UNIT 3 BREEDING SYSTEMS

Structure

3.0 OBJECTIVES

After studying this unit, you will be able to:

- summarise different system of breeding of poultry;
- discuss the common methods of mating in poultry;
- differentiate between a good layer and poor layer;
- identify the unproductive birds in a flock; and
- explain the principles of judging.

3.1 INTRODUCTION

Whether a male or female bird can be kept for breeding purpose or not is determined largely by the kind of progeny (young ones) they produce. This is true regardless of the character involved. A male whose dam (mother) had a high record of egg production mated to a female with a high egg production record frequently produces daughters that lay prolifically (in large amounts). The results secured from a given mating are determined largely by the genetic contribution of the birds mated rather than by their physical appearance.

3.2 SYSTEMS OF BREEDING

The breeding systems can be classified depending on whether it is aimed to increase homozygosity or heterozygosity into random mating, inbreeding (breeding for increased homozygosity) and outbreeding (breeding for increased heterozygosity).

3.2.1 Random Mating

Mating of individual without any selection. This is used in developing a control population which is required to compare and measure the effects of other breeding systems. Control population also helps to estimate the effects of the environment which in turn, helps to estimate the true genetic gain through any breeding method.

3.2.2 Inbreeding

It is defined as mating between individuals which are more closely related to each other than the average relationship between all individuals in a population. Inbreeding can be consistently carried out for several generations. There are three distinct methods:

a) **Close inbreeding**: Mating between sibs and parents and progeny. Full sib mating and back crossing of the progeny to the younger of the parents are often practiced.

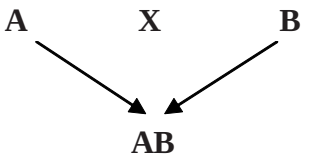
b) **Strain Formation:** Developing a small group of animals within a breed and variety with a special character in view. This is a mild form of inbreeding. For example, Babcock strain of Single Comb White Leghorn developed to lay heavier eggs.

c) **Line breeding:** This is inbreeding with an ancestral line and is the most intensive form of back-crossing. Line breeding is back crossing to the same parent for several generations in succession.

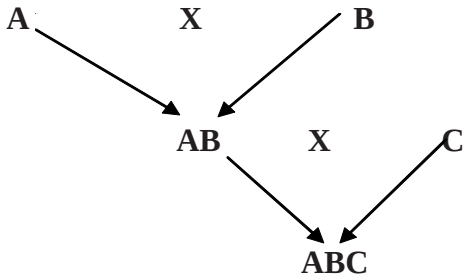
3.2.3 Outbreeding

This is the opposite of inbreeding in the sense that the relationship of the individuals which are mated is less close than the average relationship within the population. Mating between strains or inbred lines are the forms of outbreeding. The methods of outbreeding (cross breeding) are outlined below:

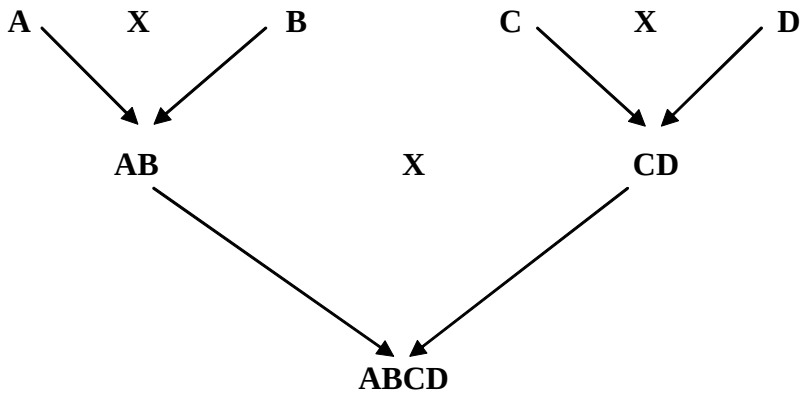
a) **Single or 2-way cross**: Two different populations (inbred lines, strains or breeds) are crossed to produce a first filial (F_1) generation which is purely for commercial purpose but not for breeding. F_1 here usually exhibits hybrid vigour especially when inbred lines are involved. When two inbred lines of the same breed are crossed, the progeny is said to be in-crossbred.



b) **Three-way cross:** In this method, F_1 crossbred females (AB) are mated to males of a third line (C), to obtain a F_2 progeny (ABC).



c) Four way or double cross: Two different single crosses (AB and CD) are crossed to obtain ABCD.



