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Mini Review

Impact of Plant Tissue Culture (PTC) in Modern Agriculture

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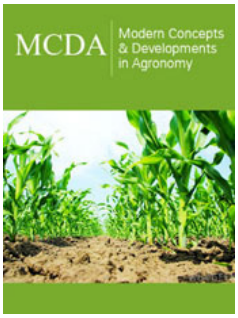

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Abstract

Since last century, Plant Tissue Culture (PTC) exhibited enormous contribution in the science, mainly in last three to four decade, after the development of the newer technologies such as direct/indirect organogenesis, direct/indirect somatic embryogenesis, synthetic seed production, hybridization, somaclonal variation, haploid culture, and germplasm conservation. PTC is a biotechnological tool which contributes to the industries, horticulture, forestry and agricultural production in the way of crop improvement in terms of food, fodder, fibres, fuel and production of new varieties. This is one of the progressive steps towards commercialization, which will be helpful for the developing countries to fulfil the challenges of food availability of growing populations in a restricted land area.

Keywords: Agriculture; Floriculture; Modern tools; PTC; Somatic embryogenesis; Varieties

Introduction

Production of whole plant from the part of plant (explant) or cell under an aseptic condition is called as Plant Tissue Culture (PTC). Totipotency of cell is main phenomenon of this component of plant biotechnology where whole plant regenerate from any single cell [1]. Within short period of time, large scale of elite genotypes mass produced through rapid multiplication with the micropropagation technique, this exploits the fundamental property of plant cell [2]. Nowadays, PTC becoming a very important technique for the development of mankind as it is useful in breeding methods for various crops which can considered as an alternative method of traditional propagation method [3]. Prevention of dormancy phenomenon and embryo rescue (produced by incompatible cross) and shortening of the lifecycle in some species was successful by the PTC technique [4]. PTC technique helps the developing countries to fulfil the challenges of food availability of growing populations in a restricted land area. With this, it is also useful for conservation of RET categories plant as well as nearly extinct species [5]. Crop development through traditional (conventional) breeding method have some problems such as less productivity, low quality in several years which impact on the insufficient supply of material and higher cost [6]. It is todays need to modernize the conventional breeding programmed with modern breeding techniques which will be helpful in crop improvement, maximum production and cheaper cost which ultimately fulfil the growing demand. Use of PTC with genetic engineering techniques, induced the novel character in plant species which saves time and efforts to use the conventional plant breeding programs [7]. PTC plays a key role in different sectors such as plant breeding, agriculture and industries as it is accompaniments for the productions of the plant through the method of micropropagation, through the production of synthetic seeds, the production of haploids, hybridization programme, somaclonal variation, genetic transformation and eradication of pathogens. Feeding of media with both elicitors (biotic and abiotic), for enhancing the productions of secondary metabolites [4]. For the commercial production of phytocompounds

use of different types of bioreactors has also been reported. Instead of comma after Instead of this, it also helpful to release the pressure of overexploitation of naturally growing plants [7]. Among all, Somatic embryogenesis, and production of new varieties through plant tissue culture in modern agricultural have been considered for the present review.

Somatic embryogenesis in modern agriculture

Naturally, the embryo is formed from the fusion of male and female gametes i.e., sexual reproduction and these are known as zygotic embryos through which whole plantlets regenerates. In PTC, the embryos regenerates through somatic cell and these are similar to the zygotic embryos and thus it is bypass of sexual reproduction [8]. The embryos produced from somatic cell in *in vitro* condition, these differentiated cell divide, undergo morphological and biochemical changes and form whole plantlets. Different types of explants such as leaf, petiole, root, ovule, and meristem can be used for direct and indirect somatic embryogenesis [9]. These explants inoculated on different types of semisolid nutrient media, after some period, globular, heart, torpedo and cotyledonary stages embryo will be observed without formation of callus called direct somatic embryogenesis. If callus formed from these explants after cell culture of callus different stages of embryo can be observed called indirect somatic embryogenesis. These embryos transferred in field condition in different ways which are enlisted below:

A. Cotyledonary somatic embryo inoculated on same medium for further growth, once plantlets formed then hardened in pots and kept these pots in same condition for short time period, and finally transferred to the field condition [10].

B. Production of synthetic seeds: Encapsulate these embryos with calcium-alginate (hydrated synthetic seeds) and polyoxyethylene (for desiccated synthetic seeds). Once synthetic seeds are produced, sow in the soil for development of plantlets.

C. These synthetic seeds can be handled easily for transport, storage, and sowing like zygotic seeds [11].

D. Mixing of emerging seedling in the gel and sown to the soil.

E. Through distant incompatible crosses the zygotic embryo can be rescued by fluid drilling process [4].

The above process is useful to overcome dormancy and seed sterility. An important role of somatic embryogenesis is reported in woody plant for clonal propagation, synthetic seed production, cryopreservation and germplasm conservation [12]. Many reports were available for production of synthetic seeds in different fruit plant and forest trees which are economically significant [11,13,14].

Production of plant varieties through PTC technique

Biotechnology played important role in agricultural field [15]. Globally, the use of transgenic plant continuously increasing worldwide with huge plant propagation and turned into one of the modern technologies of agriculture worldwide [16]. The world demand for flowers and indoor plants increases continuously. The global demand of flower increases continuously, because of this increasing demand and unavailability of natural sources different companies used tissue culture techniques for the fulfillment of demand and set up the culture laboratories in companies [7]. *Gerbera*, different species of Lilies, Rose, Carnations, Orchids, Spathyphyllum, *Anthurium* and *Syngonium* are high valued ornamental plants produced by different companies through tissue cultures [17]. Protocols of tissue cultures also developed for different fruit crops such as banana, strawberry, papaya, pineapple, and grapes [18]. The protocol was also developed for different medicinal plant such as *Asparagus, Digitalis, Uraria* etc. [19-21]. PTC is considered as one of the efficient method which allow to increase the production of important crop plants such as wheat (*Triticum aestivum* L.), rice (*Oryza sativa*), sorghum (*Sorghum bicolor*), maize (*Zea mays*), potato (*Solanum tuberosum*), groundnut (*Arachis hypogaea* L.) [3].

Conclusion

In recent days, PTC technique found to be a crucial tool for modern agriculture as it significantly contributed to the advancement of agricultural sciences. The use of this technology is limited for some developed countries, and it is necessary to identify the potential of this and further exploitation of this technology in its entire dimension is necessary. Somatic embryogenesis is useful for the production of different plantlets through synthetic seed production hence can be used to overcome dormancy and sterility. Modern agriculture can become a major revenue earners and fulfillment of different plant based products. The technology has proved its usefulness, now it's our turn to use it large scale with responsible manner.

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