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Plant tissue culture in horticultural crops: A review

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Abstract
Plant tissue culture is commonly used in the field of horticulture, agriculture, plant breeding and forestry. It is applied form of biotechnology employed for propagating plants in large quantity, elimination of virus, manufacturing of secondary metabolites and aseptic cloning of plants. Tissue culture in plants has been also employed for the protection of extinct species of plants by short and medium term protection also called as slow growth and cryopreservation also termed as long term conservation. These practices had been successfully employed to protect plant species with recalcitrant seeds or dormant seeds and exhibit considerable edge over the traditional methods of conservation.

Keywords: plant tissue culture, horticultural crops

Introduction
Tissue culture of plants include growing of plants in aseptic conditions. These may be genetically modified plants that we have modified by some method or the plants that we require many duplicates all precisely simmilar. These can be achieved by tissue culture of section of small tissues from the plant we need. These little sections are from a sole mother plant or they are the outcome of genetic variation of sole plant cell which are uplifted for growth and eventually evolve to a complete plant. Plant tissue culture is frequently utilized for plant commercial production and also for research in plants.

Plant tissue culture requires the utilization of small fragments of plant tissues also called explants cultured in a medium under aseptic environment. Employing suitable growth environment for every type of explants, plants induces fastly building shoots, and, by the inclusion of appropriate regulators new roots also appear. Such plantlets are also splitted, generally at shoot stage, to fabricate great amount of new plantlets. Then these plantlets are then put in soil and grown under standard conditions. Different kind of plant are appropriate to use in classroom.

Rose cuttings, cauliflower, carnation stems and African violet leaves all can comfortably produce genetic copies through plant tissue culture technique. Florets of cauliflower provide outstanding outcomes as long as these are transformed to a whole plant in the simple media of plant tissue culture, without the need for further growth or root management. Green shoots usually appear within three weeks, with roots evolve in six weeks. The preeminent piece of the project, nevertheless, is to keep the sterile conditions as much as possible. Single fungal spores or bacterial cells that encounter the growing media will quickly reproduce itself and shortly entirely submerge the small plant fragments which we are attempting to make duplicate. The plantlets are obtained in a very short time with a small amount of plant tissue.

The advantages of plant tissue culture in horticulture are to provide the new disease-free plants, We can grow the plants throughout the year, disregarding of the season. It also not require a big area to grow plants by plant tissue culture technique. We get introduced to new varieties of fruits and vegetables in commercial market.

The main disadvantages of plant tissue culture is that It is very labor intensive and is also very costly. There is some possibility that the plants which are propagated will be of less resistance against diseases because of the kind of conditions they are provided to grow. It is very important to screen the material before being cultured; It is difficult to check any deformity and it lead to the infection of new plants. Good result id obtained if the appropriate procedure is followed, 100% success rate in the plant tissue culture technique is not guranteed. Still there is a possibility that the secondary metabolic chemical reaction gets activated with this process, and the growth of new explants or cells gets hampered, or get died.

There are some of reviews from previous researches by scientists regarding plant tissue culture in vegetable crops: The utilization of plant tissue culture in the field of vegetable science has an embracing record since the classic studies of Caplin, Steward and White.

Appropriately, the attempts of many investigators, Micropropagation techniques of most prominent types of vegetables have been advanced. Vegetative meristematic tissue has been utilized by majority of these techniques; Although, Different methods have been evolved in different crops for plant regeneration from protoplasts and from callus. Due to the absolute amount of plant varieties which are classified as vegetable crops, Complete review of literature is not feasible for this article. Additionally, micropropagation of many vital vegetables have been lately reviewed. So, the article will centralized on narrating circumstances where production of vegetable plants by tissue culturing technique depicts an economical and feasible possibilities for the vegetable sector.

Majority of vegetables utilizes the plants obtained from tissue culturing technique for field production of an wholesome product is not a viable substitute when differentiated with present system of plant production. This is for the reason that majority of vegetables are propagated through seed. These vegetable seeds are generally manufactured in generous amount and so are comparatively cheep to produce as differentiated with the plant cost acquired through micropropagation; Additionally, seeds are self-sufficient, compact, relatively genetically stable, easily handled and durable. Even in the case of vegetable crops where asexual propagation is primarly used for propagation purposes (e.g. potato, sweet potato), Plant tissue culture does not constitute an economic alternative due to the easy availability of numerous plants by seed pieces or by the use of bedding. Where *in vitro* propagation of vegetables may be the very encouraging at the situations where it acts as an supplement to prior seed technology (e.g. in specific parental genotypes production for hybrid seed production) and at some instance where there is some difficulty involved in conventional propagating methods for specified varieties.