This is usually practiced in poultry breeding for crosses between inbred lines of low viability since only a relatively small number of animals of the lines A, B, C, D need to be maintained.

d) Crossing for production of a new breed: Different breed types have been crossed to produce the modern day breeds of farm animals so as to combine desirable traits from many sources. These foundation crosses have to be subjected to inbreeding combined with selection to consolidate them into true breeding populations (breeds). Example, Cornish developed from Aseel, Malay and English game breeds.

Check Your Progress 1

Note: a) Use the space given below for your answers.

b) Check your answers with those given at the end of the unit.

1) How the breeding systems are classified?

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2) What are different systems of breeding commonly used in poultry?

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3) Define double cross.

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Activity 1

Visit a nearby poultry farm, note down the system of breeding being practised there and give your opinion and comments.

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3.3 METHODS OF MATING

Mating is defined as the pairing of a male and a female for the purpose of reproduction or production of young ones. The different methods of mating commonly practiced in poultry are as follows:

3.3.1 Pen Mating

A single male is segregated with a group of females in a pen during the breeding season. This requires marginally more labour. Number of females that can be allowed with a male (referred to as mating ratio) is 10 to 12 in case of Leghorn (Egg type birds) and 6 to 8 in case of meat type birds. Pedigreeing is possible both on sire's (father) as well as on dam's (mother) side. However, if Pedigreeing is done only on dam's side, multiple male matings can be employed in a larger pen.

3.3.2 Stud Mating

The males are usually confined at all times to small individual pens (stud) within the large laying pen. The female is held in the stud for a known period of time (till mated) after which it is removed and another is added. Two matings per week or at least once every 5 days is desirable for optimum fertility. This method requires more labour and is rarely practiced now-a-days.

3.3.3 Artificial Insemination

Artificial Insemination (AI) is the technique by which seminal fluid (semen) of male is introduced or deposited into the female reproductive tract by a pipette (Fig. 3.1). One cock will yield about 0.5 to 1.0 ml of semen (Fig. 3.2) depending upon the body weight. About 0.05 to 0.10 ml of semen is enough to inseminate one hen. This technique of mating is having many advantages and few disadvantages.

Fig. 3.1: Artificial Insemination of a hen

Fig. 3.2: Collection of semen from a cock

The advantages of artificial insemination are as follows:

- Allows unlimited number of single male mating without requiring extensive breeding equipment;
- Preferential mating avoided;
- Accurate Pedigreeing possible;
- If, due to some reason, a male of superior qualities cannot mate, it can still contribute to the next generation;
- If the males are too heavy (as in the case of Broad Breasted White Turkey) or too old for natural mating, Artificial Insemination is the method of choice;
- Hybridization between two different species is possible (eg. chicken-quail hybrid);
- In caged-layers also, fertile eggs can be obtained only by the Artifical Insemination;
- Problems of trap-nesting are avoided; and
- The incidence of sexually transmitted diseases is reduced or avoided.

Insemination of chicken must be done during the afternoon hours by which time most of the birds are expected to have laid eggs rendering their oviduct empty. Frequency of insemination is twice a week or at least once in every five days.

The disadvantages of Artifical Insemination are:

- It require more labour;
- Chances of cross contamination of birds through the inseminating equipment, especially of paratyphoid infection is possible; and
- Involves handling of birds which may cause stress.

3.3.4 Shift System of Mating

It is desirable to obtain about 100-125 chicks to evaluate a male. This requires a total time which is inversely proportional to the mating ratio. If a male has 6, 12, and 16 dams, the approximate time required to obtain the desired number of progeny is 33, 17 and 13 days, respectively. To reduce this time, the males can be shifted from one pen to another so that it will have more mates (female birds) through which it can be evaluated. Similarly, the dams also have more mates making the comparison between dams more critical and accurate.

