

Topic: Modern Concept of Gene

Course- M.Sc. 4th Semester Botany

Paper- MBOTEC-1 (Cytogenetics and Crop Improvement)

Name of Teacher- Dr. M.P. Trivedi, Head, Botany

College/University- Patna University

E-mail ID- mptrivedi1956@rediffmail.com

Mobile No: 9334318940

Modern Concept of Gene

Gene may be classically defined as an inherited mendelian factor.

The term gene was introduced by Danish Botanist Wilhelm Johannsen in 1909.

In 1909, Morgan showed that genes reside on specific chromosomes. F. Griffith in 1928 was working on a project that formed the basis that DNA was the molecule of inheritance and could be transferred.

In 1941 genetic mutations causing errors in specific steps in metabolic pathways was shown by Beadle and Tatum and the one gene, one enzyme hypothesis was formed.

In 1953, James Watson and Francis Crick were trying to put together a model of DNA and discovered the double helix structure.

In 1955, Benzer based on the studies on rII locus of T4 phage, concluded that there are three sub divisions of a gene, viz., recon, muton and cistron.

a) Recon-

Recons are the regions (units) within a gene between which recombination can occur.

b) Muton

It is the smallest element within a gene which can give rise to a mutant phenotype or mutation. This indicates that part of a gene can mutate or change.

c) Cistron

It is the largest element within a gene which is the unit of function.

The name cistron has been derived from the test which is performed to know whether two mutants are within the same cistron or in different cistrons.

Cis – Trans Test

When 2 mutations in trans position produce mutant phenotype, they are in the same cistron.

Complementation in trans position (appearance of wild type) indicates that the mutant sites are in different cistrons. There is no complementation between mutations within a cistron.

Now the gene can be defined as segment of DNA or RNA and may be operationally defined as unit of function, recombination and mutation.

Genes different from normal gene

Some examples of such genes are split gene, jumping gene, overlapping gene and pseudo gene.

Split gene

Usually a gene has a continuous sequence of nucleotides. Such nucleotides sequence code for a particular single polypeptide chain.

In some genes, the sequence of nucleotides was not continuous and interrupted by intervening sequence. Such genes are known as split genes.

Split genes have 2 types of sequences -

1. Normal sequence or exons – This represents the sequence of nucleotides which are included in m-RNA. These sequences code for a particular polypeptide chain.
2. Interrupted sequence or intervening sequence or introns – These sequences are not included in m-RNA and do not code for any polypeptide chain.

The first case of split gene was reported for ovalbumin gene of chickens.

Jumping genes –

Generally a gene occupies a specific position on the chromosomes called locus. However, in some cases a gene keeps on changing its position within the chromosome and also between the chromosomes of the same genome. Such genes are known as Jumping genes or transposons or transposable elements.

The first case of jumping gene was reported by Barbara McClintock in maize as early as in 1950. Later on transposable elements were reported in the chromosome of *E.coli* and other prokaryotes.

The transposable elements are of 2 types, viz, insertion sequence and transposons.

Insertion sequence –

Such sequences do not specify for protein and are of very short length. They are reported in some bacteria, bacteriophages and plasmids.

Transposons

These are coding sequences which code for one or more proteins. They are usually very long sequences of nucleotides.

Overlapping genes –

Such genes are found in tumor producing viruses such as ϕ x 174, SV40 and G4

In virus ϕ x 174 gene A overlaps gene B.

In G4 virus, the gene A overlaps gene B and gene E overlaps gene D.

In case of overlapping genes, the complete sequence codes for one protein and a part of such nucleotide sequence can code for another protein.

Pseudogene-

There are some DNA sequences, especially in eukaryotes, which are non-functional or defective copies of normal genes. These sequences do not have any function.

Pseudogenes are reported in humans, mice and Drosophila.

On overall description, gene can be conceptualized as below –

1. An inherited mendelian factor is known as gene.

The alternative form of a gene is known as allele. Generally each gene has two allelic forms. Some genes have multiple allelic forms.

2. Genes are located on the chromosomes.
The home of the gene on a chromosome is known as locus.
3. Genes can be divided into cistron, recon and muton.
4. Gene is a macromolecule which is composed of DNA. In some bacteriophage, it is RNA.
5. Sometimes two or more genes are inherited together, such are known as linked genes. Some genes are linked with a particular sex, they are called as sex linked gene.
6. The alleles in which intragenic recombination occurs are separated by small distances within a gene and are functionally related.
7. Genes may be split in nature. The split genes have two types of sequences: exons and introns.
8. Genes may be Jumping or transposable.
9. Genes may be overlapping.
10. Genes are operational unit.