ANIMAL GENETICS & BREEDING

UNIT – III

The Principles of Animal Breeding

Theory

Selection and It's Type

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Selection

- Selection is differential propagation of genetic material to next generation.
- The process of differential survival and reproduction of different individuals (genotypes) in population is called selection.
- 2 types of selection:-

  Natural selection

  Artificial selection

Natural selection	Artificial selection
1.Principle- “Survival of fittest” in given environment.	1.Standards laid down by the breeder, which animals retain and allow to become parents of next generation
2.It is measured by survivability and reproductive success of the individual.	2.Under control of certain set rules. To govern the probability that an individual reproduce
3.A very slow process and usually takes hundreds/ thousands of generations to produce meaningful effects.	3.Fast process and bring about considerable change in genetic composition of population over short periods.

4.Occur at gametic stage:- • Segregation of homologous chromosomes at meiosis for gamete formation. • Gamete competition. **At zygotic stage:-** • Embryonic growth and development • Maturity rate • Mating ability • Total progeny produced • Birth to adulthood	**4.Can be conducted when genotypes are more attractive, productive, more efficient functionally and preferred by the breeder**

5.Example:- origin and development of new species of animals and plants	**5.Example:- development of new varieties/ breeds of animals and plants.**
6.Mediated by force of nature & animal which best fit in their environment have higher survival rate and produce more no. of progeny	6.Mediated by man & in this, choosing the individuals to become parents of next generation

Types of natural selection

1.**Stabilizing selection/ Centripetal/ Unifying selection on balanced selection**

- Stabilizing selection is a form of natural selection that screens against the outliers, or exceptions to the trait.
- This type of selection favours average sized individuals while eliminates small sized individuals.
- It reduces variation and hence does not promote evolutionary change.
- However, it maintains the mean value in a population from generation to generation.
- If we draw a graphical curve of population, it is bell-shaped.
- This type of selection favours heterozygotes.

Features of stabilizing selection

- Operate in constant or unchanging environment
- Keeps a population genetically constant
- Favours the average or normal phenotypes
- Introduce homozygocity in the population
- Check accumulation of mutation

Example:

- The coats of a species of mice in a forest will all be the best color to act as camouflage in their environment.
- Human birth weight, the number of eggs a bird lays, and the density of cactus spines
- Selection against homozygous sickle-cell sufferers, and the selection against the standard HgbA homozygotes by malaria.
- In the human populations, inhabiting in tropical and subtropical Africa the sickle cell gene produces a variant form of the protein haemoglobin, which differs from the normal haemoglobin by a single amino acid. It is caused by the substitution of glutamic acid by valine at sixth position of beta chain of haemoglobin.

2. Directional Selection (Progressive Selection)

In this selection, the population changes towards one particular direction. It means this type of selection favours small or large-sized individuals and more individuals of that type will be present in next generation. The mean size of the population changes.

Features of directional selection

- Due to change in the environment in particular direction
- Favours the phenotype which is non-average or extreme
- Alters the mean value of the trait in the population in one direction
- Favours accumulation of those mutations that increases fitness in the changing

environment

- Eliminate normal or average individuals

Examples: Evolution of DDT resistant mosquitoes, industrial melanism in peppered moth, evolution of giraffe and Antibiotic Resistance in Bacteria.

3.Diversifying/ Disruptive/ Bidirectional/ Centrifugal/ 2-way selection

- This type of selection favours both small-sized and large-sized individuals.
- Selection favours two diverse types at a time and eliminating the individuals with intermediate (heterozygotes) phenotypic values.
- Selection results in little change in phenotypic, breeding value, gene frequencies and avg. performance.
- This kind of selection is opposite of stabilizing selection and is rare in nature but is very important in bringing about evolutionary change.

Features of disruptive selection

- Previously homologous population break up into several different adaptive forms
- Extreme values have highest fitness and intermediate or mean values are relatively

disadvantageous

- It occurs when a population previously adapted to a non-homologous environment is

subjected to divergent selection pressure in different parts of its distributional area.

Dissortative mating:- phenotype of mated individuals are less similar.

Variance is reduced in offspring generation.

Increases heterozygotes at expense of homozygotes.

Progeny population less variable.

Gene frequencies do not change in subsequent generation.

Assortative mating:- Similar phenotypic individuals are mated.

Increased the variance in offspring generation.

Finally emerge in two separate and distinct sub populations one with better performance and other with poor performance.

Heterozygous genotypes are reduced in subsequent generations and homozygous genotypes are increased.

Random mating:- Increases the variability in offspring generation very slightly.