The major drawback of the system is the overlapping of the paternity when the males are changed since the viability of spermatozoa ranges from 7-21 days. It has been found that this problem of overlapping of pedigree can be avoided greatly by using AI, because, the sperms held in the oviduct cannot compete with those in the fresh semen. Therefore, the eggs laid on the second day after AI is attributable to the new sire. Similar results is possible with natural mating, but the chances of preferential mating or time taken before the new male mates with the female concerned restricts the accuracy under natural mating. The other problems include the difference in vigour, virility and fertility of the successive cocks, difficulty in record keeping and more labour involvement etc.

The shift normally followed is as follows:

- 1st day First shift males in breeding pens.

- 2nd day Start of collection of fertile eggs.
- 15th day Removal of first shift males.
- 20th day AI using the semen of second shift males and the males are allowed into the pen.
- 22nd day Eggs are laid from 8th to 21st day (both days inclusive) are pooled and designated to have been fertilized by first shift males. Start of collection of fertile eggs on 22nd day and onwards.
- 29th day Second shift males removed.
- 35th day AI using the semen from third shift males and the males allowed into the pen. Eggs collected from 22nd to 34th day are pooled and designated to have been fertilized by second shift males; and so on.

However, pen mating or AI is the commonly practiced methods of mating in most of the poultry breeding farms.

3.3.5 Flock Mating

In this type of mating, large numbers of hens in a flock are kept with cocks in the ratio of 10 hens per cock. Method is good to reduce operating cost because of large number of fowls per unit. This method is preferred where pedigree records are not maintained.

This system of mating has the following disadvantages:

- Males develop tendency to fight each other (When one male become aggressive prevents others from mating).
- Dominating tendency of male causes low fertility.
- Pedigree cannot be maintained.

Check Your Progress 2

Note: a) Use the space given below for your answers.

b) Check your answers with those given at the end of the unit.

1) What are the different methods of mating in poultry?

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2) Which method do you feel is best for fertility?

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Activity 2

Visit a nearby poultry farm, collect information onthe method of mating being employed in the farm and give your opinion and comments.

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3.4 CULLING FOR BETTER PRODUCTION

Culling refers to the identification and removal of the non-laying or low producing hens from a laying flock. Unless the birds are removed, they are suitable for marketing or home cooking. It would be more profitable to eliminate poor or non-layers early in their life than to wait until later. But, a successful method of selecting high and low producing pullets before they start laying, beyond eliminating the weak, has not been definitely worked out. Birds of low vigour, slow maturing, should be culled during the growing period itself before they are shifted to the layer house. Removing the inferior birds reduces the cost of producing eggs, reduces the incidence of disease and increases the available space for high producing hens. Hens eat feed whether or not they are laying. Removing the cull birds will make more feed and space for more productive birds. It is a commercial practice that when the birds are shifted to the layer house, they are visually examined and birds which are weak and unthrifty are culled; this is probably referred to as "sight culling".

3.4.1 Sight Culling

Sight culling is removal of obviously undersized, under developed, weak, crippled or discarded birds which have very little chance of becoming good laying hens when being placed in the laying house. Any bird which has a permanent genetic or injury-produced deformity such as crossed beak, slipped wing, one or both eyes blind, or any leg deformity that can interfere with the bird's ability to mate or to reach feed, water or lay in the nest is removed. It is most economical to remove these birds from the flock as soon as they are noticed or identified.

Similarly, the sick or unthrifty birds will often have short, narrow, emaciated (thin, weak) bodies and appear listless or droopy**;** small pale combs and wattles generally indicate chronic poor health. These birds have to be removed from the flock as soon as possible to avoid disease problems that may spread to other birds.

Culling at night is recommended, since the birds are less likely to be frightened and reduce egg production. A flashlight with the lens covered with blue cellophane will make it easier to detect poor layers without disturbing the other birds. However, even after the pullets are housed in layer houses, some of them may be uneconomical due to poor production abilities. Such birds are identified by judging them at or after 26 to 28 weeks of age. Pullets can be judged for both present production as well as persistency of production; the latter popularly referred to as "past production".

