



# A Review on Artificial Seed Production in Fruit Crops

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## ABSTRACT

Synthetic seeds are commonly called as encapsulated somatic embryos. For largescale clonal propagation these are widely used and mainly produced from the somatic cells. For the preparation of synthetic seeds different plant parts like shoot tips, axillary buds are used in addition to somatic embryo. Synthetic seeds are beneficial in cutting down the cost of production of micro-propagated plants. An advanced method for production of synthetic seeds is thought to be a valuable replacement tool for the generation of many commercial crops and beneficial technique for the extensive propagation of finite plant genotypes. In several fruit crops characters like tiny seed size, presence of reduced endosperm, nature of seeds lower germination rate, heterozygosity and seed lessness of some varieties are the limiting factors for the success through propagation of seeds. Presence of recalcitrant seeds in several fruit crop species limits the storage of the seeds to few weeks or months Throughout the world several methods are studied for the propagation of the fruit plants for various genetic engineering, breeding, and pharmaceutical purposes. Due to this the artificial seeds would be of more useful for the exchange of elite and axenic plant materials between various laboratories and many extension centres due to comfort in handling and small bead size. Because of these advantages use of encapsulation technology has become more famous in most of the fruit crops. In this review the scope, types and procedure of artificial seed production and the use of synthetic seed production in various fruit crops.

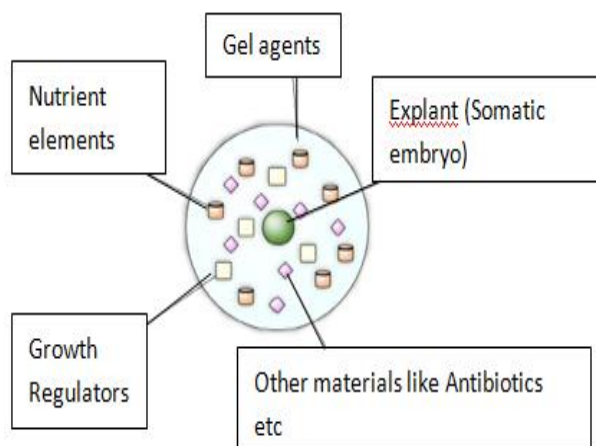
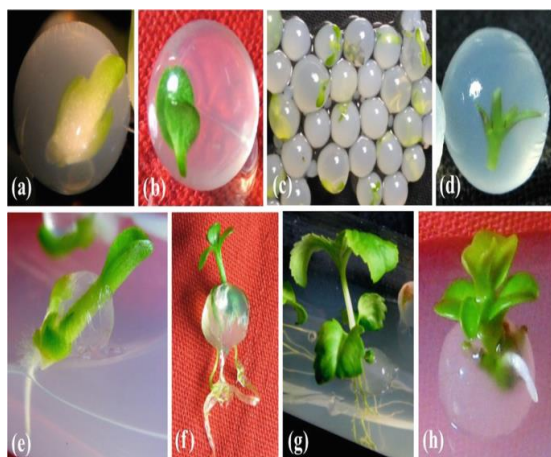
**Key words:** - Artificial seeds, Encapsulation, somatic embryos, clonal propagation, somatic cells

