TECHNICAL BULLETIN NO.45

SEED PROPAGATION IN DRAGON FRUIT

A Practical Guide for Growing Dragon Fruit through Seed

Boraiah KM
Priyanka Jadhav
Harisha CB
Basavaraj PS
Hanamant M Halli
Vijayakumar HP
VD Kakade
KK Pal
K Sammi Reddy

ICAR-National Institute of Abiotic Stress Management
Malegaon, Baramati-413 115

Seed Propagation in Dragon Fruit

A Practical Guide for Growing Dragon Fruit through Seed

Boraiah KM
Priyanka Jadhav
Harisha CB
Basavaraj PS
Hanamant M Halli
Vijayakumar HP
VD Kakade
KK Pal
K Sammi Reddy

राअस्ट्रैप्रसं
NIASM

Indian Council of Agricultural Research
National Institute of Abiotic Stress Management
ISO 9001:2015
Malegaon (Kh.), Pune – 413 115 (MS)
www.niasm.icar.gov.in

Citation:

Boraiah KM, Jadhav PS, Harisha CB, Basavaraj PS, Hanamant M Halli, Vijayakumar HP, VD Kakade, KK Pal and K Sammi Reddy. 2024. Seed Propagation in Dragon Fruit: A Practical Guide for Growing Dragon Fruit through Seed. Technical Bulletin No. 45. ICAR- National Institute of Abiotic Stress Management, Baramati. Pp. 11.

Published by:

Director, ICAR-National Institute of Abiotic Stress Management, Baramati, Pune, Maharashtra.

ISBN No: 978-81-949091-8-7

Design and art by

Mr. Pravin More, Senior Technical Assistant (Computer)

Disclaimer:

Background

Dragon fruit, a popular exotic crop, is gaining recognition across continents due to its distinctive nutritional benefits and economic potential. As a CAM (Crassulacean Acid Metabolism) plant, it exhibits remarkable resilience to climate challenges, and suitable for resource-poor regions experiencing abiotic stresses. With the expansion of dragon fruit cultivation into diverse climatic environments, there is an urgent need to develop new varieties and hybrids to meet the nutritional need of the local populations at affordable price and adapt to regional conditions. Currently, many countries rely on introduced clonal varieties; however, shifting consumer preferences and the impacts of climate change highlighted the necessity for locally adaptable varieties. To support these initiatives, sexual propagation through seeds is essential for advancing varietal development and hybrid multiplication beside creating genetic variability through hybridization. Despite the widespread use of vegetative propagation among farmers, nursery growers, and researchers, knowledge about seed propagation in dragon fruit remains limited.

The widespread use of vegetative propagation in the cultivation of dragon fruit clones could create a bottleneck in expanding the genetic diversity of this newly introduced crop in various countries around the world. In this context, we have established comprehensive methodology for sexual/seed propagation, encompassing key process such as; 1. Seed extraction, 2. Seed germination, and 3. Seedling hardening and establishment. This method supports breeding programs through seed propagules besides serving as a valuable propagation technique for academicians, researchers, and farmers. By providing detailed practical insights into seed propagation, we hope to empower dragon fruit stakeholders, fostering innovation and sustainability in the cultivation of this new fruit. In addition to providing platform for broadening the crop's genetic variability, this propagation techniques will enable the multiplication and cultivation of hybrids and hybrid varieties, ensuring the future sustainable dragon fruit farming.

Seed Propagation Procedure

Sexual propagation through seed involves three processes *viz.* seed extraction, seed germination and seedling establishment, which are described in the following sections.

A. Seed Extraction:

Seed extraction is the first important process in vegetable and fruit crops and in general, it comprises principal steps including peeling, cutting, smashing and sieving to separate seeds from peel and flesh. However, it is slightly differing in dragon fruit as it contains 8000–10,0000 (approx.) seeds inside the thick peel and each seed is surrounded by transparent gelatinous mucilage made-up of polysaccharides. Thus, extraction of seed requires an important step (*i.e.* squeezing) to separate the mucilage from seed. The stepwise detailed seed extraction procedure is explained below in flow chart 1 and Fig. 1 for better understanding.

Step 1: Cutting
Select fully matured and ripened fruit and cut into two pieces with a knife. Seperate the pulp and peel by hand peeling or scooping with a spoon or scooper.