3.4.2 Present Production

Non-layers are the birds old enough to have produced eggs but have not yet started laying and poor layers are the pullet which have started laying but are producing fewer than expected number of eggs. Present production may be determined by examining the vent, pubic bones, comb, wattles and earlobes.

(i) Comb and wattle: A good layer will have more active and well developed ovary and hence more sex steroids are secreted which includes testosterone which is responsible for good development of combs and wattles.

(ii) Eye: Good layers tend to open their eyelids much more than poor and non-layers in order to receive more light stimulus required for egg production.

(iii) Vent: When the egg is being laid, there will be relaxation of the pubic bones to help passage of egg and oviposition. When it occurs frequently, as in case of good layers, the pubic bones remain relaxed. This relaxation causes the otherwise round vent (Cloaca) to become oblong. Added to this, during oviposition, there will be vaginal secretions to help passage and laying of egg which makes the vent moist. Therefore, vent of a laying hen is large, moist and dilated and tends to become oblong in shape. In case of non-layers, it will be small, contracted and dry.

(iv) Distance between pubic bones: In case of good layers, due to frequent relaxation of the pubic bones, they become more flexible, thinner and remained separated by a larger distance. In non-layers, the bone will be stout and very hard.

Table 3.1: Judging Present Production

Particulars	Good Layer	Poor Layer	Non-layer
Comb	Large, red, warm	Small, less warm, shrunken	Underdeveloped
Eyes	Big, bright and active	Comparatively smaller and less active	Appears dull and inactive
Vent	Oblong, moist and pink	Less oblong, may be moist and pink	Round, dry and has a yellow ring
Distance between two pubic bones	At least three fingers	Less than three fingers	Maximum one finger
Distance between tip of the breastbone and pubic bones	At least four fingers, the region being soft and pliable	Less than four fingers, not very soft	Hardly two fingers, very hard and rubbery

One finger is approximately 1.25 to 1.5 cm

(v) Distance between tip of the breastbone and pubic bones: This is a measure of abdominal capacity. Good layers consume more feed than poor or non-layers. They will also have well developed ovary and oviduct (about 20 times as large as the same organs of a non-productive hen). Hence, there will be some structural change in the skeletal system to accommodate these changes. In addition, due to constant pressure of the viscera (organs) and the weight of egg in the oviduct, the abdominal muscles become flabby (loose) in case of good layers. Capacity to produce eggs is shown by the depth or distance from the front of the keel to the centre of the back, the space between the end of the keel and the pubic bones, the width and length of the back, and by the width and length of the keel. A depth of 4 to 5 fingers from the end of the keel to the pubic bones is associated with good rate of production, while a depth of 2 or 3 fingers indicate fair to poor production.

3.4.3 Persistency of Production

The persistency of production (Past Production) of a laying hen can be measured by the following parameters:

(i) Moulting: Persistence of production is measured by the condition of the plumage. As long as the hen lays regularly, she usually retains her old feathers, But, if for any reason other than sickness or broodiness, she stops laying, the feathers begin to drop and this condition is called as 'moulting'. Hens referred to as "late moulters" will lay for 12 to 14 months before moulting, while others, referred to as "early moulters" may begin to moult after only a few months in production. Late moulters are generally the better laying hens and early moulters are generally poor layers.

The order in which birds lose their feathers is fairly definite. The feathers are lost from the head first followed in order by the neck, breast, body, wings and tail.

(ii) Pigmentation: Xanthophylls, the yellow pigment responsible for yolk colour will be present in various parts of the body *viz.* round the vent, earlobes, eyelids, beaks, shanks etc. Before the birds begin to lay (Non-layers), the pigment is replenished regularly by the feed the birds eat. But, when the birds begin to produce eggs, the xanthophylls will be taken for yolk colouration and hence, the tissue from where the xanthophyll is oxidized does not get the pigment; and therefore, they get discoloured or bleached or de-pigmented.

It can also be noted that non-layers are characterized by presence of yellowish colour round the vent whereas both poor and good layers will definitely have bleached vent.

The order of bleaching of pigments is presented in Table 3.2.