## INTRODUCTION

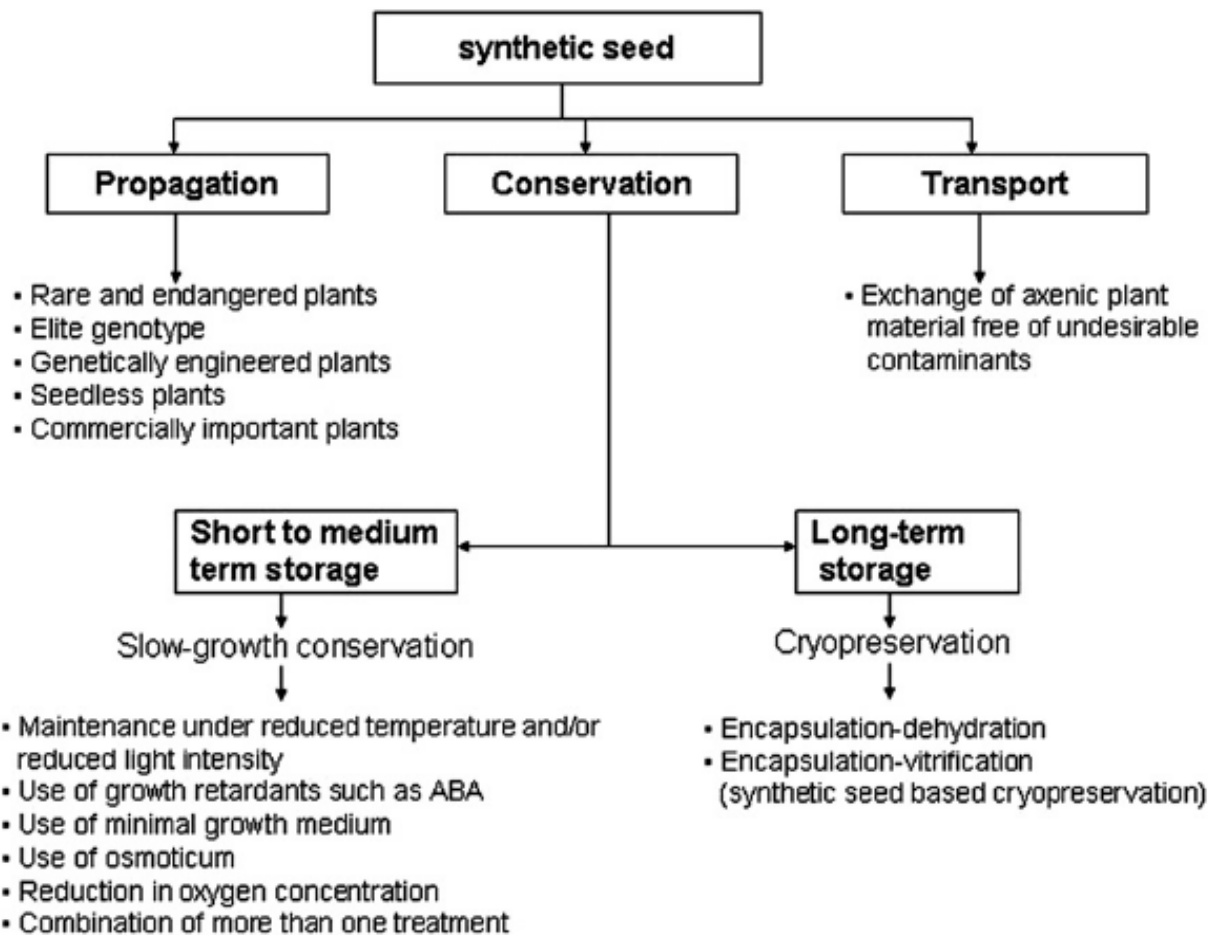
Under in vitro conditions, encapsulation is the most effective approach for protecting micro propagules and converting them to synseeds (Redenbaugh, 1993). Germination is aided by this encased material (Latif et al., 2007). Horticultural crops are the subject of the majority of studies. It was first used in clonal propagation to create artificial seeds by encasing them in endosperm. The demand for artificial seeds has increased since the discovery of in vitro somatic embryo development. Seed serves as a medium for the transmission of genetic constitution in plants, resulting in proliferation, storage and dispersion Bewely and Black, 1985. They have the potential to produce significant amounts of food at a lower cost than true seeds [Roy & Mandal 2008] [Murashige 1977] coined the term "syn seeds" to refer to artificial seeds that are "encapsulated somatic embryos." Gray et al. (1991) later described artificial seeds as "the practical use of somatic embryo designed for the commercial production of plants." Micro propagules, shoot tops, auxiliary buds, root segments, protocorm-like structures, and microshoots are examples of explants [Ara et al., 2000, Sharma & Shahzad 2012, and Danso & Ford 2003]. Encapsulated explants are in materials such as alginate gel, dimethyl sulfoxide (DMSO), and hydro gel, among others, to protect them from mechanical damage and allow for germination. [Asmah et al., 2011] They function as true seeds and grow into seedlings under favourable conditions. Artificial seeds have been used to grow a variety of fruits, vegetables, cereals, orchids, ornamentals, and forest trees [Bapat & Rao (1987,1988); Rai et al., 2008; Singh et al., 2009; Nyende et al., 2003; Mathur et al., 1989; Sicurani et al., 2001; Ganapathi et al., 1992; Rout et al., 2001; Corrie and Tandon, 1993; Faisal and Anis, 2007; Sharma et al.,1994; Sarkar and Naik,1998; Maruyama et al.,1997; Singh et al., 2006a,b Ara et al., 1999; Mandal et al., 2000; Naik and Chand, 2006; Micheli et al., 2007; Chand and Singh, 2004].