The traditional process of plant tissue is also described as the *in vitro* design of organs, tissues. cells, or a complete plant under a controlled and healthy environment (Thorpe, 2007) to produce the same type of plant. Outgoing clones are true to type the selected type. A positive attitude contributes to a culture of better growth and reproduction. It includes the provision of adequate nutrients, proper gas and water conditions, pH medium, adequate temperature. Tissue culture is extensively utilized for multiplication of plants on large scale., In recent years tissue culture is of vital industrial significance in elimination of diseases, plant propagation, secondary metabolites production and plant improvement rather than their use in the field of research. Small namedexplants are utilised for manufacturing multiple number of plants in a consecutive way. We can multiply single explant into multiple number of plants in relatively less span of time and space under aseptic conditions, disregarding of weather and season annualy (Akin-Idowu *et al*., 2009) [2]. Extinct, rare and endangered varieties have been grown successfully and preserved by tissue culture technique due to its high multiplication coefficient and less demand on amount of plants and space. Additionally, tissue culture is reffered as very systematic technology for improving plants by gametoclonal variants and somaclons production. Aseptic propagation has a wide adaptability to produce plants of superior quality, isolating benefecial plants in suitable modified genotypes with stress tolerance capabilities, high yielding capacity and better disease resistance (Brown and Thorpe, 1995) [3]. Some callus cultures produce improved varieties. Commercially produced plants using micropropagation techniques have various advantages over conventional methods of propagation, cutting, seeding and ventilation etc. Rapid distribution processes that can lead to the production of uninfected plants (Garcia-Gonzales *et al*., 2010) [4]. Coryodalis yanhusuo, an important medicinal plant is still propagated by somatic embryogenesis from callus acquired by the tumor to produce disease-free nodules (Sagare *et al*., 2000) [5]. Meristem beverage culture of banana bunchy top virus (BBTV) and brome mosaic virus (BMV) was developed (El-Dougdoug and El-Shamy, 2011) [6]. High yields were obtained by increasing the pathogen germplasm-free in moth conditions. Up to 150% Increased yield of uninfected potatoes immersed in controlled water (Singh, 1992) [7].

The plant culture of plant tissue contains all the nutrients that are essential for normal growth and plant development. It usually contains micronutrients, macronutrients, vitamins, other organic compounds, plant growth hormones, carbon source and other gelling agents. Murashige and Skoog medium (MS medium) are widely used in vegetable applications for many plant species in laboratory conditions. The pH of the media also plays an important role as it affects both plant growth and the role of plant growth regulators. Estimated value between 5.4 - 5.8. Both solid and liquid methods can be used to grow plants. Intermediate formation, especially plant hormones and a source of nitrogen have a detrimental effect on the initial explosion response. Plant growth regulators (PGR play) play an important role in determining the development of plant and tissue cells in the media. Auxins, cytokinins and gibberellins are widely used to control plant growth. The type and selection of hormones used depends largely on the type of plant, tissue or organ to be repaired and the purpose of the test (Ting, 1982) [8]. Auxins and cytokinins are widely used by plant regulators in plant tissue growth and their number determines the type of culture established or regenerated. High levels of auxins tend to promote root formation, while high concentrations of cytokinins tend to re-shoot. The combination of auxin and cytokinin together causes the emergence of weight-bearing cells called callus. High root implantation and proliferation were observed in Stevia rebaudiana, where a moderate dose of 0.5 mg / l NAA (Rafiq *et al*., 2007) [9]. Cytokinins generally favor cell division and cause the formation of shoots and the repetition of axillary shoots. The ratio of cytokinin to auxin tends to replicate shoot and high auxin to cytokinins ratio leads to root formation. Shoot detection and recurrence were found to be high, when the black pepper callus was transferred to a BA-given medium at a concentration of 0.5 mg / l (Hussain *et al*., 2011) [10].

Micropropagation

In plants vegetative or clonal propagation is most commonly used form of plant tissue culture technology, around 500 million plants are generated in a year, of which 90% of them belongs to ornamentals (Debergh, 1994) [11]. Micropropagation is attained by increasing axillary bud breaking, adventitious buds production directly or indirectly by callus and somatic embryogenesis (Murashige, 1974, 1990) [12]. Cracking of axillary bud is restricted by total of axillary buds put in the culture. Adventitious budding has a substantial possibility for multiplication, even as shoot may develop from some slice of the inoculum. Somatic embryogenesis has the possibility of creating largest number of plantlets, till date, it happen in some species.

Commercially, micropropagation employs a multistage process which consists of five phases (Debergh and Read,

1991) [14]. Starting stage is 'Stage 0' also called preparative stage, 'Stage 1' denotes formation of axenic and viable cultures, 'Stage 2' – proliferation, 'Stage 3'- production of cuttings, 'Stage 4' – redevelopment of plantlets in protected structures. Every phase has its perticular difficulties which must be solved skillfully.

In floriculture

By bringing tissue culture in floriculture marketing, tissue culture is now not only restricted to labs but also become available to the commercial world (Murashige, 1978; Chu and Kurtz, 1990) [15]. In 1990, more than 300 commercial opperations all over the world were conducted (Murashige, 1990; Debergh and Zimmerman, 1991) [15, 14, 13, 14]. In 1970s, most of these were situated in USA and in the Netherlands, but by the 1980, most of this venture occured in Asia and Central america, due to less production cost and better air transport links. In the floriculture market, the utilization of plant tissue culture seems to be common for few plants like orchids, Gerbera, Spathiphullum (Debergh, 1994) [11] and Boston fern (Zimmerman and Jones, 1991) [14]. Different commercial laboratories have capacity upto 200000 plantlets every week (Hartman, 1988) [19].