Table 3.2: Order of Bleaching of Pigments

Tissue Bleached	Number of Eggs
Vent	When first egg is laid
Eyelids	6-8
Earlobes	9-10
Beaks	11-35
Underside of foot	66
Front of shanks	95
Back of shanks	159
Top of toes	175
Hock joint	180

Here are some examples to calculate the persistency of egg production, age of the pullets and age at sexual maturity.

Example 1: To obtain persistency (% egg production).

Assumptions:

a) Age at sexual maturity (ASM) : 154 days

b) Age at judging : 280 days

c) Area bleached : Front of shank

Calculations:

Based on the order of bleaching of pigments i.e. front of shank (Table 3.2), number of eggs produced is 95.

Therefore, number of days in production = Age at judging – Age at sexual maturity

= 280 – 154

= 126 days

That means, in 126 days, 95 eggs are produced.

$$\text{Persistency} = \frac{\text{No. of eggs produced}}{\text{No. of days in production}} \times 100$$

$$= \frac{95}{126} \times 100$$

= 75.40 %

Example 2: To obtain age of pullets.

Assumptions:

a) Age at sexual maturity (ASM) : 154 days

b) Egg production : 44%

c) Tissue bleached : Underside of foot.

Calculations:

Based on the order of bleaching of pigments i.e. Underside of foot (Table 3.2), number of eggs produced is 66 at a rate of 44%. In other words, pullets required 100 days to produce 44 eggs. Therefore,

$$\text{Number of days in production} = \frac{\text{No. of eggs produced}}{\text{Rate of egg production}} \times 100$$

$$= \frac{66}{44} \times 100$$

= 150 days

Age of the pullets = Number of days in production + Age at sexual maturity

= 150+154

= 304 days

Example 3: To obtain age at sexual maturity (ASM)

Assumptions:

a) Age of pullet : 400 days

b) Number of egg produced : 175

c) Rate of egg production : 77.78%.

Calculations:

Since 175 eggs are produced, tops of toes are likely to be bleached (Table 3.2). Therefore,

$$\text{Number of days in production} = \frac{\text{Number of egg produced}}{\text{Rate of egg production}} \times 100$$

$$= \frac{175}{77.78} \times 100$$

= 225 days

Age at sexual maturity = Age of pullets –Number of days in production

= 400 – 225

= 175 days

Check Your Progress 3

Note: a) Use the space given below for your answers.

b) Check your answers with those given at the end of the unit.

1) What do you mean by culling?

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2) Persistency of production can be measured by ..... and .....

3) Present production can be determined by examining ....., ……, ……, …… and .....

Activity 3

Calculate the following parameters based on the assumptions given below:

a) Persistency (% egg production)

Assumptions:

Age at sexual maturity (ASM)	:	160 days
Age at judging	:	350 days
Area bleached	:	Back of shank

b) Age of pullets

Assumptions:

Age at sexual maturity (ASM)	:	157 days
Egg production	:	72%
Tissue bleached	:	Top of toes

c) Age of secual maturity

Assumptions:

Age of pullet	:	420 days
Number of egg produced	:	180
Rate of egg production	:	81.81%

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3.5 JUDGING OF POULTRY

For the purpose of judging, poultry is divided into the following groups:

- Exhibition or standard breed group
- Utility or production group
- Exhibition cum utility group

Judging is carried out on the basis of general appearance, grace and body characters of birds for specific breeds and varieties of poultry. Physical examination by careful observation, handling and assessment of bird is the correct way of judging poultry. It is carried out by score card method by allotting points which are as follows:

Table 3.3: Score Card

Particulars	Points
Condition and vigour	25
Shape	25
Size	25
Colour, good width, uniform body depth and good capacity of abdomen with soft pliable skin	25
TOTAL SCORE	**100**