### CONCEPT OF ARTIFICIAL SEEDS

Explants in artificial seeds are analogous to zygotic embryos in conventional seeds, and artificial seeds mimic conventional seeds. Development inhibitors, pesticides, bio fertilisers, and other substances are used in addition to explants and gel agents. Until being dehydrated, these capsules are sealed with a calcium chloride (CaCl<sub>2</sub>) solution and then washed with clean water for 40 minutes. These seeds can be stored for a long time. The seed coat softens and starts to grow after being rehydrated.



## SCOPE OF ARTIFICIAL SEEDS



## TYPES OF ARTIFICIAL SEEDS

The artificial seeds are divided into two types they are

- 1) Hydrated seeds
- 2) Desiccated seeds (Ara et al., 2000; Bapat & Mhatre 2005)

### 1) Hydrated seeds

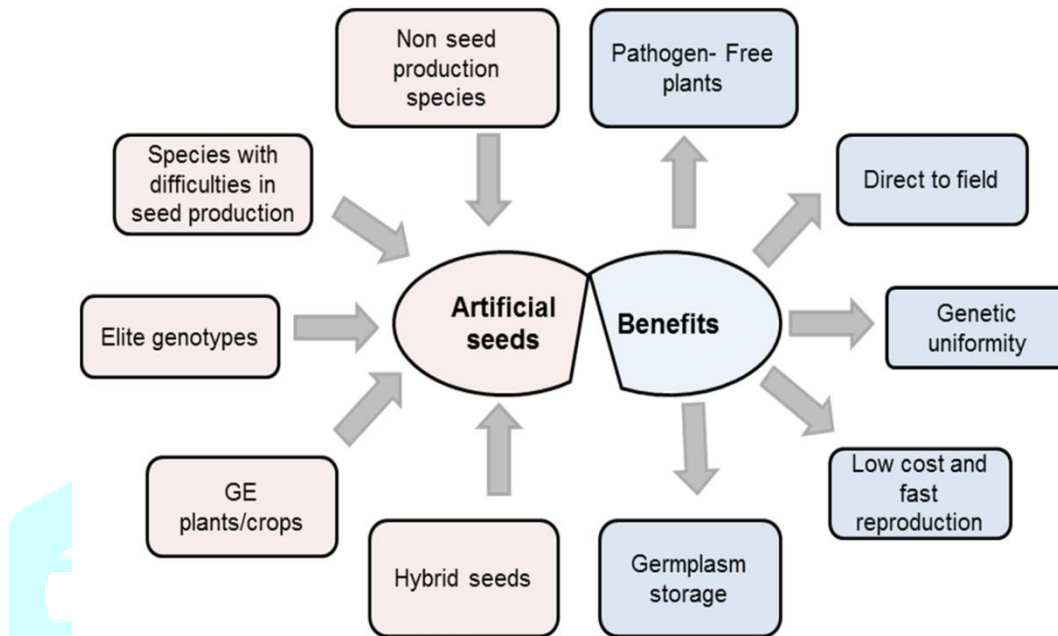
These seeds are produced by the encapsulation of hydrogel to somatic embryos. They are produced in recalcitrant and desiccation sensitive plant species (Ara et al, 2000).