⬇

Step 2: Slicing
Once the peel is removed, slice the pulp into smaller pieces using a knife.

⬇

Step 3: Smashing
Transfer the sliced pulp pieces into a cotton bag, which acts as a filter to separate the seeds and mucilage. Smash the pieces within a cotton bag, to loosen the fibrous pulp around the seeds.

⬇

Step 4: Squeezing
Hold the mouth of the cottoon bag with one hand and squeeze the smashed pulp towards the end of the bag with other hand. The mucilage flows out of the bag, leaving the seeds behind.

⬇

Step 5: Sieving (washing)
Transfer the seeds onto a mesh sieve (0.4 mm) under running tap water. Gently rub the seeds back and forth to remove mucilage and any fibrous debris and then drain out the water.

⬇

Step 6: Spreading
Spread the seeds on a thick paper sheet for a few hours to allow the paper to absorbs excess water.

⬇

Step 7: Drying
Transfer the seeds from paper sheet to Petri plates and allow for air dry under shade for 2-3 days.

⬇

Step 8: Storing
Store well dried seeds in a cool and dry place inside a airtight seedbox/container.

Flow chart 1. Seed exatrction steps in the drgaon fruit

Figure 1. Pictorial flow chart illustrating the steps involved in seed extraction process in dragon fruit.

B. Seed germination:

Keep well-dried seeds onto germination paper inside a Petri dish. About 100 to 200 seeds can be kept in small to medium sized Petri plate (diameter 100–125 mm) but don't heap the seed in one place, spread evenly. Moist the seed with distilled or sterile water using a dispenser. Since dragon fruit seeds are photoblastic in nature, incubate at room temperature (25–30° C) for 25 days with artificial light (12–14 hours a day) is recommended. The seeds start sprouting in 3–4 days after sowing (DAS) (Fig. 2b) and root hairs start forming, which are attached to surface within 5–6 DAS (Fig. 2c). Radicle and hypocotyl elongation takes place during 8–18 DAS (Fig. 2d) and cotyledon leaves emerge above the ground level between 10–12 DAS (Fig. 2e). Thus, germination in dragon fruit is considered as epigeal type of germination. After 18–20 DAS (Fig. 2f), when seedlings length reaches to 1.5–2.0 cm with full emergence of green-colored cotyledonary leaves, the seedlings are ready for transfer to pro-trays.

C. Seedling and crop establishment

Seedling establishment is a very crucial process in sexual propagation of dragon fruit as seedlings are very delicate at the early stages. Hence, sequential and gradual hardening of seedlings is pre-requisite prior to planting in the main field. It involves transferring seedlings from room temperature/germination chamber to plastic tray (Fig. 4) followed by transferring them into polybags or plastic pots (Fig. 5) prior to planting in the main field (Fig. 7). All the steps are described along with the stage/age of seedlings or plant (Fig. 4–9).

Growing media for propagation in tray is very crucial as it supports initial growth of the seedlings. It is a mixture of coco-peat and vermicompost in 3:1 ratio and preparation of growth media for tray transplanting is illustrated in figure 3. Similarly, for pot transplanting, the media is mainly red or lighter soils and vermicompost in 10:1 ratio to avoid excess moisture. Whereas well-established plants can be transplanted in the main field with any soils (preferably light soils) enriched with FYM or organic manures. It is essential to make one or two feet raised bed to avoid waterlogging. Manures and fertilizers should be applied in very low quantity (1–2 kg of FYM /pole) during the initial growth. Gradually, the dose of manures and fertilizers can be increased once the crop switches to reproductive phase. In general, 10–12 kg of mannures and 0.6:0.8:0.5 kg of N:P:K may be applied per pole in three splits in a year. Preferably, first one with little higher dose at initation of flowering (April-May),

second one at peak flowering and fruiting (July-August) and third split at end of the flowering or vegetative phase (October-November). Dragon fruit is highly responsive to organic mannures and fertilzers since it requires nutreints throught the year gradually but slowly.

