig up to the time of weaning her first litter. The farmer should consider the following points when selecting gilts for breeding:

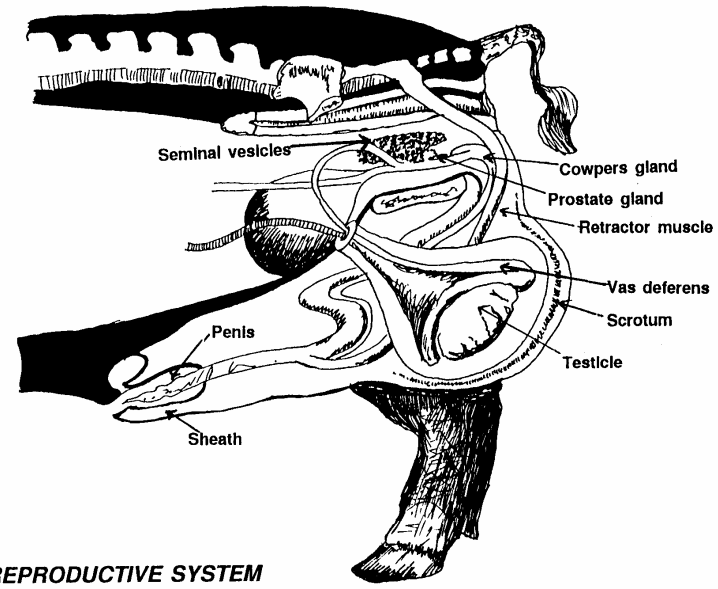
- **health and longevity** (select from strains or families that have reared two good litters a year for three or more years in succession)
- **Prolificacy** (strains or families that produced many good litters of healthy, strong piglets)
- **Mothering qualities** (good temperament and milking qualities in the sow. Temperament is partly due to breed but can also be passed on from mother to daughter. Milking capacity is partly affected by the breed but is also affected by feeding and management).
- **Good food converters** (this is measured by the Food Conversion Ratio or FCR. A good FCR would be 3.5 an average FCR would be 5 and a bad FCR would 6.5).
- **Good carcass qualities or good conformation** (there should be at least twelve well spaced teats, a good long back, a fine shoulder, not too broad across the top, fine, silky skin which is a sign of good health and good strong feet and legs. There should be no abnormalities.

Selecting Boars

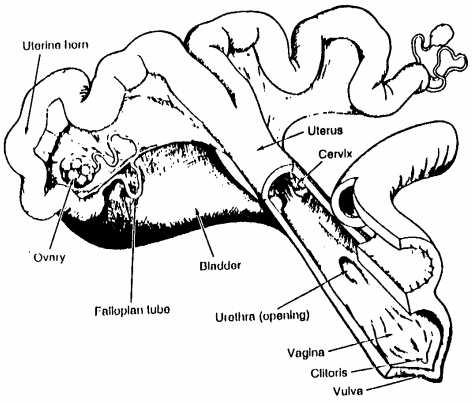
The boar is the single most important animal in the piggery because half his genes will be carried by all his offspring. When selecting a boar, pay attention to the following points:

- **Conformation** (the boar must have good conformation and particular attention should be paid to his feet and legs)
- **Nipples** (the boar must show at least twelve even and well spaced nipples to pass on this trait to his female offspring)
- **Tests** (always use boars that have been performance tested. In the case of an older boar, buy one that has been progeny tested.
- **Prepotence** (try to find a boar that is prepotent which means that his gene base is so consolidated that he almost cannot fail to pass on his good qualities!)

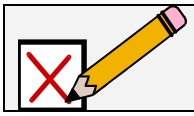
THE PIG REPRODUCTIVE SYSTEM



MALE REPRODUCTIVE SYSTEM



FEMALE REPRODUCTIVE SYSTEM



SELF ASSESSMENT
Perform the self assessment test titled 'Self Assessment Test 2.1'
If you answer incorrectly, review the notes and try the test again.

SET TASK

1. Discuss pig performance testing with an experienced tester. If possible, observe a performance test being carried out. Make notes.

2. Talk with a pig breeder. Observe or discuss husbandry operations undertaken at different stages of breeding, including:

    - Weaning to service
    - Early pregnancy
    - Mid pregnancy
    - Late pregnancy
    - Lactation

Note: If making "real life" observations is impossible due to accessibility problems; you may undertake research into the above either through a library or on the internet.

How to do a virtual tour – First go to a major search engine and enter "Pig Farm Tours" you will find a large number of results, choose the most relevant sites and locate the above information.

ASSIGNMENT
Complete Assignment 2.