Application of micropropagation in plants: A brief review

S. Indira Devi, A. Gaitri Devi, T. Basanta Singh, Chongtham Sonia, Kh. Rishikanta Singh and Umakanta Ngangkham*

ICAR Research Complex for NEH Region Manipur Centre, Imphal, Manipur

*Corresponding Author: ukbiotech@gmail.com

Micropropagation is the practice of rapidly multiplying stock plant material to produce many progeny plants, by using a variety of tissue, cell and organ culture methods (Altman and Loberant, 1998). Micropropagation indicates the aseptic culture of small sections (i.e., explants) of tissues and organs, in closed vessels with defined culture media and under controlled environmental conditions. Plant cell or tissue culture technique depends mainly on the concept of totipotency which refers to the ability of a single cell to regenerate the entire plant by expressing the full genome by cell division (Brown et al 1995). Plant tissue culture medium contains all the nutrients required by the plant for their normal growth and development. It is mainly composed of macronutrients, micronutrients, plant growth regulators, source of carbon, other organic components and gelling agents in case of solid medium. The pH of the media is adjusted between 5.4 – 5.8 which affects both the activity of the plant growth regulators and the growth of the plants (Murashige 1974; Loberant and Altman, 2010). This technology is widely used to provide a huge number of plantlets for planting from seedless plants, plants with difficulty of asexual reproduction or where micropropagation is the cheaper means of propagating (e.g., Orchids).

Micropropagation is one of the most commercially efficient and practically oriented plant biotechnology that have rapid generation of a large number of clonal plants of many plant species and also in many cases micropropagation is practiced in production of virus or other pathogen free plants (Thorpe et al 2007; Idowu et al 2009). Moreover, in the generation of transgenic plants and somatically bred plants micropropagation is now act as the technical link. The ability to regenerate entire plants from cells, tissues, or organs that have "foreign" DNA inserted and expressed is important for the efficient production of transgenic plants, if not the only one. Moreover, micropropagation is used for germplasm storage and the protection of endangered species (Hussain et al 2012).

Methods of Micropropagation

Based on genotypes and economical values, multiplication of plantlets through in-vitro process may be achieved with the following 333335 different methods:

Meristem Culture

Meristem is the region of cells capable of division and growth or small population of rapidly proliferating cells that can produce whole plants. In this method of micropropagation, the meristem along with few subtending leaf primordia is placed into a suitable growing medium where they are induced and allowed to grow new meristem. After some weeks when an elongated rooted plantlet is produced and reached a considerable height, these plantlets are transferred into the soil. A disease-free plant can be produced by this method and also this technique can be successfully utilized for rapid multiplication of various plant species.

Callus Culture

Callus is an unorganized, undifferentiated mass of cells in vitro condition. In callus culture, selected plant tissue is placed in an artificial growing medium with other favorable conditions until the callus is formed. After the production of callus, they are transferred into a culture medium containing plant growth regulators for the induction of adventitious organs. Then, few weeks old new plantlet is exposed gradually to the environmental condition.

Suspension Culture

Suspension culture is the cell culture of plant in which the single cells or small aggregates of cells are allowed to grow in suspension media and allow to function and multiply. In this method, cells or groups of cells are dispersed and allowed to grow in an aerated and sterile liquid culture medium. Such method is commonly used for studying cell growth and development and to extract certain components from plant cells in industrial scales.

Embryo Culture

In embryo culture method, the embryo is excised and placed into a culture medium with proper nutrient in aseptic condition. To acquire a quick and ideal growth into plantlets, it is transferred to soil. To overcome the embryo and to produce interspecific and intergeneric hybrids, embryo culture is commonly used.

Protoplast Culture

In protoplast culture, the plant cell is isolated with the help of wall degrading enzymes and cultured in a suitable culture medium under controlled condition to reform the cell wall and callus. After few weeks, under suitable conditions, the cell develops a cell wall followed by an increase in cell division and cellular differentiation and grows into a new plantlet.

Stages of Micropropagation

In short, steps of micropropagation can be divided into five stages

Preparation of donor plant

It is the initial stage of micropropagation. In this stage the mother6 plants are selected and grown under controlled conditions before using them for culture initiation.

Culture Initiation and Establishment

In this stage the explants are established in a suitable culture medium. This stage involves the isolation of the explant from the selected stock mother plant followed by treatment with bactericide and fungicide and rinsing with sterile distilled water. Then the explant is surface sterilized by using the disinfectants like sodium hypochlorite and mercuric

chloride and rinsing with sterile distilled water and then the explant is established on an appropriate culture medium.

Multiplication

The rapid multiplication of shoots or rapid somatic embryo formation in a defined culture medium is performed in this stage. During shoot multiplication stage, the propagules or shoot is multiplied by repeated subcultures in well-defined environment and optimized culture media along with plant hormones until the desired planned number of plantlets is attained.

4. Rooting

In this stage, the shoots are placed for the development of roots to a define nutrient medium containing more auxin and cytokinin ratio which is performed in the laboratory.

5. Acclimatization

In this stage, the plantlets are weaned and hardened which is done by transferring gradually from high to low humidity and from low to high light intensity. Then the plants are transferred to an appropriate substrate and gradually hardened under greenhouse condition.

Conclusion

Micropropagation is one of the best options for mass multiplication of plant simultaneously diseases, pest free, uniformity and true-to-type propagation methods. This micropropagation process can be carried out in control environment condition throughout the year irrespective of the season compared to the conventional propagation methods. New opportunities have been created for producers, farmers and nursery owners for high quality planting materials of fruits, vegetables, ornamentals and forest tree species.

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