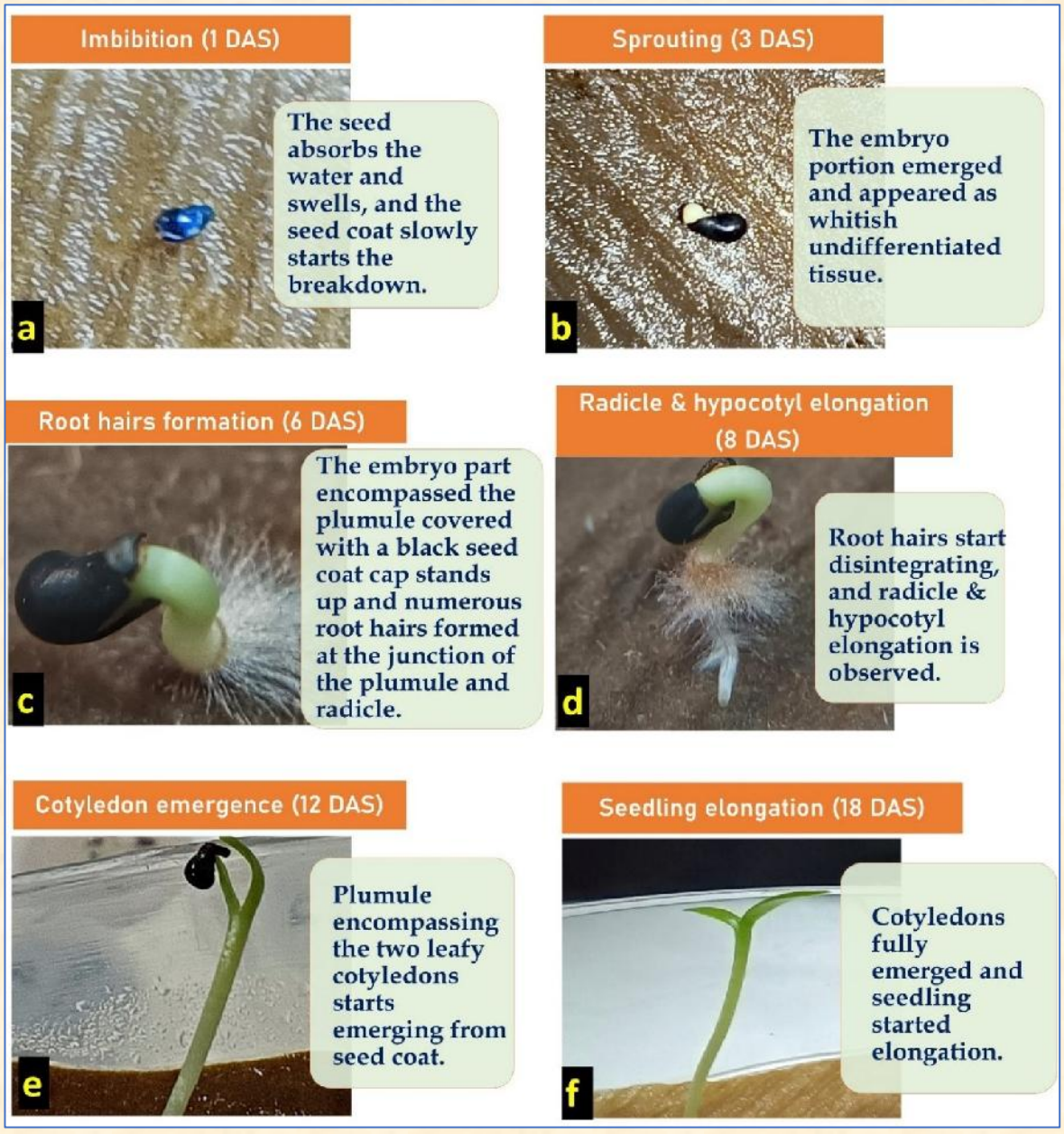

Figure 2. Sequential events of seed germination in dragon fruit

Coco-peat (CP) Vermicompost (VC) Mixing CP & VC at 3:1 Filling to tray

Figure 3. Preparation of growing media for tray transplanting

1. Tray transplanting:

Seedlings of three weeks old (Fig. 4a) are carefully taken out from the germination paper using forceps and transferred to 50-celled plastic planting trays (Fig. 4b) filled with coco-peat and vermicompost (3:1 ratio). Each cell of the tray is planted with only one seedling (Fig. 4c). The seedling can be grown in the tray up to three months under green-house condition with controlled temperature (25–30°C) and relative humidity (around 70%).