### 2) Dehydrated seeds

The seeds are naked with polyoxyethylene glycol encapsulation and later desiccated. This dehydration arises either by overnight drying in an unsealed petri dishes or by reducing relative humidity/moisture of the seeds (Ara et al., 2000). The higher level of osmotic potential is attained by increasing the strength of gel and on addition with several osmoticants like mannitol, sucrose, etc (Sundararaj, 2010) to the medium that can induce the tolerance to desiccation and it can be induced by various stresses like low temperature and deficiency of nutrients (Pond & Cameron, 2003) etc. They are made in the somatic embryos in order to tolerate the desiccation process (Sharma et al., 2013)

## ADVANTAGES OF ARTIFICIAL SEEDS:

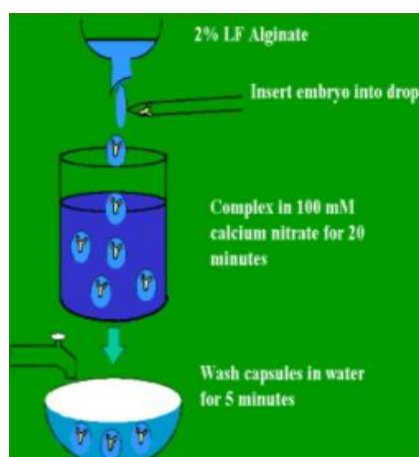
- Appropriate for the large-scale production of seeds.
- Protection of extinct, endangered and elite species germplasm.
- Proper handling of seeds during their transport and storage.
- Extended storage at ultra-low temperatures in liquid nitrogen at  $-196^{\circ}\text{C}$  known as cryopreservation.
- Appropriate for the production of seeds in the plants that are not able to produce seeds.



## ENCAPSULATION METHODS FOR SYNTHETIC SEEDS

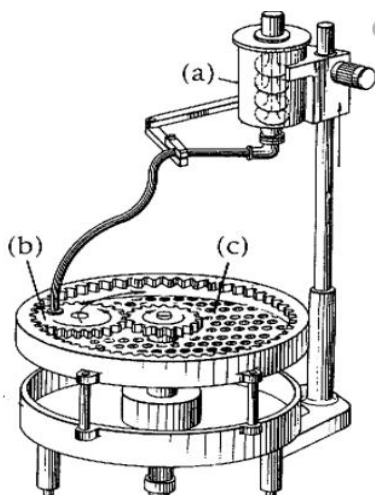
### Dropping procedure

- It is one of the most convenient methods for the encapsulation of synthetic seeds.
- Nearly 2-3% of the sodium alginate solution is dripped from the funnel that is from the tip of funnel.
- These Somatic embryos are then injected into the drops of the sodium alginate.
- These embryos are kept in Calcium salt for around 20 minutes.
- Later wash them in sterile water and are then transfer it into an air tight container for the storage of seeds.



### Automatic encapsulation process

- Rapid method for the production of artificial seeds.
- Alginate solution is fed into the supply tank along with the embryos.
- These alginate capsules are then planted into the seedling trays by means of a vacuum seeder.
- To plant these seedlings in field the Stanhay planter is widely used.
- The coating should be hydrophobic for proper handling of the seeds mechanically.



- (a) The planet gear outer periphery
- (b) A Punched (perforated) plate
- (c) Perforated plate has ca. 1,200 with orifices of 5 mm in diameter and the droplets of alginate solution formed at the orifices drops into the hardening vessel
- (d) A stand

### **ARTIFICIAL SEED PRODUCTION IN VARIOUS FRUIT CROPS**

#### **Banana: -**

- Suckers are commonly used to propagate banana plants. Since the production of sucker is restricted each year, this artificial seed production is used. Tissue culture has gained popularity as a means of propagation. In vitro, the shoot tips are encased in 3% sodium alginate.