Table 3.4: Characteristics of Birds to be Accounted in Judging

Parameters	Features of Good Layers	Features of Poor or Bad Layers
1. Head region		
i. Head	Strongly feminine in females and masculine in males, square and broad at the top.	Tendency to be masculine in female, crow headed, narrow and tapering at the top.
ii. Comb and wattles	Full, red, waxy, warm, velvety.	Dry, scaly, wrinkled, cold, coarse.
iii. Beak	Sticky, well curved, broad and rather short.	Narrow, very long, thin, sharp and pointed.
iv. Eyes	Bright, alert and well set.	Dull, sleepy, may have squint.
v. Earlobes	Full, waxy, velvety, colours as per breed specification.	Shrunken, wrinkled, coarse, off-colour to the breed.
2. Neck	Stocky and rather short.	Long and thin.
3. Body		
i. Nature	Capacious (large).	Limited capacity.
ii. Back	Broad and straight.	Narrow and crooked (bent or curved).
iii. Keel bone	Long, properly curved, flexible.	Short, crooked and hard.
iv. Pubic bones**	Wide apart, thin, soft and pliable. Distance between two pubic bones is more than 2 to 3 fingers.	Close together, thick and stiff. Distance between two pubic bones is less than 1 to 2 fingers.
v. Distance between keel and pubic bones**	More than 4 to 5 fingers.	Less than 2 to 3 fingers.
vi. Skin	Thin, soft, oily and silky.	Thick, dry and rough.
vii. Abdomen	Large, soft and free from lumps of fat.	Small, hard and with lumps of fat.
viii. Vent**	Large, oval and moist.	Small, round and dry.
ix. Plumage	Tight, compact, colour specific for breed and variety.	Loose, may be off-coloured for breed and variety.

4. Legs	Thin, soft and flat at back.	Thick, hard and rounded at the back.
5. Temperament	Friendly and always happy.	Shy, nervous, cries when caught.
6. Appetite	Healthy, crop always nearly full .	Mincing appetite and poor layer.
7. Pigmentation**	Pigment bleaches out from beak, shin, vent, shank and eye ring as laying advances and they will appear faint in colour.	Due to non-bleaching, beak, shin, vent, shank and eye-ring are brightly coloured.

**** These characters are especially important for females, while others are of common importance

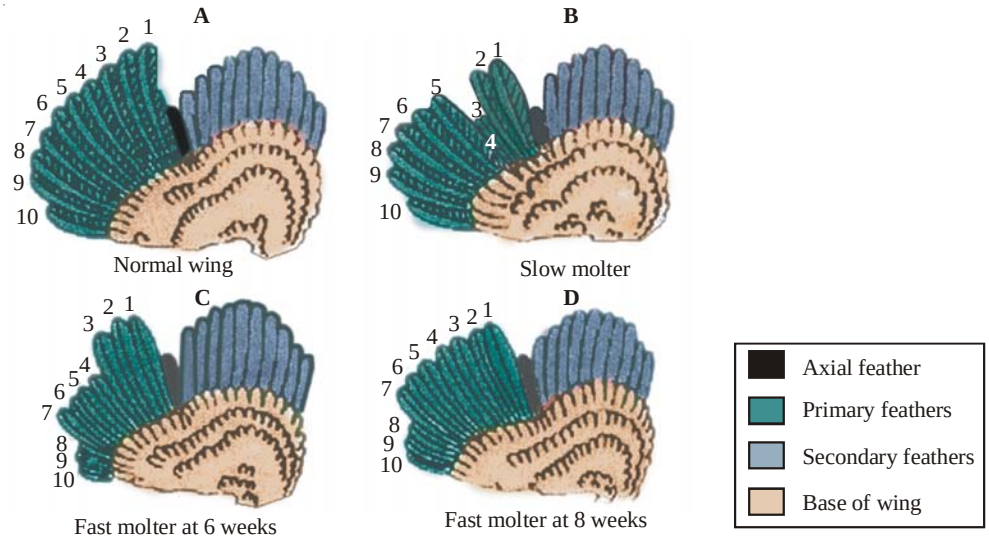

Fig. 3.3: Characteristics of feather based on moulting

Check Your Progress 4

Note: a) Use the space given below for your answers.

b) Check your answers with those given at the end of the unit.

1) For the purpose of judging, poultry is divided into how many groups?

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2) On the basis of which parameters, judging is carried out?

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Activity 4

Visit a nearby layer farm. Restrain a bird in production and judge the bird's production status based on score card or their characteristic features as at Table 3.4.