Generally, breaking of axillary bud by shoot tips and single node explants is the accetable starting material (Debergh, 1994) [11]. Although In Amaryllaceae, Iridaceae and Liliaceae, different kind of explants like base plates of corms and bulbs, bulb scales and inflorescences are utilized (Krikorian and Kann, 1986) [20]. Moreover, Plants belong to Gesneriaceae and Begoniaceae are often regenerated straight on the explant and cultured medium (George and Sherrington, 1984) [21]. Moreover, there is a increasing intrest towards utilizing self-rooted ornamental plants rather than using grafts. Moreover, material used for micropropagation is being utilized as stock plants to get micro cuttings, like Ficus spp and Rhododendron spp. (Debergh, 1994) [11].

In Olericulture

Micropropagation can also be done in different kind of vegetables (Murashige, 1978; Reynolds, 1986, 1994; Seckinger, 1991; Krikorian, 1994) [15, 22, 23, 24, 25]. Although, ex-vitro mini-tubers and virus-free micro-tubers are the exceptions. Also there is no extensive production of planting material. Reformable methods based on adventitious budding, shoot tip culture and/or direct nor indirect somatic embryogegesis are accesible for prime vegetable crops (Reynolds, 1986) [22]. These comprises of onion, tomato, cole crops, cantaloupe, watermelon, pea, cucumber, bean, pepper, carrot, artichoke, garlic, eggplant and pumpkin. Since majority of these vegetables are opperated as transplants with the auxillary rise in cost. This is astonishing that that micropropagation technology is not the segment of production cycle (Thrope, 1990) [26]. Traditional vegetatively propagated tropical root and tuber crops like cassava, aroids, sweet potato and yams help to make the progress, as these kind of material are made with some pathogen free and help in fethcing higher yields (Krikorian, 1994) [25]. The advancement for seed-based vegetative propagation of male sterile hybrids and developed synthetic seed technology will doubtlessly enhance the production and utilization of micropropagated vegetative planting material.

Pomology

Axillary shoot multiplication in micropropagation has been utilized commercially in fruit and nut crop production since the end of 1970s (Zimmerman, 1991) [14]. Small (soft) fruit crops was of initial uses, such as raspberry and strayberry, and for rootstocks for many fruit trees, such as apple, pear, peach, apricot, cherry and plum. Self-rooted cultivars production has been finite due to the time needed for field assesment of performance of trees (Zimmerman and Swartz, 1994) [14]. *In vitro* cultivation of plants help to increase the production of nursery plants belong to Rubus species (blackberry and raspberry).Only less amount of success in case of tropical fruit trees had been noticed (Litz and Jaiswal, 1991; Grosser, 1994) [29, 30]. Some commonly micropropagated fruit trees are passion fruit, papaya, banana, and pineapple. Moreover tropical fruits like jackfruit, fig and mulbery which are woody in nature are also micropropagated from shoot tips and nodal explants. Also, regeneration through somatic embryogenesis has been attained in mango, loquat (from nuclear tissue), citrus spp., plantain (from leaf tissue), banana and date palm (from shoot tips) (Litz and Jaiswal, 1991) [29].

Problems and limitations

However, micropropagation has been the most effective implementation of plant tissue culture technology, but there are still some issues suppressing its wider utilization. Generally micropropagaded plants respond well in the field conditions, but sufficient time has not been passed for the field assessment of long term production of fruit tree rootstocks. The value of mass production of plantlets varies from species to species and it also depend on the method used. In ornamental and fruit crops, the costs are generally bearable. Although, in case of vegetable crops, the plantlets produced in lab are 3-10 times that of traditional method. So, except the genetic gains, disease free plants, etc off-setting, the difference in cost is unbearable (Thorpe, 1990) [26].

For micro propagation, the higher labour cost (estimated at 75-85%) mean that there is a requirement for scale-up and mechanisation of the opperations (Vasil, 1991a). The prime issue with woody plants are that they are tough to manipulate and regenerated explants are drawn from mature trees.

Additionally, tissue culture help in producing off-type plants and this is threat to nurserymen (Swartz, 1991) [34]. Model off-type plants are dwarf in nature, colour changed or mosaic patterns, change in growth habit and productivity also changes. These changes happen more regularly when in micro propagation is by adventitious than by enhanced axillary budding.

Conclusion

The drastically increasing world population and rising living standards of people, means there is need of more food and needs of all should be satisfied. To led a healthy lifestyle it is important to include fruit and vegetables in our daily diet. With the increase in modernization there is a continuous demant of tropical fruit and vegetables in temperate countries and vice versa. Due to urbanization there is less availability of land. So, increased yields are required and most importantly by maintaining quality in situation of increased pests and diseases. With the increasing living standard of people worldwide the demand for ornamental crops automatically increased. As specified above plant tissue culture technology has played a vital role in improvement and production of horticultural produce. The role of *in vitro* techniques explored above will play in important role in providing vegetables, fruits and ornamentals to satisfy the needs of mankind.

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