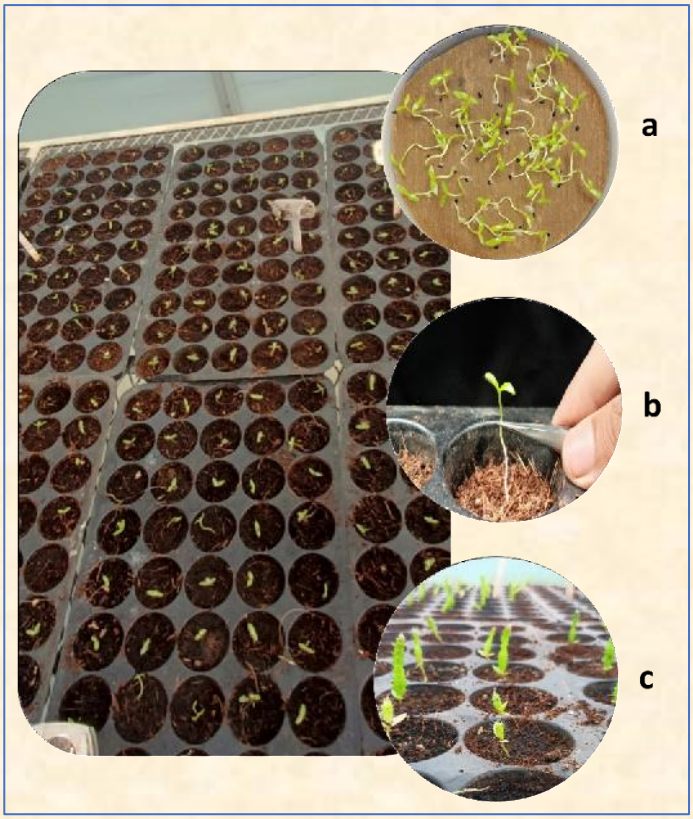

Figure 4. Tray transplanting of seedlings

2. Pot transplanting:

Three months old seedlings (pencil size thickness with 4–5 cm height) can be removed from trays along with root-mud ball and transferred to smaller polybags or pots (1.5 – 2 L) (Fig. 5a). These bags are filled with red soil and vermicompost (10:1). When seedlings start to produce side cladodes with elongation of soft spines (about 5 months old), transfer them to bigger polybags or pots (4–5 L filled with light or red soils (Fig. 5b). Maintaining optimum number of side cladodes is very crucial for establishment of seedling and for attaining vigorous growth of

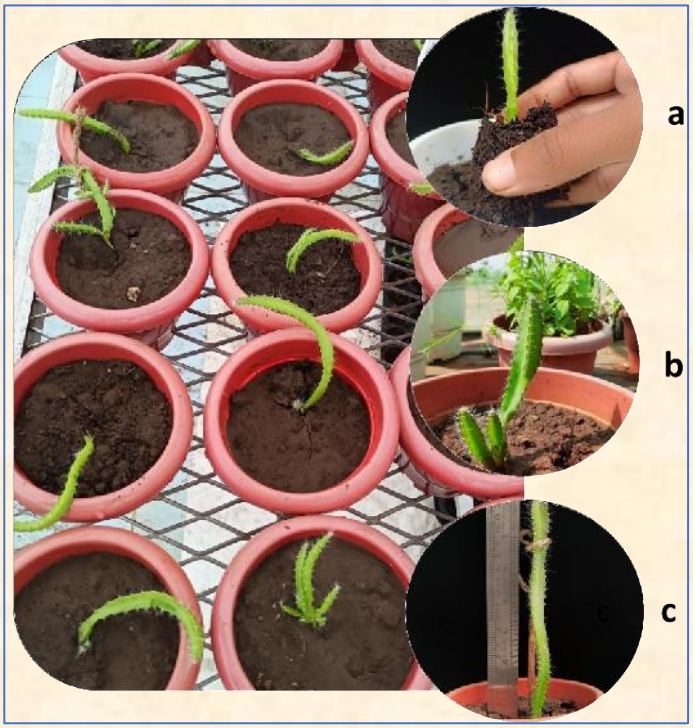

Figure 5. Pot transplanting of seedlings

seedlings. Maintain single main cladode, if sufficient seedlings are available. Hence, pinching of younger side cladodes and stacking the main cladode (Fig. 5c) is an important practice at this stage to ensure single or productive main cladode. This enhances the horizontal growth and maturation of primary cladode and development of hard spines replacing the softer hairy spines (Fig. 6). This stage indicates the hardening of the seedlings, which are ready for field transplanting.