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3.6 LET US SUM UP

The breeding systems can be classified depending on whether it is aimed to increase homozygosity or heterozygosity into random mating, inbreeding and outbreeding. The different methods of mating followed in poultry are pen mating, stud mating, artificial insemination, shift system of mating and flock mating. Culling refers to the identification and removal of the non-laying or low producing hens from a laying flock. Unless the birds are discarded, they are suitable for marketing or home cooking. It is obvious that it would be more profitable to eliminate poor and non-layers early in life, than to wait until later. But, a successful method of selecting high and low producing pullets before they start laying, beyond eliminating the obviously weak, has not been definitely worked out. Birds of low vigour, slow maturing, should be culled during the growing period itself before they are shifted to the layer house. For purpose of judging, poultry is divided into the following groups: exhibition or standard breed group, utility or production group, exhibition cum utility group.

3.7 GLOSSARY

Bleach : To remove the colour or become white or colourless.

Breeding : Mating between birds/animals.

Dam : Female parent of an animal or bird.

Flock : A group of animals or birds that live or feed together.

Heterozygosity : Dissimilar.

Homozygosity : Similar.

Hybrid Vigour : The increased vigour or general health, resistance to disease, and other superior qualities that are often manifested in hybrid organisms, especially plants and animals.

Pedigree : a list of the ancestors from whom an animal has come from. A list of the ancestors of a purebred animal.

Sire : Male parent of an animal or bird.

3.8 SUGGESTED FURTHER READING

Jull, M.A. 1982. *Poultry Husbandry*, Tata McGraw-Hill Publishing Company Ltd., New Delhi.

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Sreenivasaiah, P.V. 2006. *Scientific Poultry Production - A Unique Encyclopaedia*, Third revised and enlarged edition, International Book Distributing Co.

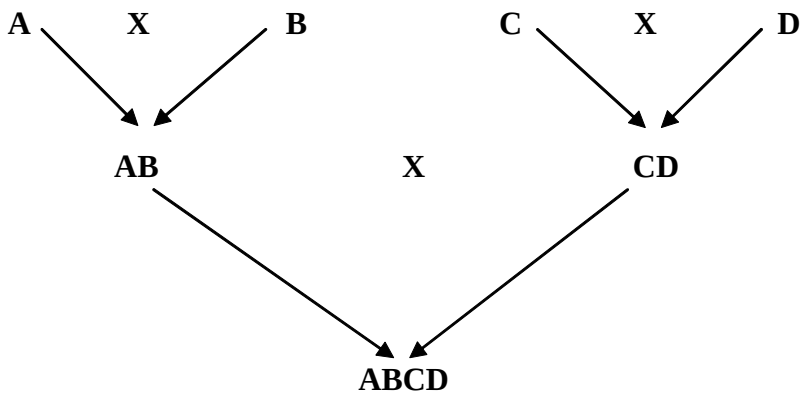
3.10 ANSWERS TO CHECK YOUR PROGRESS

Check Your Progress 1

1) Breeding systems are classified based on whether it is aimed to increase the homozygosity or Heterozygosity into random mating, inbreeding and outbreeding.

2) The common system of breeding used in poultry are both inbreeding and outbreeding.

3) In double cross, two different single crosses (AB and CD) are crossed to obtain ABCD.



This is usually practiced in poultry breeding for crosses between inbred lines of low viability since only a relatively small number of animals of the lines A, B, C, D need to be maintained.

Check Your Progress 2

1) The different methods of mating in poultry are pen mating, stud mating, artificial insemination, shift system of mating and flock mating.

2) Flock mating and Artificial Insemination is best for fertility.

Check Your Progress 3

1) Culling refers to the identification and removal of the non-laying or low producing hens from a laying flock.

2) Moulting and Pigmentation.

3) Vent, pubic bones, comb, wattles and earlobes.

Check Your Progress 4

1) For the purpose of judging, poultry is divided into three groups:

   - Exhibition or standard breed group
   - Utility or production group
   - Exhibition cum utility group

2) Judging is carried out on the basis of general appearance, grace and body characters of birds for specific breeds and varieties of poultry. Physical examination by careful observation, handling and assessment of bird is the correct way of judging poultry.

OLP-001 INTRODUCTION TO POULTRY FARMING