Agri Articles
(e-Magazine for Agricultural Articles)
Volume: 04, Issue: 06 (NOV-DEC, 2024)
Available online at http://www.agriarticles.com

Gene Cloning and Its Role in Plant Breeding

(*Anubhav Sharma, R.K. Gupta, Akankhya Guru, Anurag Tripathi and Amit Nagar)
Department of Genetics and Plant Breeding, J.V. College, Baraut (Baghpat), U.P.
*Corresponding Author's email: rudhirshrma907@gmail.com

The process of making duplicates of a particular gene or DNA segments is known as gene cloning. Using gene cloning, gene of interest is isolated and inserted into a vector (like a plasmid). The vector is subsequently introduced into the host organism (like bacteria). Gene cloning is a vital tool in biotechnology, medicine and genetic research. In 1972, scientists **Stanley Cohen** and **Herbert Boyer** succeeded in cloning a gene for the first time. They created a technique for introducing a gene into a plasmid, a bacterial molecule that is small and circular made of DNA. Through this process, the gene was able to replicate itself in bacteria that is followed by cloning. The bases of contemporary genetic engineering and biotechnology were established by their work. In plant breeding, gene cloning enables researchers to isolate and replicate particular genes that regulate desired characteristics and speeding up the breeding process.

Mechanism of gene cloning

The vector genome forming recombinant DNA is mixed with the isolate genome segment. Recombination DNA is transferred into the host cell, which is typically a bacterium. Once inside the bacterium, the recombinant DNA replicates and form multiple copies as a bacteria cell divide. Gene cloning can be achieved by following the different methods-

- **Cell based DNA cloning**- A procedure that makes several cells with the same DNA from a single cell's DNA molecule.
- **Cell free DNA cloning (PCR)-** Endogenous DNA that has partially degraded and been released into plasma, free of cells.

Requirements for gene cloning (cell based)

- DNA fragments containing the desired genes to be cloned.
- Restriction enzyme and ligase enzyme.
- **Vector**-to transport preserve and multiple Cloned DNA within a host cell.
- **Host cell** -In which r-DNA can replicates.

Steps of Gene Cloning

Gene cloning has seven essential steps-

- Isolation of particular DNA fragments containing the desired gene for cloning.
- To create r-DNA, isolate DNA is inserted into an appropriate vector
- Insertion of recombinant DNA into an appropriate host.
- Choosing the alternate host cells and locating the clone that has the desired gene.
- The introduced genes expression and multiplication within the host.
- Isolation of several gene copies or the protein that the gene expresses.
- Cloning up the separated protein or gene copy.

Applications of gene cloning:

- A particular gene can be isolated and its nucleotide sequence is determined.

- ❖ The function of proteins, enzymes and RNA can be studied.
- ❖ Gene cloning enables the synthesis of proteins like growth hormones ad insulin.
- ❖ Gene cloning facilitates the study of gene interaction, functions and disease causing mechanism by scientists.
- ❖ Crop characteristics like resistance to disease pests and environment factors can be improved by cloning genes.

Additionally, encourages certain genetically modified crops with higher nutritional content and yield.

Merits of gene cloning

1. Comprehending Gene Function: Researchers can examine the intricate workings of genes by cloning them. Through the analysis of cloned genes, researchers can examine the role these genes play in particular traits or illnesses.

2. Model Organisms: Genetically modified organisms (GMOs) bearing cloned genes are made possible by gene cloning. These model organisms are very useful for researching diseases and intricate biological processes.

3. Applications in Medicine: Gene Therapy- The development of gene treatments to cure genetic problems can be aided by gene cloning. Genetic flaws can be fixed by introducing healthy copies of genes into the cells of patients.

- ✓ **Disease Models**: By cloning genes linked to specific diseases, models of the diseases may be produced, which can be used to test novel treatments and comprehend the mechanisms underlying the diseases.

4. Agriculture

- ✓ **Better Crops-** Gene cloning can be used to create crops with desired characteristics, such resistance to environmental stressors, diseases, or pests. This will increase yields and promote more sustainable agriculture.
- ✓ **Enhancement of Livestock**: It makes it possible to improve breeds of livestock by adding advantageous characteristics like faster growth rates or resistance to disease.

Demerits of gene cloning

- ➢ **Medical application-**Immune rejection or ethical questions concerning cloning human embryos can occur when cloning is done for medical purposes, such as producing genetically identical cells or organs for transplants.
- ➢ **Agriculture application-** Reducing genetic variety through plant or animal cloning for agricultural purposes might increase crop or livestock ility to pests and diseases, hence compromising food security.
- ➢ **Conservation Efforts-** Cloning endangered species may aid in their preservation, but it may also result in genetic bottlenecks and less adaptability, which could pose a threat to their long-term viability.
- ➢ **Research and Development**- Cloning raises ethical concerns concerning the manipulation of genetic material and the repercussions for ecosystems and species, even if it can further scientific knowledge.

Future perspective of gene cloning

Herbert Boyer and Stanley Cohen: They created the biotechnology sector by developing a technique for cloning genetically modified molecules in foreign cells.

Ian Wilmut- He produced Dolly the sheep, the first cloned mammal, in 1997.

References

1. Gene cloning and DNA analysis by T.A.BROWN (Chapter no. 5 page no.4)
2. (http://www.uop.edu.pk/ocontents/Lec%20no%201 (8).pdf)