Figure 6. Cladode with hard spines replacing the soft hairs

3. Field transplanting:

One year old plant with primary cladode size about mother plant cladode (from which fruit was harvested) bearing 3–4 hard brown colored spines, are planted in the main field (Fig. 7a). Plants in the open field grow rapidly and cladodes reach at the top of the square structure (Fig. 7b) within 6–7 months of field transplantation. During this period, pruning the side cladodes and training the main cladode are essential. Once the cladode reaches the top structure, allow the side cladodes for branching out (Fig. 7c). Regular pruning and training are essential to remove diseased and non-reproductive

Figure 7. Field transplanting of plants

cladodes and maintain ideal canopy structure. However, only diseased and lower cladodes (below the top) can be removed during early years (up to 4–5 years) of pruning. During later years (5 years after) of pruning maintain number of cladodes (approx. 150–200) per pole for optimizing the flower or fruit load.

The plants start bearing flower buds (Fig. 8a) in 5–6 months old cladodes. Flowering (opening of floral bud/anthesis) takes place around 20 days after emergence of bud (Fig. 8b) and developed into fruit (Fig. 8c) after 30–35 days after anthesis. The fruit is composed of an outer peel and flesh embodying with numerous tiny black seeds (Fig. 8d).

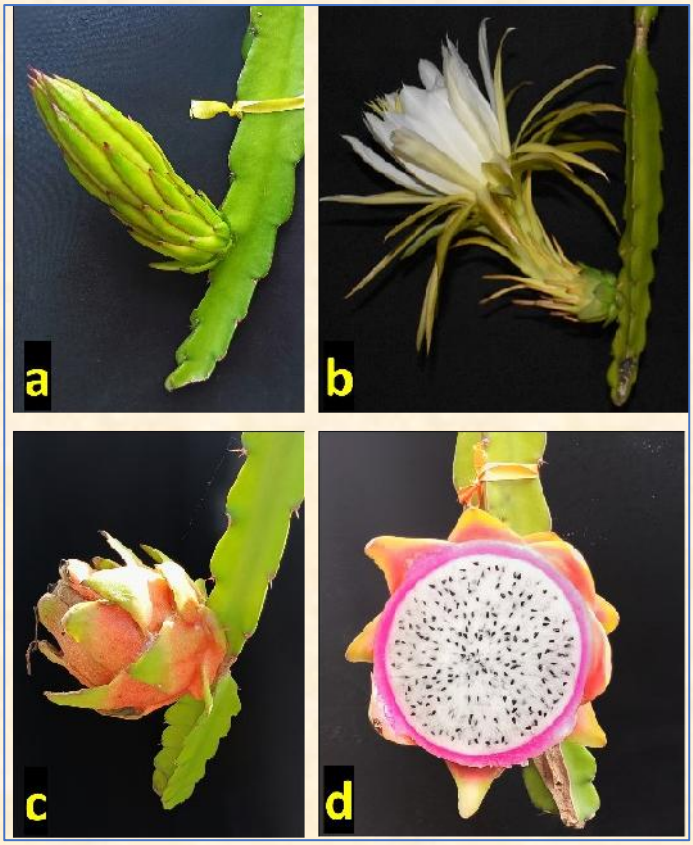

Figure 8. Important reproductive stages in dragon fruit *viz.* flower bud development (a), anthesis or flowering (b), fruit (c) and seed development (d).

