Hardy-Weinberg Principle

HARDY-WEINBERG PRINCIPLE

Hardy-Weinberg principle states that allele frequencies in a population are stable and is constant from generation to generation. Gene pool remains constant. This is called genetic equilibrium. Sum total of all the allelic frequencies is 1. Individual frequencies, for example, can be named p, q, etc. In a diploid, p and q represent the frequency of allele *A* and allele *a*.

Frequency of *AA* individuals in a population is simply p^2. This is simply stated in another ways, i.e., the probability that an allele A with a frequency of p appears on both the chromosomes of a diploid individual is simply the product of the probabilities, i.e., p^2.

Frequency of *aa* individuals in a population is simply q^2

Frequency of *Aa* individuals in a population is simply 2pq

Hence, $p^2+2pq+q^2=1$.

This is a binomial expansion of $(p+q)^2$.

When frequency measured, differs from expected values, the difference indicates the extent of evolutionary change. Disturbance in genetic equilibrium, or Hardy- Weinberg equilibrium, would then be interpreted as result of evolution.

Factors affecting Hardy-Weinberg equilibrium

Five factors are known to affect Hardy-Weinberg equilibrium. These are –

1. gene migration or gene flow
2. genetic drift
3. mutation
4. genetic recombination
5. natural selection

1. **Gene migration or gene flow**: When migration of a section of population to another place and population occurs, gene frequencies change in the original as well as in the new population. New genes/alleles are added to the new population and these are lost from the old population. There would be a gene flow if this gene migration, happens multiple times.

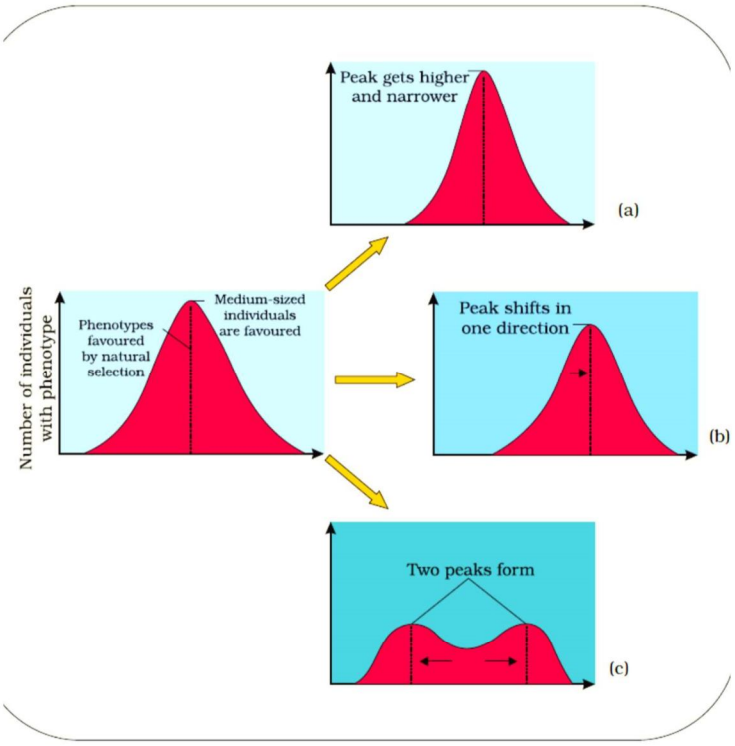
2. **Genetic drift**: If the change in gene frequencies occurs by chance, it is called genetic drift. Sometimes the change in allele frequency is so different in the new sample of population that they become a different species. The original drifted population becomes founders and the effect is called **founder effect**.

3. **Mutation**: Microbial experiments show that pre-existing advantageous mutations when selected will result in observation of new phenotypes. Over few generations, this would result in Speciation.

4. **Genetic recombination**: Genetic recombination during gametogenesis produces changes in allele frequency and hence may disrupt Hardy-Weinberg equilibrium.

5. **Natural selection**: Natural selection is a process in which heritable variations enabling better survival are enabled to reproduce and leave greater number of progeny. A critical analysis shows that variation due to mutation or variation due to recombination during gametogenesis, or due to gene flow or genetic drift results in changed frequency of genes and alleles in future generation.

Along with the enhanced reproductive success, natural selection makes it look like different population. Natural selection can lead to stabilisation, directional change (more individuals acquire value other than the mean character value) or disruption (more individuals acquire peripheral character value at both ends of the distribution curve).



Diagrammatic representation of the operation of natural selection on differen traits : (a) Stabilising (b) Directional and (c) Disruptive

Gene pool - total genes and their alleles in a population