Population genetics

Population genetics is the science of changes in the representation of alleles of individual genes in the population. These changes can be the result of both natural selection and genetic drift.

A **Population'** is usually defined as a **group of individuals'** of the same species with a **common gene pool** that inhabits a certain area. Furthermore, we consider that individuals can interbreed freely and come from the same ancestor. Therefore, the concept of population cannot be applied well to a species with predominant vegetative reproduction.

The gene pool of a population is the set of all genes that occur in a population.

Types of populations

Autogamous population

It is created by individuals that reproduce by *autogamy* (self-fertilization). Each individual hermaphrodite produces both male and female gametes. A Homozygousn individual (dominant or recessive) can only produce homozygous offspring. Heterozygote produces heterozygotes only 50% of the time (Mendel's 2nd Law). Over time, two *pure lines* of homozygotes are created here, heterozygotes are constantly decreasing until they almost disappear. However, they will never completely disappear from the population.

Homozygous individuals (AA or aa alleles) produce homozygous offspring. Heterozygous individuals (Aa alleles) produce 50% heterozygous, 25% homozygous dominant and 25% homozygous recessive offspring.

This group includes, for example, self-pollinated plants or hermaphrodites.

Allogamic population

In an allogamous population, an individual is created by the fusion of 2 gametes from organisms of different sexes.

This group includes, for example, gonochorists or pollinated plants.

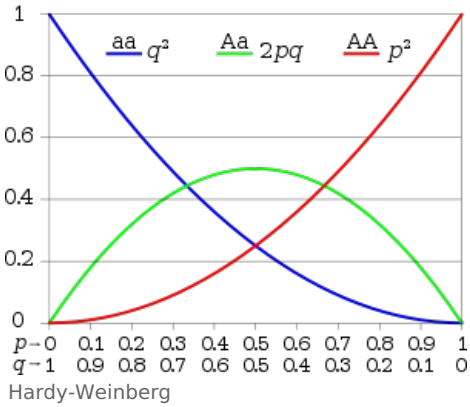
A special case is a **panmictic population** where the same probability of crossing over any 2 individuals in the population must be guaranteed. ***Hardy-Weinberg Law*** applies here, with which we can calculate the genotypic composition of a panmictic population.

Hardy-Weinberg law

"The proportion of individual alleles does not change in a panmictic population."

Terms of the Act:

- there are no mutations (for the monitored gene);
- there are no selections;
- no migration occurs;
- the population must be panmictic and very numerous.



Hardy-Weinberg

dominant allele frequency [p]; ``recessive allele frequency *[q]*

- The probability of a dominant homozygote is p × p, a recessive homozygote q × q, for a heterozygote 2pq.

  p + q = 1 (i.e. 100%)

- The overall genotypic composition of the population can be expressed using the formula:

  $p^2 + 2pq + q^2 = 1$

External influences acting on the gene pool of the population

- **Mutational pressure**

  There can be, for example, the emergence of completely new alleles or the change of a dominant allele to a recessive one and vice versa. The frequency of these phenomena is very low and the changes are hardly manifested during one generation.

- **Selection Pressure**

Selection, or natural selection, has a great influence. If an allele favors its carrier over individuals without this allele, the frequency of this allele will gradually increase in subsequent generations. Unfavorable alleles gradually decrease (dominant disappears relatively quickly, recessive disappears slowly and never completely disappears) because they disadvantage their carriers (so-called negative selection).

- **Migration**

  Migration can mean the enrichment of the gene pool with new alleles (but also its impoverishment). Organisms often live in a very specific place, where they can form more or less isolated subpopulations. Migration is necessary for the exchange of genes (*gene flow*) between such populations. The potential spread of these alleles again depends on their adaptive value (effect of selection) - conditions in the original and new habitat may differ.

- **Genetic Drift**

  Genetic drift or shift are random shifts in the frequency of individual alleles within the gene pool of a given population. In practice, this means that these changes in frequency are not subject to selection, but depend purely on chance during the formation of gametes and zygotes (even the bearer of an advantageous allele does not have to pass this allele on to his offspring and it will not appear in the next generation). These changes are cumulative - over time, one allele may even become fixed and the other allele disappear. Genetic drift is applied in relatively small populations - the smaller the population - the more pronounced the effect of drift and the more often one of the alleles will be fixed.

Links

Source

- ŠÍPEK, A. *Genetika populací* [online]. [cit. 2010-10-24]. <http://www.genetika-biologie.cz/genetika-populaci>.