COVERAGE OF BIOLOGICAL ISSUES BASED ON THE HARDY-WEINBERG LAW

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Abstract. *The Hardy-Weinberg law is a law describing the distribution of the meeting rate of alleles and genotypic classes in freely interbreeding populations that differ in alleles of a single gene, and today it is often used in biological matters. In this article, Hardy-Weinberg examines the essence of the law.*

Keywords: *population, population gene pool, Hardy-Weinberg law, gene frequency, genotype frequency, gene alleles.*

Introduction. A population is understood as a set of relatively isolated organisms that have existed for a long time in a certain place of the distribution area of the species, freely interbreeding with each other, differing in some characteristics from other populations of this species. Each population is considered a small part of the species.

The study of populations from the genetic side began in the 30s of the XX century. Russian scientist S.S.In his article "some aspects of the evolutionary process from the point of view of modern genetics", published in 1926, Chetverikov argued that each population contains many hidden and explicit mutations. From Scientists R. "Genetic theory of natural selection" Fischer, N.P.Dubinin "Genetic-automatic processes and their role in evolution", S."Evolution of Mendelian populations" Wright , N.P.Dubinin and D.D.In Romashev's work "The genetic structure of a species and its evolution", an experimental analysis of population genetics is highlighted.[1]

The Hardy-Weinberg law, a law describing the distribution of the meeting rates of alleles and genotypic classes in freely crossing populations differing in alleles of the same gene, was independently proposed in 1908 by the English mathematician J. Hardy and the German physician V. The Weinbergs opened. According to the Hardy-Weinberg law, in cases where mutation, selection pressure, migration and gene drift do not occur, the rate of cross-meeting of alleles is transmitted from generation to generation unchanged.

Methods. There are no absolute homozygous populations in nature. Because even self-fertilizing organisms can sometimes be fertilized from the outside. Secondly, mutational variability may occur in them under the influence of the external environment. Accordingly, it is never possible to find populations that are one hundred percent homozygous. For example, if a cotton plant is considered self-pollinating, then lateral pollination is 20-25 percent.

One of the methods of studying population genetics in vivo is to determine the rate of meeting of homozygous and heterozygous forms by one gene in it. For example, suppose that in a population forms with different alleles of the same gene, for example, AA and AA, are equal. Then in this case it is a testis and pollinator in a plant population, and alleles of one gene in an egg and sperm in animal populations are in the ratio of 0.5 A and 0.5 A. In the F1 generation, which developed as a result of their mutual free crossing, homozygote AA-0.25, heterozygote AA-0.50, homozygote AA-0.25. In the next generation, when homozygous and heterozygous forms are crossed in a free state, the dominant allele a is 0.50, and the recessive allele a is 0.50. In England, in order to explain how alleles of genes are inherited in populations that interbreed with foreign ones, the mathematician G. Hardy and the doctor in Germany V. Weinberg introduced into science a formula for the distribution of genotypic and phenotypic classes of exceptional populations. In their opinion, the ratio of dominant and recessive forms in populations remains unchanged if, under certain conditions, the repeatability of alleles does not change. According to the Hardy-Weinberg formula, the rate of meeting of one allele in the population was determined by q, and the rate of meeting of the D allele was (1-q). This is the ratio of genotypic classes in the offspring obtained as a result of their crossing.

	qD	(1-q)d
qD	q^2 DD	q(1-q)Dd
(1-q)d	q(1-q)Dd	$(1-q)^2$ dd

If we summarize the results obtained, then the distribution of genotypic and phenotypic classes according to the Hardy-Weinberg formula will look fundamentally as follows:

q2 DD: 2Q (1-q)Dd: (1-q) 2 dd.