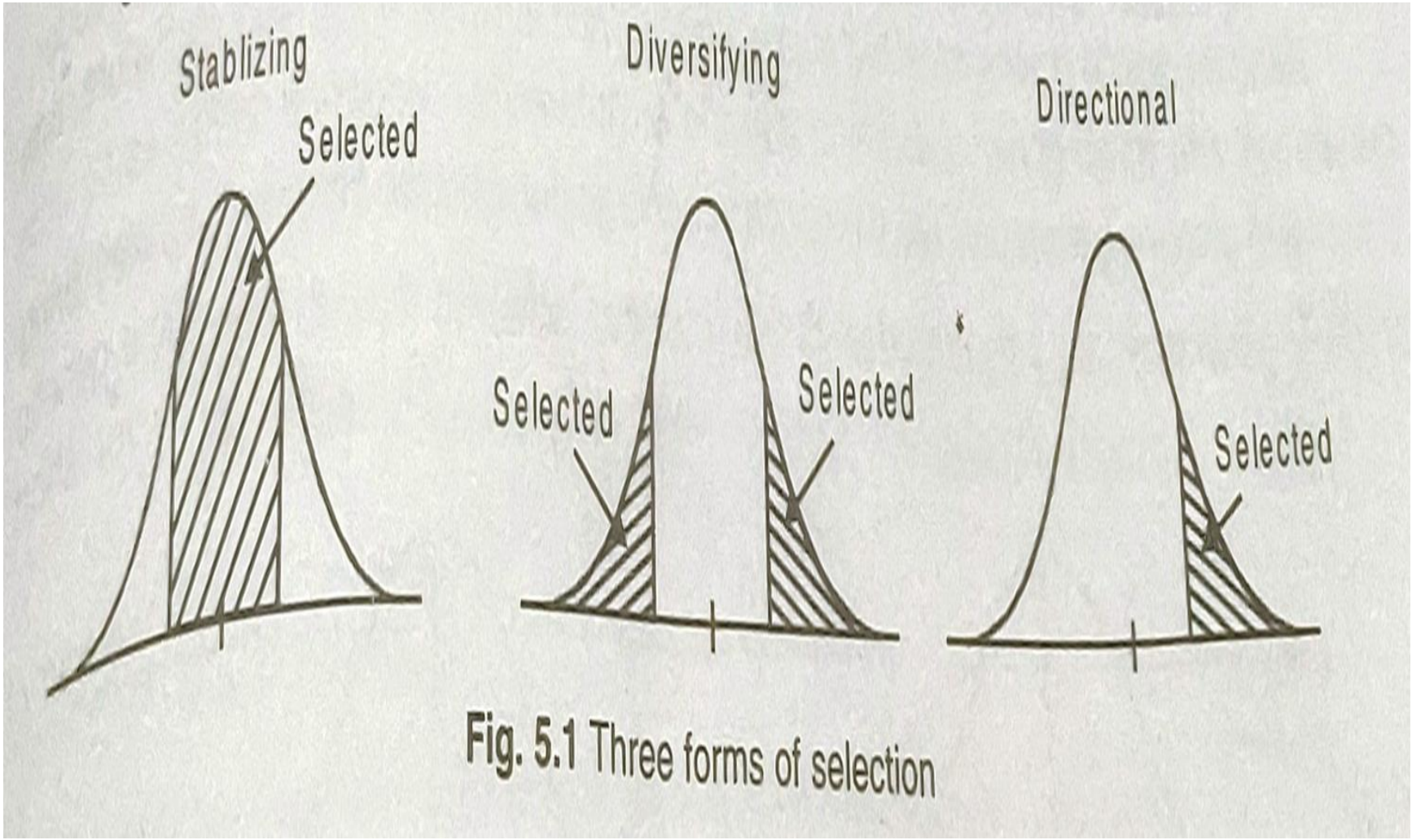

Fig. 5.1 Three forms of selection

❖ **MULTISTAGE SELECTION**:- The selection involves the identification of individuals which are superior and it is a complex process completed in different stages/ ages of animal known as multistage selection.

First stage of selection	At the birth of animal
Second stage of selection	At growth and maturity
Third stage of selection	At pedigree of the animal
Young male selection	On libido, semen quality, semen freezability
Last stage of selection	On breeding value for the character

❖ **MULTITRAIT SELECTION**:-

- The economic value of animal depends upon several characters known as overall performance of total breeding value (net merit) of animal.
- Net economic value of an animal depends upon several traits.
- Breeding merit of an animal determined on several traits simultaneously and not by a single trait, to improve the overall economic value based on simultaneous selection for several character, which is known as multi trait selection

❖ **Multitrait – Multisource selection index**:-

- The accuracy of selection for low heritability traits can be increased by using information from other sources (individual's relatives records) for such traits.
- The selection index for two or more traits is obtained from individual and its relative's records, such selection index is known as multitrait – multisource index.
- It is constructed on principle of selection index theory.

❖ **Combined selection**:-

- The selection of an individual on basis of two or more source of information is called as combined selection or index selection.
- An index combining information from various relatives (dam, sib or progeny) with or without individual's own record.
- In this multiple regression technique is used.
- These multiple regression coefficients are to be used as weighting factors.
- Combined selection uses all the information available about each individual's B.V. , combined into an index of merit.

❖ **Consequences of selection**:-

- Basic effect of selection is to change gene frequencies and genetic properties of population.
- Population mean is changed as a result of selection.
- Long term selection should lead to fixation of alleles with consequent loss/ exhaustion of genetic variance at selection limit. This will reduce the phenotypic variance and at last selection will not result in any response.

- Due to selection there is disagreement between expected and observed response to selection called as insufficient response.
- The selection in opposite direction known as bidirectional selection or two way selection. Due to this, response is not equal and this inequality of selection called as asymmetry of response to selection.
- The selection acts on additive genetic variance which goes on diminishing in future generations as a result of continuous selection.
- Due to continuous selection there will be no genetic variance and hence there will be no response to further selection.

- When there is no response to selection it is said that selection limit has reached and such population is called at selection limit or plateaued population, this is also known as selection plateau.
- The phenotypic level of a trait at which the response ceases is called as selection limit.
- Selection limits reached between 20-30 generations.
- Selection limit can be overcome by introducing new genetic material either through mutation or through outcrossing.

THANK YOU