MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
BILA TSERKVA NATIONAL AGRARIAN UNIVERSITY

FACULTY OF AGROBIOTECHNOLOGY

Department of Genetics, Breeding and Seed Production of Agricultural Crops

TASKS AND EXERCISES IN GENETICS

Methodical instructions for practical and self-study work of applicants for the first (bachelor's) level of higher education in the specialty 201 "Agronomy"

Bila Tserkva
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Tasks and exercises in genetics: methodical instructions for practical classes and home tasks in the discipline “Genetics” for applicants of the first (bachelor's) level of higher education in specialties 201 “Agronomy” / comp. Lozinskyi M.V., Kumanska Y.O., Yurchenko A.I., Sydorova I.M., Samoilyk M.O. Bila Tserkva, 2024. 93 p.

The guidelines provide genetic problems on the patterns of inheritance of traits in intraspecific hybridization, interaction of non–allelic genes, chromosomal theory and molecular basis of heredity, population genetics, test tasks for final control of knowledge, and a list of recommended literature. The proposed methodological instructions for each type of genetic tasks provide the necessary theoretical explanations and methods for solving them, which will help higher education students to work independently on their solution and master the necessary material.

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INTRODUCTION

Genetics (from the greek *genesis*) is the science of heredity and variability of living organisms in their ontogenetic and phylogenetic development and methods of their management. This is one of the youngest branches of biology, but it is nevertheless a central one.

The rapid development of genetics and cytology in conjunction with physics, chemistry, and mathematics has led to significant discoveries in biology, such as the decoding of DNA and the genetic code of heredity, and protein biosynthesis.

Joint research in biochemistry and molecular genetics has given rise to a new branch of science and technology – DNA technology, which studies the laws of heredity and variability at a qualitatively new level. In essence, DNA technology is the art of using the accumulated knowledge, methods and techniques of physical and chemical biology and molecular genetics to design new organisms with specified hereditary traits and properties.

In the twenty–first century, genetics is not only the theoretical basis of breeding, but is increasingly being incorporated into practical breeding, bringing the latter to a qualitatively new level in creating varieties and hybrids that meet the growing demands of production.

The experience of teaching genetics shows that in order to sustainably master its main provisions, higher education students need to learn how to solve various genetic problems on their own, which will help them master terminology, establish connections between individual phenomena of heredity, form a holistic view of genetic laws, and develop genetic thinking.

Solving genetic problems will allow higher education students to practically apply theoretical knowledge of genetics, test their knowledge, and understand the practical importance of genetics for breeding.

The following rules should be memorized and followed: 1) the solution of genetic situations is not only mathematics or mechanical combination of gametes (filling the Pennet lattice) and nucleotides – completion of complementary DNA or i–RNA strands;

2) analysis of genetic situations requires logical application of theoretical knowledge of each independent topic (module). Understanding the next topic is based on the knowledge and understanding of the previous one;

3) each genetic term carries a semantic load, therefore, when analyzing genetic situations independently, it is necessary to use textbooks and manuals on genetics.

PATTERNS OF INHERITANCE OF TRAITS IN INTRASPECIFIC HYBRIDIZATION

Intraspecific hybridization is hybridization between parental forms belonging to the same biological species.

The basic laws of inheritance of traits in intraspecific hybridization were established by G. Mendel (1865) using the *method of hybridological analysis developed* by him, which remains one of the main methods of genetic analysis to this day. Hybridization analysis is based on the method of crossing.

It is necessary to remember the basic requirements of hybridological analysis, formulated by G. Mendel, which remain quite important and mandatory today:

– the parental forms (maternal and paternal) are preliminarily checked for constancy;

– parental forms must be constant and differ in one or a small number of pairs of contrasting traits;

– it is mandatory to carry out accurate quantitative accounting of plants in generations (F_1, F_2) for each pair of traits under study.

Such an approach to the experiment allowed G. Mendel to establish the true quantitative nature of the cleavage and to identify patterns of distribution of hereditary factors:

1) uniformity of first generation hybrids;

2) the law of cleavage, or purity of gametes;

3) the law of independent distribution or independent combination of genes.

Educational edition

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