Life Cycle of Dragon Fruit: Important Growth Stages from Seed to Seed

Seed-to-seed dragon fruit takes a minimum of two years for fruiting if following the proper crop management practices to ensure good growth and development. Regular bearing starts after third year (for breeding purpose) onwards and it takes about 4–5 years for commercial fruiting. Whereas, vegetatively propagated crop can starts bearing flowering after one or one and half year itself. The principal stages (seed germination, vegetative growth, flower bud formation, flowering/anthesis, fruit and seed development) of dragon fruit life cycles are shown in figure 9 along with the age considered from seed sowing (DAS). In general, the plant/crop can be maintained up to 20-30 years by nourishing it with good nutrient and pest/disease management in addition to proper pruning and training.

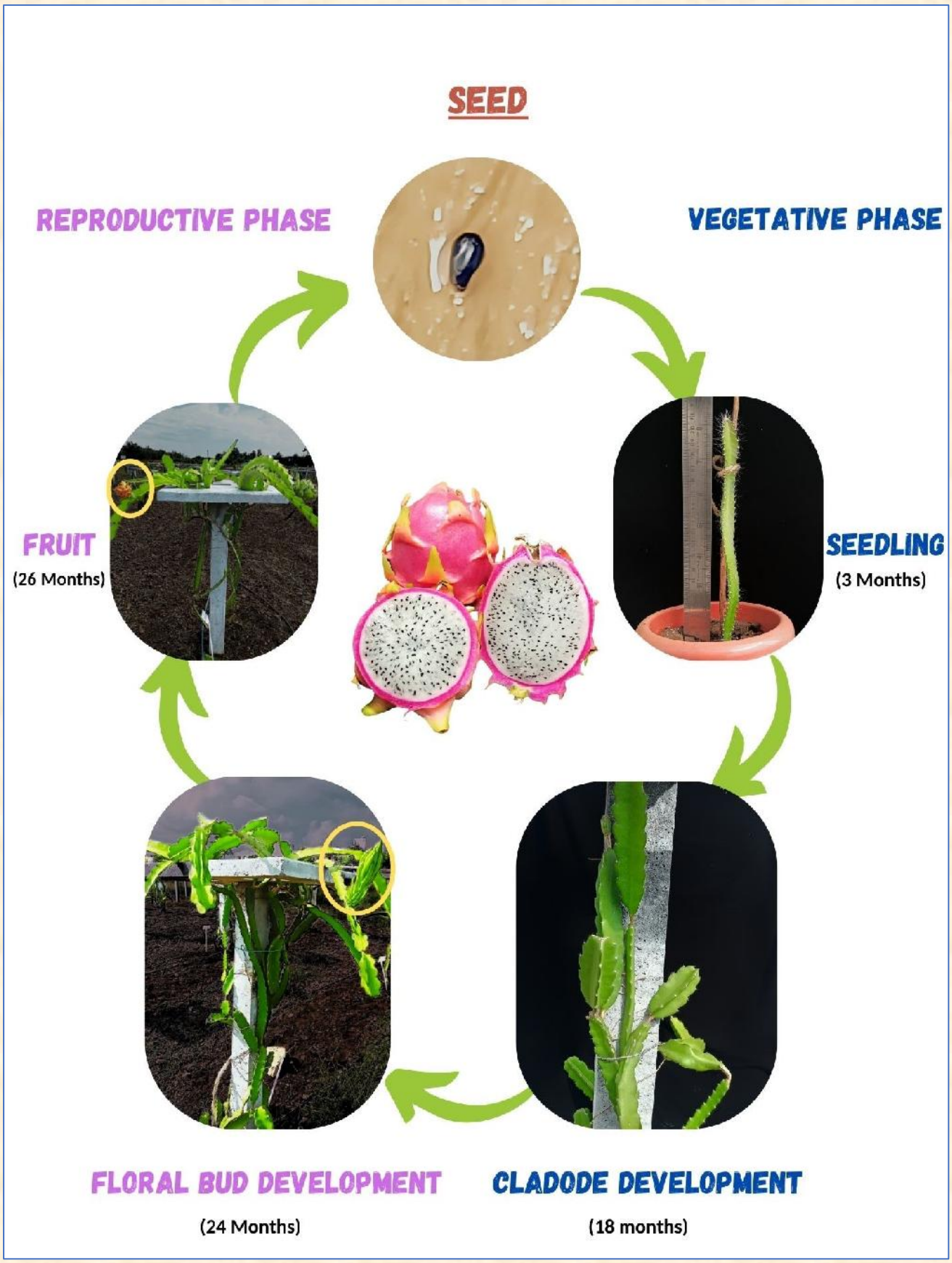

Figure 9. Important growth phases of dragon fruit (seed to seed)

