TISSUE CULTURE'S APPLICATION FOR HORTICULTURAL CROPS

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1. Tissue culture created the possibility to generate a whole plant from single cells or tissues, which opened new approaches to plant improvement. It has become an essential technique to produce plants with desired genetics, characteristics, and productivity.
2. The production of horticulture crops is the most extensive application of plant tissue culture techniques.
3. Horticulture is defined as the branch of plant agriculture that focuses on the cultivation of fruits, vegetables, and ornamental plants.
4. The goal of the in-vitro production of ornamental plants is to produce disease-free and large numbers of genetically identical plants.
5. An additional benefit of the tissue culture technique is that it doesn't require a large number of stock plants for mass production.
6. This technique also allows for the production of hybrids of incompatible plants by embryo rescue, somatic hybridization, or embryo culture.
7. The application of successful tissue culture techniques to produce disease free-plants, ornamentals, vegetable crops, and fruit crops.

Ornamental Crops

1. In 1990, over 300 ornamentals were introduced to the commercial market (worldwide) by tissue culture techniques.
2. Over 500 million plants are produced by using the technique, out of which 90% are ornamentals.
3. The use of this technique is a routine in some ornamental industries that include orchids, *Gerbera, Spathiphyllum* (Spathe or peace Lilies), and Boston fern. Some commercial labs can produce up to 200,000 *in vitro* plantlets per week!

The three primary goals of producing ornamentals by tissue culture technique are:

1. Production of disease-free plants
2. Rapid production of a large number of genetically identical plants
3. Introduction of new varieties or genotypes

- The micropropagation of ornamentals is achieved by enhancing axillary (lateral) bud breaking and the production of adventitious (bud present elsewhere in the plant) buds.

- The most suitable explant/starting material for *in vitro* ornamentals is axillary bud breaking using shoot tip and single node explants.
- In some other plants like Lily, Allium, and Irises, bulb scales, base plates of corms and bulbs, and the inflorescence is considered a suitable explant.

Vegetable Crops

Vegetables are a rich source of vitamins and minerals and constitute one of the largest commodities in the world. However, only limited vegetables have been produced on a large-scale using tissue culture techniques. The four main purposes of propagation of vegetables using tissue culture are:

1. Production of plantlets of that species in which propagation of plant through seed is a difficult process
2. Production of genetically identical plants on large-scale
3. Production of virus-free plant materials
4. Crop improvement

The three techniques mainly used to produce major vegetable crops of the world include:

1. Somatic embryogenesis
2. Enhanced axillary branching using stem tips and lateral buds
3. Adventitious shoot formation

- The development of a somatic embryo occurs directly and indirectly (by callus formation).
- The crops that follow the direct pathway include cauliflower and potato. Whereas, plants like carrot, asparagus, sweet potatoes, pumpkins, and potatoes develop through the formation of callus.
- Enhanced axillary branching exploits stem tips and lateral buds as explants. Once the explants are established in labs by this method, they can be subcultured for many generations with increased shoot formation.
- The vegetable crops produced by this technique include broccoli, cucumber, asparagus, garlic, cabbage, lettuce, tomato, potato, and sweet potato. This technique works best in reducing the genetic abnormalities in the plants.
- The production of vegetable crops by the adventitious root formation has been successfully observed in asparagus, potato, tomato, broccoli, brussels sprouts, chive, cabbage, carrot, garlic, kale, lettuce, and pepper. The major disadvantage of this technique is enhanced genetic variability.

Fruit Crops

- Most fruit crops are propagated by vegetative techniques to preserve genetic traits.
- Only a limited number of fruit crops have been experimented on with *in vitro* production using tissue culture.
- Initially, it was used for soft fruit crops like strawberry and raspberry, and rootstock of tree fruits like peach, apple, cherry, and apricot.

The tissue culture of fruit crops is followed for mainly five purposes that include:

1. Mass propagation of the desired line of the plants
2. Obtain virus-free plants
3. Rapid mass production of plants for breeding purposes
4. Preserve germplasm
5. Produce haploids for the breeding program

- The fruit crops that are most widely produced by clonal propagation include banana, papaya, passion fruit, fig, mulberry, and jackfruit.
- The development of plants through somatic embryogenesis has had limited success. The plants successfully propagated by somatic embryogenesis include Citrus spp., mango, banana, and date palm.
- Some other applications of the tissue culture technique include the production of pathogen-free plants, whose major use is in germplasm conservation (preservation).