# 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 ∆G**.

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| **R or ∆G = $h^2$ S** | where, $h^2$ = heritability<br>S = selection differential |
| **R or ∆G/ year = $h^2$ S / GI** | where,<br>$h^2$ = heritability<br>S = selection differential<br>GI = generation interval |

**Factors affecting genetic gain**

The factors affecting the response to selection are heritability, selection differential and generation interval. Maximum gain will result when the selection differential (S) and the heritability ($h^2$) are high and the Generation Interval is low.

- **Heritability:** The genetic gain depends on the $h^2$ of the character in the generation from which the parents are selected and if the $h^2$ is high, the genetic gain will also be more, because the environmental variation will be less.
- **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.

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| **Selection differential S = (Ps - P)** | where,<br>Ps = mean of the selected parents<br>P = mean of the population |

The selection differential may also be expressed in terms of phenotypic standard deviation (standard deviation is the measure of variability) as

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| $\mathbf{S = i\ \sigma_p}$ | where<br>i = intensity of the selection<br>$\sigma_p$ = phenotypic standard deviation |

The intensity of the selection is also called as selection pressure and it is the mean deviation of the selected individuals in units of standard deviation. The intensity of selection is symbolized by "i". It depends on the proportion of the individuals selected and it can be determined from the tables of properties of normal distribution.

**i = Selection differential / Phenotypic standard deviation**

**Factors affecting selection differential**

- proportions of the animal selected for breeding; smaller the number larger the selection differential,
- herd size; larger the herd size, smaller the 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 artificial insemination 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.
    - 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 favourable 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.

(source: ICAR NBAGR,IASRI etc)