Advantages

1. Utilization of genetic diversity: Seed propagation allows to exploit and utilize the new genetic variability in dragon fruit.
2. Supports development of hybrid and varieties: It enables the raising, multiplication, and cultivation of hybrid and advancing the segregating generation during varietal development.
3. Improvement of clonal varieties: It facilitates to improve and diversify the clonal varieties through introgressive hybridization that can be tailored to meet local market needs.
4. Rapid and mass multiplication of hybrids and varieties: Enormous seeds in a fruit (approx. 8–10 K) enable bulk and rapid multiplication of healthy seedlings of high yielding hybrids/varieties having unique quality traits.
5. The advanced and upscaling seed-nursery industries can create huge employment opportunities.

Limitations

1. Requires skilled manpower and resources: Seed propagation demands semi-skilled labour and resources such as sterile soil and special media, which may not be readily available in all the places.
2. Time-consuming process: Due to long juvenile phase, often taking a minimum of 4-5 years for plants to reach the peak flowering or commercial fruiting. Otherwise, it is absolute necessary for varietal/hybrid development since the first flowering or reproductive switch starts at second year onwards itself.
3. Lack of awareness: A basic understanding of the growth stages involving seed germination and seedling development are crucial for effective crop management and successful establishment.
4. Risk of pathogen infection: There is a potential risk of fungal infection and other pathogens affecting seeds and seedlings establishment, which can impact plant health.
5. Seed propagated plants not true to type and heterogenous and heterozygous plants may arise due to out crossing.

Important facts and precautions**

1. Squeezing is an important step in seed extraction because mucilage can prevent proper seed drying, if left unremoved, and subsequently promotes fungal infections and affects germination process.
2. Seeds should be stored in an airtight container in dry and cool place and ensure good germination percentage prior to mass multiplication of seedlings.
3. The side cladodes (similar to tillers/branches in other crops) emerging from seedlings can be multiplied as new plantlets by planting in media/soils.
4. Understanding the growth stages and required weather conditions is essential.
5. Always use healthy seeds which are free from fungal infections.
6. Use light and sterile soil or growth media for planting.
7. Ensure use of sterile Petri dishes, germination paper, and pots for planting.
8. Seedlings need to be hardened before planting in the main field; wait at least one year or until they attain a minimum growth. Considering the delicacy, softer and watery tissue, avoid direct exposure to sunlight and hence establishment of seedlings under greenhouse (tray transplanting step as depicted in Fig. 5) and net-house (pot transplanting steps as depicted in Fig. 6) conditions are advised to ensure gradual hardening of the seedlings.
9. Avoid overwatering, only moisten the soil when necessary.
10. Keep seedlings away from direct sunlight for first year but ensure that seedlings are receiving enough light.
11. Regularly pinch or prune the seedlings to promote healthy and optimum branching.
12. Use stakes to support the seedlings for better growth, but be careful not to anchor their aerial roots to the stakes.
13. Take care of plants by protecting against ants, snails, and fungal infections.
14. It is important to note that all the recommended management practices should be followed for establishing better seedling and crop growth.

**Note: The seed propagation methodology explained in this technical bulletin is universally applicable and can be replicable. The growers should aware the above facts and precautions for better establishment of crop through seed propagules. However, the methodology or steps may be varying place to place depending on the prevailing local climatic and weather conditions.

Notes

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

राअस्ट्रैप्रसं
NIASM

SEED PROPAGATION IN DRAGON FRUIT

A Practical Guide for Growing Dragon Fruit through Seed

About The Publication

This Technical Bulletin covers practical aspects of essential processes—seed extraction, germination, seedling hardening and crop establishment—helping the growers, researchers, and academicians about how to grow the dragon fruit through seed for research or commercial purpose. This practical knowledge also supports the development and rapid multiplication of hybrids and varieties. With clear pictorial illustrations, flowcharts and simple language, this book is an excellent resource for beginners who want to grow dragon fruit via seed.