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An Introduction to Plant tissue culture

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Introduction

Plant tissue culture was a new addition to the methods of plant breeding that developed around the 1950s. It has a great significance in plant biotechnology especially in the crop improvement programmes. It is gaining attraction as an effective propagation method that embraces cell technology to propagate new plants in artificial environments using tissue fragments from plant media. It is becoming as an alternative means to vegetative propagation of plants. In vitro growing plants are usually free from bacterial and fungal diseases. Plant Tissue culture is the in vitro aseptic culture of cells, tissues, organs or whole plant under controlled nutritional and environmental conditions often to produce the clones of plants. The resultant clones are true-to-type of the selected genotype.Plant Tissue Culture is a collection of techniques used to maintain or grow plant cells, tissues or organs under sterile conditions on a nutrient culture medium of known composition. It is widely used to produce clones of a plant in a method known as micropropagation. Plant Tissue Culture is widely used in –

- Obtaining disease free plants
- Rapid propagation of plants those are difficult to propagate
- Somatic hybridization
- Genetics improvement of commercial plants
- Obtaining androgenic and gynogenic haploid plants for breedingprogrammes

Importance of Plant Tissue Culture in Agriculture

As an emerging technology, the plant tissue culture has a great impact on both agriculture and industry, through providing plants needed to meet the ever increasing world demand. It has made significant contributions to the advancement of agricultural sciences in recent times and today they constitute an indispensable tool in modern agriculture.

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Biotechnology has been introduced into agricultural practice at a rate without precedent. Tissue culture allows the production and propagation of genetically homogeneous, disease-free plant material. Cell and tissue in vitro culture is a useful tool for the induction of somaclonal variation. Genetic variability induced by tissue culture could be used as a source of variability to obtain new stable genotypes. Interventions of biotechnological approaches for in vitro regeneration, mass micropropagation techniques and gene transfer studies in tree species have been encouraging. Genetic engineering can make possible a number of improved crop varieties with high yield potential and resistance against pests. Genetic transformation technology relies on the technical aspects of plant tissue culture and molecular biology for:

- Production of improved crop varieties
- Production of disease-free plants
- Genetic transformation
- Production of secondary metabolites
- Production of varieties tolerant to salinity, drought and heat stresses

Basic Requirements of Plant Tissue Culture

The main requirements of plant tissue culture are:

- Laboratory Organisation
- Culture Media
- Aseptic Conditions

General Technique of Plant Tissue Culture:

General technique of plant cell, tissue and organ culture is almost the same with a little variation for different plant materials. There are certain basic steps for the regeneration of a complete plant from an explant cultured on the nutrient medium.

- Selection and Sterilization of Explant: Suitable explant is selected and is then excised from the donor plant. Explant is then sterilized using disinfectants.
- Preparation and Sterilization of Culture Medium:A suitable culture medium is prepared with special attention towards the objectives of culture and type of explant to be cultured. Prepared culture medium is transferred into sterilized vessels and then sterilized in autoclave.

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- Inoculation: Sterilized explant is inoculated on the culture medium under aseptic conditions.
- Incubation: Cultures are then incubated in the culture room where appropriate conditions of light, temperature and humidity are provided for successful culturing.
- Sub culturing: Cultured cells are transferred to a fresh nutrient medium to obtain the plantlets.
- Transfer of Plantlets: After the hardening process (i.e., acclimatization of plantlet to the environment), the plantlets are transferred to green house or in pots.

Types of Plant Tissue Culture

On the basis of explant used, there are different types of plant tissue culture techniques which are as following;

- Single cell culture: Single cell culture is a method of growing isolatedsingle cell aseptically on nutrient medium under controlled condition.
- Embryo culture: Embryo culture may be defined as aseptic isolation of embryo from the bulk of maternal tissue of mature seed or capsule and in vitro culture under aseptic and controlled physical condition in glass vials containing nutrient semisolid or liquid medium to grow directly into plantlet.
- Antherculture: Androgenesis is the in vitro development of haploid plants originating from potent pollen grains through a series of cell division and differentiation.
- Pollen culture: Pollen culture is the in vitro technique by which the pollengrains are squeezed from the intact anther and then cultured on nutrient medium where the microspores without producing male gametes.
- Somatic Embryogenesis: Somatic embryogenesis is the process of a single or group of cells initiating the development pathway that leads to reproducible regeneration of non zygotic embryos capable of germinating to form complete plants.
- Protoplast Culture: It is the culture of isolated protoplasts which are naked plant cells surrounded by plasma membrane which is potentially capable of cell wall regeneration, cell division, growth and plant regeneration on suitable medium under aseptic condition
- Shoot tip and Meristem culture: The tips of shoots can be cultured in vitro producing clumps of shoots from either axillary or adventitious buds. This method can, be used for clonal propagation.

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- Explant Culture: There are variety of forms of seed plants *viz.* trees, herbs, grasses, which exhibit the basic morphological units i.e. root, stem and leaves. Parenchyma is the most versatile of all types of tissues. They are capable of division and growth.

Plant in vitro culture techniques

- Micropropagation –Micropropagation is used to develop high-quality clonal plants (Smith 1990). The main advantages are attributed to the potential of rapid, large scale propagation of new genotypes, the use of small amount of original germplasm.
- Somatic cell genetics- Contribution of in vitro methods to plant breeding i.e. somatic cell genetics is most significant, mostly in terms of haploid production and somatic hybridization.
- Transgenic plants- Expression of mammalian genes or other plant gene is becoming routine for several plant species. It has proved beneficial for the engineering of species that are resistant against insects, virus and other pathogens as well as herbicide.

Conclusion

Plant tissue culture represents the most promising areas of application at present time and giving an out look into the future. The areas ranges from micropropagation of ornamental and forest trees, production of pharmaceutically interesting compounds, and plant breeding for improved nutritional value of staple crop plants. The rapid production of high quality, disease free and uniform planting stock is only possible through micro-propagation. New opportunities has been created for producers, farmers and nursery owners for high quality planting materials of fruits, ornamentals, forest tree species and vegetables. Plant production can be carried out throughout the year irrespective of season and weather. The in vitro culture has a unique role in sustainable and competitive agriculture and forestry and has been successfully applied in plant breeding for rapid introduction of improved plants. Plant tissue culture has become an integral part of plant breeding. It can also be used for the production of plants as a source of edible vaccines. There are many useful plant-derived substances which can be produced in tissue cultures.Plant cell culture has made great advances. Perhaps the most significant role that plant cell culture has to play in the future will be in its association with transgenic plants. It has a great role to play in agricultural development and productivity.