Selection and bases of selection:

Definition:

It is a process in which certain individuals in a population are preferred to others for the production of the next generation.

Selection is also can be defined as, differential reproduction among individuals with different genotypes.

Types of selection:

There are two types of selection:

1. Artificial and 2. Natural selection

1. Natural selection:

It is differential reproduction among individuals with different genotypes not resulting from manipulation of the population by breeder.

Natural selection acts on the phenotype, or the observable characteristics of an organism, such that individuals with favorable phenotypes are more likely to survive and reproduce than those with less favorable phenotypes.

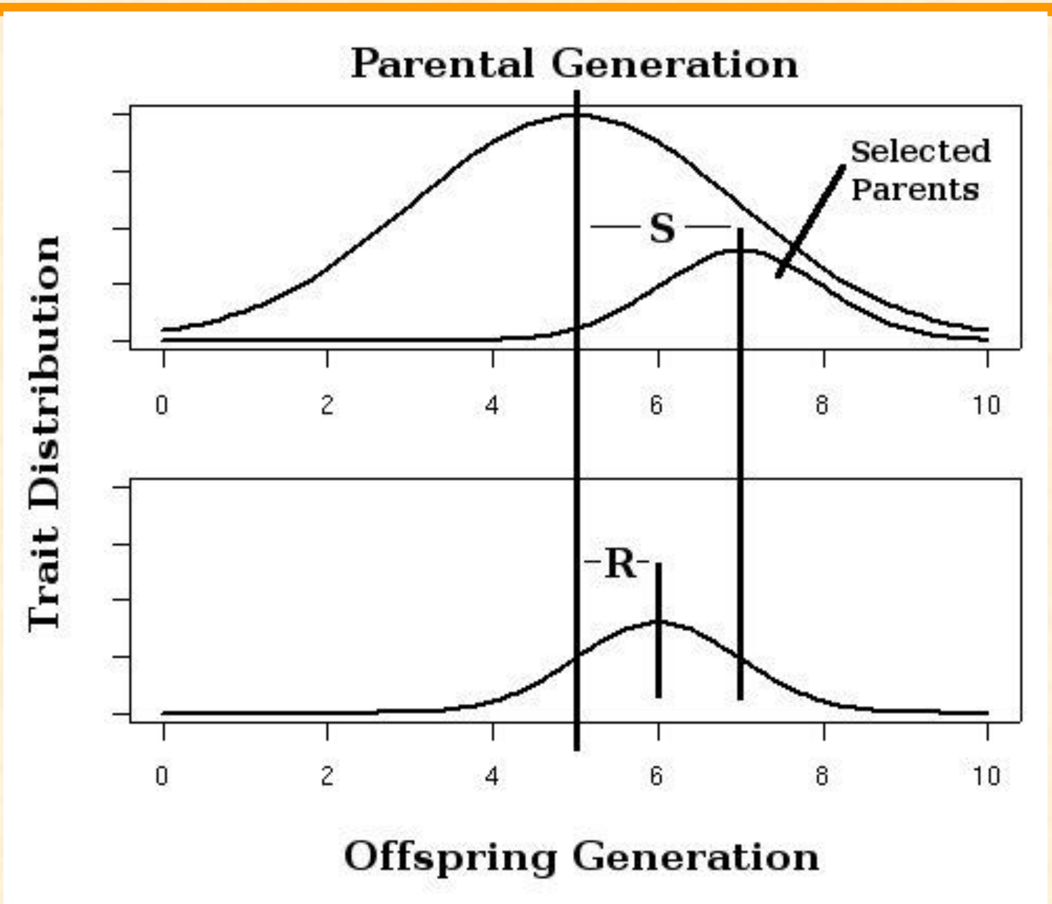
Also, natural selection arises from genetic differences among individuals in fitness (Darwinian fitness).

Fitness is number of offspring per individual which survive to breeding age.

Many traits contribute fitness such as disease resistance, age at sexual maturity, anatomy of the reproductive tract, libido, mating behaviour, maternal behaviour, milk production, and longevity.

2. Artificial selection:

In artificial selection the breeder chooses the parents of the next generation. The breeder determines which replacements will be retained and how long will be allowed to remain in the population.



The strategies of genetic progress through selection are:

1. Selection within breed/strain involves comparing animals of the same breed and mating the preferred animals to produce the next generation.

2. Selection between breeds or strains which can achieve dramatic and rapid genetic change when there are large genetic differences between the breeds chosen for the characteristics of economic importance.

Bases and types of selection:

I. Selection for one trait.
II. Selection for multiple traits.

I. Selection for one trait:

There are three possible bases for differential reproduction among genotype:

1. Directional selection.
2. Stabilizing selection.
3. Disruptive selection.

1. Directional selection:

It is of the greatest concern to the animal produces.

It is selection of individuals to be parents of the next generation whose phenotypes more nearly approach a maximum (or minimum) for some trait, e.g. high body weight, high egg production, lower mortality.

Other individuals are not allowed to reproduce because they are poorer in phenotypic merit for the trait upon which selection is based.

The effect of directional selection for heritable trait is to change gene frequency in the next generation.

