BASIC CONCEPTS OF ANIMAL BREEDING:

- From the beginning, human being is interested in the improvement of domesticated animals.
- He used the simple process called selection in the early days. Later he introduced the techniques like inbreeding and outbreeding with the knowledge of genetics.
- At present latest techniques like cloning of animals, production of transgenic animals etc also were adopted.

SYSTEMS OF BREEDING :

- Animal breeders follow the various methods of breeding techniques for the improvement of available breeds or to produce the better breeds. Some of these techniques are described below.

Inbreeding

- Inbreeding is the mating of related individuals within 4 to 6 generations. It is defined as the mating of more closely related individuals than the average of the population.
- Inbreeding includes close breeding and line breeding.
- **Close breeding** is the mating of the male and female of the same pair of parents or a sire to his daughter or a dam to her son. This mating is followed in the individuals, if both of them are outstanding.
- **Line breeding** is the mating of the related animals, but they are not as close as the animal selected for close breeding.

Advantages and disadvantages of inbreeding :

- It increases the homozygosity and decreases the heterozygosity. So it favours the genetic uniformity. It is the best method of getting true strains from the unknown stocks.
- It sorts out the characters and helps in the **selection** of die desired animals and the **culling** of the undesired individuals.
- Inbreeding reduces the reproductive efficiency, causes inbreeding depression and the outward expression of undesired hereditary characters.

ii. Outbreeding

- Outbreeding is the breeding of unrelated animals. It includes outcrossing, cross breeding and species hybridization.
- **Outcrossing** is the crossing of unrelated pure breeding animals of different traits within the same breed. The offspring is called outcross.
- **Cross breeding** is the mating of animals of different breeds. The offspring is called **crossbreed.**

Species hybridisation :

- It is the crossing of two different species of a genus. It is less common in animals and more common in plants. Jack (male ass) is crossed to mare (female horse) to produce mule.
- Stallion (male horse) is crossed to Jennet (female ass) to produce hinny. Mules are always sterile, hinny is inferior to mule as a work-animal. It is also sterile.

Advantages and Disadvantages of outcrossing and crossbreeding :

- These methods are highly effective for characters that are largely under the control of genes which are polygenic and cumulative like milk production, growth rate etc.
- It is also a **method to introduce a desirable character in a breed** in which that character does not exist.
- This introduced character is improved by **grading up.** It is the practice of breeding sires of a given breed to a nondescript female and their offspring for generation after generation.
- Crossbreeding requires the maintenance of two or more pure breeds in order to produce the crossbreeds.

HETEROSIS OR HYBRID VIGOUR :

- It is the phenomenon in which the crossing of unrelated individuals result in the progeny with increased vigour.
- This progeny may be due to crossing of different strains, breeds, races or even species.
- The offspring has a large number of loci with dominant genotypes than either of the parents has.

PROGENY TEST :

- Certain characters like milk-yield in cattle are sex-limited characters. The genes for these characters are located on autosomes of both sexes, but their expression is limited to one sex only.
- Most of these genes are polygenic with cumulative expression. So these characters are quantitative (expression depends on number of genes) and they follow the quantitative inheritance.
- The genes for these characters are inherited from both males and females. The male animal can not be ignored at the time of animal breeding, as the genes for the high-yield of milk are also inherited form the male.
- To assess these genes in the male animal, in which they do not express, the progeny test is conducted.
- **Progeny test is the assessment of characters of the parent/s by studying the characters of its progeny.**
- A cow is crossed to a bull. The female progeny is found to be high yielding. It is inferred that the genes for milk are more in progeny than those in the mother.
- The genes for milk are inherited from the mother along with the father. The male animal is with more number of these genes. If the female progeny is low yielding it is inferred that these genes are less in the progeny than those in the mother.
- The male animal is with less number of these genes. Thus, the progeny test is a tool for the animal breeders to assess the male animals for the characters, generally not expressed in them.

Other methods of animal breeding:

1. **Artificial insemination (AI)** the semen of the desirable male is injected into the female reproductive tract
2. **Multiple ovulation and embryo transfer technology (MOET)** the cow is administered with FSH to produce 6 to 8 ovules (multiple ovulation) this female is crossed with desirable male and the zygote of 8 to 32 cell stages are placed in surrogate mothers

CLONING :

- Cloning refers to the production of genes or cells or organisms with identical genetic constitution.
- Clone is a population of cells or individuals which are genetically identical. Cloning may be of different types:
- **i. Gene cloning** : Multiplication of specific gene into several copies by recombinant DNA technology or polymerase chain reaction (PCR).
- **ii. Cell cloning :** Production of specific cell types, e.g. production of hybridoma cells that produce monoclonal antibodies.
- **iii. Organism cloning** : Production of individual plant or animals with identical genetic constitution.
- In higher organisms cloning depends on totipotency i.e. ability of single cell to divide and regenerate into complete individual.
- Plant cells usually possess totipotent ability. But in animals only zygotes possess this ability.
- **Ian Wilmut** (1997) from U.K. produced a clone of adult lamb and named it as **Dolly.** The procedure involved the following.
- Isolation of udder cell (vegetative or somatic *2n* cells) from a sheep (template of Dolly) and the subsequent culture to form several cells.
- Isolation of egg cell from a female sheep. The nucleus is removed from the egg (denucleation).
- Denucleated egg cell is fused with udder cell by electrical stimulus to get a fusion product. It is similar to a fertilized zygote.
- The fused cell, with the impulse of an electric current is forced to divide under *invitro conditions.* After a few divisions, the blastocyst is formed. This blastocyst is implanted in the uterus of a foster or surrogate mother.
- The lamb produced by surrogate mother is genetically and phenotypically identical to sheep from which the udder cells were used for cloning.

TRANSGENIC ANIMALS :

- Both animals and plants can take up DNA from their surrounding diverse environments and become transgenic organisms.
- **R.D. Palmiter** and **R.L. Brinter,1982** isolated the gene for the growth hormone in rabbit and in humanbeing.

- These genes were tagged to the promoter region of a mouse gene. The promoter with the gene for growth hormone of rabbit or humanbeing was ligased to the vector pBR 322 to produce recombinant DNA.
- This rDNA was transferred to the zygote of a mouse *in vitro.* The embryo was implanted in the uterus of mice.
- The new born was found to be transgenic. **Transgenic animal** is the organism in which its own genome contains a part of the genome of other animal.
- Transgenic animals with desired traits are produced by transferring the respective gene from the other animal.
- DNA can be taken into mammalian cells by several methods, like microinjection of eggs, by virus vectors (**transduction**) or by direct uptake of DNA stimulated by calcium or an electric current **(transfection).**
- Transgenic animals are used to produce expensive and rare proteins for use in medicine ("pharming" of drugs).