According to this formula, the ratio of phenotypic and genotypic classes remains unchanged for several generations if selection does not occur in a given population. The ratio of phenotypic classes is manifested in the inheritance of traits without intermediate ones. When traits are fully inherited, genotypic classes are inherited in a state corresponding to the Hardy-Weinberg formula. [2]

Illustrative example: In the population, Rh-negative people make up 16% (DD), and Rh-positive people make up 84%. Determine the frequency of homozygotes (DD) and heterozygotes (DD) among Rh-positive individuals in the population based on the Hardy-Weinberg law.[4]

Solution: (based on the Hardy-Weinberg law)

Gene frequency in the population: D+D= 1 or 100%

Frequency of genotypes in the population: D2 +2dd+D2 =1 or 100%

(dd)=16% (DD+2Dd)=84%

d2=0,16

D=0.4 means D = 0.6

d2 +2Dd+d2 =1

According to the formula

d2 +2Dd+d2 = 1

DD (0.6) 2=0.36 or 36%

Dd 2 (0,6x0,4)=0.48 or 48%

Results. In the process of evolution, one genotype in a population alternates with another genotype. The change in the proportion of the genotype of a population expresses the essence of population dynamics. Genetic factors of population dynamics include mutation process, selection, segregation, population wave and gene drift.

Knowledge of population genetics allows us to determine the value of genotype selection. Suppose that in a population homozygous recessive organisms (AA) produce offspring by 99%, and organisms with a dominant allele (AA) - by 100%. The difference in selection between them, that is, the genotype selection coefficient, is S. In the case of such a situation in this population, the selection coefficient will be S=1.00-0.99=0.01. While organisms with dominant and recessive alleles have equal chances to survive and produce offspring in the population, the selection coefficient is 0. One of the organisms in a population with two different aa alleles, aa will not be able to produce offspring without pink color, then the selection coefficient will be equal to 1. For example, if organisms with a homozygous recessive allele become unusable due to selection, then over time the frequency of occurrence of this allele in the population will decrease. Selection always limits the spread of genes that are not suitable for environmental conditions. In this sense, the struggle for survival can be compared to a cross race for offspring between organisms. As a result of such a race, the set of very harmful mutations in the population decreases compared to the set of less harmful populations. On the contrary, the accumulation of mutations adapted to environmental conditions in the population is on average. The accumulation of certain genes is also related to the number of organisms in populations. In populations, organisms with the same alleles are often found if the number of individuals is small. As a result, the percentage of homozygous forms in the population increases, selection quickly eliminates harmful mutations.

The rate of elimination of dominant and recessive alleles in the population is different. In populations, dominant alleles cause lethal, semi-lethal, partially pink, completely pink forms and various morphological, physiological defects, as well as recessive alleles.

At the same time, it becomes invalid already in the first generation due to the selection of genes that cause dominant lethality, semi-lethality and a slap in the face. Other dominant genes with relatively low survival rates are eliminated by natural selection over several generations. If the mutation of dominant genes increases the adaptation of the organism to the environment, then selection at the same time ensures the reproduction of dominant genes as they are transmitted from generation to generation. Recessive mutations, unlike dominant mutations, accumulate in populations in a heterozygous state and, as a result, form a large stock of mutations in a latent state. If recessive mutations are extremely harmful and do not have pubescence, then selection completely excludes them from the population. If the recessive gene is 0.5% in the population, then according to the Hardy-Weinberg law AA is 0.25, AA is 0.50, AA is 0.25. Therefore, selection cannot completely exclude recessive mutations from the population.[3]

Discussion. Genetic changes in the population are certainly the cause of microevolution. In addition to gene mutation, chromosomal and genomic mutations play an important role in the historical development of organisms. Because they quickly transition recessive mutations into a homozygous state.

The Hardy-Weinberg law is important for population genetics. The law shows that rare alleles in populations are preserved in most cases in heterozygous organisms. The Hardy-Weinberg law is very difficult to apply in natural conditions, since populations are constantly exposed to external and internal factors that disrupt the genetic balance. For this reason, it would be advisable to consider the Hardy-Weinberg law as the initial form for the creation of later population-genetic models.

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