#### **Papaya: -**

- It can be used to make synthetic seeds. The papaya plant contains sodium alginate that encapsulates the somatic embryos. The occurrence of encapsulated embryos is determined by the length of time exposed to calcium chloride and the sodium alginate concentration.





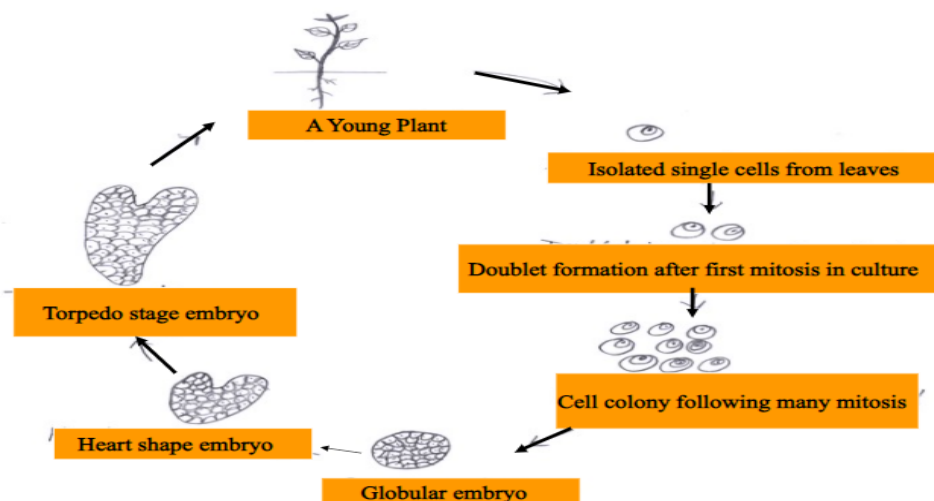
S.no	Plant Species	Propagules encapsulated	References
1	<i>Actinidia deliciosa</i> (Kiwifruit)	Buds apical and axillary	Adriani et al. (2000), Romay Alvarez et al. (2002)
2	<i>Ananas comosus</i> (Pine apple)	Axillary buds are the buds on the ends of the axill	Soneji et al. (2002), Gangopadhyay et al. (2005)
3	<i>Carica papaya</i> (Papaya)	Somatic embryos are a type of embryo that develops in the	Castillo et al. (1998)
4	Citrus sp.	Somatic embryos are a type of embryo that develops from the	Antonietta et al. (1999, 2007)
5	<i>Malus pumila</i> (Apple rootstock M.26)	Buds on the apex a few pointers Nodes and axillary buds	Piccioni and Standardi (1995),
6	<i>Mangifera indica</i> (Mango)	Somatic embryos are a type of embryo that develops in the	Ara et al. (1999)
7	<i>Morus indica</i> (Mulberry)	Axillary buds are the buds on the ends of the axill	Bapat et al. (1987),
8	<i>Musa sp.</i> (Banana)	Shoot tips and apices of somatic embryos	Ganapathi et al. (1992),
9	<i>Pistacia vera</i> (Pistachio)	Embryonic mass and somatic embryos	Onay et al. (1996)
10	<i>Psidium guajava</i> (Guava)	Shoot tips, nodal segments, and somatic embryos	Rai and Jaiswal (2008),
11	Pear ( <i>Pyrus communis</i> )	Shooting advice	Nower et al. (2007)
12	Pomegranate ( <i>Punica granatum</i> )	The parts of the nodal system	Naik and Chand (2006)
13	<i>Rubus idaeus</i> (Raspberry)	Microcutting from shoot buds obtained in vitro	Piccioni and Standardi (1995), Romay Alvarez et al. (2003)
14	<i>Vitis vinifera</i> (Grape)	Somatic embryos are a type of embryo that develops from the	Das et al. (2006)

