Quadrant II – Transcript and Related Materials

Programme: Bachelor of Science (Third Year)

Subject: Botany

Course Code: BOD 101

Course Title: Plant Tissue Culture

Unit: Somatic Hybridization

Module Name- Cybrids and their applications

Module No: 40

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Cybrids and their applications

Introduction

Hybridization involves the fusion of protoplasts of two different genomes. During fusion, the two protoplasts stick together; the plasma membrane fuses at a small localized region at the point of contact making a protoplast bridge; the bridge extends and rounds off forming a fusion product. When the nuclei of any one parent is eliminated, a cybrid is produced.

A cybrid or cytoplasmic hybrids are eukaryotic cell lines produced by the fusion of protoplasts from two phylogenetically different species. It has a nuclear genome of one species and the cytoplasm of both the parental species.

The objective of producing cybrids is to combine the cytoplasmic genes of one species with the nuclear and cytoplasmic genes of another species.

Cybrids provide unique opportunities for the following

1. Transfer of plasma genes of one species into the nuclear background of another species.
2. Recovery of recombinants between parental mitochondrial or chloroplast DNA
3. Production of a wide variety of parental/ recombinant chloroplast with parental/ recombinant mitochondria.
4. Mitochondria from one parental species may be combined with the chloroplast of another parental species.

Production of a cybrid

1. The desired protoplasts are isolated either by mechanical method or enzymatic method.
2. After testing the viability of the protoplast, they are fused together by mechanical, chemical, or electrical methods.
3. The successfully formed protoplasts are selected and cultured in a suitable medium.
4. The cybrids growing in the culture medium, first regenerate the cell wall to form a cybrid cell. The cybrid cell then divides further to form a callus and finally regenerates a plant.
5. The cybridization is confirmed by checking for the expression of the desired characters. Once confirmed, the cybrid plants are multiplied.

During the cybrid production, one of the most crucial steps is the elimination of the nucleus of one of the parent cells. This can be achieved in the following ways.

1. Irradiating the protoplast of one species with X-rays or gamma rays prior to fusion to inactivate their nuclei.
2. Gamma fusion is used to bring about interspecific and intergeneric combinations.
3. Preparing enucleate protoplasts (cytoplasts) of one species and fusing them with a normal protoplast of another species.

An enucleated protoplast of one species can be produced by:

1. Gradual elimination of the chromosomes of one species from a hybrid cell during subsequent mitotic divisions.
2. Elimination of the nucleus of one species.
3. Fusion of a normal protoplast of one species with an enucleated protoplast / a protoplast with an inactive nucleus of another species.

Applications of a Cybrid

1. Means of genetic recombinations in asexual/ sterile plants - Protoplasts of sexually sterile plants can be fused with a fertile protoplast to produce fertile diploids and polyploids.
2. Overcoming barriers of sexual incompatibility - In plant breeding programmes, sexual crossings at interspecific or intergeneric levels fail to produce hybrids. This method has found application in industry and agriculture.
3. Cytoplasmic male sterility - Transfer of cytoplasmic male sterility along with genes that code for the rate of photosynthesis, tolerance to temperature, and resistance to diseases or herbicides.

Experiments on cybridization have resulted in plants with reconstructed cytoplasm combining mitochondrial DNA and chloroplast DNA encoded traits from both parents.