ANIMAL GENETICS & BREEDING

UNIT – III

The Principles of Animal Breeding

Theory

Response to selection

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Response to selection

- The change produced by selection is the change of the population mean in the offspring. This is called as the **response to selection**,
- Symbolized by “R”.
- The response to selection is the difference of mean phenotypic value between the offspring of the selected parents and the whole of the parental generation before selection.
- The response to selection is also called as the expected genetic gain, symbolized by ΔG.
- R or $\Delta G = h^2 S$
- R or ΔG/ year $= h^2 S / GI$
- where, h^2 = heritability, S = selection differential and GI = generation interval

Factors affecting Response to selection

- These are heritability, selection differential and generation interval.
- **Heritability:** The genetic gain depends on the h^2 of the trait in the generation from which parents are selected and if the h^2 is high, the genetic gain will also be more, because the environmental variation will be less.
- **Additive genetic variability of traits**
- **Intensity of selection**
- **Accuracy of selection (r_{AP})**
- **Population size**
- **Generation interval**

Selection differential

- **Selection differential:** The average superiority of the selected parents is called as selection differential, symbolized by “S”. It is defined as the difference between the mean phenotypic value of the individuals selected as parents and the mean phenotypic value of all the individuals in the parental generation before selection.
- **SD = (Ps - P), can also be expressed as,**
- **$S = i\, s_p$**
- The intensity of the selection symbolized by “i” is also called as selection pressure and it is the mean deviation of the selected individuals in units of standard deviation. It depends on the proportion of the individuals selected and it can be determined from the tables of properties of normal distribution.

Factors affecting selection differential

- Proportions of the animal selected for breeding; smaller the number larger the selection differential,
- **Herd size**; larger herd size, smaller proportions of animals selected,
- Reproductive rate; in cattle selection differential will be less whereas in pigs, it will be more because of more litter size and
- Use of AI and frozen semen increases selection differential or selection intensity in case of males and in females, super ovulation and embryo transfer increases the selection differential or selection intensity.
- ***Generation interva*l**: It is the time interval between generations and is defined as the average age of the parents when the offspring is born. This varies between species and selection procedure. Management practices for early breeding in females reduces GI and breeding practices like progeny testing increases the GI.

- The average generation intervals for different species are:
- Cattle- 4-5 yrs
- Sheep- 3-4 yrs
- Swine- 1.5-2 yrs
- Chicken- 1- 1.5 yrs
- Horse- 8-12 yrs.

Accuracy of selection

- The accuracy for selection is directly related to the heritability of the trait. The heritability is high, the selection on phenotype will permit an average estimation of breeding value. If heritability is low, many errors will be made. Increased accuracy in selection can be obtained by comparing the animals in controlled environmental conditions. Correlation may be made for the age of the individual, age of the dam and sex to remove non-genetic variations. The techniques may increase the heritability of the trait by reducing the environmental variation. When the accuracy of selection on individual is low, accuracy can be increased by
- using additional measurements for the trait from the same individual,
- using measurements of correlated traits and
- using measurements of relatives.

Selection limit

When the selection is carried out continuously, the response to selection will be more for a few generations, and then it slows down and finally stops. When the response to selection has stopped, the population is said to be at “plateau” or “selection limit”. The main cause for this is fixation of favorable genes. This causes reduction or absence of genetic variation. Therefore further improvement depends on introduction of new genetic variation. The new genetic variation can be introduced by cross breeding, , mutation and genetic engineering.

Indirect Selection

- Indirect selection is the selection applied to some character other than the one to which it is desired to improve.
- If we want to improve character **x**, we might select for another character **y** and achieve progress through the ***correlated response*** of character x.
- The character to which selection is applied is called as **secondary character**
- CR_x is correlated response of character x resulting from selection applied to the secondary character Y
- $CR_x = i_y\ h_y\ r_A\ \sigma_{A(x)}$

- **Advantages or application of indirect selection**
- Applicable when the two characters have high genetic correlation
- Heritability of character under selection (h^2_x) is sufficiently high than h^2_y
- Difficult to measure character Y than X
- Information on character X is early in life
- Information on character X is costly to measure
- Desired character is measurable in only one sex
- Used for reducing the generation interval