### PROCEDURE FOR ARTIFICIAL SEED PRODUCTION

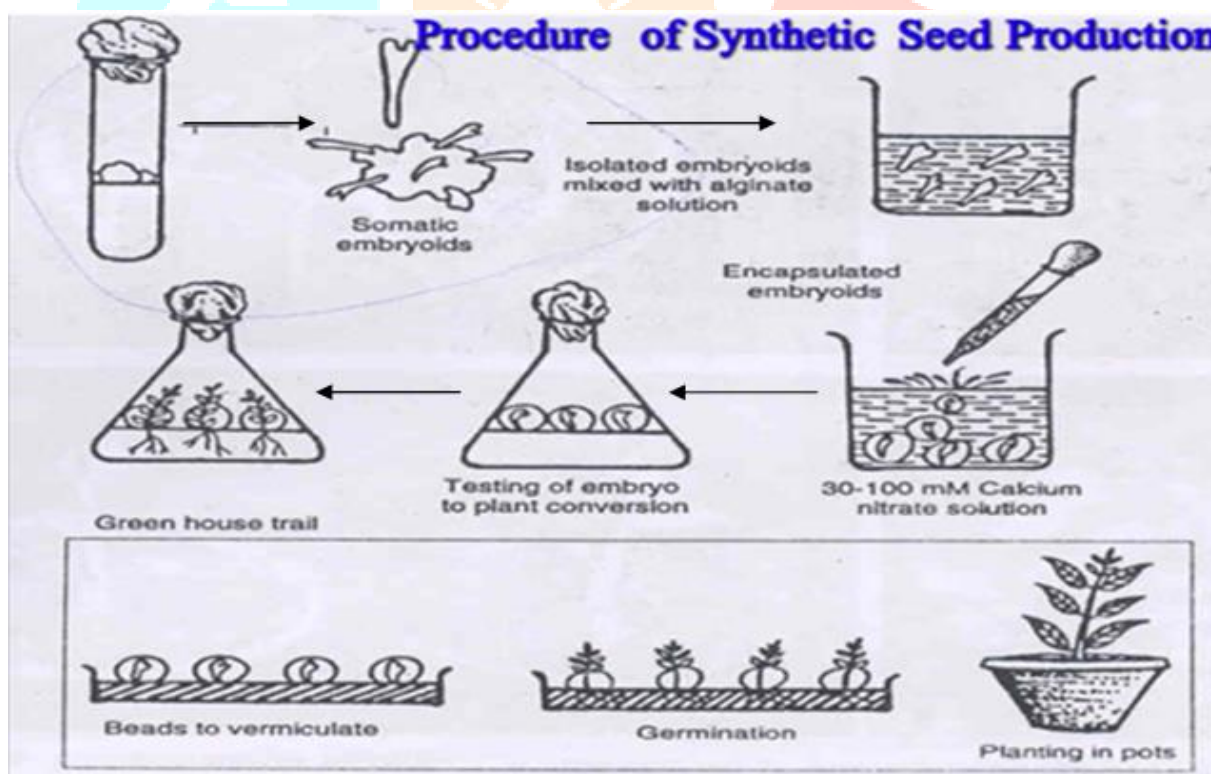
Somatic embryos are formed by cultivating somatic cells. The following are the various steps involved in the development of artificial seeds:

1. Initiation of somatic embryogenesis
2. Embryos from somatic cells (mature)
3. Detach and synchronise somatic embryos. Mass production of the embryos
4. Encapsulation of mature somatic embryos
5. Dehydration
6. Field Preparation

7. Somatic Embryogenesis:-



The selection of crops is made based on their technical and commercial importance, and then a somatic embryo is created. The next stage involves converting normal plants into mature somatic embryos. Embryo processing is then mechanised after that. The embryoids are encapsulated after the mature embryos have been given a treatment to cause dormancy. Watering, fertilisation, transplantation, and other criteria for greenhouse and field transition must be met etc.



Conclusion: -

Several attempts have been made to grow artificial fruit seeds. Encapsulation is essential for germplasm survival, non-seed producing plants, lower plantlet costs, and longer storage times. Aside from these benefits, there are some drawbacks, such as the artificial seeds lower field survival rate and the inability of seeds without embryos to establish proper root systems. Under non-sterile conditions and for cryopreservation, it could be improved at a commercial stage.

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