Alleles with favourable effects are increased in frequency at the expense of less favourable alleles at the same loci and assuming no change in the environment, the phenotypic average for the trait in the population is increased.

The name "directional selection" is descriptive of the increase in average phenotypic merit.

2. Stabilizing selection:

It can be done by two methods:

1. Phenotypes from around the population mean are selected e.g. practiced mainly in the breeding of pets and show animals weights.

2. In another less common form of stabilizing selection, the extremes of both directions are selected and paired with each other so that the mean of the population remain unchanged but variability is increased.

The effect of stabilizing selection causes no changes in gene frequency or in phenotypes.

3. Disruptive (diversifying) selection:

It is that type of selection favouring both phenotypic extremes and the aim is to increase the magnitude of the extremes; and it is of limited importance in livestock breeding (in research for formation of inbred lines and divergent selection as sires are chosen for "maleness" and dams for "feminine" expression).

It is that type of selection characterized by:

1. **Favoring both phenotypic extremes,**
2. **With lower reproduction from individuals near the average.**

Genetic gain from selection:

Response to selection (R):

Definition:

It is the difference of mean phenotypic value between the progeny of selected parents and the whole of the parental generation before selection was made (population mean).

R = Average of the progeny of selected parents - Average of the population from which the parents are selected.

$$R = \bar{x}_P - \bar{x}_B$$

The response to selection is dependent upon selection differential.

Selection differential:

It is the difference of mean phenotypic value between the individuals selected as parents and the whole individuals in the parental generation before selection was made (population mean).

S = Average of selected parents - Average of the *population* from which the parents are selected.

$$S = \bar{X}_{\text{Selected}} - \bar{X}_{\text{Base}}$$

NB: Response to selection is also dependent upon the selection differential, S.

Methods of selection

Selection can be classified on the basis of phenotypic selection or of genotypic (genetic) selection as the following:

I. Phenotypic selection:

- **A. Individual or mass selection.**
- **B. Family selection.**
- **C. Within family selection.**
- **D. Combined selection.**

II. Genotypic (genetic) selection:

- **A. Pedigree selection.**
- **B. Family selection.**
- **C. Progeny testing selection.**

Breeding value and the aids to selection:

Selection is the business of making decisions about the animal in the light of information.

Breeders have to start and consider the "Beeding value" (BV) of an animal.

Breeding value is the really it’s genetic worth and is what animal breeding is all about.

To help make decisions, there is a number of well recognized sources from which the required information can be obtained.

These are referred to "aids to selection" and are as follows:

A. **Individual or mass selection.**
B. **Lifetime performance records.**
C. **Pedigree information.**
D. **Progeny performance.**
E. **Performance of other relatives (family selection).**

Breeders have to start and consider the "Breeding value" (BV) of an animal.

Breeding value is the really it's genetic worth and is what animal breeding is all about.

The phenotype of an individual can then be shown as follows:

$$P = G + E = BV + E$$

Estimation of breeding value:

A. Individual's own performance or mass selection (Performance testing):

BV = heritability of the trait x (individual average – average of contemporaries).

Or BV = h2 x (individual deviation).

$$EBV = h^2\left(P - \overline{P}\right) \qquad Acc = \sqrt{h^2 x 1} = h$$

B. Multiple records on an individual (Lifetime performance records):

$$B.V = \frac{n\,h2}{1 + r\,(n-1)}$$ (Average deviation of the dam's records from her contemporaries).

$$\frac{n\,h2}{1 + r\,(n-1)}$$ (Accurcy) (Confidence factor).

C. Performance of other relatives (sib information or selection):

The formula for b which should be used in the formula for estimated breeding value is as follows:

$$b = \frac{gh^2n}{1+(n-1)t}$$

Where

g = ½ for full sibs or ¼ for half sibs
h2 = heritability
n = the number of sibs.
t = the correlation among the sibs.

D. Pedigree information:

The breeding value concept can be used with pedigrees where the principle is to predict a BV for the subject animal in the pedigree:

$$\underset{\text{(Son)}}{\text{B.V}} = \frac{1/2\ n\ h2}{1 + r\ (n-1)}$$

(Average deviation of the dam's records from her contemporaries).

$$\frac{1/2\ n\ h2}{1 + r\ (n-1)}$$

Confidence factor (reg. coefficients).

E. Progeny performance (Progeny testing):

Being decisions on the performance of animal's progeny is called progeny testing.

It is a technique generally used for males because they are responsible for more progeny in their lifetime than any one female.

Progeny testing is usually in these situations:

a. For weakly inherited traits.

b. For traits expressed in one sex (e.g. milk production).

c. For traits expressed after slaughter (e.g. carcass composition).

The main points concerned with getting the best results from progeny testing are these:

a. Test as many sires as possible (5 or 10 would be minimal).

b. Make sure the dams are all randomized to each sire, within age groups if possible.

c. Produce as many progeny per sire as is possible (at least 10-15 of either sex for growth traits but up to 300-400 offspring for traits like calving difficulty and fertility).

d. No progeny should be culled until the end of the test.

Disadvantage of progeny testing:

1. Takes time.

2. The keeping of progeny groups for long periods can be an expensive operation.

Thank You For Your Attention